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Contribution to the taxonomy of the *Oecetis* (*Oecetis*) *tripunctata* (Fabricius, 1793) species group (Trichoptera: Leptoceridae)

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Abstract. Unsettled, dubious *Oecetis tripunctata* taxa are studied applying the principles and practices of fine phenomics relying on the ventral profile of the gonopods and the lateral profile of the phallic organ. The distribution of *Oecetis tripunctata* (Fabricius, 1793) is restricted to the Palaearctic Faunal Region. 14 new species were described from the Oriental Faunal Region: *Oecetis anhua* s. nov., *O. baneswara* sp. nov., *O. baoloca* sp. nov., *O. bhubaneswa* sp. nov., *O. dagna* sp. nov., *O. dhaulia* sp. nov., *O. gujara* sp. nov., *O. halonga* sp. nov., *O. hoabinha* sp. nov., *O. kamba* sp. nov., *O. orissa* sp. nov., *O. peraka* sp. nov., *O. prenna* sp. nov., *O. sabarma* sp. nov. and one species *Oecetis lata* Johanson, Pham, Malm & Sjöberg, 2020 was recorded from Vietnam. 2 new species were described from Australasian Faunal Region: *O. kokopa* sp. nov., *O. parom* sp. nov. as new records of the *Oecetis tripunctata* species group. 10 new species were described from the Afrotropical Faunal Region, including mailand Africa and Madagascar: *O. anka* sp. nov., *O. banda* sp. nov., *O. bua* sp. nov., *O. conga* sp. nov., *O. congana* sp. nov., *O. ghana* sp. nov., *O. manta* sp. nov., *O. maroa* sp. nov., *O. volta* sp. nov., *O. zoa* sp. nov., and one species *Oecetis kagerana* Kimmins, 1956 was recorded from Ghana, as well as *O. maculipennis* Ulmer, 1922 was placed to the *Oecetis tripunctata* species group. This replacement has necessitated revising and renaming the *Oecetis maculipennis* species group describing 2 new species: *O. kimminsiana* sp. nov. and *O. nkwanta* sp. nov. *Oecetis maculipennis* species group was renamed as *Oecetis kimminsiana* species group.

Keywords. Caddisflies, fine phenomics, speciation trait, *Oecetis*, new species.

INTRODUCTION

Oecetis tripunctata (Fabricius, 1793) was long treated as a species with very wide distribution and with highly varying specific character states of stepwise cross-vein anastomosis pattern on forewing and of the simplified shape of the gonopods. Therefore every taxonomist working on its identity from various faunal regions have determined specimens as *tripunctata* and set aside for a necessary revision (Yang & Morse 2000, Malicky 2005, Oláh & Malicky 2011, Oláh & Mey 2013). Such specimens were identified as *tripunctata* from Palaearctic Faunal Region (Austria, Bulgaria, France, Germany, Greece, Portugal, Russia, Syria), Oriental Region (India, Indonesia (Sumatra, Nias, Sulawesi, Bali), Laos, Malaysia (Perak, Sarawak), Nepal, Philippine, Sri Lanka, Taiwan, Thailand, Vietnam) (Malicky 2005, Oláh & Malicky 2011), from Australasia (Papua New Guinea) (Oláh & Mey 2013) as well as several species were listed as potential synonyms from the Afrotropical Region (Yang & Morse 2000). It was clear that a major revision is seriously needed to sort synonyms from valid species in this complex (Yan & Morse 2000, Malicky 2005).

Working on our Trichoptera material collected in Batanta Island (Indonesia, West Papua) we have discovered a single male specimen from this *tripunctata*-like complex of species. To complete our Batanta Island study I have decided to revise all my specimens from the Palaearctic, Oriental, Australasian and Afrotropical Faunal regions set aside earlier as similar to *Oecetis tripunctata*.

Starting to work on the specimens of the *Oecetis tripuinctata* species group it was discovered that the nominate species of the *Oecetis maculipennis* Ulmer, 1922 species group established by Chen (1993) and confirmed by Yang &

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Morse (2000) is actually a typical member of the *Oecetis tripunctata* species group. Therefore I have revised this small group of species composed only of four species in order to transfer *Oecetis maculipennis* to the *Oecetis tripunctata* species group and rename the group of *Oecetis maculipennis*.

MATERIAL AND METHODS

Careful comparative analysis applying the principles and practices of fine phenomics was focused to search speciation traits exhibiting highest morphological diversity and lowest variability in order to delineate incipient sibling species. Moreover, to have simple and reliable trait accessibility in daily routine taxonomical studies was a primary target including searching stability of the observational angle as well as comparability and exact reproducibility of the character states. The ventral profile of the gonopods proved to be a diverse and stable, not variable character together with the lateral profile of the phallic organ. These genital structures form the basis to delineate species in the *Oecetis tripunctata* species group. Both the lateral and dorsal profile of the segment X is rather instable due to great shape variability and liability to distortion during copulation and preparation. The lateral profile of the gonopod is highly observation angle sensitive due to its dorsal ridge pattern.

In this paper I have drawn the phallic organ in lateral view, just by outlining its exact lateral profile together with the paramere. The apical margin the phallic organ is discernible as membranous due to the variously extruded endotheca. This region of the phallic organ is drawn by thinner line. The phallic structure is represented by phallic apodeme, phallic shield, sclerotized strips of phallic shield, phallobase, phallotheca, endotheca, endothecal membrane, paramere, U-shaped phallotremal sclerite and ejaculatory duct. The position and visibility of the endothecal membrane, U-shaped phallotremal sclerite and the ejaculatory duct are unstable depending on the erection state of the organ as well as on the preparation processes; their diagnostic value is low, therefore they are not drawn.

In species description and diagnosis the focus was directed to the speciation traits of the gonopod and to the phallic organ stably diverging among species. There are possible divergences also in wing venation, wing colour and pattern. However, I have all the frequently very old specimens stored in alcohol, therefore wing pattern and colour is not reliably preserved for a comparative study. I have detected only the regular or irregular character states of the step-wise cross-vein pattern on forewing.

Depositories. Nanjing Agricultural University, Nanjing, Jiang-xi Province, China (NAU). Oláh Private Collection, Debrecen, Hungary, under national protection by the Hungarian Natural History Museum, Budapest (OPC).

TAXONOMY

Species groups in the *Oecetis* (*Oecetis*) MacLachlan, 1877 subgenus

The genus *Oecetis* McLachlan, 1877, is one of the largest among caddisflies, populating both the lentic and the lotic habitats, frequently abundant and distributed throughout the world in all faunal regions. The genus is divided into four so called monophyletic subgenera (Chen 1993). *Oecetis* (*Oecetis*) MacLachlan, 1877 subgenus is characterized with character states of *(1)* one paramere spine in the phallus; *(2)* the absence of upper part of male segment X; *(3)* cerci frequently fused to segment X; *(4)* phallic organ frequently globular; *(5)* paramere as long as phallus.

Seven species groups have been recognised in the *Oecetis* (*Oecetis*) subgenus (Chen 1993). Delineation of species group is based on six randomly selected characters, reflecting the speculative nature of phylogeny and the reality of chimerism that is the retigeny or diktiogeny, the dominance of incongruences in integrative organisation: anastomosis cross-vein pattern on fore-

wing, sternum IX, segment X, cercus, gonopod and phallotheca.

(1) *Oecetis (O.) unicolor* group is confined to the Australasian Region. Characterized by phallotheca with right anterolateral lobe and posterior end with dorsal process covering paramere.

(2) *Oecetis (O.) tripunctata* species group is distributed in the Palaearctic, Oriental, Australasian and Afrotropical Regions. Characterized by broad cerci completely fused to segment X and by simple, elongated and medially separated gonopods; forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by at least its length.

(3) *Oecetis (O.) furva* species group is distributed in Palaearctic, Nearctic, Afrotropical and Neotropical Regions. Characterized by sternum IX with membranous posterior pit reaching between gonopods.

(4) *Oecetis (O.) ochracea* species group is distributed in Palaearctic, Nearctic and Oriental Regions. Characterized by gonopods with basoventral lobe visible in lateral view.

(5) *Oecetis (O.) lacustris* species group is distributed in Palaearctic and Oriental Regions. Characterized by gonopods with mesal edges of basal portions smooth and touching or closely approximate for at least 1/3 of their length in ventral view, generally broad and short.

(6) *Oecetis (O.) bicuspida* species group is distributed in the Afrotropical Region. Characterized by gonopods with mesal edges of mesobasal lobes smooth and approximate for no more than 1/4 in their length in ventral view, phallus with left anterior lobe membranous.

(7) *Oecetis (O.) kimminsiana* species group is distributed in the Afrotropical Region. Characterized by gonopods with mesal edges of mesobasal lobes sharply toothed and approximate for no more than 1/4 in their length in ventral view; phallus with left anterior lobe sclerotized. This species group was named originally as *Oecetis (Oecetis) maculipennis* by Chen (1993) in his PhD Thesis work and accepted later by Yung & Morse (2000). Their suggestion was based on the misidentification of Kimmins (1962). Kimmins has presented and drawn *Oecetis kimminsiana* sp. nov. erroneously as *Oecetis maculipennis* Ulmer, 1922. *Oecetis maculipennis* is a typical member of *Oecetis tripunctata* species group with corresponding genital structure, but irregular stepwise pattern of the anastomosis cross-veins, similarly to many more Afrotropical species of the *O. tripunctata* group.

Oecetis (Oecetis) tripunctata (Fabricius, 1793) species group

This poorly known species group is distributed in the Palaearctic, Oriental, Australasian and Afrotropical Regions. Characterized by broad cerci completely fused to segment X and by simple, elongated and medially separated gonopods. Forewing anastomosis cross-veins are arranged in stepwise; transverse base of MA is distad of transverse base of MP3+4, by at least its length. However, this apomorphic cross-vein pattern is unstable and liable to perturbation and reversion. Several species in the Afrotropical Region with typical genital structure of cerci and gonopods exhibits irregular stepwise patterns of cross-vein anastomosis.

West Palaearctic species

Oecetis tripunctata (Fabricius, 1793)

Material examined. **France,** St. Saven, River Gartempe, 9. VII. 1986, light leg. J. Oláh (7 males, OPC). **Hungary**, Bucsa, Hortobágy-Berettyó canal, 15. VII. 1962., singled leg. J. Oláh (4 males, 2 females; OPC). Hungary, Bucsa, Hortobágy-Berettyó canal, 19. VII. 1964, singled leg. J. Oláh (3 males, 1 female; OPC). Hungary, Hortobágy National Park, Bátorliget, 3. VII. 2010, light leg. J. Oláh & M. Oláh (6 males, 2 females, OPC). Hungary, Pocsaj, River Ér, 12. VII. 2010, light leg. J. Oláh (2 females, OPC). Hungary, River Öregtúr at Petőfi Tree of Nagyar, 16.VII.2010 light leg. J. Oláh (8 males, 4 females, OPC). Hungary, River Batár at Magosliget, 20.VII.2010 light leg. J. Oláh (16 males, OPC). Hungary, River Gőgő-Szenke at Nagyszekeres, 13. VIII. 2010 light leg. J. Oláh & R. Horváth (3 males, OPC).

Oriental species

Oecetis anhua sp. nov.

Oecetis tripunctata (Fabricius, 1793): Yang & Morse 2000: 119–121. Misidentification.

Material. Holotype: **China**, An-hui Province, Jin Xian, N30.70, E118.35, Song-cun, Ding-xi-he, 33 km E of Jin Xian, 120 m elevation, 8.VI, 1990, leg. J. Morse & C. Sun (1 male, NAU).

Diagnosis. (After Yang & Morse 2000). Specimens from Anhui, Fujian, Jiangsu, Sichuan and Yunnan provinces were identified as new Chinese record of *Oecetis* (*O.*) *tripunctata* (Fabricius, 1793). The new species *Oecetis anhua* differs from *Oecetis tripunctata* (Fabricius, 1793) by both the lateral and ventral shape of the gonopods. The lateral profile of the gonopods possesses pronounced basodorsal and basoventral lobes lacking at *O. tripunctatus*. The apical half of the gonopod narrowing with mesad turning apex, not mesad spatulate.

Description. After Yang & Morse, 2000:119–121; 246: figures: 132 A,B,C,D.

Head, thorax, scape reddish brown. Forewing rubbed in alcohol, membrane hyaline of 7.5–7.9 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

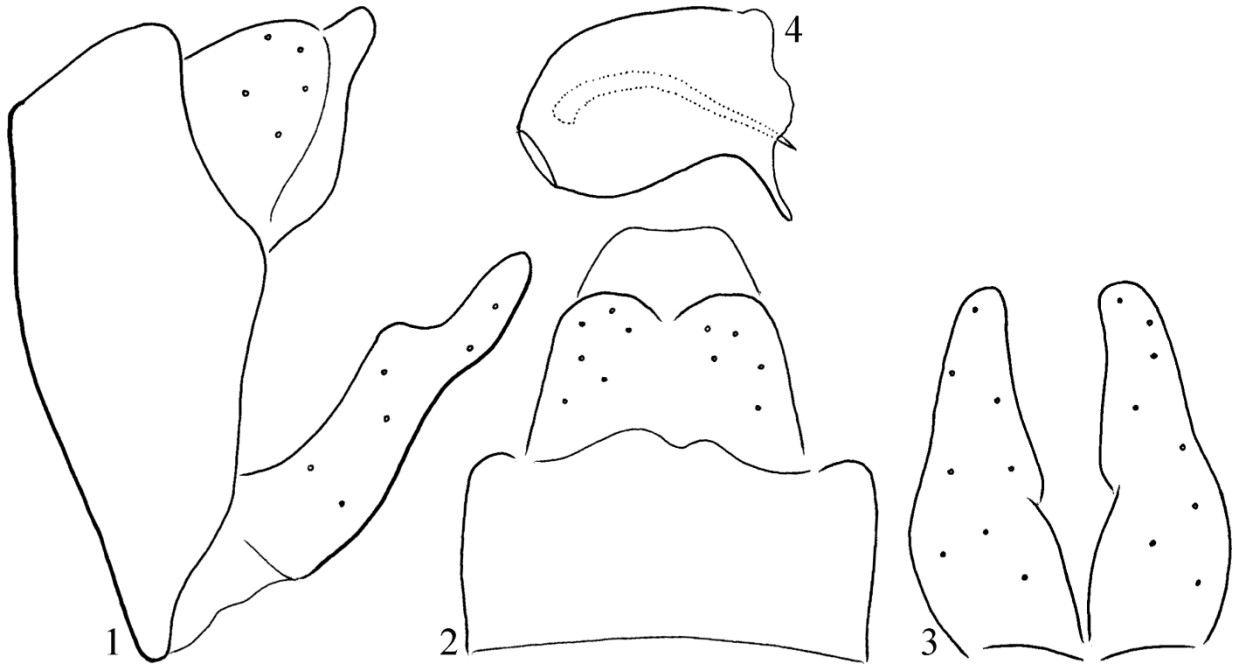
Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis baneswara sp. nov.

(Figures 1–4)

Material examined. Holotype: **India**, Orissa State, near Bhubaneswar, Dhauli, marsh, 20–28.II.1987, light leg. J. Oláh (1 male, OPC). Paratype: same as holotype (5 males, OPC).

Diagnosis. *Oecetis baneshwara* sp. nov. has resemblance to *Oecetis orissa* sp. nov. another species collected from the same marshy area in



Figures 1–4. *Oecetis baneswara* sp. nov. Holotype: 1 = male genitalia in left lateral view, 2 = male genitalia in dorsal view, 3 = gonopods in ventral view, 4 = phallic organ in left lateral view.

Dhauli, Orissa State, but a single paratype also from Gujarat State. *Oecetis baneshwara* is distinguished from *O. orissa* by having longer tergum IX and shorter sternum IX; dorsal profile of segment X almost truncated, not excised; lateral profile of gonopod with undulating, not straight ventrum; ventral profile of gonopod with long, not short apical mesad produced region. Phallic organ with almost right angled and slender, not obtuse angled and robust apicoventral lip.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX with long tergum and very short ventrum. Lateral profile of segment X with slightly upward directed apex, truncated in dorsal view. Cerci completely fused to segment X, as long as high in lateral view. Lateral profile of gonopod with stepwise ending, long mesal apex in ventral view. Apicoventral lip of the phallic organ almost right-angled and slender.

Etymology. Coined after the name of locus typicus, a noun in apposition.

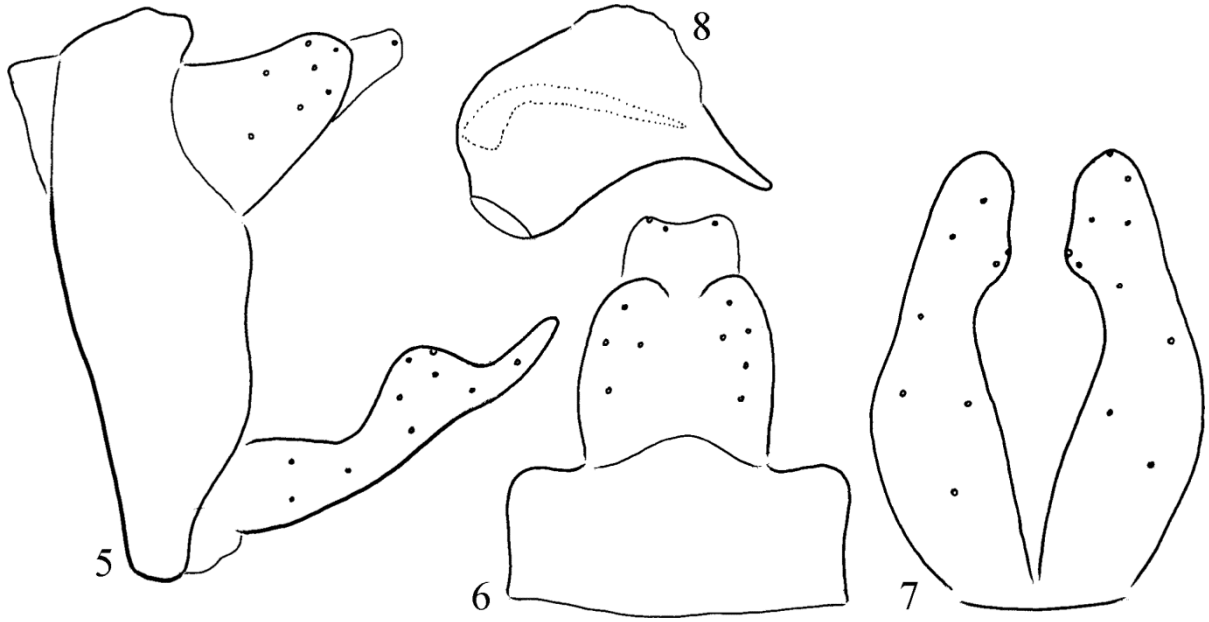
***Oecetis baoloca* sp. nov.**

(Figures 5–8)

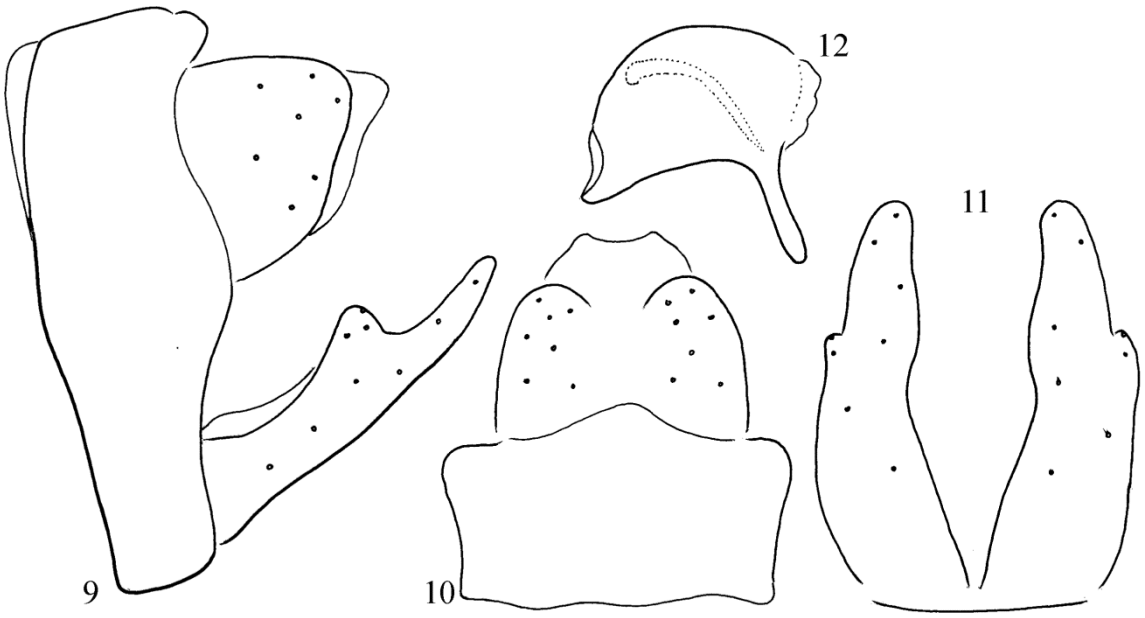
Oecetis tripunctata (Fabricius, 1793): Oláh 2013:129. Misidentification.

Material examined. Holotype: **Vietnam**, Lam Dong Province, Baoloc, Dai Binh River, 22.X. 1988, light leg. J. Oláh (1male, right wings embedded in permanent preparates, OPC). Paratypes: same as holotype (6 males, OPC).

Diagnosis. *Oecetis baoloca* sp. nov. has resemblance to *Oecetis hoabinha* sp. nov. but distinguished by having shorter sternum IX; dorsal profile of segment X slightly excised and long (wide), not rounded and short (narrow); lateral profile of gonopod with undulating, not straight



Figures 5–8. *Oecetis baoloca* sp. nov. Holotype: 5 = male genitalia in left lateral view, 6 = male genitalia in dorsal view, 7 = gonopods in ventral view, 8 = phallic organ in left lateral view.



Figures 9–12. *Oecetis bhubaneswa* sp. nov. Holotype: 9 = male genitalia in left lateral view, 10 = male genitalia in dorsal view, 11 = gonopods in ventral view, 12 = phallic organ in left lateral view.

ventrum, ventral profile of gonopod with short apical region strongly mesad produced. Phallic organ with more obtuse angled apicoventral lip.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length, forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX with slightly longer tergum than ventrum. Lateral profile of segment X visible as a simple lobe, a continuation of cerci, truncated quadrangular in dorsal view. Cerci fused to segment X, longer than high in lateral view. Lateral profile of gonopod with strong middle lobe, very short mesal apex in ventral view. Apicoventral lip of the phallic organ obtuse angled and tapering.

Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis bhubaneswa sp. nov.

(Figures 9–12)

Material examined. Holotype: **India**, Orissa State, near Bhubaneswar, Dhauli, marsh, II.1983, light leg. J. Oláh (1 male, OPC). Paratype: same as holotype (5 males, OPC). India, Orissa State, near Bhubaneswar, Dhauli, marsh, 8–10. III.1985, light leg. J. Oláh (1 male, OPC). India, Orissa State, near Bhubaneswar, Dhauli, marsh, 16. III.1985, light leg. J. Oláh (6 males, OPC). India, Orissa State, near Bhubaneswar, Dhauli, marsh, 30. III.1985, light leg. J. Oláh (1 male, OPC). India, Orissa State, near Bhubaneswar, Dhauli, marsh, 30. III.1985, light leg. J. Oláh (1 male, OPC). India, Orissa State, near Bhubaneswar, Dhauli, marsh, 22. II.1987, light leg. J. Oláh (28 males, OPC).

Diagnosis. *Oecetis bhubaneswa* sp. nov. has resemblance to *Oecetis baneswara* sp. nov. but distinguished by dorsal profile of segment X almost truncate, not excised; lateral profile of gono-

pod with straight, not undulating ventrum and the subapical dorsal lobe more produced; ventral profile of gonopod with shorter apical region pronouncedly mesad produced. Phallic organ with more produced apicoventral lip.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length, forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight anterad with longer tergum than ventrum. Lateral profile of segment X visible as short vertical setaless continuation of cerci, rounded laterad and slightly excised in dorsal view. Cerci fused to segment X, shorter than high in lateral view. Lateral profile of gonopod with strong, high and short middle lobe, long mesal apex and a small lateral lobe in ventral view. Apicoventral lip of the phallic organ obtuse-angled long and digitiform.

Etymology. Coined after the name of locus typicus, a noun in apposition.

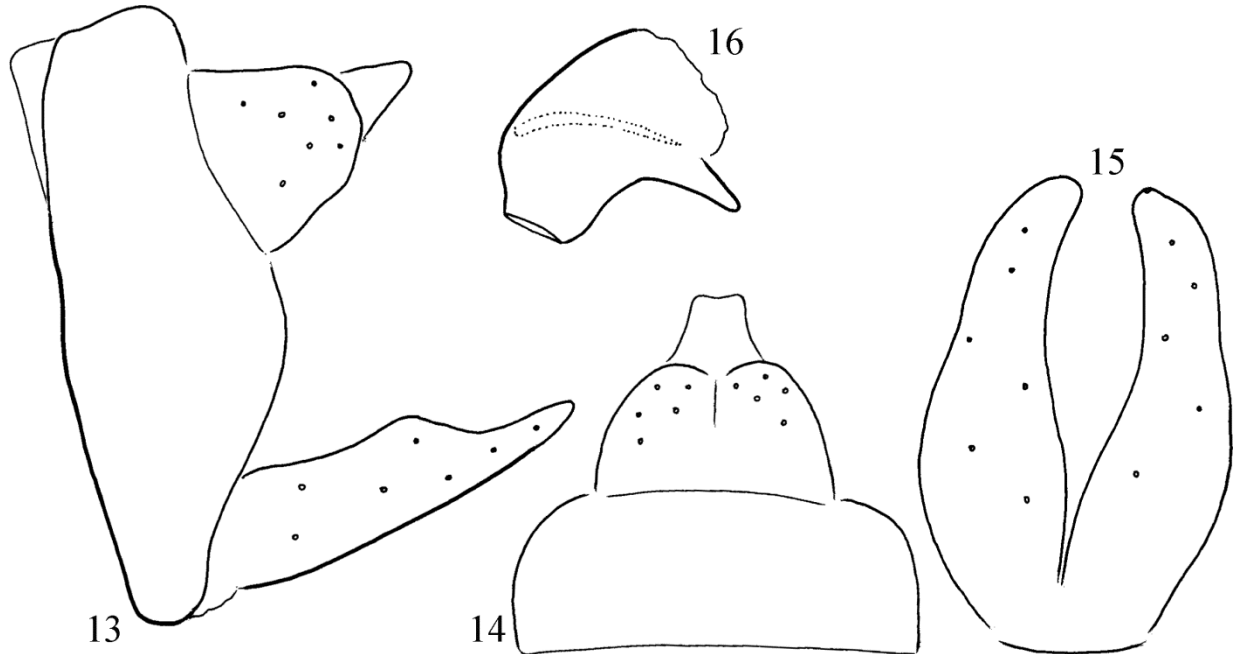
Oecetis dagna sp. nov.

(Figures 13–16)

Oecetis tripunctata (Fabricius, 1793): Oláh 2013:129. Misidentification.

Material examined. Holotype: **Vietnam**, Lam Dong Province, Baoloc, Da Gna River, 21.X. 1988, light leg. J. Oláh (1male, OPC).

Diagnosis. *Oecetis dagna* sp. nov. has resemblance to *Oecetis hoabinha* sp. nov. but distinguished by dorsal profile of segment X slightly excised, not rounded; lateral profile of gonopod with almost straight, not with concave basodorsum; ventral profile of gonopod with mesad produced apex, not simply rounded and subapical dorsal lobe produced visible. Phallic organ with more robust apicoventral lip.



Figures 13–16. *Oecetis dagna* sp. nov. Holotype: 13 = male genitalia in left lateral view, 14 = male genitalia in dorsal view, 15 = gonopods in ventral view, 16 = phallic organ in left lateral view.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length, forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX rounded posterad. Lateral profile of segment X visible as short triangular, setaless continuation of cerci, narrow and long in dorsal view. Cerci fused to segment X, shorter than high in lateral view. Lateral profile of gonopod two-partite; long quadrangular basal and digitiform tapering apical region; simple, elongated and tapering in ventral view. Apicoventral lip of the phallic organ obtuse-angled short and tapering.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Oecetis dhaulia* sp. nov.**

(Figures 17–20)

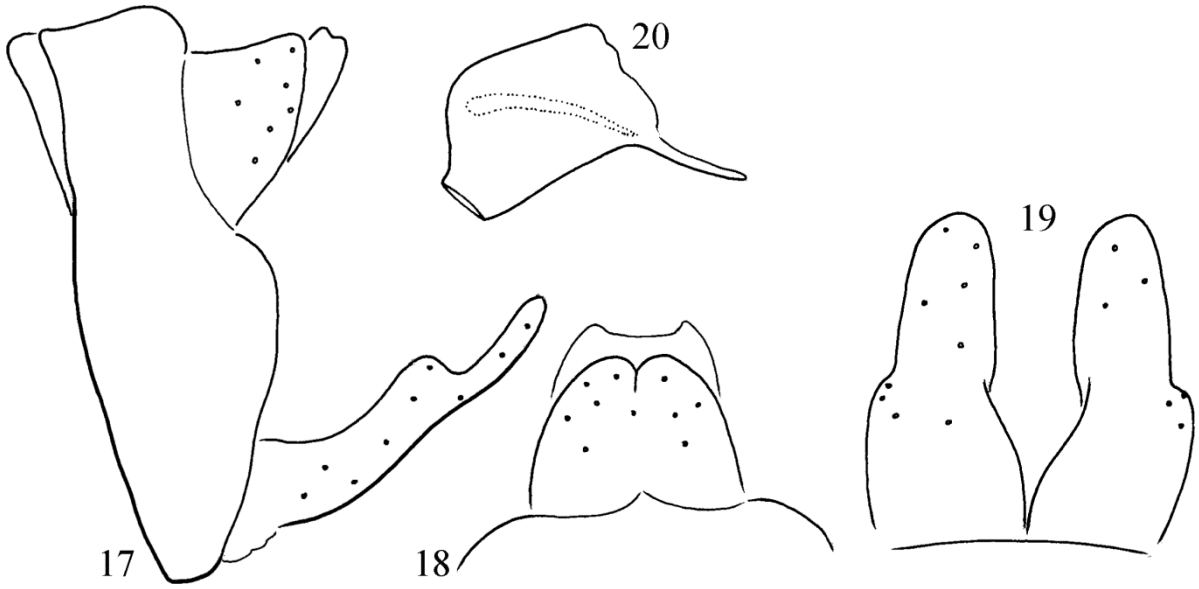
Material examined. Holotype: **India**, Orissa State, near Bhubaneswar, Daya River, 21.II.1985, light leg. J. Oláh (1 male, OPC).

Diagnosis. *Oecetis dhaulia* sp. nov. has resemblance to *Oecetis gujara* sp. nov. but distinguished by the shorter cerci; by the lateral profile of gonopod with more produced subapical dorsal lobe; ventral profile of gonopod with robust, rounded apical half, not slender, narrowing and mesad turning. Phallic organ shorter.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length, forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight anterad, with rounded pleural region posterad. Lateral profile of segment X visible as a setaless continuation of cerci, with upward directed bifid apex; short and wide, mesally excised in dorsal view. Cerci fused to segment X, subtriangular in lateral view. Lateral profile of gonopod two-partite; higher arching basal and digitiform tapering apical region; robust, two-partite in ventral view. Apicoventral lip of the phallic organ obtuse-angled long and slender.

Etymology. Coined after the name of locus typicus, a noun in apposition.



Figures 17–20. *Oecetis dhaulia* sp. nov. Holotype: 17 = male genitalia in left lateral view, 18 = male genitalia in dorsal view, 19 = gonopods in ventral view, 20 = phallic organ in left lateral view.

Oecetis gujara sp. nov.

(Figures 21–24)

Material examined. Holotype: **India**, Gujarat State, Ghandinagar, Sabarmati River, 22.IV.1992, light leg. J. Oláh (1 male, OPC). Paratype: same as holotype (3 males, OPC). India, Rhajasthan State, Banswara, Mahi River, 26. IV. 1992, light leg. J. Oláh (3 male, OPC).

Diagnosis. *Oecetis gujara* sp. nov. has resemblance to *Oecetis dhaulia* sp. nov. but is distinguished by the longer cerci; by the lateral profile of gonopod with less produced subapical dorsal lobe; ventral profile of gonopod with slender, narrowing and mesad turning apical half, not robust and rounded. Phallic organ longer.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

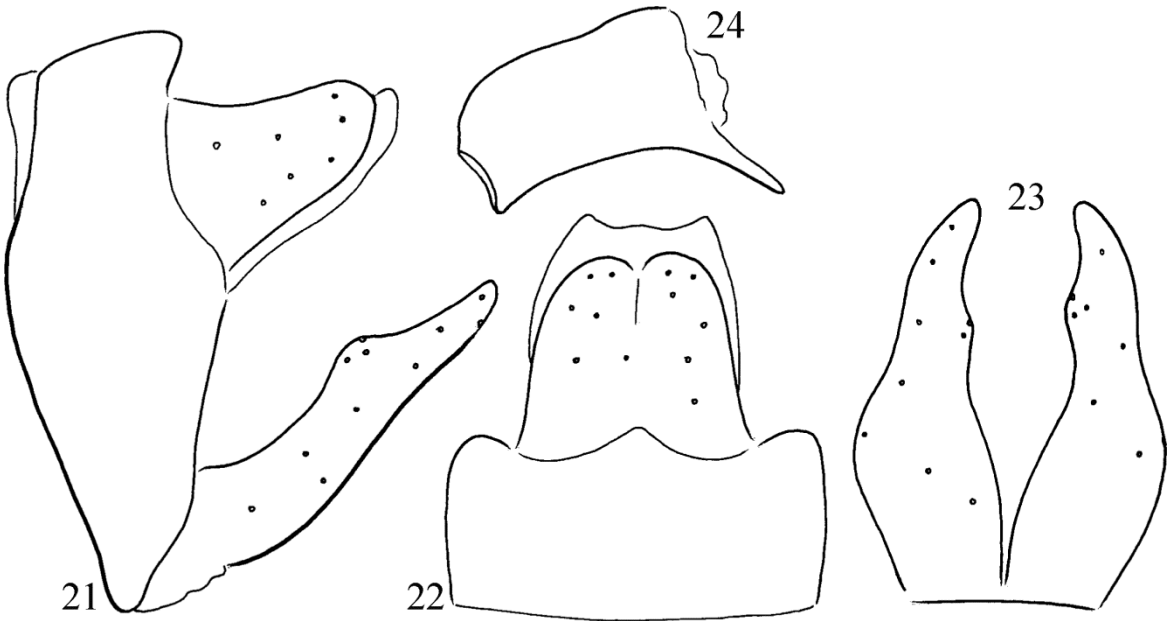
Male genitalia. Segment IX straight anterad, with rounded pleural region posterad; tergum long, ventrum short in lateral view. Lateral profile of segment X visible as a setaless marginal continuation of cerci, with upward directed rounded apex; short and wide, mesally excised in dorsal view. Cerci fused to segment X, elongated in lateral view. Lateral profile of gonopod two-partite; higher arching basal and digitiform tapering apical region; robust, two-partite in ventral view with an additional mesal hump middle on the apical region. Apicoventral lip of the phallic organ very obtuse-angled long and slender.

Etymology. Coined after the name of locus typicus, a noun in apposition.

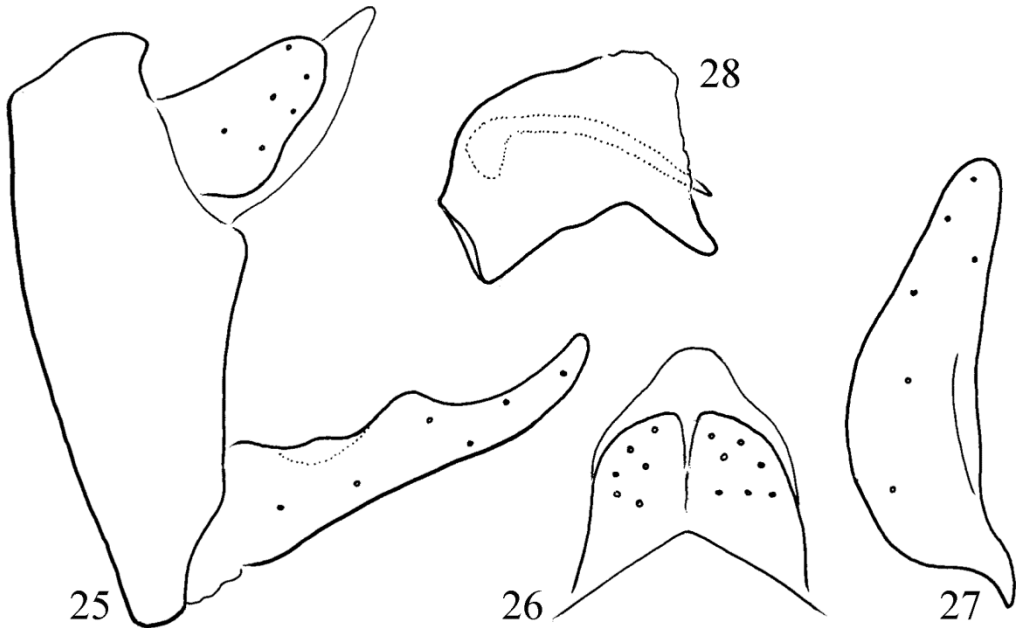
Oecetis halonga sp. nov.

(Figures 25–28)

Material examined. Holotype: **Malaysia**, Perak, Halong stream, 4.XII.1993, light leg. G. Robinson (1 male, OPC). Paratype: Malaysia, Perak, Halong stream, 9.XII.1993, light leg. G. Robinson (1 male, OPC).



Figures 21–24. *Oecetis gujara* sp. nov. Holotype: 21 = male genitalia in left lateral view, 22 = male genitalia in dorsal view, 23 = gonopods in ventral view, 24 = phallic organ in left lateral view.



Figures 25–28. *Oecetis halonga* sp. nov. Holotype: 25 = male genitalia in left lateral view, 26 = male genitalia in dorsal view, 27 = gonopods in ventral view, 28 = phallic organ in left lateral view.

Diagnosis. *Oecetis halonga* sp. nov. has resemblance to *Oecetis dagna* sp. nov. but distinguished by the lower cerci; by the lateral profile of gonopod with pronounced subapical dorsal lobe; ventral profile of gonopod with narrowing, but straight vertical mesal margin, not with mesad turning apical half. Apicoventral lip on phallic organ more right angled, not obtuse angled.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length, forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight anterad, with subtriangular pleural region posterad; tergum long, ventrum short in lateral view. Lateral profile of segment X visible as a setaless marginal continuation of cerci, with tapering apex; short and narrowing with blunt apex in dorsal view. Cerci fused to segment X, elongated with constricted basal region in lateral view. Lateral profile of gonopod with broad basement; undulating dorsum on the basal region and tapering and upward arching apical region; simple narrowing elongated structure in ventral view. Apicoventral lip of the phallic organ almost right-angled, short triangular in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Oecetis hoabinha* sp. nov.**

(Figures 29–32)

Oecetis tripunctata (Fabricius, 1793): Oláh 2013:129. Misidentification.

Material examined. Holotype: **Vietnam**, Hoa Binh Province, 8 km to Dabac, 31.I.1986, light leg. J. Oláh (1 male, OPC). Paratypes: same as holotype (2 males, OPC). Vietnam, Hoa Binh Province, towards Dabac, 21.X.1986, light leg. J. Oláh (2 males, OPC).

Diagnosis. *Oecetis hoabinha* sp. nov. has resemblance to *Oecetis dagna* sp. nov. but distinguished by dorsal profile of segment X rounded, not slightly excised; lateral profile of gonopod with concave, not with almost straight baso-

dorsum; ventral profile of gonopod with simply rounded, not mesad produced apex, and no dorsal lobe visible. Phallic organ with less robust apicoventral lip.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight anterad, with rounded pleural region posterad; tergum long, ventrum slightly shorter in lateral view. Lateral profile of segment X visible as a setaless marginal continuation of cerci, with tapering apex; long and narrow with blunt apex in dorsal view. Cerci fused to segment X, subtriangular in lateral view. Lateral profile of gonopod with broad basement, concave dorsum on the basal region and narrow apical region; two partite with broader and longer basal region in ventral view. Apicoventral lip of the phallic organ almost obtuse-angled, short in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Oecetis kamba* sp. nov.**

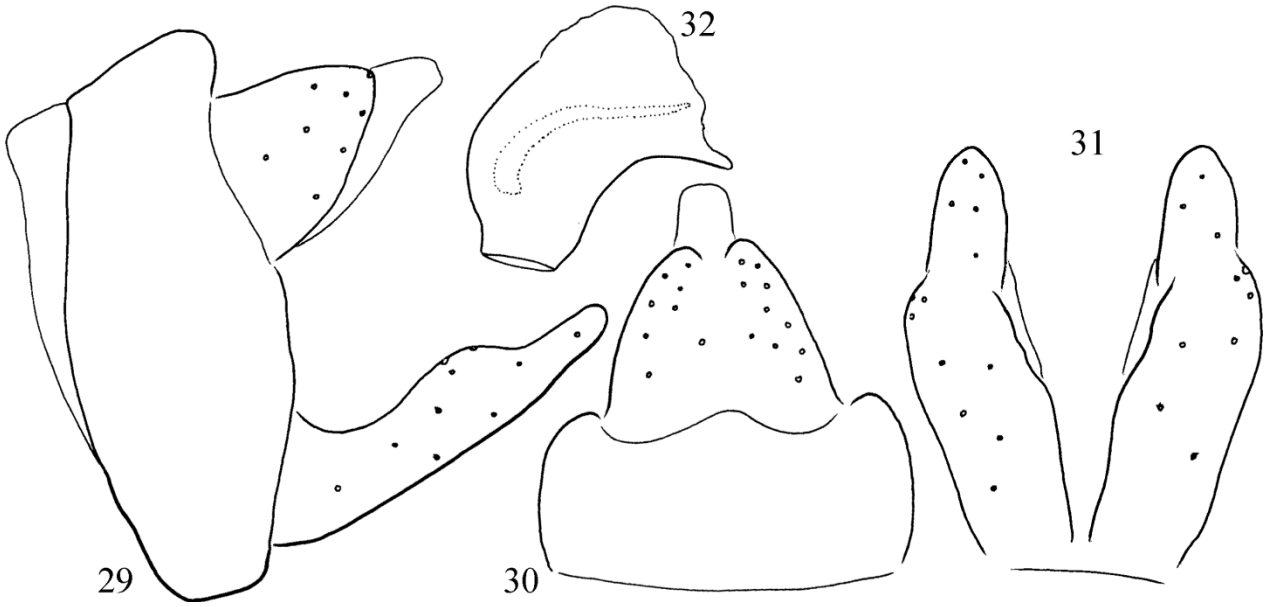
(Figures 33–36)

Oecetis tripunctata (Fabricius, 1793): Oláh & Malicky 2011:22. Misidentification.

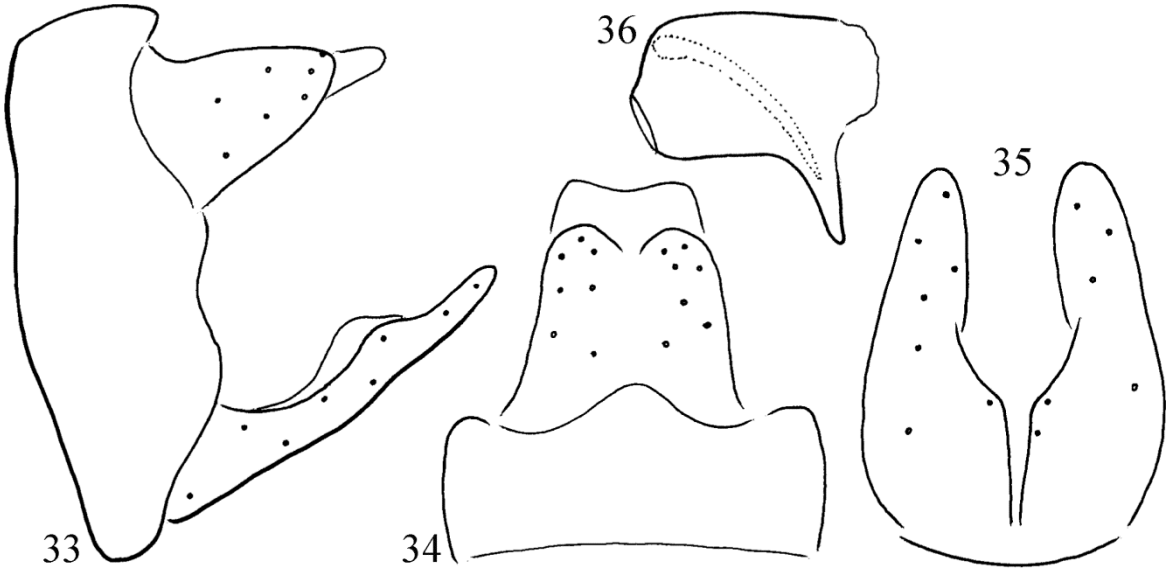
Material examined. Holotype: **Indonesia,** Sumatra, Way Kambas National Park, 22.VI.2009, light trap. leg. Z. Ecsedi (1 male, OPC). Paratypes: same as holotype (8 males, OPC).

Diagnosis. *Oecetis kamba* sp. nov. has resemblance to *Oecetis halonga* sp. nov. but distinguished by wide and excised segment X, not narrow and rounded; by the longer cerci; by the lateral profile of gonopod with more concave dorsum, with pronounced subapical dorsal lobe; ventral profile of gonopod with mesad produced, not with straight vertical basal region. Apicoventral lip on phallic organ slender.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol,



Figures 29–32. *Oecetis hoabinha* sp. nov. Holotype: 29 = male genitalia in left lateral view, 30 = male genitalia in dorsal view, 31 = gonopods in ventral view, 32 = phallic organ in left lateral view.



Figures 33–36. *Oecetis kamba* sp. nov. Holotype: 33 = male genitalia in left lateral view, 34 = male genitalia in dorsal view, 35 = gonopods in ventral view, 36 = phallic organ in left lateral view.

membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight anterad, with rounded convex pleural region posterad; tergum long, ventrum slightly shorter in lateral view. Lateral profile of segment X visible as short setaless lobe; short and wide with slightly excised truncated apex in dorsal view. Cerci fused to segment X, elongated subtriangular in lateral view. Lateral profile of gonopod slender, upper margin of the mesal lobe visible; two partite with broader and longer basal region in ventral view. Apicoventral lip of the phallic organ almost right-angled, long and strong in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis lata Johanson, Pham, Malm & Sjöberg, 2020

Material examined. **Vietnam**, Thai Nguyen Province, Phu Luong, Dang Dat River, 26.V. 1987, light leg. J. Oláh (15 males, OPC).

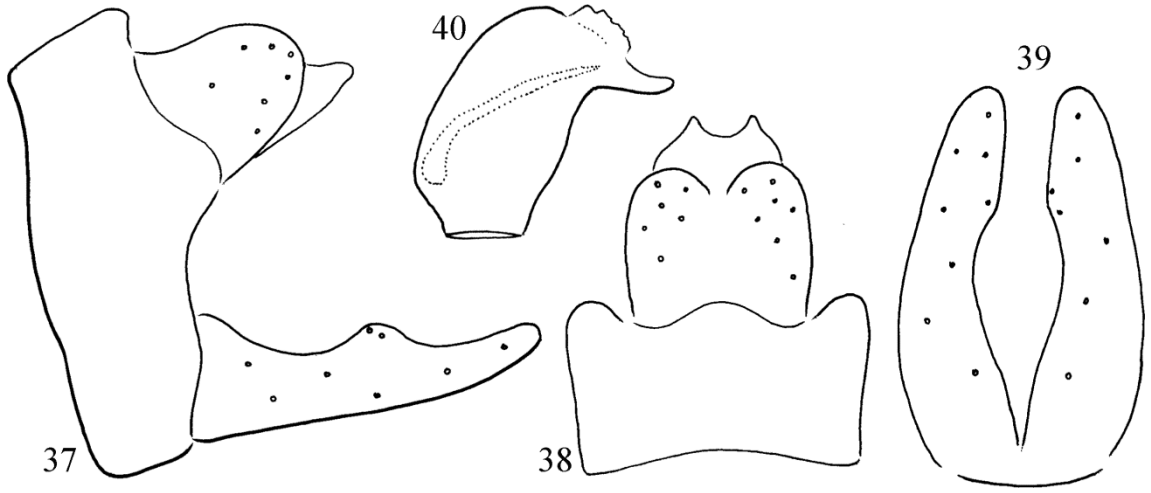
Oecetis orissa sp. nov.

(Figures 37–40)

Material examined. Holotype: **India**, Orissa State, near Bhubaneswar, Daya River, 21.II.1985, light leg. J. Oláh (1 male, OPC). Paratype: same as holotype (23 males, OPC). India, Orissa State, near Bhubaneswar, Dhauli, marsh, 20–28.II.1987, light leg. J. Oláh (1 male, OPC). India, Gujarat State, Ghandinagar, Sabarmati River, 22.IV.1992, light leg. J. Oláh (1 male, OPC).

Diagnosis. *Oecetis orissa* sp. nov. has resemblance to *Oecetis baneshwara* sp. nov. but distinguished by having shorter tergum IX and longer sternum IX; dorsal profile of segment X excised, not truncated; lateral profile of gonopod with straight, not undulating ventrum; ventral profile of gonopod with short, not with long apical mesad produced region. Phallic organ with obtuse angled and robust, not with almost right angled and slender apicoventral lip.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise,



Figures 37–40. *Oecetis orissa* sp. nov. Holotype: 37 = male genitalia in left lateral view, 38 = male genitalia in dorsal view, 39 = gonopods in ventral view, 40 = phallic organ in left lateral view.

transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight anterad, with rounded triangular pleural region posterad; tergum long, ventrum only slightly shorter in lateral view. Lateral profile of segment X visible as short setaless triangular lobe; short and wide with deeply excised apex in dorsal view. Cerci fused to segment X, semicircular in lateral view. Lateral profile of gonopod with pronounced middle lobe; two partite with mesally extended apical region in ventral view. Apicoventral lip of the phallic organ almost right-angled, robust digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Oecetis peraka* sp. nov.**

(Figures 41–44)

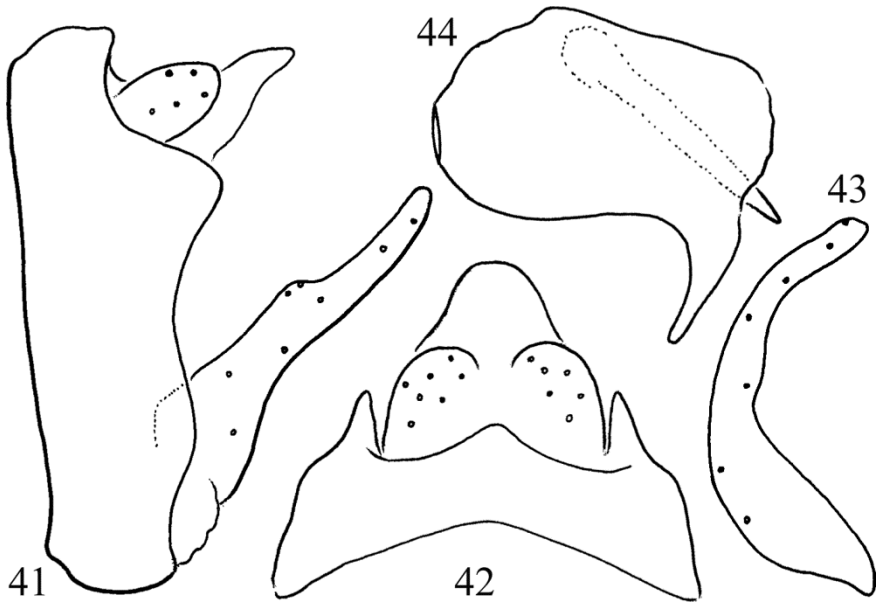
Material examined. Holotype: **Malaysia**, Perak, Halong stream, 21.XI.1993, light leg. G.S. Robinson (1 male, OPC).

Diagnosis. *Oecetis peraka* sp. nov distinguished from all the known species by having stepwise pattern of cross-veins in anastomosis on the forewing chimeric, that is the transverse base of MA is distad of transverse base of MP3+4 only a little more than its length; the cerci is small; dorsal profile of segment X rounded; ventral profile of gonopod slender arching laterad, not robust. Phallic organ rather large with anterad turning apicoventral lip.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by just a little more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX regular straight vertical anterad, with triangular pleural region posterad; tergum slightly shorter than ventrum in lateral view. Lateral profile of segment X visible as a slightly S-formed setaless lobe; with slightly tapering blunt apex in dorsal view. Cerci rather small, fused to segment X, foliform in lateral view. Lateral profile of gonopod slender with small middle lobe; arching mesad in ventral view. Apicoventral lip of the phallic organ rounded-angled, digitiform, downward directed in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.



Figures 41–44. *Oecetis peraka* sp. nov. Holotype: 41 = male genitalia in left lateral view, 42 = male genitalia in dorsal view, 43 = gonopods in ventral view, 44 = phallic organ in left lateral view.

***Oecetis prenna* sp. nov.**

(Figures 45–48)

Oecetis tripunctata (Fabricius, 1793): Oláh 2013:129. Misidentification.

Material examined. Holotype: **Vietnam**, Lam Dong Province, Dalat, Prenn waterfall, 19.X. 1988, light leg. J. Oláh (1male, OPC). Paratype: Vietnam, Cuc Phuong National Park, 400 m, 17.X.1986, light leg. J. Oláh (1 male, OPC).

Diagnosis. *Oecetis prenna* sp. nov. has resemblance to *Oecetis halonga* sp. nov. but distinguished by the higher cerci; by the lateral profile of gonopod with pronounced middle constriction; ventral profile of gonopod with narrowing, and slightly mesad turning apical half. Apicoventral lip on phallic organ slender and regularly right angled.

Description. Head, thorax, scape light brown yellowish in alcohol. Forewing rubbed in alcohol, membrane hyaline of 8 mm length, forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

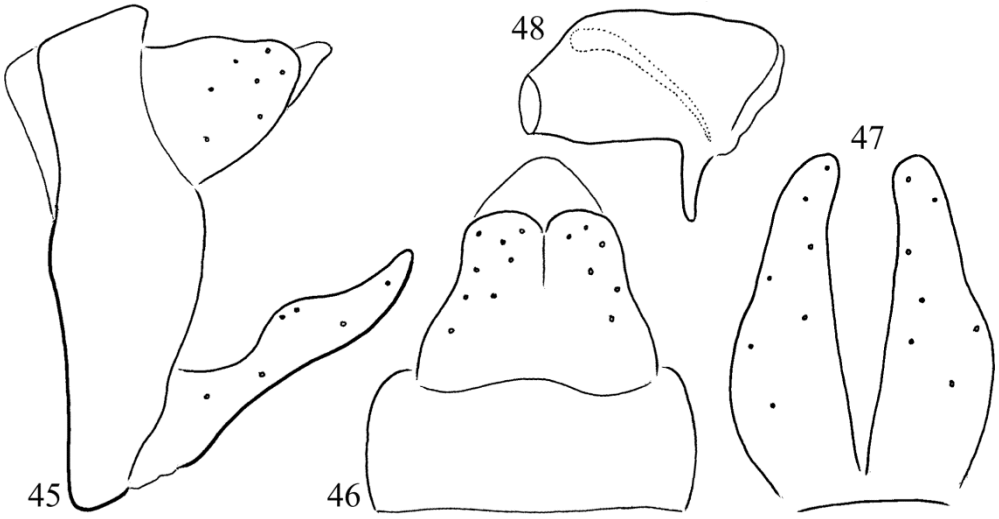
Male genitalia. Segment IX regular straight vertical anterad, with rounded convex pleural region posterad; tergum longer than ventrum in lateral view. Lateral profile of segment X visible as a small narrowing setaless lobe; with subtriangular blunt apex in dorsal view. Cerci large, fused to segment X, foliform in lateral view. Lateral profile of gonopod slender highly constricted before the middle lobe; straight narrowing in ventral view. Apicoventral lip of the phallic organ regular right-angled, digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

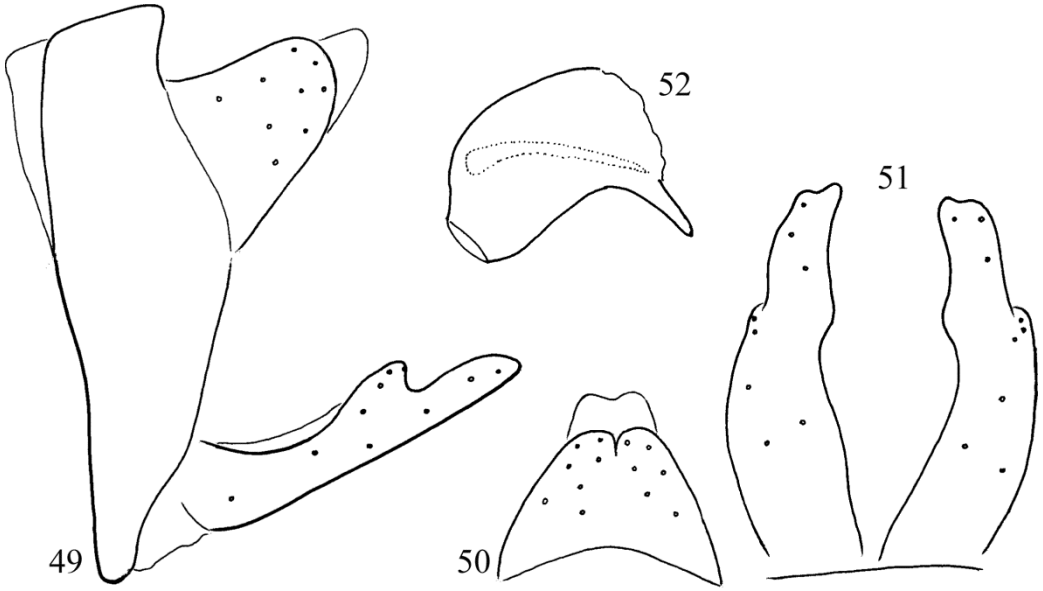
***Oecetis sabarma* sp. nov.**

(Figures 49–52)

Material examined. Holotype: **India**, Gujarat State, Ghandinagar, Sabarmati River, 22.IV.1992, light leg. J. Oláh (1 male, OPC). Paratype: same as of holotype (1 male, OPC).



Figures 45–48. *Oecetis prenna* sp. nov. Holotype: 45 = male genitalia in left lateral view, 46 = male genitalia in dorsal view, 47 = gonopods in ventral view, 48 = phallic organ in left lateral view.



Figures 49–52. *Oecetis sabarma* sp. nov. Holotype: 49=male genitalia in left lateral view, 50 = male genitalia in dorsal view, 51 = gonopods in ventral view, 52 = phallic organ in left lateral view.

Diagnosis. *Oecetis sabarma* sp. nov distinguished from all the known species by the particularly patterned gonopod both in lateral and ventral view, the subapical dorsal lobe is strongly produced in the lateral profile, as well as the head almost bifid in ventral view; dorsal profile of segment X excised.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by just a little more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX regular straight vertical anterad, with rounded convex pleural region posterad; tergum longer than ventrum in lateral view. Lateral profile of segment X visible as a small narrowing setaless lobe; with slightly excised blunt apex in dorsal view. Cerci large, fused to segment X, foliform in lateral view. Lateral profile of gonopod slender constricted before the posterad produced middle lobe; particularly patterned apical region in ventral view. Apicoventral lip of the phallic organ right-angled, digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

Australasian species

Oecetis kokopa sp. nov.

(Figures 53–56)

Oecetis tripunctata (Fabricius, 1793): Oláh & Mey 2013:422. Misidentification.

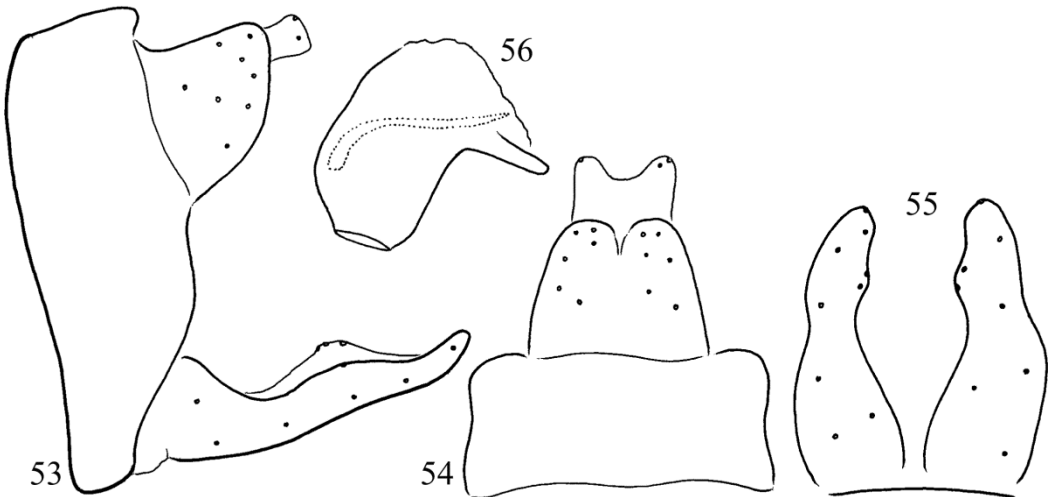
Material examined. Holotype: **Papua New Guinea**, East New Britain Provinz, 33 km SW Kokopo Aranam, Rapmarine River, 180 m, 04° 35'56"S 152°06'06"E, 2 III.2000, leg. M. Schaarschmidt & F.P. Roick (1male, OPC).

Diagnosis. *Oecetis kokopa* sp. nov. has some resemblance to *Oecetis parom* sp. nov. but distinguished by having shorter sternum IX; dorsal profile of segment X deeply excised; lateral profile of gonopod with deep dorsal concavity; ventral profile of gonopod with middle constriction. Phallic organ with more robust and right angled apicoventral lip.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight vertical anterad, with rounded convex pleural region posterad; tergum longer than ventrum in lateral view. Lateral profile of segment X visible as a small quadrangular setaless lobe, slightly broadening apicad; with deeply excised apex in dorsal view. Cerci large, fused to segment X, triangular in lateral view. Lateral profile of gonopod with broad basement, less produced middle lobe and well produced mesal margin visible even in lateral view; subapical mesal lobe in ventral view. Apicoventral lip of the phallic organ regular right-angled, digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.



Figures 53–56. *Oecetis kokopa* sp. nov. Holotype: 53 = male genitalia in left lateral view, 54 = male genitalia in dorsal view, 55 = gonopods in ventral view, 56=phallic organ in left lateral view.

Oecetis parom sp. nov.

(Figures 57–60)

Material examined. **Indonesia**, West Papua, Batanta Island, River Waridor, 00°86840”S, 130° 52516”E, 18.I.2013, light trap, leg. Horváth, (1 male, OPC).

Diagnosis. *Oecetis parom* sp. nov. has some resemblance to *Oecetis baneswara* sp. nov. but distinguished by having shorter tergum IX and longer sternum IX; dorsal profile of segment X excised; lateral profile of gonopod with straight, not undulating ventrum; ventral profile of gonopod with straight vertical, not rounded lateral margin, as well as the mesad produced region short and differently shaped. Phallic organ with obtuse angled apicoventral lip.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight vertical anterad, with almost straight vertical with less produced pleural region posterad; tergum and ventrum almost with the same length in lateral view. Lateral profile of segment X visible as a tapering triangular lobe; with slightly excised apex in dorsal view. Cerci large, fused to segment X, semicircular in lateral view. Lateral profile of gonopod with broader basal two thirds, less produced middle lobe and slender digitiform in lateral view; two-partied in ventral view. Apicoventral lip of the phallic organ rounded right-angled, slender pointed in lateral view.

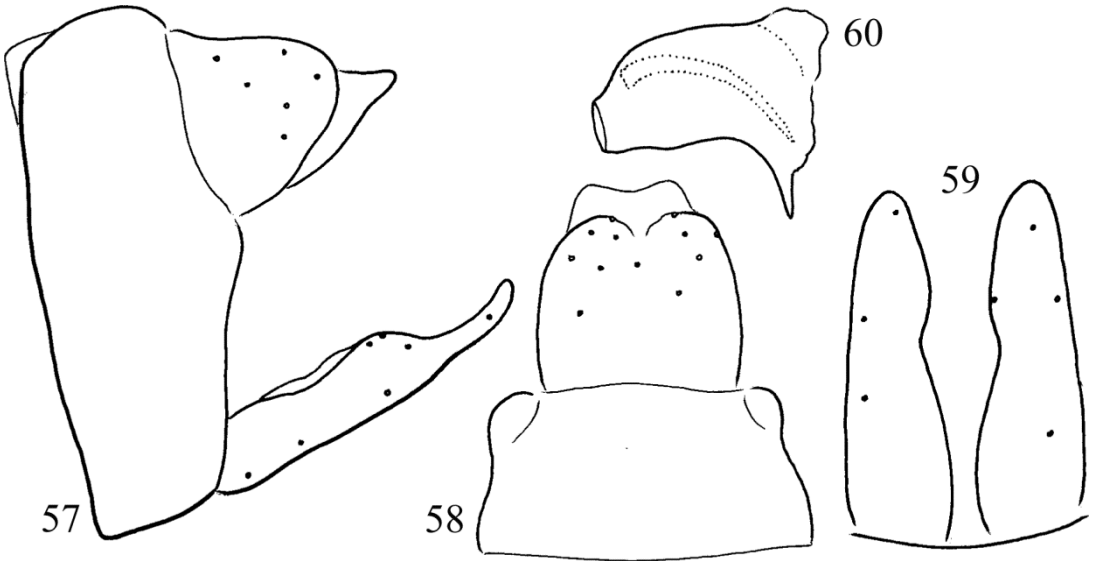
Etymology. I dedicate this particular species from the *Oecetis tripunctata* species group to my wife as we say in Hungarian to my “*párom*”, a noun in apposition.

Afrotropical species

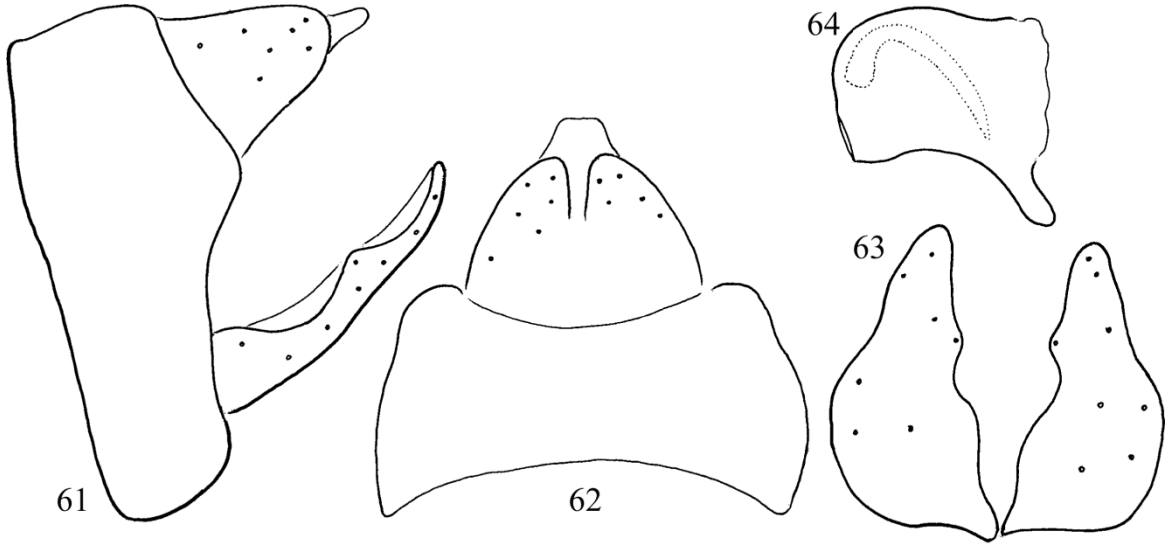
Oecetis anka sp. nov.

(Figures 61–64)

Material examined. Holotype: **Madagascar,** Ankazoabo Tulear Province, Station Hydrologique du Banian, VII.1957, leg. R. Paulian (1 male, OPC). Paratype: same as holotype (8 males, OPC).



Figures 57–60. *Oecetis parom* sp. nov. Holotype: 57 = male genitalia in left lateral view, 58 = male genitalia in dorsal view, 59 = gonopods in ventral view, 60 = phallic organ in left lateral view.



Figures 61–64. *Oecetis anka* sp. nov. Holotype: 61 = male genitalia in left lateral view, 62 = male genitalia in dorsal view, 63 = gonopods in ventral view, 64 = phallic organ in left lateral view.

Diagnosis. *Oecetis anka* sp. nov. has resemblance to *Oecetis kagerana* Kimmins, 1956 described from Uganda, but distinguished by having cerci longer; dorsal profile of segment X with truncate apex, not excised; lateral profile of gonopod with deep dorsal concavity both basad and apicad of the dorsal subapical lobe, not straight; ventral profile of gonopod more robust. Phallic organ with digitiform, not triangular apicoventral lip.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX straight vertical anterad, with rounded triangular pleural region posterad; tergum longer than ventrum in lateral view. Lateral profile of segment X visible as a small elongated setaless lobe; with narrowing and truncate apex in dorsal view. Cerci large, fused to segment X, rounded triangular in lateral view. Lateral profile of gonopod with broad basement, less produced middle lobe and well produced mesal margin visible even in lateral view; subapical mesal lobe in ventral view. Apicoventral lip of the phallic organ regular obtuse-angled, robust and digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

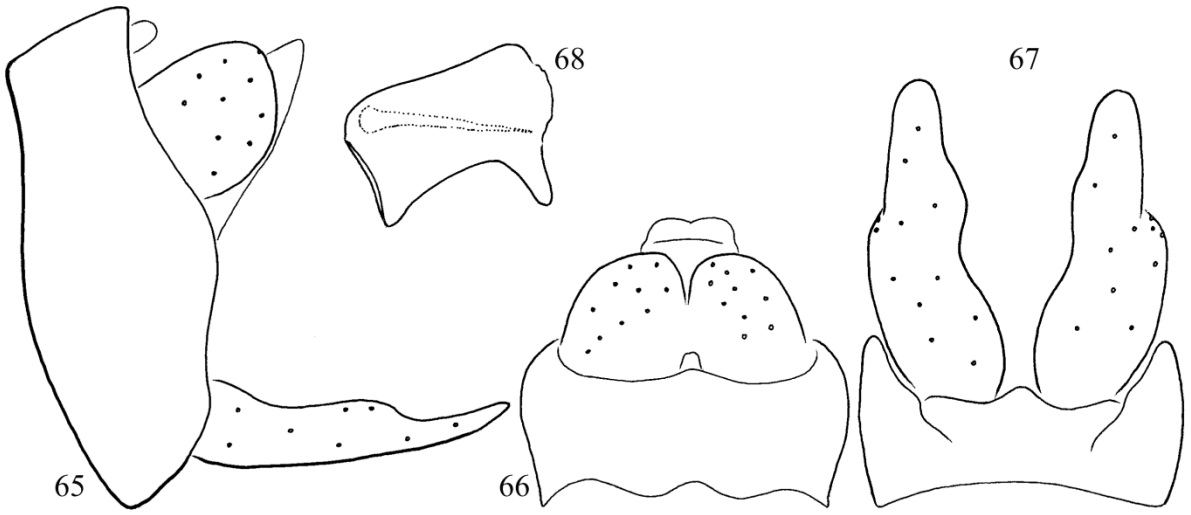
***Oecetis banda* sp. nov.**

(Figures 65–68)

Material examined. Holotype: **Ghana,** Banda-Nkwanta, 13–17.IX.1965, light leg. S. Endrődy-Younga (1 male, OPC).

Diagnosis. *Oecetis banda* sp. nov. has resemblance to *Oecetis kagerana* Kimmins, 1956 described from Uganda, but distinguished by having cerci more produced; dorsal profile of segment X wide, not narrowing; lateral profile of gonopod with shallow dorsal concavity basad of the dorsal subapical lobe, not straight; Phallic organ with right-angled, digitiform, not obtuse-angled, triangular apicoventral lip.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in stepwise,



Figures 65–68. *Oecetis banda* sp. nov. Holotype: 65 = male genitalia in left lateral view, 66 = male genitalia in dorsal view, 67 = gonopods in ventral view, 68 = phallic organ in left lateral view.

transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX slightly convex vertical anterad, with rounded triangular pleural region posterad; tergum longer than ventrum in lateral view. Lateral profile of segment X visible as a small elongated setaless triangular lobe; with short and truncate, slightly bifid apex in dorsal view. Cerci large, fused to segment X, semicircular in lateral view. Lateral profile of gonopod with broad basement, less produced middle lobe and digitiform tapering apical region; bipartite in ventral view. Apicoventral lip of the phallic organ obtuse-angled, robust and digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis bua sp. nov.

(Figures 69–72)

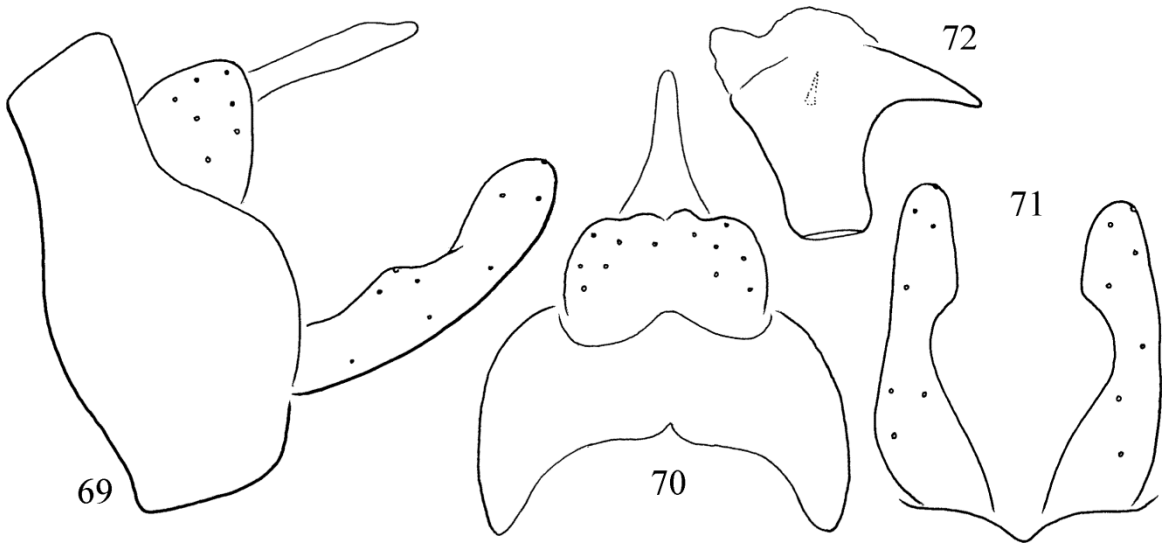
Material examined. Holotype: **Ghana,** Bui Camp, Volta River, 16-20.XI.1965, light leg. S. Endrődy-Younga (1 male, OPC).

Diagnosis. *Oecetis bua* sp. nov. has resemblance to *Oecetis congana* sp. nov. and *Oecetis volta* sp. nov. The three species are highly chimeric with pronounced apomorphic character states. They have plesiomorphic irregular stepwise cross-vein pattern on forewing anastomosis, not typical stepwise pattern of the *Oecetis tripunctata* species group; apomorphic character state of the very short, abbreviated paramere; apomorphic character state of the slender, extremely elongated segment X. *Oecetis bua* sp. nov. is distinguished by the spatulate apical region of gonopods, especially in lateral view as well as by the longer and more slender apicoventral lip of phallic organ.

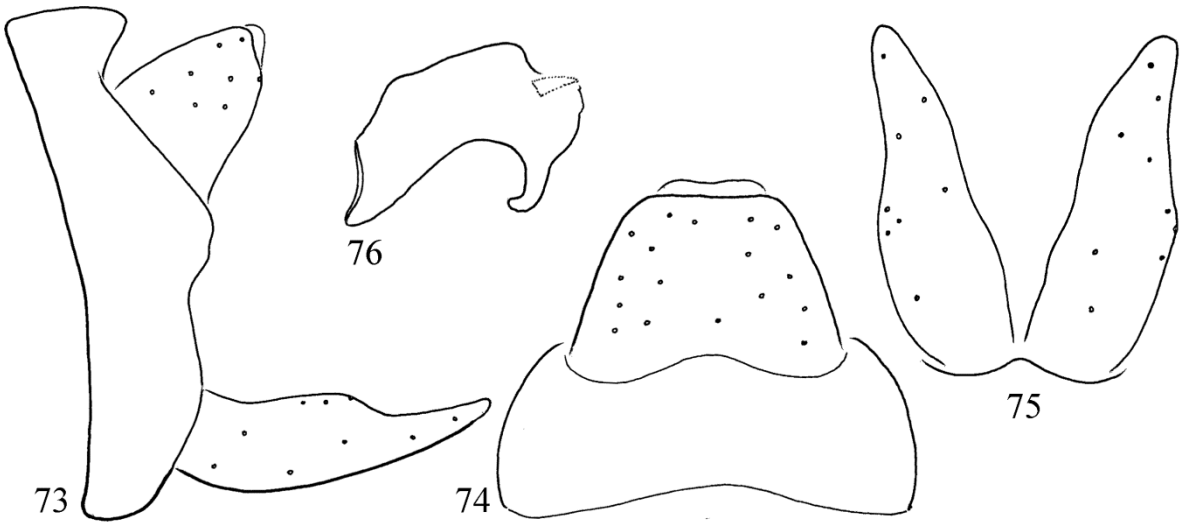
Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 5 mm length. Forewing anastomosis cross-veins are arranged in irregular stepwise pattern. Tibial spurs 1,2,2.

Male genitalia. Segment IX slightly convex vertical anterad, with rounded basal region posterad; tergum shorter than ventrum in lateral view. Lateral profile of segment X visible as a long dititiform structure; long digitiform with broad basement in dorsal view. Cerci large, fused together, semicircular in lateral view. Lateral profile of gonopod with broad apical region; bipartite with mesally extended apical region in ventral view. Apicoventral lip of the phallic organ rounded right-angled, robust, strong tapering digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.



Figures 69–72. *Oecetis bua* sp. nov. Holotype: 69 = male genitalia in left lateral view, 70 = male genitalia in dorsal view, 71 = gonopods in ventral view, 72 = phallic organ in left lateral view.



Figures 73–76. *Oecetis conga* sp. nov. Holotype: 73 = male genitalia in left lateral view, 74 = male genitalia in dorsal view, 75 = gonopods in ventral view, 76 = phallic organ in left lateral view.

***Oecetis conga* sp. nov.**

(Figures 73–76)

Material examined. Holotype: **Brazzaville-Congo,** Brazzaville, park, 23.XII.1963, light leg. S. Endrődy-Younga (1 male, OPC). Paratype: same as holotype, but: 24.X.1963 (6 males, OPC); 17.XI.1963 (9 males, 1 female; OPC); 19.XI.1963 (2 male, 1 female; OPC); 22.XI.1963 (1 male, OPC).

Diagnosis. *Oecetis conga* sp. nov. has resemblance to *Oecetis bua* sp. nov. and *Oecetis volta* sp. nov. with its apomorphic, abbreviated paramere. However, segment X short and wide, plesiomorphic, not slender and elongated as well as the forewing has cross-vein anastomosis of

typical apomorphic stepwise pattern. This is again a rather chimeric character combination.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 6 mm length. Forewing anastomosis cross-veins arranged in irregular stepwise pattern. Tibial spurs 1,2,2.

Male genitalia. Segment IX slightly concave vertical anterad, with irregular pleural region posterad; tergum longer than ventrum in lateral view. Lateral profile of segment X visible as a small short just visible lobe; short and truncate in dorsal view. Cerci large, fused together and to segment X, subtriangular in lateral view. Lateral profile of gonopod with broad basement, less produced middle lobe and digitiform tapering apical region; tapering in ventral view. Apico-ventral lip of the phallic organ rounded-angled, robust and digitiform with anterad curving apex in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

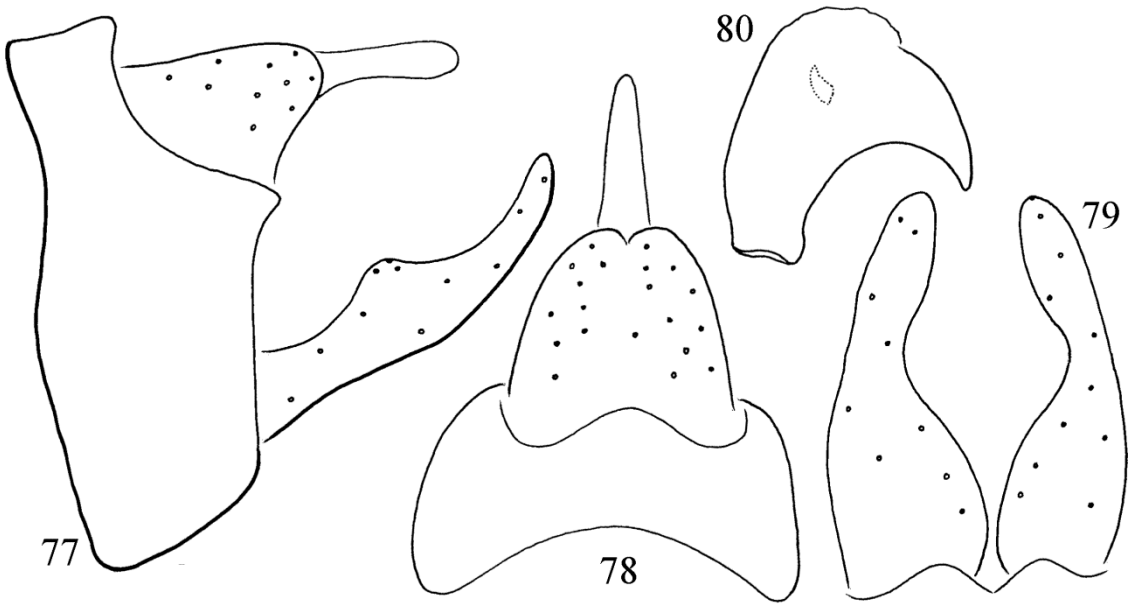
***Oecetis congana* sp. nov.**

(Figures 77–80)

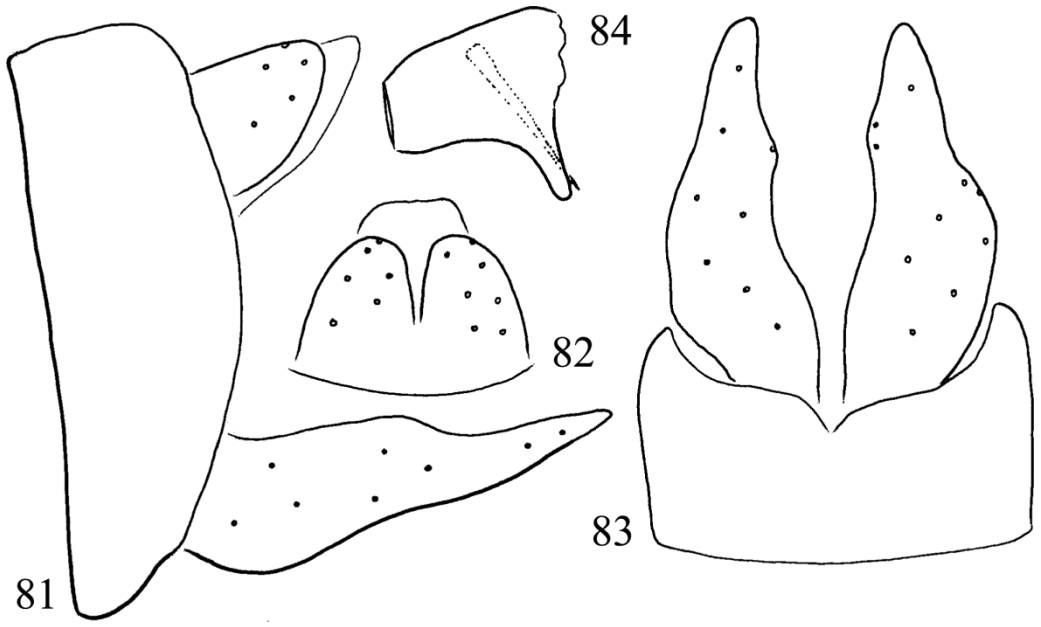
Material examined. Holotype: **Brazzaville-Congo,** Brazzaville, park, 21.XII.1963, light leg. S. Endrődy-Younga (1 male, OPC). Paratype: same as holotype: 19.XI.1963 (1 male, 1 female, OPC); 30.XII.1963 (1 female, OPC).

Diagnosis. *Oecetis congana* sp. nov. has resemblance to *Oecetis bua* sp. nov. and *Oecetis volta* sp. nov. The three species are highly chimeric with pronounced apomorphic character states. *Oecetis congana* sp. nov. is distinguished by the longer cerci, well produced dorsal lobe of gonopod in lateral profile; as well as by the anterad curving and triangularly broad apico-ventral lip of phallic organ.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 6 mm length. Forewing anastomosis cross-veins are arranged in irregular stepwise pattern. Tibial spurs 1,2,2.



Figures 77–80. *Oecetis congana* sp. nov. Holotype: 77 = male genitalia in left lateral view, 78 = male genitalia in dorsal view, 79 = gonopods in ventral view, 80 = phallic organ in left lateral view.



Figures 81–84. *Oecetis ghana* sp. nov. Holotype: 81=male genitalia in left lateral view, 82=male genitalia in dorsal view, 83=gonopods in ventral view, 84=phallic organ in left lateral view.

Male genitalia. Segment IX slightly concave vertical anterad, with sharp triangular pleural region posterad; tergum shorter than ventrum in lateral view. Lateral profile of segment X visible as a long digitiform structure; long and digitiform in dorsal view. Cerci large, fused together and to segment X, subtriangular in lateral view. Lateral profile of gonopod with constricted basement, produced middle lobe and digitiform tapering upward turning apical region; bipartite in ventral view. Apicoventral lip of the phallic organ rounded-angled, robust and triangular with anterad curving apex in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Oecetis ghana* sp. nov.**

(Figures 81–84)

Material examined. Holotype: **Ghana,** Bui Camp, Volta River, 16-20.XI.1965, light leg. S. Endrődy-Younga (1 male, OPC). Paratypes: same as holotype (3 males, OPC); same as holotype, but 27.X.1965 (6 males, OPC)

Diagnosis. *Oecetis ghana* sp. nov. has resemblance to *Oecetis kagerana* Kimmins, 1956 described from Uganda, as well as to *Oecetis anka* sp. nov. described here from Madagascar, but distinguished from boths by dorsal profile of segment X with wide and truncate apex, not excised of *O. kagerana* and not narrow of *O. anka*; lateral profile of gonopod without dorsal concavity of *O. anka* and without right-angled dorsal lobe of *O. kagerana*; ventral profile of gonopod with tapering apex. Phallic organ with straight paramere, *O. anka* and *O. kagerana* have basal curved paramere; apicoventral lip of phallic organ digitiform, not triangular like at *O. kagerana* and almost right-angled, not obtuse angled like at *O. anka*.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 5 mm length. Forewing anastomosis cross-veins are arranged in stepwise, transverse base of MA is distad of transverse base of MP3+4, by more than its length. Tibial spurs 1,2,2.

Male genitalia. Segment IX regular straight vertical anterad, rounded posterad; tergum longer than ventrum in lateral view. Lateral profile of

segment X visible as a marginal setaless continuation of cerci; with short and truncate apex in dorsal view. Cerci large, fused to segment X, subtriangular in lateral view. Lateral profile of gonopod with broad basement, less produced middle lobe and digitiform tapering apical region; bipartite in ventral view. Apicoventral lip of the phallic organ rounded right-angled, robust and digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis kagerana Kimmins, 1956

Material examined. **Ghana,** Bui Camp, Volta River, 27.X.1965, light leg. S. Endrődy-Younga (12 males, OPC).

Oecetis maculipennis Ulmer, 1922

Oecetis maculipennis Ulmer, 1922:61–63: "Material: Sudan, 1. Coll.le Roi: 2♀ Bahr el Ghazal 1.III. 1913, abends; 1♀ Bahr el Ghazal 8.III.; 2♂ bahr el Zeral 13.III. 2. Coll. Hesselberger: 6♂♀, Nr. 9, Bahr el Zeral 30.I.1912; 9♂♀, Nr. 11, Shambe 2.II.; 25♂♀, Nr. 14, Shambe 4.II.; 6♂♀, Nr. 25, Shambe 19.II."

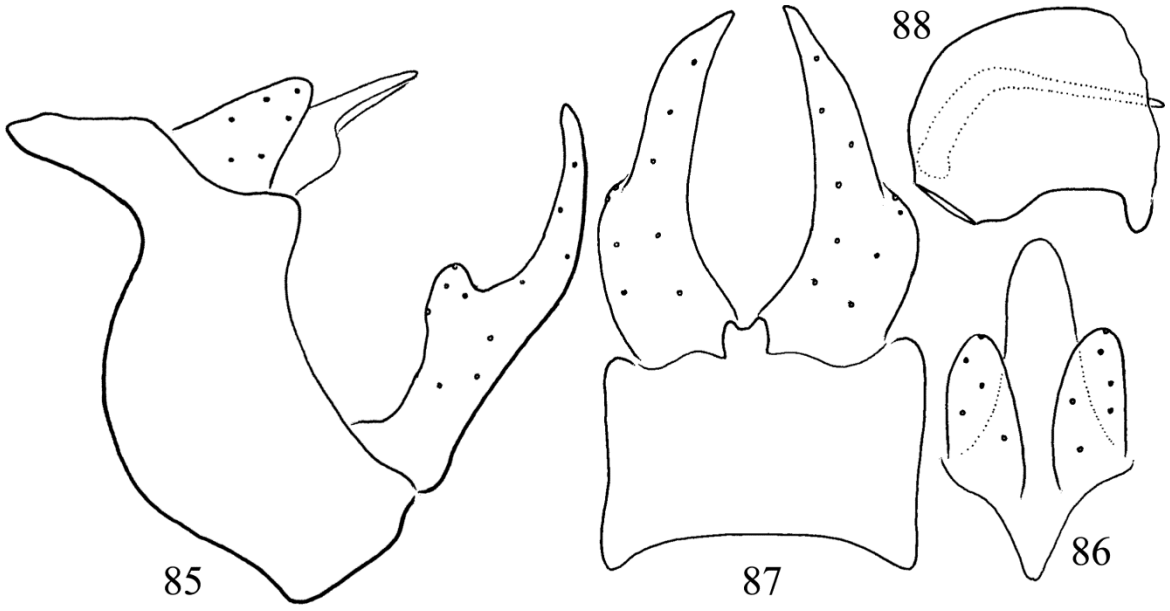
Oecetis manta sp. nov.

(Figures 85–88)

Material examined. Holotype: **Madagascar,** Mantasoa, VIII.1953, leg. J. M. (1 male, OPC). Paratype: same as holotype (1 male, OPC)

Diagnosis. *Oecetis manta* sp. nov. has resemblance to *Oecetis maroa* sp. nov. and *Oecetis zoa* sp. nov. The three species are chimeric with plesiomorphic character state of the rather free cerci, not fused to segment X. *Oecetis manta* sp. nov. is distinguished by the posterad produced dorsal lobe of gonopod in lateral profile; by the almost right angled paramere and the short and blunt apicoventral lip of phallic organ.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in irregular stepwise pattern. Tibial spurs 1,2,2.



Figures 85–88. *Oecetis manta* sp. nov. Holotype: 85 = male genitalia in left lateral view, 86 = male genitalia in dorsal view, 87 = gonopods in ventral view, 88=phallic organ in left lateral view.

Male genitalia. Segment IX S-form anterad, tergum shorter than ventrum in lateral view. Lateral profile of segment X with broad basement and narrow continuation; broad, fat digitiform in dorsal view. Cerci small, elongated, subtriangular in lateral view. Lateral profile of gonopod with constricted basement, produced middle lobe and digitiform tapering and upward turning apical region; bipartite in ventral view. Apicoventral lip of the phallic organ right-angled, robust very short digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Oecetis maroa* sp. nov.**

(Figures 89–92)

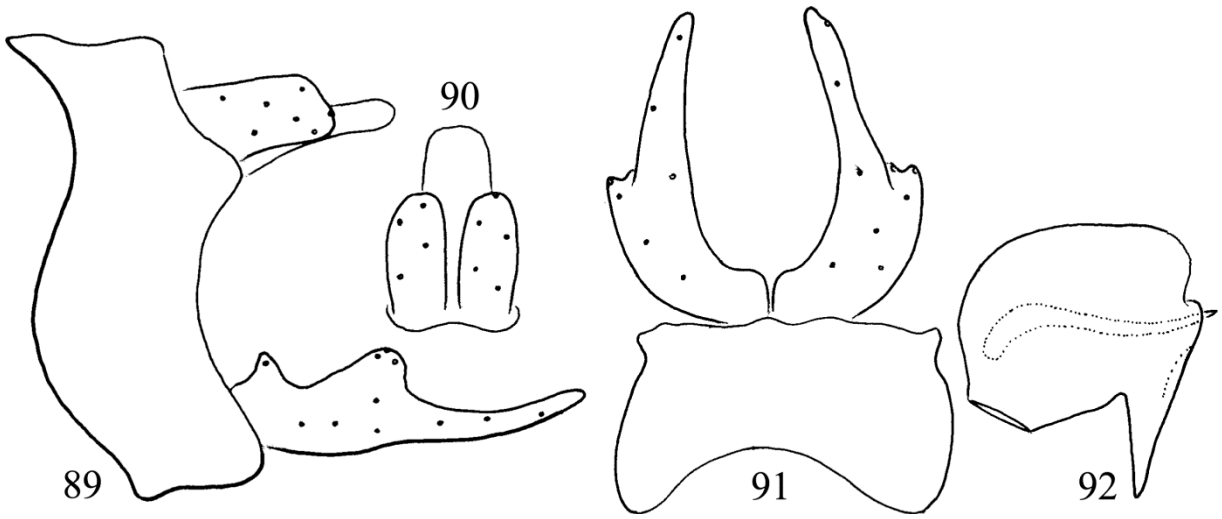
Material examined. Holotype: **Madagascar,** Maroantsetra, Ambodivoangy, 1955, leg. J. V. (1 male, OPC). Paratype: same as holotype (2 females, OPC).

Diagnosis. *Oecetis maroa* sp. nov. has resemblance to *Oecetis maroa* sp. nov. and *Oecetis zoa* sp. nov. The three species are chimeric with plesiomorphic character state of the rather free cerci, not fused to segment X. *Oecetis maroa* sp. nov. is distinguished by the laterad produced dorsal lobe of gonopod well discernible in ventral profile; the presence of the additional basodorsal lobe on gonopods; the anterad directed pointed apicoventral lip of phallic organ.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins arranged in irregular stepwise pattern. Tibial spurs 1,2,2.

Male genitalia. Segment IX S-form anterad, tergum as long as ventrum in lateral view. Lateral profile of segment X digitiform; broad, fat digitiform in dorsal view. Cerci small, elongated, subquadrangular in lateral view. Lateral profile of gonopod with dorsobasal lobe, produced middle lobe and digitiform tapering and upward turning apical region; bipartite in ventral view. Apicoventral lip of the phallic organ right-angled, long narrowing in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.



Figures 89–92. *Oecetis maroa* sp. nov. Holotype: 89=male genitalia in left lateral view, 90=male genitalia in dorsal view, 91=gonopods in ventral view, 92=phallic organ in left lateral view.

Oecetis volta sp. nov.

(Figures 93–96)

Material examined. Holotype: **Ghana,** Bui Camp, Volta River, 16-20.XI.1965, light leg. S. Endrődy-Younga (1 male, OPC).

Diagnosis. *Oecetis volta* sp. nov. has resemblance to *Oecetis bua* sp. nov. and *Oecetis congana* sp. nov. The three species are highly chimeric with pronounced apomorphic character states. *Oecetis volta* sp. nov. is distinguished by the short cerci, long apical region of gonopods; as well as by the downward directed, robust and short apicoventral lip of phallic organ.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 6 mm length. Forewing anastomosis cross-veins are arranged in irregular stepwise pattern. Tibial spurs 1,2,2.

Male genitalia. Segment IX slightly concave vertical anterad, rounded basal region; tergum shorter than ventrum in lateral view. Lateral profile of segment X digitiform; broad based and tapering in dorsal view. Cerci small, semicircular in lateral view. Lateral profile of gonopod with broad basement, less produced middle lobe and long digitiform apical region; bipartite in ventral view. Apicoventral lip of the phallic organ right-angled, robust, triangular in lateral view.

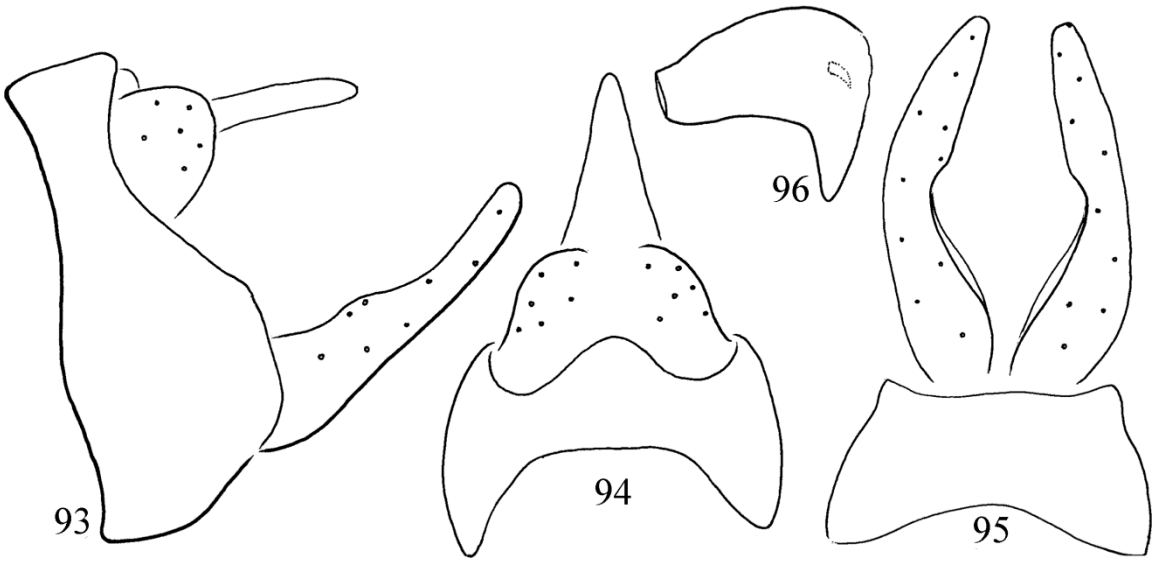
Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis zoa sp. nov.

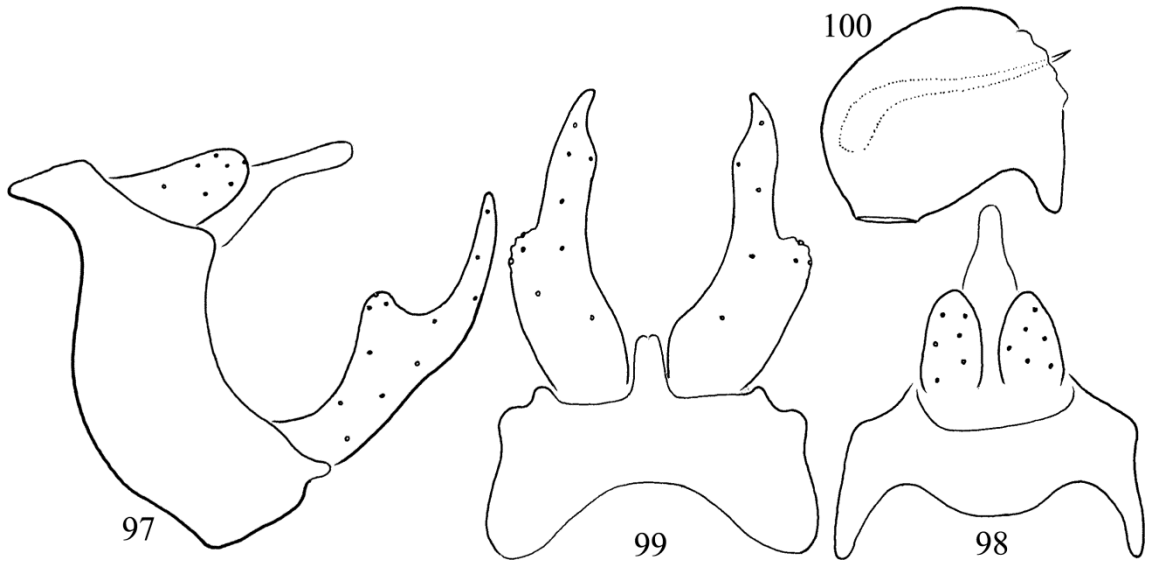
(Figures 97–100)

Material examined. Holotype: **Madagascar,** Ankazoabo Tulear Province, Station Hydrologique du Banian, VII.1957, leg. R. Paulian (1 male, OPC). Paratypes: same as holotype (1 male, OPC). Madagascar, Mantasoa, VIII. 1953 leg. J. M. (1 male, OPC).

Diagnosis. *Oecetis zoa* sp. nov. has resemblance to *Oecetis manta* sp. nov. and *Oecetis maroa* sp. nov. The three species are chimeric with plesiomorphic character state of the rather free cerci, not fused to segment X. *Oecetis zoa* sp. nov. is distinguished by the pointed and mesad excised head of gonopod in ventral profile; by the presence of the apicomesal digitiform process on ventrum IX; by the short and blunt apicoventral lip of phallic organ accompanied by paramere with basal curve.



Figures 93–96. *Oecetis volta* sp. nov. Holotype: 93 = male genitalia in left lateral view, 94 = male genitalia in dorsal view, 95 = gonopods in ventral view, 96=phallic organ in left lateral view.



Figures 97–100. *Oecetis zoa* sp. nov. Holotype: 97 = male genitalia in left lateral view, 98 = male genitalia in dorsal view, 99 = gonopods in ventral view, 100=phallic organ in left lateral view.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 8 mm length. Forewing anastomosis cross-veins are arranged in irregular stepwise pattern. Tibial spurs 1,2,2.

Male genitalia. Segment IX S-form anterad, tergum shorter than ventrum in lateral view. Lateral profile of segment X with broad basement and narrow continuation; broad, fat digitiform and tapering in dorsal view. Cerci elongated, foliform in lateral view. Lateral profile of gonopod with constricted basement, produced middle lobe and digitiform tapering and upward turning apical region; bipartite in ventral view. Apicoventral lip of the phallic organ right-angled, robust, short digitiform in lateral view.

Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis (O.) *kimminsiana* species group

This species group was established by Chen (1993) in his PhD Thesis work and listed by Yang and Morse (2000) as *Oecetis maculipennis* relying on the Kimmins's drawings drawn not from the type of *Oecetis maculipennis* Ulmer, 1922 collected in Sudan, but from specimen collected from Uganda. I have recognised that *Oecetis maculipennis* Ulmer, 1922 is a typical species of the *Oecetis tripunctata* group and specimen from Uganda drawn and identified by Kimmins (1962) as *Oecetis maculipennis* is a new species described here as *Oecetis kimminsiana* sp. nov. The group was created by Chen (1993) examining the drawings of *Oecetis kimminsiana* sp. nov. misidentified by Kimmins as *Oecetis maculipennis* Ulmer, therefore here I change the species group name accordingly: *Oecetis (O.) kimminsiana*.

The species group is characterized by gonopods with mesal edges of mesobasal lobes sharply toothed and approximate for no more than 1/4 in their length in ventral view; phallus with left anterior lobe sclerotized. This *Oecetis* group is distributed in the Afrotropical Region with four known species: *Oecetis jasikana* Gibbs, 1973 (Ghana); *O. kimminsiana* sp. nov. (Uganda); *O. nkwanta* sp. nov. (Ghana); *O. sunyai* Gibbs, 1973 (Ghana).

Oecetis kimminsiana sp. nov.

Oecetis maculipennis Ulmer, 1922: Kimmins 1962: 113: "Specimens from Uganda and Ghana determined by myself as *maculipennis* agree fairly well with Ulmer's figures." "The chief difference be-

tween these figures and those given by Ulmer is that in ventral view the claspers are incurved apically, not divergent as shown by Ulmer." Misidentification.

Material examined. Specimen from Uganda, Lake Victoria deposited in the British Museum (Natural History).

Diagnosis. Specimen from Uganda drawn and identified by Kimmins (1962) as *Oecetis maculipennis* Ulmer from Sudan is a distinct species describedhere as *Oecetis kimminsiana* sp. nov. It has resemblance to *Oecetis maculipennis* Ulmer, 1922, but differs by having lateral profile of gonopod with very broad basement, not simple elongated shape as of *O. maculipennis* Ulmer, that is almost identical to the gonopod plane of the *Oecetis tripunctata* species group, without broad basement. In ventral view the basal region touching mesad and with teeth, not separated and slightly and gradually broadening basad as drawn for *O. maculipennis* Ulmer. The lateral profile of the phallic organ at *Oecetis kimminsiana* sp. nov. is gradually rounded downward, not right-angled rounded downward that is drawn by Ulmer for *Oecetis maculipennis*.

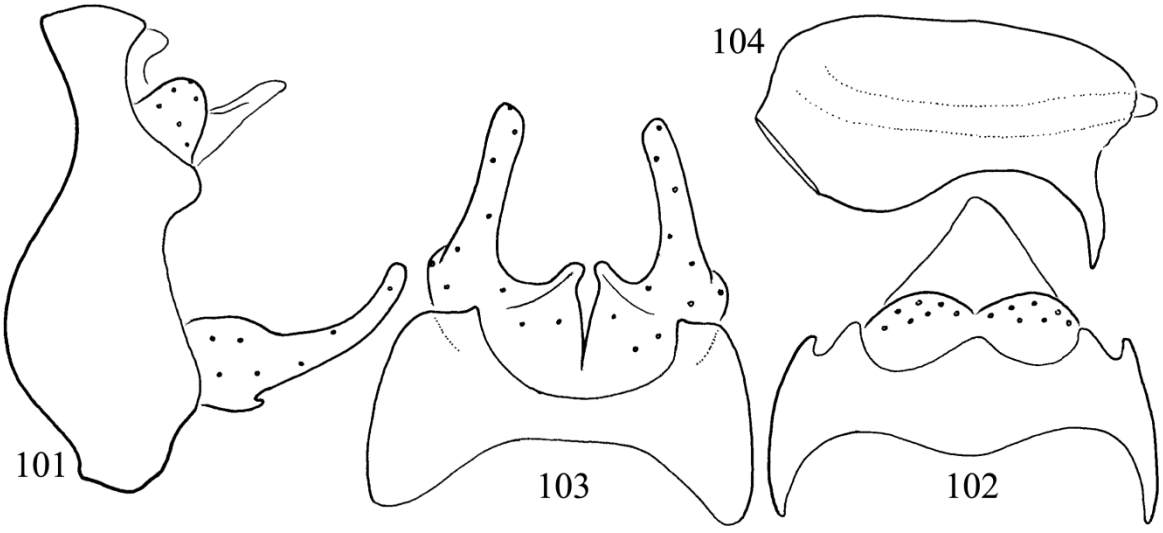
Description. Description is based upon the original wing and genital drawings (Kimmins 1962:111: figures: 81C, 112: figures: 81F,G; 114: figures 81 K, L, M). Anastomosis cross-veins with irregular stepwise pattern. Segment IX narrow with much produced almost elongated lobe-like process on dorsal apicopleural region; cerci completely fused to segment X, segment X truncated in dorsal view; lateral profile of gonopod with very broad base demarcated both by dorsal and ventral lobe; ventral profile with touching toothed basement. Phallic organ short with downward curving and pointed apicoventral lip.

***Oecetis nkwanta* sp. nov.**

(Figures 101–104)

Material examined. Holotype: **Ghana,** Banda-Nkwanta, 9–12.IX.1965, light leg. S. Endrődy-Younga (1 male, OPC).

Diagnosis. *Oecetis nkwanta* sp. nov. has resemblance to *Oecetis sunyani* Gibbs, 1973 but differs by cerci short, not long; dorsal profile of segment X triangular, not quadrangular; the gonopods differ significantly both in dorsal and lateral views; the mesal digitiform process on the basal enlargement of gonopod single and larger, not doubled and short; phallic organ longer, apicoventral lip slender, not robust; paramere inside the phallic organ with blunt apex, not spine-like pointed.



Figures 101–104. *Oecetis nkwanta* sp. nov. Holotype: 101 = male genitalia in left lateral view, 102= male genitalia in dorsal view, 103 = gonopods in ventral view, 104 = phallic organ in left lateral view.

Description. Head, thorax, scape yellowish light brown. Forewing rubbed in alcohol, membrane hyaline of 9 mm length. Forewing anastomosis cross-veins are arranged in irregular stepwise pattern. Tibial spurs 1,2,2.

Male genitalia. Segment IX narrow, S-form anterad, biconcave posterad; cerci fused to segment X, segment X regular triangular in dorsal view; lateral profile of gonopod with very broad base demarcated both by dorsal and ventral lobe; ventral profile with touching toothed basement. Phallic organ short with downward curving and pointed apicoventral lip.

Etymology. Coined after the name of locus typicus, a noun in apposition.

Oecetis sunyani Gibbs, 1973

Material examined. **Ghana,** Bui Camp, Volta River, 27.X.1965, light leg. S. Endrődy-Younga (11 males, OPC).

Acknowledgement – Taxonomic revisions depend on specimens. Unfortunately the sampling capacity in taxonomy is symptomatically extremely pour, limited and rapidly declining in our western culture. The present survey only covers less than ten percent of the possible potential diversity of the *Oecetis tripunctata* species complex due to the highly limited sampling coverage. Most of the specimens for this world-wide survey were collected by great collectors, the French R. Paulian (Madagascar) and the Hungarian S. Endrődy-Younga (Africa). Their personal endeavour is highly acknowledged and I am deeply grateful to them. The Oriental faunal region was sampled mostly in India and Vietnam relying on my own resources as well as the first specimens of *Oecetis* (*Oecetis*) *tripunctata* (Fabricius, 1793) were collected by me some 60 years ago when I was 20 years old and just started my university studies. In summer of 1962 I have collected by netting 4 males and 2 females along the Hortobágy-Berettyó canal of the Hungarian Lowland at my home village, Bucsa. I still remember the details of my first caddisfly collection. Here I take the opportunity to thank my mother for generating and strengthening my devotion to science and caddisflies.

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Opusc. Zool. Budapest, 2022, 53(1): 31–50

A new species of *Moniligaster* Perrier, 1872 (Annelida, Moniligastridae) from India, with status revision of *M. deshayesi minor* Michaelsen, 1913

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Abstract. The genus *Moniligaster* Perrier, 1872 is restricted to the Western Ghats mountain regions of the southern Peninsular India. A new species, *Moniligaster julkai* Narayanan & Paliwal, sp. nov., is described and illustrated using samples found in the Kerala districts of Kottayam and Pathanamthitta. Apart from that, the status of *Moniligaster deshayesi minor* Michaelsen, 1913 is critically reviewed, and it is upgraded to species rank as *Moniligaster minor* Michaelsen, 1913, based on a collection made near its type locality. Furthermore, new distributional records for other *Moniligaster* species are provided. With this discovery, the genus *Moniligaster* now has a total of 14 recognised species.

Keywords. Endemism, Kerala, Oligochaeta, rubber plantation, Western Ghats.

INTRODUCTION

Western Ghats is denoted as a world heritage site (UNESCO 2021) and more importantly one among the eight 'hottest hotspots' of global biodiversity (Mittermeier *et al.* 2011). In India, Western Ghats and the west coast plains are the areas with highest diversity of earthworm fauna, which is about 58.4% of all recorded earthworm species of the country (Narayanan *et al.* 2020). Taxonomic works on the earthworms of the Western Ghats mountain ranges started in the last quarter of the 19th century by the description of *Perichaeta* (now *Megascolex*) *lawsoni* from Nilgiris by Bourne (1886). Since then many species have been described from this unique land by eminent taxonomists (Michaelsen 1910, Cognetti 1911, Stephenson 1915, 1916, 1924, 1925, Aiyer 1929, etc.). With 264 recorded species, the earthworm fauna of the Western Ghats Biodiversity Hotspot has been relatively well recognized (Narayanan *et al.* 2020, 2021*a*). About 70% of the currently known species were recorded in the early part of the last century. However, several new genera and species of earthworms have been described from this region in the last 25 years (Julka *et al.* 1997, 2004, Nair *et al.* 2010). Nevertheless, considerable areas of the Western Ghats are yet to be explored with respect to earthworm fauna, especially various kinds of forests, riparian habitats, mountain grasslands, scrublands etc.

In the recent past a number of new moniligastrid earthworm species have been described from Kerala part of the Western Ghats (Narayanan *et al.* 2017, 2021*a*). In this communication we report a new *Moniligaster* species

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viz., *Moniligaster julkai* sp. nov., from the state. As a taxonomic side note, we discuss about the status of *Moniligaster deshayesi minor* Michaelsen, 1913, based on the details from the newly obtained specimens and it is raised to specific rank as *Moniligaster minor*. Furthermore, additional distributional records of several *Moniligaster* Perrier, 1872 species are provided.

MATERIAL AND METHODS

Collection and preservation. Earthworms were collected from several districts of southern Kerala by digging the soil with a spade, hand-sorting the soil for earthworms and also searching for organic microhabitats such as fallen tree trunks and leaf litter. Specimens collected were preserved in 5% formalin and later transferred to 95% ethanol. All relevant morphological and anatomical characterisation of the earthworms were carried out under a Nikon stereomicroscope (Model: SMZ 800N). Illustrations were made with the help of a camera lucida attached to the microscope. The type specimens of the new species are deposited in the national repository at the Zoological Survey of India - Western Ghats Regional Centre, Kozhikode, India. All the other specimens are housed in the Advanced Centre of Environmental Studies and Sustainable Development, Mahatma Gandhi University, Kottayam, Kerala, India.

General abbreviations of the terms used are as follows. Cl. – Clitellum; C.Atr.D. – Common atrial duct; L.L.G. – Leaflet-like glands; M.H.L. – Mass of hairpin loops; Pr.C. – Prostatic capsule; Pr. – Prostate; Pr.D. – Prostatic duct; Sp.A. – Spermathecal ampulla; Sp.Atr.G. – Spermathecal atrial gland; Sp.Atr.G.D. – Spermathecal atrial gland duct; Sp.D. – Spermathecal duct; S.M.A. – Secondary male aperture; Sp.P. – Spermathecal pore; T.S. – Testis sac; Vd. – Vas deferens.

Institutional abbreviations. ACESSD: Advanced Centre of Environmental Studies and Sustainable Development, Mahatma Gandhi University, Kottayam, Kerala, India; ZMUH: Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Hamburg (now CeNak – Centre of Natural History), Germany; ZSIK: National Zoological Collections, Zoological Survey of India – Western Ghat Regional Centre, Kozhikode, India.

RESULTS

Family Moniligastridae Claus, 1880

Genus *Moniligaster* Perrier, 1872

Moniligaster julkai Narayanan & Paliwal, sp. nov.

(Figures 1A–D)

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Material examined. *Holotype*. Aclitellate (ZSIK Reg. No. ZSI/WGRC/IR.INV.19324), rubber plantation, Puthuvely (9°50'4.0"N 76°35' 19.3"E) (4 km south of Koothattukulam town), Kottayam District, Kerala State, India, 2 September 2021, 41 m a.s.l., leg. R. Anuja, S.P. Narayanan, V.M. Kannan. *Paratypes*. 4 aclitellates (ZSIK Regd. No. ZSI/WGRC/IR.INV. 19325), same data as for holotype; 1 clitellate (ZSIK Regd. No. ZSI/WGRC/IR.INV.19326), evergreen forest, between Chalakkayam and Plapally (09°22'51.4"N 77°03'00.5"E), Pathanamthitta District, Kerala State, India, 20 August 2013, 259 m a.s.l., leg. S.P. Narayanan, S. Sathrumithra, D. Kuriakose and S.A. Sasi.

Additional material examined. 1 aclitellate, 2 juveniles (Regd. No. ACESSD/EW/1367), streamside within evergreen forest, Attathodu (09°24'09.5"N 77°01'30.5"E), Pathanamthitta District, Kerala State, India, 20 August 2013, 342 m a.s.l., leg. S.P. Narayanan, S. Sathrumithra, D. Kuriakose, S.A. Sasi. 3 aclitellates, 4 juveniles (Regd. No. ACESSD/EW/1362), home garden, Puthuvely (9°50’4.0"N 6°35’19.3"E), Kottayam District, Kerala State, India, 9 September 2017, 41 m a.s.l., leg. R. Anuja, S. Sathrumithra, E. Thomas. 1 aclitellate (Regd. No. ACESSD/EW/1363), home garden, Uzhavoor (9°47'12.3"N 76° 36'59.3"E), Kottayam District, Kerala State, India, 9 September 2017, 73 m a.s.l., leg. R. Anuja, S.

Sathrumithra, E. Thomas. 2 aclitellates (Regd. No. ACESSD/EW/1364), rubber plantation, Marangattupally (9°44'12.3"N, 76°36'38.5"E), Kottayam District, Kerala State, India, 9 September 2017, 24 m a.s.l., leg. R. Anuja, S. Sathrumithra, E. Thomas. 3 aclitellates, 1 juvenile (Regd. No. ACESSD/EW/1365), home garden, Puthuvely (9°50'4.0"N 76°35'19.3"E), Kottayam District, Kerala State, India, 30 October 2018, 41 m a.s.l., leg. R. Anuja, P. Kumar, N.P. Sreekanth. 2 aclitellates, 7 juveniles (Regd. No. ACESSD/ EW/1366), rubber plantation, Puthuvely (9°50' 5.2"N, 76°35'19.5"E), Kottayam District, Kerala State, India, 24 September 2020, 35 m a.s.l., leg. S.P. Narayanan, R. Anuja, N.G. Vishnu.

Diagnosis. Colour blue. Length 156–238 mm, diameter 6.5–8.5 mm, segments 237–342. Male pores paired, in transverse slits, lateral to *b* setal lines, at intersegmental furrow 10/11. Spermathecal pores paired, at *cd* setal lines, at intersegmental furrow 7/8. Genital markings absent. Gizzards, large, 2–3 in segments 12–16. Vas deferens a mass of hairpin loops, mass larger than testis sac, entering prostate directly, a little above the ectal end in the glandular portion. Prostates glandular, tubular, slender entally, bulbous at base, duct sinuous and bulged at base; prostatic capsule slender, tubular with smooth margins. Spermathecal atrial glands paired in segment 7, duct of each gland about five times the length of common atrial duct, which is hidden in the parietes in segment 7.

Description. External. Colour bluish, dorsum dark, ventrum pale; body circular in cross section. Dimensions: Holotype length 238 mm, width 8 mm at segment 9, segments 323; paratypes length 180–222 mm, width 6.5–8 mm at segment 9, segments 237–295; other materials: length 156–236 mm, width 6.5–8.5 mm at segment 9, segments 237–342. Setae lumbricine, small, closely paired, present from segment 2; setal formula *aa* =12.67 *ab* = 1.05 *bc* = 12.67 *cd* = 0.32 *dd* at segment 8 and *aa* = 17 *ab* = 0.89 *bc* = 17 *cd* = 0.33 *dd* at segment 20 (n=1). Clitellum annular, on segments 10–½14 (4 ½), colour reddish, setae visible, a pair of pale whitish patch present in front of the secondary male apertures in segment 10. Spermathecal pores paired, small transverse slits at intersegmental furrow 7/8, aligned at *cd* setal lines. Secondary male apertures paired, male pores in transverse slits at intersegmental furrow 10/11, lateral to *b* setal lines (Fig. 1A); small, puckered epidermal thickenings present in front and back of secondary male apertures at segments 10 and 11 (in clitellate specimen, visible only in high magnification). Female pores paired, minute, at intersegmental furrow 11/12, at *b* setal lines? Nephridiopores present from segment 4 to posterior end, on *cd* setal lines; at *d* lines in Uzhavoor specimen. Genital markings absent.

Internal. Bluish pigmentation in circular muscle layer. Septa 4/5 slightly muscular, 5/6–8/9 strongly muscular, septum 9/10 delicate. Gizzards, large, 2–3 in segments 12–16, septa pushed back to 16–20; intestinal origin in segment 27. Commissures for extra-oesophageal vessels present on posterior face of septum 8/9. Testis sacs paired, in segments 10–11,12, sacs flat and oblong or pear-shaped; vas deferens long, large mass of hairpin loops in segments 9–13 (in holotype LHS in 12–13 and RHS 11–12), mass larger than testis sac, nearly hidden by hairpin loops, vas deferens zigzag-shaped before entering the prostate directly, at median side, a little above the ectal end in glandular portion, without penetrating musculature. Prostates paired, extending from segment 11 to segments 13–15, glandular, tubular, slender entally, bulbous at base (2.5 times thicker than the slender portion), ectal end sinuous and thick (Fig. 1B), glands reddish (holotype light yellowish) to bulbous portion, thin layer of chalk-white glands at slender portion, in aclitellate specimens whitish glands are weakly developed, in certain individuals prostate may be twisted upwards and confined to segment 11, or hook-shaped entally or U-shaped or bent on itself; prostatic capsule slender, smooth, tubular; prostatic duct with 'n-shaped' bent before the junction with prostate gland, blunt at junction with parietes (Fig. 1C), about one third of the combined length of gland and duct. Spermathecae paired in segment 8, ampulla ovoidal, each with a coiled duct penetrating septum 7/8 to discharge at junction of long, slightly sinuous ducts of spermathecal atrial

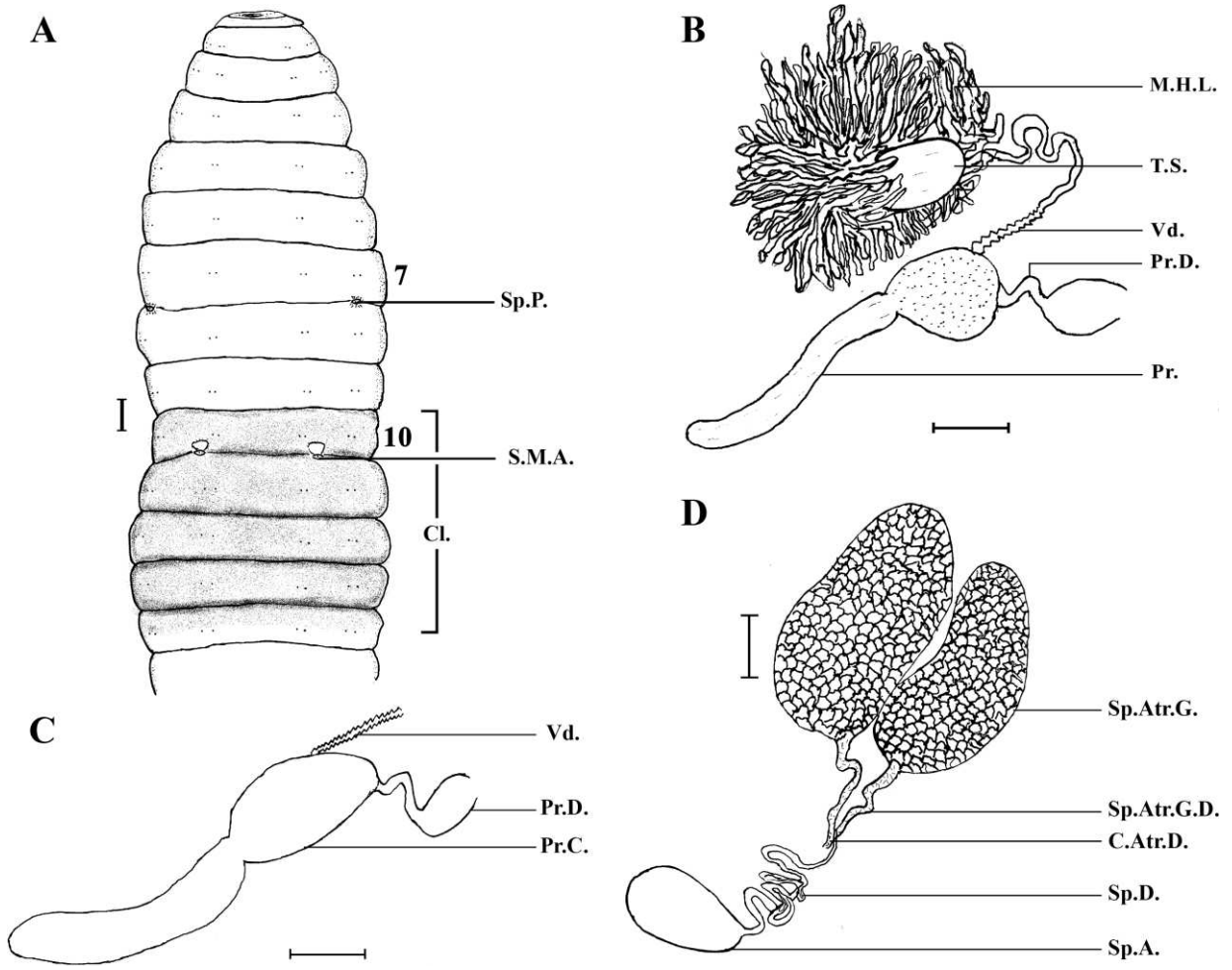

Figure 1. *Moniligaster julkai* Narayanan & Paliwal, sp. nov.: A = Ventral view; B = Prostate of right hand side, dorsal view; C = Prostatic capsule of right hand side, dorsal view; D = Spermatheca of the right hand side, dorsal view.

glands (Fig. 1D), atrial glands long and flat with slight bent, duct of each atrial gland about five times the length of common atrial duct, common atrial duct roughly concealed within parietes in segment 7. Ovarian chamber complete, ovisacs paired in segment 12, extending to segment 13–14, slightly bent or narrowed towards posterior side. Nephridia avesiculate; functional at segment 10.

Ingesta. Fine reddish lateritic soil.

Habitat. Evergreen forest, home garden, rubber plantation, streamside with reeds in evergreen forest.

Biology. Endogeic species. Autotomy and regeneration of lost parts appear to be common. Cysts of parasitic protozoans were found in the gizzard region in one specimen each from the Marangattupally and Puthuvely (holotype).

Distribution. Endemic to India: Kerala State: Kottayam District: Marangattupally, Puthuvely, Uzhavoor; Pathanamthitta District: Attathodu, between Chalakkayam and Plapally.

Etymology. Specific epithet '*julkai'* is an eponym, named in honor of Dr. Jatinder Mohan Julka, eminent Indian earthworm taxonomist and academician, for his tremendous contributions to

Table 1. Comparison of *Moniligaster julkai*, sp. nov. with other closely related species

Character	*M. gravelyi* Stephenson, 1915[1,2]	*M. troyi* Jamieson, 1977[3]	*M. bahli* Narayanan & Julka, 2021[4]	*M. blakemorei* Narayanan & Julka, 2021[4,5]	*M. keralensis* Narayanan & Julka, 2021[4,5]	*M. julkai* Narayanan & Paliwal, **sp. nov.**
Length	118–130 mm	60–63 mm	75–134 mm	81–136 mm	58–155 mm	156–238 mm
Diameter	5–6 mm	3.5–3.7 mm	4.5–7 mm	3.5–7 mm	3–6 mm	6.5–8.5 mm
Segments	139 (1 ex.)	123–153	135–200	183–278	109–201	237–342
Spermatheca	atrial gland single (?); ampulla ovoid	atrial glands paired; duct of each gland *c*. 1/4 the length of common atrial duct; ampulla elongate-ovoid	atrial glands paired; duct of each gland *c*. 1/5 the length of common atrial duct; ampulla ovoid	atrial glands paired; duct of each gland *c*. four times the length of common atrial duct; ampulla ovoidal	atrial glands paired; duct of each gland about as long as common atrial duct; ampulla elongate-ovoid	atrial glands paired; duct of each gland *c*. five times the length of common atrial duct; ampulla ovoidal
Prostates	strap-shaped	club-shaped	strap-shaped	bluntly club-shaped	tubular	tubular
Prostatic capsule	tubular with deeply incised margins and nodulated surface	(?)	Tubular with smooth margins and a few nodulations at ental end	club-shaped with smooth margins	tubular with smooth margins	tubular with smooth margins
Length of prostatic duct	*c*. 1/7 the length of gland plus duct	*c*.1/3 the length of gland plus duct	*c.* 1/7 the length of gland plus duct	*c.* 1/3 the length of gland plus duct	*c.* 1/9 the length of gland plus duct	*c.* 1/3 the length of gland plus duct
Vas deferens	segments 9–10, enters prostate entally	segment 9, enters prostate sub-ectally	segments 9–12 (–16), enters prostate sub-entally	segments 9–11(–12), enters prostate near entally	segments 9–10, enters prostate sub-ectally	segments 9–12(–13), enters prostate sub-ectally
Gizzards	4–5 (in segments 13–18)	3 (in segments 13–15)	3–4 (in segments 13–18)	2 (in segments 12–16)	3–6 (in segments 14–20)	2–3 (in segments 12–16)
Intestinal origin	in segment 25	in segment 27	in segments 24–26	in segments 26–28	in segments 27–29	in segments 27

Data from: [1]Stephenson (1915); [2]Gates (1940); [3]Jamieson (1977); [4]Narayanan *et al.* (2021); [5]Present study.

the taxonomic and ecological studies on the earthworms of India and neighboring countries.

Remarks. *Moniligaster julkai* sp. nov. belongs to the '*gravelyi*' group of *Moniligaster* species characterized by *(i)* vas deferens opening directly into the prostate, *i.e.*, without penetrating the longitudinal muscle layer, *(ii)* spermathecal atria confined to segment 7, and *(iii)* leaflet like glands absent on the vas deferens. The group consists of six species, apart from the new species described in this paper: *M. gravelyi* Stephenson, 1915, *M. troyi* Jamieson, 1977, *Moniligaster bahli* Narayanan & Julka, 2021, *M. blakemorei* Narayanan & Julka, 2021 and *M. keralensis* Narayanan & Julka, 2021.

M. julkai sp. nov. is distinguished from *M. gravelyi* and *M. bahli* by the shape of the prostate (tubular *vs* strap-like). It can also be differentiated from *M. troyi* by the large size of the atrial gland duct, and from *M. blakemorei* by the tubular shape of the prostatic capsule. However, it differs from *M. keralensis* by larger size (length 156–238 *vs* 58–155 mm; diameter 6.5–8.5 mm *vs* 3–6 mm; segments 237–342 mm *vs* 109–201), the length of the prostatic duct, and intestinal origin (in segments 27 *vs* segments 27–29). Detailed comparison of these species is provided in Table 1.

Status revision of *Moniligaster deshayesi minor* Michaelsen, 1913

Michaelsen (1913) described a subspecies of *M. deshayesi,* namely, *Moniligaster deshayesi* var. *minor* Michaelsen, 1913, based on a single clitellate specimen collected by Shunkara Nayama Pilley (misnomer of Shankara Narayana Pillai) on 26 December 1911 from Chimungi (now Chemmunji: Narayanan *et al.* 2016). Later, Gates (1940) in his revision of the genus synonymised it with *M. deshayesi*. Since then it was considered as a junior synonym of *M. deshayesi*. However, Blakemore (2007) treated it as a subspecies without furnishing any details. Concurrently, certain web based databases treated it as a variety or subspecies (e.g. https://earthwormsofindia.com, http://earthworm.uw.hu etc.). Though following Gates (1940), Narayanan *et al.* (2016) treated it as a synonym of *Moniligaster deshayesi* in the checklist of Kerala earthworms. During a recent survey of the earthworms near the type locality of *M. d. minor* we have obtained many specimens of a *Moniligaster* species. Careful studies of the key taxonomic features of these freshly collected specimens revealed that they are *M. d. minor* which is unmistakably distinct from *M. deshayesi*. Therefore, being distinct taxa, it is resurrected from the synonymy of *Moniligaster deshayesi* Perrier, 1872 and raised to species rank as *Moniligaster minor* Michaelsen, 1913. Here we discuss the details of the newly obtained *M. minor* along with figures.

Moniligaster minor Michaelsen, 1913

(Figures 2A–D, 3)

Moniligaster deshayesi var. *minor* Michaelsen, 1913: 78.
Moniligaster deshayesi var. *minor*: Stephenson 1923: 122.
Moniligaster deshayesi (part): Gates 1940: 499.
Moniligaster deshayesi minor: Blakemore 2007: 9.

Type material. *Holotype*. Clitellate, (ZMUH 8096) (Michaelsen 1913, Gates 1940, Reynolds & Wetzel 2020), Chimungi, Thiruvananthapuram District, Kerala State, India, 26 December 1911, leg. Shunkara Nayama Pilley.

Material examined. 1 clitellate, 13 aclitellates (Reg. No. ACESSD/EW/1126), from thick root mat of grasses growing on rocky hilltop near shola forest, Agasthyarkoodam peak (8°36'58.1" N, 77°14'45.1"E) in Neyyar Wildlife Sanctuary (21 km from Bonacaud), Thiruvananthapuram District, Kerala State, India, 1865 m a.s.l., 4 October 2014, leg. D. Kuriakose, S.P. Narayanan, T. Augustine, S.A. Sasi, S. Sathrumithra. 13 clitellates (Reg. No. ACESSD/EW/1127), shola forest, same collection data as for preceding. 3 aclitellates (Reg. No. ACESSD/EW/1128), higher altitude evergreen forest, Athirumala (8°37'4.4"N, 77°13'47.2'E) (16 km from Bonacaud) in Neyyar Wildlife Sanctuary, Thiruvananthapuram District, Kerala State, India, 1011 m a.s.l., 27 April 2016, leg. S.P. Narayanan, Al Badush, S. Sathrumithra.

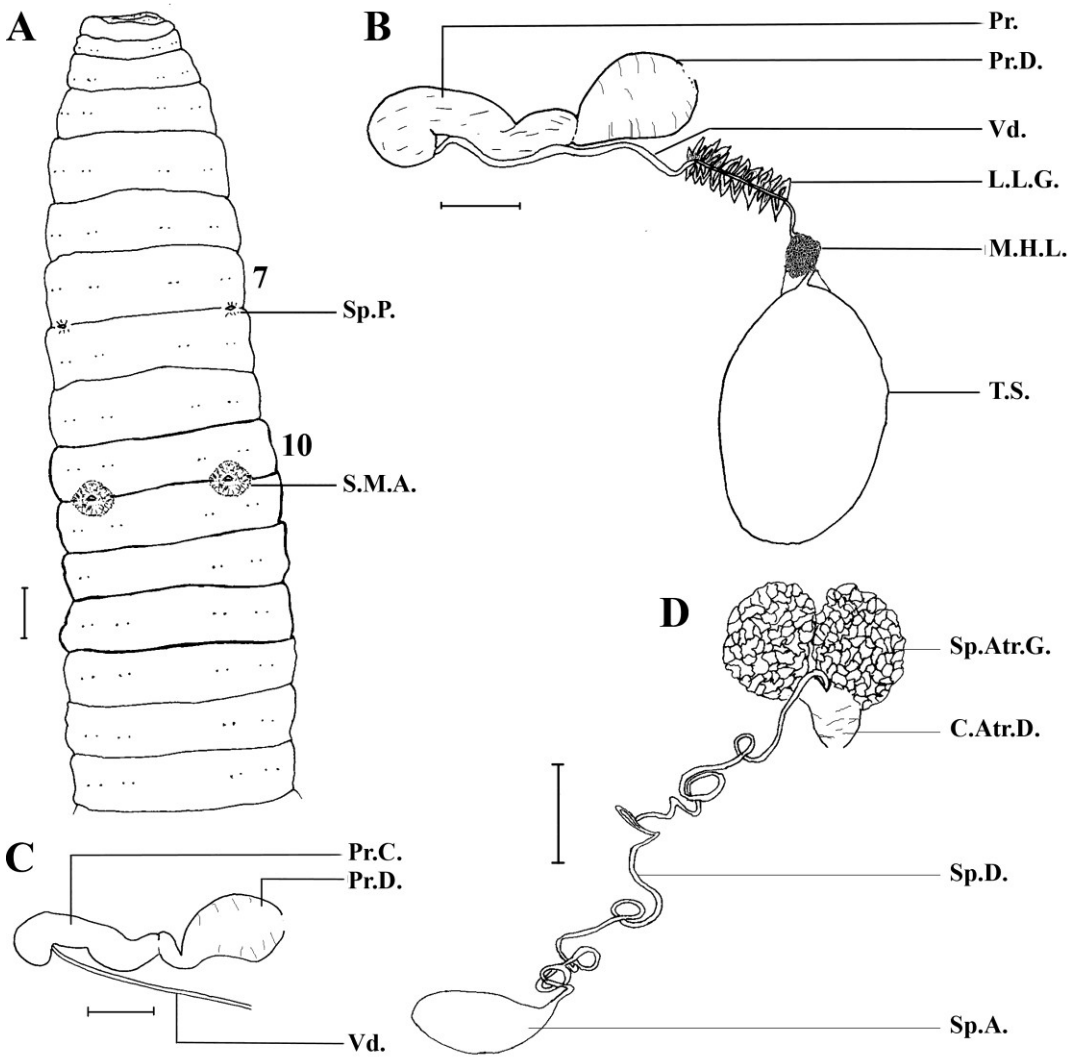

Figure 2. *Moniligaster minor* Michaelsen, 1913: A = Ventral view; B = Prostate of left hand side, dorsal view; C = Prostatic capsule of left hand side, dorsal view; D = Spermatheca of the left hand side, dorsal view.

Diagnosis. Colour brownish to bluish. Length 69–122 mm, diameter 3–6 mm, segments 112–200. Secondary male apertures paired, minute, transverse invagination, in centre of a shallow transversely oval depression, between *b*–*c* setal lines, median to *c* setae, at intersegmental furrow 10/11. Spermathecal pores paired, at *cd* setal lines, at intersegmental furrow 7/8. Genital markings absent. Gizzards 4–5 in segments 14–19. Vas deferens, coiled into mass, mass smaller than testis sac, passing through light mass of leaflet-like glands, small size and less in number, ental portion slender, entering prostate directly, at the ental end. Prostates short, glandular, tubular-shaped, prostatic duct bulged at ectal end; prostatic capsule tubular with smooth margins. Spermathecal atrial gland paired in segment 7, duct of each gland about one third the length of common atrial duct.

Description. *External features*. Colour brownish to bluish; body circular in cross section. Dimensions: length 69–122 mm, width 3–6 mm at segment 9, segments 112–164. Setae lumbricine, present on segment 2, closely paired; setal formula *aa* = 5.71–7.5 *ab* = 0.65–1.33 *bc* = 7.5–8

cd = 0.25–0.27*dd* at segment 9 and *aa* = 8–10 *ab* = 0.97–1.09 *bc* = 10–13.33 *cd* = 0.2–0.29 *dd* at segment 20 (n=3). Clitellum annular, distinct, brown to reddish colour at segments 10–13 (4). Spermathecal pores paired, large transverse slits at intersegmental furrow 7/8, aligned at *cd* setal lines (Fig. 2A). Secondary male apertures paired, minute, transverse invagination, in centre of distinct pale coloured, shallow transversely oval depression at intersegmental furrow 10/11, between *b*–*c* setal lines, median to *c* setae. Female pores, paired, conspicuous, at intersegmental furrow 11/12, at *b* setal lines. Nephridiopores minute, almost in one rank at or close to *d* setal lines, recognizable from segment 3, functional at segment 10. Genital markings absent.

Internal anatomy. Septa 6/7/8/9 slightly muscular, septum 9/10 delicate. Gizzards 4–5 in segments 14–19; intestinal origin in segments 26–28; commissures of extra-oesophageal vessels present on the posterior face of septum 8/9 and 9/10. Testis sacs paired, asymmetrical, in segments 9–12 on one side and dislocated to segments 13–16 on the other side but retaining connection with septum 9/10 through a narrow tube like membranous structure; vas deferens in segments 9–15, coiled, mass smaller than testis sac, passing through light mass of small leaflet-like glands, less in number, ental portion slender, entering prostate directly without entering musculature, at the ental end of the prostate gland. Prostates paired, glandular, tubular, extending from segment 11 to segments 12–15 (3.8–5 mm long), slightly bent entally with a notch mesially (Fig. 2B), in some specimens prostate bent on itself or twisted and projecting to anterior side; prostatic capsule tubular (Fig. 2C), margins smooth, slightly narrowed towards ectal side, ectal portion of prostatic duct bulged (conspicuous in clitellate specimens, less distinct in aclitellates), bound down to the parietes by several diagonal muscles, greater than one third of the combined length of gland and duct. Spermathecae paired in segment 8, ampulla elongate-ovoidal, with lightly coiled duct penetrating septum 7/8 to emerge in segment 7 to discharge at the junction of spermathecal atrial glands duct (Fig. 2D); duct of each atrial gland about one third the length of common atrial duct. Ovarian chamber complete, horseshoe shaped; ovisacs paired in segment 12, extending to segments 16–19. Nephridia avesiculate; functional at segment 10.

Ingesta. Mostly fine soil with bits of delicate rootlets, tiny pieces of bark and quartz.

Habitat. Higher altitude evergreen forest (above 1000 m) and shola forest–grassland complex.

Distribution. Endemic to India, it is restricted to the higher altitudes of Agasthyamalai Biosphere Reserve (Kerala State: Thiruvananthapuram District: Agasthyarkoodam peak, Athirumala, both in Neyyar Wildlife Sanctuary and Chimungi (= Chemmunji) in Peppara Wildlife Sanctuary) (Fig. 3).

Remarks. *M. minor* belongs to a group of *Moniligaster* species, characterized by (1) vas deferens opening directly into prostate, i.e., without penetrating the longitudinal muscle layer, (2), spermathecal atria confined to segment 7, and (3) leaflet-like glands present on the vas deferens. The only other member of the group is *Moniligaster deshayesi* Perrier, 1872. *M. minor* can be differentiated from *M. deshayesi* by the shape of the prostatic capsule, which is smooth and tubular against ‘rod like’ with ridges in *M. deshayesi.* The length of the prostate gland is shorter (3.85–5 mm) as compared to longer prostates (12–15 mm) in *M. deshayesi*. Vas deferens long, coiled, passing through light mass of smaller sized leaflet-like glands, entering at ental end of prostate *vs.* long, with a number of loops, passing through heavy mass of larger leaflet-like glands, entering slightly below the ental end of prostate in *M. deshayesi.* Nephridiopores are in almost one rank at or close to *d* setal lines as compared to irregular dislocation ventrally to *ab* setal lines in segments behind clitellum in *M. deshayesi.* Based on the above mentioned key characters we herein elevate *M. minor* to the species rank as *Moniligaster minor* Michaelsen, 1913. Further, *M. minor* is easi-

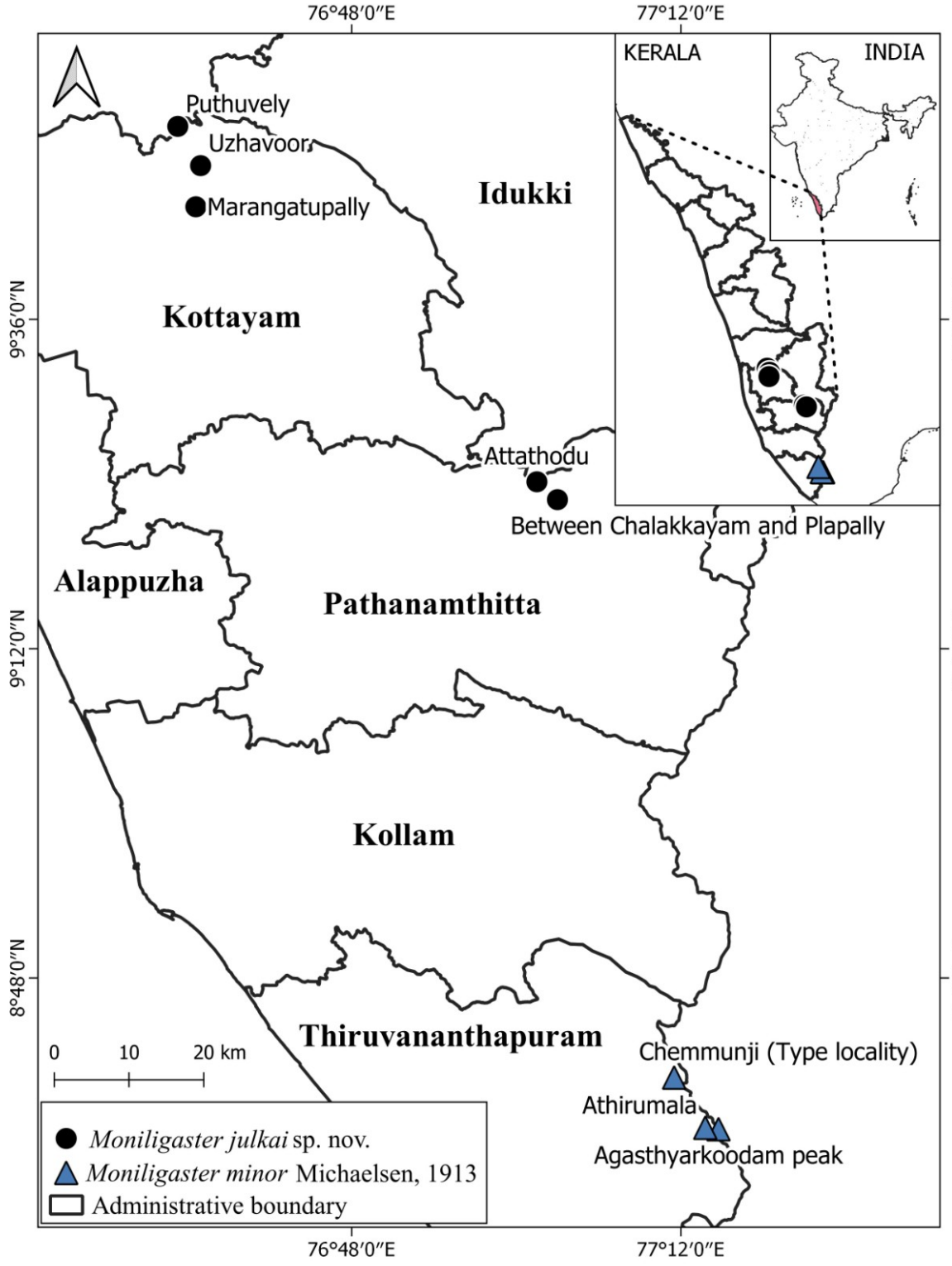

Figure 3. Current known distribution of *Moniligaster julkai* sp. nov. and *Moniligaster minor* Michaelsen, 1913

Table 2. Comparison of the characters of *Moniligaster deshayesi* Perrier, 1872 and *M. minor* Michaelsen, 1913

Character	*Moniligaster deshayesi* Perrier, 1872[1,2,3,4]	*Moniligaster minor* Michaelsen, 1913[4,5]
Length	114–163 mm	69–122 mm
Diameter	4–8 mm	3–6 mm
Segments	136–195	112–200
Nephridiopores	irregular dislocation ventrally to *ab* setal lines in segments behind clitellum	almost in one rank at or close to *d* setal lines
Female pores	minute, on or close to setae *b*	conspicuous, at *b* setal lines
Spermatheca	atrial glands paired; duct of each gland *c.*1/2 to 1/3 the length of common atrial duct; ampulla ovoid	atrial glands paired; duct of each gland *c.*1/3 the length of common atrial duct; ampulla elongate-ovoidal
Prostates	dark red, long (12–15 mm), rod-like, narrowed ectally	chalk white to yellowish white, short (3.8–5 mm), tubular, slightly bent entally with a notch mesially
Prostatic capsule	raised into crisscrossed ridges, prostatic duct slender	smooth, ectal portion of prostatic duct bulged
Length of prostatic duct	*c.* 1/4th the length of gland plus duct	greater than1/3rd the length of gland plus duct
Vas deferens	passing through heavy mass of larger leaflet-like glands, entering slightly below the ental end of prostate	passing through light mass of smaller leaflet-like glands, entering at ental end of prostate
Gizzards	4–5 (in segments 13–20)	4–5 (in segments 14–19)

Data from: [1]Gates (1940), [2]Aiyer (1929), [3]Stephenson (1923), [4]present study, [5]Michaelsen (1913).

Table 3. Records of *Moniligaster minor* and *M. deshayesi* along with altitudinal and habitat details

Sl No.	Location	District	State	Reference	Altitude	Habitat
	Moniligaster minor					
1	Chimungi (= Chemmunji)	Thiruvananthapuram	Kerala	Michaelsen (1913)	1200 m	?
2	Agasthyarkoodam peak	Thiruvananthapuram	Kerala	Present study	1865 m	Shola forest and from thick root mat of grasses growing on rocky hilltop near shola forest
3	Athirumala	Thiruvananthapuram	Kerala	Present study	1011 m	Higher altitude evergreen forest
	Moniligaster deshayesi					
1	Neduvangand (= Nedumangad)	Thiruvananthapuram	Kerala	Michaelsen (1910)	68 m	?
2	Courtallam	Tenkasi	Tamil Nadu	Stephenson (1926)	160 m	?
3	Tenmalai(= Thenmala)	Kollam	Kerala	Aiyer (1929)	500 m	?
4	Anachardie	Thiruvananthapuram	Kerala	Gates (1940)	?	?
5	Charupara	Kollam	Kerala	Sathrumithra *et al.* (2018)	266 m	Semi evergreen forest
6	Njandukombu	Kollam	Kerala	Sathrumithra *et al.* (2018)	146 m	Semi evergreen forest
7	Kurichi	Pathanamthitta	Kerala	Sathrumithra *et al.* (2018)	534 m	Evergreen forest
8	Kallipara in Kottavasal (Reg. no. ACESSD/EW/162)	Kollam	Kerala	Present study	474 m	Evergreen forest

9	Near to Ambanad estate (Reg. no. ACESSD/EW/186)	Kollam	Kerala	Present study	795 m	Evergreen forest
10	Between Kumbavurutty and Kottavasal (Reg. no. ACESSD/EW/619)	Kollam	Kerala	Present study	241 m	Disturbed evergreen forest
11	Pulachippara in Achankovil Forest (Reg. no. ACESSD/EW/620)	Kollam	Kerala	Present study	288 m	Deciduous like forest near teak plantation
12	Priya estate (Reg. no. ACESSD/EW/621)	Kollam	Kerala	Present study	486 m	Disturbed evergreen forest
13	Aluvamkudy (Reg. no. ACESSD/EW/605)	Pathanamthitta	Kerala	Present study	513 m	Evergreen forest
14	Pandimotta in Shendurney Wildlife Sanctuary (Reg. no. ACESSD/EW/1294)	Kollam	Kerala	Present study	174 m	Evergreen forest
15	below Ponmudi (Reg. no. ACESSD/EW/1318)	Thiruvananthapuram	Kerala	Present study	800 m	Evergreen forest

ly distinguished from *M. deshayesi* by the characteristics as given in table 2.

Type locality of *M. minor,* Chimungi (= Chemmunji) is close to the present collection sites, Agasthyarkoodam peak and Athirumala and are practically at the same altitudinal range. *M. deshayesi* is known to inhabit mainly evergreen, semi-evergreen and disturbed evergreen forests, below 800 m altitude, whereas *M. minor* is confined to the higher altitude evergreen forest and shola-grassland complex above 1000 m (Table 3).

Additional distributional records of *Moniligaster* spsecies from Kerala

Moniligaster aiyeri Gates, 1940

Moniligaster aiyeri Gates, 1940: 493.

Material examined. 1 aclitellate (Reg. No. ACESSD/EW/1047), shola forest, Agasthyarkoodam (8°36'56.1"N, 77°14'45.1"E) in Neyyar Wildlife Sanctuary, Thiruvananthapuram District, Kerala State, India, 1865 m a.s.l., 4 October 2014, leg. D. Kuriakose, S.P. Narayanan, T. Augustine, A. Sasi, S. Sathrumithra.

Brief description. Colour bluish. Length 118–456 mm, diameter 12–13 mm, segments 189–310. Spermathecal pores transverse slits, in *cd* setal lines, at intersegmental furrow 7/8. Male pores paired, transverse elliptical apertures, nearer to *b* setal lines. Gizzards 4–6, in segments 16–23. One or both testis sacs dislocated posteriorly under ovarian chamber. Vas deferens long, slender, thickened portion into cluster of loops which is larger than testis sac; vas passes under longitudinal musculature before entering anterior ental end of prostate; prostates mushroom-shaped, prostatic capsule spheroidal. Spermathecal atrial glands in segments 7 and 8, duct of each atrial gland about one fourth the length of common atrial duct, atrial gland duct only recognizable after removal of basal portions of the glands.

Habitat. Shola forest.

Distribution. Endemic to India, restricted to the higher altitudes of Agasthyamalai Biosphere Reserve. Kerala State: Thiruvananthapuram District: Agasthyarkoodam – Neyyar Wildlife Sanctuary* (*present record) (Fig. 4); Tamil Nadu State: Muthukkuzhi (Gates 1940).

Remarks. Dimensions of the present specimen - length 303 mm, width 12 mm, segments 285. It has five gizzards in segments 16–20. Hence the diagnosis of the species has been updated based on the present specimen from the Agasthyarkoodam. Recently, Narayanan *et al.* (2016) mistakenly included it in Kerala checklist. Recent record of *M. aiyeri* from Kerala state by Thakur *et al.* (2021) is clearly a misidentification. The key

diagnostic features of *M. aiyeri*, is its characters of prostate, which is erect and mushroom-like and vas deferens joins the prostate at its ental end, but in the figure provided, it is shown that the prostate as long, tubular with wider base, directed anteriorly, vas deferens join the prostate at its middle. Other key features such as penetration of vas deferens through the longitudinal musculature of the body wall prior to junction with the prostate, segmental location of spermathecal atrial glands are not mentioned. Hence the present record of *M. aiyeri* becomes the first positive report of this species from the political boundary of the Kerala state.

Moniligaster blakemorei Narayanan & Julka, 2021

Moniligaster blakemorei Narayanan *et al.,* 2021a: 385.

Material examined. 1 clitellate, 6 aclitellates (Reg. No. ACESSD/EW/1296), roadside in evergreen forest, above Moozhiyar KSEB office (9°19'7.2"N 77°4'49.7"E), Pathanamthitta District, Kerala State, India, 689 m a.s.l., 27 September 2011 leg. T. Augustine, S.P. Narayanan. 1 aclitellate (Reg. No. ACESSD/EW/1297), road side in evergreen forest, near Moozhiyar dam (9°18'18.1"N, 77°3'15.7"E), Pathanamthitta District, Kerala State, India, 27 September 2011, leg. T. Augustine, S.P. Narayanan. 1 clitellate, 4 aclitellates (Reg. No. ACESSD/EW/1298), *Ochalandra* reed break in evergreen forest, Gavi in Periyar Tiger Reserve, Pathanamthitta District, Kerala State, India, 28 September 2011, leg. S.P. Narayanan, T.K. Subash. 5 clitellates, 4 aclitellates (Reg. No. ACESSD/EW/1299), disturbed evergreen forest, Pampa in Periyar Tiger Reserve (9°24'7.79"N, 77°4'1.3"E), Pathanamthitta District, Kerala State, India, 266 m a.s.l. 28 August 2013, leg. A. Sasi, S. Sathrumithra, S.P. Narayanan, D. Kuriakose. 4 clitellates (Reg. No. ACESSD/EW/1300), stream side with reeds in evergreen forest, Attathodu (9°24'9.6"N, 77°1' 30.5"E), Pathanamthitta District, Kerala State, India, 342 m a.s.l. 20 August 2013, leg. S.P. Narayanan, S. Sathrumithra, D. Kuriakose and A. Sasi. 1 aclitellate (Reg. No. ACESSD/EW/ 1301), evergreen forest, near to Ambanad estate (9°2' 26.4"N, 77°7'6.3"E), Kollam District, Kerala State, India, 795 m a.s.l., 24 August 2013, leg. S.P. Narayanan, D. Kuriakose, S. Sathrumithra, A. Sasi. 11 aclitellates (Reg. No. ACESSD/EW/ 1302), evergreen forest, Aluvamkudi (9°16'7.8"N, 77°00'6.8"E), Kollam District, Kerala State, India, 513 m a.s.l., 21 August 2013, leg. S.P. Narayanan, S. Sathrumithra, D. Kuriakose, A. Sasi. 4 clitellates, 5 aclitellates, 2 juveniles (Reg. No. AC ESSD/EW/1309), home garden, Poonjar (9°34' 46.03"N, 076°42'43.1"E), Kottayam District, Kerala State, India, 54 m a.s.l., 11 May 2017, leg. R. Anuja, S. Sathrumithra, E. Thomas, V.T. Kurien. 2 clitellates, 2 aclitellates, 2 juveniles (Reg. No. ACESSD/EW/1310), rubber plantation, Poonjar (9°39'42.0"N, 76°48'48.2"E), Kottayam District, Kerala State, India, 54 m a.s.l., 11 May 2017, leg. R. Anuja, S. Sathrumithra, E. Thomas, V.T. Kurien. 5 aclitellates, 3 juveniles (Reg. No. ACES SD/EW/1311), rubber plantation, Munnilavu (9° 41'24.7"N, 76°46'58.6"E), Kottayam District, Kerala State, India, 59 m a.s.l., 18 December 2018, leg. R. Anuja, P. Kumar, N.G. Vishnu (Fig. 4).

Brief description. Colour bluish. Length 81–136 mm, diameter 3.5–7 mm, segments 183–278. Secondary male apertures paired, large transverse slits, slightly lateral to *b* setal lines at intersegmental furrow 10/11. Spermathecal pores, paired, small transverse slits, close to *cd* setal lines at intersegmental furrow 7/8. Genital markings absent. Gizzards 2 in segments 12–16. Testis sacs asymmetrical. Vas deferens a mass of hairpin loops, mass about as large as testis sac, entering prostate directly, near to ental end. Prostates glandular, bluntly club-shaped, prostatic capsule shiny, smooth, club-shaped. Spermathecal atrial glands paired in segment 7, duct of each gland about four times the length of common atrial duct.

Habitat. Forest (disturbed evergreen*, evergreen, *Ochlandra* reed breaks* and semi evergreen*), home garden and rubber plantation (*present record).

Biology. Specimens from Attathodu and Gavi had protozoan cysts in the region of gizzards and ovisacs.

Distribution. India: Kerala State: Kollam District: near to Ambanad estate*; Kottayam District: Melukavu, Munnilavu* and Poonjar*; Pathanamthitta District: above Moozhiyar KSEB office*, Aluvamkudi*, Attathodu*, Gavi in Periyar Tiger Reserve*, near Moozhiyar dam*, Pampa in Periyar Tiger Reserve*, between Aranamoozhi and Ilampampa (*present records; Narayanan *et al.* 2021*a*).

Remarks. Diagnosis of the species is updated based on the present materials from Kollam, Kottayam and Pathanamthitta districts of Kerala state. Segmental location of gizzard varied in specimens from Moozhiyar (Reg. no. ACESSD/EW/1296–1297) area, where it is in segments 12–13 or 13–14. Whereas, a specimen from Pampa it is in segments 15–16. First gizzard in the segment 13 is weak compared to the one in 14, in specimen from near Moozhiyar Dam (Reg. no. ACESSD /EW/1297). Gizzard being large, septa are pushed back to posterior, even up to segment 18. Specimen from the Ambanad estate (Reg. no. ACESSD/EW/1301) of Kollam district, prostate on the right hand side is twisted and directed anteriorly. Specimens from the Kottayam district showed a slight difference in the shape of prostate and joining of vas deferens to prostate. Pathanamthtitta and Kollam districts specimens have bluntly club-shaped prostate and vas joins the prostate sub-entally, whereas Kottayam specimens have narrowly club-like prostate and vas joins prostate at its middle.

***Moniligaster deshayesi* Perrier, 1872**

Moniligaster deshayesi Perrier, 1872: 130.

Material examined. 2 clitelates, 12 aclitellates, 3 juveniles (Reg. No. ACESSD/EW/162), evergreen forest, Kallipara in Kottavasal (9°4'17.4"N, 77°12'24.5"E), Kollam District, Kerala State, India, 474 m a.s.l., 22 August 2013, leg. S.P. Narayanan, T. Augustine, S.A. Sasi, S. Sathrumithra, D. Kuriakose. 1 clitellate, 4 aclitellates (Reg. No. ACESSD/EW/186), evergreen forest, near to Ambanad estate (09°02'26.4"N, 77°07' 06.3"E), Kollam District, Kerala State, India, 795 m a.s.l., 23 August 2013, leg. D. Kuriakose, S. Sathrumithra, S.P. Narayanan, T. Augustine, A. Sasi. 1 aclitellate (Reg. No. ACESSD/EW/605), evergreen forest, Aluvamkudy (9°16'07.8"N, 77°00'16.8"E), Pathanamthitta District, Kerala State, India, 513 m a.s.l., 21 August 2013, leg. S.P. Narayanan, D. Kuriakose, S. Sathrumithra, A. Sasi. 1 clitellate, 2 aclitellates (Reg. No. ACESSD/EW/619), disturbed evergreen forest, between Kumbavurutty and Kottavasal (9°04' 26.2"N, 77°11'26.8"E), Kollam District, Kerala State, India, 241 m a.s.l., 23 August 2013, leg. D. Kuriakose, S. Sathrumithra, S.P. Narayanan, T. Augustine, A. Sasi. 1 aclitellate, 3 juveniles (Reg. No. ACESSD/EW/620), deciduous like forest near teak plantation, Pulachippara (9°5'58.9"N, 77°8'46.7"E), Kollam District, Kerala State, India, 288 m a.s.l., 23 August 2013, leg. D. Kuriakose, S. Sathrumithra, S.P. Narayanan. 2 aclitellates (Reg. No. ACESSD/EW/621), disturbed evergreen forest, Priya estate (9°2'45"N, 77°7'39.1"E), Kollam District, Kerala State, India, 486 m a.s.l., 24 August 2013, leg. S.P. Narayanan, D. Kuriakose, S. Sathrumithra, T. Augustine, A. Sasi. 2 clitellates (Reg. No. ACESSD/EW/1294), evergreen forest, Pandimotta (9°14'23.9"N, 76° 55'24.2"E) in Shendurney Wildlife Sanctuary, Kollam District, Kerala State, India, 174 m a.s.l., 19 June 2015, leg. S. Sathrumithra, P. Manoj, D. Raju. 1 aclitellate (Reg. No. ACESSD/EW/1318), evergreen forest, below Ponmudi, Thiruvananthapuram District, Kerala State, India, 800 m a.s.l., 2 October 2014, leg. S.P. Narayanan, D. Kuriakose, S. Sathrumithra, S.A. Sasi (Fig. 4).

Brief description. Colour bluish. Length 114–163 mm, diameter 4–8 mm, segments 136–195. Clitellum red, in segments 10–13, intersegmental furrows distinct. Secondary male apertures paired, between *b* and *c* setal lines at intersegmental furrow 10/11. Spermathecal pores paired, in *cd* setal lines at intersegmental furrow 7/8. Nephridiopores minute, recognizable from segment 3, from segment 13 to posterior end dislocated dor-

sally or ventrally to *ab* setal lines but quite irregularly. Genital markings absent. Four to five gizzards in segments 13–20. Testis sacs confined to segments 9 and 10 or dislocated posteriorly. Vas deferens a mass of hairpin loops passing through heavy mass of large leaflet-like glands, entering prostate directly, slightly below the ental end. Prostate glandular, long, prostatic capsule rod like, with crisscrossed ridges, prostatic duct slender. Spermathecal atrial glands paired in segment 7, duct of each gland smaller than common atrial duct.

Habitat. Forest (deciduous like*, disturbed evergreen*, evergreen and semi evergreen) (*present study; Sathrumithra *et al.* 2018).

Distribution. India: Kerala State: Kollam District: between Kumbavurutty and Kottavasal*, Charupara, near to Ambanad estate*, Njandukombu, Pandimotta in Shendurney Wildlife Sanctuary*, Pittny, Priya estate*, Pulachippara in Achankovil Forest*, Tenmalai (= Thenmala); Pathanamthitta District: Aluvamkudy*, Kurichi; Thiruvananthapuram District: Anachardie, below Ponmudi, Neduvangand (= Nedumangad) (*present record; Michaelsen 1910; Aiyer 1929; Gates 1940; Sathrumithra *et al.* 2018). *Elsewhere.* Tamil Nadu State, India: Courtallam (Stephenson 1926).

Remarks. Type specimen of the species is perhaps from the Southern Western Ghats portion of the Kerala State, India. Stephenson (1915) has recorded *M. deshayesi* from the Parambikulam. Later, during the revision of the genus Gates (1940) stated that Stephenson's specimens do not belong to *M. deshayesi* due to the lack of leaflet-like glands on the vas deferens. Recently, Thakur *et al.* (2021) reported *M. deshayesi* from the Parambikulam Tiger Reserve, but the figures depicted by them lack the diagnostic features (*e.g.* shape of the prostate, absence of leaflet-like glands on the vas deferens, etc.) implying it to be a different species.

Moniligaster horsti Gates, 1940

Moniligaster horsti Gates, 1940: 506.

Material examined. 1 aclitellate (Reg. No. AC ESSD/EW/1295), higher altitude evergreen forest, between Pettymudi and Parappayarkudi (10° 11.250'N, 77°1.519'E), Idukki District, Kerala State, India, 1627 m a.s.l., 22 February 2019, leg. S.P. Narayanan, A. Mohan, R. Nair (Fig. 4).

Brief description. Colour bluish to brownish. Length 118–206 mm, diameter 8 mm, segments 189–191. Spermathecal pores large transverse slits, slightly median to *c*, at intersegmental furrow 7/8. Male pores paired, transverse slits, at about mid *bc*. Gizzards 4–5, in segments 14–20. Testis sacs in segment 10. Vas deferens coiled into a mass of hairpin loops, mass twice the size of testis sac; vas deferens passes under longitudinal musculature before entering ental end of prostate; prostates ovoid, capsule ovoidal to anvil-shaped. Spermathecal atrial glands in segments 7 and 8, duct of each atrial gland about one fourth the length of common atrial duct, which is longitudinally placed and partially buried in parietes.

Habitat. Forest (disturbed evergreen, evergreen, higher altitude evergreen* and shola forests) (*present record; Narayanan *et al.* 2021*a*).

Distribution. India: Kerala State: Palakkad District: Karimalagopuram in Parambikulam Tiger Reserve; Idukki District: between Pettymudi and Parappayarkudi*, Moothassery, Ozhuvathadam, Pampadum Shola National Park (*present record; Narayanan *et al.* 2021*a*). *Elsewhere.* Tamil Nadu State: Bungitappal (Gates 1940).

Remarks. Present specimen had five gizzards in segments 16–20. Hence the diagnosis of the species has been updated based on the present specimen from the Idukki district.

Moniligaster keralensis Narayanan & Julka, 2021

Moniligaster keralensis Narayanan *et al.,* 2021*a*: 386.

Material examined. 1 juvenile (Reg. No. ACE SSD/EW/1269), grassland, Kurisumala in Wagamon, Kottayam District, Kerala State, India, 17 August 2018, leg. R. Anuja, V. Balan, T. Subash. 2 clitellates (Reg. No. ACESSD/EW/1272), road side in evergreen forest, Chelikuzhi (9°23'17.4"N, 76°56'00.8"E), Pathanamthitta District, Kerala State, India, 514 m a.s.l., 26 September 2011, leg. S.P. Narayanan, T. Augustine, T.K. Subash. 1 clitellate, 4 aclitellates, 3 juveniles (Reg. No. ACESSD/EW/1273), Vallikettu (9°22'00.0"N, 76° 58'43.8"E), evergreen forest, Pathanamthitta District, Kerala State, India, 139 m a.s.l., 26 September 2011, leg. T. Augustine, S.P. Narayanan, T.K. Subash. 4 aclitellates, 1 juvenile (Reg. No. ACESSD/EW/1274), disturbed forest with reeds and canes, Chenthamarakokka near Gavi (9°25'1.00"N, 76°58'43.8"E) in Periyar Tiger Reserve, Pathanamthitta District, Kerala State, India, 947 m a.s.l., 28 September 2011, leg. T.K. Subash, T. Augustine. 1 clitellate, 5 aclitellates (Reg. No. ACESSD/EW/1275), evergreen forest, between Aranamoozhi and Ilampampa (9°18' 51.6"N, 77°7'24.1"E) in Periyar Tiger Reserve, Pathanamthitta District, Kerala State, India, 1056 m a.s.l., 27 September 2011, leg. S.P. Narayanan, T. Augustine. 1 aclitellate (Reg. No. ACESSD/ EW/1276), road side in evergreen forest, above Moozhioyar KSEB office I (9°19'7.2"N, 77°4' 49.7"E), Pathanamthitta District, Kerala State, India, 689 m a.s.l., 27 September 2011, T. Augustine, leg. S.P. Narayanan. 8 aclitellates, 3 juveniles (Reg. No. ACESSD/EW/1277), shola-like forest, Varayadumkokka in Periyar Tiger Reserve (9°22'41.5"N, 77°8'58.3"E), Pathanamthitta District, Kerala State, India, 1055 m a.s.l., 28 September 2011, leg. T. Augustine, S.P. Narayanan, T.K. Subash. 4 aclitellates (Reg. No. ACE SSD/EW/1278), evergreen forest, Attathodu (9° 24'9.6"N, 77°1'30.5"E), Pathanamthitta District, Kerala State, India, 342 m a.s.l., 20 August 2013; leg. S.P. Narayanan, S. Sathrumithra, D. Kuriakose, A. Sasi. 2 clitellates, 10 aclitellates, 1 juvenile (Reg. No. ACESSD/EW/1279), disturbed evergreen forest edge, Pampa in Periyar Tiger Reserve (9°24'7.79"N, 77°4'1.3"E), Pathanamthitta District, Kerala State, India, 266 m a.s.l., 20 August 2013, leg. A. Sasi, S. Sathrumithra, S.P. Narayanan, D. Kuriakose. 4 aclitellates (Reg. No. ACESSD/EW/1280), evergreen forest, between Chalakkayam and Plappally (9°22'51.4"N, 76°56' 00.8"E), Pathanamthitta District, Kerala State, India, 259 m a.s.l., 20 August 2013, leg. S.P. Narayanan, S. Sathrumithra, D. Kuriakose, A.S. Sasi. 9 clitellates, 1 aclitellate (Reg. No. ACESSD /EW/1281), semi evergreen forest, Thalamanam Reserve Forest (9°13'23.4"N, 76°56'17.3"E), Pathanamthitta District, Kerala State, India, 350 m a.s.l., 11 June 2016, leg. S. Sathrumithra. 7 clitellates, 2 aclitellates, 1 juvenile (Reg. No. ACES SD/EW/1282), rubber plantation, Thalamanam settlement area (9°13'31.6"N, 76°56'9.6"E), Pathanamthitta District, Kerala State, India, 329 m a.s.l., 11 June 2016, leg. S. Sathrumithra. 5 aclitellates, 2 juveniles (Reg. No. ACESSD/EW/ 1283), teak plantation, Kakara temple (9°14' 21.5"N, 76°54'4.3"E), Pathanamthitta District, Kerala State, India, 385 m a.s.l., 28 October 2016, leg. S. Sathrumithra. 2 aclitellates, 1 juvenile (Reg. No. ACESSD/EW/1284), teak plantation, Avolikuzhi (9°14'31.5"N, 76°54'4.3"E), Pathanamthitta District, Kerala State, India, 385 m a.s.l., 27 October 2016, leg. S. Sathrumithra. 12 aclitellates, 11 juveniles (Reg. No. ACESSD/ EW/1285), streamside in evergreen forest, Njaloor (9°15'2.7"N, 76°52'17.6"E), Pathanamthitta District, Kerala State, India, 339 m a.s.l., 27 October 2016, leg. S. Sathrumithra. 25 aclitellates, 2 juveniles (Reg. No. ACESSD/EW/1286), semi evergreen forest, Chempanaruvi (9°7'51.8" N, 77°1'2.6"E) in Mannarapara Forest Range, Pathanamthitta District, Kerala State, India, 57 m a.s.l. 28 October 2016, leg. S. Sathrumithra. 4 aclitellates, 2 juveniles (Reg. No. ACESSD/ EW/1287), Aruvapulam, Pathanamthitta District, Kerala State, India, 28 October 2016, leg. S. Sathrumithra, mixed crop area. 4 aclitellates, 2 juveniles (Reg. No. ACESSD/EW/1288), mixed vegetation area, Athumukalam Range (9°14' 41.8"N, 76°53'44.7"E), Pathanamthitta District, Kerala State, India, 378 m a.s.l., 27 October 2016, leg. S. Sathrumithra. 1 aclitellate, 1 juvenile (Reg. No. ACESSD/EW/1289), shola-grassland ecotone, Eanipara shola (10°10'37.8"N, 77°2'59.8"E) in Eravikulam National Park, Idukki District, Kerala State, India, 2140 m a.s.l., 22 November

2016, leg. S.P. Narayanan, S. Sathrumithra, G. Christopher. 1 clitellate (Reg. No. ACESSD/EW/1290), shola-grassland ecosystem, Pettymudi forest camp shed area (10°10'26.87 N, 77°1' 25.6"E) in Eravikulam National Park, Idukki District, Kerala State, India, 1966 m a.s.l., 21 November 2016, leg. S.P. Narayanan, S. Sathrumithra, G. Christopher. 7 clitellates, 1 aclitellate (Reg. No. ACESSD/EW/1291), shola forest, Meenthottychola (10°10'21.4 N, 77°0'2.3" E) in Eravikulam National Park, Idukki District, Kerala State, India, 2010 m a.s.l. 22 November 2016, leg. S.P. Narayanan, S. Sathrumithra, G. Christopher. 2 aclitellates (Reg. No. ACESSD/EW/1292), beneath decaying wood in evergreen forest, Inchiparathodu (9°25'16 N, 77°17'14"E) in Periyar Tiger Reserve, Idukki District, Kerala State, India, 1050 m a.s.l., 22 January 2019, leg. S.P. Narayanan, Sreehari K. Mohan. 1 aclitellate (Reg. No. ACESSD/EW/1293), *Ochlandra* reed break, Gavi in Periyar Tiger Reserve, Pathanamthitta District, Kerala State, India, 28 September 2011, leg. S.P. Narayanan, T.K. Subash. 1 aclitellate (Reg. No. ACESSD/EW/1374), grassland, near Thangalpara (9°39'59.3"N, 76°54' 1.4"E) in Wagamon, Kottayam District, Kerala State, India, 1010 m a.s.l., 17 October 2018, leg. R. Anuja, V. Balan, T. Subash (Fig. 4).

Brief description. Colour bluish. Length 58–155 mm, diameter 3–6 mm, segments 109–201. Secondary male apertures paired, large transverse slits, slightly lateral to *b* setal lines, at intersegmental furrow 10/11. Spermathecal pores paired, small transverse slits, close to *cd* lines, at intersegmental furrow 7/8. Genital markings absent. Gizzards 3–6 in segments 14–20. Vas deferens a mass of hairpin loops, mass as large as testis sac, entering prostate directly, near the ectal end. Prostates glandular, tubular with irregular margins, slightly flattened, prostatic capsule tubular, smooth, prostatic duct bent downwards and narrowed. Spermathecal atrial glands bilobed in segment 7, glands bound together, duct of each gland about as long as the common atrial duct.

Habitat. Forest (disturbed*, evergreen, mixed vegetation*, *Ochlandra* reed breaks*, semi evergreen, shola* and shola-like forests*), higher altitude grassland*, mixed crop area*, plantations (cardamom, black pepper, rubber, teak) (*present record).

Biology. Autotomy and regeneration is very common. A specimen from the Meenthottychola (Reg. no. ACESSD/EW/1291), Idukki district had parasitic protozoan cysts on the ovisacs.

Distribution. Most widespread species within the genus. India: Kerala State: Idukki District: Chathurangappara, Eanipara shola in Eravikulam National Park*, Inchiparathodu in Periyar Tiger Reserve*, Meenthottychola in Eravikulam National Park*, Peruvanthanam, Pettymudi forest camp shed area in Eravikulam National Park*; Kottayam District: Kurisumala in Wagamon*, near Thangalpara in Wagamon*; Pathanamthitta District: above Moozhioyar KSEB office*, Aluvamkudy, Aruvapulam*, Athumukalam*, Attathodu*, Avolikuzhi*, between Aranamoozhi and Ilampampa in Periyar Tiger Reserve*, between Chalakkayam and Plappally*, Chelikuzhi*, Chempanaruvi in Mannarapara Range*, Chengara, Chenthamarakokka near Gavi in Periyar Tiger Reserve*, Gavi in Periyar Tiger Reserve*, Kakara*, Kurichikanam, Mundomoozhy, Njaloor*, Pampa in Periyar Tiger Reserve*, Pananthodu, Thalamanam*, Thannithodumoozhy, Vallikettu*, Varayadumkokka in Periyar Tiger Reserve*; and Kollam District: Kottavasal, near to Ambanad estate (*present records; Narayanan *et al.* 2021*a*).

Remarks. As reported by Narayanan *et al.* (2021*a*) majority of the specimens possess four gizzards in segments 14–19 but in certain specimens it ranged from 3–6 (in segments 17–20). Body dimensions and number of gizzards in selected specimens are given in table 2. Narayanan *et al.* (2021*a*) stated that the prostates extending from segment 11 to segments 13–14.

Table 4. Length, width, number of segments and number of gizzards in selected specimens of *Moniligaster keralensis* Narayanan & Julka, 2021 from various localities

Locality name (Reg. no.)	Length	Width	Segments	Gizzards (in segments)
Vallikettu (ACESSD/EW/1273)	N	N	N	4 (16–19)
Chenthamarakokka (ACESSD/EW/1274)	N	N	N	5 (14–18)
Between Aranamoozhi and Ilampampa (ACESSD/EW/1275)	N	N	N	6 (13–18), 5 (16–20), 5 (15–19)
Above Moozhiyar KSEB office I (ACESSD/EW/1276)	141 mm	6 mm	201	N
Varayadumkokka (ACESSD/EW/1277)	N	N	N	3 (17–19)
Pampa (ACESSD/EW/1279)	N	N	N	5 (12–16)
Between Chalakkayam and Plappally (ACESSD/EW/1280)	N	N	N	5 (14–18)
Thalamanam reserve forest (ACESSD/EW/1281)	136 mm	5 mm	201	3 (16–18)
Kakara temple (ACESSD/EW/1283)	80 mm	4 mm	140	6 (13–18)
Njaloor (ACESSD/EW/1285)	155 mm	5.5 mm	193	N
Aruvapulam (ACESSD/EW/1287)	N	N	N	3 (18–20)
Eanipara Shola in Eravikulam National Park (ACESSD/EW/1289)	N	N	N	3 (14–16)
Inchiparathodu in Periyar Tiger Reserve (ACESSD/EW/1292)	68 mm, 58 mm	3.5 mm, 3 mm	156 133	5 (14–18), N

N – Not counted/measured

But certain specimens exceeds this limit, Aruvapulam (ACESSD/EW/1287) specimen it is in segments 11–15, specimen collected between Aranamoozhi and Ilampampa (ACESSD/EW/1275) it is in 11–16, and Varayadumkokka (ACESSD/EW/1277) in 11–17. Apart from this certain individuals prostate is not directed posteriorly, instead either single or both prostates may be erect, twisted and confined to segment 11, or directed anteriorly or bent like a hook. Based on the present materials from Idukki and Pathanamthitta districts of Kerala state, the species diagnosis is updated.

DISCUSSION

The genus *Moniligaster*, has a complex taxonomic history beginning with the description of *Moniligaster deshayesi* by Perrier (1872) with type locality as Sri Lanka. However, later Michaelsen (1910) doubted its Sri Lankan origin and it has not been included in the recent updated checklist of the Sri Lankan earthworms (Narayanan *et al.* 2021*b*). There is a strong distributional pattern within various earthworm groups along the Western Ghats. The southern Western Ghats is dominated by the megascolecid and moniligastrid species (Narayanan *et al.* 2020). Present findings from the southern Western Ghats portion are also agreeing the same. *Moniligaster* species are primarily associated with forest habitats especially shola forest (Narayanan *et al.* 2021*a*). Discovery of a new *Moniligaster* earthworm mainly from human habitation is of significance and several new species are anticipated to be described from outside the protected areas within the Western Ghats. Previously Narayanan *et al.* (2021*a*) has recorded *M. blakemorei* and *M. keralensis* from the human modified habitats such as home garden, mixed crop field and plantations (*Elettaria cardamomum*, *Hevea brasilensis*, *Tectona grandis* etc.). It corroborates that they can withstand the anthropogenic activities. With the addition of *M. julkai* sp. nov. and resurrection of *M. minor,* total valid species known in the genus has been raised to 14, among these 12 are recorded in Kerala state.

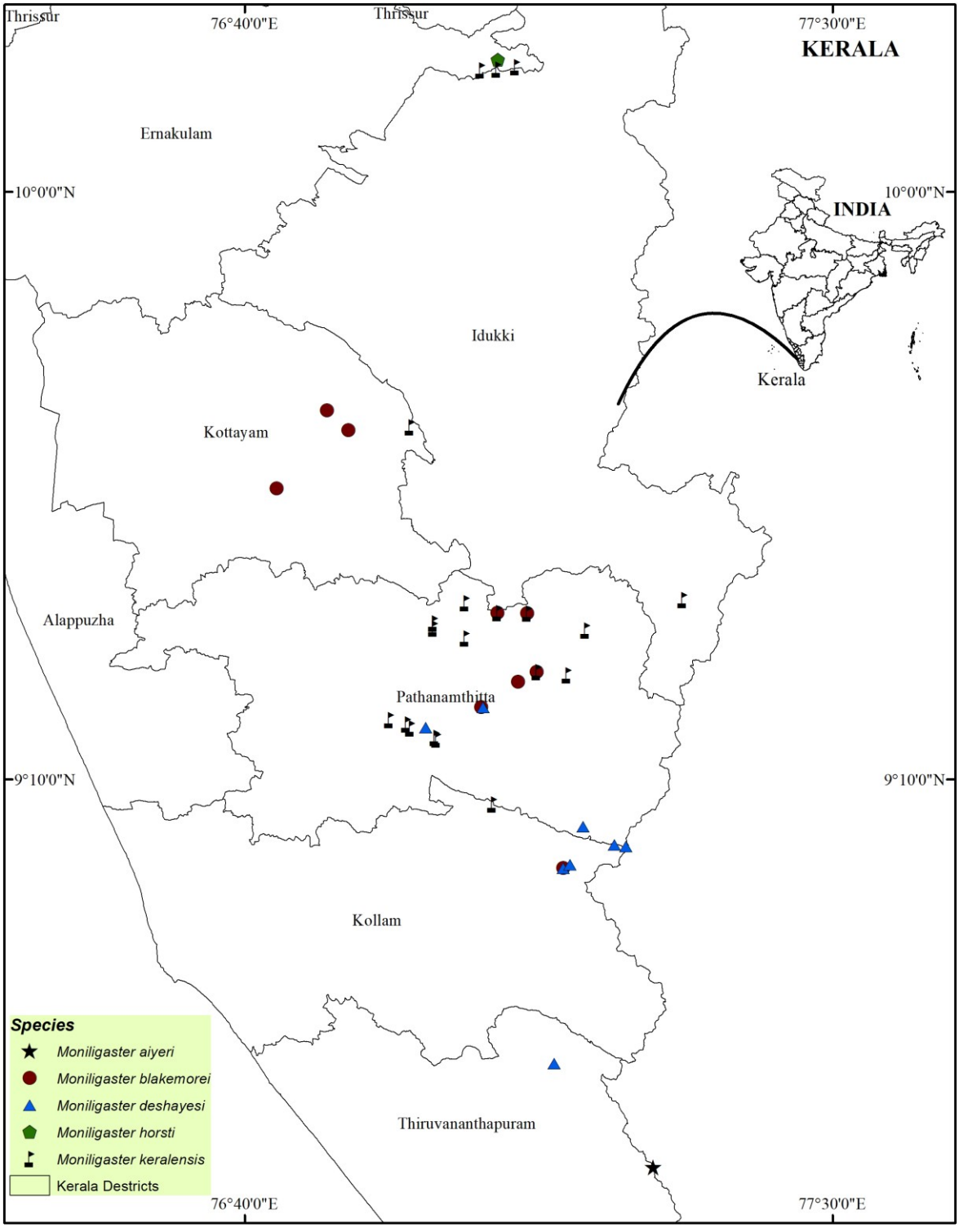

Figure 4. Map of sampling localities of various *Moniligaster* species recorded in this study.

Key to the species of the genus *Moniligaster* Perrier, 1872 (modified from Gates 1940; Narayanan *et al.* 2021*a*)

1. Vas deferens penetrates longitudinal muscle layer prior to junction with prostate **2**
– Vas deferens enters prostate directly, without penetrating longitudinal muscle layer **4**

2. Prostatic capsule anvil-like ***Moniligaster horsti*** Gates, 1940
– Prostatic capsule different **3**

3. Body length > 400 mm; prostatic capsule spheroidal ... . ***Moniligaster aiyeri*** Gates, 1940
– Body length < 200 mm; prostatic capsule disc–like and latero–mesially flattened .... ***Moniligaster stephensoni*** Gates, 1940

4. Spermathecal atrial glands confined to segment 7..... **5**
– Spermathecal atrial glands in segments 7 and 8 ..... **12**

5. Leaflet–like glands present on vas deferens **6**
– Leaflet–like glands absent on vas deferens **7**

6. Prostate long, capsule with criss–crossed ridges, prostatic duct slender ..... ***Moniligaster deshayesi*** Perrier, 1872
– Prostate short, capsule smooth, prostatic duct bulged ....***Moniligaster minor*** Michaelsen, 1913

7. Vas deferens joins prostate at or close to ental end **8**
– Vas deferens joins prostate at or close to ectal end **10**

8. Prostatic capsule with deep incisions on margins..... ..... ***Moniligaster gravelyi*** Stephenson, 1915
– Prostatic capsule without marginal incisions..... **9**

9. Prostatic capsule tubular, ental end slightly sinuous and nodulated.....***Moniligaster bahli*** Narayanan & Julka, 2021
– Prostatic capsule club–shaped, ental end without nodulations.....***Moniligaster blakemorei*** Narayanan & Julka, 2021

10. Prostates clavate, duct of each atrial gland short, about ¼ the length of common atrial duct..... ..... ***Moniligaster troyi*** Jamieson, 1977
– Prostates tubular..... **11**

11. Duct of each atrial gland about as long as common atrial duct.....***Moniligaster keralensis*** Narayanan & Julka, 2021
– Duct of each atrial gland about five times the length of common atrial duct..... .....***Moniligaster julkai*** Narayanan & Paliwal sp. nov.

12. Prostate and duct bound to parietes in a C–shaped figure, capsule ovoidal.....***Moniligaster michaelseni*** Gates, 1940
– Prostate and duct not bound to parietes, capsule shape otherwise..... 13

13. Prostatic capsule reniform, without nodulations..... .....***Moniligaster perrieri*** Michaelsen, 1907
– Prostatic capsule short, tubular and U–shaped, with irregularly placed nodulations..... .....***Moniligaster cernosvitovi*** Gates, 1962

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Opusc. Zool. Budapest, 2022, 53(1): 51–65

Modelling of climatic tolerances of three earthworm species; *Satchellius mammalis*, *Lumbricus friendi* and *Lumbricus festivus* using Maximum Entropy Modeling

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Abstract. Earthworm distributions are poorly known and individual species climatic tolerances, even less so. This paper sets out to use three species with a mainly Anglo-French distribution to test out whether using Maximum Entropy Modelling (Maxent) could be useful when studying earthworm distributions. It also gives an indication of how the likely climatic changes over a 50 year period will affect them. Overall the software seems to give useful information of where across Europe a particular species will thrive, even if not currently recorded there. It gives a real insight into how particular species might be better able to survive longer drier periods than others and which are on the edge of their climatic range already. Maxent modelling was clearly successful in demonstrating that the distributions of the ecologically different earthworm species are affected by a combination of different environmental variables. In the case of the epigeic *Satchellius mammalis* they are the annual temperature range, the precipitation of the driest month and the mean annual precipitation, for the epi-endogeic *Lumbricus festivus* they are the precipitation of the driest month, the precipitation of the wettest month and the annual temperature range. For the anecic *Lumbricus friendi* the most important environmental variables proved to be the annual temperature range, the mean diurnal temperature range and the precipitation seasonality.

Keywords. Annelida, Oligochaeta, distribution, climate change, range shift.

INTRODUCTION

It is well known that different earthworm species have very different environmental tolerances (Lee 1985). For example some earthworm species have cocoons that are more frost resistant, others more drought resistant (Holmstrup 1994). To predict the possible impact of climate change software such as Maxent (Phillips *et al.* 2006) developed by the American Museum of Natural History, can be used. This software allows the input of detailed maps of environmental variables as well as the location data of specimens. Using Maxent, and suitable environmental variables, it is also possible to model the effects of future climactic conditions on the suitability of different environmental locations for the different earthworm species. Consequently, potential future predictions with regards to habitat change or climate change could be considered.

Maxent was successfully used to predict the distribution of an endogeic earthworm *Hormogaster elisae* Álvarez, 1971 in central Spain using climatic and soil variables (Machán *et al.* 2015). Latif *et al.* (2017) used Maxent to model the distribution of the epigeic sibling species pair *Eisenia fetida* (Savigny, 1826) / *Eisenia andrei* Bouché, 1972 in Iran and showed that the most important environmental variables in determining the natural distribution of *E. fetida*/*andrei* were annual mean temperature and precipitation in the driest months followed by the mean diurnal range of temperature and precipitation in the wettest months. Also, using Maxent modelling Geraskina & Shevchenko (2019) successfully demonstrated that the main climatic factor influencing the distribution of the two epigeic species *Dendrobaena octaedra* (Savigny, 1826) and *D. attemsi* (Michaelsen, 1902) in the northwestern Caucasus

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is the precipitation in the driest month which has an effect on the desiccation of the litter layer and so on the survival of the epigeic worms in the driest summer months.

With ever increasing understanding of the importance of earthworms as ecosystem engineers (Lavelle *et al.* 2016), understanding the likely effect of climate change on distribution of individual species is crucial. However, testing of environment modelling like Maxent on continental scale data is still very rare, mainly due to the lack of continent-wide datasets.

Earthworm distribution globally is quite poorly known (Blakemore 2010). The UK, despite having a relatively small fauna with full identification keys present since the late 1940's (Sims & Gerard 1985), mirrors this poor distributional data (Carpenter *et al.* 2011). With the establishment of the earthworm society of Britain and in particular its launch of NERS (National Earthworm Recording Scheme) this situation is gradually starting to change now with over 12,000 good quality data records which together with other available datasets are analysed here.

We hope this preliminary analysis can be the beginning of future detailed continental-scale work making informed judgments on how climatic changes and habitat destruction might be affecting these important soil ecosystem engineer taxa.

MATERIALS AND METHODS

In this study, Maximum Entropy Modelling (Maxent^{R}) (Phillips *et al.* 2006) was used to investigate the potential distributions of different earthworm species. Using the specimen location data, as well as certain bioclimatic data that we provided, Maxent produced a map detailing the suitability of different environmental locations for each species.

Specimens. The data for the species used were collected in three different ways. The first was through a compilation of Museum collections data and private research data. Specifically these were; The Natural History Museum London with collections data from the late 1800's to the present day (400 relevant records), The Hungarian Natural History Museum Budapest with collections dating from the middle 1900's to the present day (approx. 80 relevant records), The Smithsonian Institution in Washington DC with collections data from the late 1800's to the present day (approx. 25 relevant records) and 8 records of *Satchellius mammalis* from Sweden and Norway from private research data held by Christer Erseus in Sweden collected between 2008 and 2012.

For each piece of collections data which contained a vague location, an extensive search was carried out to find that location and obtain its latitude and longitude. This was not always possible. This may have been due to place name changes, or places with the same name and region such that the location given was not specific enough to differentiate, or errors in recording the location given. In such cases, that data record was disregarded.

Alongside collections data, data records from the Earthworm Society of Britain were also used to provide detailed information about earthworm populations in Great Britain. This data includes some historical records but most records were collected in the past 10 years (approx. 10,000 records). The location of sample, as well as latitude and longitude are recorded.

The third way data was collected using the book of Bouché (1972) where he recorded large amounts of location data for different earthworm species across France. Although this data is now 50 years old the climatic conditions are mapped to the time recorded at so the data is still very valid. The data for the each species used in this study were compiled and latitudes and longitudes for the locations were searched via Google Maps.

Three species of earthworms were selected for detailed mapping across Europe; *Satchellius mammalis* (Savigny, 1826), *Lumbricus friendi* (Cognetti, 1904) and *Lumbricus festivus* (Savigny,

1826). These species were selected because their restricted ranges are centering on the Anglo-French region from which the greatest proportion of our records are, and because these species had limited ranges therefore it could be deduced that they are particularly sensitive to changes in the climatic variables.

For investigating the effect of the land use on the range of widely distributed peregrine earthworms two of the UK's most common earthworm species were selected; the endogeic *Aporrectodea caliginosa* (Savigny, 1826) and the epi-endogeic *Lumbricus rubellus* Hoffmeister, 1843.

Due to the possibility of sampling bias in regards to the Earthworm Society of Britain, a map containing the location of every record of the society was also created.

The model. The model was created using eleven different bioclimactic variables from WorldClim 1.4, at a size of 30 arc-seconds. This was to allow high detail on smaller locations, such as the British Isles. A selection of important variables relating to both temperature and precipitation levels was chosen. The bioclimatic variables chosen were:

1. Annual Mean Temperature
   This variable shows the mean temperature of a location for a single year.
2. Mean Diurnal Range
   This variable demonstrates the mean range in temperatures on a single day.
3. Maximum Temperature of the Warmest Month
   This variable demonstrates the highest temperature that occurs in a location, in the month which is on average warmest in that location.
4. Minimum Temperature of the Coldest Month
   This variable demonstrates the lowest temperature that occurs in a location, in the month which is on average coldest in that location.
5. Temperature Range
   This variable shows the range in temperature between the average temperature of the warmest month and the average temperature of the coldest month.
6. Mean Temperature of the Wettest Quarter.
   This variable demonstrates the mean temperature during the wettest three months of the year in that location.
7. Mean Temperature of the Driest Quarters
   This variable shows the mean temperature during the driest three months of the year in that location.
8. Annual Precipitation
   This variable shows the amount of precipitation a location gets over an entire year.
9. Precipitation of the Wettest Month
   This variable shows the amount of precipitation a location gets during the month with the most precipitation.
10. Precipitation of the Driest Month
    This variable shows the amount of precipitation a location gets during the month with the most precipitation.
11. Precipitation Seasonality
    Precipitation seasonality measures the variation of precipitation totals between each month over the year.

The temperature variables were chosen to reflect the effect of temperature fluctuations on the distribution of different earthworm species on different time scales. For example, Mean Diurnal Range was chosen to reflect how daily temperature fluctuations may affect earthworm distribution, whilst Temperature Range and Annual Mean Temperature were chosen to reflect how temperature fluctuations over an entire year may affect earthworm distribution. Similarly Maximum Temperature of the Warmest Month and Minimum Temperature of the Coldest Month were both chosen to investigate the possibility that some earthworms may prefer mild climates, and the effects of high and low temperatures on earthworm activity and the durability of their cocoons. For example, in the case of Minimum Temperature of the Coldest Month, this may be due to soil freezing.

The precipitation variables were chosen to reflect how the availability of moisture in the soil fluctuates through the year. Annual Precipitation was chosen to reflect how much water is available in a location during a year. The Precipitation of Wettest and Driest months was chosen to reflect how a sustained period of large amounts of water,

or lack of water, in the soil may affect earthworm populations, especially those not known to aestivate in the driest months. Precipitation Seasonality was chosen to reflect how large or small variations in precipitation over the year may affect earthworm populations.

Future projections of each of these bioclimatic variables were also used to produce the future projections of the suitability of different environmental locations for each species. Specifically we used the RCP 6.0 (Representative Concentration Pathway) pathway projected to 2050. The reason we chose RCP 6.0 is because it was the higher of the two middle RCP's, providing a possible worst case scenario, without using RCP 8.5 which may be overestimating future supply of fossil fuels (Rutledge 2011, Wang *et al.* 2017). We also did not attempt to produce maps for climate projections after 2050, due to that providing too much uncertainty.

The importance of different predictor variables for each species analyzed was determined according to Analysis of Variable Contributions (AVC). The variables that make a significant contribution to the model are those which have high values of permutation importance (PI) (Phillips *et al.* 2006).

In the case of Great Britain, land use was also investigated to ascertain whether it also has a large effect on earthworm distributions. Land use maps were taken from the Centre for Ecology and Hydrology (CEH). Land use for Ireland and Northern Ireland were not included.

RESULTS

1. *Satchellius mammalis* shows mainly Anglo French distribution which is primarily concentrated around the Western North coast of France, the Netherlands and Belgium. According to Maxent, all regions of the UK, except exposed westerly areas of Northern Ireland, Westerly highland areas of Scotland and an area of eastern England, are favourable. Hotspots seem to be centred around South coastal regions and the Welsh English border (fig. 1).

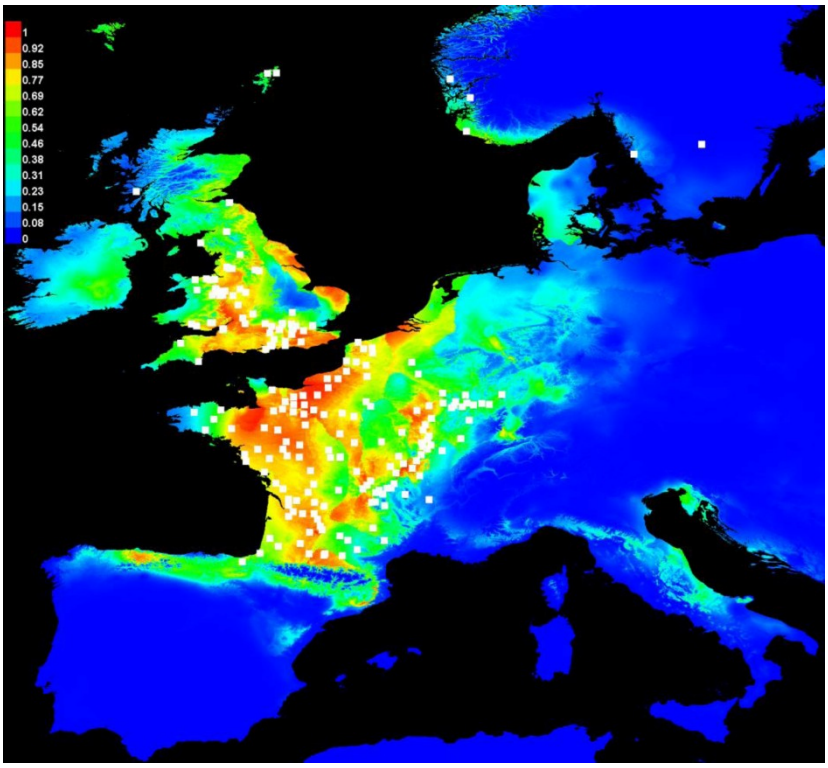

Figure 1. *Satchellius mammalis.* Present European distribution map with climatic variables.

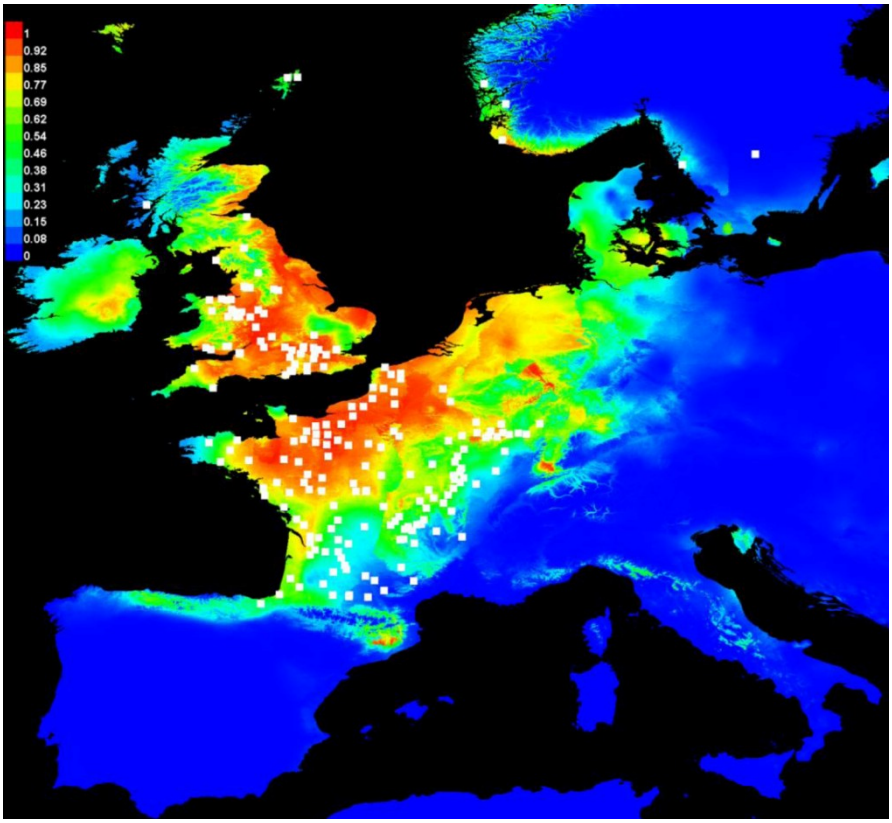

Figure 2. *Satchellius mammalis.* Predicted future European distribution map with climatic variables.

Table 1. Importance of different climatic variables in determining the distribution of *S. mammalis* according to the AVC data.

Variable	Percent contribution	Permutation importance
Temp Annual Range	39.7	43.7
Precip Driest Month	22	27.4
Mean Precipitation	1.9	9.7
Mean Temp	0.7	6.6
Mean Diurnal Range	1.5	5.1
Mean Temp Wettest Quarter	3.6	3
Precipitation Seasonality	4	2
Min Temp Coldest Month	25.2	1.3
Mean Temp Driest Quarter	0.3	1.2
Precip Wettest Month	1.1	0
Max Temp Warmest Month	0	0

The main variables determining the distributions according to AVC (Table 1) are: temperature annual range and the precipitation in the driest month. This would suggest this species is less drought resistant. It fits well to the maps produced as the area of East Anglia is one of the driest in the country and this species seems to fare less well in those drier more easterly regions

Modelling the future distribution of *S. mammalis* shows a predicted widening of range in the more northerly regions it inhabits but the souther-

ly regions become less favourable (fig. 2). This is especially true in the UK with a predicted larger scale increase in optimal conditions like higher annual temperature in the northern regions and more precipitation in the summer.

If we incorporate in the model the UK land use map it is clear that the extent of the most favourable area for this species notably shrinks but its geographic location in the UK still remains largely the same (fig. 3).

Using the climatic predictions set in combination with the land use data a possible south western shift of the species' favourable range would appear in comparison with the modelling without land use data (fig. 4)

2. *Lumbricus friendi* distribution (fig. 5) shows that the UK is only on the very fringes of this species climatic range currently. South eastern France, especially around the mountainous areas such as the Pyrenees and Massif Central, are favourable. A favourability towards mountainous regions is also supported by a clustering around the Alps in the East. However, they are not found in the highest altitudes of these ranges, just the surrounding areas. The most important predictors of the present distribution according AVC (Table 2) are; the temperature annual range, mean diurnal temperature range and precipitation seasonality. Future predictions with the warmer climatic conditions do not appear to be favourable for *L. friendi* (fig. 6) as the most favourable areas disappear almost entirely in the predictions, however the extent of the suboptimal areas especially in northern France and in the Ardennes, Belgium seems to be increasing. Taking into account the semi-peregrine nature of this species (Csuzdi & Szlávecz, 2004) this might indicate a possible North-Eastward shift in its distribution.

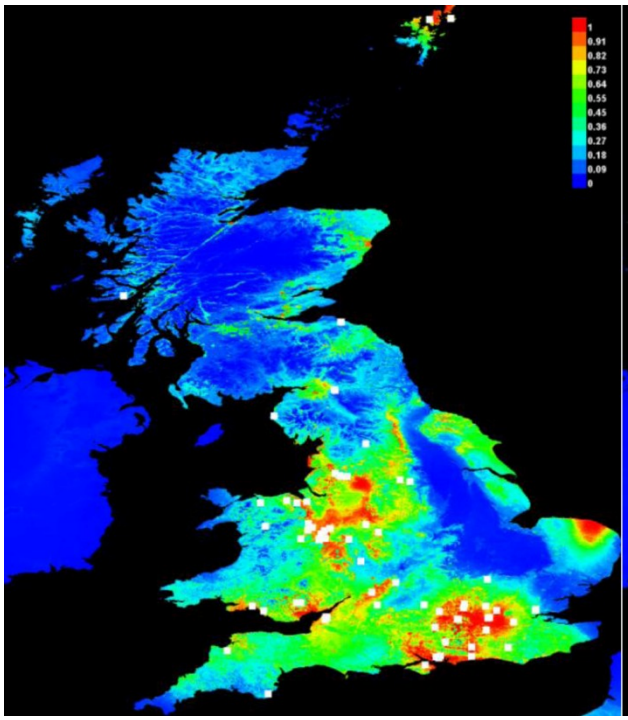

Figure 3. *Satchellius mammalis*. Present UK distribution map with the addition of land use data.

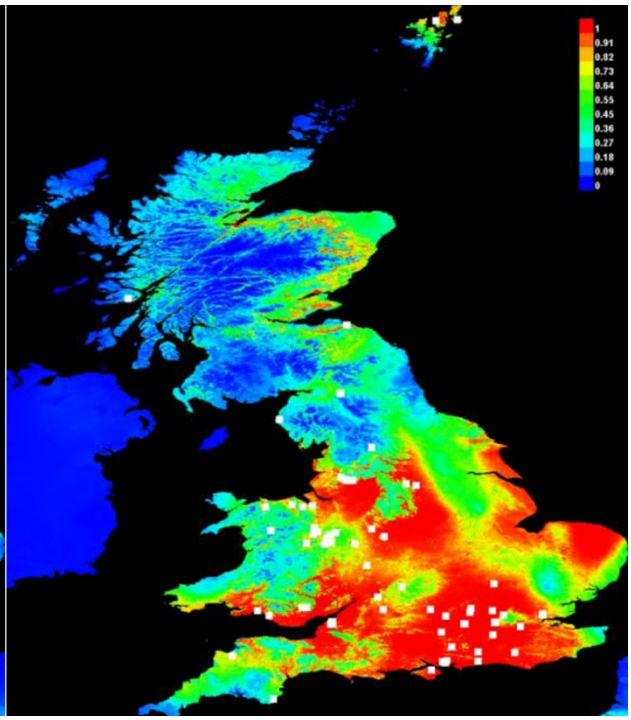

Figure 4. *Satchellius mammalis*. Predicted future UK distribution map with land use data.

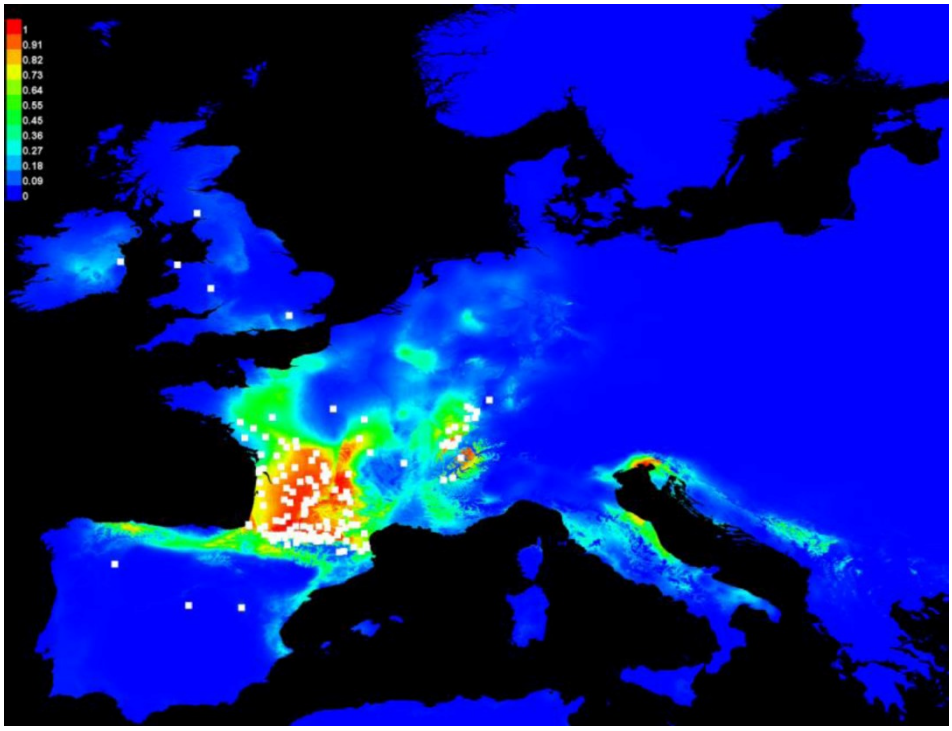

Figure 5. *Lumbricus friendi.* Present European distribution map with climatic variables.

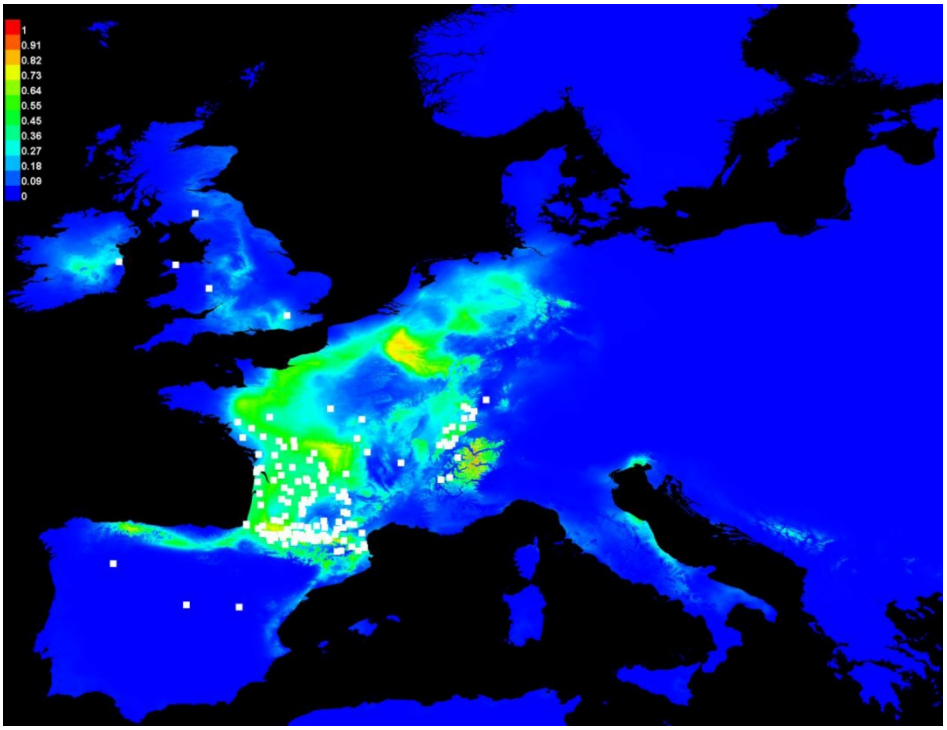

Figure 6. *Lumbricus friendi*. Predicted future European distribution map with climatic variables.

Table 2. Importance of different climatic variables in determining the distribution of *L. friendi* according to the AVC data.

Variable	Percent contribution	Permutation importance
Temp Annual Range	23.1	31.9
Mean Diurnal Range	22.3	24.2
Precipitation Seasonality	27.3	15.8
Mean Temp	3.9	7.7
Precip Driest Month	6.9	6.5
Precip Wettest Month	4.3	5
Mean Temp Wettest Quarter	4.8	3.6
Min Temp Coldest Month	0.4	2.3
Mean Temp Driest Quarter	5.8	1.7
Mean Precipitation	0.4	0.9
Max Temp Warmest Month	1	0.4

3. *Lumbricus festivus* shows a typical Atlantic distribution type (Csuzdi & Zicsi 2003) centring in Southern and Midland regions of the UK and the more northerly France. The major areas of unsuitability in the UK are the areas of higher altitude such as the Lake District, Pennines, Western Scotland and central Wales. A large area of eastern England is also less favourable (fig. 7).

The predicted favourable locations for this species remain mostly the same with the future predictions with indication of a slight Northern shift of its range in France and also in UK. This is especially prominent in the UK, where most of the country becomes incredibly favourable, including the previously unsuitable areas of eastern England (fig. 8). The AVC (Table 3) indicates that, like *S. mammalis,* this species is not very drought resistant. The driest areas in the UK, in the east, are areas the species is not thought to be found. The second largest factor is precipitation in the wettest month then the third is temperature annual range. So this species is very sensitive to the amount of rainfall the region has and therefore is unlikely to survive prolonged dry periods.

Incorporating the land-use data into our model shows a negative effect on the predictions, especially in a large area of Eastern England which becomes more prominently unsuitable (fig. 9). This restricted range largely overlaps with the present distribution of the species and explains its lack from Eastern England instead of the illustrated favourable climatic conditions.

In the future prediction, as with fig. 9, larger areas of the UK become more favourable for the species (fig. 10). However, the increased favourability is more concentrated on the southern and north westerly coasts of England and the Eastern regions still remain unfavourable. This shows that land use data does have a significant negative effect on the predictions for this species, compared to fig. 8.

To demonstrate if land use has an effect on widespread species we have modelled the distribution of *Ap. caliginosa* (figs. 11–12) and *L. rubellus* (figs. 13–14) two of the most common species throughout Europe. Apart from exposed Westerly regions these species are common in most areas. According to the model predictions incorporation of land-use data makes almost no difference to the range of these species.

DISCUSSION

The AVC tables produced by Maxent analysis proved to be very useful in determining the specific climatic conditions that each species is most susceptible to. For two of the three species analysed (*S. mammalis* and *L. festivus*) precipi

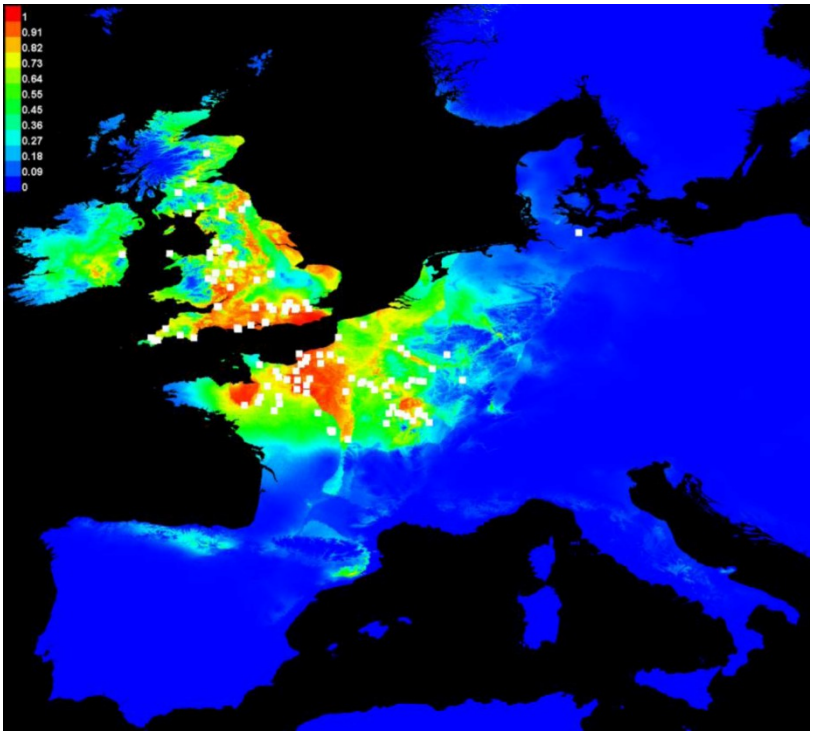

Figure 7. *Lumbricus festivus.* Present European distribution map with climatic variables.

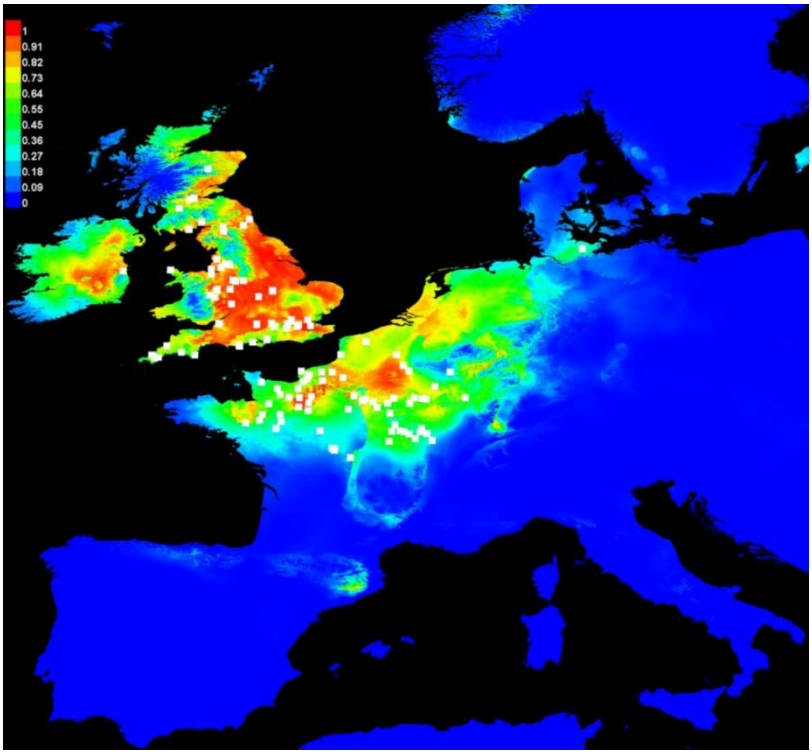

Figure 8. *Lumbricus festivus*. Predicted future European distribution map with climatic variables.

Table 3. Importance of different climatic variables in determining the distribution of *L. festivus* according to the AVC data.

Variable	Percent contribution	Permutation importance
Precip Driest Month	14.6	33.2
Precip Wettest Month	3.6	18.8
Temp Annual Range	41.9	17
Precipitation Seasonality	6.9	9.3
Min Temp Coldest Month	16.8	8.5
Mean Temp Driest Quarter	9.2	6.8
Mean Temp	1	2.8
Mean Temp Wettest Quarter	3.5	2
Mean Diurnal Range	0.9	1.4
Mean Precipitation	0.9	0.2
Max Temp Warmest Month	0.7	0

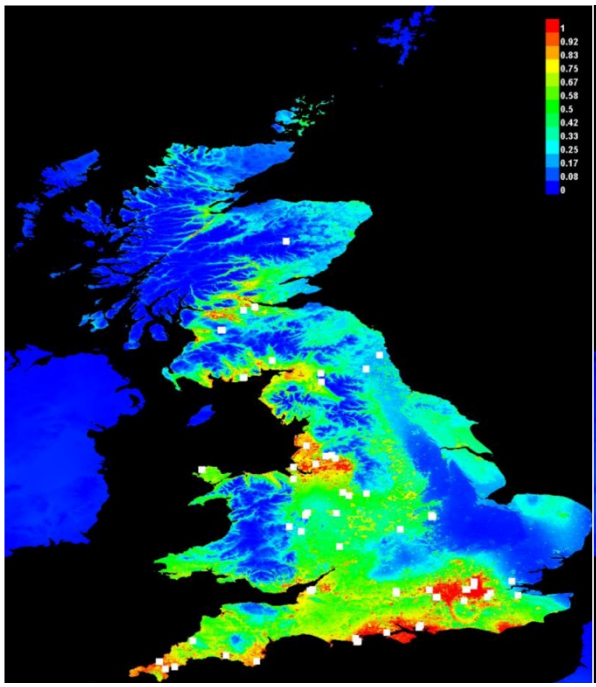

Figure 9. *Lumbricus festivus.* Present UK distribution map with land use included.

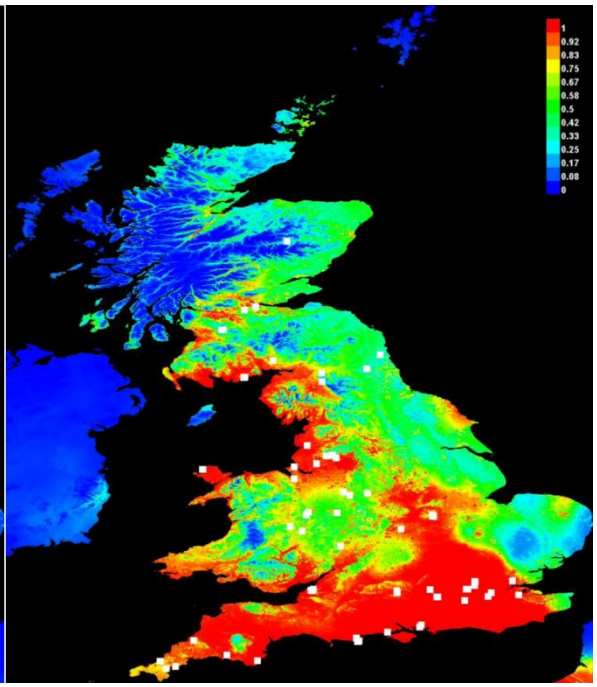

Figure 10. *Lumbricus festivus.* Predicted future UK distribution map with land use included.

tations in the driest months were among the most significant predicting factors, indicating that they are not drought tolerant. However, the third species (*L. friendi*) was more susceptible to temperature ranges.

Bouché (1972) in his extensive volume on the lumbricid worms of France presented an excellent insight into the climatic tolerances of the individual species including *Satchellius mammalis*. It is a species with a healthy distribution in the UK and France, with the western and northern French coast and the southern British coast being particular hotspots. Bouché (1972) stated the species was likely to be restricted to the Northern, Western and central areas of France, not being

found below a line running from Strasbourg to Perpignan. He also stated however, that if introduced there, they would also thrive in a small area of Italy. When modelling the data available, Maxent predicted exactly that (fig. 1), so illuminating the incredible insight by Bouché but importantly also giving weight to the reliability of Maxent to correctly predict species tolerances even from a relatively small sample size.

One interesting area to explore in the UK for this species is a large area not considered habitable around Peterborough in the South, Leicester in the west, Grantham in the north and Boston in the east (fig. 3). This needs a lot more investigative work as to exactly what the factors are affecting this. We assume, especially with an epigeic species like S. *mammalis,,* which is not able to aestivate in the summer, the most likely explanation would be due to this area having the driest conditions in the UK. When the potential future predictions are considered it seems that this area will become more habitable, which again could be due to a higher predicted rainfall due to climate change (fig. 4).

We considered under sampling could be skewing the presumed tolerances for this species. It is possible that the Earthworm Society of Britain does not sample as much in the east of England. To investigate this we mapped the location of every sample collected by the Earthworm Society of Britain (fig. 15). As can be seen on the map, there does appear to be a degree of under sampling in the east of England. However, we do have samples there so this alone does not explain Maxent showing a lack of suitable environmental conditions in this area. If the east of England contained suitable environmental conditions for the species, it is likely that Maxent would have predicted this based on the extensive sampling from the rest of Great Britain.

One of the rare lumbricid earthworms in Europe is *Lumbricus friendi.* There are just four records for the UK known of this species but we have numerous records from France, where the main extent of its worldwide distribution can be found. The records however, appear only to be found in very particular habitat types, and it would seem associated with certain (not high) altitudes, and the cooler moister climes which characterise them (fig. 5). This is demonstrated by a clustering of the species around the bases of the Pyrenees, the Massif Central, and the Alps, however, not being found higher in the mountain ranges themselves. Altitude though cannot be the sole contributor to this distribution, with specimens also being found in lower lying areas further away from these mountain ranges. This species seems to be particularly sensitive to climate with a very limited range of tolerable conditions, as shown by the future predictions largely reducing its suitable habitats (fig. 6). The climatic variables which are most important to this particular species seem to be precipitation seasonality and annual temperature range. So it would appear they need a constant rainfall with limited variation between months and a low but not freezing temperature but this need a lot more investigation.

The Maxent map for *L. friendi*, a species considered recently for a red list in the UK, shows it is absolutely on the boundary of its climatic tolerances in the UK and is not a species that is suffering due to any particular habitat loss or change but a species on the absolute fringes of its ecological tolerance (and not likely to be much aided from being added to a red list) and never likely to thrive. With a species with such narrow tolerances the future could be disastrous, however the 50 years predictions again seem to be suggesting a more rosy outlook for the species in the UK albeit not anywhere else in its range (fig. 6).

It is interesting that modelling identified another highly suitable region for *L. friendi* along the Adriato-Mediterranean region. Just recently, Stojanović *et al.* (2014) reported this species for the first time from Serbia. Although this record may be due to introduction like the North American ones (Csuzdi and Szlávecz, 2004) it also demonstrates the predicting power of Maxent analysis with its highlighting of favourable regions.

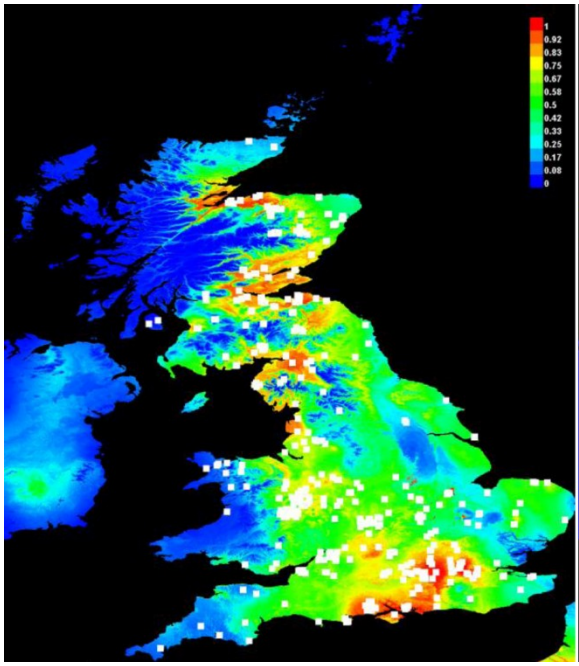

Figure 11. *Aporrectodea caliginosa.* Present UK distribution map without landuse information.

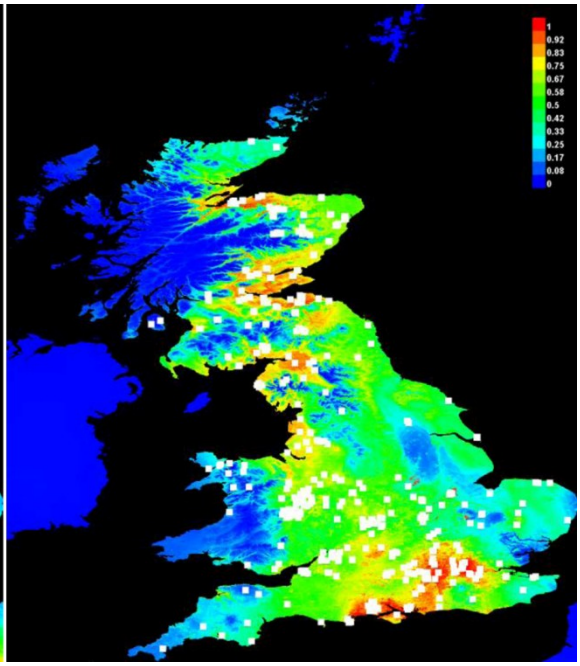

Figure 12. *Aporrectodea caliginosa.* Present UK distribution map with landuse information.

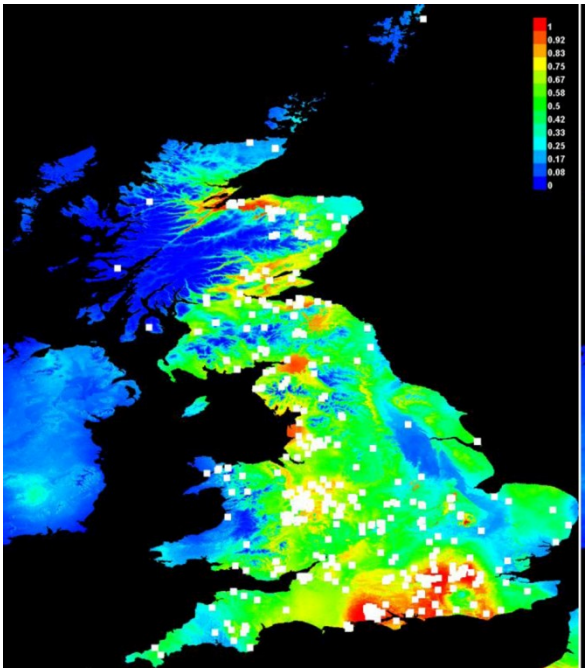

Figure 13. *Lumbricus rubellus.* Present UK distribution map without landuse information.

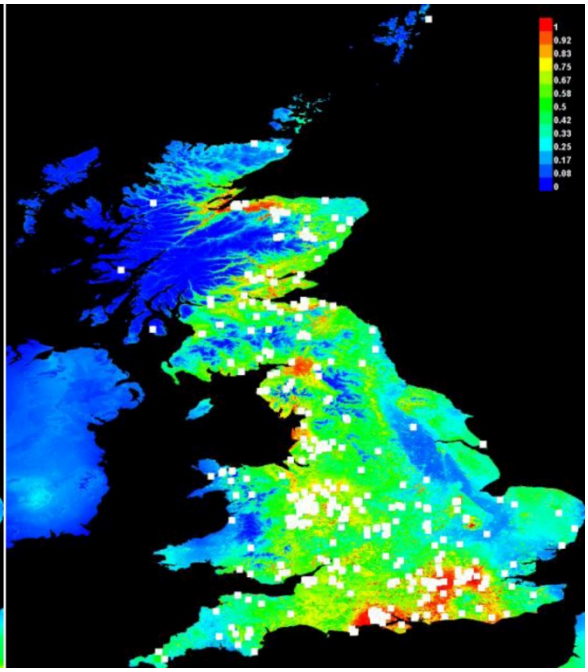

Figure 14. *Lumbricus rubellus.* Present UK distribution map with landuse information.

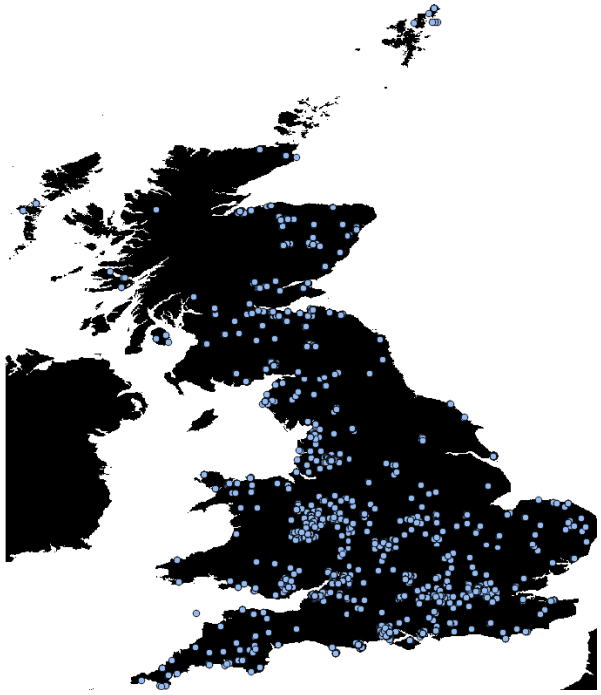

Figure 15. Map of the British Isles showing the Earthworm society of Britain's sampling localities.

Another species of interest is *Lumbricus festivus* (fig. 7). This species is not as rare as *L. friendi* however, is still considered rare in the UK. Within France it appears to have a northern distribution which is also predicted will extend out through Belgium and into the Netherlands. This would need to be tested via records from these countries. Similarly in the UK this species has a southerly distribution. It consequently appears that the areas around the English Channel and southerly North Sea seem to provide the most favourable conditions for this species. However, Maxent does also predict a very favourable channel through France running from Le Havre and the surrounding area right through to Lyon and beyond. This again would need to be explored further as this does not quite match the records produced by Bouché (1972).

But how much could land use play a role in the distribution of earthworm species? Another useful feature of Maxent is that other maps can be overlayed as well, so we used in this paper CEH land use map. Looking at very common Europe wide species with broad climatic tolerances such as *Aporrectodea caliginosa* (figs. 11–12) and *Lumbricus rubellus* (figs. 13–14) we set to test if land-use were to affect their range. The results appeared to show there is very little difference between maps solely based on climate and when land use was added for these species. These worms can survive in most areas whether it be urban, agricultural or wild. However, when comparing this to a map of *Satchellius mammalis* (figs. 1, 3), one of the more 'sensitive' species, we can see that in this case land use has had a clear effect. Areas in the east in particular suggest a dearth of records even beyond that predicted for the dry climatic conditions alone, which our current data set supports. Looking at the land-use maps closely this seems to tie in with this species struggling in areas being converted to arable lands. However, agriculture based more on pastures for livestock do not have such a significant effect, as shown in the more westerly regions. So although this feature needs to be investigated further, in this limited study land use does seem to be a useful factor to consider for species with limited ranges. As we do not currently have detailed land use maps for Europe it might also be useful to investigate the effect of land use on the favourability of regions in France for certain species. This may be especially enlightening in the case *Lumbricus friendi*, which we know to be sensitive to climactic conditions, and may also be sensitive to different land uses.

CONCLUSION

This is an initial study to test Maximum Entropy Modelling on a limited number of earthworm records and species. Species distribution models of course always have limitations (Jarnivich & Young 2015, Carneiro *et al.* 2016) however, the initial results do seem to indicate that Maxent is a useful tool to use in ascertaining general climatic tolerances and trends in the distribution of individual earthworm species; and that it would be worthwhile investing time and energy in a broader study with a greater number of records with a much broader geographical distribution (Rutgers *et al*. 2016)

This was especially evident with the case of *L. friendi* in the west Balkans and in France. It seems in particular to be useful with those species unable to cope with large fluctuations of temperature, or moisture. It therefore could also, when future predictions can be made of precipitation and temperature fluctuations enable us to broadly predict the likely vitality and range of these species.

Our results clearly emphasises that a lot more work needs to be carried out in collating all known verified records of European earthworm species as well as systematically collecting large quantities of species level data. From this study however, we do feel, once generated, this information alongside the use of environmental modeling like Maxent, should start to help us have a much healthier picture of how our earthworms are faring and how they are likely to fare in the future.

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On the Trichoptera of the Balkan: survey on species complexes of *Polycentropus ierapetra*, *Rhyacophila balcanica*, *R. bosnica* and *Notidobia nekibe*

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Abstract. The Balkan mountain ranges represent the most diverse hot spots of the European biodiversity still very far from being completely explored. Besides new faunistic data here we have described *Drusus gornistok* Oláh, sp. nov. in the *D. discophorus* species complex, surveyed four species complexes and described *Polycentropus maglic* Oláh, sp. nov. , *P. staraplanina* Oláh, sp. nov. in the *Polycentropus ierapetra* new species complex; *Rhyacophila albanica* Oláh & Ibrahimi sp. nov., *R. montenegra* Oláh, sp. nov. , *R. syrikaltera* Oláh & Ibrahimi sp. nov. in the *Rhyacophila balcanica* new species complex; *R. kozara* Oláh, sp. nov. , *R. sarplana* Oláh, sp. nov. , *R. staraplana* Oláh, sp. nov. in the *Rhyacophila bosnica* new species complex; *Notidobia kerkina* Oláh, sp. nov. , *N. koraba* Oláh, sp. nov. , *N. lakmosa* Oláh, sp. nov. , *N. vaillanti* Oláh, Vinçon & Ibrahimi sp. nov. in the *Notidobia nekibe* new species complex. The subspecies status of the following taxa were raised to species rank: *Polycentropus adana* Sipahiler, 1996 stat. nov., *P. anatolica* Sipahiler, 1989 stat. nov., *P. dirfis* Malicky, 1974 stat. nov., *P. ikaria* Malicky, 1974 stat. nov., *P. isparta* Sipahiler, 1996 stat. nov., *P. kalliope* Malicky, 1976 stat. nov., *P. septentrionalis* Kumanski, 1986, stat. nov., *P. slovenicus* Malicky, 1998 stat. nov.

Keywords. Trichoptera, Balkan Mountains, species complexes, new species, biodiversity hotspot.

INTRODUCTION

In this paper we have elaborated all of our set aside caddisfly specimens collected during the last few years mostly in the Balkan Mountain ranges with fewer specimens from the Carpathians. Applying the principles and more sophisticated procedures of fine phenomics and focusing on speciation traits of paraproct and/or phallic organ we have enlarged our resolution capacity and realised that our set aside specimens of *Rhyacophila balcanica* and *Rhyacophila bosnica* represent undescribed new incipient sibling species forming new species complexes. Similarly, we have established the *Polycentropus ierapetra* and *Notidobia nekibe* new species complexes and re-examined all the known species and furthermore described altogether 13 species new to science.

MATERIAL AND METHODS

Most of the specimens were collected by net or umbrella sweeping and all of the specimens are kept in 70 percent alcohol. To apply the principles and procedures of fine phenomics in order to find the first signatures of reproductive isolation in species complexes, to search species boundaries, to delimite closely related incipient taxa, and to

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recognize the young phylogenetic species we have cleared and carefully cleaned the genitalia of all of the available specimens. Each specimen were cleared in 10 percent of hot, not boiling sodium hydroxide and the duration of digestion process is adjusted individually to the effectiveness of clearing process. The dissolution rate depends on the species or even on the particular specimens having different nutritive state or physiological condition of the tissues. The digestion state can be easily followed by tissue transparency. Dissolution rate of the soft tissues, the clearing transparency, is clearly visible by naked eye. The remnant macerated tissue was carefully removed mechanically by fine-tipped forceps and needles. The genital structures were traced using a drawing tube mounted on a WILD M3Z microscope.

Depositories. (1) Department of Biology, Faculty of Mathematics and Natural Sciences, University of Prishtina, Prishtina, Kosovo (DBF MNSUP). (2) Hungarian Natural History Museum, Hungary (HNHM). (3) National Museum, Prague, Czech Republic (NMPC) and the (4) Oláh Private Collection, Debrecen, Hungary, under national protection by the Hungarian Natural History Museum, Budapest (OPC).

TAXONOMY

Philopotamidae Stephens, 1829

Philopotamus montanus Donovan, 1813

Material examined. **Albania**, Delvina Region, between Bistrica Village and Syri i Kaltër, 127 m, N39°55'53" E020°09'13", 13.V.2017, leg. S. Beshkov & A. Nahirnic (4 males, OPC). **Romania**, Vâlcea county, Parâng Mts, Obrâşia Lotrului, open spring area, 500 m along Transalpina (67C) road, downstream from N45°22'27.7", E23°39' 4.0", 1915 m, 30.VI.2016, leg. J. Oláh & J. Oláh jr. (5 males, 2 females; OPC). Apuseni Mts., Vladeasa Mt., Stâna de Vale, upper section of Ciripa stream, N46°40.546' E22°38.515', 1360 m, 6.VII.2016, leg. J. Kecskés (3 males, 2 females; OPC).

Remarks. Fully pigmented adult male from Albania, Delvina Region with uniform brown wings without any dark brown pattern.

Philopotamus variegatus Scopoli, 1763

Material examined. **Romania**, Vâlcea county, Parâng Mts, Obrâşia Lotrului, open spring area, 500 m along Transalpina (67C) road, downstream from N45°22'27.7", E23°39'4.0", 1915 m, 30.VI. 2016, leg. J. Oláh & J. Oláh jr. (5 males, OPC).

Wormaldia carpathica Oláh, 2019

Material examined. **Serbia**, Pčinja district, Vranje municipality, Besna Kobila Mts, forest brook along Ruski Put, 1460 m, N42.53206°, E22.20277°, 25.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (2 male, 3 females; OPC). Pčinja district, Vranje municipality, Besna Kobila Mts, open brook S of Planinarski dom, 1600 m, N42.52929°, E22.19760°, 25.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (1 male, OPC). Pirot district, Pirot municipality, Stara Planina, forest seeps N of Jelovica, 950 m, N43.23212°, E22.84662°, 24.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (9 males, 8 females; OPC). Zaječar district, Knjaževac municipality, Stara Planina, forest brook E of Mt. Babin zub, 1535 m, N43.38057°, E22.63269°, 23.IX.2021, leg. T. Kovács (3 males, OPC).

Remarks. This widely distributed species was described from Albania, Bulgaria, Czech Republic, Hungary, Macedonia, Poland, Romania, Slovakia, Ukraine, that is from all the mountain ranges of the Carpathians and part of the Balkan. These are the first records from Serbia.

Psychomyiidae Walker, 1852

Tinodes braueri McLachlan, 1878

Material examined. **Albania**, Delvina Region, between Bistrica Village and Syri i Kalter, 127 m, N39°55'53"; E020°09'13", 13.V.2017, leg. S. Beshkov & A. Nahirnic (3 males, OPC).

***Tinodes erato* Malicky, 1976**

Material examined. **Albania**, Gjirokastër county, Tepelenë municipality, Kurvelesh, Gurrit Stream E of Progonat, 1025m, N40°12.625' E19° 58.108' leg. P. Juhász, T. Kovács, D. Murányi, 29.VI.2018 (3 males, 5 females; OPC).

***Tinodes pallidulus* McLachlan, 1878**

Material examined. **Bulgaria**, Eastern Rhodopi Mts, Borovitza Valley, between Duzhdovnitza and Pudartzi, 359m, N41.68591°; E25.282159° 13.VI.2018, S. Beshkov, B. Zlatkov, R. Bekchiev leg. (5 males, OPC).

***Tinodes unicolor* Pictet, 1834**

Material examined. **Albania**, Korçë county, Kolonjë municipality, Leskovik, roadside spring W of the town, 575 m, N40.14503° E20.57265°, 30.IV.2021, leg. T. Kovács, D. Murányi, P. Olajos (1 male, OPC).

Polycentropodidae Ulmer, 1903

***Plectrocnemia brevis* McLachlan, 1871**

Material examined. **Bulgaria**, W. Stara Planina Mts, between Kopilovtsi and Kopren, N43.3338°, E22.8641°, 843m, 11.IX.2021, leg. S. Beshkov & A. Nahirnić-Beshkova (1 male, OPC).

***Plectrocnemia geniculata* McLachlan, 1871**

Material examined. **Macedonia**, Pelister Mts, Planinarski Dom „Shiroka", 1955m, N41°00'17"; E21°10'07", 6.VIII.2016, leg. S. Beshkov & A. Nahirnic (1 male, OPC).

***Polycentropus excisus* Klapálek, 1894**

Material examined. **Albania**, Korca Region, Dardha, 1276m, N40°31'34"; E020°49'33", 26. VI.2017 meadow near stream with *Salix, Fagus* forest and hill with *Astragalus*, lamps, light traps leg. S. Beshkov & A. Nahirnic (1 male, OPC). Albania, Delvina Region, between Bistrica Village and Syri i Kalter, 127 m, N39°55'53"; E20° 09'13"13.V.2017, leg. S. Beshkov & A. Nahirnic (3 males, OPC).

***Polycentropus ierapetra* species complex**

Polycentropus ierapetra Malicky, 1972 was described and delineated by the genital structure, actually by the bilobate structure of the gonopod lateral profile with declared similarity to *P. excisus* Klapálek, 1894, *P. intricatus* Morton, 1910, *P. schmidi* Novák & Botosaneanu, 1965, and particularly to *P. corniger* McLachlan, 1884. The *Polycentropus* Curtis, 1835 genus is very diverse in the Neotropical, Nearctic and Palaearctic fauna regions, represented by 15 species in the Australasian faunal region, and only by two species both in the Afrotropical and Oriental fauna regions. There are four basic types of gonopods in lateral profile observed in lateral view: (1) Elongated monolobate with basodorsal small structures present in the Palaearctic, Nearctic, Neotropical, Afrotropical, Oriental and dominating in the Australasian faunal region. (2) Elongated monolobate with small apicoventral structures, present in the Nearctic and Neotropical faunal regions. (3) Abbreviated regular monolobate very frequent in the Nearctic and Neotropic faunal regions. (4) Abbreviated bilobate gonopod with variously organized lobes.

Based on the character state of the bilobate gonopod in this survey we delineate *Polycentropus ierapetra* species complex by relying on the list of Malicky (1998, 2004): *adama*, *anatolica*, *baroukus*, *dirfis*, *ikaria*, *isparta*, *kalliope*, *septentrionalis*, *slovenica*, adding to the complex four known: *corniger*, *ichnusa*, *milikuri*, *djaman* and two new species: *P. maglic* sp. nov., *P. staraplanina* sp. nov. However, there are many and variously incongruent or transient character states in the lateral profile of the gonopod in the *Polycentropus* genus resulted in chimeric composition and created by retigeny or dictiogeny. Therefore, the present list, like any classification is artificial. There are a good number of *Polycentropus* species in the Palaearctic region with similar bilobate gonopod requiring future studies in relation to the *Polycentropus ierapetra* species

complex: *armeniacus*, *cianficconiae*, *divergens*, *excisus*, *flavostictus*, *kingi*, *mazdacus*, *pirisinui*, *radaukles* and *schmidi*.

In most genera and species in the Polycentropodidae family the segment X is membranous and the sclerotized fused complex of cerci and paraproct dominates over the genital structure, frequently exhibiting high diagnostic value. Compared to gonopods the character state of the plesiomorphically bilobate paraproct, being frequently the speciation trait and therefore the most diverse genital structure in the family, has more important function in speciation processes and higher diagnostic value in delineation of incipient species. The plesiomorphic character state of the paraproct is characterized by well produced dorsal and ventral branches. In apomorphic character state the ventral branches could be vestigial, completely lost or in opposite much produced giving a ventral support for the phallic organ (Oláh & Johanson 2010).

In this species complex most species listed by Malicky (1998, 2004) with bilobate gonopod character state have both the dorsal and ventral branches of the heavily sclerotized paraproct well produced preserving the plesiomorphic character state of the paraproct structure. However, in a few species, including unfortunately the nominate species *Polycentropus ierapetra* the ventral branch of the paraproct is highly reduced or completely vestigial.

Polycentropus ierapetra has the apomorphic bilobate character state of gonopod together with the apomorphic character state of paraproct having almost completely lost ventral branches, similarly to many more species among the Palaearctic members of the *Polycentropus* genus with variously bilobate apomorphic lateral profile of gonopod accompanied by incomplete apomorphic paraproct that is without ventral branches; *armeniacus*, *corniger*, *djaman*, *excisus*, *ichnusa*, *ierapetra*, *kingi*, *mazdacus*, *pirisinui*, *radaukles*, *schmidi*, *septentrionalis*, *staraplanina* sp. nov. Frequently there is an internal spine or digitate process, as a neoformation on various parts of the mesal surface of the cercus having no paraproctal origin. This variously sclerotized structure may be confused with the ventral branches of the paraproct. In this survey we do not investigate these species. Their study is reasonable to combine with *Polycentropus* species from other faunal regions, including the species rich Nearctic and Neotropical regions.

Here we examined the species listed by Malicky (2004) as subspecies or closely related species to *Polycentropus ierapetra*. Unfortunately most of the species listed as subspecies of *P. ierapetra* are highly diverged from the nominal species having complete plesiomorphic paraproct with well produced dorsal and ventral. Among the examined taxa the ventral branch is lacking only at *P. corniger*, *P. djaman*, *P. ichnusa*, *P. ierapetra*, *P. septentrionalis* and *P. staraplanina* sp. nov. Subspecies and races have been already taken out from science (Oláh *et al.* 2018) therefore here we raise the subspecies to species rank.

Polycentropus adana **Sipahiler, 1996 stat. nov.**

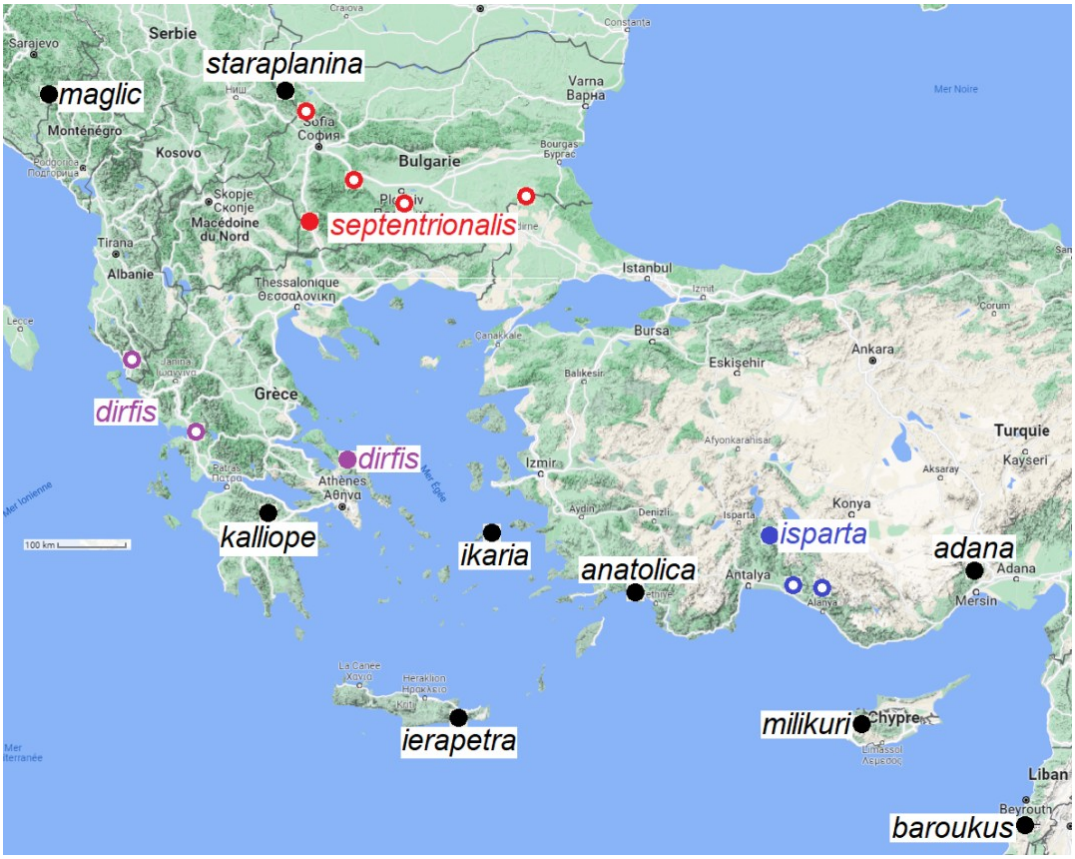
(Map 1)

Polycentropus ierapetra adana ssp. nov. Sipahiler, 1996:301–302: „Holotype ♂ and paratype ♂: Turkey, Adana, Çamliyayla, Daripinari köyü, 1000 m, 23.4.1993; same place, 20.5.1993 1 ♂; leg. Sipahiler, holotype in ZSM., paratypes in my collection." „*P. i. adana* ssp. nov. is closely related to *P. i. isparta* ssp. nov. and well characterized by the shape of the curved and long intermediate appendages and inner basal projections, of which the dorsal branches are also long and pointed at the tips."

Polycentropus anatolica **Sipahiler, 1989 stat. nov.**

(Map 1)

Polycentropus ierapetra anatolica ssp. nov. Sipahiler, 1998:132134: „Holotype ♂ and paratype ♂: Turkey, Muğla, 10 km to Dalaman, 36°20'N 36°44'E, 17.5.1987 leg. and coll. Sipahiler." „This new subspecies of *P. ierapetra* differs from all the other subspecies in the shape of the inferior appendages."



Map 1. Distribution of the new *Polycentropus ierapetra* species complex in the Balkan and in Turkey. **(**Filled circle represents type locality)

Polycentropus baroukus Botosaneanu & Diaz, 1983

(Map 1)

Polycentropus baroukus Botosaneanu & Diaz, 1983: 131–132: Lebanon: „Matériel. Holotype ♂ et allotype ♀ (avec 17 paratypes ♂ et 6 paratypes ♀), station 6: Nabaa Aazibi (torrent Jezzîne) du Nahr el Aouali; Massif de Niha, altitude 900 m, 22.VI. 1981. 43 paratypes ♂ et 12 paratypes ♀ des stations 1,2,3,5,6,7,8, à des dates diverses."

Polycentropus corniger McLachlan, 1884

(Map 2)

Polycentropus corniger McLachlan, 1884:53-54: „Portugal (near Villa Real, Traz-os-Montes, 21rd June, Eaton, 5♂, 8♀); French Pyrenees (near Quillan, Aude, 8th July, Eaton, 1♂)."

Polycentropus dirfis Malicky, 1974 stat. nov.

(Map 1)

Polycentropus ierapetra dirfis Malicky, 1974a:18–19: „Holotypus ♂: Graecia, Insel Eu böa, Dirfis, 500 m, 28.5.1973, leg. Aspöck, Rausch und Ressl; in coll Malicky." „Die Form der unteren Anhänge ist wie bei ssp. *ikaria*. Hingegen ist der Innenteil der oberen Anhänge, der ebenfalls nach unten gebogen ist, viel breiter. Die Präanalsklerite sind im basalen Teil stark blasenförmig erweitert, und der stark abgeknickte Distalteil ist viel länger als bei den anderen beiden bekannten Unterarten. Das 10. Segment hat in Dorsalansicht weit ausladende Distalecken."

Polycentropus ierapetra euterpe Malicky, 1976:94: „Die Form der unteren Anhänge ist wie bei den sspp. *ikaria* und *dirfis* (Malicky & Kumanski 1974), die Präanalsklerite sind hingegen wie bei der Nominatform, doch sind der basale und distale Teil

(d.h. vor und nach dem Knick) gleich lang. Charakteristisch für die ssp. *euterpe* sind: Innenteil der oberen Anhänge sehr lang, schmal und stark nach unten gebogen (noch starker als bei ssp. *ikaria*); ihr Außenteil ist ziemlich kurz und stumpf, der Dorn an der Innenseite ihrer Oberkante sehr klein."

Polycentropus ieropetra euterpe Malicky, 1976: Malicky 1998: „Die Merkmale von *P. ierapetra dirfis* und *P. ierapetra euterpe* erwiesen sich als innerhalb der Variationsbreite der Populationen liegend; *euterpe* Malicky, 1976 ist daher ein Synonym von *dirfis* Malicky, 1974 (n. syn.)."

Material examined. **Albania**, Delvina Region, between Bistrica Village and Syri i Kalter, 127 m, N39°55'53"; E20°09'13"13.V.2017, leg. S. Beshkov & A. Nahirnic (3 males, OPC). **Greece**, 3 km NE Loutro, N38.97 E21.2, 40 m, 30.VII.2007, leg. M. Bálint (11 males, OPC).

Polycentropus djaman Martynov, 1927

(Map 2)

Polycentropus djaman Martynov, 1927:182–183: **Kazakhstan**, „2 pupae (one pupa with ♂ imago). Torrent Karaba-tau, East Karatau, 25–30.VI.24, A. Martynov; Larva. Torrent Ak-Tash, 15.VI.24, O. Martynova." „In the structure of the 10-th segment *P. djaman* resembles *P. flavomaculatus* Pict. and *P. flavistictus* Hag.; preanal appendages appear to be peculiar (dentiform process), but in their large size they remind those in *P. flavostictus* of *P. corniger* McLachl. Pedes genitals are short, as, fore instance, in *P. flavostictus* but excised, somewhat resembling those in *P. corniger*. Thus, this species is distinct, in some features resembling such Mediterranean species, as *P. flavostictus* (Madeira) and *P. corniger* (Portugal, Pyrenees)."

Polycentropus ichnusa Malicky, 1974

(Map 2)

Polycentropus ichnusa Malicky, 1974:229–230: Holotypus ♂: „Sardinien", leg. Krausse, coll Zool Museum, Berlin." „Kopulationsapparat: Ähnlich wie bei *P. corniger* und *P. ierapetra* mit massiven, kompakten unteren Anhängen, die an der oberen Leiste stark sklerotisiert und pigmentiert sind."

Polycentropus ierapetra Malicky, 1972

(Map 1)

Polycentropus ierapetra Malicky, 1972:32–33: **Greece**, „Holotypus ♂: Kreta, Ierapetra, 18.4.1971, leg. Malicky. Allotypoid ♀ und einige Paratypoide vom selben Ort vom 13.5.1971 und von vier weiteren kretischen Fundorten. Alle in meiner Sammlung." „Diese Art ist durch die ♂ Genitalstructuren, besonders durch die Form der gonopoden, sehr gut charakterisiert und mit keiner anderen bekannten europäischen Art verwechselbar. Aehnlichkeiten bestehen mit *P. excisus* Klap. (Botosaneanu, 1960a), *P. intricatus* Mort. (Morton, 1910), und *P. schmidi* Novák und Botosaneanu (1965), aber am nächsten ist sie sichtlich mit *P. corniger* McL. (McLachlan 1874-80) aus Spanien verwandt."

Polycentropus ikaria Malicky, 1974 stat. nov

(Map 1)

Polycentropus ierapetra ikaria n. ssp. Malicky, 1974a:18. „Holotypus ♂, Allotpus ♀ und mehrere Paratypen: Graecia, Insel Ikaria, Mileopo-Monokampion, 280–650 m, 22.5.1973, leg. Aspöck, Rausch und Ressl; alle in coll. Malicky." „Von den kretischen Nominatform (Malicky, 1972) unterscheidet sich ssp. *ikaria* durch die Proportionen verschiedener Teil des ♂-Kopulationsapparates. An der unteren Anhängen ist, seitlich gesehen, der ventral Teil viel massiver als der dorsale. Der Innenteil der oberen Anhänge, der bei den Kretern ein kurzes Dreieck ist, ist bei *ikaria* lang, schmal und sensenförmig nach unten gebogen. Die Präanalsklerite, bei der Nominatform gebogen und im Endteil nach außen-unten geschwungen, sind bei *ikaria* gerade, und nur der kurze Endteil ist etwa 90° nach außen gebogen. Das 10. Segment ist, von dorsal gesehen, rechteckigparallel."

Polycentropus isparta Sipahiler, 1996 stat. nov

(Map 1)

Polycentropus ierapetra isparta ssp. nov. Sipahiler, 1996:301–302: „Holotype ♂ and paeratypes (1♂, 1♀): Turkey, Isparta, Sütçüler, Yazili Kanyon (at light), 30.5.1993; Antalya, Gündogmus, Güneycik Köyü, Alara Çayi, 11.8.1993 1♂; Antalya, Akseki,

Map 2. Distribution of the new *Polycentropus ierapetra* species complex outside Balkan and Turkey

Ibradi, Handost mevkii, Manavgat Çayi, (at light), 1♂, 1♀; leg. Sipahiler, holotype in ZSM, paratypes in my collection."

Polycentropus kalliope Malicky, 1976 stat. nov.

(Map 1)

Polycentropus ierapetra kalliope n. ssp. Malicky, 1976:94. „Holotypus ♂ und Paratypen: Griechenland, Peloponnes, Karterion, 25.7.1974; Paratypen auch von Kefalarion, 26.7.1974. Alle leg et coll. Malicky." „Von allen bischer bekanten Unterarten unterscheidet sich diese dadurch, daß der lange, schmale Innenteil der oberen Anhänge nach oben gebogen ist. Die Präanalsklerite sind schlank und spitz und in den Proportionen wie bei ssp. *euterpe*. Der Außenteil der oberen Anhänge ist kurz dreieckig, der Dorn innen an der Oberkante sehr klein. Der obere Teil der unteren Anhänge ist relative flach und nich so stark nach dem unten gerümmt wie bei den anderen bekannten Unterarten."

Polycentropus maglic Oláh, sp. nov.

(Figures 1–4, Map 1)

Material examined. Holotype: **Bosnia & Herzegovina**, Maglic Mountains, Sutjeska National Park, 1–2.IX.1988, leg. J. Oláh (1 male, OPC). Paratype: same as holotype (1 male, OPC).

Diagnosis. This new sibling species in the *Polycentropus ierapetra* species complex having paraproct complete with dorsal and ventral branches has resemblance to *Polycentropus slovenicus* Malicky, 1998, but differs by the longer and slender ventral branch of the paraproct and the bilobate lateral profile of the gonopod has the dorsal lobe shorter, not longer than its ventral lobe.

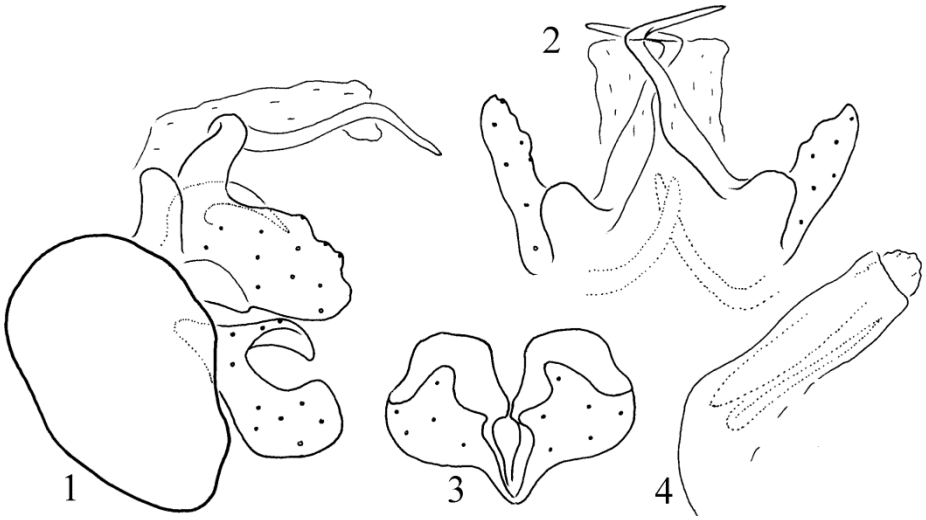
Description. Light brown animal. Length of forewing 6 mm. Segment IX composed of heavily sclerotized and fused sternum and pleuron with almost regular ovoid lateral profile as well as by a pair of digitiform sclerotized structure, remnant of tergum IX partially adhered to the cercal-paraproctal complex. Segment X membranous structure covering the cercal-paraproctal complex. Cercal-paraproctal complex forms a pair of large, elongated ovoid cerci and larger dorsal and smaller ventral branches of paraproct. Gonopods typically bilobate, particularly constructed as detailed in the lateral and ventral views of drawings.

Etymology. Named after the locus typicus, a noun in apposition.

Polycentropus milikuri Malicky, 1975

(Map 1)

Polycentropus milikuri Malicky, 1975:84–85: „Holotypus ♂ und Allotypus ♀: Zypern, Troodos-Gebirge, südlich von Milikuri, 600 m, 1.5.1974, leg. Malicky & Wagner, in meiner Sammling." „Vom allgemeinen Bau der *P. ierapetra*-Verwandt



Figures 1–4. *Polycentropus maglic* Oláh, sp. nov. Holotype male: 1 = genitalia in left lateral view; 2 = genitalia in dorsal view; 3 = gonopods in ventral view; 4 = phallic organ in left lateral view.

schaft, mit folgenden Besonderheiten: Präanalsklerite im basalen Drittel schulterartig abgesetzt, Endteil rechtwinklig abgebogen und nach schräg unten-aussen gerichtet. Aussenteil der oberen Anhänge oval, Innen teil tief ins Segment eingezogen und am Innenrand mit einem grossen, nach unten gebogenden Dorn. Untere Anhänge kurz, massive, mit einigen stark sklerotisierten Höchern in der Anordnung nach Abb. 10/1,2 und 5."

Polycentropus septentrionalis Kumanski, 1986, stat. nov.

(Map 1)

Polycentropus ierapetra septentrionalis Kumanski, 1986:185–186: „Bulgaria, Struma valley, realway station Stara Kresna, 10.VI.1975; Sestrimo village, the foothills of Ograzhden Mt. 19.IX.1981; Rhodopes Mts., Lukovitza river, above Asenograd, 8.VIII. 1983; Strandzha Mt. Ropotamo river, 2 km above Krushevetz village, 4.VIII.1981; Eastern part of the Stara planina Mt, Kamtsia river, 2 km from the Kamtshia barrage, 15.VI.1984. Holotype chosen among the specimens from the Rhodopes." „The new species is closely related to the nominal form, but resembling the other subspecies to a lesser extent. It is the only form of this species with the inner spine of the superior appendages set not at their dorsal margin, but somewhat lower. Feebly developed inner basal part of the superior appendages and the strongly curved dorsal thorns are features relating the most distantly distributed subspecies – *P. i. ierapetra* Mal. and *P. i. septentrionalis* n. subsp. Surprisingly, the other subspecies, though inhabiting areas between Crete and Bulgaria, seems to be not so close to the new subspecies."

Material examined. **Bulgaria**, Eastern Rhodopi Mts, below Komuniga Village, 494m, N41°47' 46"; E25°12' 06" 12.VI.2018, leg. S. Beshkov, B. Zlatkov, R. Bekchiev (2 males, OPC). Bulgaria, Eastern Rhodopi Mts, below Komuniga Village, 494m, N41°47'46"; E25°12' 06" 14.VI.2018, leg. S. Beshkov, B. Zlatkov, R. Bekchiev (1 male, OPC). Bulgaria, Eastern Rhodopi Mts, Borovitza Valley, between Duzhdovnitza and Pudartzi, 359m, N41.68591°; E25.282159°, 13.VI.2018, leg. S. Beshkov, B. Zlatkov, R. Bekchiev (6 males, OPC). **Macedonia**, Pelister Mts, Planinarski Dom „Shiroka", 1955m, N41°00'17"; E21°10' 07", 6.VIII.2016, leg. S. Beshkov & A. Nahirnic (1 male, OPC).

Polycentropus slovenica Malicky, 1998 stat. nov.

(Map 2)

Polycentropus ierapetra slovenica Malicky, 1998:326-328: „Holotypus: ♂, Slowenien, Mlini, Sočerga, 29.VI.1990, leg. C. Krušnik, in meiner Sammlung." „Habitus wie üblich, Vorderflügellänge 6 mm. Kopulationsarmaturen: Der Distalteil der Dorsal-

stäbe ist relativ lang, nach unten geknickt und in sich bogenförmig verdreht, so wie bei der Nominatform und bei subsp. *anatolica*. Die unteren Anhänge haben in Lateralansicht einen schlanken, geraden Dorsallappen, der in Ventralansicht rundlich aussieht, und einen deittlich kürzeren Ventrallapen. Der Innenast der Präanalanhänge ist kurz, aus breiter Basis scharf zugespitzt und nach unten gebogen. Er entspringt an der Ventralkante des Anhanhgs und ist deutlich kürzer als bei den Unterarten *dirfis*, *ikaria* und *anatolica*."

Polycentropus staraplanina Oláh, sp. nov.

(Figures 5–7, Map 1)

Material examined. Holotype: **Bulgaria**, W. Stara Planina Mts, above Gorni Lom Village, on Lyava Reka, the road to Martinovo, N43.42714°, E022.74467°, 13.IX.2021, 795 m, leg. S. Beshkov & A. Nahirnić-Beshkova (1 male, OPC). Paratypes: same as holotype (2 males, OPC).

Diagnosis. This new sibling species in the species complex having paraproct incomplete with dorsal branches only has resemblance to *Polycentropus septentrionalis* Kumanski, 1986. Differs from it by the low and regularly tapering cerci the bilobed lateral profile of the gonopod less excised as well as its ventral and ventrocaudal pattern is completely different.

Description. Light brown animal. Length of forewing 7 mm. Segment IX composed of the heavily sclerotized and fused sternum and pleuron with slightly parallel-sided lateral profile as well as by a pair of digitiform sclerotized structure, remnant of tergum IX partially adhered to the cercal-paraproctal complex. Segment X membranous structure covering the cercal-paraproctal complex. Cercal-paraproctal complex forms a pair of large, elongated and tapering cerci and larger broad-based dorsal branches of paraproct; ventral branches of paraproct reduced almost lacking. Gonopods typically bilobed particularly constructed as detailed in the lateral and ventral views of drawings.

Etymology. Named after the locus typicus, a noun in apposition.

Hydropsychidae Curtis,1835

Diplectrona albanica Oláh, 2020

Material examined. **Albania**, Korçë county, Kolonjë municipality, Leskovik, roadside spring W of the town, 575 m, N40.14503° E20.57265°, 30.IV.2021, leg. T. Kovács, D. Murányi, P. Olajos (1 male, OPC).

Hydropsyche bulbifera McLachlan, 1878

Material examined. **Albania**, Korçë county, Maliq municipality, Zëmblak, Devoll River N of the village, 830 m, N40.70804° E20.87123°, 28.IV.2021, leg. T. Kovács, D. Murányi & P. Olajos (6 males, 1 female; OPC).

Hydropsyche tabacarui Botosaneanu, 1960

Material examined. Bulgaria, Rila Mts, above Rila Monastery, Kirilova polyana, 1488m, N42.15519, E23.40036 18.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC).

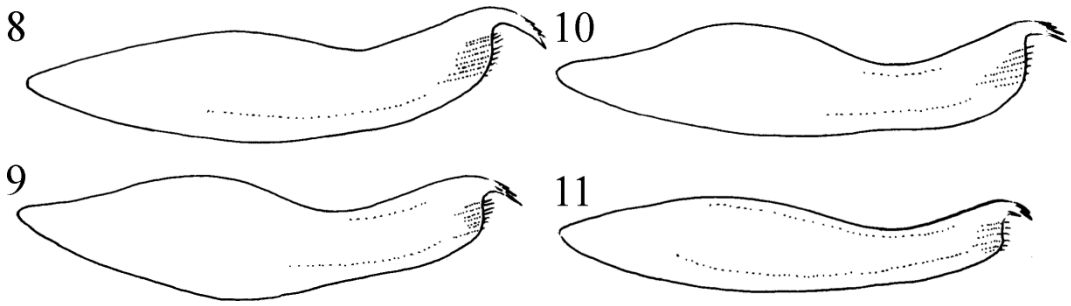
Rhyacophilidae Stephens,1836

Rhyacophila balcanica new species complex

(Map 3)

This new species complex belongs to the *Rhyacophila vulgaris* species group. Its species have medium-sized body and marble forewing pattern. Segment IX with abbreviated ventrum and elongated median dorsoapical lobes. Cerci fused dorsally to segment X forming together a trilobed apical ending; ventral arm of segment X slim attached to epiproct (anal sclerite of Schmid), paraproct (apical band of Schmid) well developed, membranous. Second segment of gonopod, the harpago is small. Phallic organ composed of phallotheca without dorsal process, membranous endotheca, simple and tube-like aedeagus and robust, pronounced variously modified pair of parameres. At present four species belong to this new species complex: *Rhyacophila albanica* sp. nov., *R. balcanica* Radovanović, 1953, *R. montenegra* sp. nov., *R. syrikaltera* sp. nov.

Figures 5–7. *Polycentropus staraplanina* Oláh, sp. nov. Holotype male: 5 = genitalia in left lateral view; 6 = gonopods in ventral view; 7 = phallic organ in left lateral view.



Figures 8–11. *Rhyacophila albanica* Oláh & Ibrahimi sp. nov. Holotype male: 8 = left paramere in left lateral view, Albania, Bulqizë; Paratypes: 9 = left paramere in left lateral view, Albania, Bulqizë; 10 = left paramere in left lateral view, Albania, Skrapar; 11 = left paramere in left lateral view, Albania, Schmid drawing.

Rhyacophila albanica Oláh & Ibrahimi sp. nov.

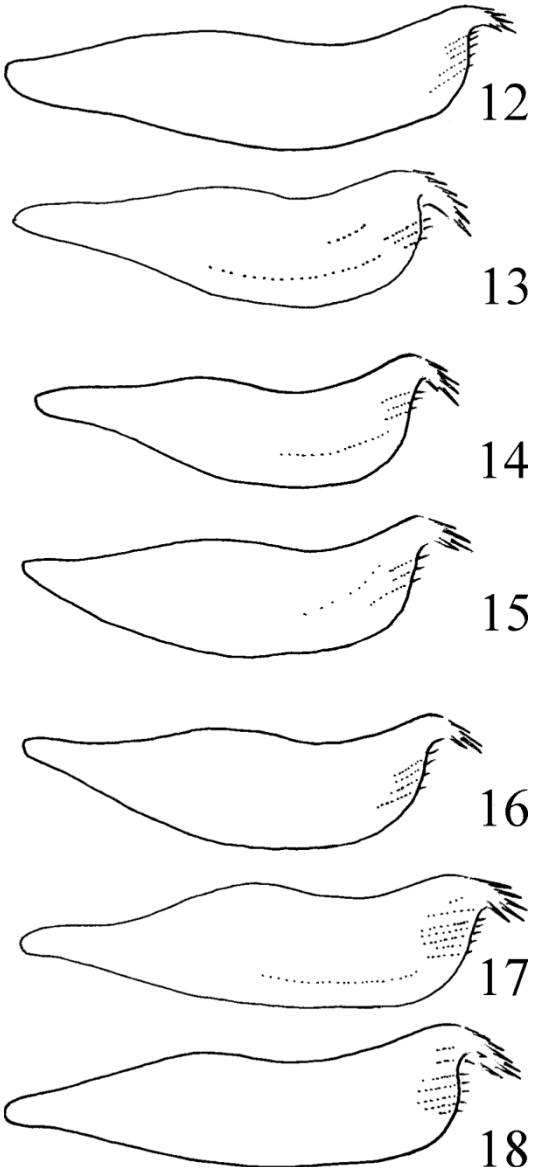
(Figures 8–11, Map 3, Photo 1)

Rhyacophila balcanica Radovanović, 1953. Schmid 1970:120 „(Macédoine, Albanie)", Pl. IX, fig. 1–2. Misidentification.

Material examined. Holotype: **Albania**, Bulqizë district, Çermenikë Mts, Ballenjë, open stream, N41°21.621', E20°14.472', 1365 m, 20.VI.2012, UV light, leg. Z. Fehér, T. Kovács, D. Murányi (1 male, OPC). Paratypes: same as holotype (1 male, 1 female; OPC). Albania: Skrapar district, Ostrovicë Mts, Backë, brook and spring NE of the village, N40°31.346' E20° 25.096', 1650 m, 12.X.2012, leg. P. Juhász, T. Kovács, D. Murányi, G. Puskás (1 male, OPC). Albania Tomorr Mountains. Stream nearby the Hotel Perla N40.63152°, E20.19809°, 1336 m, 15.IX.2019. leg. H. Ibrahimi, A. Bilalli, M. Musliu. (2 males, DBFMNSUP).

Diagnosis. This incipient sibling species is diverged and delineated by the lateral shape of the paraproct. Closest to *Rhyacophila balcanica*, but the apical half of the paramere is low (narrow), not as high (wide) as in *balcanica* as well as the mesad turning dorsoapical spinose process more slender.

Description. Medium sized species with marble wing pattern and forewing length of 17 mm. Segment IX with abbreviated ventrum and elon-



Figures 12–18. *Rhyacophila balcanica* Radovanović, 1953. 12 = left paramere in left lateral view, Bosnia-Herzegovina, Kadino Selo; 13 = left paramere in left lateral view, Bosnia-Herzegovina, Sutjeska; 14–15 = left paramere in left lateral view, Kosovo; 16 = left paramere in left lateral view, Macedonia; 17-18 = left paramere in left lateral view, Albania, Bjesket-Nemuna.

gated median dorsoapical lobes. Cerci fused dorsally to segment X forming together a trilobed apical ending; ventral arm of segment X slim attached to epiproct (anal sclerite of Schmid), paraproct (apical band of Schmid) well developed, membranous. Second segment of gonopod, the harpago is small. Phallic organ composed of phallotheca without dorsal process, membranous endotheca, simple and tube-like aedeagus and robust, pronounced variously modified pair of parameres.

Photo 1. Locus typicus of *Rhyacophila albanica* Oláh & Ibrahimi sp. nov. (D. Murányi)

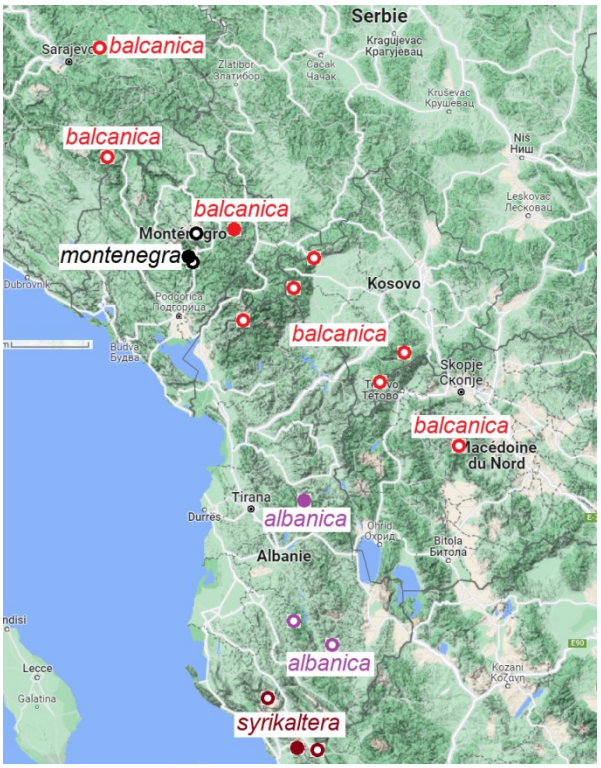
Etymology. Named after the locus typicus.

***Rhyacophila balcanica* Radovanović, 1953**

(Figures 12–18, Map 3)

Rhyacophila balcanica Radovanović, 1953:39. From the German summary: „Fundort: ein Männchen auf dem Bjelassitza-Gebirge in Montenegro (am 12. VIII. 1948).” Translation from the original Serbian text: the Type locality in Bjelasica Mts. at Sisko Jezero Lake, nearby Biogradska Gora.

Material examined. **Albania**, Bjeshkët e Nemuna Mts (=Prokletije Mts), Shala valley, Theth village, Okol hamlet, N42°24’48”, E19°45’37”, 840 m, 15.VIII.2018, leg. S. Beshkov & A. Nahirnic (2 males, OPC). **Bosnia-Herzegovina**, Kadino Selo, Mokro Krzulj Potok, N43.93168° E18.64548°, 12.VII.2008, leg. M. Bálint & S. Lelo (1 male HNHM). Sutjeska National Park, spring stream, 2.IX.1988, leg. J. Oláh (1 male, OPC). **Kosovo**, Novosellë (Novoselo), Drini i Bardhë spring (Beli Drim spring) (580 m) [in and around the spring and the outlet stream, limestone rocks, caves and karstic forest], N42°44.239’ E20°18.408’, 12.X.2005, leg. T. Deli, V. Erőss,



Map 3. Distribution of the new *Rhyacophila balcanica* species complex

V. Fehér & D. Murányi (2 males, 1 female, HNHM). Sharr Mountains, Prizren – Shtërpcë road, tributary of Lepenc River, N42.17506°, E20.97593°, 1410 m, 12.VI.2013. leg. H. Ibrahimi (3 males, DBFMNSUP). Sharr Mountains, Prevallë, Lumbardhi i Prizrenit River, N42.161°, E20.9533°, 1664 m, 18.IX.2013. leg. H. Ibrahimi. (2 males, DBFMNSUP). Kosovo, Bjeshkët e Nemuna Mountains, Lloqan Mountain, above Lloqan Village, middle section of the Lloqan River, N42.5518°, E20.1624°, 1333 m, 13.VI. 2014. leg. H. Ibrahimi (1 male, DBFMNSUP). **Macedonia**, Vardar region, Jakupica Mts, Nežilovo, Babuna Spring NW of the village, N41° 41.417' E21°24.974', 1275m, 3.X.2013, leg. T.Kovács, D.Murányi, (2 males, 2 females; OPC). Polog region, Šar Planina, Bozovce, open stream, brooks and seeps W of the village, N42°03.147', E20°46.920', 1880 m, 24.06.2014, P. Juhász, T. Kovács, D. Murányi (2 males, OPC).

New diagnosis. Species with marble wing pattern and forewing length of 19 mm. This probably ancestral incipient sibling species of the complex distributed in Bosnia-Herzegovina, Montenegro, Kosovo, Macedonia and North Albania, is diverged and delineated by the lateral shape of the paraproct. Closest to *Rhyacophila albanica* sp. nov. but the apical half of the paramere is high (wide), not as low (narrow) as in *albanica*, as well as the mesad turning dorsoapical spinose process more robust.

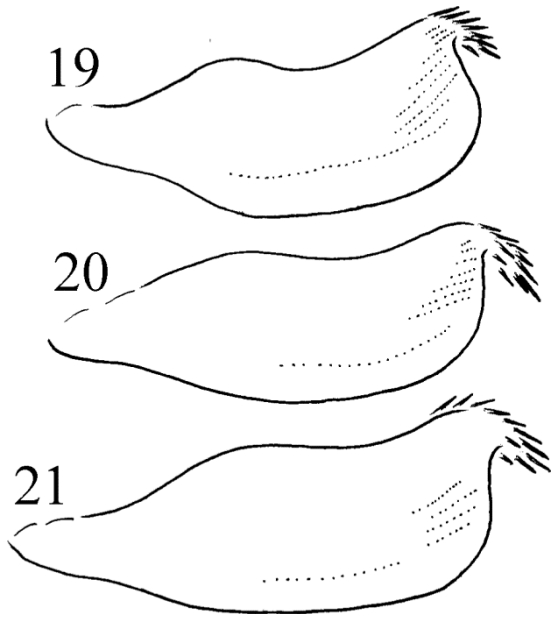
Rhyacophila montenegra Oláh, sp. nov.

(Figures 19–21, Map 3, Photos 2– 3)

Material examined. Holotype: **Montenegro**, Maganik Mts. Mrtvo Duboko, Canyon of river Mrtvica, Mrtvica, N42°43'47.2", E19°20'22.9", 7.V.2003, leg. P. Juhász, T. Kovács, V. Pešić, P. Sevola, (1 male, OPC). Paratypes: Montenegro, Kolasin municipality, Monastir Moraca, karst spring and its outlet at monastery, N42°45.942', E19°23.436', 300 m, 19.VIII.2011, UV, leg. Sz. Czigány, & D. Murányi (1 males, OPC). Sinjajevina Mts. Gornji Lipovo NW 4km, beech forest and forest brook, 1351m, N42°53.829', E19° 23.140', 11.X.2008, leg. L. Dányi, Z. Fehér, J. Kontschán & D. Murányi (1 male HNHM).

Diagnosis. This incipient sibling species is diverged and delineated by the lateral shape of the paraproct. Closest to *Rhyacophila balcanica*, but the apical two thirds of the paramere is very high (wide) as well as the mesad turning dorsoapical spinose process more produced without mesoapical spine cluster longer than the apical margin itself.

Description. Medium sized species with marble wing pattern and forewing lenght of 17 mm. Segment IX with abbreviated ventrum and elongated median dorsoapical lobes. Cerci fused dorsally to segment X forming together a trilobed apical ending; ventral arm of segment X slim attached to epiproct (anal sclerite of Schmid), paraproct (apical band of Schmid) well developed, membranous. Second segment of gonopod, the harpago is small. Phallic organ composed of phallotheca without dorsal process, membranous endotheca, simple and tube-like aedeagus and robust, pronounced variously modified pair of parameres.



Figures 19–21. *Rhyacophila montenegra* Oláh, sp. nov. Holotype male: 19 = left paramere in left lateral view, Montenegro, Maganik; Paratypes: 20 = left paramere in left lateral view, Montenegro, Sinjavevina; 21 = left paramere in left lateral view, Montenegro, Kolasin.

Etymology. Coined from the name of locus typicus, a noun in apposition.

Remarks. It requires more study, how this particularly organised paramere developed in the middle of the distributional area of the putative ancient species.

Rhyacophila syrikaltera Oláh & Ibrahimi sp. nov.

(Figures 22–24, Map 3, Photo 4)

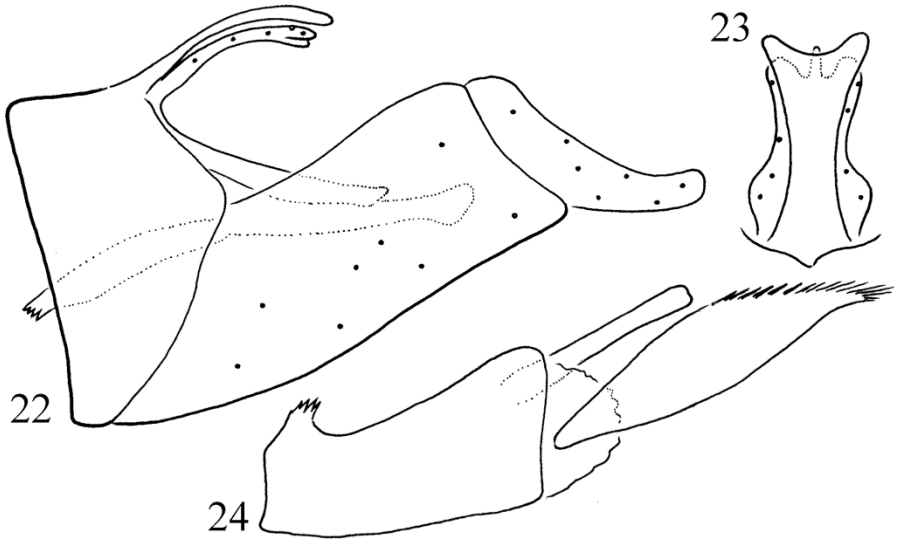
Material examined. Holotype: **Albania**, Delvina Region, Syri i Kaltër near Bistrica Village, 155 m, N39°55'23"; E20°11'30" 23.X.2017, leg. S. Beshkov & A. Nahirnic (1 male, OPC). Allotype: same as holotype (1 female, OPC). Paratype: same as holotype (1 female, OPC). Gjirokastër county, Finiq municipality, Syri i Kalter spring, N39°55'23"; E020°11'30", 155 m, 3.XI.2018, leg. S. Beshkov & A. Nahirnic (10 males, 1 female; OPC). Gjirokastër county, Tepelenë municipality, Kurvelesh, Gurrit Stream E of Progonat, 1025m, N40°12.625' E19°58.108' leg.

Photo 2. Locus typicus of *Rhyacophila montenegra* Oláh, sp. nov. in April (T. Kovács)

Photo 3. Locus typicus of *Rhyacophila montenegra* Oláh, sp. nov. in November (T. Kovács)

P. Juhász, T. Kovács, D. Murányi, 29.VI.2018 (1 male, OPC). Albania, Tepelenë district, Kurveleshi area, Progonat, Gurrit Stream spring area, E of the village, N40°12.629' E19°58.237', 1045m, 14.X.2013, leg. P.Juhász, T.Kovács, D. Murányi, G.Puskás, (3 males, 1 female; OPC). Albania: Gjirokastër county, Dropull, Drino River, 39.912978°N, 20.336181°E, 29.IX.2014, leg. H. Ibrahimi (2 males; DBFMNSUP).

Diagnosis. The smallest member of the species group, differentiated very distinctly from all the other members of the complex by the lateral shape of the paramere and especially by the development of the dorsoapical spine cluster. According to our present knowledge this most diverged



Figures 22–24. *Rhyacophila syrikaltera* Oláh & Ibrahim sp. nov. Holotype male: 22 = genitalia in left lateral view 23 = genitalia in dorsal view; 24 = phallic organ in left lateral view.

Photo 4. Locus typicus of *Rhyacophila syrikaltera* Oláh & Ibrahim sp. nov. (G. Puskás)

member of the species complex is organised in the southern margin or tip of the distributional area of the species complex.

Description. Medium sized species with marble wing pattern; forewing length 16 mm. Segment IX with abbreviated ventrum and elongated median dorsoapical lobes. Cerci fused dorsally to segment X forming together a trilobed apical ending; ventral arm of segment X slim attached to epiproct (anal sclerite of Schmid), paraproct (apical band of Schmid) well developed, membranous. Second segment of gonopod, the harpago is small. Phallic organ composed of phallotheca without dorsal process, membranous endotheca, simple and tube-like aedeagus and robust, pronounced variously modified pair of parameres.

Etymology. Coined from the name of locus typicus, a noun in apposition.

***Rhyacophila biegelmeieri* Malicky, 1984**

Material examined. **Albania**, Librazhd Region, Shkumbini River Valley, near Qukës, 287m, N41.1458°, E20.3766°, 29.X.2018, leg. S. Beshkov & A. Nahirnic (15 males, OPC). **Montenegro**, Moraca River Valley, near Bioce Village, N42.52733°, E019.35492°, 195m, 6.X.2019, leg. S. Beshkov & A. Nahirnic (4 males, OPC).

***Rhyacophila brevifurcata* Kumanski, 1986**

Material examined. **Serbia**, Pčinja district, Bosilegrad municipality, Besna Kobila Mts, Crna Stream W of Musulj, N42.51688°, E22.24835°, 1210 m, 25.IX.2021, leg. P. Juhász, T. Kovács, D. Murányi (3 males, 1 female; OPC). Pčinja district, Vranje municipality, Besna Kobila Mts, forest brook along Ruski Put, 1460 m, N42.53206°, E22.20277°, 25.IX.2021, leg. P. Juhász, T. Ko-

vács & D. Murányi (1 male, OPC). Pirot district, Pirot municipality, Stara Planina, forest seeps N of Jelovica, 950 m, N43.23212°, E22.84662°, 24.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (3 males, 2 females; OPC)

Rhyacophila bosnica new species complex

(Map 4)

This new species complex in the *R. tristis* species group of the *R. invaria* arm in the *R. philopotamoides* branch is established here with five species: *R. bosnica* Schmid, 1970, R. *cibinensis* Botosaneanu & Marinković, 1967, *R. kozara* sp. nov., *R. sarplana* sp. nov., *R. staraplana* sp. nov. However, perhaps many more species are waiting to be collected and described in the isolated Balkan mountain ranges. Divergences among incipient sibling species of the *R. bosnica* complex are well discernible in the lateral profile of the head of the dorsal arm of segment X. However, there are definite shape divergences in the dorsal profile of the fused head of the dorsal arm of segment X, but difficult to draw due to the extreme sensitivity of the observational angle. There are discernible divergences in the structure of the lateral and ventral profiles of the aedeagus, but difficult to expose free as well as the membranous endotheca and the mostly membranous paramere and the membranous ventral lobe of aedeagus liable to shape distortion due to copulatory activities or to clearing and cleaning preparatory processes.

Rhyacophila bosnica Schmid, 1970

(Map 4)

Rhyacophila bosniaca Botosaneanu & Marinković, 1967:1145–1147. (**Nomen nudum**). „La description d'une nouvelle espèce de Vucialuka, Bosnie (*bosniaca* Schmid) n'est pas encore publiée au moment où nous écrivons ces lignes, mais nous avons pu en prendre connaissance grâce aux dessins que M. le Dr F. Schmid a eu l'amabilité de nous confier. Or, l'un de nous (M. Marinković) ayant capturé en Bosnie (24 mars 1957, Chavnitzi, Mt Bjelachnitza = Bjelače), plusieurs exemplaires ♂ de cette espèce, nous sommes en mesure d'en figurer l'armature génitale (fig. 1) et de la comparer à celle d'une nouvelle espèce fort voisine que nous décrirons (*R. cibinensis*, n. sp.)."

Map 4. Distribution of the new *Rhyacophila bosnica* species complex

Rhyacophila bosnica Schmid, 1970:161: „Holotype ♂: Yougoslavie, Bosnie, Vućjaluka = Vučja Luka." Cette espèce est étroitement apparentée à *cibinensis*, dont elle ne se distingue que par quelques détails de la forme du Xe segment et des appendices inférieurs."

Remarks . We had no access to type or any other specimens to examine the nominate species of this new species complex. However, there are excellent drawings published by Botosaneanu & Marinković (1967) and by Schmid (1970) available to compare with the three new species.

Rhyacophila cibinensis Botosaneanu & Marinković, 1967

(Map 4)

Rhyacophila cibinensis Botosaneanu & Marinković, 1967:1147–1149: „Matériel, localités. Le 19 mai 1963, 5♂ et 3♀ (leg. B. Kis) furent capturés à Paltini = Păltiniș, près de deux affluents du Rîul Mare; cette localité est située dans les Monts de Cibin, Carpates méridionales, 1400 m alt. environ, plus loin de Sibiu (Hermannstadt). Holotype ♂ et allotype ♀ dans la collection Botosaneanu, les paratypes ♂ et ♀ sont gardés dans les collections Botosaneanu, Marinković et Schmid."

Material examined. **Romania**, Parâng Mts. to Gilcescu Lake = Gâlcescu Lake, N45.38°, E23.62°, 1490 m a.s.l., 3.VI.2007. leg. Bálint, Thessinger & Taubmann (1 male, OPC).

Rhyacophila kozara Oláh, sp. nov.

(Figure 25, Map 4)

Rhyacophila bosnica Schmid, 1970: Oláh & Kovács, 2015:107. Misidentification.

Material examined. Holotype: **Bosnia & Herzegovina**, Banja Luka region, Kozara Mts. Kozarac, forest stream above the city, 410 m, N44°59.920', E16°52.868', 16.III.2012, leg. T. Kovács, D. Murányi, & G. Puskás (1 male, OPC). Paratype: same as holotype (6 males, OPC).

Diagnosis. According to the lateral profile of the complex of segment X, paraproct and epiproct this new species is most close to the nominate species, *R. bosnica* Schmid, 1970. described from Vućjaluka, and drawn also from Bjelasnica Mt. (Botosaneanu & Marinković 1967) both localities are more south in Bosnia & Herzegovina compared to Kozara Mts. *R. kozara* sp. nov. differs by its shorter lobe of the harpago and longer dorsal process of the phallotheca. The most striking and stable divergence is detectable in the lateral profile of the complex of segment X, paraproct and epiproct, especially the fused dorsal arm of segment X. Apex of this arm produced posterodorsad, not anterodorsad.

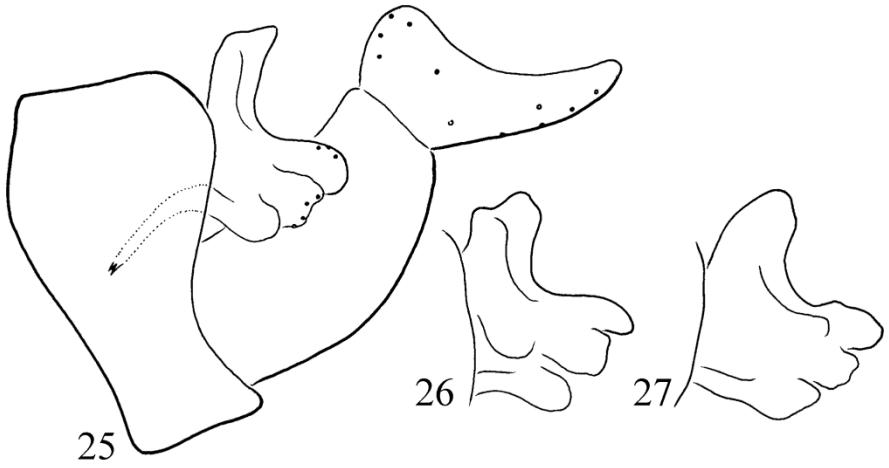
Description. Medium sized species without discernible forewing pattern in alcohol; forewing length 12 mm. Segment IX with abbreviated ventrum and elongated dorsum. The fused complex of segment X, paraproct (U-shaped apical band) and epiproct (anal sclerite) exhibit well discernible divergence in the posterodorsad produced head of the dorsal arm of segment X in lateral view. Second segment of gonopod, the harpago with elongated ventral lobe. Phallic organ composed of phallotheca (phallobase) with rather long dorsal process, membranous endotheca, less sclerotized, almost membranous paramere and the aedeagus with membranous ventral lobe and the slightly sclerotized dorsal lobe of ejaculatory duct.

Etymology. Coined from the name of locus typicus, a noun in apposition.

Rhyacophila sarplana Oláh, sp. nov.

(Figure 26, Map 4, Photo 5)

Material examined. Holotype: **North Macedonia**, Polog region, Tetovo municipality, Šar Planina, Bozovce, open stream above the village, N42.05023°, E20.78765°, 1750 m, 26.IV.2021, leg. T. Kovács, D. Murányi & P. Olajos (1 male, OPC). Paratype: same as holotype (1 male, OPC). **Albania,** Tropojë district, Tropojë, Bjeshkët e Nemuna Mts. (=Prokletije Mts), open stream on Mt. Callumit above the town, N42.498620° E20.124430°, 1970 m, 7.VII.2009, leg. Z. Barina, D. Pifko, G. Runk (1 male, HNHM).



Figures 25–27. *Rhyacophila kozara* Oláh, sp. nov. Holotype male: 25 = genitalia in left lateral view. 26 = *Rhyacophila sarplana* Oláh, sp. nov. Holotype male: segment X and paraproct, epiproct complex; 27 = *Rhyacophila staraplana* Oláh, sp. nov. Holotype male: segment X and paraproct, epiproct complex

Photo 5. Locus typicus of *Rhyacophila sarplana* Oláh, sp. nov. (T. Kovács)

Diagnosis. According to the lateral profile of the complex of segment X, paraproct and epiproct this new species is distinguished from all the others by the bilobate lateral profile of the head of the dorsal arm of segment X.

Description. Medium sized species without discernible forewing pattern in alcohol; forewing length 11 mm. Segment IX with abbreviated ventrum and elongated dorsum. The fused complex of segment X, paraproct (U-shaped apical band) and epiproct (anal sclerite) exhibits well discernible divergence in the bilobed produced that is the concave head dorsum of the dorsal arm of segment X in lateral view. Second segment of gonopod, the harpago with elongated ventral lobe. Phallic organ composed of phallotheca (phallobase) with short and stout dorsal process, membranous endotheca, less sclerotized, almost membranous paramere and the aedeagus with membranous ventral lobe and the slightly sclerotized dorsal lobe of ejaculatory duct.

Etymology. Coined from the name of locus typicus, a noun in apposition.

***Rhyacophila staraplana* Oláh, sp. nov.**

(Figure 27, Map 4)

Material examined. Holotype: **Serbia**, Stara Planina Mts, Crni Vrh, Košarište NE 720 m, stream, N43°25’20.1”, E22°35’55.4”, 1115 m, 23.05.2017, P. Juhász, T. Kovács, P. Olajos (1 male, OPC). Paratypes: same as holotype (1 male, 2 females; OPC).

Diagnosis. According to the lateral profile of the complex of segment X, paraproct and epiproct this new species is distinguished from all the others by the bilobate lateral profile of the head of the dorsal arm of segment X.

Description. Medium sized species without discernible forewing pattern in alcohol; forewing

length 12 mm. Segment IX with abbreviated ventrum and elongated dorsum. The fused complex of segment X, paraproct (U-shaped apical band) and epiproct (anal sclerite) exhibits well discernible divergence in the monolobate head dorsum of the dorsal arm of segment X with middle produced lobe in lateral view. Second segment of gonopod, the harpago with elongated ventral lobe. Phallic organ composed of phallotheca (phallobase) with long dorsal process, membranous endotheca, less sclerotized, almost membranous paramere and the aedeagus with membranous ventral lobe and the slightly sclerotized dorsal lobe of ejaculatory duct.

Etymology. Coined from the name of locus typicus, a noun in apposition.

Rhyacophila diakoftensis **Malicky, 1983, in Cakin & Malicky, 1983**

Material examined. **Albania**, Berat Region, between Ibrolara and Vale, Polican distr., 217m, N40°33'36"; E020°05'38", 16.X.2016, leg. S. Beshkov & A. Nahirnic (1 male, 1 female; OPC). Albania, Gjirokastër Region, Këlcyrë (Klisura) Gorge on Aoos (Vjosa) River near Këlcirë (Klisura) Village, N40.29646°, E020.16260°, 176m, 3.X.2019, leg. S. Beshkov & A. Nahirnic (4 males, 16 females; OPC).

Remarks. The presence of additional setae on parameres is not indicated nor mentioned in the original species drawings and description. Moreover, the absence of additional setae is mentioned and emphasized at *R. diakoftensis* by the author when compared it with his new species *R. biegelmeieri* Malicky, 1984. All the five males of *R. diakoftensis* examined from Albania have additional setae on the parameres subapicad and ventromesad. The sibling species *R. neretva*, *R. nyurga* and *R. pascoei* all have small cluster of additional setae on parameres subapically ventromesad beside the large apical seta. The presence of additional setae was probably overlooked, in the original species description of *R. diakoftensis*.

Rhyacophila fischeri **Botosaneanu, 1957**

Material examined. **Bulgaria**, Eastern Rhodopi Mts, Hambar Dere near Strazhetz, 569m, N41°21'08", E25°50'35" 15.V.2018, S. Beshkov, leg. B. Zlatkov, R. Bekchiev (4 males, OPC). W Stara Planina Mts. Gushovski Monastir above Tchiprovtzi Town, N43.3661°, E22.8402°, 808 m, 26.VI.2021, leg. S. Beshkov & A. Nahirnic-Beshkova (1 male, OPC). **Serbia**, Preshevo distr., above Trnava Village, 800m, N42°16'18"; E21° 36'47" 09.VII.2016, leg. S. Beshkov & A. Nahirnic (1 male, OPC).

Rhyacophila kimminsiana **Botosaneanu, 1958**

Material examined. **Romania**, Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 29.VI.2016, singled leg. J. Oláh & J. Oláh jr. (6 males, OPC). Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 30.VI.2016, singled leg. J. Oláh & J. Oláh jr. (1 male, OPC). Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 30 VI.2016, light trap leg. J. Oláh & J. Oláh jr. (1 female, OPC).

Rhyacophila loxias **Schmid, 1970**

Material examined. **Bulgaria**, Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469m, N42.20767°, E023.55093°, 21.7.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (2 males, OPC). W Stara Planina Mts. Gushovski Monastir above Tchiprovtzi Town, N43.3661° E22.8402°, 808 m, 26.VI.2021, leg. S. Beshkov & A. Nahirnic-Beshkova (1 male, OPC).

Rhyacophila mocsaryi **Klapálek, 1898**

Material examined. **Bulgaria**, Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469m, N42.20767°, E023.55093°, 21.7.2020, leg.S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC). **Romania**, Lotru Mts, Obirsia Lotrului, dawn swarm along Lotru River, 30.VI.2016 singled leg. J. Oláh & J. Oláh jr. (1 female, OPC).

***Rhyacophila motasi* Botosaneanu, 1957**

Material examined. **Romania**, Apuseni Mts., Vladeasa Mt., Stâna de Vale, upper section of Ciripa stream, N46°40.546', E22°38.515', 1360 m, 6.VII.2016, leg. J. Kecskés (20 males, 2 females; OPC).

***Rhyacophila neretva* Oláh, 2016, in Olah & Beshkov, 2016**

Material examined. **Montenegro**, Moraca River Valley, near Bioce Village, N42.52733°, E19.35492°, 195m, 6.X.2019, leg. S. Beshkov & A. Nahirnic (4 males, OPC).

***Rhyacophila nubila* Zettwerstedt, 1840**

Material examined. **Albania**, Korçë Region, Dardha, 1276m, N40°31'34", E020°49'33", 26.6. 2017 meadow near stream with *Salix, Fagus* forest and hill with *Astragalus*, lamps, light traps leg. S. Beshkov & A. Nahirnic (1 male, OPC). Librazhd Region, Shkumbini River Valley, near Qukes, 287m, N41.1458°, E020.3766°, 29.X. 2018, leg. S. Beshkov & A. Nahirnic (11 males, 8 females; OPC).

***Rhyacophila obtusa* Klapálek, 1894**

Material examined. **North Macedonia**, Southwestern region, Vevčani municipality, Jablanica, Vevčani, forest stream above the village, 1190 m, N41.23257°, E20.57229°, 28.IV.2021, leg. T. Kovács, D. Murányi & P. Olajos (4 males, OPC). **Serbia**, Pirot district, Pirot municipality, Stara Planina, forest seeps N of Jelovica, 950 m, N43.23212°, E22.84662°, 24.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (6 males, 2 females; OPC)

***Rhyacophila polonica* McLachlan, 1879**

Material examined. **Bulgaria**, Sofia Region, near Beli iskar village, Rila Mts. N42.20766°, E23.55083°, 1468 m, 28.VII.2020, leg. D. Kaynarov (40 males, 1 female; OPC).

***Rhyacophila torrentium* Pictet, 1834**

Material examined. **Bulgaria**, Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469m, N42.20767°, E23.55093°, 21.7.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC).

***Rhyacophila trescavicensis* Botosaneanu, 1960**

Material examined. **North Macedonia**, Southwestern region, Vevčani municipality, Jablanica, Vevčani, forest stream above the village, 1190 m, N41.23257°, E20.57229°, 28.IV.2021, leg. T. Kovács, D. Murányi & P. Olajos (1 male, OPC).

***Rhyacophila tristis* Pictet, 1834**

Material examined. **Albania**, Korçë Region, Dardha, 1276m, N40°31'34", E20°49'33", 26.VI. 2017 meadow near stream with *Salix, Fagus* forest and hill with *Astragalus*, lamps, light traps leg. S. Beshkov & A. Nahirnic (1 male, 1 female; OPC). **Romania**, Vâlcea county, Parâng Mts, Obrâşia Lotrului, open spring area, 500 m along Transalpina (67C) road, downstream from N45° 22'27.7", E23°39'4.0", 1915 m, 30.VI.2016, leg. J. Oláh & J. Oláh jr. (7 males, 2 females; OPC). Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 30.VI.2016, singled leg. J. Oláh & J. Oláh jr. (6 males, 3 females; OPC). Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 29.VI. 2016, singled leg. J. Oláh & J. Oláh jr. (8 males, 3 females; OPC). Vâlcea county, Parâng Mts, Obrâşia Lotrului, forested side stream at the forest line, 30.VI.2016, leg. J. Oláh & J. Oláh jr. (8 males, 5 females; OPC). Apuseni Mts., Vladeasa Mt., Stana de Vale, upper section of Ciripa stream, N46°40.546', E22°38.515', 1360 m, 6. VII.2016, leg. J. Kecskés (7 males, 8 females; OPC).

Glossosomatidae Wallengren, 1891

***Agapetus krawanyi* Ulmer 1938**

Material examined. **Serbia**, Svrljig municipality, Svrljishki Timok River Gorge, near Nish

evac village, 430m N43°28'15", E022°05'27", 30.V.2018, leg. S. Beshkov, A. Nahirnic, C. Plant & P. Jaksic (1 male, OPC).

***Agapetus ochripes* Curtis 1834**

Material examined. **Bulgaria**, W. Stara Planina Mts, Zarezan Tcheshma above Tchuprene on Tchuprenska Reka river, 674m, N43.4874°, E22.6154°, 24.VI.2021, leg. S. Beshkov & A. Nahirnić-Beshkova (1 male, OPC).

***Agapetus rectigonopoda* Botosaneanu 1957**

Material examined. **Macedonia**, Mt. Suva Planina, Kozjak Venec, N41°53'27", E21°13'26", 1070m, 21.VII.2018, leg. S. Beshkov (1 male, OPC).

***Glossosoma bifidum* McLachlan, 1879**

Material examined. **Albania**, Delvina Region, Syri i Kalter near Bistrica Village, 155 m, N39° 55'23", E20°11'30" 23.X.2017, leg. S. Beshkov & A. Nahirnic (2 males, 1 female; OPC). Albania, Gjirokastër county, Finiq municipality, Syri i Kaltër spring, N39°55'23", E20°11'30", 155 m, 6.VIII.2018, leg. S. Beshkov & A. Nahirnic (9 males, OPC).

***Glossosoma conformis* Neboiss, 1963**

Material examined. **Bulgaria**, W. Stara Planina Mts, Zarezan Tcheshma above Tchuprene on Tchuprenska Reka reiver, 674m, N43.4874°, E22.6154°, 24.VI.2021, leg. S. Beshkov & A. Nahirnić-Beshkova (8 males, OPC).

***Glossosoma discophorum* Klapálek, 1902**

Material examined. **Albania**, Gjirokastër county, Finiq municipality, Syri i Kaltër spring, N39°55'23", E20°11'30", 155 m, 6.VIII.2018, leg. S. Beshkov & A. Nahirnic (1 male, OPC).

Phryganeidae Leach, 1815

***Agrypnia varia* Fabricius, 1793**

Material examined. **Albania**, Prespa Lake, near Pustets Village, 849m., N40°46'14", E20° 54'32", 19.VIII.2017, *Typha, Phragmitis, Mentha*, lake shore, lamps, light traps leg. S. Beshkov & A. Nahirnic (7 males, 10 females; OPC). **Bulgaria**, Sofia Region, Dragoman distr., Tchepun Hill, below Petrovski Krust summit, 1167m, 14.VIII.2020, N42.94797°, E22.95211°, leg. at light S. Beshkov (10 male, 5 females; OPC). **Macedonia**, Galichitza Mts, between Dvata Yavora and Bulgarska Tchuka Top, 1587m, N40° 59'27", E20°51'28" 03.VII.2016, leg. S. Beshkov & A. Nahirnic (2 male, 1 female; OPC).

***Phryganea ochrida* Malicky, 1975**

Material examined. **Macedonia**, Pelister-Prespa Lake, Slivnitsa Village-Sveta Bogoroditsa Monastery, N40°58'06", E21°05'30", 1135m, 07.VIII.2016, leg. S. Beshkov, A. Nahirnic, B. Zlatkov (2 males, OPC). **Albania**, Prespa Lake, near Pustets Village, 849 m., N40°46'14", E20° 54'32", 19.VIII.2017, *Typha*, *Phragmitis*, *Mentha*, lake shore, lamps, light traps leg. S. Beshkov & A. Nahirnic (5 males, 2 females; OPC).

Brachycentridae Ulmer, 1903

***Brachycentrus montanus* Klapálek, 1892**

Material examined. **Bulgaria**, Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469m, N42.20767°, E023.55093°, 21.7.2020, leg.S. Beshkov, A. Nahirnic & D. Kaynarov (12 males, 15 females; OPC).

Uenoidae Iwata, 1927

***Thremma anomalum* McLachlan, 1876**

Material examined. **Serbia**, Moravica district, Ivanjica, Golija Mts, forest stream and its sidebrook along road No.197, 1500m, N43° 20.289', E20°15.059', leg. P. Juhász, T. Kovács & D. Murányi, 26.VI.2018 (1 male, OPC). Zaječar district, Knjaževac municipality, Stara Planina, open brooks on Mt. Midžor, 1885 m, N43.39002°, E22.67431°, 23.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (3 males, 1 female; OPC).

Lepidostomatidae Ulmer, 1903

***Crunoecia monospina* Botosaneanu, 1960**

Material examined. **Serbia**, Zaječar district, Knjaževac municipality, Stara Planina, forest brook E of Mt. Babin zub, 1535 m, N43.38057°, E22.63269°, 23.IX.2021, leg. T. Kovács (1 male, OPC).

***Lepidostoma hirtum* Fabricius, 1775**

Material examined. **Albania**, Delvina Region, between Bistrica Village and Syri i Kalter, 127 m, N39°55'53", E20°09'13", 13.V.2017, leg. S. Beshkov & A. Nahirnic (4 males, OPC).

Limnephilidae Kolenati, 1848

Drusinae Banks, 1916

***Drusus biguttatus* (Pictet, 1834)**

Material examined. **Albania**, Bjeshkët e Nemuna Mts. (= Prokletije Mts), Radohima Mt., between Qafa e Thorës pass and Theth village, south-east of Shtegu peak, 1657m, N42.3854°, E19.7502°, 19.VII.2018, leg. S. Beshkov & A. Nahirnic (6 males, OPC). Bjeshkët e Nemuna Mts (=Prokletije Mts), Radohima Mt., between Qafa e Thorës pass and Theth village, south-east of Shtegu peak, N42°23'04", E019°45'25", 1562 m, 15.VIII.2018, leg. C. Plant (1 male, OPC). **Bulgaria**, Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469m, N42.20767°, E23.55093°, 21.7.2020, leg.S. Beshkov, A. Nahirnic & D. Kaynarov (4 males, OPC). Sofia Region, near Beli Iskar village, Rila Mts. N42.20766°, E23.55083°, 1468 m, 28.VII.2020, leg. D. Kaynarov (1 male, OPC). Bulgaria, Sofia Region, under Zavrachitsa Chalet, Rila Mts, N42.181264° E23.641052°, 1973m 12.VII.2021, leg.D. Kaynarov (6 males, OPC).

***Drusus botosaneanui* Kumanski, 1968**

Material examined. **Bulgaria**, Sredna Gora Mts, near Panagyurski Kolonii, 1119m, N42° 35'28", E24°13'34", 13.VIII.2017, meadow in *Fagus* forest, lamps, light traps, leg. S. Beshkov & R. Bekchiev (1 male, OPC). Bulgaria, W. Stara Planina Mts, above Gorni Lom Village, on Lyava Reka, the road to Martinovo, N43.42714°, E22.74467°, 13.IX.2021, 795 m, leg. S. Beshkov & A. Nahirnić-Beshkova (45 males, 29 females; OPC). **Macedonia**, Plačkovica Mountains, South-eastern region, Radoviš municipality, Plačkovica Mts, forest brook beneath Beli Kamen resorts, 1335 m, N41°44.672', E22°30.356', 5.X.2017, leg. S. Beshkov, J. Kecskés, Sz. Kovács, S. Nagy, A. Nahirnic & Zs. Pap (1 male, 1 female; OPC). **Serbia**, Braničevo district, Žagubica municipality, Beljanica Mts, Krupaja, Krupajsko Vrelo, 235 m, N44.18377°, E21.60915°, 22.IX.2021, leg. P. Juhász, T. Kovács, D. Murányi (1 male, 1 female; OPC).

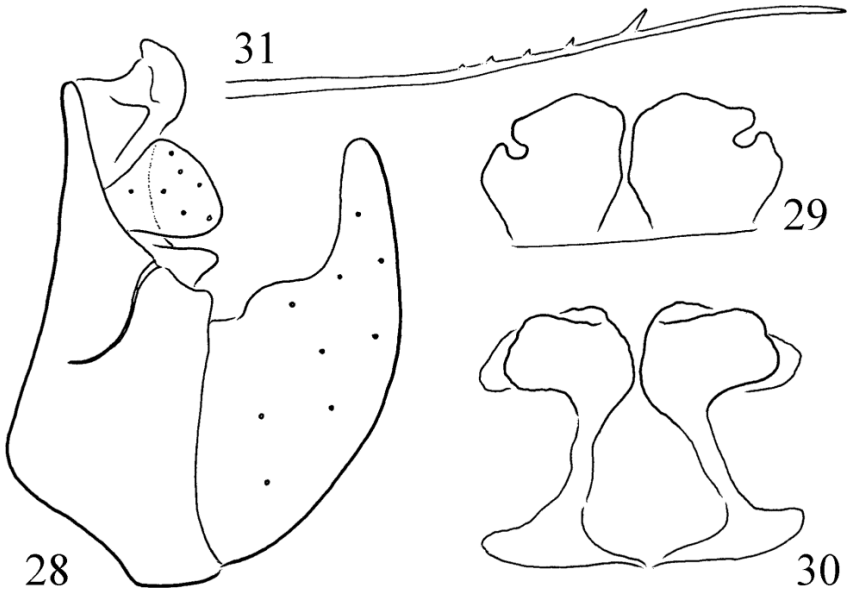
***Drusus discolor* (Rambur, 1842)**

Material examined. **Bulgaria**, Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469 m, N42.20767°, E023.55093°, 21.7.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (128 males, 19 females; OPC). Rila Mts, Sapareva Banya Distr., above Panichishte Resort, N42.25575°, E23.29940°, 1450m, 20.VII.2020, leg. S. Beshkov, A. Nahirnic, D. Kaynarov & T. Baron (2 males, OPC). Rila Mts, Tiha Rila above Rilski Monastir, N42.13837°, E023.47227°, 1972m, 19. VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC). Bulgaria, Rila Mts, Above Belmeken Reservoir, Rokerska Chuchura, N42.14619°, E23.76575°, 1937m, 15.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC). Bulgaria, Kyustendil Region, Obedishte, between Rilski Monastery and Kirilova Polyana, Rila Mts, N42.142703°, E23.35605°, 1228m, 04.VI.2021, leg. D. Kaynarov (1 male, 1 female; OPC).

***Drusus gornistok* Oláh, sp. nov.**

(Figures 28–31, Photo 6)

Material examined. Holotype: **North Macedonia**, Southwestern region, Debarca municipality, Velmej, Gorni Istok Spring and its outlet, 865 m, N41.27912°, E20.91887°, 1.V.2021, leg.



Figures 28–31. *Drusus gornistok* Oláh sp. nov. Holotype male: 28 = genitalia in left lateral view; 29 = paraproct in dorsal view; 30 = paraproct in caudal view; 31 = left paramere in lateral view.

Photo 6. Locus typicus of *Drusus gornistok* Oláh sp. nov (D. Murányi)

T. Kovács, D. Murányi & P. Olajos (1 male, OPC). Paratype: same as holotype (1 male, OPC).

Diagnosis. This castanean brown species belongs to the species with large upward arching triangular gonopods inhabiting the Balkan Mountains. Most close to *Drusus juliae* Oláh, 2011, a member of the *D. discophorus* species complex in the *D. bosnicus* species group with a single robust, erected primary spine on the paramere. *D. gornistok* sp. nov. differs from *D. juliae* by the speciation trait of the paraproct that is characterized by the dorsal branch curving anterad, not upward in lateral view as well as its basal region constricted, not broadening in dorsal view; apical pattern of both the dorsal and ventral branches are more complex. Among the periphallic organ, the cerci stalked, not subquadratic and the gonopod with finger-like apical region, not gradually narrowing.

Description. Male (in alcohol). Dark castanean; cephalic and thoracic sclerites dark, almost black especially on the dorsum; cephalic and thoracic setose warts brown; appendages including legs except coxa and proximal portion of femur lighter brown, haustellum and intersegmental membranous teguments whitish. Spurs of male 1.3.3. Forewing length 12 mm.

Male genitalia. Posterodorsal black spinate area on tergite VIII slightly extended posteriorly, two-patched and armed with specialized peg-like setae; less pigmented oval area discernible between the patches and encircled anteriorly by the darker basic colour of the tergite. Segment IX longer ventrally; very short bridle-like dorsally; its lateral length elongated by rounded triangular lobe anterad, shifted ventrad; midlateral sclerotized strips of sternite IX not pronounced; vestige

of sternal lateral suture of the fused segment IX well developed and deeply downward curving in the middle. Segment X fused to tergite IX forming together the short dorsal bridle. Cerci are stalked in lateral view. Paraproctal complex forming a closed structure around the anal opening by the dorsal and ventral branches; the anterad directed obtuse dorsal apices of the dorsal branches short and diverting laterad into rounded lobes both in dorsal and caudal views; ventral branches of the paraproct spread laterad with straight bottom. Gonopods upward arching broad triangular large lobe with finger-like apical region in lateral view. Parameres slender with a single robust erected primary spine.

Etymology. Coined from the name of locus typicus, a noun in apposition.

Drusus malickyorum Oláh, 2017

Material examined. **Albania**, Bjeshkët e Nemuna Mts (= Prokletije Mts), Shala valley, Theth village, Okol hamlet, N42°24'48", E19°45'37", 840 m, 15.VIII.2018, S. Beshkov & A. Nahirnic leg (3 males, 1 female; OPC).

Drusus osogovicus Kumanski, 1980

Material examined. Holotype: original labels: **Bulgaria**, ♂ and 4 Paratypes (2♂♂ and 2♀♀): Ossogovska Mt. (SW Bulgaria), hostel „Osogovo", 1640 m a.s.l., 18-19.VI.1979, (leg. J. Ganev, at light), in the National Museum of Natural History, Sofia. Kyustendil province, Ossogovska planina, spruce forest brook below Trite buki hut, 42°10'27.78", 22°38'3.96", 5. VII. 2016, leg. K. Harmos, T. Kovács & G. Magos (2 females, OPC). Ossogovo Mts, below Ruen (=Autotransport) chalet, above Kyustendil town, N42.1743°, E022.6342°, 1512m, 19.VI.2020, leg S. Beshkov & A. Nahirnić (3 males, OPC). **Serbia**, Besna Kobila, Mosul, 28.VI.2016, leg. H. Ibrahimi (1 male, OPC). Sveti Nikola, 27.VI. 2016, leg. H. Ibrahimi (1 male, OPC). Besna Kobila Mts, Musulj, Crna stream, N42°31"00.4", E22°14'44.2", 22.V.2017, leg. P. Juhász, T. Kovács & P. Olajos (14 males, 2 females; OPC). Besna Kobila Mts, Musulj, left arm of the left tributary of Crna stream, N42°31'12.9", E22°14' 48.1", 1251 m, 22.V.2017, leg. P. Juhász, T. Kovács & P. Olajos (1 female, OPC). Besna Kobila Mts, Gornja Ljubata, Debeli Rid, stream, N42° 29'31.5", E22°15'14.7", 22. V. 2017, leg. P. Juhász, T. Kovács & P. Olajos (1 female, OPC). Besna Kobila Mts, Kriva Feja, Ruski Put, Stance stram, N42°32'15.5", E22°13'15.3", 22.V.2017, leg. P. Juhász, T. Kovács & P. Olajos (9 males, 6 females; OPC). Besna Kobila Mts, Kriva Feja SE 3860 m, Ruski Put, stream, N42°31'52.5", E22°12'15.2", 22. V. 2017, leg. P. Juhász, T. Kovács & P. Olajos (10 males, 3 females; OPC).

Remarks. Both in the lateral and caudal views of the paraproct we have detected some signs of divergences, the possible product of integrative organisation in isolation, between the populations sampled in Bulgaria at the locus typicus and in Serbia in the Besna Kobila Mountain and in Sveti Nikola of the Serbian Stara Planina.

Drusus popovi Kumanski, 1980

Material examined. **Serbia**, Pirot district, Pirot municipality, Stara Planina, Dojkinačka Stream below Tri kladenca Waterfall, N of Dojkinci, N43.31944°, E22.82193°, 1700 m, 24.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (1 male, 8 females; OPC).

Drusus serbicus Marinkovic, 1971

Material examined. **Serbia**, Moravica district, Ivanjica, Golija Mts, forest stream and its sidebrook along road No.197, 1500m, N43° 20.289', E20°15.059' leg. P. Juhász, T. Kovács & D. Murányi, 26.VI.2018 (2 males, 1 female; OPC). Raška district, Novi Pazar, Golija Mts, Radaljica, spring brooks in forest edge by the settlement 1595m, N43°16.495', E20°20.896' leg. P. Juhász, T. Kovács, D. Murányi, 26.VI.2018, (10 males, 13 females; OPC).

Drusus zivici Kucinic, Previsic, Stojanovic & Vitecek, 2017

Material examined. **Serbia**, Stara Planina Mts, Crni Vrh, Babin zub, Dojčino spring, N43° 22'00.3", E22°35'54.1", 1538 m, 24.V.2017, leg.

P. Juhász, T. Kovács & P. Olajos (4 males, 2 females; OPC). Stara Planina Mts, Ravno Bučje, Ravnobučka stream, N43°26'55.4", E22°34'13.6", 23.V.2017, leg. P. Juhász, T. Kovács & P. Olajos (2 females, OPC). Stara Planina Mts, Crni Vrh, Košarište NE 720 m, stream, N43°25'20.1", E22°35'55.4", 1115 m, 23.V.2017, leg. P. Juhász, T. Kovács & P. Olajos (1 male, OPC). Stara Planina Mts, Topli Do, Stimoljski dol, N43°21' 17.2", E22°44'40.8", 25.V.2017, leg. P. Juhász, T. Kovács & P. Olajos (7 males, 2 females; OPC). Stara Planina Mts, Crni Vrh, Babin zub, Rekitska stream, N43°22'52.0", E22°37'57.2", 1524 m, 24.V.2017, leg. P. Juhász, T. Kovács & P. Olajos (19 males, 10 females; OPC).

***Ecclisopteryx alkon* Oláh & Oláh, 2017**

Material examined. **Bulgaria**, Rila Mts, above Rila Monastery, Kirilova polyana, 1488m, N42.15519°, E023.40036°, 18.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (14 males, 3 females; OPC). Rila Mts, Above Belmeken Reservoir, Rokerska Chuchura, N42.14619°, E23.76575°, 1937m, 15.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC).

***Ecclisopteryx madida* McLachlan, 1867**

Material examined. **Serbia**, Pomoravlje district, Despotovac municipality, Beljanica Mts, Strmosten, Lisine Izvor, 435 m, N44.10460°, E21.64099°, 22.IX.2021, leg. P. Juhász, T. Kovács, & D. Murányi (37 males, 61 females; OPC).

Limnephilinae Kolenati, 1848

Limnephilini Kolenati, 1848

***Glyphotaelius pellucidus* Retzius, 1783**

Material examined. **Bosnia & Herzegovina**, Bosnia, Sarajevo Region, above Konjic, N43° 38'50", E017°59'15", 652m, 2.VII.2017, leg. S. Beshkov & A. Nahirnic (2 males, OPC).

***Grammotaulius nigropunctatus* Retzius, 1783**

Material examined. **Bosnia & Herzegovina**, Bosnia, Sarajevo Region, above Konjic, N43° 38'50"; E017°59'15", 652m, 2.VII.2017, leg. S. Beshkov & A. Nahirnic (1 male, OPC)

***Limnephilus auricula* Curtis, 1834**

Material examined. **Bulgaria**, Ossogovo Mts below Ruen (= Autotransport) chalet, above Kyustendil town 1505m., N42°10'28", E22°37' 56.5", 23.IX.2018, at lamps, light traps, leg. S. Beshkov & A. Nahirnic (11 males, OPC).

***Limnephilus affinis* Curtis, 1834**

Material examined. **Albania**, S. Albania, Ionian Sea Coast, Butrint Lake, near the opening to Sea, N39°44'47", E019°59'49",18 m, 22.X.2017, leg. S. Beshkov & A. Nahirnic (10 males, 6 females; OPC).

***Limnephilus bipunctatus* Curtis, 1834**

Material examined. **Bulgaria**, Ossogovo Mts below Ruen (= Autotransport) chalet, above Kyustendil town 1505m., N42°10'28", E22°37' 56.5", 23.IX.2018, at lamps, light traps, leg. S. Beshkov & A. Nahirnic (11 males, OPC).

***Limnephilus coenosus* Curtis, 1834**

Material examined. **Bulgaria**, Blagojevgrad province, Pirin Mts, left side brook of Ribno Ezero, 41°44'31.9", 23°27'07.9", 7040 feet, 3. VII. 2016, leg. K. Harmos, T. Kovács & G. Magos (2 males, OPC). Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469m, N42.20767°, E023.55093°, 21.7.2020, leg.S. Beshkov, A. Nahirnic & D. Kaynarov (1male, OPC). Rila Mts, Tiha Rila above Rilski Monastir, N42.13837°, E023.47227°, 1972m, 19.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC).

***Limnephilus decipiens* (Kolenati), 1848**

Material examined. **Bulgaria**, Ossogovo Mts below Ruen (= Autotransport) chalet, above Kyustendil town 1505m., N42°10'28", E22°37' 56.5", 23.IX.2018, at lamps, light traps, leg. S. Beshkov & A. Nahirnic (1 males, OPC).

***Limnephilus extricatus* McLachlan, 1865**

Material examined. **Bulgaria**, Rila Mts, A-bove Belmeken Reservoir, Rokerska Chuchura, N42.14619°, E023.76575°, 1937m, 15.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC). **Montenegro**, Durmitor Mts, Zabljak distr., Uskocki Canyon, Pirlitor, Vrela, N43° 09'42", E019°13'53", 1273m, 5.VIII.2015, leg. S. Beshkov & A. Nahirnic (1 male, OPC).

***Limnephilus flavicornis* Fabricius, 1787**

Material examined. **Albania**, Prespa Lake, near Pustets Village, N40°46'14", E20°54'32", 849m. *Typha, Phragmitis, Mentha*, lake shore, 19.VIII.2017, lamps, light traps, leg. S. Beshkov & A. Nahirnic (1 male, 1 female; OPC). **Bulgaria**, Sofia Region, Dragoman distr., Tche-pun Hill, below Petrovski Krust summit, 1167m, 14.VIII.2020, N42.94797°, E022.95211°, leg. at light S. Beshkov (2 males, OPC).

***Limnephilus flavospinosus* Stein, 1874**

Material examined. **Albania**, Korçë Region, Morava Mt, above Dishnica village 1564m, N40°38'52", E020°51'28" 25.6.2017, mountain stony meadows, *Corylus, Polypodium*, etc, lamps, light traps, leg. S. Beshkov & A. Nahirnic, (1 males, OPC). Prespa Lake, near Pustets Village, N40°46'14", E020°54'32", 849m., *Typha, Phragmitis, Mentha*, lake shore, 19.VIII.2017, lamps, light traps, leg. S. Beshkov & A. Nahirnic (1 male, 1 female; OPC). Shkodra Region, Mal Kolaj, Velipoje distr. 0m, N41.9255, E019.4375, 29.IX.2018, at lamps and light traps, leg. Beshkov & A. Nahirnic (5 males, 2 females; OPC). **Montenegro**, Moraca River Valley, near Bioce Village, N42.52733°, E019.35492°, 195m, 6.X. 2019, leg. S. Beshkov & A. Nahirnic (14 males, 3 females; OPC).

***Limnephilus graecus* Schmid, 1965**

Material examined. **Albania**, Delvina Region, Syri i Kalter near Bistrica Village, 155 m, N39°55'23", E20°11'30", 23.X.2017, leg. S. Beshkov & A. Nahirnic (5 males, 2 females; OPC). Delvina Region, Muzina distr., near Dhrovjan N39°54'52", E020°12'06", 389 m, 21. X.2017, leg. S. Beshkov & A. Nahirnic (8 males, 6 females; OPC).

***Limnephilus griseus* (Linnaeus), 1758**

Material examined. **Macedonia**, Plachkovitza Mts between Beli Kamen Hotel and Lisec Village, 1328m, N41°44'41", E022°30'20", 24.IX.2018, lamps, light traps, leg. S. Beshkov & A. Nahirnic, (1 male, OPC).

***Limnephilus hirsutus* (Pictet), 1834**

Material examined. **Bulgaria**, Sredna Gora Mts, below Bratiya top, N42°35'35", E24°09'30", 1473 m, meadow above *Fagus* forest, 27.VII. 2017, lamps, light traps, leg. S. Beshkov & R. Bekchiev, (4 males, OPC).

***Limnephilus lunatus* Curtis, 1834**

Material examined. **Albania**, Librazhd Regi-on, Shkumbini River Valley, near Qukes, 287m, N41.1458°, E020.3766°, 29.X.2018, leg. S. Besh-kov & A. Nahirnic (13 males, 13 females; OPC). Librazhd Region, Shkumbini River Valley, near Qukes, N41.1458°, E020.3766°, 287m, 29.X. 2018, leg. S. Beshkov & A. Nahirnic (1 male, OPC). **Bulgaria**, Sredna Gora Mts, above Pirdop Town, 1380 m, N42°36'56", E24°12'58", 14.VIII. 2017, *Fagus* forest, lamps, light traps, leg.S. Beshkov & R. Bekchiev, (1 male, OPC). Sredna Gora Mts, below Bratiya top, N42°35'35", E24°09'30", 1473 m, meadow above *Fagus* forest, 27.VII.2017, lamps, light traps, leg. S. Beshkov & R. Bekchiev (1 male, OPC).

Limnephilus marmoratus Curtis, 1834

Material examined. **Albania**, Bjeshkët e Nemuna Mts. (=Prokletije Mts), Radohima Mt., between Qafa e Thorës pass and Theth village, south-east of Shtegu peak, N42°23'04", E19°45' 25", 1562 m, 15.VIII.2018, leg. C. Plant (1 male, OPC). Albania, Lushnja Region, above Ardenica Village, N40.8265°, E19.5882°, 127m, 2.XI. 2018, leg.S. Beshkov & A. Nahirnic (1 male, OPC). **Montenegro**, Durmitor Mts, Nadgorje, N43°11'33", E019°02'39", 1735m, 6.VIII.2015, leg. S. Beshkov & A. Nahirnic (5 males, 3 females; OPC).

Limnephilus rhombicus Linnaeus, 1758

Material examined. **Albania**, Elbasan county, Librazhd municipality, open stream and its sidebrooks in Fushë Studë, N41°18.427', E20° 23.039', 1105m, 1.VII.2018 leg. P. Juhász, T. Kovács, D. Murányi, (6 males, OPC). **Bulgaria**, between Ponor and Bezden Villages, Kostinbrod distr., 913m, N42.91343°, E23.09819°, 22.VIII. 2020, leg. light trap S. Beshkov & V. Gashtarov (1 male, OPC).

Limnephilus sparsus Curtis, 1834

Material examined. **Bulgaria**, Strandzha Mts, Near Slivarovo Village, N41°58'20", E27°39'27", 376m, 10.X.2014, leg. S. Beshkov (6 males, OPC). **Macedonia**, Plachkovitza Mts between Beli Kamen Hotel and Lisec Village, 1328m, N41°44'41", E22°30'20", 24.IX.2018, lamps, light traps, leg. S. Beshkov & A. Nahirnic, (1 male, 2 females; OPC).

Limnephilus stigma Curtis, 1834

Material examined. **Serbia**, W Serbia, Prijepole Region, Zvijezda, Savina Voda near Jabuka, N43°22'03", E019°33'07", 1117m, 16.VII.2014, leg.S. Beshkov (1 male, OPC).

Chaetopterygini Hagen, 1858

Annitella triloba Marinkovic, 1955

Material examined. **Macedonia**, Pelagonia region, Bitola municipality, Pelister Mts, Capari, spring area of Caparska Stream, 1955 m, N41°00.227', E21°10.075', 3.X.2017,, leg. P. Juhász, T. Kovács & D. Murányi (3 males, 1 female; OPC).

Chaetopteroides kosovarorum Ibrahimi & Oláh, 2013

(Map 5, Photos 7–10)

Material examined. **Serbia**, Pčinja district, Vranje municipality, Besna Kobila Mts, Stance Stream along Ruski Put, N42°32'14.7114", E22° 13'15.6714", 1525 m, 25.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (4 males, 5 females; OPC). Pčinja district, Bosilegrad municipality, Besna Kobila Mts, Crna Stream W of Musulj, N42.51688°, E22.24835°, 1210 m, 25.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (2 males, 2 females; OPC). Pčinja district, Bosilegrad municipality, Besna Kobila Mts, forest spring along Ruski Put, N42.53086°, E22.26580°, 1320 m, 25.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (2 males, 4 females; OPC). Zaječar district, Knjaževac municipality, Stara Planina, Tri kid. Spring on Mt. Midžor, N43.40012°, E22.66437°, 1945 m, 23.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (4 males, 9 females; OPC). Zaječar district, Knjaževac municipality, Stara Planina, open brooks on Mt. Midžor, N43.39002°, E22.67431°, 1885 m, 23.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (6 males, 14 females; OPC). Zaječar district, Knjaževac municipality, Stara Planina, Mt. Babin zub, Dojčino Vrelo, N43.36670°, E22.59922°, 1560 m, 23.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (3 males, 2 females; OPC). Pirot district, Pirot municipality, Stara Planina, forest brook N of Jelovica/Široke Luke, N43°15'32.256", E22° 50'43.6914", 1050 m, 24.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (2 females, OPC). Pirot district, Pirot municipality, Stara Planina, Dojkinačka Stream below Tri kladenca Waterfall, N of Dojkinci, N43.31944°, E22.82193°, 1700 m, 24.IX.2021, leg. P. Juhász, T. Kovács & D. Murányi (1 male, 6 females; OPC).

Remarks. In our previous studies on the *Chaetopteroides* genus we have recorded or described

seven species from different isolated mountain ranges (Oláh *et al.* 2013, Oláh *et al*. 2019): *Chaetopteroides maximus* (Kumanski, 1968): Vitosha Mt., Bulgaria; *Ch. bulgaricus* (Kumanski, 1969): Pirin Mts., Bulgaria; *Ch. kosovarorum* Ibrahimi & Oláh, 2013: described from the Kosovo territory of the Kopaonik Mts., Kosovo; *Ch. plackovicensis* Oláh & Ibrahimi, 2019: Plackovica Mts., Macedonia; *Ch. rilaensis* Oláh, 2019: Rila Mts., Bulgaria; *Ch. tunik* Oláh, 2013: Kožuf Mts., Macedonia; *Ch. veges* Oláh, 2013: Osogovska Mts., Bulgaria.

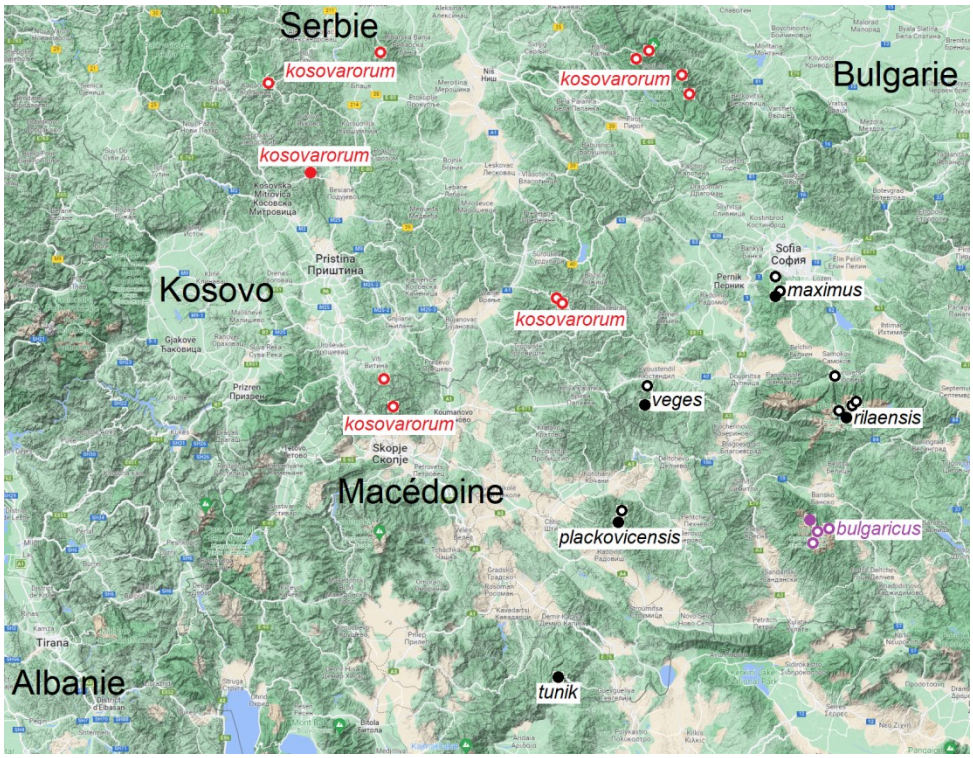
Based upon the commonality, generality and locality ranking principles we have concluded that *Chaetopteroides kosovarorum* seems to represent the ancestral species in the genus. It has the largest distributional area covering several mountain ranges in Serbia, Kosovo and Macedonia. The distribution of the other six species is very isolated and restricted to a single mountain range along the eastern distributional periphery of the putative ancestral species (Oláh *et al.* 2019). The present records of *C. kosovarorum* in the northern region of Serbia in Besna Kobila and Stara Planina mountains further increase the known distributional area of this ancestral species.

***Chaetopteroides rilaensis* Oláh, 2019**

(Map 5)

Material examined. **Bulgaria**, Blagoevgrad Region, under Granchar Chalet, Rila Mts. N42.116713°, E23.612181°, 2131 m, 23.VIII. 2020, leg. D. Kaynarov (1 male, OPC).

Remarks. *Chaetopteroides bulgaricus* Kumanski, 1969 reported from the Rila Massif (Oláh *et al.* 2013) in fact belong to *Chaetopteroides rilaensis* Oláh, 2019; therefore *Ch. rilaensis* Oláh, 2019 is probably restricted to the Rila Massif while *C. bulgaricus* Kumanski, 1969 is probably restricted to the Pirin Massif (Map 5).



Map 5. Distribution of the *Chaetopteroides* genus.

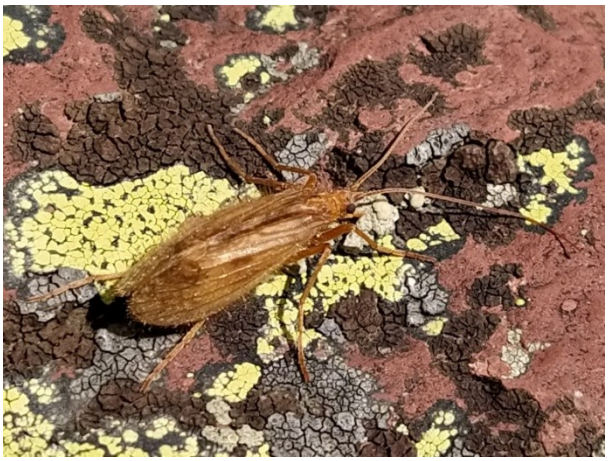


Photo 7. *Chaetopteroides kosovarorum* Ibrahimi & Oláh, 2013 (T. Kovács)

Photo 8. Open springs area of Mt. Midžor in Stara Planina, Serbia (T. Kovács)

Photo 9. Open brooks on Mt. Midžor, 1885 m in Stara Planina, Serbia (T. Kovács)

Photo 10. Dojkinačka Stream below Tri kladenca Waterfall, 1700 m in Stara Planina, Serbia (T. Kovács)

***Chaetopteryx bosniaca* Marinkovic, 1955**

Material examined. **Macedonia**, Vardar region, Čaška municipality, Golešnica Mts, Gorno Jabolčište, forest brook and open brook N of the village, 1285 m, N41°44.951', E21°29.230', 6.X. 2017, leg. P. Juhász, T. Kovács & D. Murányi (2 males, 1 female; OPC).

***Chaetopteryx stankovici* Marinkovic, 1966**

Material examined. **Albania**, Tirana Region, Dajt Mt, Shkalla Village, 893m, N41°19'49", E019°57'55", 24.X.2017, leg. S. Beshkov & A. Nahirnic (1 male, OPC). **Macedonia**, Eastern region, Vinica municipality, Plačkovica Mts, Lumen (Lomija) Stream beneath Mt. Lisec, 1170 m, N41°45.858', E22°30.995', 5.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (1 male, 7 females; OPC). Vardar region, Čaška municipality, Golešnica Mts, Gorno Jabolčište, forest brook and open brook N of the village, 1285 m, N41° 44.951', E21°29.230', 6.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (9 males, OPC).

***Psilopteryx montanus* Kumanski, 1968**

Material examined. **Macedonia**, Pelagonia region, Bitola municipality, Pelister Mts, spring area of Ezerska Stream beneath Golemo Ezero,

2200 m, N40°58.142', E21°12.431', 3.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (1 male, 7 females; OPC). Pelagonia region, Bitola municipality, Pelister Mts, spring area of Ezerska Stream beneath Golemo Ezero, 2200 m, N40° 58.142', E21°12.431', 3.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (1 male, OPC). Southeastern region, Radoviš municipality, Plačkovica Mts, forest brook beneath Beli Kamen resorts, 1335 m, N41°44.672', E22°30.356', 5.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (6 males, 1 female; OPC). Pelagonia region, Bitola municipality, Pelister Mts, Capari, spring area of Caparska Stream, 1955 m, N41°00.227', E21° 10.075', 3.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (8 males, 3 females; +1 male malformed! OPC).

Stenophylacini Schmid, 1955

Allogamus uncatus Brauer, 1857

Material examined. **Macedonia**, Pelagonia region, Bitola municipality, Pelister Mts, spring area of Ezerska Stream beneath Golemo Ezero, 2200 m, N40°58.142', E21°12.431', 3.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (7 males, 2 females; OPC). Pelagonia region, Bitola municipality, Pelister Mts, Dva Groba, spring of Maloviška Stream, 2060 m, N40°59.113', E21° 10.100', 3.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (3 males, OPC). Pelagonia region, Bitola municipality, Pelister Mts, Capari, spring area of Caparska Stream, 1955 m, N41°00.227', E21° 10.075', 3. X. 2017, leg. P. Juhász, T. Kovács & D. Murányi (13 males, 32 females; OPC).

Enoycila costae Mclachlan, 1876

Material examined. **Albania**, Berat Region, between Ibrolara and Vale, Polican distr., 217m, N40°33'36", E020°05'38" 16.X.2016, leg. S. Beshkov & A. Nahirnic (1 male, OPC). Librazhd Region, Shkumbini River Valley, near Qukes, 287m, N41.1458°, E20.3766°, 29.X.2018, leg. S. Beshkov & A. Nahirnic (2 males, OPC).

Halesus digitatus Schrank, 1781

Material examined. **Albania**, Mt. Thanës, near Bulqizë town, above Plani i Bardhë village, N41°28'35", E20°09'18", 788 m, 17.VIII.2018, leg. S. Beshkov, A. Nahirnic & C. Plant (1 female, OPC).

Mesophylax impunctatus McLachlan, 1884

Material examined. **Greece**, Peloponessos, Chelmos Mts, between Kalavrita and Peristera, 1776m, N38°01'48", E022°13'06", 11.5.2017, mountain steppe, *Astragalus*, light traps leg. S. Beshkov & A. Nahirnic (1 male, OPC).

Parachiona picicornis Pictet, 1834

Material examined. **Romania**, Vâlcea county, Parâng Mts, Obrâşia Lotrului, open spring area, 500 m along Transalpina (67C) road, downstream from 45°22'27.7", 23°39'4.0", 1915 m, 30.VI. 2016, leg. J. Oláh & J. Oláh jr. (5 males, 2 females; OPC). Romania, Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 29.VI. 2016, singled leg. J. Oláh & J. Oláh jr. (7 males, OPC).

Potamophylax depilis Szczesny, 1994

Material examined. **Bulgaria**, Sredna Gora Mts, near Panagyurski Kolonii, 1119m, N42°35' 28"; E024°13'34", 13.VIII.2017, meadow in *Fagus* forest, lamps, light traps, leg. S. Beshkov & R. Bekchiev (1 male, OPC).

Potamophylax fules Oláh & Ibrahimi, 2013

Material examined. **Romania**, Vâlcea county, Parâng Mts, Obrâşia Lotrului, open spring area, 500 m along Transalpina (67C) road, downstream from N45°22'27.7", E23°39'4.0", 1915 m, 30.VI. 2016, leg. J. Oláh & J. Oláh jr. (1 male, OPC). **Serbia**, Stara Planina Mts, Crni Vrh, Košarište NE 720 m, stream, N43°25'20.1",E22°35'55.4", 1115 m, 23. V. 2017, P. Juhász, T. Kovács & P. Olajos (3 males, 6 females; OPC).

***Potamophylax goulandriorum* Malicky, 1975**

Material examined. **Albania**, Delvina Region, Syri i Kalter near Bistrica Village, 155 m, N39° 55'23", E020°11'30" 23.X.2017, leg. S. Beshkov & A. Nahirnic (3 males, 4 females; OPC).

***Potamophylax gurunaki* Malicky, 1992**

Material examined. **Macedonia**, Pelagonia region, Bitola municipality, Pelister Mts, Dva Groba, spring of Maloviška Stream, 2060 m, N40°59.113', E21°10.100', 3.X.2017, leg. P. Juhász, T. Kovács & D. Murányi (15 males, 16 females; OPC).

***Potamophylax latipennis* Curtis,1834**

Material examined. **Romania**, Hargita Mts, 7.IX.2017, singled, leg. J. Oláh jr. (3 males, OPC).

***Potamophylax luctuosus* Piller & Mitterpacher, 1783**

Material examined. **Romania**, Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 29.VI.2016, light trap, J. Oláh & J. Oláh jr. (1 male, OPC). **Bulgaria**, W Stara Planina Mts. Gushovski Monastir above Tchiprovtzi Town, N43.3661°, E022.8402°, 808 m, 26.VI.2021, leg. S. Beshkov & A. Nahirnic-Beshkova (2 males, OPC)

***Potamophylax millenii* Klapalek, 1842**

Material examined. **Romania**, Dambovița county, Southern Carpathians, Bucegi Mts. Brătei stream valley, Negru stream, N45.38328°, E25.350528°, 14. VII. 2016 leg. Z. Baczo & J. Kecskés (4 males, 1 female; OPC).

***Potamophylax nigricornis* (Pictet, 1834)**

Material examined. **Romania**, Dambovița county, Southern Carpathians, Bucegi Mountains, Brătei stream valley, Negru stream, N45.383283°, E25.350528°, 14. VII. 2016 leg. Z. Baczo & J. Kecskés (1 male, 1 female; OPC). Dambovița county, Southern Carpathians, Bucegi Mountains, Brătei stream valley, Negru stream, N45.383424°, E25.389155°, 14. VII. 2016 leg. Z. Baczo & J. Kecskés (1 male, OPC). Bucegi Mts. Lalomita stream, N45.425296, E25.444064, 1917 m, 15. VII. 2015, leg. Z. Baczó & J. Kecskés (2 males, 1 female; OPC). Vâlcea county, Parâng Mts, Obrâșia Lotrului, open spring area, 500 m along Transalpina (67C) road, downstream from N45° 22'27.7", N23°39'4.0", 1915 m, 30.VI.2016, leg. J. Oláh & J. Oláh jr. (1 male, OPC).

***Potamophylax seprus* Olah, Lodovici, & Valle, 2011**

Material examined. **Albania**, Tirana Region, Mali me Gropa Mts, NW of Qafa e Selites Pass, N41.37706°, E20.01645°, 1222m, 1.X.2019, leg. S. Beshkov & A. Nahirnic (1 male, OPC).

Remarks. This species was described from a single male specimen collected in the Tomor Mts., Skrapar Region, Albania. The single male from Mali me Gropa Mts., Albania is the second known specimen of this large sized and rare *Potamophylax* species.

***Rhadicoleptus macedonicus* Botosaneanu & Riedel, 1965**

Material examined. **Bulgaria**, Rila Mts, Tiha Rila above Rilski Monastir, N42.13837°, E23.47227°, 1972m, 19.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (2 males, OPC).

***Stenophylax caesareicus* Schmid, 1959**

Material examined. **Bulgaria**, Eastern Rhodopi Mts, near Zvezdel Village, 616m, N41° 28'25", E025°31'48", 18.V.2018, leg. S. Beshkov (7 males, 10 females; OPC). Rila Mts, Beli Iskar River Valley, above Beli Iskar Village, 1469m, N42.20767°, E023.55093°, 21.7.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC). **Greece**, Peloponessos, Taygetos Mts, Sparti region, Taygetos refuge, below Profitis Ilias peak, 1561m, N36°57'00", E22°22'02" 08.

V.2017, leg. S. Beshkov & A. Nahirnic (8 males, 6 females; OPC).

***Stenophylax fissus* McLachlan, 1875**

Material examined. **Albania**, Gjirokastër county, Finiq municipality, Syri i Kaltër spring, N39°55'23", E20°11'30", 155 m, 03.XI.2018, leg. S. Beshkov & A. Nahirnic (2 males, OPC). Shkodra Region, Stara Village, Hot district, 496m, N42.3711°, E019.4703°, 4.XI.2018, leg. at lamps and light traps, S. Beshkov & A. Nahirnic (2 males, OPC). **Greece**, Peloponessos, Chelmos Mts, between Kalavrita and Peristera, 1776m, N38°01'48", E022°13'06", 11.5.2017, mountaine steppe, *Astragalus*, light traps leg. S. Beshkov & A. Nahirnic (1 male, 1female; OPC).

***Stenophylax meridiorientalis* Malicky, 1980**

Material examined. **Montenegro**, Moraca River Valley, near Bioce Village, N42.52733°, E019.35492°, 195m, 6.X.2019, leg. S. Beshkov & A. Nahirnic (1 male, OPC). **Serbia**, E. Serbia, Bela Palanka District, Slivovicki Vis, above Slivovic village, 925m, N43°08'29", E22°23'12" 21.6.2017, *Artemisia alba*, limestone meadow, lamps, light traps leg. S. Beshkov, A. Nahirnic, C. Plant & P. Jaksic (3 males, 1 female; OPC).

***Stenophylax mitis* McLachlan, 1875**

Material examined. **Macedonia**, Petrina Planina - Galichicha, between Ochrid and Velestovo, 1005m, N41°05'26", E20°49'38" 9.VI. 2018, leg. S. Beshkov & A. Nahirnic (1 male, OPC). **Serbia**, E. Serbia, Bela Palanka District, Slivovicki Vis, above Slivovic village, 925m, N43°08'29", E22°23'12" 21.6.2017, *Artemisia alba*, limestone meadow, lamps, light traps leg. S. Beshkov, A. Nahirnic, C. Plant & P. Jaksic (2 males, 4 females; OPC).

***Stenophylax nycterobius* McLachlan, 1875**

Material examined. **Serbia**, E. Serbia, Bela Palanka District, Slivovicki Vis, above Slivovic village, 925m, N43°08'29", E022°23'12", 21.VI. 2017, *Artemisia alba*, limestone meadow, lamps, light traps leg. S. Beshkov, A. Nahirnic, C. Plant & P. Jaksic (7 males, 5 females; OPC).

***Stenophylax permistus* McLachlan, 1895**

Material examined. **Serbia**, E. Serbia, Bela Palanka District, Slivovicki Vis, above Slivovic village, 925m, N43°08'29", E22°23'12" 21.VI. 2017, *Artemisia alba*, limestone meadow, lamps, light traps leg. S. Beshkov, A. Nahirnic, C. Plant & P. Jaksic (1 male, 1 female; OPC).

***Stenophylax sequax* McLachlan, 1875**

Material examined. **Bulgaria**, Rila Mts, above Rila Monastery, Kirilova polyana, 1488m, N42.15519°, E023.40036°, 18.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC). Rila Mts, Above Belmeken Reservoir, Rokerska Chuchura, N42.14619°, E23.76575°, 1937m, 15.VII.2020, leg. S. Beshkov, A. Nahirnic & D. Kaynarov (1 male, OPC). **Serbia**, E. Serbia, Bela Palanka District, Slivovicki Vis, above Slivovic village, 925m, N43°08'29", E22°23'12", 21.6.2017, *Artemisia alba*, limestone meadow, lamps, light traps leg. S. Beshkov, A. Nahirnic, C. Plant & P. Jaksic (1 male, 1 female; OPC).

***Stenophylax tauricus* Schmid, 1964**

Material examined. **Albania,** Elbasan county, Librazhd municipality, open stream and its sidebrooks in Fushë Studë, 1105m, N41°18.427', E20°23.039' leg. P. Juhász, T. Kovács, D. Murányi, 1.VII.2018 (1 male, 2 females; OPC).

***Stenophylax wageneri* Malicky, 1971**

Material examined. **Albania**, Shkodra Region, Stara Village, Hot district, 496m, N42.3711°, E19.4703°, 28.IX.2018, at lamps and light traps, leg. S. Beshkov & A. Nahirnic (3 males, OPC). Shkodra Region, Stara Village, Hot district, 496m, N42.3711°, E19.4703°, 4.XI.2018, leg. at lamps and light traps S. Beshkov & A. Nahirnic (3 males, OPC). **Montenegro**, Moraca River Valley, near Bioce Village, N42°31'38.3874",

E19°21'17.64", 195m, 6.X.2019, leg. S. Beshkov & A. Nahirnic (4 males, OPC).

Beraeidae Wallengren, 1891

Beraea pullata Curtis, 1834

Material examined. **Romania**, Lotru Mts, Obirsia Lotrului, 1578 m, N45.463°, E23.620°, 29.VI.2016, singled leg. J. Oláh & J. Oláh jr. (1 female, OPC).

Beraea zawadil Malicky, 1977

Material examined. **Albania**, Gjirokastër county, Dropull municipality, Tsamantas Mts, Sotirë, stream in the village, 480m, N39°49.199', E20°21.654'leg. P. Juhász, T. Kovács, D. Murányi, 29.VI.2018 (2 males, 3 females; OPC).

Beraeamyia hrabei Mayer, 1937

Beraeamyia hraběi Mayer, 1937:35, 38 (original description).
Beraeamyia Hraběi: Mayer 1938a: 58–60 (redescription of male in German).
Beraeamyia Hraběi: Mayer 1938b: 5–8/12–14 (diagnosis, redescription of male).
Beraeamyia hraběi: Botosaneanu 1961: 66 (description of female).
Beraeamyia hraběi: Botosaneanu & Sýkora 1963:132–134 (description of pupa).

Type material examined: Syntype: male (NMPC): „*Beraeamyia hraběi* / 1♂ - Frývald 24.VI.36". Type locality: N Slovakia, Rajecká Lesná (=Frývald) ca. 22 km SSW of Žilina, ca. 49°02N, 18°42E, ca. 620 m.

Other material examined: **Bulgaria**, Stara Planina, Ogosta River, spring, 4.VII.1977, leg I. Janeva (2 females, OPC). Central Stara Planina Mts, Elenova Gora reserve near Skobelevo Village, Mazalat Forestry, N42°44'34", E25°08'50", 872m, 1.VIII.2014, leg. S. Beshkov (1 male, OPC). **Czech Republic**, SE Moravia, Bílé Krapaty Mts, right tributary of Klanečnice stream 1.7 km SW of Strání, N48°53'48", E17°41'13", 460–500 m, 9.VII.2010, leg. P. Chvojka (1 female, NMPC); the same but 9.VII.–12.VIII.2010, Malaise trap, leg. P. Chvojka & J. Macek (1 male, NMPC). **Slovakia**, N Slovakia, Malá Fatra Mts, slope of Kľak Mt. 25 km SSW of Žilina, ca. N49°00', E18°39', *ca*. 600 m, 6.VII.1937, K. Mayer leg. (original label: „Beraeamyia / Hraběi Mayer ♀ / Klak 6.VII.37"), (1 female, NMPC). E Slovakia, Bukovské vrchy Hills, Zbojský potok stream above Nová Sedlica 27 km ENE of Snina, N49°03'23", E22°30'27", 430 m, 15.VII.1990, leg. P. Chvojka (1 male NMPC).

Remarks: We have collected a single male and two female specimens from Stara Planina Mts. Bulgaria very far from the locus typicus of this interesting species. We have decided to compare the fine phenomics of both the male and female with the type specimens.

The description of *Beraeamyia hrabei* Mayer was based on three male specimens (syntypes) from Northern Slovakia („Lučanka near Liptovský Sv. Mikuláš" and „Frývald") (Mayer 1937). Mayer's collection was deposited in Masaryk University, Brno, Czech Republic, it is quite well preserved and organized but probably incomplete. We were able to discover only a single syntype from „Frývald" (=Rajecká Lesná), the remaining two syntypes are seemingly missing. The single syntype as well as the whole Mayer's collection will be deposited in the National Museum, Prague, Czech Republic (NMPC).

We have recorded remarkable shape stability in both the male and female genital structures between all the compared specimens. Slight differences are discernible only in the terminal lobe structure of the digitiform pair of processes on the basal plate of the gonopods. However, population samples with more specimens from more populations are required to quantify the stability and variability of the trilobed terminal structure of the basal plate processes.

Beraeamyia kutsaftikli Malicky, 1975

Material examined. **Albania**, Gjirokastër county, Dropull municipality, Tsamantas Mts, Sotirë, stream in the village, 480m, N39°49.199', E20°21.654'leg. P. Juhász, T. Kovács, D. Murányi, 29.VI.2018 (3 males, OPC).

Beraeamyia schmidi Botosaneanu, 1960

Material examined. **Albania**, Delvina Region, between Bistrica Village and Syri i Kalter, 127 m, N39°55'53", E20°09'13"13.V.2017, leg. S. Beshkov & A. Nahirnic (1 male, OPC).

Sericostomatidae Stephens, 1836

Notidobia Stephens, 1829

The genital structure of the *Notidobia* genus is characterized by compact lateral profile of the sagittaly flattened gonopod without any splitting, but with ventro-basomesal and/or ventromarginal spine-like processes as well as well sclerotized paraproct. According to the paraproct structure there are two species groups in the genus. (1) Species group with paraproct of downward directed head represented by the type species of the genus widely distributed in entire Europe and nominate species of the group: *Notidobia ciliaris* Linnaeus, 1761 and by the diversified *Notidobia nekibe* species complex of ten species having downward directed hook-formation on the parapoct head. (2) Species group with well separated and heavily sclerotized pair of upward directed paraprocts: *Notidobia demelti* Malicky, 1974 represented by three species distributed in the Caucasus and Turkey.

Notidobia nekibe new species complex

(Map 6)

Notidobia nekibe new species complex in the *Notidobia* genus is a well defined taxon characterized by very specialized paraproct having a pair of downward curving heavily sclerotized hook formation on the apical region. This hook formation is lacking in all of the known 23 extant and 4 extinct genera of the Sericostomatidae family distributed in all faunal regions except Australasia. Based on the ventro-basomesal and/or ventromarginal spine-like processes on the gonopod there are three lineages in the complex: (1) *Notidobia nekibe* lineage, the nominate single species of this lineage has only a pair of ventro-basomesal spine-like processes on the gonopod. (2) *Notidobia melanoptera* lineage has ventro-basomesal and ventromarginal spine-like processes on the gonopod represented by five species: *Notidobia kerkina* sp. nov., *N. lakmosa* sp. nov., *N. melanoptera* Stein, 1863, *N. salihli* Malicky & Sipahiler, 1993, *N. vaillanti* sp. nov. (3) *Notidobia bizensis* lineage has ventro-basomesal and basad moved ventromarginal spine-like processes on the gonopod represented by three species: *Notidobia bizensis* Malicky & Sipahiler, 1993 *N. koraba* sp. nov., *N. nogradorum* Oláh, 2010.

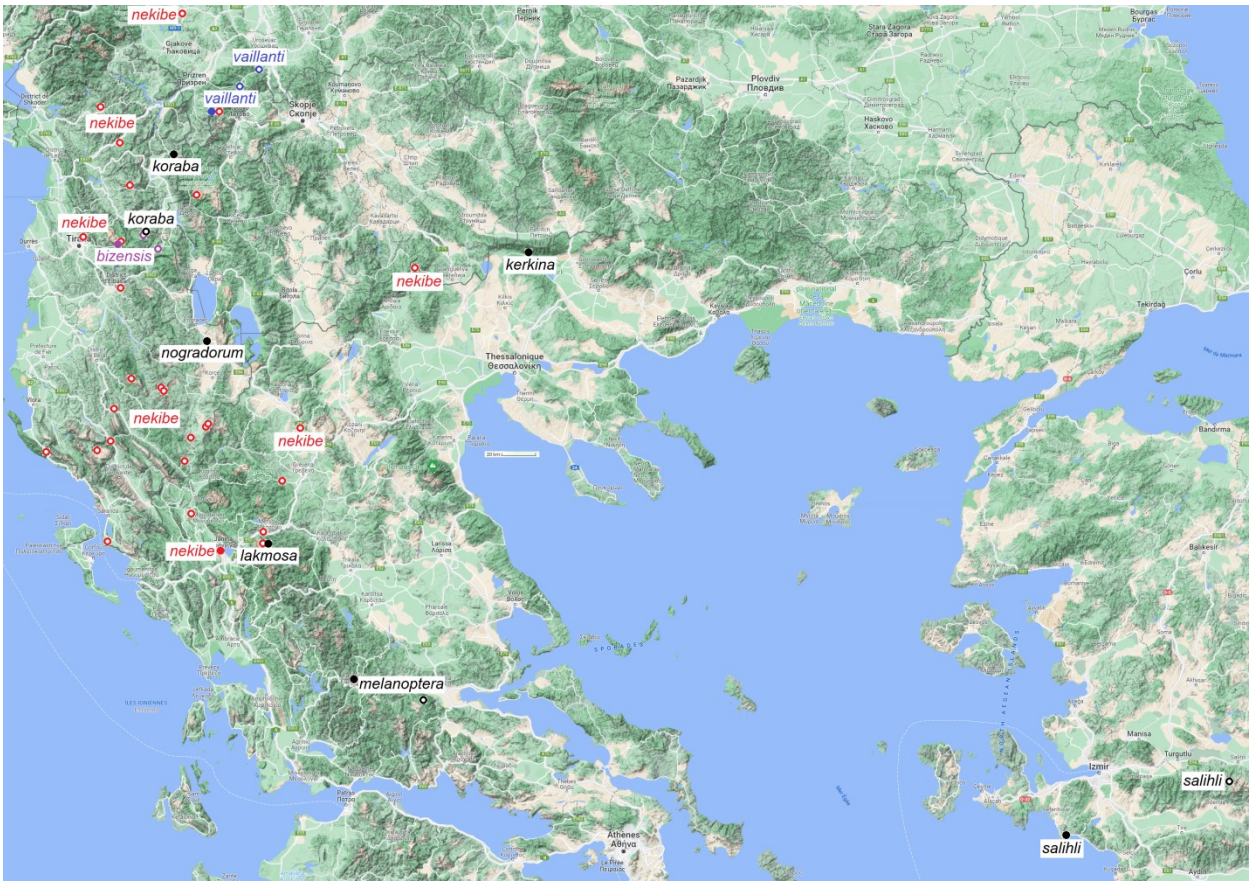
Notidobia bizensis Malicky & Sipahiler, 1993

(Figures 32–34, Map 6)

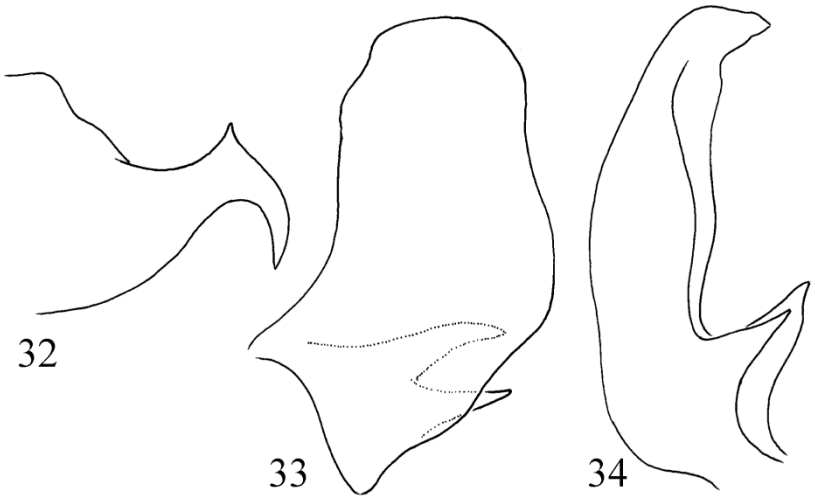
Notidobia bizensis Malicky & Sipahiler, 1993:472–473: „Holotypus ♂: Albanien, Bize bei Shengjergji = Shëngjergj, 1400–1500 m, 10–15.VII.1961."

Material examined. **Albania**, Elbasan county, Librazhd municipality, open stream and its sidebrooks in Fushë Studë, 1105m, N41°18.427', E20°23.039', leg. P. Juhász, T. Kovács, D. Murányi, 1.VII.2018 (1 male, 1 female; OPC). Bulqizë district, Çermenike Mts. open brook beneath Mt. Kaptine, N41°23.212', E20°17.506', 1610 m, 21.VI.2012, leg. Z.Fehér, T.Kovács & D. Murányi (1 male, 3 females; OPC). Bulqizë district, Çermenike Mts. open brook beneath Mt. Kaptine, N41°23.199', E20°17.338', 1600 m, 21.VI.2012, leg. Z. Fehér, T. Kovács & D. Murányi (2 females, OPC).

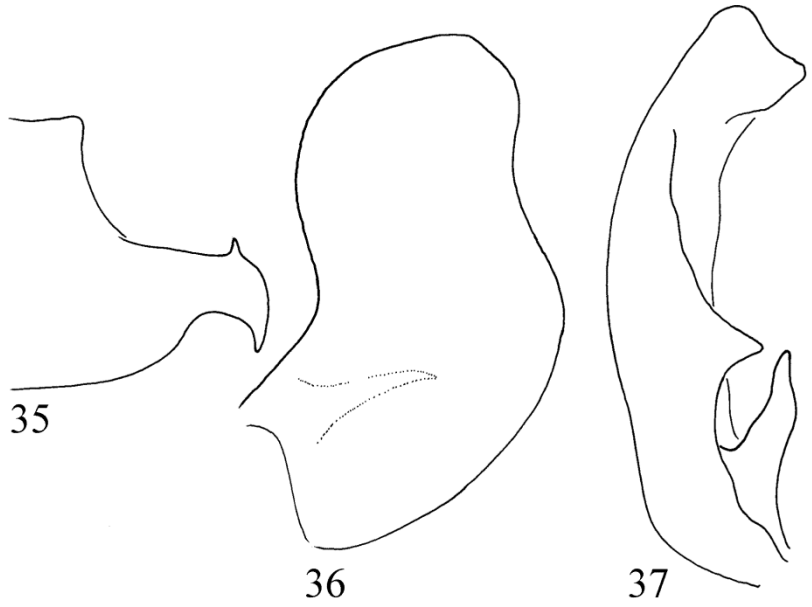
New diagnosis. Most close to *Notidobia nogradorum* Oláh, 2010, but differs by the more pointed dorsal and upward directed spine-like process on the terminal hook-formation of the paraproct and the hook is smaller. The lateral profile of the gonopod differently shaped as well as in lateral view the ventro-basomesal and ventromarginal spine-like processes are separated only on the apical half having a long fused basal region forming together a common basement, not deeply split.



Map 6. Distribution of the new *Notidobia nekibe* species complex



Figures 32–34. *Notidobia bizensis* Malicky & Sipahiler, 1993. Male: 32 = paraproct in lateral view; 33 = left gonopod in left lateral view; 34 = left gonopod in ventral view.



Figures 35–37. *Notidobia kerkina* Oláh, sp. nov. Holotype male: 35 = paraproct in lateral view; 36 = left gonopod in left lateral view; 37 = left gonopod in ventral view.

***Notidobia kerkina* Oláh, sp. nov.**

(Figures 35–37, Map 6)

Notidobia salihli Malicky & Sipahiler, 1993: Oláh 2010:113, misidentification.

Material examined. Holotype: **Greece**, Serres county, Kerkini Mts. Ano Poroia, stream and spring in a platan forest, 511 m, N41° 17.637' E23° 02.187', 30.III.2007, leg. L. Dányi, Z. Erőss, Z. Fehér, J. Kontschán & D. Murányi (1 male, HNHM).

Diagnosis. Most close to *Notidobia salihli* Malicky & Sipahiler, 1993, but differs by the more pronounced pointed dorsal spine-like process on the terminal hook-formation of the paraproct and the hook is less rounded apicad. The lateral profile of the gonopod almost regular S-shaped as well as in lateral view the ventro-basomesal spine-like process is small, not long.

Description. Male (in alcohol). Dark castanean species. Cephalic and thoracic sclerites dark brown, almost black especially on the dorsum; appendages including legs lighter brown; haustellum and intersclerital membranous teguments whitish. Forewing length 11 mm; wing membrane brown, densely covered with decumbent setae.

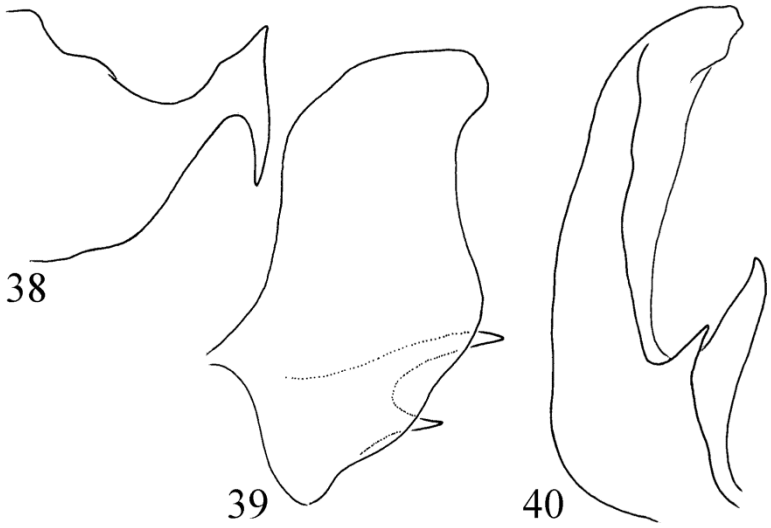
Male genitalia. The dorsal spine-like process on the terminal hook-formation of the paraproct pointed pronounced and the hook apical margin directed almost straight ventrad. The lateral profile of the gonopod regular S-shaped as well as in lateral view the ventro-basomesal spine-like process is small, the marginal spine-like process is shifted midway, short and blunt.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Notidobia koraba* Oláh, sp. nov.**

(Figures 38–40, Map 6)

Material examined. Holotype: **Albania**, Dibër county, Korab Mts, spring and stream, 1.5 km E of Radomirë, 1440 m, N41°49.032', E20°30.016', 26.VI.2007, leg. L. Dányi, Z. Erőss, Z. Fehér, A. Hunyadi & D. Murányi (1 male, HNHM). Paratypes: same as holotype (3 males, 6 females; HNHM). Albania, Bulqizë district, Çermenikë Mts. open brook beneath Mt. Kaptine, N41° 23.212', E20°17.506', 1610 m, 21.VI.2012, leg. Z. Fehér, T. Kovács & D. Murányi (2 males, 2



Figures 38–40. *Notidobia koraba* Oláh, sp. nov. Holotype male: 38 = paraproct in lateral view; 39 = left gonopod in left lateral view; 40 = left gonopod in ventral view.

females; OPC). Bulqizë district, Çermenikë Mts. open brook beneath Mt. Kaptine, N41°23.199', E20°17.338', 1600 m, 21.VI.2012, leg. Z. Fehér, T. Kovács & D. Murányi (2 females, OPC).

Diagnosis. Most close to *Notidobia bizensis* Malicky & Sipahiler, 1993, but differs by the more produced dorsal spine-like process on the terminal hook-formation of the paraproct and the hook is straight, not curved. The lateral profile of the gonopod differently shaped as well as in lateral view the ventromarginal spine-like process is significantly shorter than the ventro-basomesal process.

Description. Male (in alcohol). Dark castanean species. Cephalic and thoracic sclerites dark brown, almost black especially on the dorsum; appendages including legs lighter brown; haustellum and intersclerital membranous teguments whitish. Forewing length 11 mm; wing membrane brown, densely covered with decumbent setae.

Male genitalia. Pointed dorsal spine-like process on the terminal hook-formation of the paraproct very produced, upward directed. The lateral profile of the gonopod differently shaped as well as in lateral view the ventromarginal spine-like process is significantly shorter than the ventro-basomesal process.

Etymology. Coined after the name of locus typicus, a noun in apposition.

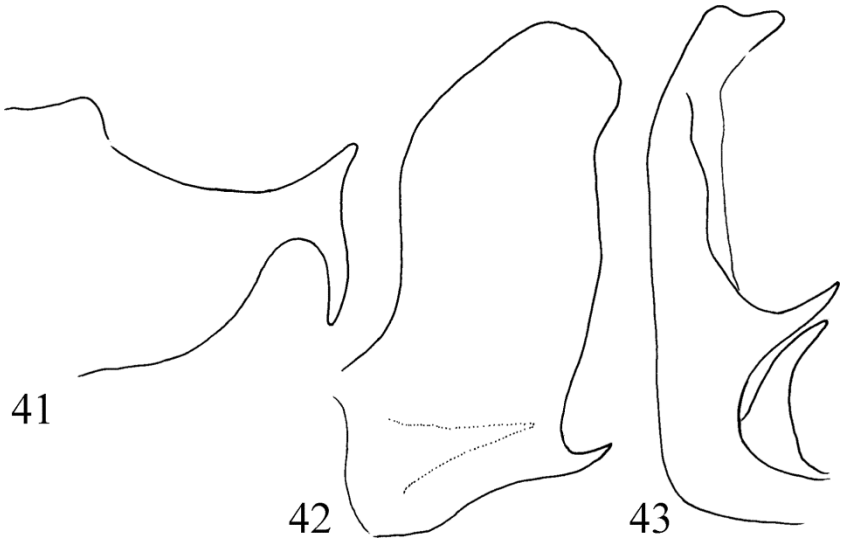
***Notidobia lakmosa* Oláh, sp. nov.**

(Figures 41–43, Map 6)

*Material examined***.** Holotype: **Greece**, Thessaly, Trikala peripheral unit, Lakmos Mts. Chaliki, open torrent and brook N of the village, 1225 m, N39°41.908', E21°11.037', 9.V.2011 leg. J. Kontschán, D. Murányi Szederjesi & Ujvári (1 male, HNHM). Paratypes: same as holotype (7 males, HNHM).

Diagnosis. Most close to *Notidobia vaillanti* sp. nov., but differs by the more pronounced pointed dorsal spine-like process on the terminal hook-formation of the paraproct and the hook is longer, more slender and less curved. The lateral profile of the gonopod differently shaped having the apical region more slender and posterad directed as well as in ventral view the ventro-basomesal spine-like process is small, not long.

Description. Male (in alcohol). Dark castanean species. Cephalic and thoracic sclerites dark brown, almost black especially on the dorsum; appendages including legs lighter brown; haustellum and intersclerital membranous teguments



Figures 41–43. *Notidobia lakmosa* Oláh, sp. nov. Holotype male: 41= paraproct in lateral view; 42 = left gonopod in left lateral view; 43 = left gonopod in ventral view.

whitish. Forewing length 11 mm; wing membrane brown, densely covered with decumbent setae.

Male genitalia. The dorsal spine-like process on the terminal hook-formation of the paraproct pointed pronounced and the hook apical margin directed almost straight ventrad. The lateral profile of the gonopod with posterad directed apical region as well as in lateral view the ventrobasomesal spine-like process is small, the marginal spine-like process is long, upward directed and slender pointed.

Etymology. Coined after the name of locus typicus, a noun in apposition.

***Notidobia melanoptera* Stein, 1862**

(Figurers 44–46, Map 6)

Notidobia melanoptera Stein, 1862:415: „30. *Notidobia melanoptera* m. Piceo nigra, antennis, alis pedibusque fuliginosis. Long. corp. 8½ millim., alar. super. 11 millim. ♂." „Von *N. ciliaris* Linn. (*atrata* Fabr.) unterscheidet sich diese Art hauptsächlich durch die Gröfse und die dunkel gefärbten Beine. Nur diese eine griechische Sericostomide in der K. Sammlung wurde von Dr. Krüper eigesandt."

Notidobia melanoptera Stein, 1862: Klapálek 1903:2–3: „Mehrere ♂ und ♀ Karpenisi (Central Greece!) (Apfelbeck)."

Notidobia melanoptera Stein, 1862: Malicky 1978: „Stein (1863) beschrieb eine *Notidobia melanoptera* aus Griechenland; der genau Fundort ist nicht bekannt. Von Originalmaterial ist nur 1 Weibchen erhalten, das sich im Zoologischen Museum der Humboldt-Universität in Berlin befindet.

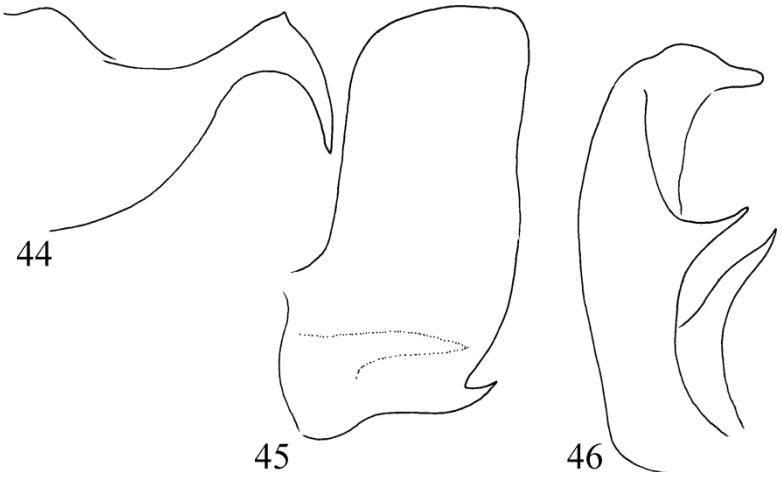
Notidobia melanoptera Stein, 1862: Sipahiler & Malicky 1987:103: „*Notidobia melanoptera* Stein, 1863, die für einen Endemiten Mittelgriechenlands gehalten worden war.

Notidobia melanoptera Stein, 1862: Malicky & Sipahiler 1993:471: „*N. melanoptera* kommt nur in Mittel-Griechenland vor."

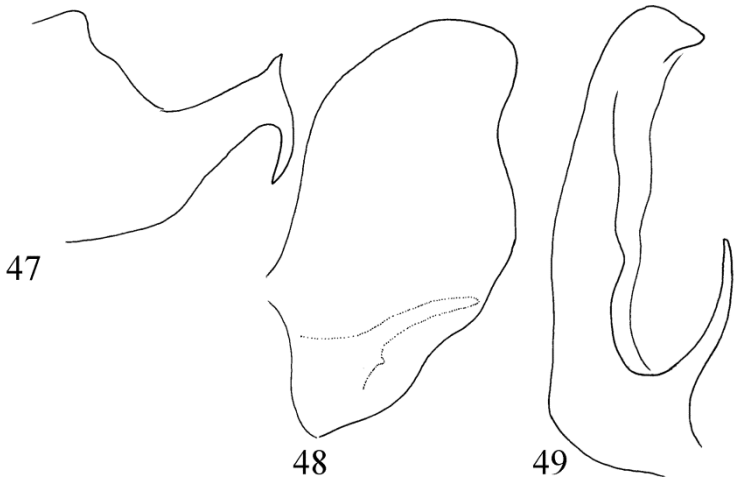
Notidobia melanoptera Stein, 1862: Malicky 2005: 131: „Daten: „Greece", Krüper, Museum Berlin, 1♀ (Holotypus);"

Material examined. **Greece**, Iti GR56 zw. Kastanea u. Katafigion, N38°50', E22°17', 1400 m, 8.VI.1987, leg. H. Malicky (10 males, 1 female; OPC).

New diagnosis. According to the lateral profile of the gonopod and the short dorsal spine-like process on the terminal hook-formation of the paraproct this species is more close to *Notidobia salihli* Malicky & Sipahiler, 1993, but distinctly differs by the long and slender hook formation of the paraproct, short and robust as well as rounded apicad at *N. salihli* as well as the mesad shifted marginal spine like process pointed and slender, not robust and blunt.



Figures 44–46. *Notidobia melanoptera* Stein, 1862. Male: 44 = paraproct in lateral view; 45 = left gonopod in left lateral view; 46 = left gonopod in ventral view.



Figures 47–49. *Notidobia nekibe* Klapálek, 1903. Male: 47 = paraproct in lateral view; 48 = left gonopod in left lateral view; 49 = left gonopod in ventral view.

Notidobia nekibe Klapálek, 1903

(Figures 47–49, Map 6)

Notidobia nekibe Klapálek, 1903:3–4: **Greece**, „Schwarz, die Hinterschienen und Hintertarsi hell gelbbraun, noch heller als bei *ciliaris*, seidenglänzend. „ „1 ♂ Jannina (Ioanina!) (Apfelbeck).”

Material examined. **Albania**, Gjirokastër county, Tepelenë municipality, Kurvelesh, Gurrit Stream E of Progonat 1025m, N40°12.625’, E19°58.108’ leg. P. Juhász, T. Kovács, D. Murányi, 29.VI.2018 (3 male, 1 female; OPC). Korçë county, Kolonjë municipality, Leskovik, roadside spring W of the town, 575 m, N40.14503°, E20.57265°, 30.IV.2021, leg. T. Kovács, D. Murányi, P. Olajos (3 males, OPC). Kolonjë district, Grammos Mts, Rehovë, forest brook E of the village, N40°20.111’, E20° 43.467’, 1445 m, 11.05.2014, T. Kovács, D. Murányi (4 males, OPC). Kolonjë district, Grammos Mts, Rehovë, spring at the Rehovë Monastir, N40°20.019’, E20°42.968’, 1265 m, 11.05.2014, T. Kovács, D. Murányi (3 males, 1 female; OPC). Kolonjë district, Barmash, large spring and its outlet in tall rush stands, NE of the village, N40°

17.034', E20°37.814', 955 m, 11.V.2014, T. Kovács, D. Murányi (12 males, 3 females; OPC). Erseke County, Grammos Mts, 2.8 km E of Starje, valley of Alikolare stream NW of Mt. Qukapeci, 1864 m, N40.361280°, E20.754580° 19.VII.2006, leg. Z. Barina, T. Pifkó & D. Pifkó (5 males, HNHM). Periferi Berat, Dardhë, beneath N slope of Çuka Partizan, 810 m, N40°26'45.0234", E20° 4'34.608", 9.IV.2006, leg. Z. Barina, T. Pifkó & D. Pifkó (1 male, HNHM). Skrapar County, Backe, spring section of River Mrbreti, under Mt. Faqekuq, 1969m, 5.VII.2006, leg. Z. Barina, T. Pifkó & D. Pifkó (1 male, 2 females, HNHM). Skrapa County, Backe, stream under the pass between Mt. Frengu and Mt. Faqekuq, 1913 m, 4.VII.2005, leg. Z. Barina, T. Pifkó & D. Pifkó (5 males, 2 females, HNHM). Skrapar county, Ceremica stream W of the village, 1534m, 6.VII.2006, leg. Z. Barina, T. Pifkó & D. Pifkó (2 males, 1 female, HNHM). Skrapar county, Ostrovicë Mts, Krojmbret spring NE of Backë, between the Frengu and Faqekuq Peaks, N40°31.753', E20° 25.152', 1965m, 21.VIII.2006, leg. Z. Fehér, A. Hunyadi, T. Huszár & D. Murányi (1 male, HNHM). Skrapar County, under the Mt. Ostrovica, 1960m, 6.VII.2006, leg. Z. Barina, T. Pifkó & D. Pifkó (5 males, 1 female, HNHM). Vlorë county, Cikë Mts, spring N of the Llogara Pass, N40°12'11.4", E19°35'15.5", 979m, 11.V.2006, leg. L. DányiI, J. Kontschán & D. Murányi (3 males, HNHM). Skrapar district, Ostrovicë Mts, Backë, spring with Juncus, N (above) the village, N40°31'13.2", E20°24'31.0", 1610 m, 29.V.2013, leg. P. Juhász, T. Kovács, G. Magos, G. Puskás, (19 males, 4 females; OPC). Diber district, Deje Mts. Sidestream of the Varoshit stream along the road to Lure area, 1215 m, N41°39.824', E20°11.720', 18.V 2010 leg. Z. Barina, Fehér, D. Murányi D. Pifkó & Ujvari (2 males, 1 female, HNHM). Mat district, Deje Mts. Hurdhe Muhur, open brook E of the village, 895 m, N39°41.908', E21°11.037', 20.V.2010 leg. Z. Barina & D. Pifkó (6 males, 4 females, HNHM). Bulqizë district, Çermenikë Mts, spring with Juncus, 2 km W of Bizë, N41°20'22.5", E20°08'04.5", 1390 m, 27.V.2013, leg. P. Juhász, T. Kovács, G. Magos, G. Puskás, (6 males, 9 females; OPC). Pukë District, rocky stream above Blinisht, N42°4' 58.44", E19°57'48.24", 1010m, 13.V.2014 leg. Z. Barina, D.Pifkó & G.Puskás (1 male, 4 females; OPC). Elbasan district Shushice**.** Burimi te Byshekut, 175 m asl. (limestone rocks stream) N41.1005°, E20.1249°, 17.04.2014 leg. Fehér, Németh, Mizsei (1 male, 1 female; OPC). Albania: Mirditë, Nënshejt village. N41°51.848', E20° 07.088', 1175 m, 4.VI.2013, leg. H. Ibrahimi, (2 males, 1 female; DBFMNSUP). Tepelenë, Uji i Ftoftë. N40°15.011', E20°03.548', 165 m. 2.VI. 2013, leg. H. Ibrahimi. (3 males. DBFM NSUP). Skrapar, Baçkë village. N40°31.314', E20° 24.833', 1750 m. 1.VI.2013, leg. H. Ibrahimi (1 male, 1 female; DBFMNSUP). Mt. Tomor, near Ujanik, N40.6148°, E020.1949°, 1476 m, 15.VII. 2018, leg. S. Beshkov & A. Nahimic (3 males, 1 female; OPC). Sarandë District, Vrinë, shore of river Lumi i Pavllës, 10m, N39.71786 E20.02033, leg. Z. Barina, D. Pifkó & G. Puskás 08.V.2014 (2 males, 1 female; OPC). **Greece**, Ioannina county, E of Metsovo, „Metzoboy 1987" spring, 39°45' 16.6", 21°08'56.4" 1027m, 13.V. 2006, leg. L. Dányi, J. Kontschán & D. Murányi (2 males, HNHM). Ioannina county, Kalpaki, Vellas Monasteri, karstic spring, 39°51'57.0", 20°37'26.1", 419m, 12.V.2006, leg. L. Dányi, J. Kontschán & D. Murányi (2 males, 1 female, HNHM). **West Macedonia**, Kozani peripheral unit, Neapoli, Aliakmonas River NE of the city, N40°19.976', E21°24.678', 555 m, 08.05.2014, T. Kovács, D. Murányi (8 males, 1 female; OPC). Grevena peripheral unit, Zakas, spring by the Venetikos River NE of the village, N40°02.285', E21°17.323', 690 m, 09.05.2014, T. Kovács, D. Murányi (4 males, 1 female; OPC). **Kosovo**, Reč. Radavac, 700 m, 17. V.1971, leg. Papp & Horvátovich **(**Pejë/Peč, spring area of Drini i Bardhë River in Radavc) (1 male, OPC). **Macedonia**, Polog region, Bistra Mts. Galicnik, stream at the village, 1435 m, N41°35.615', E20°39.965', 1. VII. 2010, leg. D. Pifkó Z. & Barina (1 males, HNHM). Polog region, Šar Planina, Bozovce, open brook W of the village, N42°02.759', E20° 47.776', 1545 m, 24. VI.2014, P. Juhász, T. Kovács, D. Murányi (2 males, OPC). Vardar region, Kožuf Mts, open brook in bushy alpine grassland towards Ski Kožuf, N41°11.968', E22°13.550', 1610 m, 25.VI. 2014, P. Juhász, T. Kovács, D. Murányi (1 male, OPC).

Remarks. *Notidobia nekibe* Klapálek, 1903, the nominate species of the complex is a very abundant inhabitant of spring areas, spring streams, small streams in Kosovo, Albania, Macedonia and Greece. According to the commonality and locality principles the possible ancestral species of the complex *Notidobia nekibe* is split from *Notidobia ciliaris* by developing the unique character state of the paraproctal head of the heavily sclerotized downward curving hook formation an unique genetical integration in the entire Sericostomatidae family. This specific character state of the paraproctal terminalia is combined with a single pair of ventromarginal spine-like process. The ventral mesobasal spine-like process lacking at its ancestral species *Notidobia ciliaris*, but present at all the other species of the complex even at *N. sagarrai* integrated independently very far, is also absent at *N. nekibe.*

Examining one population from Kosovo, 24 populations from Albania, three populations from Macedonia and four populations from Greece, we have recorded the paraproctal hook formation rather stable, but the ventromarginal spine-like process exhibited significant unstability. In lateral profile it is characterized with ventrobasal variously vestigial additional spine. It may require a special study covering more populations with more specimens to establish the real nature of any undergoing speciation processes represented by this ventrobasal additional spine.

Notidobia nogradorum Oláh, 2010

(Figures 50–52, Map 6)

Notidobia nogradorum Oláh, 2010:114–115. „This new species belongs to the homegeneous group of species: *Notidobia melanoptera* Stein, 1863 (Greece), *N. nekibe* Klapálek, 1903 (Greece), *N. sagarrai* Navas, 1917 (mistake: Sardinia, valid: Spain), *N. bizensis* Malicky et Sipahiler, 1993 (Albania) and *N. salihli* Malicky et Sipahiler, 1993 (Turkey). It is closest to *N. bizensis*, but differs by having (1) more robust and curve-shaped groove pattern on the IXth dorsum, not slender and straight; (2) the heavily sclerotized pair of paraproctal processes with extremely enlarged dorsal and downcurving hook-formation, not with small hook; (3) the two spine-shaped processes on the basomesal surface of the gonopod with separated individual bases, not with long joint basal plate." „Type material – Holotype, male, HNHM. Albania, Korcë district, Zvirine, Trifti Spring N of village, 835 m, N40°47.644', E20°44.128, 24.V.2007, leg. Z. Barina, Cs. Németh & D. Pifkó (1 male)."

Notidobia nogradorum Oláh, 2010: Malicky 2018:45. „I have directly compared the holotype of *Notidobia nogradorum* with the holotype of *N. bizensis* and found no differences in all relevant characters. Both species have been described from Albania. *Notidobia nogradorum* Oláh, 2010 = *Notidobia bizensis* Malicky & Sipahiler 1993. nov. syn."

Material examined. Holotype: **Albania**, Korcë district, Zvirine, Trifti Spring N of village, 835 m, N40°47.644', E20°44.128, 24.V.2007, leg. Z. Barina, Cs. Németh & D. Pifkó (1 male).

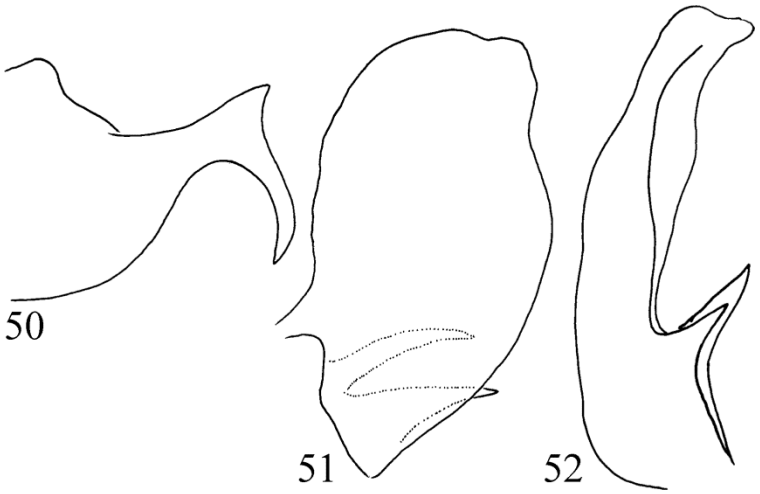
New diagnosis. Most close to *Notidobia bizensis* Malicky & Sipahiler, 1993, but differs by the less pointed and posterad, not upward directed dorsal spine-like process on the terminal hook-formation of the paraproct and the hook is longer and slender. The lateral profile of the gonopod differently shaped as well as in lateral view the ventro-basomesal and ventromarginal spine-like processes are deeply split, not separated only on the apical half having a long fused basal region forming together a common basement.

Notidobia sagarrai (Navas, 1917)

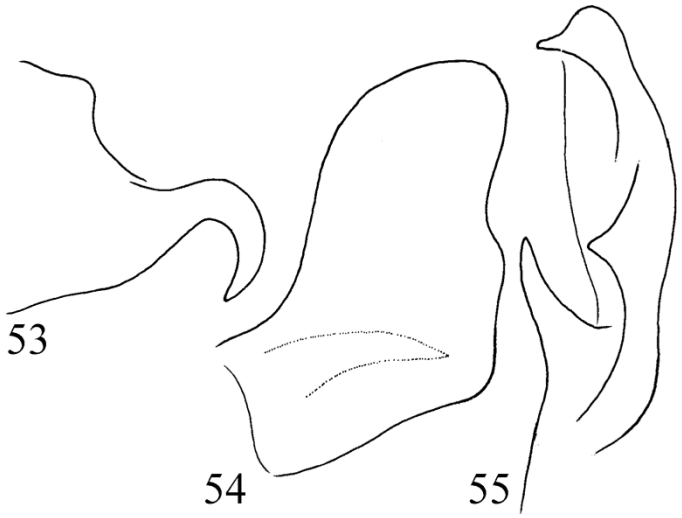
(Figures 53–55)

Cunia sagarrai Navas, 1917:14–16: „Patria. Cataluña: Santa Susana, Montseny, 26 de Abril de 1916. (Col. m.)."

Remarks. We have not got any specimen for a detailed genital study however, the pictures of Schmid (1949) and Malicky (1983) make possible to compare them to other species of the complex with downward directed hook-like paraproct terminalia. This is an interesting species diverged independently in Spain far from the relatives, the other members of *Notidobia nekibe* complex so diverse and populating the Balkan South of Kosovo and western coastal territories of Turkey.



Figures 50–52. *Notidobia nogradorum* Oláh, 2010. Male: 50 = paraproct in lateral view; 51= left gonopod in left lateral view; 52 = left gonopod in ventral view.



Figures 53–55. *Notidobia sagarrai* (Navas, 1917). Male: 53 = paraproct in lateral view; 54= left gonopod in left lateral view; 55 = left gonopod in ventral view.

Its genital structure suggests a diversification from the same genetical background and realised by the random rearrangement and combination of the same components of the ancient species of the genus *Notidobia ciliaris*. However, the genetical combination of components has produced the hook formation on the paraproctal terminal without any dorsal spine-like process present at all other members of the *Notidobia nekibe* species complex.

Notidobia salihli Malicky & Sipahiler, 1993

(Figures 56–58, Map 6)

Notidobia salihli Malicky & Sipahiler, 1993:471–472: „Holotypus ♂: Turkey, 4 km W Ürkmez, 38°04'N 26°56'E, 0 m, 19.V.1992, leg Malicky."

Material examined. Paratypes: **Turkey**, 19 km S Salihli, N38°23', E28°05', 1000m, 22.V.1992, leg. H. Malicky & F. Sipahiler (7 males, 2 females, OPC).

New diagnosis. According to the lateral profile of the paraproct most close to *Notidobia kerkina* sp. nov., but differs by the periphallic organ of gonopod having rectangular shape, not S-form shaped as well as by the less pronounced pointed dorsal spine-like process on the terminal hook-formation of the paraproct and the hook is distinctly rounded apicad.

Notidobia vaillanti Oláh, Vinçon & Ibrahimi, sp. nov.

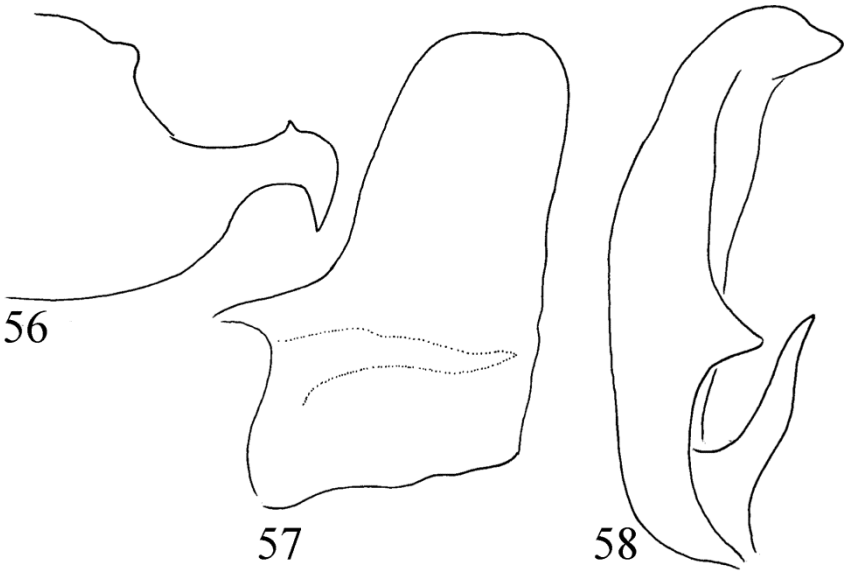
(Figures 59–61, Map 6)

Notidobia salihli Malicky & Sipahiler, 1993: Oláh & Kovács 2015:130. Misidentification.

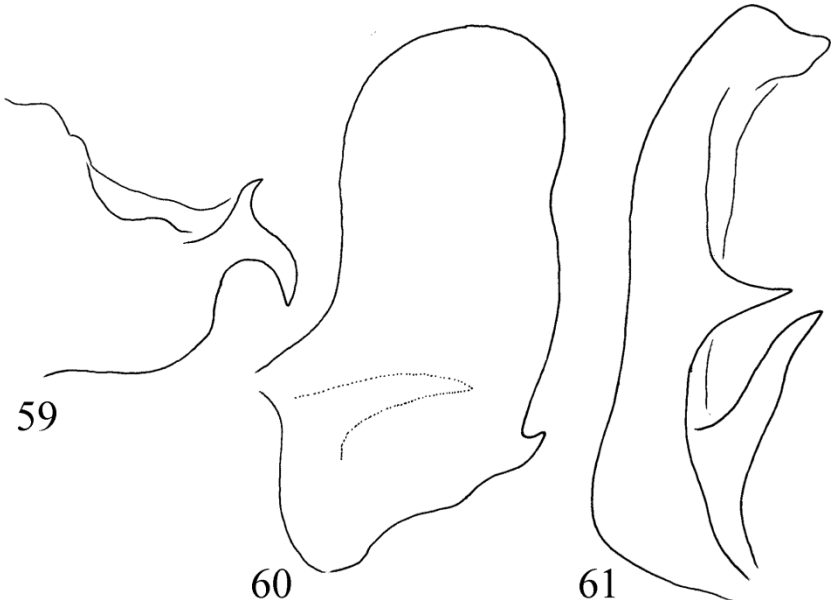
Material examined. Holotype: **Macedonia**, Polog region, Šar Planina, Bozovce, open stream, brooks and seeps W of the village, N42°03.147', E20°46.920', 1880 m, 24.VI.2014, P. Juhász, T. Kovács, D. Murányi (1 male, OPC). Paratypes: same as holotype (5 male, 1 female, OPC). **Kosovo**, Midstream area of Lepenc River, Brod village, Sharr Mountains. N42.2694°, E21.1261°, 702 m, 18.VI.2013, leg. H. Ibrahimi (2 males, DBFMNSUP). Midstream area of Lepenc River, Brod village, Sharr Mountains. N42.2694°, E21.1261°, 702 m, 19.VI.2013, leg. H. Ibrahimi (4 males, 1 female, OPC). Upstream area of Lepenc River, Sharr Mountains. N42.1813°, E20.9781°, 1465 m, 05.VI.2010, leg. H. Ibrahimi (1 male, 1 female; DBFMNSUP).

Diagnosis. Most close to *Notidobia lakmosa* sp. nov., but differs by the posterad curving pointed dorsal spine-like process on the terminal hook-formation of the paraproct and the hook is shorter, more robust and more curved. The lateral profile of the gonopod differently shaped having the apical region rounded withoud pronounced posterad direction as well as in ventral view the ventro-basomesal spine-like process is longer.

Description. Male (in alcohol). Dark castanean species. Cephalic and thoracic sclerites dark brown, almost black especially on the dorsum; appendages including legs lighter brown; haustellum and intersclerital membranous teguments whitish. Forewing length 11 mm; wing membrane brown, densely covered with decumbent setae.



Figures 56–58. *Notidobia salihli* Malicky & Sipahiler, 1993. Male: 56 = paraproct in lateral view; 57= left gonopod in left lateral view; 58 = left gonopod in ventral view.



Figures 59–61. *Notidobia vaillanti* Oláh, Vinçon & Ibrahimi, sp. nov. Holotype male: 59 = paraproct in lateral view; 60 = left gonopod in left lateral view; 61= left gonopod in ventral view.

Male genitalia. The dorsal spine-like process on the terminal hook-formation of the paraproct pointed pronounced and turning posterad the hook formation robust and curving. The lateral profile of the gonopod with rounded apical region as broad as the basal region; in lateral view the ventro-basomesal spine-like process is long, the marginal spine-like process is pointed, laterad directed.

Etymology. We have dedicated this remarkable member of the *Notidobia nekibe* species complex recently collected in Macedonia and Kosovo to our colleague François Vaillant whose important studies on the European species of the genus *Wormaldia* contributed significantly to our revisory works on *Wormaldia* both in the Balkan mountain ranges and in western Europe.

Oecismus mucidus McLachlan, 1876

Material examined. **Albania**, Korçë Region, Dardha, 1276m, N40°31’34”, E020°49’33”, 26.6.2017 meadow near stream with *Salix, Fagus* forest and hill with *Astragalus*, lamps, light traps leg. S. Beshkov & A. Nahirnic (1 male, OPC).

Sericostoma flavicorne Schneider, 1845

Material examined. **Albania**, Delvina Region, between Bistrica Village and Syri i Kalter, 127 m, N39°55’53”, E020°09’13” 13.V.2017, leg. S. Beshkov & A. Nahirnic (4 males, 1 female; OPC).

Sericostoma schneideri Kolenati, 1848

Material examined. **Bulgaria**, W Stara Planina Mts. Gushovski Monastir above Tchiprovtzi Town, N43.3661°, E22.8402°, 808 m, 26.VI. 2021, leg. S. Beshkov & A. Nahirnic-Beshkova (1 male, OPC). W. Stara Planina Mts, Zarezan Tcheshma above Tchuprene on Tchuprenska Reka river, 674m, N43.4874, E22.6154°, 24.VI. 2021°, leg.S. Beshkov & A. Nahirnić-Beshkova (40 males, 10 females; OPC).

Sericostoma turbatum McLachlan, 1876

Material examined. **Bulgaria**, Kraljevo, above Kamenica Village, Stolovi Mt. Veliki čukar, N43° 36’07”, E020°41’08”, 688 m, 4.VII.2021, leg. S. Beshkov & A. Nahirnic-Beshkova (1 male, 2 females; OPC).

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