

RESEARCH ARTICLE

Review of the Afrotropical genus *Neomaruina* Vaillant (Diptera, Psychodidae, Psychodinae)

Gunnar Mikalsen Kvifte* and Trond Andersen

Department of Natural History, University Museum of Bergen, University of Bergen, P.O. Box 7800, 5020 Bergen, Norway

Received: 18 May 2017; Accepted: 25 July 2017

Abstract – The genus *Neomaruina* is diagnosed, with several new apomorphic characters recognized. *Neomaruina ghanæ* n. sp. is described and illustrated based on an adult male specimen from Boti falls in Ghana. *Neomaruina usambarica* Wagner and Andersen, 2007 is redescribed and illustrated based on type and new material, in order to supplement the original description and to document variation in shape of gonostyli. A key to adults of all described *Neomaruina* species is presented, and the distribution of the genus within the Afrotropical region is discussed.

Keywords: Psychodidae / *Neomaruina* / new species / Afrotropical / taxonomy

1 Introduction

The genus *Neomaruina* was described by Vaillant (1963) from larvae collected in rapid-flowing streams where they attach to rocky substrates with conspicuous ventral adhesive organs (often termed “suckers”). Initially this was interpreted as evidence of a relationship with the chiefly Neotropical genus *Maruina* Müller, 1895. However, ventral suckers are also present in the Oriental genus *Neotelmatoscopus* Tonnoir, 1933 and in the more distantly related taxa *Horaiella* Tonnoir, 1933 (Psychodidae: Horaiellinae) and Blephariceridae (Duckhouse, 1985; Courtney, 2000). The widely divergent structures of the larvae and adults suggest that ventral adhesive organs in the larvae have evolved at least five times independently within Psychodomorpha s.l. (including Psychodidae, Tanyderidae and Blephariceridae).

Of the three lineages of Psychodinae with ventral suckers in their aquatic larvae, a recent revision is available for *Neotelmatoscopus* (Curler and Courtney, 2009), while *Maruina* was last treated in a monograph by Hogue (1973). Duckhouse (1985) reviewed *Neomaruina* including detailed descriptions of two species and two new combinations; however, several characters of the adult stages have still not been elucidated and no identification key is available.

Five species of *Neomaruina* are described so far: *N. deviata* (Tonnoir, 1939) and *N. pseudomaxima* (Tonnoir, 1939) from the Rwenzori Mountains in Uganda; *N. torosa* Duckhouse, 1985 and *N. stuckenbergi* Vaillant, 1963 from the Zomba Plateau in Malawi; and *N. usambarica* Wagner and Andersen, 2007 from the West Usambara Mountains in Tanzania (Duckhouse, 1985; Tonnoir, 1939; Vaillant, 1963;

Wagner and Andersen, 2007, see also Fig. 13). In the present contribution we review the diagnostic characters for all known species of *Neomaruina*, and describe *Neomaruina ghanæ* n. sp. based on adult specimens collected in Ghana. Further, we provide additional character evidence for *N. usambarica* Wagner and Andersen, 2007 based on previously unpublished material from Tanzania. An identification key and distribution map for all six described *Neomaruina* species are presented.

2 Materials and methods

The examined material was collected with nets and Malaise traps during expeditions to Ghana and Tanzania conducted by staff of the Zoological Museum of Bergen (now the University Museum of Bergen) in 1990 and 1991. Prior to examination the specimens were macerated in KOH and mounted on slides in Canada Balsam. For detailed information regarding the localities in Tanzania see Andersen and Johanson (1992).

Measurements are given as ranges followed by the mean when more than 3 specimens were available. All measurements were taken with an ocular micrometer in μm with an accuracy of 4 μm , except wing length which is given in mm with an accuracy of 0.02 mm. Morphological terminology follows Kvifte (2015).

All material is housed in the entomological collection at the University Museum of Bergen, Norway (ZMBN).

3 Results

Neomaruina Vaillant, 1963

Neomaruina Vaillant, 1963: 338. Type species: *Neomaruina stuckenbergi* Vaillant, 1963, by monotypy.

* Corresponding author: gunnar.kvifte@uib.no

Diagnostic characters (adult male): Eyebridge constricted, with 2–3 facet rows at base and 3–4 facet rows at middle of body axis; frons and clypeus fused; antenna with 13 flagellomeres; flagellomeres 1–11 symmetrical nodiform with Y-shaped ascoids, flagellomeres 12 and 13 diminutive, globular; labellum dorsoventrally compressed with distal row of digitiform sensilla; anepisternum with dorsal wing-shaped projection; tarsomere 5 with dorsal bilobed projection; male genitalia symmetrical with Y-shaped basiphallus and spatulate distiphallus fused with L-shaped parameres, surstyli shorter than epandrium with distal cluster of 3 or more unstriated, short tenacula.

Remarks. Newly recognized diagnostic characters are listed in italics above. For diagnoses of adult females and immature stages, see Duckhouse (1985).

Neomaruina ghanae n. sp.

(Figs. 1–7)

Type material. Holotype male: Ghana, Eastern Province, Boti Falls, 6.1894°N 0.2175°W, 19.xi.1990, sweep net, leg. J.S. Amakye.

Etymology. Named after the country of origin.

Diagnostic characters. Interocular suture incomplete, basiphallus without median keel and basally without lateral lobes, gonostylus S-shaped, evenly tapering towards apex; surstyli with 3 tenacula.

Description

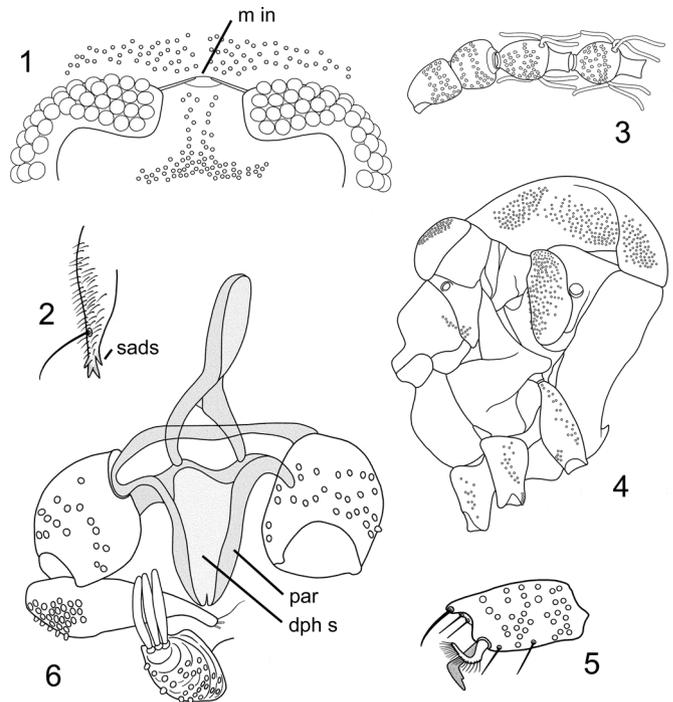
Adult male (n = 1).

Head. Wider than long; vertex about one-fifth of total head length, angular in dorsal view. Dorsal supraocular setae not discernible. Eyebridge (Fig. 1) of 2–4 irregular rows of facets, constricted basally, separated by 6 facet diameters. Interocular suture broadly V-shaped, unsclerotized medially; remnants of interocular spur preserved as internal sclerite of vertex. Setae alveoli on frons forming broadly T-shaped patch, reaching second posterior facet row. Length (in μm) of palp segments: 80, 152, 130, 200; 4th palp segment fully sclerotized. Labellum (Fig. 2) dorsoventrally compressed with three apical digitiform sensilla, one subapical to lateral digitiform sensillum, one dorsolateral and one ventral seta. Antennae (Fig. 3) of specimen incomplete with only up to 9 flagellomeres preserved; scape cylindrical, 96 μm ; pedicel elongate ovoid, 80 μm , 0.75 \times as broad as long; preserved flagellomeres symmetrical nodiform with internode approximately a third of flagellomere length, length (in μm) of preserved flagellomeres 120, 116, 120, 120, 108, 104, 100, 80.

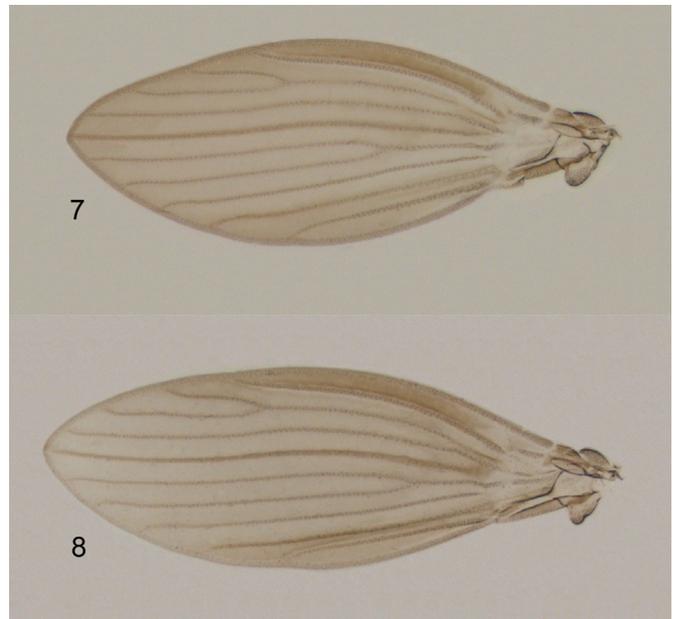
Thorax (Fig. 4). With wing-like dorsal extension of anepisternum barely reaching dorsal suture. Dorsum with large sections laterally and medially bare of seta alveoli. Scutellum with two longitudinal stripes of seta alveoli. Anepimeron triangular with micropilosity only; katepimeron triangular, bare; laterotergite with lateral stripe of seta alveoli at lower third. Metathoracic spiracle with operculum setose.

Legs. All coxae with dorsoventral stripes of seta alveoli, mid coxa also with apical rounded patch of seta. Legs short, less than twice height of coxa; 5th tarsomeres with dorsal apical extensions (Fig. 5).

Wing (Fig. 7). 1.62 mm long, 0.62 mm wide; membrane without pilosity. Area between C and R₁ infuscate; vague infuscations also present at base of R₅, between CuA₁ and

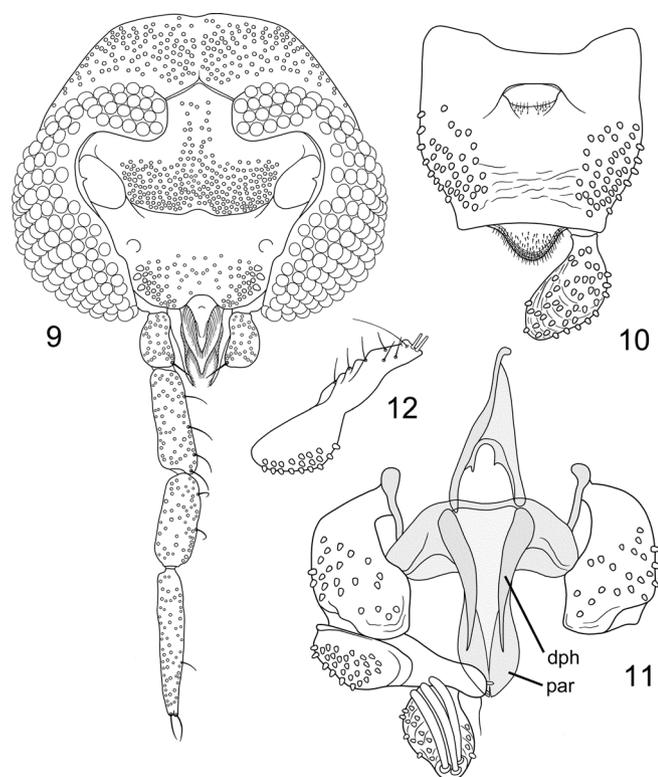


Figs. 1–6. *Neomaruina ghanae* n. sp., adult male. (1) Eyebridge and interocular suture, dorsal view. (2) Labellum, lateral view. (3) Scape, pedicel and basal flagellomeres, lateral view. (4) Thorax, lateral view. (5) Apical tarsomere, lateral view. (6) Terminalia, dorsal view (right gonostylus and surstyli not shown). *Abbreviations:* dph s – distiphallic spatula, m in – median interruption of interocular suture, par – paramere, sads – subapical digitiform seta of labellum.



Figs. 7–8. *Neomaruina* spp., adult males, wings. (7) *N. ghanae* n. sp. (8) *N. usambarica* Wagner and Andersen.

CuA₂ and between CuA₂ and C. C with two breaks; basal crossveins reduced; R₅ with outline slightly stronger sclerotized than rest of wing. Radial fork distal of CuA₂ apex, both distal to medial fork. Jugum U-shaped.



Figs. 9–12. *Neomaruina usambarica* Wagner and Andersen, adult male. (9) Head, dorsal view. (10) Epandrium, proctiger and right surstylus, ventral view. (11) Terminalia, dorsal view (right gonostylus, epandrium, proctiger and right surstylus not shown). (12) Gonostylus, ventral view. *Abbreviations:* dph – distiphallomere; par – paramere.

Genitalia (Fig. 6). Symmetrical. Hypandrium not discernible. Gonocoxites reniform without apparent parbasal processes; gonocoxal condyles weakly J-shaped, tapering towards middle where they curve anteriorly. Gonostyles acuminate with distal patch of poorly visible sensilla. Aedeagus with basiphallus Y-shaped with medial suture in “stem”, stem weakly sclerotized, spatulate. Distiphallus reduced or fused with parameres. Parameres hammer-shaped with broad end of hammer-head connected to basiphallus, narrow end pointed towards and probably connected with gonocoxal condyles; shaft not recurved, fusing indistinctly at apex with interparameral membrane (of aedeagal origin?); parameral-aedeagal complex reaching beyond apex of gonocoxites. Epandrium slightly longer than broad, sides converging slightly towards apex; with single large ovoid aperture. Surstylus subconical, about length of epandrium, covered in spatulate setae, apically with three tenacula. Tenacula unstriated, blunt; small beak-like projection present ventral to base of tenacula. Proctiger not visible in specimen.

***Neomaruina usambarica* Wagner and Andersen, 2007**

Neomaruina usambarica Wagner and Andersen, 2007: 293.

(Figs. 8–12)

Material examined. Holotype male: Tanzania, Tanga Region, West Usambara Mountains, Mazumbai, 4.813° S 38.504° E, loc F, 5.xi.1990, sweep net, leg. T. Andersen; paratype male: Tanzania, Tanga Region, West Usambara Mountains, Mazumbai, loc. A, 4–12.ii.1991, Malaise trap, leg.

T. Andersen; 3 males, Tanzania, Tanga Region, West Usambara Mountains, Mazumbai, Locs G, E & F, 2–6.xi.1990, Malaise trap, leg. T. Andersen.

Diagnostic characters. See key.

Redescription

Adult male ($n=5$, if not otherwise stated).

Head (Fig. 9). Wider than long; vertex about one third of total head length, rounded. Dorsal supraocular setae not discernible. Eyebridge of 3–4 irregular rows of facets, separated by 5–7 facet diameters. Interocular suture broadly U-shaped, complete; spur developed or undeveloped. Seta alveoli on frons forming broadly T-shaped patch, reaching interocular suture. Length (in μm) of palp segments ($n=5, 3, 2, 2$): 76–100, 84; 140–144; 156; 180–216. Labellum flat with four apical digitiform sensilla and two lateral setae. Antennae incomplete in all known specimens; scape cylindrical, slightly wider apically than at base; pedicel globular; flagellomeres 1–5 symmetrical nodiform with internode approximately one third of flagellomere length. Length (in μm) of scape, pedicel and first five flagellomeres ($n=5, 5, 5, 4, 2, 1, 1$): 76–100, 88; 72–76, 72; 120–148, 132; 108–128, 120; 112–116; 112; 108.

Thorax. With wing-like dorsal extension of anepisternum short, reaching only two rows of seta alveoli above dorsal suture. Dorsum covered in seta alveoli except two bare mediolateral stripes; bare stripes of dorsum disrupted dorsal to wing base by triangular patch of seta alveoli. Scutellum with two longitudinal stripes of seta alveoli. Anepimeron triangular with sparse coverage of seta alveoli; katepimeron pentagonal, bare; laterotergite with lateral stripe of seta alveoli in lower third. Metathoracic spiracle with operculum setose.

Legs. All coxae with dorsoventral stripes of seta alveoli, mid coxa also with mesoapical rounded patch of seta. Legs not preserved in any specimens.

Wing (Fig. 8). 1.6–1.76, 1.68 mm long; 0.58–0.68, 0.62 mm wide; membrane without pilosity. Area between C and R₁ infuscate. C with two breaks; basal crossveins reduced; R₅ with outline strongly sclerotized. Radial fork distad of CuA₂, both distal to medial fork. Jugum broadly angularly V- to U-shaped.

Genitalia (Figs. 10–12). Symmetrical. Hypandrium fused with parameral sheath and parbasal processes of gonocoxites, with ellipsoid expansion medially. Gonocoxites reniform; gonocoxal condyles well-developed, broad, arched, strongly angular. Gonostyles weakly S-shaped with broadened base (Wagner and Andersen 2007, Fig. 20); apically with row of about 4 digitiform sensilla, subapically with elongate setiform sensillum, ventrally with additional row of setiform short sensilla (Fig. 12). Aedeagus (Fig. 11) with basiphallus Y-shaped with broad distal arms and developed median keel, weakly bilobed at base. Distiphallus reduced or fused with parameres. Parameres L-shaped, recurved halfway towards apex, widened apically, connected by median membrane. Parameral-aedeagal complex reaching level of apex of gonocoxites. Epandrium (Fig. 10) slightly longer than broad, sides converging slightly towards apex, with single large subrectangular aperture. Surstylus club-shaped, slightly shorter than epandrium, covered with elongate setae, apically with three tenacula. Tenacula unstriated, blunt. Proctiger with oval setose epiproct and broad subrectangular hypoproct, both poorly sclerotized.

Key to males of *Neomaruina* Vaillant

The male of *N. pseudomaxima* (Tonnoir) is unknown.

- | | | |
|---|--------|--|
| 1. Interocular suture complete (Fig. 9).
– Interocular suture interrupted medially (Fig. 1). | 2
4 | |
| 2. Gonostylus droplet-shaped, without apical sensilla. Surstylus with 6–8 tenacula. Uganda.
– Gonostylus more elongate (e.g. Figs. 11 and 12), with apical sensilla. Surstylus with 3–5 tenacula. | 3 | <i>N. deviata</i> (Tonnoir, 1939) |
| 3. Gonostylus tapering from base to apex, with subapical setiform sensillum. Hypandrium narrower than base of parameres. Surstylus with 3 tenacula. Tanzania.
– Gonostylus thickened at base and abruptly narrowing towards apex; with apical group of spiniform sensilla. Hypandrium broader than base of parameres. Surstylus with 5 tenacula. Malawi. | | <i>N. usambarica</i> Wagner and Andersen, 2007

<i>N. torosa</i> Duckhouse, 1985 |
| 4. Jugum rounded. Base of ejaculatory apodeme without lateral lobes. Surstylus with 3 tenacula. Ghana.
– Jugum pointed. Base of ejaculatory apodeme with lateral lobes. Surstylus with 4 tenacula. Malawi. | | <i>N. ghanæ</i> n. sp.

<i>N. stuckenbergi</i> Vaillant, 1963 |

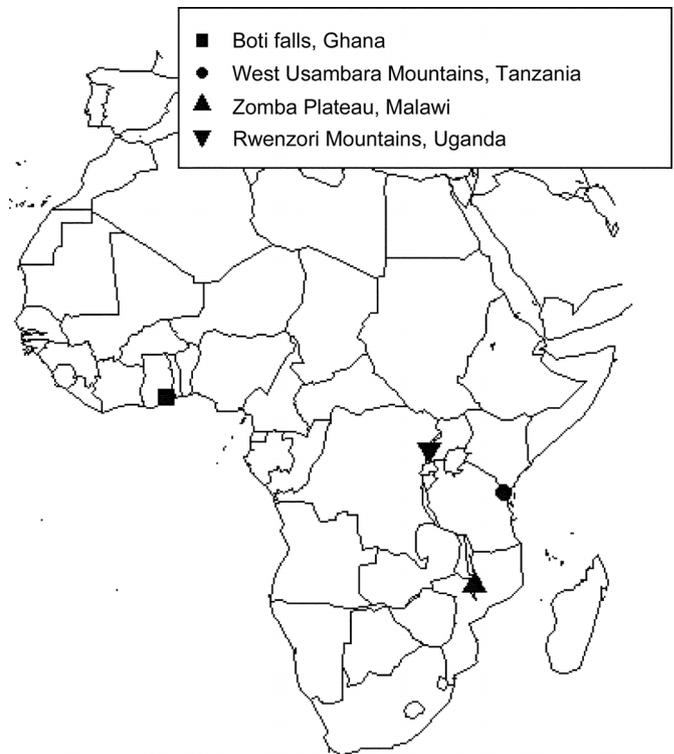


Fig. 13. Map of Africa showing the distribution of the *Neomaruina* species. Boti falls, Ghana: *N. ghanæ* n. sp.; West Usambara Mountains, Tanzania: *N. usambarica* Wagner and Andersen; Zomba Plateau, Malawi: *N. torosa* Duckhouse, *N. stuckenbergi* Vaillant; Rwenzori Mountains, Uganda: *N. deviata* (Tonnoir), *N. pseudomaxima* (Tonnoir).

Key to females of *Neomaruina* Vaillant

The females of *N. deviata*, *N. usambarica* and *N. ghanæ* are unknown.

- | | | |
|---|---|--|
| 1. Body vestiture black. Labellum with distal row of 7 peg-like sensilla. Wing length 3.9–4.3 mm. Uganda.
– Body vestiture grey. Labellum with distal row of 4–5 peg-like sensilla. Wing length 1.9–2.1 mm. | 2 | <i>N. pseudomaxima</i> (Tonnoir, 1939) |
| 2. Internal sclerite of female genitalia reaching base of median digit (Duckhouse, 1985, Fig. 42). Sclerotized band at base of subgenital plate thick along entire length, expanded medially and along lateral margins. Malawi.
– Internal sclerite of female genitalia convex distally, not reaching base of median digit (Duckhouse, 1985, Fig. 38). Sclerotized band at base of subgenital plate very narrow except median expansion, lateral margins not reaching edges of subgenital plate. Malawi. | | <i>N. torosa</i> Duckhouse, 1985

<i>N. stuckenbergi</i> Vaillant, 1963. |

4 Discussion

Neomaruina shares with *Psychoda* Latreille, *Rhipido-psychoda* Vaillant and *Epacretron* Quate the modified labellum with apical peg-like sensilla, which was suggested by both Quate (1959) and Vaillant (1990, 1991) to be a character of high phylogenetic value. Both Duckhouse (1985) and Vaillant (1990, 1991) considered *Neomaruina* and *Psychoda* to be closely related, which was also corroborated by the results of a quantitative phylogenetic analysis by Cordeiro (2013). The characters observed in the present study are in agreement with Cordeiro (2013), although e.g. the variable extent of the interocular suture in *Neomaruina* shows that the loss of this suture in *Psychoda* is not a unique apomorphy for the genus.

Our results come from examination of Malaise trap and sweep net collections from large expeditions to Ghana and Tanzania in the early 1990s, which yielded several hundred psychodid specimens. Still, only a very limited number of *Neomaruina* specimens were found, as was also the case for Tonnoir (1939) and Wagner and Andersen (2007). We deem it likely that the highly specialized larvae make the adults more localized and their abundances more difficult to assess by generalized collection methods. Probably more targeted, microhabitat-based sampling like that of B.R. Stuckenberg, which yielded the 12 specimens described by Duckhouse

(1985), will prove a more fruitful approach for collecting *Neomaruina* in the future.

The centre of diversity for *Neomaruina* appears to be in the East African mountain ranges, with species described from the Zomba Plateau (Malawi), the Rwenzori Mountains (Uganda) and the West Usambara Mountains (Tanzania) (Fig. 13). However, our description of a new species from Boti falls in Ghana (approximately 300 m a.s.l.), as well as the low abundances in non-targeted collection material, suggests that the genus may be overlooked elsewhere in the Afrotropical region.

Acknowledgements. The holotype of *N. ghanae* was collected by Dr. Joseph S. Amakye, IAB, Accra. Gladys Ramirez made most of the slide preparations. We are indebted to Rüdiger Wagner for access to his collection, and to Greg Curler for illuminating discussions on the ventral suckers in psychodiform larvae. Greg Curler and two anonymous reviewers provided very useful feedback on an earlier version of the manuscript.

References

- Andersen T, Johanson KA. 1992. Caddisflies (Trichoptera) from a mountain rain forest in NE Tanzania. In: Otto C, ed. *Proceedings of the Seventh International Symposium on Trichoptera, Umeå, Sweden*. Leiden: Backhuys Pub., pp. 59–64.
- Cordeiro DP. 2013. Filogenia de *Psychoda sensu lato* (Diptera, Psychodidae, Psychodinae) e o uso de marcadores moleculares na associação de sexos e identificação de espécies no Brasil. Thesis Dr. Sci. Biol. Univ. Federal do Paraná, Curitiba, 169 p.
- Courtney GW. 2000. Family Blephariceridae. In: Papp L, Darvas B, eds. *Contributions to a manual of Palearctic Diptera* (with special reference to flies of economic importance). Appendix. Budapest: Science Herald, 2000, pp. 7–30.
- Curler GR, Courtney GW. 2009. A revision of the world species of the genus *Neotelmatoscopus* Tonnoir (Diptera: Psychodidae). *Syst Entomol* 34: 63–92.
- Duckhouse DA. 1985. A re-examination of *Neomaruina* (Diptera, Psychodidae), with observations on its life-history and affinities and redefinition of the tribe Psychodini. *Ann Natal Mus* 26: 601–620.
- Hogue CL. 1973. A taxonomic review of the genus *Maruina* (Diptera, Psychodidae). *Nat Hist Mus Los Angel Cty Sci Bull* 17: 1–69.
- Kvifte GM. 2015. The Afrotropical genera of Psychodini: redefinition of the tribe, first Afrotropical record of *Perithreticus* Vaillant, 1973 and description of *Soeliella* gen. nov. (Diptera: Psychodidae: Psychodinae). *Zootaxa* 3986: 115–126.
- Quate LW. 1959. Classification of the Psychodini (Psychodidae: Diptera). *Ann Entomol Soc Am* 54: 444–451.
- Tonnoir AL. 1939. Psychodidae. *Br Mus (Nat Hist): Ruwenzori Exped 1934–5* 1: 35–80
- Vaillant F. 1963. An African Psychodid larva with ventral suckers (Diptera: Psychodidae). *Ann Natal Mus* 15: 333–343.
- Vaillant F. 1990. Propositions pour une révision de la classification des Diptères Psychodidae Psychodinae. *Bull Soc Vaud Sci Nat* 80: 141–163.
- Vaillant F. 1991. Sur la position générique et tribale de deux espèces de Diptères Psychodidae Psychodinae – classification de 2 espèces de Diptères. *Bull Inst R Sci Nat Belg Entomol* 61: 207–209.
- Wagner R, Andersen T. 2007. Psychodidae (Diptera: Nematocera) from the West Usambara Mountains, Tanzania. In: Andersen T, ed. *Contributions to the systematics and ecology of aquatic Diptera – a tribute to Ole A. Sæther*. Columbus, OH: The Caddis Press, pp. 287–307.

Cite this article as: Kvifte GM, Andersen T. 2017. Review of the Afrotropical genus *Neomaruina* Vaillant (Diptera, Psychodidae, Psychodinae). *Ann. Limnol. - Int. J. Lim.* 53: 309–313