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Notes on Sciomyzini (Diptera) of East Africa

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Abstract. This study examines two taxonomic groups of Sciomyzini flies from East Africa. First, the new species *Pherbellia markovi* **sp. nov.** is described and shown to be related to the Nigerian *Pteromicra zariae*, with supporting evidence presented for transferring the latter species to the genus *Pherbellia*. Second, new distribution records are provided for *Graphomyzina kivuana*, representing the first reports of this species from Ethiopia and Kenya. The study further investigates the content, unusual cosmopolitan distribution patterns, and phylogenetic relationships of the genus *Graphomyzina*, incorporating both ecological data and molecular phylogenetic analyses. As part of this work, new *COI* sequences were obtained for two *Graphomyzina* species and deposited in GenBank. Preliminary results of this study were presented at the XII All-Russian Dipterological Symposium (Saint Petersburg, 21–24 October 2024).

Keywords: Diptera, Sciomyzidae, *Pherbellia*, *Graphomyzina*, *Pteromicra*, East Africa

Заметки по Sciomyzini (Diptera) Восточной Африки

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Аннотация. Рассмотрены две группы Sciomyzini из Восточной Африки. (1) Описана *Pherbellia markovi* **sp. nov.**, родственная нигерийскому виду *Pteromicra zaria*, обсуждаются причины переноса *Pt. zariae* в род *Pherbellia*. (2) *Graphomyzina kivuana* впервые приводится в Эфиопии и Кении. Объем, беспрецедентное космополитическое распространение и родственные взаимоотношения рода *Graphomyzina* обсуждаются с использованием экологических данных и молекулярной филогении. Были получены и депонированы в Генбанке новые последовательности *COI* двух видов *Graphomyzina*. Работа была доложена на XII Всероссийском диптерологическом симпозиуме, Санкт-Петербург, 21–24 октября 2024 года.

Ключевые слова: Diptera, Sciomyzidae, *Pherbellia*, *Graphomyzina*, *Pteromicra*, Восточная Африка

Introduction

The family Sciomyzidae appears to have originated in the Holarctic region, where it exhibits its greatest diversity. Most species prefer temperate or cold climates, with the notable exception of *Sepedon* (and possibly several related genera), which has successfully colonized tropical regions worldwide. Other sciomyzid genera likely entered the Afrotropical realm during colder geological periods, persisting today primarily in mountainous areas and southernmost Africa, where they remain rarely collected.

The recent comprehensive treatment of West African Sciomyzidae by Knutson et al. (Knutson et al. 2018) prompted us to examine East African material in the Zoological Museum of Moscow University (ZMUM). Our collections from Tanzania, Kenya, and Ethiopia contained three Sciomyzini species, including *Ditaeniella milleri* Vikhrev & Murphy, 2022, which was treated in a separate publication (Vikhrev, Murphy 2022). The current study focuses on the remaining East African material representing *Pherbellia* Robineau-Desvoidy, 1830; *Graphomyzina* Macquart, 1835; and *Pteromicra* Lioy, 1864, while addressing relevant taxonomic and biogeographic questions. Although the ZMUM holds extensive East African *Sepedon* material (Tetanocerini), we defer treatment of this genus to future research.

Material and methods

All illustrations presented in this work are original unless otherwise stated. In this publication, figures are referenced with capital letters (Fig. or Figs.) when referring to illustrations contained herein, while lowercase (fig. or figs.) is used when citing figures from external sources.

Standard morphological terminology follows conventional abbreviations: *f1*, *t1*, *f2*, *t2*, *f3*, *t3* = fore-, mid-, hind- femur or tibia, respectively; *ac* — acrostichal setae; *dc* — dorsocentral setae; *prst* — presutural; *post* — postsutural; *a*, *p*, *d*, *v* = anterior, posterior, dorsal, ventral seta(e).

The studied specimens are permanently housed in the collections of the Zoological Museum of Moscow University (ZMUM), Russia.

The mitochondrial *COI* gene barcoding fragment was sequenced at Lopukhin Federal Research and Clinical Center of Physical-Chemical Medicine, Russia, Moscow. Additional sequence data were obtained from the Barcode of Life Data (BOLD) System. Phylogenetic analyses were conducted using Maximum Parsimony methods as implemented in the MEGA X software package.

Results

I. *Pherbellia markovi* sp. nov.

Fig. 1

Type material: the holotype, ♀: TANZANIA, Mbeya Mt. Range, 8.846° S, 33.534° E,

Figs. 1–2. *1* — ♀ holotype of *Pherbellia markovi* sp. nov.; *2* — ♂ of *Graphomyzina kivuana* Verbeke, 1950

Рис. 1–2. *1* — ♀ голотип *Pherbellia markovi* sp. nov.; *2* — ♂ *Graphomyzina kivuana* Verbeke, 1950

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Figs. 3–4. Wing of *Pherbellia zariae* (as *Pteromicra zariae*): *3* — from the original description (Knutson et al. 2018: 94, fig. 36); *4* — from Vala et al. (Vala et al. 2021: 1827, fig. 15)

Рис. 3–4. Крыло *Pherbellia zariae* (как *Pteromicra zariae*): *3* — из первоописания (Knutson et al. 2018: 94, fig. 36); *4* — из Vala et al. (Vala et al. 2021: 1827, fig. 15)

2380 m, 12.12.2015, N. Vikhrev; paratype ♀: the same locality and collector, 25.12.2021, both stored in ZMUM.

Description. Female. Body length 5.5–5.8 mm, wing length 4.2–4.5 mm.

Head wider than long. Frons very slightly narrowed anteriorly, shining brown with yellowish fore margin and a pair of small blackish orbito-antennal spots. Frontal triangle indistinct, of the same colour as the rest of frons, visible only as a triangular area devoid of frontal ground setulae. Two pairs of equally strong orbital setae. Gena and face dirty-yellow, occiput dark. Gena one third of height of eye. Antenna entirely black, postpedicel elongate elliptical, 2/3 as wide as width of gena. Arista brown, with medium dense brown hairs, total width of aristal hairing one third as wide as width of postpedicel. Palpus yellow with black apex.

Thorax dark brown, only scarcely shining; scutum with a pair of distinct grey submedian vittae along *dc* rows; lower pleura also grey pruinose; prosternum yellow, bare. Thoracic chaetotaxy: propleural seta strong, 1 postpronotal, 1 presutural, 2 notopleural, scutellum with 2 pairs of setae; 2 *post dc*, prescutellar *ac* absent, anepisternum bare, anepimeron with 6 setulae. Katepisternum with short black setulae.

Wing with costal margin entirely dark; the rest of wing with reticulate pattern consisting of 6–7 dark stripes, the preapical brown stripe wider than others, the very apex of wing hyaline (Fig. 1). Anal vein reaching posterior margin of wing. Halter with brown knob.

Legs. Coxae and trochanters yellow; femora yellow with black apices; tibiae mostly black, only in basal third dirty-yellow. Fore tarsus black with contrasting white 5-th tarsomere; mid and hind tarsi with tarsomeres 1 and 2 whitish; tarsomeres 3 to 5 blackish. Only one preapical seta on *t1* and *t3*; *f2* with typical *a* seta at middle; *f3* with 2-3 *ad* in apical half. Hind coxa bare on inner posterior margin.

Abdomen shiny brown, without distinct median vitta.

Etymology. The new species is named in honor of Alexander V. Markov in recognition

Figs. 5–6. Wings of *Pherbellia nana*: *5* — *Ph. nana nana* from Schorno et al. (Schorno et al. 2019: 113); *6* — *Ph. nana reticulata* (Son, Suh 2020: 580, fig. 3D)

Рис. 5–6. Крылья *Pherbellia nana*: *5* — *Ph. nana nana* из Schorno et al. (Schorno et al. 2019: 113); *6* — *Ph. nana reticulata* (Son, Suh 2020: 580, fig. 3D)

Figs. 7–8. Palaearctic *Graphomyzina: 7 — limbata* (photo: Gabor Keresztes); *8 — clathrata*

Рис. 7–8. Палеарктические виды *Graphomyzina: 7 — limbata* (фото: Gabor Keresztes); *8 — clathrata*

of his significant contributions to scientific research and public education.

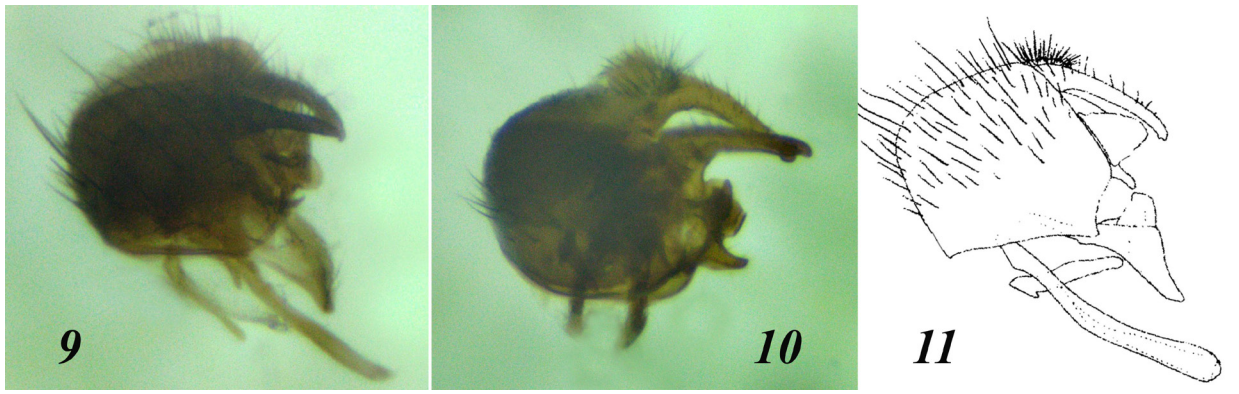
Biology. Unknown.

Specific diagnosis. Our examination builds upon the work of Knutson et al. (Knutson et al. 2018), who reviewed West African Sciomyzidae and described *Pteromicra zariae* Knutson & Deeming, 2018 (Figs. 3–4; here treated as *Pherbellia* — see Generic Diagnosis below). This species is currently known only from the type series: Nigeria, Zaria [11.1° N, 7.7° E], Dumbi Wood (holotype ♂ deposited at National Museum of Wales, Cardiff; paratypes 2♀ at National Museum of Natural History, Washington, and Institute for Agricultural Research, Samaru) (Knutson et al. 2018).

Knutson et al. (Knutson et al. 2018) additionally noted an undescribed related species from East Africa represented by a single male specimen from Tanzania: Pare Mountains (approximately 3.8° S, 37.7° E; corrected from the erroneous 'Pawe Mt.' in the original publication), collected 30 May 1963 by G. Hernrich (Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa). While briefly characterized by Knutson et al. (Knutson et al. 2018: 75), we confirm our female specimens represent this same taxon.

The two related African *Pherbellia* species differ as follows:

— Body length ♀ 5.5 mm. Two pairs of orbital setae. Antenna entirely black. Aristal setulae brown. Palpi black at apex. Wing



Figs. 9–11. Postabdomen with enlarged posterior surstyli of *Graphomyzina: 9 — clathrata*; *10 — kivuana*; *11 — yavana* (Knutson et al. 1990: 283, fig. 5)

Рис. 9–11. Постабдомен с увеличенными задними сурстилями видов *Graphomyzina: 9 — clathrata*; *10 — kivuana*; *11 — yavana* (Knutson et al. 1990: 283, fig. 5)

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darker: costal margin entirely dark; the rest of wing with reticulate pattern consisting of 6–7 dark stripes (Fig. 1). Apices of all femora black; *t2* and *t3* mostly black, only in basal third dirty-yellow . . . . . ***markovi*** sp. nov.

— Body length ♀ 3.0 mm. One pair of orbital setae. Antenna yellow. Aristal setulae white. Palpi entirely yellow. Wing pattern lighter: costal margin indistinctly darkened, reticulate pattern consisting of 4–5 dark stripes (Figs. 3–4). All femora and tibiae yellow . . . . . ***zariae*** (Knutson & Deeming)

Generic diagnosis. Knutson et al. (Knutson et al. 2018) classified both *P. zariae* and our new species *Pherbellia markovi* sp. nov. within *Pteromicra*, following Rozkošný's (Rozkošný 1987: 8–9) key to Palaearctic Sciomyzidae genera which assigns Sciomyzini with shining frons and predominantly black bodies to *Pteromicra*. However, this classification presents difficulties as no known *Pteromicra* species exhibits patterned wings. We find biogeographic evidence more compelling. *Pteromicra* shows a strict cold-temperate distribution, with no species occurring south of Central Europe. Conversely, *Pherbellia* includes several southern European species, with two documented from North Africa (*P. cinerella* Fallén, 1820 and *P. nana* Fallén, 1820). We propose that *Pherbellia zariae* comb. nov. and *P. markovi* sp. nov. represent descendants of *P. nana* that colonized Sub-Saharan Africa during past humid periods when the Sahara supported savanna rather than desert ecosystems.

Supporting this hypothesis, *P. nana* displays remarkably similar wing patterning — predominantly reticulate with hyaline apical regions (compare Figs. 1, 3–4 with Figs. 5–6).

Additional shared characters include dark rings at posterior femoral apices and conspicuously white fifth tarsomere on fore tarsi.

II. *Graphomyzina kivuana* Verbeke, 1950

Pherbellia (*Graphomyzina*) *kivuana* Verbeke, 1950: Knutson (Knutson 1980); Vala et al. (Vala et al. 2012)

Figs. 2, 10

Material examined: ETHIOPIA, *Oromia* Reg.: Ziway Lake, 7.910° N, 38.735° E, 1640 m, 11–13.03.2012, N. Vikhrev, 1♂; Awasa Lake, 7.079° N, 38.479° E, 1690 m, 15-16.03.2012, N. Vikhrev, 1♂. KENYA, *Nyandarua* Co., Ol Bolosat Lake, 0.12° S, 36.43° E, 2330 m, 20–23.12. 2013, N. Vikhrev and D. Gavryushin, 26 ♂♀.

Distribution. Congo (Zaire), Rwanda. New country records: Ethiopia and Kenya.

Remarks. Verbeke's (Verbeke 1950: 12) description stating 'tarses I noirs' requires correction — the fifth tarsomere of the forelegs is actually white.

Discussion

1. Diagnosis and content of *Graphomyzina*. *Sciomyza limbata* Meigen, 1830 = *Graphomyzina elegans* Macquart, 1835 was afterwards moved to the genus *Pherbellia*, with most authors currently accepting *Pherbellia* (*Graphomyzina*) *limbata* (Meigen, 1830) as valid (Vala et al. 2012). Verbeke (Verbeke 1950: 11) advocated reinstating *Graphomyzina* at generic rank, including West European *G. limbata* and three African species he described: *G. kivuana* Verbeke, 1950; *G. cingulata* Verbeke, 1950 and *G. costata* Verbeke, 1950. His generic diagnosis emphasized three key characteristics: reticulate wing pattern; scutum with distinct dark spotting, as well as broad and low head morphology. Knutson (Knutson 1980) subsequently proposed treating *Graphomyzina* as a subgenus of *Pherbellia*. However, given evidence suggesting *Pherbellia's* paraphyly (Tóthová et al. 2013), we support Verbeke's generic classification.

Based on Verbeke's (Verbeke 1950: 11) diagnostic criteria, we propose transferring *Pherbellia clathrata* Loew, 1874 to *Graphomyzina* (Fig. 8). This species shares the characteristic wing and scutal patterns, and notably possesses distinctive posterior surstyli resembling walrus tusks — a feature remarkably similar to those of *G. kivuana* and *G. javana* (Figs. 9–11).

With this revision, *Graphomyzina* now comprises ten species (Vala et al. 2012; present study):

G. limbata Meigen, 1830: Europe (Fig. 7)

G. clathrata Loew, 1874, **comb. nov**.: E Europe to Far East (Fig. 8)

G. kivuana Verbeke, 1950: Afrotropical (Fig. 2)

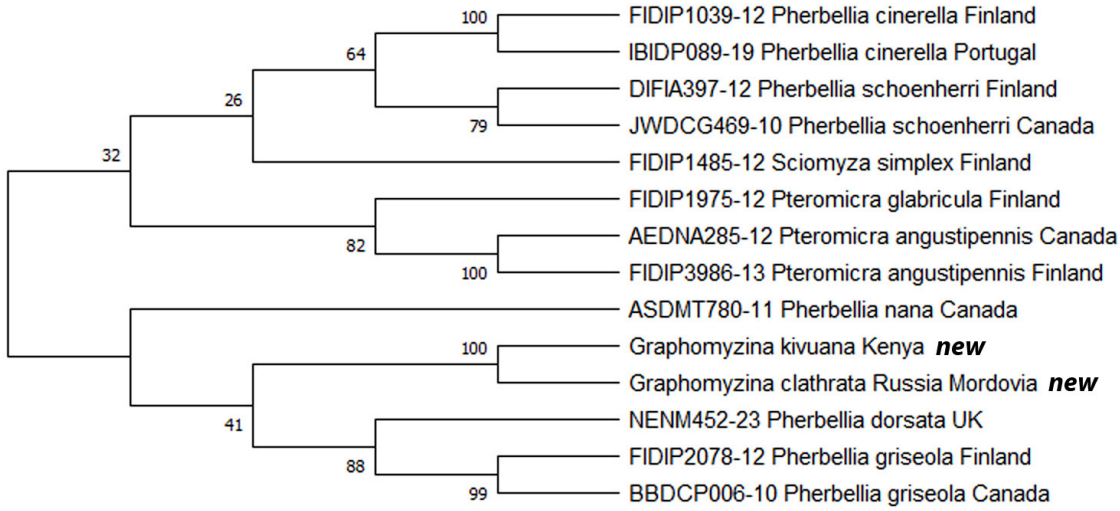

Fig. 12. Phylogenetic relationships among Sciomyzini taxa reconstructed using Maximum Parsimony analysis. The bootstrap consensus tree (1000 replicates) depicts inferred evolutionary relationships, The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test is shown next to the branches. Analysis includes 14 nucleotide sequences comprising 657 aligned positions. BOLD accession numbers are provided for all sequences, with newly generated sequences marked accordingly

Рис. 12. Филогенетический анализ некоторых таксонов Sciomyzini методом максимальной парсимонии. Для представления эволюционной истории анализируемых таксонов используется консенсусное дерево, построенно методом бутстрэпа (1000 повторений). Рядом с ветвями показан процент деревьев, в которых соответствующие таксоны сгруппированы вместе согласно бутстрэп-тесту. В этом анализе использовалось 14 нуклеотидных последовательностей. Всего в конечном наборе данных было 657 нуклеотидов. Для последовательностей *COI,* полученных из базы BOLD, указаны их идентификаторы

G. cingulata Verbeke, 1950: Afrotropical

G. costata Verbeke, 1950: Afrotropical

G. dives Bezzi, 1928: Fiji Islands

G. guttata Coquillett, 1901: from S USA to Colombia

G. trabeculata Loew, 1872 = *Sciomyza strigata* Wulp, 1897: California to Central America

G. javana Meijere, 1911: Yava and Australia

G. juxtajavana Knutson, Manguin & Orth, 1990: Australia

Preliminary molecular data on *Graphomyzina*. The phylogenetic relationships within Sciomyzini remain incompletely resolved, with the most comprehensive molecular study to date being that of Tóthová et al. (Tóthová et al. 2013). Their analysis of seven genes totalling 8,234 base pairs confirmed the monophyly of Sciomyzini while revealing a complex internal structure. The tribe was found to divide into two primary clades: one containing the *Pherbellia dorsata* species group along with the *P. nana* group and *P. argyra*, and another comprising all other Sciomyzini genera plus the majority of remaining *Pherbellia* species (Tóthová et al. 2013, fig. 2). This arrangement provides strong evidence for the paraphyletic nature of *Pherbellia* as currently defined.

We have tried to check the validity of the here considered genus *Graphomyzina* and its position among other Sciomyzini. No *COI* sequence of *Graphomyzina* was available. Two *COI* sequences obtained in the course of this study are marked in Fig. 12 as '**new**'. The obtained sequences were deposited in the GenBank NCBI database under the numbers: PQ354237 *Graphomyzina kivuana* Verbeke, 1950 (Kenya) (previously treated as *Pherbellia kivuana*); PQ354238 *Graphomyzina clathrata* Loew, 1874 (Russia, Mordovia) (previously treated as *Pherbellia clathrata*). We obtained the following results:

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1. *G. kivuana* and *G. clathrata* are closely related, they differ by two positions only among 657 bp in sequences examined (one of them is nonsynonymous substitution phenylalanine (F) in *G. kivuana* versus leucine (L) in *G. clathrata*).

2. Our phylogenetic reconstructions using *COI* sequences from BOLD Systems (Taxon ID: 1067943) (Taxonomy browser… 2024) consistently supported the fundamental division of Sciomyzini into Clades I and II originally proposed by Tóthová et al. (Tóthová et al. 2013).

3. Across all analyses, including the representative tree in Figure 12, both *G. kivuana* and *G. clathrata* were consistently placed within Clade I, forming a sister group relationship with the *Pherbellia dorsata* species complex. This topological arrangement received moderate bootstrap support, with values consistently ranging between 65–75% in our various analyses. We found no morphological explanation of this relationship. This result needs further verification.

Notes on unprecedented cosmopolitan distribution of *Graphomyzina*. The genus *Pherbellia* exhibits a classic Holarctic distribution, with no truly cosmopolitan species and only limited representation at biogeographic transition zones. In striking contrast, *Graphomyzina* (traditionally treated as a *Pherbellia* subgenus) displays an exceptionally broad, nearly worldwide distribution that demands explanation. Beyond the two Palaearctic species described in the 19th century, various *Graphomyzina* populations have been documented from multiple isolated regions across the globe. The African presence of *Graphomyzina* is a likely result of natural colonization during past humid periods, particularly the most recent pluvial episode ending 5000–6000 years BP when Sahara vegetation resembled xerothermic steppe. This hypothesis finds support in remarkable morphological parallels between African and Palaearctic *Graphomyzina* species:

— Costal margin of wing hyaline with 3–5 brown spots; posterior surstylus very long, curved, walrus tusk-like .... *clathrata* Loew & *kivuana* Verbeke

— Costal margin of wing entirely or mostly (with 2–3 small white spots) dark; posterior surstylus short .... *limbata* Meigen & *costata* Verbeke

However, the genus' occurrence in Central America, Australia, and especially Fiji almost certainly reflects anthropogenic introduction from Palaearctic or Afrotropical realms. The biological traits of *Graphomyzina* may predispose it to human-mediated dispersal — Nerudová-Horsáková et al. (Nerudová-Horsáková et al. 2016) demonstrated that *G. limbata* specializes as a parasitoid of the xerotherm-adapted land snail *Granaria frumentum*. Both organisms tolerate desiccation, and we propose that snails or pupa-containing snail shells could have been transported globally via livestock fodder or grain shipments during recent centuries (100–300 BP). This introduction scenario implies that many described *Graphomyzina* species should be synonymized. The taxonomic question of who should be synonymized with whom, however, requires comprehensive global sampling and analysis currently unavailable.

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