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DOI: https://doi.org/10.3897/arphapreprints.e142148

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# New data about morphology of *Kurzia longirostris* (Daday, 1898) (Crustacea, Branchiopoda) based in populations from the Congo River Basin

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**Abstract**
The African Cladocera fauna is recognized by high endemism. Several studies have helped to understand the diversity and geographic distribution of some groups of Chydoridae on the continent. However, the literature indicates the presence of species whose natural distribution is presumed to be in other continents, suggesting that the diversity and endemism in Africa are still underestimated. Despite the absence of more comprehensive knowledge about morphology of *Kurzia longirostris* to *terra typica* (Oriental region), our findings reveled slightly morphological differences between Congo River populations when compared with literature data. Looking at the high morphological variability along the range of geographic distribution, it is increasingly clear that *K. longirostris* might be indicated as a species complex. Thus, the idea of continental endemism should be tested in a future revision of the group.

**Key words**
Chari River Basin, Chydoridae, endemism, Nile Rive Basin, taxonomy

## Introduction

The African Cladocera fauna is recognized by high endemism, especially related to Chydoridae (Chiambeng and Dumont, 1998; Sinev 2006, 2008; Smirnov 2008; Van Damme and Dumont 2009; Van Damme and Eggermont 2011; Van Damme et al. 2013; Neretina and Sinev 2021). Currently, the diversity on the continent is better understood due to several studies related to species groups within *Leydigia* Kurz, 1875, *Acroperus* Baird, 1843, *Anthalona* Van Damme, Sinev and Dumont, 2011, *Coronatella* Dybowsky and Grochowski, 1894, *Nicsmirnovius* Chiambeng and Dumont, 1999 and *Biapertura* Smirnov, 1971 *emend.* Sinev 2020 (Van Damme et al. 2003; 2011; Kotov 2009; Sinev 2009; Neretina and Kotov 2015; Van Damme 2016). Despite that, we found in Africa species with a wide range of distribution which also occurs throughout areas in the

Palearctic and Oriental zones, for instance *Anthalona harti* Van Damme, Sinev & Dumont, 2011 (Van Damme et al. 2011) and *Leberis punctatus* (Daday, 1898) (Neretina and Sinev, 2016). At the same time, there are several reports of taxa considered as species-complex, for instance, *Chydorus sphaericus* (O.F. Müller, 1776), *Prendalona guttata* (Sars, 1862) and *Alona intermedia* Sars, 1862 (Dumont et al. 1981; Dumont 1981; Van Damme and Eggermont 2011). These reports suggest that the diversity and endemism in Africa is still underestimated.

*Kurzia longirostris* (Daday, 1898) also occurs in the Afrotropical zone presenting a wide range of distribution since Oriental (*terra typica*), Neotropical and Australasian regions (Gauthier 1937; Rajapaksa and Fernando 1986; Rey and Saint-Jeans 1969; Smirnov 1971; Dumont 1981; Hudec 2000; Sinev 2016). The history of taxon began when Eugen Von Daday described *Alona longirostris*. After that, Sars (1901) reported the presence of species in Brazil and suggested it translocation to genus *Pseudoalona* Sars, 1901. The name *Pseudoalona longirostris* was used in posterior publications (Brehm 1933, 1934; Gauthier 1937) until Harding (1957) indicates that *P. longirostris* fit with genus *Kurzia* Dybowski & Growshoski, 1894, assumption widely accepted in recent times (Smirnov 1971; Hudec 2000; Sinev 2016; Neretina et al. 2017).

Besides a wide geographic distribution on the tropical and subtropical areas, morphological data about *K. longirostris* present considerable variation, especially in the postabdomen, rostrum and labrum. Such findings indicate the need for taxonomic review to better understand limb morphology. To elucidate the limbs morphology of African some populations, we analyzed the morphology of *Kurzia longirostris* collected in rivers and streams from the Congo River Basin.

## Material and Methods

### Morphological analyses

The animals used for this study were selected under a binocular stereo microscope, mounted in drops of glycerin on slides and studied under an Olympus BX41 phase contrast microscope to investigate the morphological traits. The presentation of morphological structures follows the suggestions of Van Damme (2016). To enumerate the limb setae, we adopted the homology criteria of Kotov (2000a, 2000b), which exhibited stability when tested in different groups of cladocerans (Kotov et al. 2010). All drawings were made using a camera lucida and digitally covered using a graphic tablet.

### SEM processing

The samples were first fixed in 2.5% glutaraldehyde in 0.1 M phosphate buffer pH 7.3, for 4 hours. The samples were then washed three times for 5 minutes each in distilled water. The samples were then immersed in 0.5% osmium tetroxide in distilled water for approximately 30 to 40 minutes.

Afterward, the material was washed three times in distilled water for 10 minutes each time. The samples were then dehydrated in an increasing series of alcohol concentrations, starting at 7.5% and gradually increasing to a maximum concentration of 100%. Finally, the samples were brought to a critical point and then placed in stubs and metallized, making them conductive and ready for electron microscopy analysis.

All processing and acquisition of Scanning Electron Microscopy (SEM) images were performed at the Electronic Microscopy Center of the Botucatu Institute of Biosciences, UNESP, Botucatu Campus.

**Abbreviations of scientific collections**
**FDRS** Personal collection of Francisco Diogo Rocha Sousa.

**Abbreviations used in the figures and the text**
en – endite; ep – epipodite; ex –exopodite; gfp – gnathobasic filter plate; gn – gnathobase; IP – interpore distance (distance between the anterior and posterior major head pores); IDL – inner distal lobe; il – inner lobe; L1 – First limb; L2 – Second limb; L3 – Third limb; L4 – Fourth limb. ODL – outer distal lobe; PP – postpore distance (distance between the posterior major head pore and the posterior border of the head shield); s – sensillum.

**Results**
**Taxonomy**
**Class Branchiopoda Latreille, 1817**
**Order Anomopoda Sars, 1865**
**Family Chydoridae Dybowsky and Grochowski, 1894 *emend.* Frey, 1967**
**Subfamily Aloninae Dybowsky and Grochowski, 1894 *emend.* Frey, 1967**
**Genus *Kurzia* Dybowsky and Grochowski, 1894**
***Kurzia longirostris* (Daday, 1898)**
*Alona macrohyncha* in Daday (1900)

**Material Examined**
Eight adult parthenogenetic females from the Congo mainstem, Congo River Basin (-0.60979 / -4.02029, 17.6667 / 18.21978), material collected between 17.xii.2013 and 06.v.2015 (FDRS0703). Five adult females from the Kasai River, Congo River Basin (-3.26218 / -3.26218, 17.46914 / 19.2611), material collected between 20.iv.2015 and 26.iv.2015 (FDRS0704). One adult parthenogenetic female from the Itimbiri River, Congo River Basin (2.06387, 22.69562), material collected on 13.vi.2014 (FDRS0705). One adult parthenogenetic female from the Ikelemba River, Congo River Basin (0.10862, 18.29738), material collected on 19.vi.2014 (FDRS0706). One adult parthenogenetic female from the Ruki River, Congo River Basin (0.07411, 18.31294), material collected between 20.vi.2014 (FDRS0707). One adult parthenogenetic female from the Kamatsha River, Congo River Basin (-3.71521, 18.92626), material collected between 25.iv.2015 (FDRS0708).

**Description of parthenogenetic females**

**General Habitus** (Figs 1A-B, 4A-B): Rounded body, length ranging between 0.42-0.52mm, height/length ratio ranging between 0.68-0.75; dorsal margin arched, with moderate dorsal keel, without lateral projections; in dorsal (Fig. 1C) and ventral (Fig. 1D) views is compressed laterally.

**Carapace** (Figs 1E, 4E): Covered by longitudinal lines on the valves and head shields; the anteroventral margin rounded, with an evident flange; the ventral margin is almost rounded, with a distinctive rounded angle at 2/3 of the margin's length. There are 38-44 setae at valve ventral margin organized in three groups; anterior group with 5-6 long and naked setae, median group with up 21 plumose and short setae, posterior group with up

17 plumose setae. Posterior margin clearly rounded, armed with spinulae that exceed the marginal line of valves.

**Cephalic structures** (Figs 1F-J, 4F): Ocellus smaller than the eye. *Head shield* (Fig. 1F). Covered by longitudinal lines. *Rostrum* (Figs 1F-G, 4C-D). long and slightly curved, in frontal view the tip is not sharp, about 1.3-2 times longer than the antennular body. Posterior margin triangular-shaped. *Head pores* (Figs 1H, 4G-H). Three main head pores which anterior and posterior are longer than median pore, connected by a thick rim; posterior pore transversally elongated, sometimes bilobed; lateral pores inserted in a deep depression, distance from the median main head pore about 1.6 times PP; PP/IP about 0.42. *Labrum* (Fig. 1I-J). Short, armed with lateral horns. Keel triangular shaped, free of spines or notch, apex round or slightly sharp. *Antennule* – A1 (Fig. 1K). Approximately 4.5-5 times longer than wide, never extending beyond the tip of the rostrum; antennular sensory seta slender, about 2.5-3.1 times shorter than the length of the antennular body, inserted near the middle length of antennular body; nine aesthetascs which three are longer than others but shorter than the antennular body, protruding beyond the tip of rostrum. *Antenna* – A2 (Fig. 1L). Basal segment thick, with a short spine. First exopodite segment of similar length to the first endopodite segment, armed with two cluster of long setulae, apical seta bisegmented and plumose, longer than the segment itself; second exopodite segment with a bissegmented and plumose seta that as long as the longest apical setae of third segment; apical spine similar in length to the endopodite apical spine. First endopodite segment armed with a spine about two times shorter than the apical spine on third segment. Antennal formula (exo/endo): spines 001/101, setae 113/003. *Maxilla* (Fig. 1M). Well developed, with two long setulated setae.

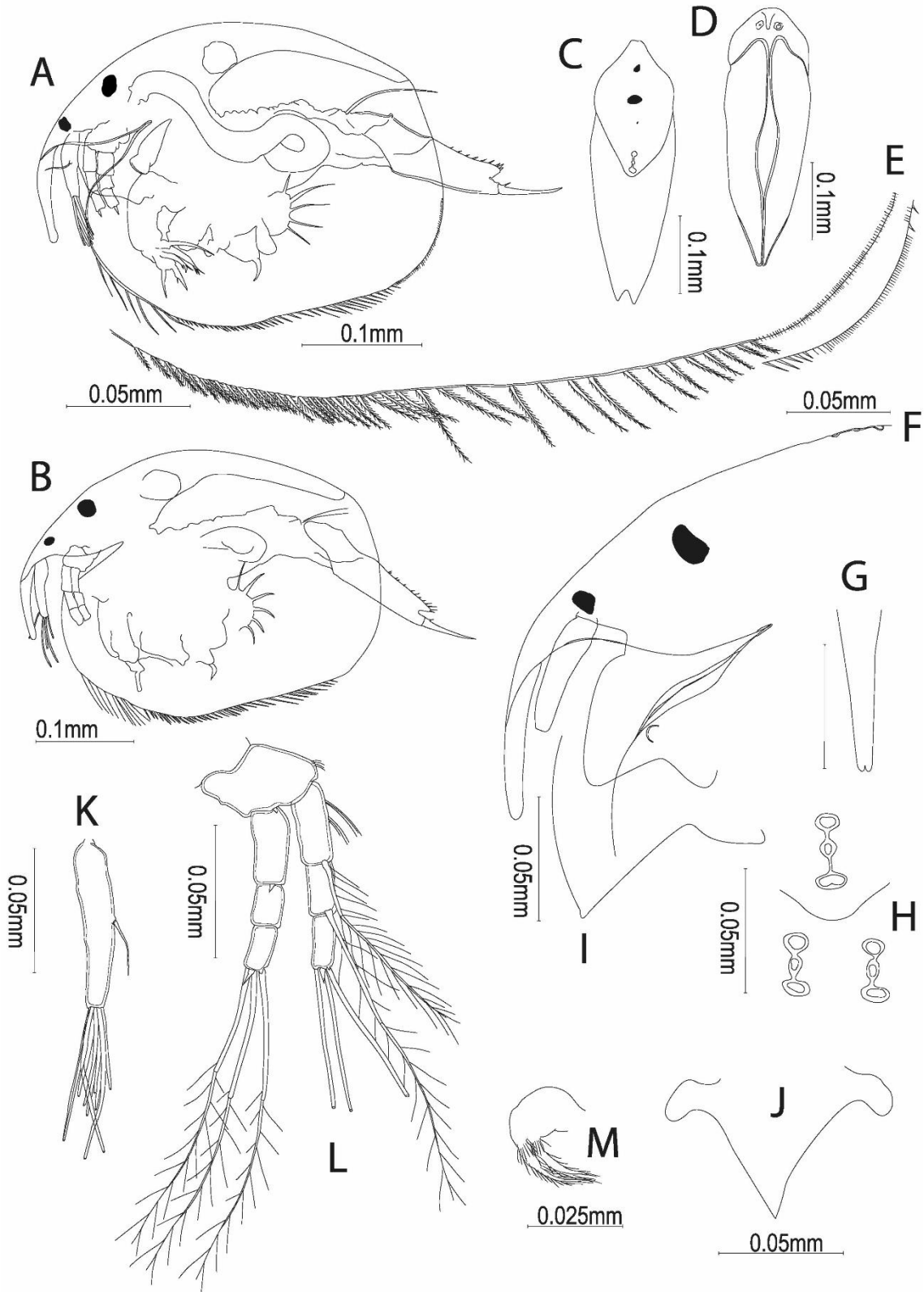


**Figure 1.** *Kurzia longirostris* (Daday, 1898) from the Congo River Basin, Africa, parthenogenetic female. A-B: Habitus. C: Dorsal view. D: Ventral view; E: Ventral margin of carapace, median and posterior portions. F: Rostrum; G, *idem*, frontal view. H: Head pores. I: Labral keel. J: *idem*, frontal view showing the lateral horns. K: Antennule. L: Antenna. M: Maxilla.

**Thoracic limbs** (Figs 2A-I, 4I): Five pairs of thoracic limbs.

*First limb* (Figs 2A-C, 4J). Epipodite oval, armed with a short digitiform projection. ODL seta bisegmented, armed with fine and short spines, longer than the IDL third seta; accessory seta plumose, similar in length to ODL seta. IDL (en4) with one group of short setulae on the corm, three setae present; seta 1 armed with spines, about two times shorter than setae 2-3 in length; seta 2 slightly shorter than seta 3; setae 2-3 chitinized and bisegmented, armed with relatively short and thick proximal spines. Endite 3 with four setae; anterior seta 1 thin and unarmed about 1.4 times longer than posterior seta (c); posterior setae (a-b) of similar length among themselves, armed with spines on the middle part, shorter than the anterior seta 1; seta (c) armed laterally with short spines, shorter than the setae (a-b). Endite 2 with three posterior setae present (d-f); seta (d) armed with short spines near to middle part, about 1.7 times shorter than the seta (e); seta (e) long, armed laterally with short spines; seta (f) about 1.2 times longer than the seta (d) and 1.3 times shorter than seta (e). Endite 1 with two posterior setae of similar length (g-h), which are bisegmented and densely setulated on the distal part. Ejector hooks of similar length among themselves and armed with spines; ventral face of the limb with 6-8 cluster of thick setulae. Gnathobase not studied.

*Second limb* (Fig. 2D). Exopodite without seta, armed with two rows of short spinulae. Inner limb portion armed with eight scrapers; scraper 1 similar in length of scraper 2; a long element present near to scraper 1 base; scrapers 3-4 similar in length, about 0.8 of scraper 1 length; scrapers 5 shorter than the scarper 4-3, about 0.8 of scraper 1 length; scrapers 6-7 of similar length, shorter than the scraper 5, about 0.4 of scraper 1 length; scraper 8 shorter than scrapers 6-7, about 0.3 of scraper 1 length; scraper 6-8 armed with spines ticker than the other scrapers. Proximal portion of the gnathobase setulated, armed with four elements; filter plate with seven setulated setae.

*Third limb* (Fig. 2E-F). Epipodite oval, with two short projections. Exopodite rectangular armed with five distal and two lateral setae; seventh seta setulated, longer than the sixth, similar in length to third seta; fifth seta geniculated, densely setulated, about 3.3 times longer than the fourth seta, about 2.5 times longer than the second seta; fourth seta densely setulated, about 2.2 longer than third seta; second seta plumose, about 3 times longer than third seta, about 1.2 times longer than first seta; first seta armed latterly with short setulae. Distal endite with three setae (1–3), seta (1–2) scraper-like, seta (3) curved and armed with many setulae bilaterally implanted; four plumose posterior setae increasing in length toward to posterior part of the endite (a–d). Basal endite with four soft anterior setae 4–7) of similar length. Gnathobase armed with four elements, the first being a cylindrical sensillum, the second a geniculated and relatively short seta, third and fourth elements naked; filter plate with five plumose setae.

*Fourth limb* (Fig. 2G-H). Pre-epipodite oval and densely setulated; epipodite oval with two projections. Exopodite wide, with six plumose marginal setae; sixth seta slightly longer than fifth seta; fourth seta about 0.8 of sixth seta length; third seta about 0.6 of sixth seta length; second seta longer than the first seta, about 0.4 of sixth seta length; first seta about 1.8 times shorter than the third seta, about 0.3 of sixth seta length; third seta about 1.5 times longer than second seta. Distal endite with four setae (1-4); seta 1 chitinized; flaming-torch-like setae (3-4) markedly shorter than the seta 1. Basal endite armed with three setulated setae which increase in length towards to gnathobase (a-c). Gnathobase with two elements, armed with a seta which is similar in length to the width of the endite; filter plate with five setae.

*Fifth limb* (Fig. 2I). Pre-epipodite rounded and densely setulated; epipodite oval, with two projections. Exopodite bilobate, armed with four plumose setae; first seta about two times shorter than fourth seta; second and third setae similar in length, about 1.6 longer than the first seta; fourth seta about 1.4 times longer than second and third setae. Internal lobe wide, rounded and with many setulae; setae 1-2 setulated; seta 1 about 1.6 times longer than seta 2. Gnathobase armed with two elements, filter plate absent.

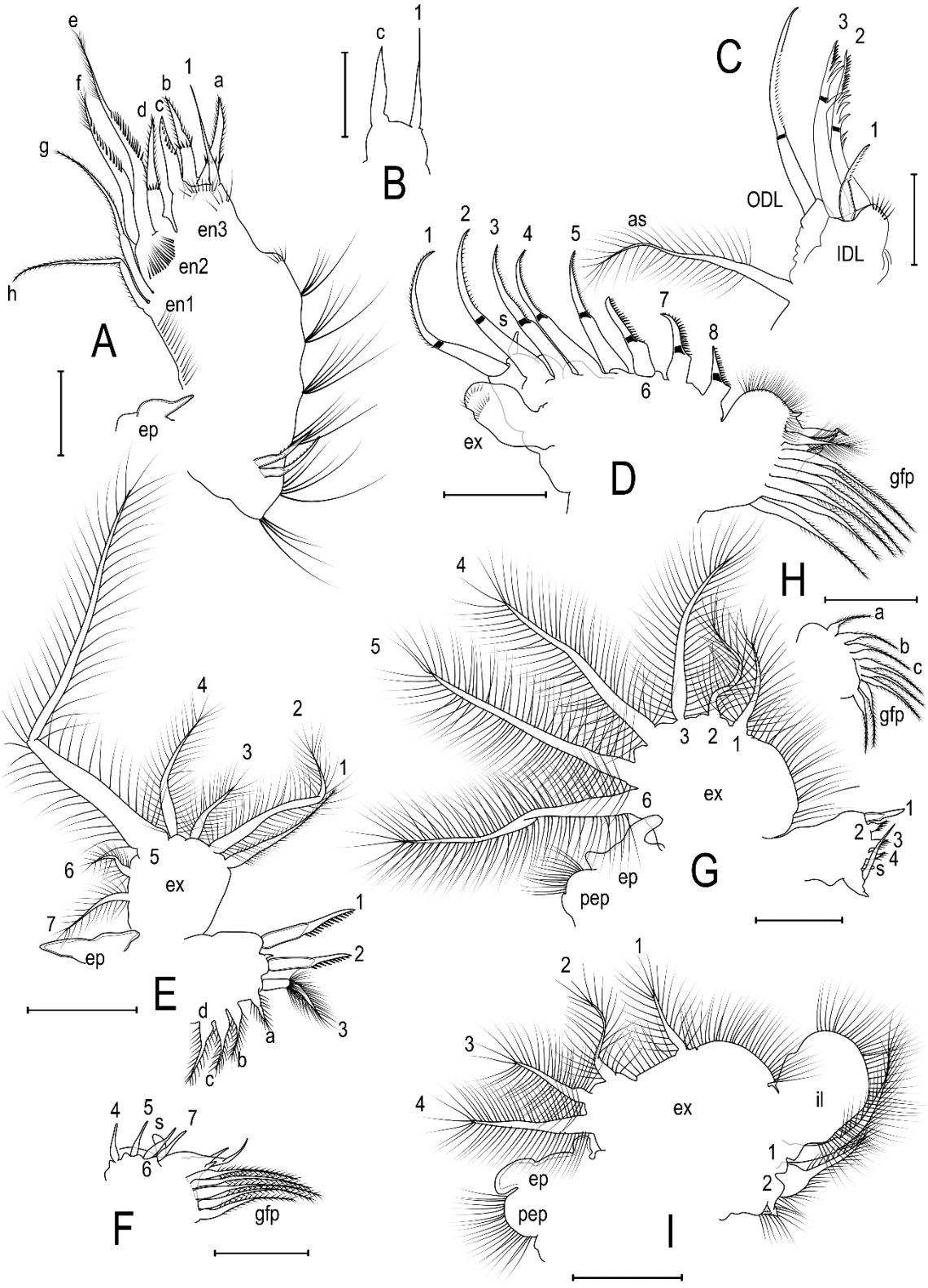

**Figure 2.** *Kurzia longirostris* (Daday, 1898) from the Congo River Basin, Africa, parthenogenetic female. A: First limb. B: *idem*, endite 3. C: idem, ODL and IDL. D: Second limb. E; Third Limb. F: *idem*, basal endite. G: Fourth limb. H: *idem*, basal endite and gnathobasic filter plate. I: Fifth limb.

**Abdominal and postabdmominal structures:** *Abdomen* (Fig. 3A). About three times shorter than the thorax, two transverse rows of setulae present at its dorsal surface. *Postabdomen* (Figs 3A-C, 4K-M). Narrow, about 4.5-7.5 times longer than wide; ventral margin slightly curved; preanal and anal margins of similar length, angles prominent; postanal part elongated, margin markedly concave, distalmost part projected beyond postabdominal claw base; 8-12 marginal denticles, distalmost denticles might be isolated, proximal most denticles might be accompanied by 1-4 fine and short spines; 11-16 lateral fascicles formed by thin and short spinulae. Postabdominal setae about 0.6 of postabdomen length, bisegmented, armed with setulae in the distal segment. *Postabdominal claw*. With spicules on the surface, longer than the anal margin, about 0.35-0.5 of the length of the postabdomen; pecten with proximalmost spinulae longer than the distalmost ones. *Basal spines* (Fig. 4M). Armed with spiculae, about 0.08-0.09 of length of the postabdominal claw, shorter than the width of postabdominal claw at its base.

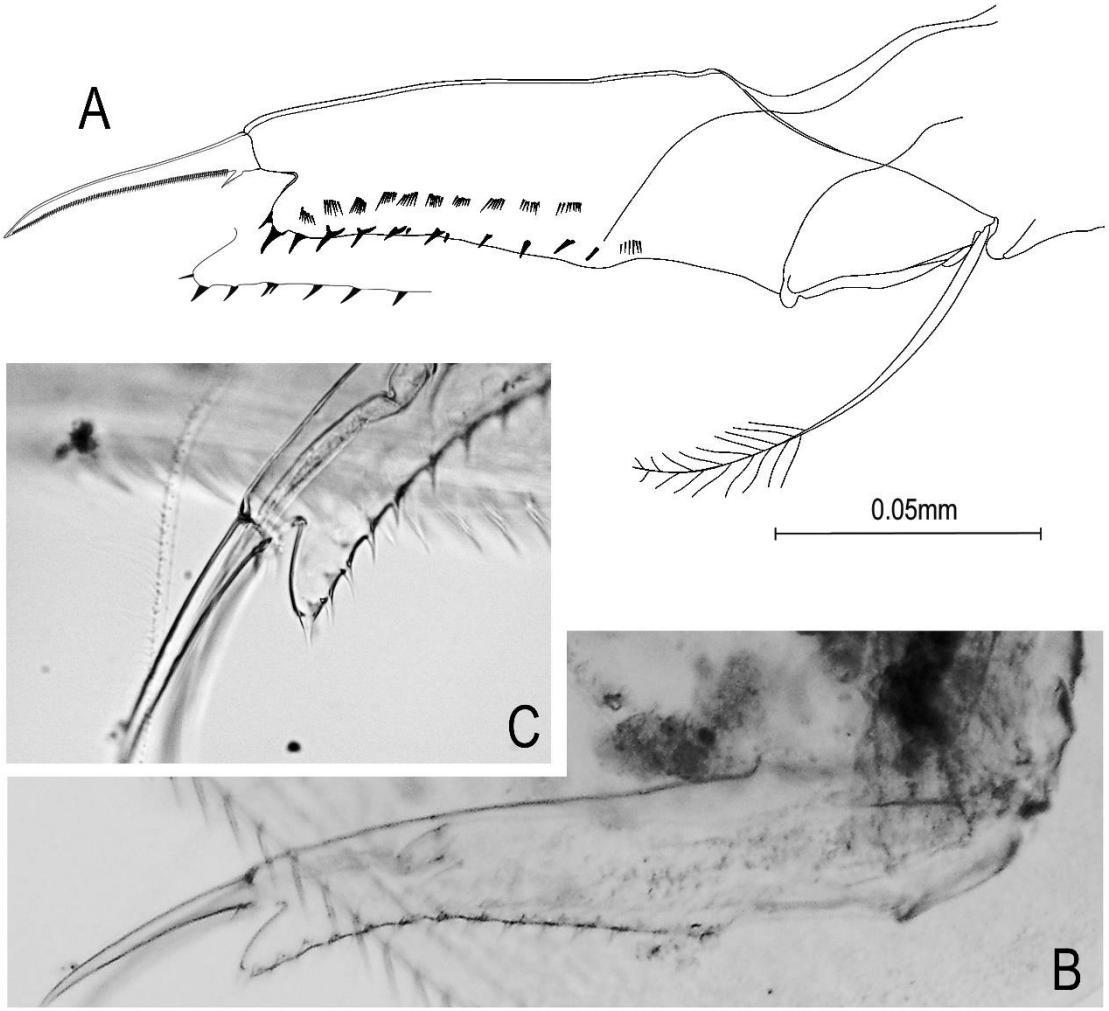

**Figure 3.** *Kurzia longirostris* (Daday, 1898) from the Congo River Basin, Africa, parthenogenetic female. A: Postabdomen. B: *idem*, showing postanal margin strongly concave. C: *idem*, distalmost part elongated.

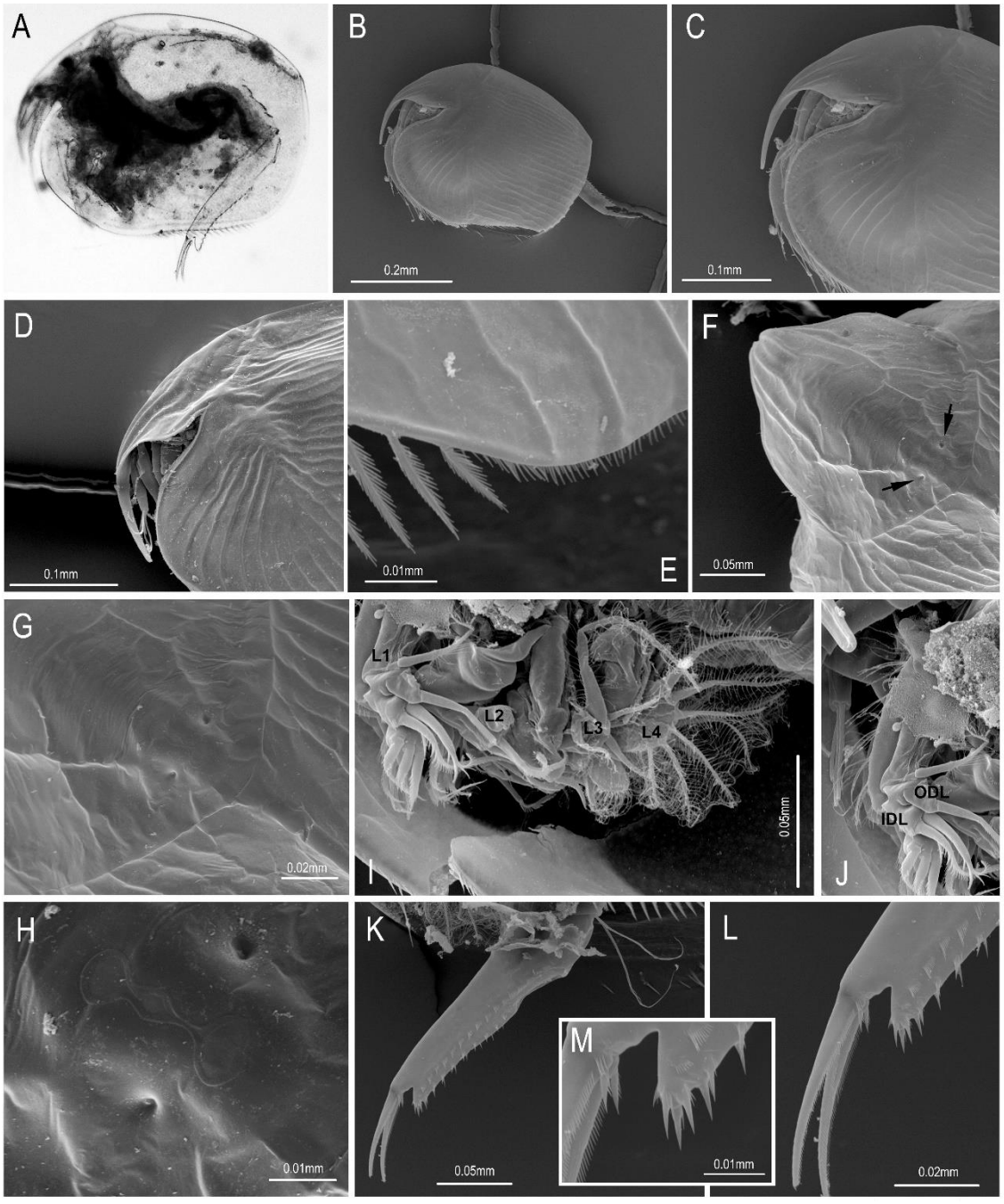


**Figure 4.** *Kurzia longirostris* (Daday, 1898) from the Congo River Basin, Africa, parthenogenetic female. A-B: Habitus. C-D: Rostrum. E: Posteroventral corner of carapace. F: Head Shield, arrows showing the position of lateral head pores. G-H: Head pores. I: Trunk limbs. J: First limb, ODL and IDL. K: Postabdomen. L: *idem*, postabdominal claws. M: *idem*, basal spines.

**Male**

We don't have studied herein. However, the drawings and a short diagnosis can be found in Smirnov (1971).

**Ephipial females**
Not studied.

**Variability**
Two individuals of *Kurzia longirostris* (Daday, 1898) presented posterior margin of carapace with two short denticles (Fig. 1E). In the postabdomen, the postanal margin might be strongly concave with distalmost part very elongated (Fig. 3B-C). As more as concave, most elongated is the distalmost part. There are some variations on the tip and length of the rostrum.

**Distribution and biology**
*Kurzia longirostris* (Daday, 1898) is widely distributed on the Oriental region (*terra typica*). In the Australasian the species might be considered rare (Smirnov and Timms 1983). Populations from the Neotropical region are observed in a few localities, especially in Brazil and Colombia (Elmoor-Loureiro et al. 2022; Fuentes-Reinés et al. 2022). In the Afrotropics, the presence of the species extends from the Nile River Basin, Chari River Basin, and Congo River Basin. The populations examined here were collected from stretches with water temperatures between 25.9-28.9°C, oxygen content 1.29-6.76 $mg/L^{-1}$, pH between 3.63-7.18, and conductivity electric between 13.3-77.1 µS/cm.

**Discussion**
Both authors, Hudec (2000) and Elmoor-Loureiro (2002), commented on a potential species complex for *K. longirostris*, highlighting the significance of comprehensive revisions in their specimens. The *K. longirostris* species was initially described in Sri Lanka and exhibits a wide distribution across the Australasia and Eastern regions (Rajapaksa and Fernando 1986; Hudec 2000; Sinev 2016). Nonetheless, a few studies have also documented presumed populations of *K. longirostris* in the Afrotropical region (Gauthier 1937; Rey and Saint-Jean 1969; Dumont 1981) and its presence there has been explained in arguments related to bird dispersal (Smirnov 1971). This hypothesis should not rejected, however, need to be tested comparing morphological data between *K. longirostris* found in Oriental region from the African populations studied here.

For now, it is possible suggest that populations studied here differs slightly from *K. longirostris sensu stricto* through the aesthetascs of antennules protruding beyond the tip of the rostrum (Rajapaksa and Fernando 1986; Hudec 2000). There are 8-12 marginal denticles on the postabdomen, accompanied by 11-16 lateral fascicules, while there are 10-14 marginal denticles in *K. longirostris* s.s. (Rajapaksa and Fernando 1986). Furthermore, differences are also observed in the proportion of setae on the limbs: the anterior seta 1 of the first limb is about 1.4 times longer than the posterior seta in African *K. longirostris*; seta 4 on the exopodite of the third limb is 2.2 times longer than seta 3, while they are short and of similar size in *K. longirostris* s.s.; seta 3 on the exopodite of the fourth limb is 1.5 times longer than seta 2, and is slightly longer in *K. longirostris* s.s.; seta 1 at the inner face of the fifth limb is about 1.6 times longer than seta 2, while 2 times longer in *K. longirostris* s.s.. When studying populations of *K. longirostris* from Nile River Basin, Smirnov (1971) illustrated the exopodite of the third and fourth limbs which are clearly similar to the material studied here, with differences in proportion of setae when compared to *K. longirostris* s.s.. However, the validity of such differences should be verified through redescription of *K. longirostris* from the Oriental region using more

comprehensive illustrations even as the morphology analyzed on the scanning electronic microscopy.

Illustrations of *K. longirostris* population from several parts of the world suggest a clear pattern of morphological variation especially associated with the postabdomen armature (Sars 1901; Brehm 1933; Gauthier 1937; Rey and Saint-Jean 1969). Several individuals from the African populations studied here also present such variation, bearing the postanal margin of postabdomen strongly concave with the distalmost part very elongated. In some cases, as more concave, as more elongated the distal part. The posterior main head pore in African populations of *K. longirostris* might be found bilobed in some individuals. Another source of variation was the presence of two short denticles on the posterior margin of carapace. This kind of variation has not been described for any species of *Kurzia* so far. *Kurzia longirostris* in South America (Brazil) bears denticles on the carapace, however, due to the rarity of material, we could not include it here (Elmoor-Loureiro – personal communication).

In summary, this morphological analysis of African populations of *Kurzia longirostris* reinforces the importance of subtropical and tropical regions for the distribution and diversity of the genus, including the report on *Kurzia media* in Colombia and Brazil (Kotov and Fuentes-Reinés 2015; Andrade et al. 2024). Despite the necessity of a more comprehensive study on the morphology of populations from the Oriental region, it is increasingly clear that *Kurzia longirostris* is a species complex. Thus, the idea of continental endemism (Frey 1987) should be tested in a future revision of the group to *Kurzia*.

**Acknowledgements**
To the Electron Microscopy Center (CME) of the Institute of Biosciences of Botucatu, UNESP, Brazil, for help with the SEM photographs. The authors thanks to Dr. Miguel Alonso and Dr. Artem Y. Sinev for criticism and suggestions to improvements of this study.

**Author contributions**
Conceptualization: Francisco Diogo Rocha Sousa, Camila Moreira-Silva, Gilmar Perbiche-Neves. Methodology: Francisco Diogo Rocha Sousa, Camila Moreira-Silva. Validation: Francisco Diogo Rocha Sousa, Lourdes Maria Abdu Elmoor-Loureiro. Formal analysis: Francisco Diogo Rocha Sousa, Camila Moreira-Silva. Writing - Original draft: Camila Moreira-Silva, Francisco Diogo Rocha Sousa, Lourdes M. A. Elmoor-Loureiro, Gilmar Perbiche-Neves. Writing - Review and Editing: Francisco Diogo Rocha Sousa, Lourdes M. A. Elmoor-Loureiro, Gilmar Perbiche-Neves. Visualization: Camila Moreira-Silva, Francisco Diogo Rocha Sousa, Lourdes M. A. Elmoor-Loureiro, Mwapu Isumbisho, Hugo Sarmento, Alberto Vieira Borges, Gilmar Perbiche-Neves. Supervision: Francisco Diogo Rocha Sousa, Gilmar Perbiche-Neves. Project administration: Mwapu Isumbisho, Hugo Sarmento, Alberto Vieira Borges, Gilmar Perbiche-Neves. Funding Acquisitio: Mwapu Isumbisho, Alberto Vieira Borges, Gilmar Perbiche-Neves.

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