

# *MESOCYCLOPS BOSUMTWII* SP. NOV. (COPEPODA: CYCLOPIDAE) FROM GHANA

ISKANDAR M. MIRABDULLAYEV<sup>1</sup>, PETER OSAM SANFUL<sup>2</sup>  
and EMMANUEL FREMPONG<sup>2</sup>

<sup>1</sup>*Institute of Zoology, Niyazov st. 1, Tashkent, 100095, Uzbekistan;*  
*e-mail: imirabdullayev@yahoo.com*

<sup>2</sup>*Department of Theoretical and Applied Biology, Kwame Nkrumah University  
of Science and Technology, Kumasi, Ghana; e-mail: pospanf@yahoo.com*

**Abstract.**— A new *Mesocyclops* species, *M. bosumtwii*, is described from Lake Bosumtwi, Ghana. It is proposed that *M. bosumtwii* belongs to the Madagascar-African “major-pilosus-insulensis species group”. A key for African species of the genus *Mesocyclops* is proposed.



**Key words.**— Copepoda, Cyclopidae, *Mesocyclops bosumtwii*, taxonomy, Lake Bosumtwi, Ghana.

## INTRODUCTION

There are known 11 species of the genus *Mesocyclops* inhabiting various waterbodies of Africa (Van de Velde, 1984; Hołyńska *et al.*, 2003). In this paper we describe a new species from Ghana.

## MATERIAL AND METHODS

Many females and males from Lake Bosumtwi (Ghana). Samples were collected in September 2005 from the deepest point of the lake (75 m) by vertical net hauls with a 63  $\mu$ m mesh net and fixed with 4% formaldehyde.

All drawings have been made using a drawing tube.

Abbreviations used are as follows:

Fu – furca;

L – length;

W – width;

Ti – medialmost apical furcal seta;

Te – lateralmost apical furcal seta;

Sd – dorsal furcal seta;

Me – lateral furcal seta;

Enp – endopodite;

P1–P5 – legs 1–5.

## TAXONOMY

*Mesocyclops bosumtwii* sp. nov.  
(Figs 1–21)

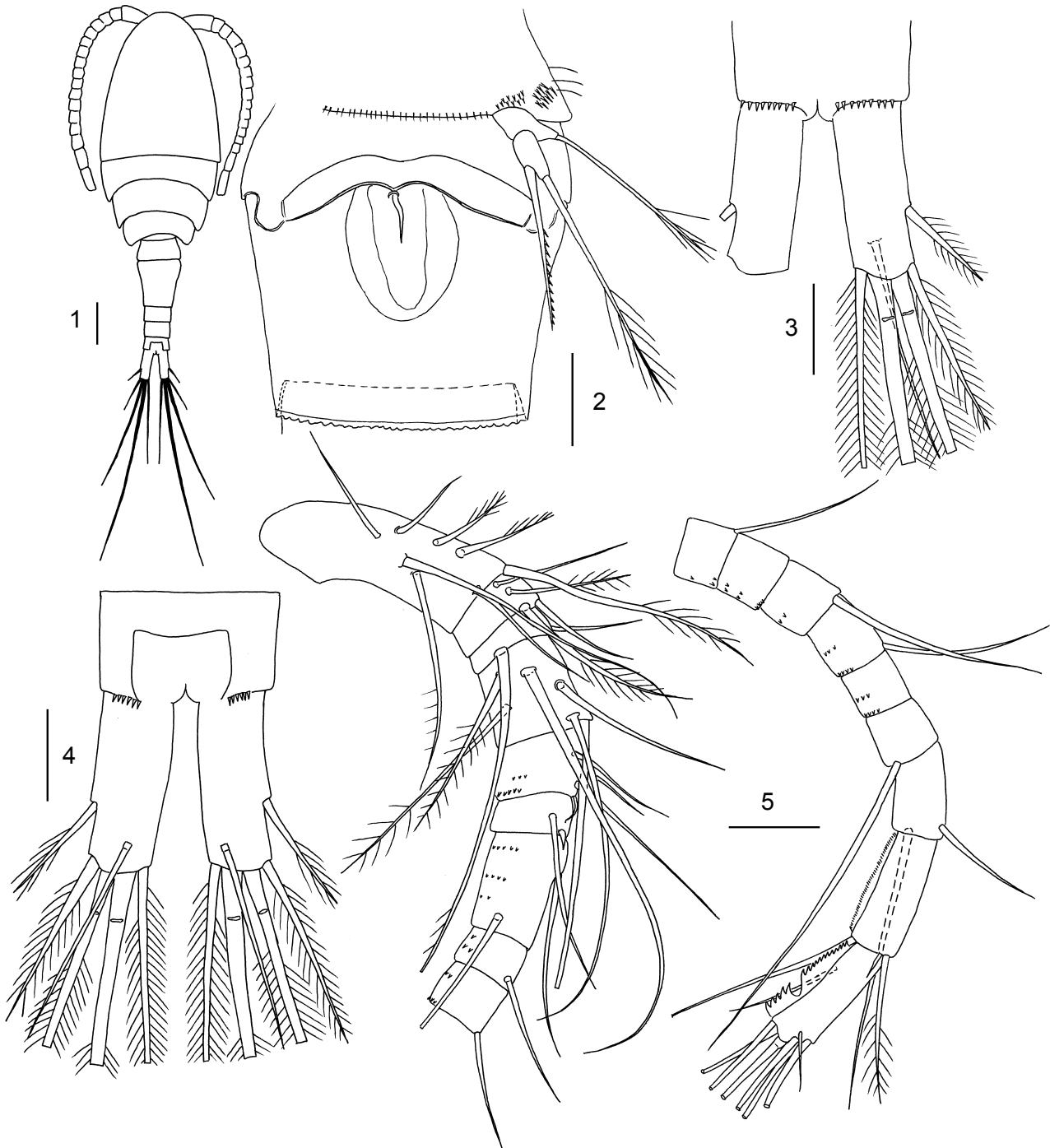
**Types material.** Female holotype, two paratypes and two allotypes (all dissected and mounted in slides) are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, USA (cat. no: 1094117 (holotype), 1094118 (paratypes), 1094119 (allotypes). Three female paratypes (cat. no: Cop. 333–335) are deposited in the Institute of Zoology, Tashkent, Uzbekistan.

**Type locality.** Lake Bosumtwi in Ghana.

**Diagnosis.** *Mesocyclops bosumtwii* belongs to a small group of congeners including *M. major* Sars, 1927, *M. pilosus* Kiefer, 1930 and *M. insulensis* Dussart, 1982. Following characters unite species of this group:

- seminal receptacle with long wide lateral arms;
- medial expansion of P1 basipodite lacking spine;
- serrate hyaline membrane of last antennular segment, extending far beyond implantation of medial seta, with 1 large notch;

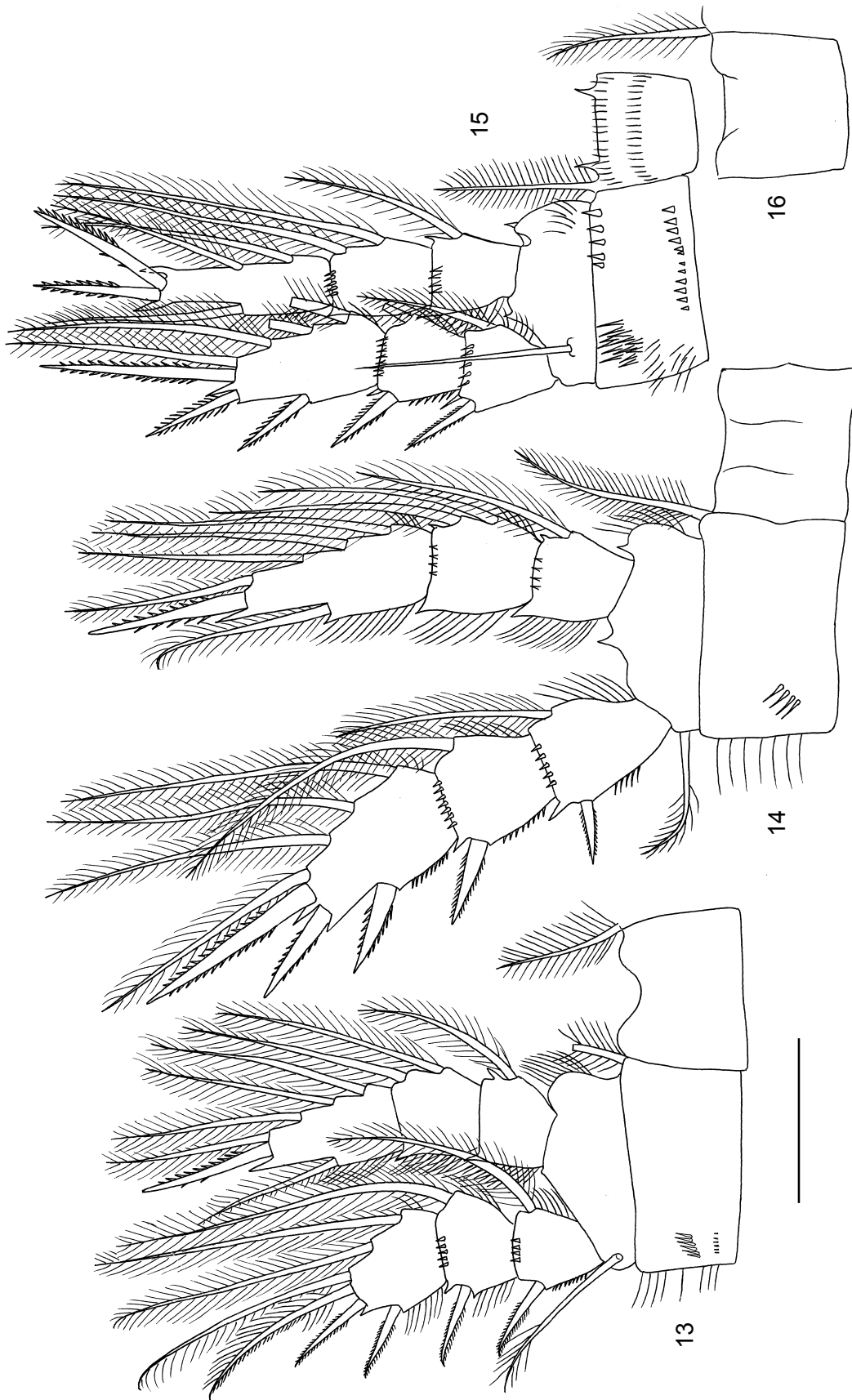
- presence of row of ventral spinules along posterior margin of pediger 5 and spinule group anteriorly to implantation of P5;
  - presence of rows of setules on caudal side of P4 intercoxal sclerites;
  - prominences on distal margin of P4 intercoxal sclerites large and acute;
  - apical seta of P5 markedly longer than spiniform medial seta;
  - inhabiting waterbodies of Africa (*M. major*) and Madagascar (*M. pilosus*, *M. insulensis*).
- Cladistic analysis also supports separation of the “*major-pilosus-insulensis*” species group (Hołyńska, 2006). *Mesocyclops bosumtwii* differs from



Figures 1–5. *Mesocyclops bosumtwii* sp. nov., female. (1) Habitus; (2) genital somite; (3) furcal ramus ventrally; (4) furcal ramus dorsally; (5) antennule. Scales (in  $\mu\text{m}$ ): 100 for 1; 50 for 2–5.



Figures 6–12. *Mesocyclops bosumtwii* sp. nov., female. (6) Antenna, frontal side; (7) basipodite of antenna, caudal side; (8) mandible; (9) maxillula; (10) palp of maxillula; (11) maxilla caudally; (12) maxilliped caudally. Scales (in  $\mu\text{m}$ ): 50 for 6; 25 for 7–12.



Figures 13–16. *Mesocyclops bosuntawii* sp. nov., female. (13) P3; (14) P2; (15) intercoxal sclerite of P3; 16. P4. Scale: 50  $\mu$ m.

*M. major*, *M. pilosus* and *M. insulensis* by:

- shape of copulatory ducts;
- lack of spinules near implantation of Te caudal setae;
- lack of distal group of setules on medial expansion of P4 basipodite;
- presence of eight setae on antennary endopodite 2;
- absence of oblique field of tiny spinules on caudal side of antennary basipodite.

**Description.** Female. Length of body 750–850  $\mu\text{m}$ . Body widest at cephalothorax (Fig. 1).

Pediger 5 (Fig. 2). Row of ventral spinules along posterior margin and spinule group anteriorly to implantation of P5.

Genital double-somite (Fig. 2). Length/width = 1.1. Seminal receptacle with long wide lateral arms; copulatory pore horseshoe-shaped; transverse ducts meet at obtuse angle anterior to copulatory pore; copulatory duct slightly curved.

Anal somite (Figs 3, 4). Posterior margin of anal somite with spinules on ventral and dorsal surfaces, spinules reduced or absent laterally.

Caudal rami (Figs 3, 4). Length/width = 2.8. Hairs absent. No spinules present at implantation of Me and Te caudal setae. Ti/L furca = 2.8. Ti/Te = 2.6. Ti/Sd = 2.1.

Antennula (Fig. 5). 17-segmented, setation pattern as in *M. leuckarti*, type species of genus: 8, 4, 2, 6, 4, 1 + 1 spine, 2, 1, 1, 0, 1, 1 + aesthetasc, 0, 1, 2, 2 + aesthetasc, 7 + aesthetasc. Last two segments with hyaline membrane. Hyaline membrane of segment 17, extending along almost entire length of the segment, with one large notch. Aesthetasc on segment 16 highly

reduced. Segments 1, 5, 7–13 ventrally adorned with spinules.

Antenna. Coxopodite, basipodite, and three-segmented endopodite with 0, 3, 1, 8, 7 setae, respectively (Fig. 6). Exopodite seta long, reaching beyond distal rim of third endopodal segment. Setae at mediobasal angle of basipodite, of equal size. Basipodite, caudal spinule ornamentation (Fig. 7) simple: near base long spinules on lateral rim; next to the spinules, oblique row of spinules; longitudinal row of spinules along lateral rim; oblique row of tiny spinules starting at distal half of medial rim. Basipodite, frontal spinule ornamentation (Fig. 6): longitudinal row of spinules along lateral rim.

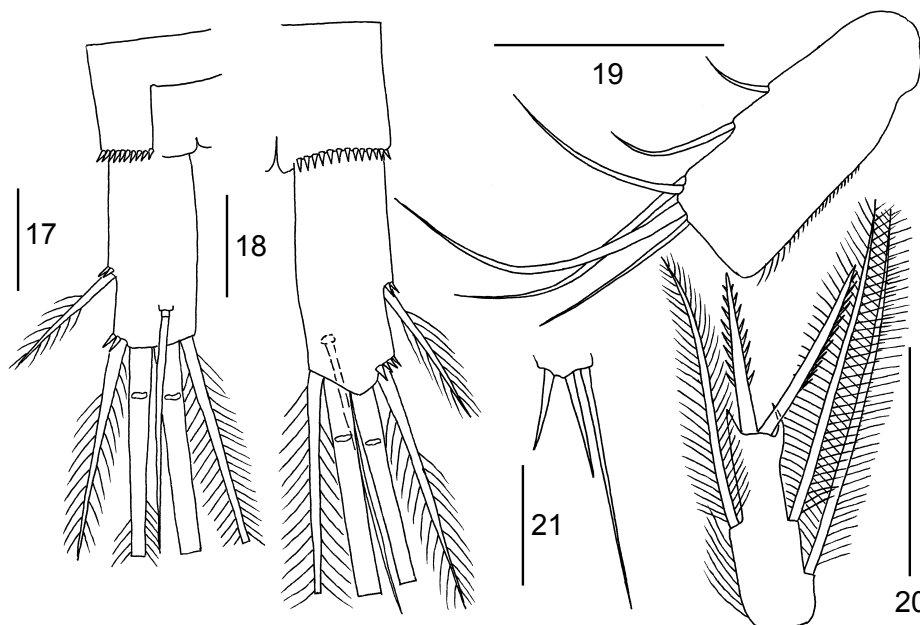
Mandibula. Typical for the genus. Mandibular palp (Fig. 8) with two long and one short setae.

Maxillula. Segmentation and setation as in *M. leuckarti* (Fig. 9). No spinules on palp (Fig. 10).

Maxilla. Segmentation and setation the same as in *M. leuckarti* (Fig. 11). Frontal surface of coxopodite without spinule ornamentation. Claw-like endite of basipodite armed with 14 strong teeth.

Maxilliped. Segmentation and setation as in *M. leuckarti* (Fig. 12). Scale-like spinules in caudal surface of basipodite arranged in two groups.

Legs 1–4. Spine and seta formula as in *M. leuckarti* (Figs 13–16). P4 intercoxal sclerite with large outgrowths and two rows of setules on caudal surface, other legs intercoxal sclerites smooth, with rounded marginal protrusions. Inner expansion of P1–P3 basipodite with distal hairs, those of leg 4 with few proximal setules on caudal side. Lateralmost seta of P1exp3 with few long setules on outer rim (Fig. 13). P4enp3 2.8 times as long as wide. Inner apical spine



Figures 17–21. *Mesocyclops bosumtwii* sp. nov., male. (17) Furcal ramus, dorsal side; (18) furcal ramus, ventral side; (19) endopodite 2 of antenna; (20) endopodite 3 of P4; (21) P6. Scales (in  $\mu\text{m}$ ): 25 for 17–20, 10 for 21.

Table 1. Data of measurements of *Mesocyclops bosumtwii* sp. nov.

	Females n = 7		Males n = 3	
	x	min-max	x	min-max
Body length, $\mu\text{m}$	796	750–850	593	575–600
Fu L/W	2.75	2.60–2.84	2.41	2.30–2.53
Ti/L Fu	2.81	2.68–2.95	2.74	2.58–2.83
Ti/Te	2.67	2.38–2.85	2.55	2.38–2.83
Ti/Sd	2.09	1.89–2.22	1.61	1.59–1.65
<b>Enp3P4:</b>				
L/W	2.86	2.65–3.07	2.73	2.50–2.83
Inner sp./L	0.89	0.83–0.94	0.92	0.86–1.00
Inner sp./outer sp.	1.24	1.18–1.37	1.20	1.16–1.25

longer than outer (inner/outer = 1.25), and slightly shorter than enp3 length. Few teeth on lateral rim of inner apical spine.

Leg 5. Segmentation and setation typical of genus (Fig. 2). Apical seta of segment 2 significantly longer than inner spine.

Biometric data are given in Table 1.

Male. Body length 575–600  $\mu\text{m}$ . Posterior margin of anal somite with spinules on ventral, dorsal and lateral surfaces. Caudal rami 2.3 times as long as wide, with smooth inner surface. Implantations of Me and Te caudal setae provided with spinules (Figs 17, 18).

Endopodite 2 of antenna bearing 6 setae (Fig. 19). Medial spine of P4enp3 slightly longer than lateral spine (Fig. 20). Medial spine of P6 slightly shorter than medial seta and about three times shorter than lateral seta (Fig. 21).

**Ecology.** Water surface temperature 27.5°C, transparency of water 1.3 m, conductivity 1143  $\mu\text{S}/\text{cm}$ , dissolved oxygen saturation 69.5%. Species co-occurred with *Mesocyclops bosumtwii*: *Brachionus calyciflorus* Pallas, 1766; *Moina micrura* Kurz, 1874; *Chaoborus* sp.

### Key to African species of the genus *Mesocyclops*

1. Medial expansion of P1 basipodite with long spine; lateral wings of receptaculum seminis narrow . . . **2**
  - . Medial expansion of P1 basipodite lacking long spine; lateral wings of receptaculum seminis broad . . . . . **4**
2. P2–P4 intercoxal sclerites bearing 2–3 rows of setules; L:W furcal rami 5; hairs on lateral sides of pediger 5 . . . . . *temisaccus* (Sars, 1927)
  - . P2–P4 intercoxal sclerites smooth; L:W furcal rami 2–4; lateral sides of pediger 5 smooth . . . . . **3**
3. Furcal rami smooth; posterior margin of anal somite bearing row of spinules only on ventral side . . . . . *rarus* Kiefer, 1981
  - . Furcal rami bearing long spinules on ventral surfaces; posterior margin of anal somite bearing row of spinules on ventral and dorsal sides . . . . . *paludosus* Lindberg, 1956
4. Ventral row of spinules present along posterior margin of pediger 5; spinule group present anteriorly to implantation of P5 . . . . . **5**
  - . Ventral row of spinules absent along posterior margin of pediger 5; spinule group absent anteriorly to implantation of P5 . . . . . **6**
5. Presence of oblique field of tiny spinules on caudal side of antennary basipodite; implantation of Te caudal setae provided with spinules . . . . . *major* Sars, 1927
  - . Caudal side of antennary basipodite without oblique field of tiny spinules; implantation of Te caudal setae without spinules . . . . . *bosumtwii* sp. nov.
6. P4 intercoxal sclerite with large outgrowths . . . . **7**
  - . P4 intercoxal sclerite with small outgrowths . . . . **8**
7. P4 intercoxal sclerite bearing row of setules; furcal rami smooth; lateral sides of pediger 5 smooth . . . . . *salinus* Onabamiro, 1957
  - . P4 intercoxal sclerite smooth; furcal rami bearing hairs in anterior half, and long spinules on ventral surface; lateral sides of pediger 5 bearing hairs . . . . . *spinus* Van de Velde, 1984
8. Furcal rami bearing hairs . . . . . *aspericornis* (Daday, 1906)
  - . Furcal rami smooth . . . . . **9**
9. Posterior margin of anal somite bearing row of spinules only on ventral side . . . . . *dussarti* Van de Velde, 1984
  - . Posterior margin of anal somite bearing row of spinules on ventral and dorsal sides . . . . . **10**
10. Lateral sides of pediger 5 smooth . . . . . *kieferi* Van de Velde, 1984
  - . Lateral sides of pediger 5 bearing hairs . . . . . **11**
11. Maxillulary palp with large spinules . . . . . *ogunnus* Onabamiro, 1957
  - . Maxillulary palp smooth . . . . . *aequatorialis* Kiefer, 1929

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## REFERENCES

- Holyńska, M. 2006. Phylogeny of *Mesocyclops* (Copepoda: Cyclopidae) inferred from morphological characters. *Zoological Journal of the Linnean Society*, 147: 1–70.
- Holyńska, M., Reid, J. W. and H. Ueda. 2003. Genus *Mesocyclops* Sars, 1914. *In*: Ueda H., Reid J. W. eds. Copepoda: Cyclopoida – genera *Mesocyclops* and *Thermocyclops*. Guides to the identification of the microinvertebrates of the continental waters of the world. Backhuys Publishers, Leiden, Vol. 20: 12–213.
- Van de Velde, I. 1984. Revision of the African species of the genus *Mesocyclops* Sars, 1914 (Copepoda: Cyclopidae). *Hydrobiologia*, 109: 3–66.

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