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# A revision of the Nigerian species of the genera *Mesocyclops* Sars, 1914 and *Thermocyclops* Kiefer, 1927 (Copepoda: Cyclopoida)

C. Y. Jeje
*Lecturer, Department of Zoology, University of Ibadan, Ibadan, Nigeria*

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*Key words:* Nigeria, *Mesocyclops, Thermocyclops* distribution, Africa

**Abstract**

The Nigerian *Mesocyclops* and *Thermocyclops* species are revised using an extensive collection of over 600 samples from Nigeria. Six species of *Mesocyclops* and three of *Thermocyclops* are recorded. Illustrated descriptions of these species and keys to their identification are given. Their occurrence and variability in Nigerian freshwater systems and their distribution in the African continent is discussed.

## Introduction

Until very recently, the systematics of Nigerian freshwater Copepoda was comprised of few and widely scattered records. By far the greatest contribution to the knowledge of cyclopoid systematics in Nigeria was by Onabamiro (1951, 1952, 1957) while investigating the ecology of 'Cyclops' and their relation to the incidence of the disease causing *Dracunculus medinesis*, the guinea-worm, in South-West Nigeria. He identified *Thermocyclops oblongatus nigerianus, Thermocyclops iwoyiensis, Tropocyclops mellanbyi, Ectocyclops ilariensis, Halicyclops korodiensis, Mesocyclops salina, Mesocyclops ogunnus, Tropocyclops confinis awiensis, Tropocyclops prasinus shagamiensis* and *Afrocyclops ikennus*. Recent studies by Jeje (in press) provide a comprehensive list, and illustrated descriptions of Nigerian Copepoda. A total of 18 species of Cyclopoida and 5 species of Calanoida were identified. In addition, all previous literature on Nigerian records was reviewed.

However, there is a need for a systematic revision of Nigerian Cyclopoida and especially of the genera *Mesocyclops* and *Thermocyclops* in light of their parasitological significance as intermediate hosts of *Dracunculus medinesis* larvae. This is because of improvement in knowledge of their systematics. These studies include that of Dussart (1980) who gives a catalogue of African Copepoda and their biogeography. The species, *Mesocyclops leuckarti*, considered cosmopolitan now appears to be restricted in distribution to Europe and West Asia. This was confirmed by Kiefer (1981) in his revision of the species of *Mesocyclops* from Africa, Asia and Australia. He concludes that *Mesocyclops leuckarti* (Claus) sensu stricto is restricted to Europe and the Western part of Asia. The *Mesocyclops* occurring in Africa, southern and eastern Asia and Australia belong to other species. Van de Velde (1984) in her revision of the African *Mesocyclops* species confirms this and identifies 12 other species from this genus of which 6 are recorded in this study from Nigeria. Dussart & Fernando (1985, in press) discuss the *Mesocyclops* species problem today and list the occurrence of *Mesocyclops* species globally.

Maas (1984) evaluates the genus *Thermocyclops* in Africa, and provides information on the detailed morphology of five species of which only one, *Thermocyclops neglectus* is recorded from Nigeria in this

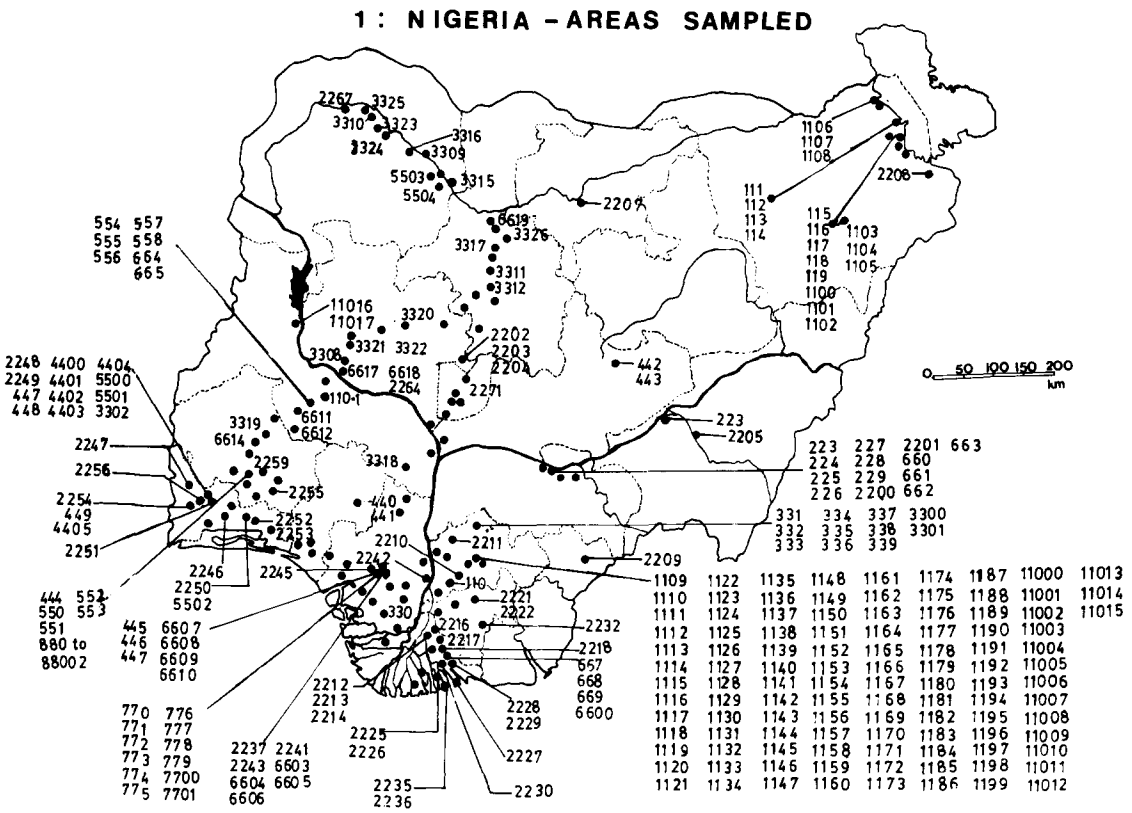



*Fig. 1.* Map of Nigeria showing sampling locations. Points may represent more than one locality which are closely situated to each other.

study. Dussart (1982) gives detailed descriptions of the copepod fauna of Madagascar, many of which are also widely distributed in Africa.

In this study, a large number of recently collected samples (1985; 312 samples) and some relevant material studied by Jeje (1982) were examined. Species of *Mesocyclops* and *Thermocyclops* need to be revised and described in the light of more recent studies. 6 species of *Mesocyclops* (of which 4 are new records for Nigeria) and 3 species of *Thermocyclops* are illustrated and described with relevant notes on their occurrence.

## Materials and methods

Samples were collected from a wide range of freshwater habitats in Nigeria (Fig. 1). Qualitative samples were collected with plankton nets with mesh sizes 10 and 25 (157 $\mu$m and 64 $\mu$m) respectively. Samples were immediately preserved in 4–5% formalin solution. Sorting and identification was done in the laboratory and specimens were observed in glycerine. Specimens were dissected in glycerine using a stereo zoom binocular microscope and drawings were made of the hyaline membrane of the antennule; Enp3P4 and connecting lamella; P5; receptaculum seminis; furcal rami and associated setae, using a camera lucida at appropriate magnifications.

Morphometric comparison with Onabamiro (1957) and Van de Velde (1984) are made for species of *Mesocyclops* where appropriate while comparisons are made with Dussart (1982) for the genus *Thermocyclops* (Tables 1–2).

Because of the large number of samples used in this study, only selected occurrence from different habitat types are provided.

**Keys to *Mesocyclops* and *Thermocyclops* of Nigeria**

1 – Inner spine of Enp3P4 at or almost at the same level as outermost ..... *Mesocyclops* ..... 2
Inner spine of Enp3P4 less than 0.5 length of outermost ..... *Thermocyclops* ..... 7

2 – P1 with spine on basipodite; receptaculum seminis with broad oblong cuticular frame *Mesocyclops rarus* Kiefer
– P1 without spine on basipodite; receptaculum seminis with long or short lateral arms ..... 3

3 – Connecting lamella of P4 with long curviform spines ..... *Mesocyclops salinus* Onabamiro
– Connecting lamella of P4 with short spines ... 4

4 – Furca with hairs on inner margin *Mesocyclops aspericornis* (Daday)
– Furca without hairs on inner margin ..... 5

5 – Spinules at points of insertion of external setae of furcal rami ..... *Mesocyclops dussarti* Van de Velde
– Spinules at points of insertion of both lateral and external setae of furcal rami ..... 6

6 – Pore canal of receptaculum seminis straight; spinous seta on distal segment of P5 shorter than feathered seta on same segment but markedly longer than feathered seta on basal segment ..... *Mesocyclops aequatorialis similis* Van de Velde
– Pore canal of receptaculum seminis slightly curved; spinous seta on distal segment of P5 shorter than feathered seta on same segment, about same length as feathered seta on basal segment ..... *Mesocyclops ogunnus* Onabamiro

7 – Furcal index less than 2.0; receptaculum seminis with broad, lateral arms of which the anterior margin is mildly curved ..... *Thermocyclops crassus* (Fischer)
– Furcal index greater than 2.0; – receptaculum seminis with slender lateral arms of which the anterior margin is slightly or strongly curved ..... 8

8 – Spinous seta: feathered seta index of distal segment of P5 less than 1.1; lateral arms of receptaculum seminis strongly curved .... *Thermocyclops neglectus* (Sars)
– Spinous seta: feathered seta index of distal segment of P5 slightly less than 1.5; lateral arms of receptaculum seminis slightly to strongly curved ..... *Thermocyclops decipiens* (Kiefer)

**Results**

Genus *Mesocyclops* Sars, 1914

List of *Mesocyclops* species recorded in Nigeria

*Mesocyclops aspericornis* (Daday, 1906)
*Mesocyclops aequatorialis similis* Van de Velde, 1984
*Mesocyclops ogunnus* Onabamiro, 1957
*Mesocyclops rarus* Kiefer, 1981
*Mesocyclops salinus* Onabamiro, 1957

*Mesocyclops aspericornis* (Daday, 1906) (Figs. 2–8)

*Mesocyclops aspericornis* was originally described from Sumatra, Singapore and Hawaii (Daday, 1906). For some time, it was thought to be a synonym of *M. leuckarti* or a subspecies of the species. It has been recently revised by Kiefer (1981).

Female: Antennule reaches to distal margin of second thoracic segment; hyaline membrane of terminal antennular segment with single, deep, notch (Fig. 2). Enp3P4 2.45–2.66 times as long as wide, inner apical spine longer than outer (Fig. 3); projections on distal margin of connecting lamella as long as wide and well developed (Fig. 4). Spinous seta of P5 shorter than feathered seta on same segment (Fig. 5). Lateral arms of receptaculum seminis slightly curved backwards, pore canal slightly curved near copulatory pore (Fig. 6). Furcal rami with characteristic, extended, row of setules along the inner margin (Figs. 7, 8); lateral seta 0.60–0.65 length of dorsal seta, spinules present at points of insertion of lateral and external setae.

Localities: 1143, 2226, 3317, 4451, 6610, 771, 8819.

Range in total length: 1.15–1.29 mm (n = 10). Furcal index: 3.33–3.43. Inner apical spine of Enp3P4 always longer than outer apical spine. This variability is also consistently recorded by Lim & Fernando (1985), contrasting with Van de Velde

*Table 1.* Comparative morphometric data of Nigerian *Mesocyclops* species.

| Species | Total length (mm) | $Enp_3P_4$ L:W | $Enp_3P_4$ $S_i$:$S_e$ | $P_5$ distal segment ss:sf | Furcal rami | |
|---|---|---|---|---|---|---|
| | | | | | L:W | $S_e$:$S_d$ |
| *Mesocyclops aspericornis* | | | | | | |
| Present study (n = 10) | 1.15 – 1.29 | 2.45 – 2.66 | 1.09 – 1.21:1 | 0.60 – 0.64:1 | 3.33 – 3.43:1 | 0.97 – 1.0 :1 |
| Van de Velde (1984) | 1.183 – 1.313 | 2.50:1 | – | – | 3.37 – 3.47:1 | – |
| *Mesocyclops aequatorialis similis* | | | | | | |
| Present study (n = 10) | 1.12 – 1.58 | 2.93 – 3.12:1 | 1.03 – 1.10:1 | 0.89 – 0.91:1 | 2.94 – 3.15:1 | 1.17 – 1.20:1 |
| Van de Velde (1984) Holotype | 1.495 | 2.81 | 0.98 | – | 3.18 | – |
| (n = 4) Allotype | 0.997 – 1.511 | 2.74 – 3.33:1 | 0.94 – 1.15:1 | – | 2.86 – 3.18:1 | – |
| *Mesocyclops ogunnus* | | | | | | |
| Present study (n = 10) | 0.90 – 1.20 | 2.50 – 3.20:1 | 1.00:1 | 0.76 – 0.80:1 | 2.69 – 3.20:1 | 1.35 – 1.37:1 |
| Onabamiro (1957) | 1.00 – 1.30 | 2.50 – 3.00:1 | 1 or > 1:1 | – | 3.10 – 3.30:1 | – |
| Van de Velde (1984) | 0.989 | 2.46 | 1.04 | – | 2.70 | – |
| *Mesocyclops rarus* | | | | | | |
| Present study (n = 10) | 1.18 – 1.42 | 2.65 – 3.00:1 | 1.54 – 1.62:1 | 0.70 – 0.76:1 | 2.06 – 2.60:1 | 1.30 – 1.33:1 |
| Van de Velde (1984) | 1.255 – 1.370 | 2.50 – 3.07:1 | – | – | 2.27 – 2.57:1 | – |
| *Mesocyclops salinus* | | | | | | |
| Present study (n = 10) | 0.97 – 1.19 | 2.50 – 3.01:1 | 1.17 – 1.40:1 | 0.76 – 0.80:1 | 2.46 – 2.70:1 | 1.80 – 1.94:1 |
| Onabamiro (1957) | 1.00 | 2.60:1 | – | – | 2.50 – 2.80:1 | – |
| Van de Velde (1984) | 0.952 | 2.44 – 2.90:1 | – | – | 2.28 – 2.89:1 | – |
| *Mesocyclops dussarti* | | | | | | |
| Present study (n = 10) | 1.15 – 1.62 | 2.78 – 2.97:1 | 1.03 – 1.11:1 | 0.70 – 0.80:1 | 2.70 – 2.85:1 | 0.89 – 0.93:1 |
| Van de Velde (1984) Holotype | 1.320 | 2.75:1 | 0.86:1 | – | 3.45:1 | – |
| Allotype | 0.800 | 3.17:1 | 1.0 :1 | – | 2.84:1 | – |
| (n = 3) Paratype | 1.274 – 1.416 | 2.78 – 2.97:1 | 0.90 – 1.05:1 | – | 3.09 – 3.48:1 | – |

(1984) where also the reverse in size differences were encountered. Projections on the distal margin of connecting lamella of P4 may be pointed or rounded at their apices. Dorsal furcal seta always slightly shorter than external.

Diagnostic characters: This species can be readily recognised by the occurrence of a continuous row of setules on the inner margin of the furcal rami.

In Nigeria, it was recorded from most habitat types studied. In Africa, it is distributed along a west to east axis (Van de Velde, 1984) and in all localities studied by her was found in low numbers only. Its occurrence in Nigeria differs from this with large numbers found in various localities. In fact, it appears to be one of the commonest *Mesocyclops* found in the country.

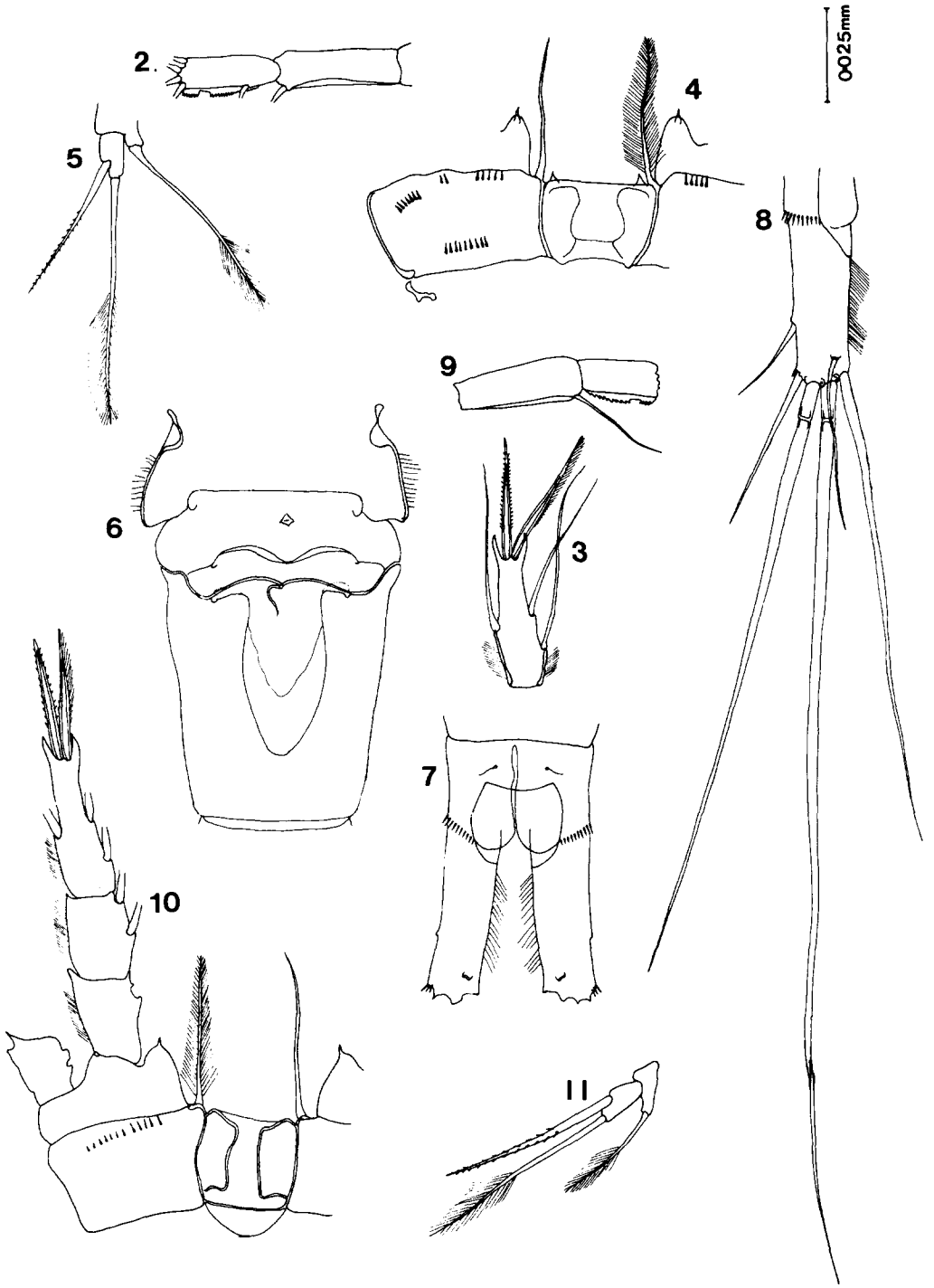
*Mesocyclops aequatorialis similis* (Van de Velde, 1984) (Figs. 9–14).

*Mesocyclops aequatorialis similis* closely resembles *M. aequatorialis aequatorialis*, but is more widely distributed on the African continent than the latter which is restricted to Lakes Kivu and Tanganyika.

Female: Antennule reaches to middle of third thoracic segment, hyaline membrane with one deep and wide notch (Fig. 9). Enp3P4 2.93 – 3.1 times as long as wide, inner apical spine usually longer than outer apical spine (Fig. 10); projections on distal margin of connecting lamella weakly developed. Spinous seta on distal segment of P5 shorter, 0.89 – 0.91 length of feathered seta on same segment, markedly longer than feathered seta on basal segment (Fig. 11). Lateral arms of receptaculum seminis long, slender, pore canal straight (Fig. 12). Furcal index 2.94 – 3.15 not pilose on inner margin; dorsal seta always longer than lateral seta; lateral and external setae with fine spinules at points of insertion (Figs. 13, 14).

Localities: 2212, 22004, 6619.

Total body length varies from 1.12 – 1.58 mm (n = 5).




*Figs. 2–8. Mesocyclops aspericornis*, female: Fig. 3. Enp3P4; Fig. 4. Connecting lamella, coxo- and basipodite P4; Fig. 5. P5; Fig. 6. Last thoracic segment and genital segment with receptaculum seminis; Fig. 7. Last abdominal segment and furcal rami, dorsal view; Fig. 8. Furca.

*Figs. 9–14. Mesocyclops aequatorialis similis*, female: Fig. 9. Antennular segment 16 & 17; Fig. 10. Enp3P4 and connecting lamella, coxo- and basipodite P4; Fig. 11. P5; Fig. 12. Last thoracic segment and genital segment with receptaculum seminis; Fig. 13. Furca; Fig. 14. Last abdominal segment and furcal rami, dorsal view.

*Mesocyclops aequatorialis similis* is not a very common species in Nigerian freshwaters and was recorded from streams, rivers and temporary habitats. It occurred only in small numbers at any single location.

*Mesocyclops dussarti* Van de Velde, 1984 (Figs. 15–20)

*Mesocyclops dussarti* was first identified from Mali as *Mesocyclops thermocyclopoides* (non Harada).

Female: Antennule reaches to middle of third thoracic segment, hyaline membrane with one deep notch, anterior curve sharply so (Fig. 15). Enp3P4 2.78–2.95 times as long as wide, inner apical spine usually slightly shorter or as long as outer apical spine; projections on distal margin of connecting lamella small, 0.40–0.51 times shorter than wide (Fig. 16). Spinous seta of P5 0.7–0.8 feathered seta implanted on the same segment (Fig. 17).

Posterior margin of proximal portion of receptaculum seminis slightly to strongly curved (Fig. 18). Furca 2.70–2.85 times as long as wide, without setules on inner margin; external furcal seta with spines at point of insertion, may be slightly shorter, equal or longer than dorsal furcal seta (Fig. 19, 20).

Localities: 11017, 2242, 4409, 4416, 668.

Total body length varies from 1.15–1.62 mm (n = 10). In Nigerian specimens, inner apical spine of Enp3P4 equal to or slightly longer than outer, also observed by Van de Velde (1984). Projections on distal margin of connecting lamella of P4 rounded or pointed. Spinous seta of P5 consistently shorter than seta on the same segment.

Van de Velde (1984) concludes that *Mesocyclops dussarti* is morphologically allied to *M. thermocyclopoides* which does not occur in Africa. The Nigerian specimens demonstrate wide variability in form. Morphometric data however are similar to Van de Velde (1984) Table 1.

It is more restricted in distribution than *M. ogunnus* which is its closest Nigerian form. Van de Velde (1984) describes *M. dussarti* as a species restricted to the Sahel-Sudan region, in swamps, pools and lakes associated with the river systems of the Senegal, Niger and Volta. This is also confirmed by the results of this study.

*Mesocyclops ogunnus* Onabamiro, 1957 (Figs. 21–26)

Female: *Mesocyclops ogunnus* is a species originally described from Nigeria. Antennule reaches distal margin of second thoracic segment, hyaline membrane with one sickle shaped deep notch (Fig. 21). Enp3P4 2.5–3.2 times as long as wide, inner and outer apical spines usually equal in length; projections on distal margin of connecting lamella of P4 small, weakly developed, rounded (Fig. 22). Spinous seta of P5 shorter than seta on the same segment (Fig. 23). Lateral arms of receptaculum seminis long, slightly curved backwards (Fig. 24). Furcal rami 2.69–3.2 times as long as wide, not pilose on internal margin; lateral and external setae with spinules at points of insertion, external seta longer than dorsal seta (Figs. 25, 26).

Localities: 115, 11014, 2293, 330, 553, 6616, 776, 883, 8864.

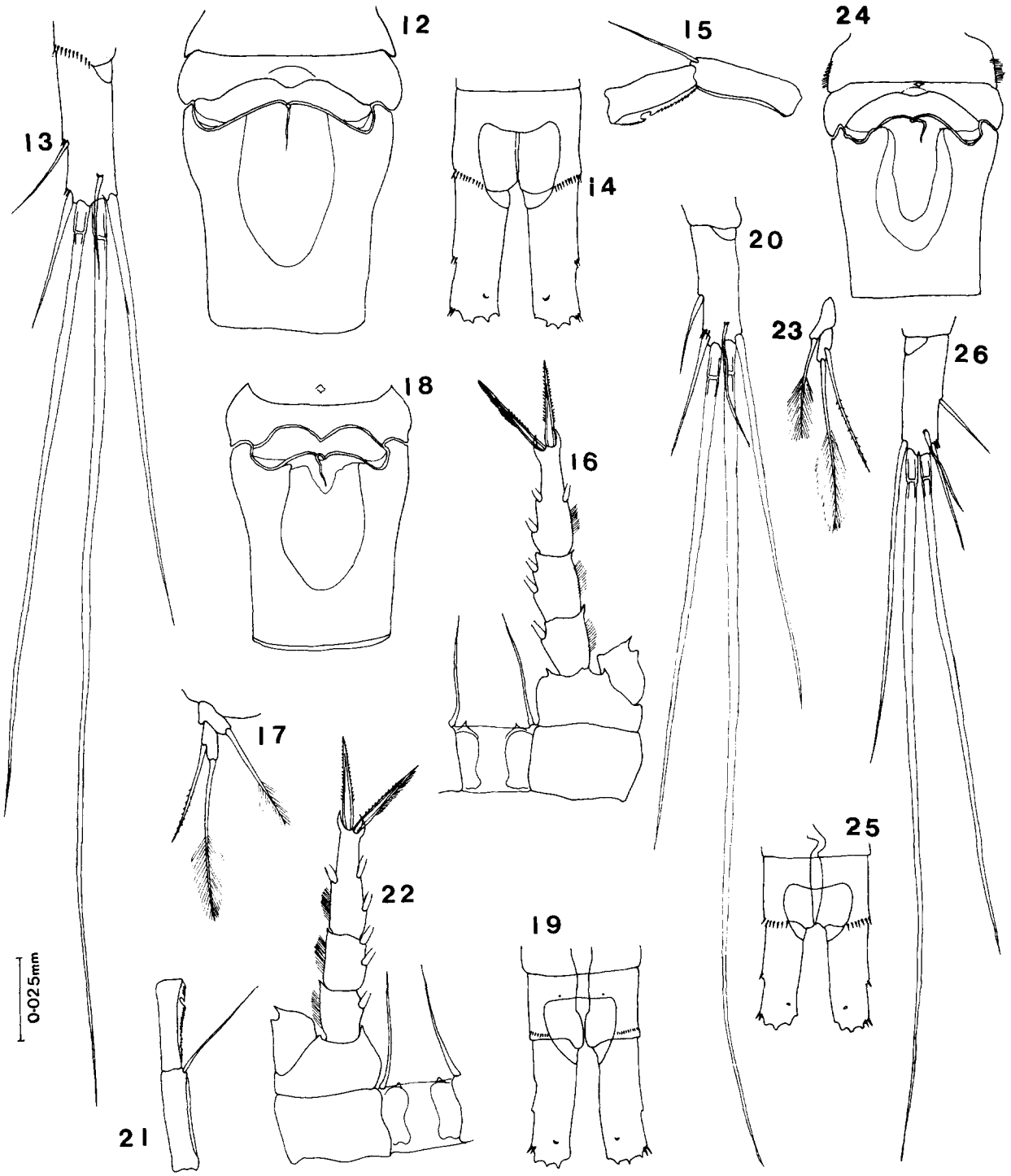
Total body length varies from 0.9–1.2 mm (n = 10). The inner apical spine of Enp3P4 in all cases examined was equal to outer in length. Nigerian specimens of *M. ogunnus* are smaller than *M. dussarti* with which it has close affinities morphologically. The lateral arms of the receptaculum seminis vary from long and slender to short and broad as in *M. dussarti*. It can be easily separated from *M. dussarti* by the presence of spines at the points of insertion of both the lateral and external setae *M. dussarti* has spines at the point of insertion of the external seta only).

It was more commonly encountered than *M. dussarti* and occurred from all types of habitats sampled.

*Mesocyclops rarus* Kiefer, 1981 (Figs. 27–33)

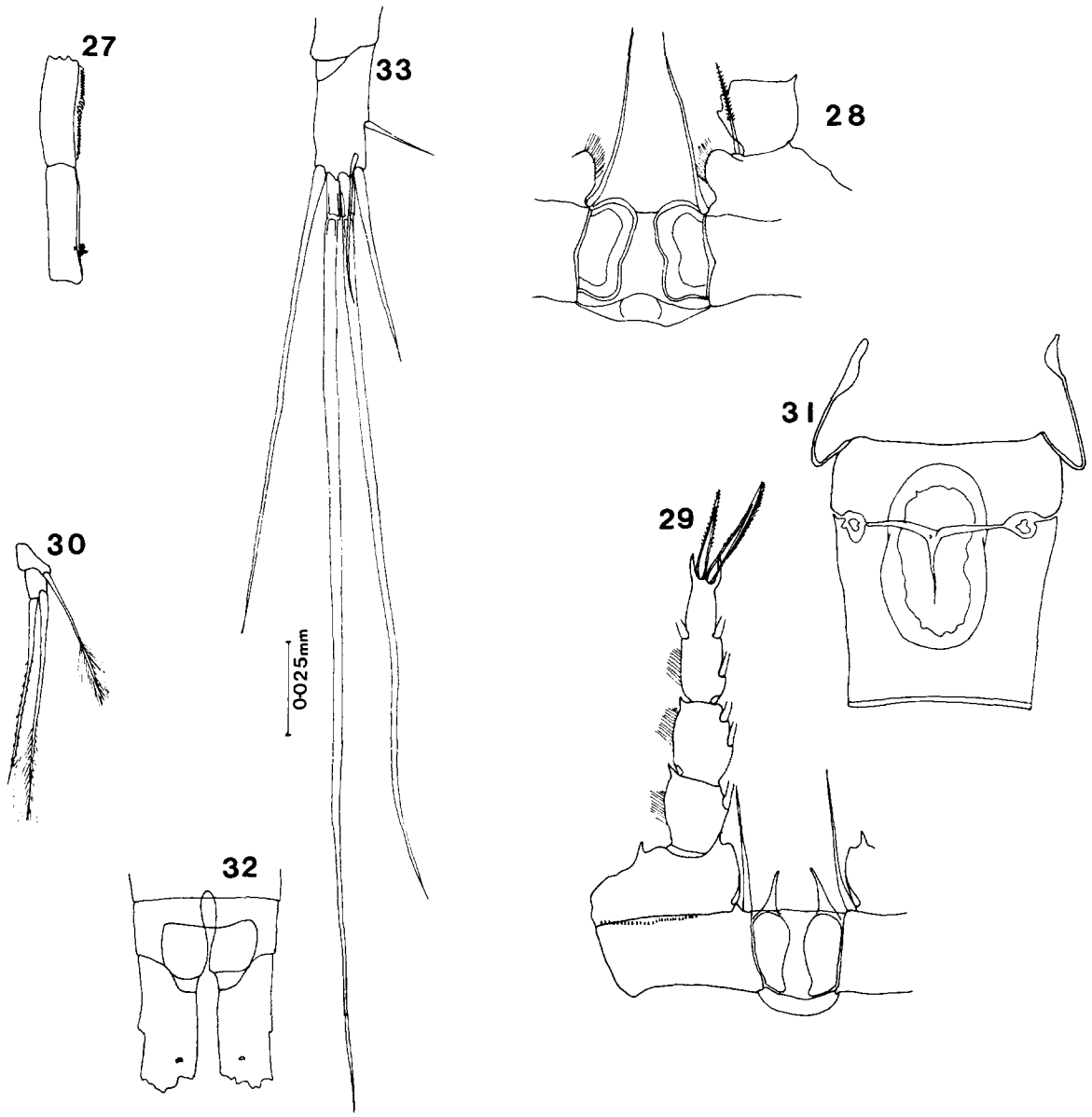
*Mesocyclops rarus* was originally described from Lake Ondo, East Africa by Kiefer (1952) as *Mesocyclops leuckarti aequatorialis*. He subsequently revised this species to its present status in 1981.

Female: Antennule reaches to middle of third thoracic segment, hyaline membrane without deep notch (Fig. 27). Spine present on inner distal basipodite of P1 (Fig. 28). Enp3P4 2.65–3.00 times as long as wide, inner apical spine always longer than outer,




*Figs. 15–20. Mesocyclops dussarti*, female: Fig. 15. Antennular segment 16 & 17; Fig. 16. Enp3P4 and connecting lamella, coxo- and basipodite P4; Fig. 17. P5; Fig. 18. Last thoracic segment and genital segment with receptaculum seminis; Fig. 19. Last abdominal segment and furcal rami, dorsal view; Fig. 20. Furca.

*Figs. 21–26. Mesocyclops ogunnus*, female: Fig. 21. Antennular segment 16 & 17; Fig. 22. Enp3P4 and connecting lamella, coxo- and basipodite P4; Fig. 23. P5; Fig. 24. Last thoracic segment and genital segment with receptaculum seminis; Fig. 25. Last abdominal segment and furcal rami, dorsal view; Fig. 26. Furca.

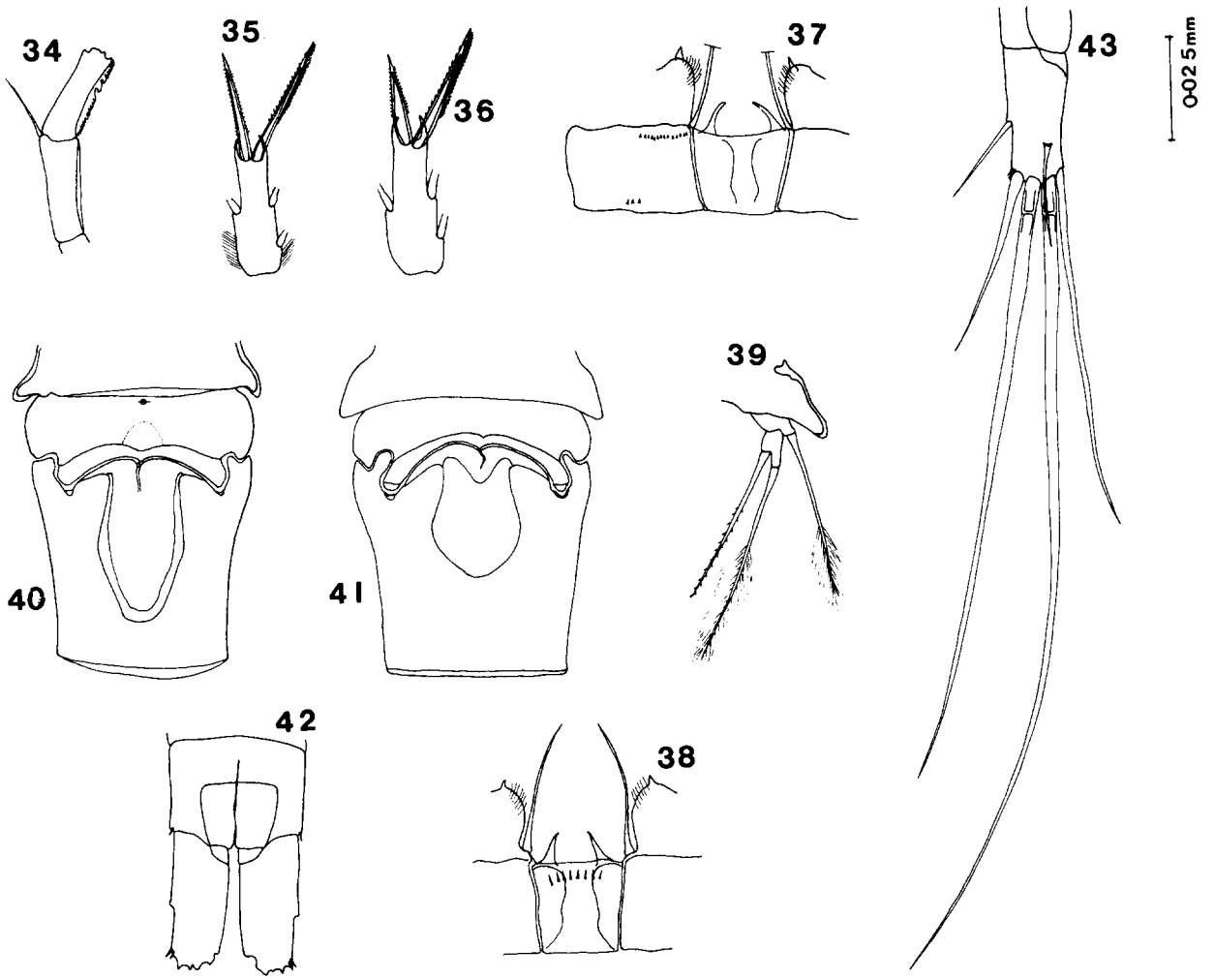



*Figs. 27–33. Mesocyclops rarus*, female: Fig. 27. Antennular segment 16 & 17; Fig. 28. Connecting lamella and inner portion of coxo- and basipodite P4; Fig. 29. Enp3P4 and connecting lamella, coxo- and basipodite P4; Fig. 30. P5; Fig. 31. Last thoracic segment and genital segment with receptaculum seminis; Fig. 32. Last abdominal segment and furcal rami, dorsal view. Fig. 33. Furca.

internal:external spine ratio: 1.54–1.62; projections on distal margin of connecting lamella always prominent, 2.75–3.00 times as long as wide, usually curved at apices slightly or sharply (Fig. 29). Spinous seta on distal segment of P5 0.70–0.76 as long as setule on same segment (Fig. 30). Receptaculum seminis with broad, oblong cuticular frame; anterior margin almost straight with mild dip in centre, pore canal long (Fig. 31). Furcal rami 2.06–2.60 times as long as wide, not pilose on internal margin; lateral and external setules without spines at points of origin, external seta 1.29–1.31 times longer than dorsal seta (Figs. 32–33).

Localities: 331.

Total body length varies from 1.18–1.42 mm (n = 10).




*Figs. 34–43. Mesocyclops salinus*, female: Fig. 34. Antennular segment 16 & 17: Figs. 35–36. Enp3P4; Figs. 37–38. Connecting lamella and coxo- and basipodite P4, frontal and caudal views; Fig. 39. P5; Figs. 40–41. Last thoracic segment and genital segment with receptaculum seminis; Fig. 42. Last abdominal segment and furcal rami, dorsal view; Fig. 43. Furca.

In Africa, this species is said to exhibit a restricted distribution to the East African Lakes, extending from the Tibesti Mountains in North Africa to Mozambique in the south (Van de Velde, 1984). This study records its occurrence in West Africa for the first time. It is suggested that its distribution may not be as restricted as hitherto observed if the systematic updatement of the genus is carried out in more African countries.

Diagnostic characters: These are the presence of a spine on the basipodite of P1, long projections on the distal margin of connecting lamella of P4 and the broad, oblong cuticular frame of the receptaculum seminis.

In Nigerian samples, it was only recorded from pond samples from a single location suggesting that it may be a rare species in Nigerian freshwaters.

*Mesocyclops salinus* Onabamiro, 1957
(Figs. 34–43)

*Mesocyclops salinus* was originally described from Nigeria by Onabamiro (1957). It has subsequently been reported from Mali (Dumont *et al.*, 1981). Its common synonyms in the literature are *Mesocyclops leuckarti aequatorialis* (Kiefer, 1952) and *Mesocyclops curvatus* (Kiefer, 1981).

Female: Antennule reaches to distal margin of sec-

ond thoracic segment, hyaline membrane with 2 separated notches (Fig. 34). Enp3P4 2.50–3.01 times as long as wide, inner apical spine always longer than outer (Figs. 35, 36); projections on distal margin of connecting lamella prominent, apices curving towards each other (Figs. 37, 38). Spinous seta on distal segment of P5 0.76–0.80 times as long as feathered seta on same segment (Fig. 39). Receptaculum seminis particularly variable in the length of the distal part with slender lateral arms, copulatory pore canal slightly curved to straight (Figs. 40, 41). Furcal rami 2.46–2.70 times as long as wide, not pilose on internal margin; lateral seta with spines at point of insertion (Figs. 42, 43).

Localities: 2291, 22003, 4408, 4417.

Total body length varies from 0.97–1.19 mm (n = 10).

Diagnostic characters: The receptaculum seminis with slender lateral arms and copulatory pore canal slightly curved to straight. Also presence of long projections on the distal margin of connecting lamella of P4.

In Nigeria, it was generally found in streams, rivers and fish ponds. As also observed by Van de Velde (1984), it was only recorded in areas south of the River Niger and its major tributary River Benue.

Genus *Thermocyclops* Kiefer, 1927

*Thermocyclops* species recorded from Nigeria

*Thermocyclops crassus* (Fischer, 1853)
*Thermocyclops decipiens* (Kiefer, 1929)
*Thermocyclops neglectus* (Sars, 1909)

*Thermocyclops crassus* (Fischer, 1853)
(Figs. 44–47)

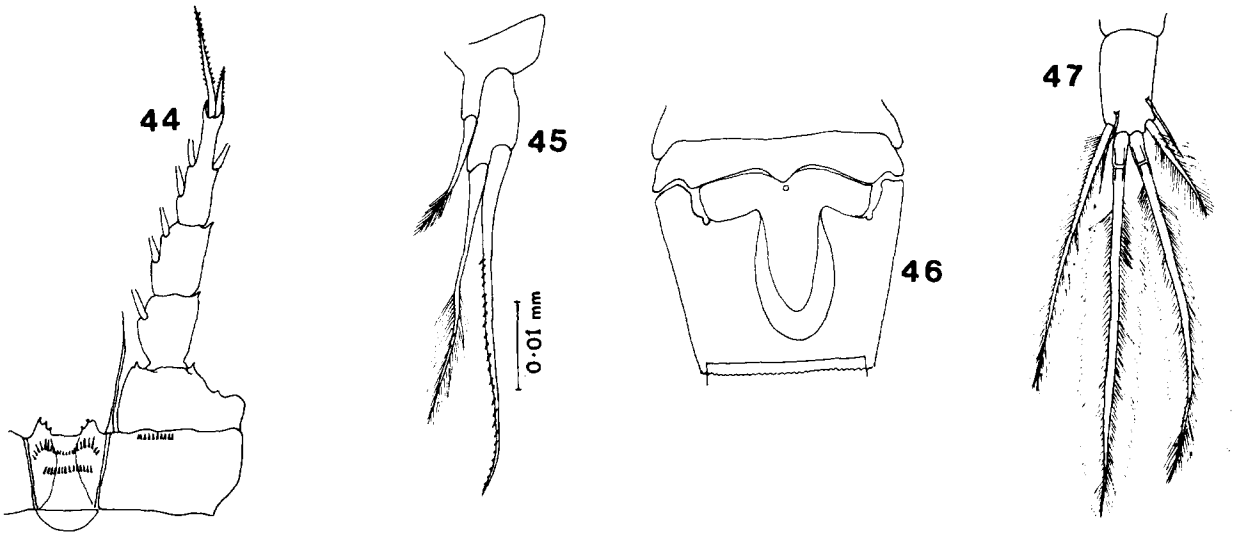
Originally described by Fischer (1853) as *Cyclops crassus*, its synonyms are *Cyclops hyalinus* Rehberg (1880); *Cyclops oithonoides* var. *hyalina* Schmeil (1892); *Mesocyclops crassus* Sars (1918); *Mesocyclops* (*Thermocyclops*) *hyalinus* Kiefer (1929a); *Mesocyclops* (*Thermocyclops*) *brevifurcatus* Harada (1931); *Thermocyclops hyalinus* Margalef (1953); *Mesocyclops* (*Thermocyclops*) *crassus* Naidenow (1966). It was recorded as *Thermocyclops crassus*, by Dussart (1969), Kiefer (1978a) and Dussart (1982). Observations of the morphology of the receptaculum seminis along with other features has made it easy to separate species of *Thermocyclops* as has been done for the genus *Mesocyclops*.

Female: Antennule reaches to distal margin of second thoracic segment. Enp3P4 2.07–2.83 times as long as wide, inner apical spine 0.45–0.48 times as long as outer; projections on distal margin of connecting lamella of P4 prominent, rounded with 2–5 spinules (Fig. 44).

Internal: external spine ratio of Enp3P4 = 2.14–2.30. Spinous seta on distal segment of P5 1.23–1.33 length of seta on same segment (Fig. 45). Receptaculum seminis with short, broad, lateral arms, anterior margin mildly curved (Fig. 46). Furcal rami 1.70–1.95 times as long as wide, lateral seta 0.82–0.84 times length of dorsal seta (Fig. 47). The furcal index of the Nigerian specimens (1.70–1.95)

*Table 2.* Comparative morphometric data of Nigerian *Thermocyclops* species.

| Species | Total length (mm) | $Enp_3P_4$ L:W | $Enp_3P_4$ $S_i$:$S_e$ | $P_5$ distal segment ss:sf | Furcal rami | |
|---|---|---|---|---|---|---|
| | | | | | L:W | $S_i$:$S_d$ |
| *Thermocyclops crassus* | | | | | | |
| Present study (n = 10) | 0.73–0.92 | 2.07–2.83:1 | 2.14–2.30:1 | 1.23–1.33:1 | 1.70–1.95:1 | 1.30–1.32:1 |
| Dussart (1982) | 0.77–0.97 | – | – | – | 2.00–2.50:1 | – |
| *Thermocyclops decipiens* | | | | | | |
| Present study (n = 10) | 0.80–0.87 | 2.00–3.30:1 | 2.81–2.85:1 | 1.40–1.46:1 | 2.60–2.80:1 | 1.51–1.53:1 |
| Dussart (1982) | 0.80–0.90 | – | – | – | 2.50:1 | – |
| *Thermocyclops neglectus* | | | | | | |
| Present study (n = 10) | 0.70–0.81 | 2.87–2.93:1 | 2.25–2.63:1 | 1.04–1.07:1 | 2.27–2.38:1 | 0.85–0.90:1 |
| Dussart (1982) | 0.70–0.83 | – | – | – | – | – |




*Figs. 44–47. Thermocyclops crassus*, female: Fig. 44. Enp3P4 and connecting lamella, coxo- and basipodite P4; Fig. 45. P5; Fig. 46. Last thoracic segment and genital segment with receptaculum seminis; Fig. 47. Furca.

was consistently lower than observed by Dussart (1982) from Madagascar (2.00–2.50).

Total body length 0.73 to 0.92 mm (n = 10).

Localities: 2262, 2296, 334, 4407.

Diagnostic characters: The furcal index is always less than 2.0 (range 1.70–1.95). The characteristic shape of the receptaculum seminis is with short, broad, lateral arms of which the anterior margin is mildly curved.

In Nigeria, *T. crassus* was found in rivers, streams and ponds. It was not as common as *T. decipiens*.

*Thermocyclops decipiens* (Kiefer, 1929)
(Figs. 48–52)

*Thermocyclops decipiens* was originally recorded and described from South Africa. It has subsequently been reported from East Africa (Kiefer, 1952a), Angola (Kiefer, 1938a) and Nigeria, West Africa (Imevbore, 1966). It appears to be tropicopolitan occurring in Asia, C. and S. America and in Australia too.

Female: Antennule reaches to distal margin of second thoracic segment. Enp3P4 3.0–3.3 times as long as wide, inner apical spine 2.81–2.85 times as long as outer, projections on distal margin of connecting lamella prominent, rounded usually with 2–3 spinules each or in a few cases were 4 or 5 (Fig. 48). P5 two segmented, spinous seta on distal segment 1.40–1.46 length of seta on same segment (Fig. 49). Receptaculum seminis with slender lateral arms, anterior margin slightly to strongly curved (Figs. 50, 51). Furcal rami 2.6–2.8 times as long as wide, lateral seta 0.62–0.67 times length of dorsal seta (Fig. 52).

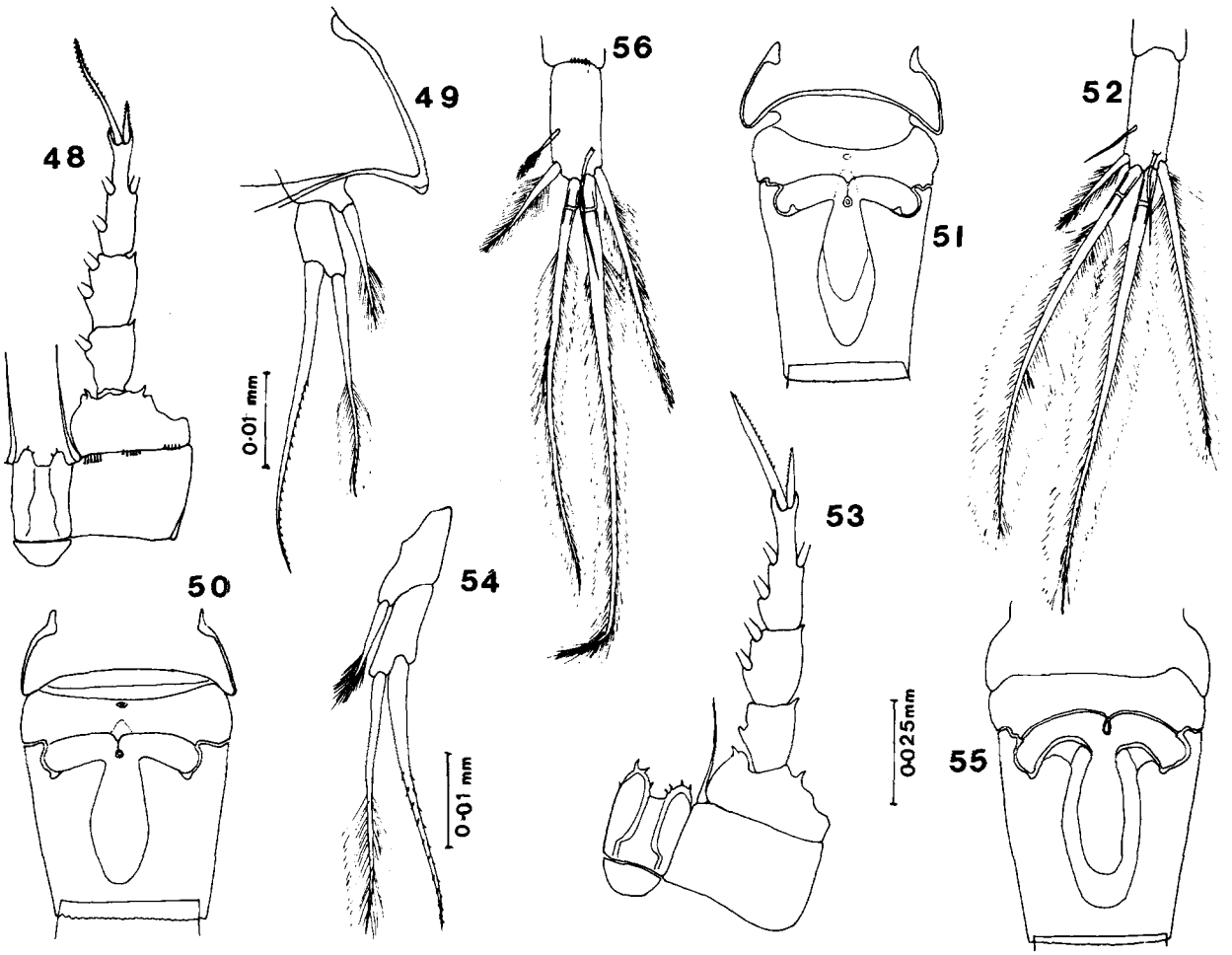
Total body length 0.80–0.87 mm (n = 10).

Localities: Almost all habitats examined 1106, 2244, 3309, 4444, 5503, 6618, 770.

Diagnostic characters: These include the spinous seta: feathered seta index of distal segment of P5 slightly smaller than 1.5 (range 1.40–1.46), and the receptaculum seminis with slender lateral arms of which the anterior margin may vary from short and strongly curved to long and slightly curved. *T. decipiens* is the commonest occurring Nigerian species of *Thermocyclops* and was recorded from a wide range of habitats as similarly observed by Dussart (1982).

*Thermocyclops neglectus* (Sars, 1909) (Figs. 53–56)

Synonyms are *Cyclops hyalinus* (non Rehberg) de Guerne & Richard (1892), *Mesocyclops neglectus* Sars (1927), *Mesocyclops* (*Thermocyclops*) *neglec-*




*Figs. 48–52. Thermocyclops decipiens*, female: Fig. 48. Enp3P4 and connecting lamella, coxo- and basipodite P4; Fig. 49. P5; Figs. 50–51. Last thoracic segment and genital segment with receptaculum seminis; Fig. 52. Furca.

*Figs. 53–56. Thermocyclops neglectus*, female: Fig. 53. Enp3P4 and connecting lamella, coxo- and basipodite P4; Fig. 54. P5; Fig. 55. Last thoracic segment and genital with receptaculum seminis; Fig. 56. Furca.

*tus* Kiefer (1929a), *Thermocyclops neglectus* Kiefer (1978a).

Female: Antennule reaches to middle of second thoracic segment. Enp3P4 2.87–2.93 times as long as wide, inner apical spine 2.25–2.63 times as long as outer; projections on distal margin of connecting lamella prominent, with 3–4 spinules each (Fig. 53). Spinous seta on distal segment 1.04–1.07 length of feathered seta on same segment (Fig. 54). Lateral arms of receptaculum seminis strongly curved (Fig. 55). Furcal rami 2.27–2.38 times as long as wide, lateral seta 0.40–0.45 times length of dorsal seta (Fig. 56).

Total body length 0.70–0.81 mm (n = 10).

Localities: 6613, 1107, 4414, 6613.

Diagnostic characters: The spinous seta: feathered seta index of distal segment of P5 slightly greater than 1.0 (range 1.04–1.07) and receptaculum seminis with strongly curved lateral arms.

In Nigerian freshwaters, *T. neglectus* did not demonstrate particularly great variability. It is of interest that all the specimens examined had 3 and 4 spinules respectively on both rounded projections on the distal margin of the connecting lamella of P4. This was also observed in the illustration of Dussart (1982). *T. neglectus* although not a very common

species like *T. decipiens*, was encountered more frequently than *T. crassus* in Nigeria. It was recorded from lakes, temporary habitats and fish ponds.

## Summary

The genera *Mesocyclops* and *Thermocyclops* found in Nigerian freshwaters are revised and keys provided. Illustrated descriptions of species are given.

The commonest species of *Mesocyclops* encountered in Nigeria are *Mesocyclops aspericornis* and *Mesocyclops ogunnus* occurring in most habitats sampled. *Mesocyclops rarus* was believed to exhibit a restricted distribution to the East African lakes, extending from the Tibesti mountains in North Africa to Mozambique in the South (Van de Velde, 1984). I recorded it from West Africa for the first time. It occurred more commonly in ponds. As also observed by Van de Velde (1982), coexistence of up to 3 *Mesocyclops* species from a single locality was frequently encountered. Nigeria has half the species of *Mesocyclops* recorded in Africa.

The commonest species of *Thermocyclops* in Nigeria is *Thermocyclops decipiens* occurring in a wide range of habitats as observed by Dussart (1982). Coexistence of *Thermocyclops* species was less frequently encountered, rarely with 2 species coexisting but usually with only one species. Variability in forms was not very characteristic of the *Thermocyclops* species studied.

It is hoped that this systematic review will be a useful contribution to the distribution of species of *Mesocyclops* and *Thermocyclops* in Africa and provide a reliable basis for the identification of species serving as intermediate hosts of *Dracunculus medinensis* in Nigeria.

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**Appendix 1**

Selected localities where species were recorded in this study. The numbers where each species was recorded is referred to in the text under locality.

| Number in text | Habitat | Locality Name |
|---|---|---|
| 115 | Lake | Lake Chad (Doro) |
| 1106 | Lake | Malamfatori |
| 1107 | Lake | Malamfatori |
| 1143 | Lake | Nike Lake Station 1 |
| 11014 | Lake | Opi Lake, Nsukka |
| 11017 | Lake | Kainji |
| 2212 | River | Nun River, Ikolo |
| 2226 | River | Bonney |
| 2242 | River | Asaba |
| 2244 | Stream | Eku-Abraka |
| 2293 | Stream | 20 km to Patani |
| 22004 | River | Yenagoa |
| 330 | Pond | Aviara |
| 331 | Pond | Nsukka Campus Botanical Garden |
| 3304 | Pond | Jebba |
| 3309 | Pond | Damba |
| 3317 | Pond | Mariga |
| 4405 | Fish Pond | Odeda Fish farm |
| 4406 | Fish Pond | Ileuso village |
| 4414 | Fish Pond | Stillwater, Moniya |
| 4416 | Fish Pond | Moniya |
| 4444 | Fish Pond | Moniya |
| 4451 | Fish Pond | Moniya |
| 553 | Dam | University of Ibadan |
| 5503 | Dam | Tabari, Gusau |
| 668 | Temporary rain pool | Port-Harcourt |
| 6610 | Marsh | Ilorin |
| 6613 | Stagnant pool | Oheorhe |
| 6616 | Temporary pool | Patani |
| 6618 | Stagnant pool | Wooru-Oja |
| 6619 | Pool | Yartafki |
| 770 | Unknown habitat | Benin-City |
| 771 | Unknown habitat | Benin-City |
| 776 | Unknown habitat | Benin-City |
| 883 | Cement Fish Tanks | Zoology Dept. University of Ibadan |
| 8819 | Cement Fish Tanks | Zoology Dept. University of Ibadan |
| 8864 | Cement Fish Tanks | Zoology Dept. University of Ibadan |