A new euryhaline copepod from Cape Town: *Halicyclops dedeckeri* n.sp. (Copepoda:Cyclopoida)

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A new species of the widely distributed cyclopid genus *Halicyclops* Norman is described from hypersaline summer pools on the bed of Milnerton Lagoon, Cape Town, South Africa. *H. dedeckeri* n. sp. appears to be most closely related to *H. thermophilus* Kiefer, 1929 and *H. spinifer* Kiefer, 1935 in that the females of all three species bear a sharp chitinous spine on each side of the genital double-somite. Unlike *H. thermophilus* and *H. spinifer*, the new species bears one spiniform and one normal seta (in addition to the three spines) on the P4 enp 3 in both sexes. The new species is being mass-cultured in laboratory tanks for use in feeding studies on marine fish larvae.

S. Afr. J. Zool. 1983, 18: 62 – 66

'n Nuwe spesie van die wydverspreide sikloopgenus *Halicyclops* Norman word beskryf vanaf poele met 'n hoë soutgehalte wat in die somer in die bodem van die Milnertonstrandmeer te Kaapstad, Suid-Afrika gevind word. *H. dedeckeri* n. sp. is klaarblyklik nou verwant aan *H. thermophilus* Kiefer, 1929 en *H. spinifer* Kiefer, 1935 aangesien die wyfies van al drie die spesies 'n skerp kitineuse stekel aan elke kant van die genitale dubbelsomiet het. In teenstelling met *H. thermophilus* and *H. spinifer* het die nuwe spesie een stekelvormige en een normale seta (bo en behalwe die drie stekels) op die P4 enp 3 in albei spesies. Die nuwe spesie word tans in massakultuur in die laboratorium gekweek vir gebruik in voedingstudies met marine vislarwes.

S.-Afr. Tydskr. Dierk. 1983, 18: 62 – 66

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Received 23 October 1982; accepted 29 October 1982

A small cyclopoid copepod with free-swimming nauplii was one of several estuarine invertebrates collected by the author from Milnerton Lagoon, Cape Town, to be tested as live food for use in feeding studies on marine fish larvae. It was found to represent an undescribed species of *Halicyclops* Norman, the fourth of the genus reported from southern Africa and the twelfth reported from sub-Saharan Africa, Madagascar and Reunion. A key to the determination of eight of these species has been provided by Wooldridge (1977).

The last review of the genus was that of Kiefer (1936), in which nine species and two subspecies were recognized. A worldwide key covering 29 species and three subspecies was provided by Lindberg (1957), and a worldwide checklist by Wilson (1958). The genus has grown considerably since those publications, now comprising 49 species and four subspecies, including the new species described here.

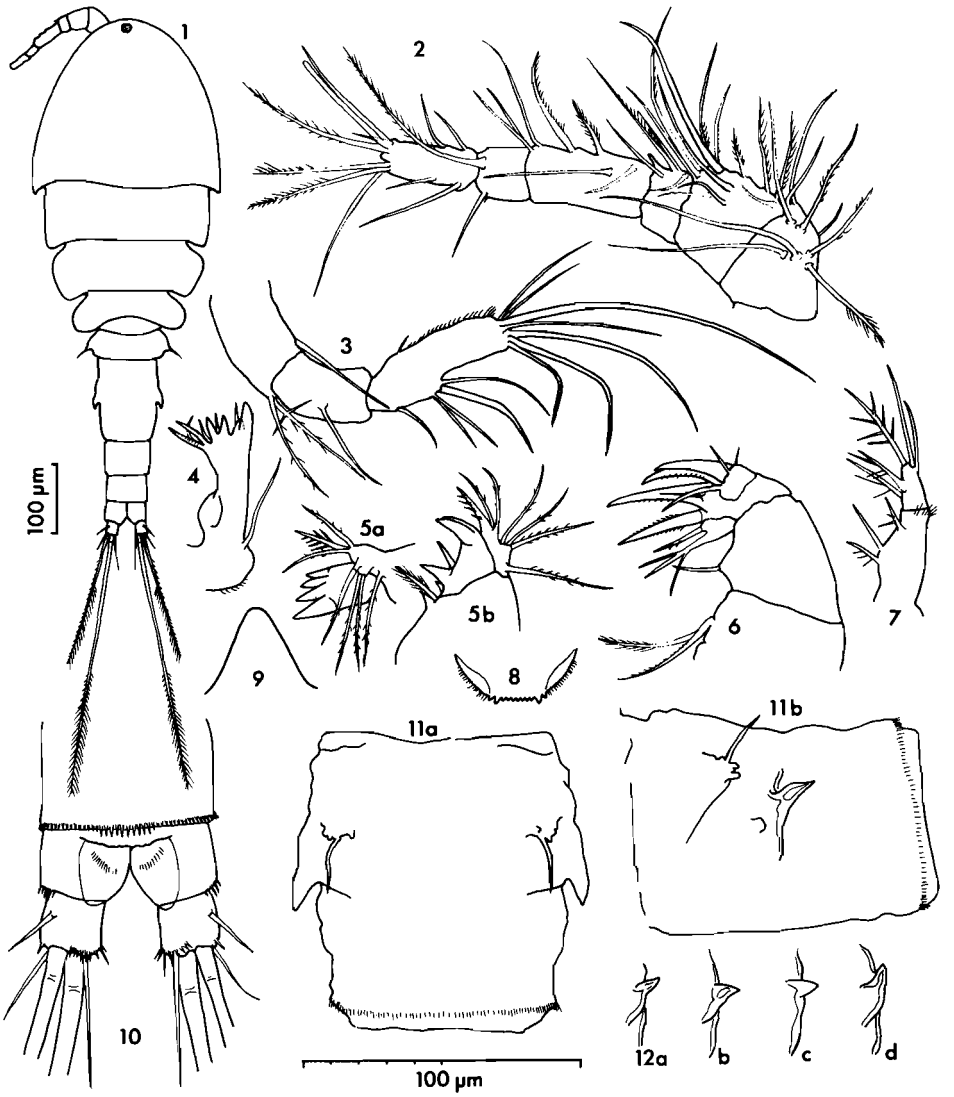
Description

Family: Cyclopidae
Subfamily: Halicyclopinae
Genus: *Halicyclops* Norman, 1903
Halicyclops dedeckeri n. sp. (Figures 1 – 19)

Holotype: South African Museum, Cape Town, SAM-A17788. Ovigerous female mounted on glass slide. Specimen taken from laboratory culture derived from collections made in February 1981, in hypersaline pools on the bed of Milnerton Lagoon, Cape Town.
Paratypes: SAM-A17789. Several hundred individuals of both sexes, nauplii, and copepodids in vial. Specimens taken from same culture as holotype.
Derivation of name: In honour of Dr A.H.B. De Decker of the South African Museum for his contributions to copepod biology in southern Africa.

Female (Figures 1 – 16): Length of ovigerous females 670 – 780 μm (excluding furcal setae); maximum width across cephalothorax 250 – 275 μm. In life, body a clear, pale yellow; eye well developed, bright red. Each ovisac with 6 – 18 spherical eggs 60 μm in diameter.

Posterior margins of genital double-somite (Figure 11) and two somites posterior to it bearing a single row of spinules completely surrounding the somites. Anal somite deeply incised and bearing spinules only laterally and ventrally (Figure 10). Free margin of anal operculum irregularly rough, not spinulose. Median dorsal spinules of pre-anal somite longer and more robust than more lateral spinules of same row (Figure 10). Posterior margin of dorsal scute



Figures 1 – 12 *Halicyclops dedeckeri* n. sp., adult female. 1. Female of length 760 µm, dorsal view; 2. A1; 3. A2; 4. Md; 5a. Mxl, ventral view showing terminal claws; 5b. Mxl, lateral view showing dorsal setae and spines; 6. Mx2; 7. Mxp; 8. Labrum; 9. Rostrum; 10. Area of caudal rami, dorsal view; 11a. Genital double-somite, dorsal view showing lateral spines and P6; 11b. Genital double-somite, lateral view, same individual; 12a – d. Lateral view of genital spines of four other adult females.

of thoracic somite 4 markedly concave in dorsal aspect (Figure 1).

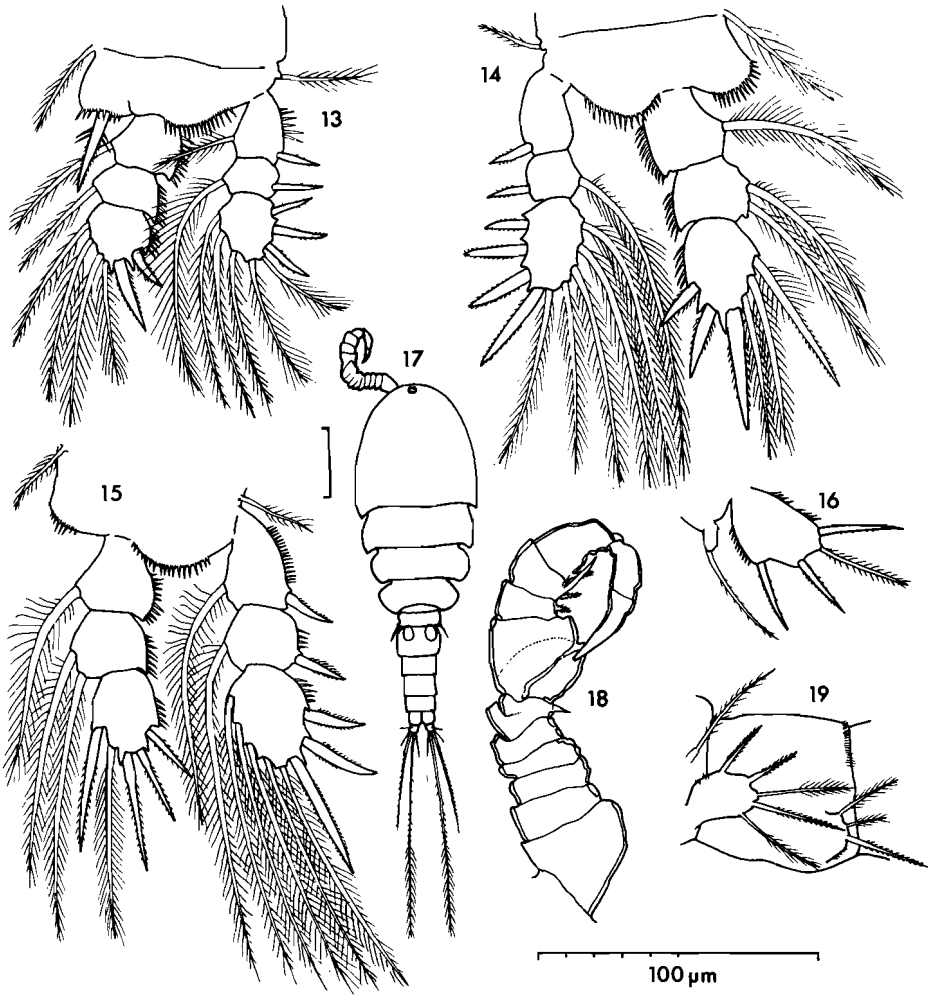
Genital double-somite bearing a chitinous spine 10 – 15 µm long on each side. Viewed laterally, the direction in which the spine points varies from horizontal (posteriad) to almost vertical (dorsad) (Figures 11 – 12), a more horizontal direction being most frequent.

Lengths of furcal setae of 12 ovigerous females: I (innermost): 48 – 62 µm; II: 338 – 375 µm; III: 160 – 205 µm; (IV) (outermost): 24 – 32 µm; V (dorsal): 19 – 28 µm. Furcal seta II twice length of III, less than length of metasome.

Appendages as illustrated (Figures 2 – 7, 13 – 16). Noteworthy features include modified proximal seta on P2 and P3 enp 3: proximal half is setiform, distal half is spiniform (Figure 14); modified proximal seta on P4 enp 3: spiniform throughout (Figure 15). P2 and P3 virtually identical. P5 seg 2 bearing a seta and 3 spines (Figure 16); P6 bearing a seta and 2 or 3 small protuberances (Figure 11). Lengths of these spines and setae, expressed as a percentage of the length of the longest spine of P5 seg 2 (Figure 16), as follows: seta of P5 seg 1: 74 – 121% (mean 104%); lateral spine of P5 seg 2: 79 – 91% (mean 85%); shortest spine of P5: 67 – 82% (mean 71%); seta of P5 seg 2: 71 – 130% (mean 104%); seta of P6: 32 – 65% (mean 50%). The absolute length of the P5 seg 2 reference spine in the 12 ovigerous females dissected ranged from 29 – 39 µm (mean 34 µm).

Male (Figures 17 – 19): Smaller and more slender than female (Figure 17). Length 490 – 550 µm; maximum width across cephalothorax: 170 – 180 µm. Life colours as in female. Somite spinulation as in female, except on genital somite (Figure 19). Furcal seta lengths: I: 32 – 40 µm; II: 260 – 305 µm; III: 138 – 162 µm; IV: 22 – 30 µm; V: 20 – 27 µm. Furcal seta II twice length of III, less than length of metasome.

A1 14-segmented (Figure 18); many long setae and at least 2 aesthetes present, not shown in the figure. Segments 6 and 7 partially fused, bearing a short spine on medial side; segments 8 and 9 partially fused, forming a reinforced notch on medial side into which the distal tip of terminal segment can apparently lock; segment II bearing a smooth spine



Figures 13 – 19 *Halicyclops dedeckeri* n. sp. 13 – 16. Adult female. 13. Pl; 14. P2; 15. P4; 16. P5. 17 – 19. Adult male. 17. Male of length 510 µm, dorsal view; 18. A1, long setae and aesthetes not shown; 19. Genital somite, lateral view showing P5 and P6.

pointing distally. Other head appendages and legs 1 – 4 as in female. P5 segment 2 bearing 2 setae and 3 spines; P6 bearing a spine and two setae (Figure 19). Lengths of these spines and setae, expressed as a percentage of the length of the longest spine of P5 seg 2, as follows: seta of P5 seg 1: 103 – 120% (mean 112%); dorsalmost (Figure 19) spine of P5 seg 2: 59 – 84% (mean 67%); spine ventral to latter: 55 – 68% (mean 65%); seta ventral to latter: 100 – 110% (mean 105%); ventralmost seta: 67 – 105% (mean 93%); dorsal seta of P6: 72 – 86% (mean 79%); short seta of P6: 36 – 73% (mean 56%); P6 spine: 88 – 114% (mean 98%). The absolute length of the P5 seg 2 reference spine in the six adult males dissected ranged from 28 – 33 µm (mean 31 µm).

Habitat: Milnerton Lagoon is a shallow body of water open most of the year to the sea (Table Bay). It was studied in depth by Millard & Scott (1954). The mouth closes off in summer, and as the water level declines, pools are left upstream in the former channel. It was in several of these very shallow (10 – 20 cm) pans that the copepods were collected. Temperature and salinity tolerance of *H. dedeckeri* have not been studied. However, occasional measurements made in culture containers in which the copepods were actively reproducing yielded values between 18 – 32 °C and 6 – 70°/∞S. It is not unlikely that their limits are still beyond these values. Animals in culture were supplied with a mixture of 10 cultured phytoplankton species that included both flagellates and diatoms. Nauplius production was variable, however, and it is hoped that more refined culture techniques (as well as the interesting naupliar stages of this species) will be the subject of a later publication.

Discussion

After making minor changes to the status of species included by Lindberg (1957) in his key (reducing *H. rotundipes* to subspecific status under *H. neglectus*, after Monchenko (1974); raising *H. neglectus septentrionalis* to specific status, after Herbst (1962)), one is still left with Lindberg's total of 29 species and three subspecies. With the addition of *H. japonicus* Ito, 1956; *H. higoensis* Ito, 1958; *H. fosteri* Wilson, 1958; *H. denticulatus* Kiefer, 1960; *H. reunionis* Kiefer, 1960; *H. gauldi* Plesa, 1960; *H. stocki* Herbst, 1962; *H. incognitus* Herbst, 1962; *H. ryukyuensis* Ito, 1962; *H. latus* Chia-Jui & Ai-Yun, 1964; *H. reunionensis* Božić, 1965; *H. aquaesurgentis* Božić, 1965; *H. ambiguus* Kiefer, 1967; *H. validus* Monchenko, 1974; *H. rotundipes aralensis* Borutskii, 1974; *H. pondoensis* Wooldridge, 1977; *H. coulli* Herbst, 1977; *H. cryptus* Monchenko, 1979; *H. clarkei* Herbst, 1982; *H. laminifer* Herbst, 1982; plus the new species, *H. dedeckeri*, one arrives at a total of 49 species

and four subspecies presently ascribed to the genus. It is pointed out by Wilson (1958) in her discussion and criticism of *Halicyclops* systematics, that several nominal species and subspecies are inadequately described. A revision of the genus would very likely alter these figures.

H. dedeckeri n. sp. is readily distinguishable from the other three *Halicyclops* species recorded to date from southern Africa (excluding Madagascar). *H. pilifer* Lindberg, known from the west coast of India, was tentatively identified by De Decker (in Hill 1966) from Umlalazi estuary, Natal. A re-examination of Hill's specimens (permanent slide mounts of two undissected females in De Decker's collection) also led the present author to an identification of *H. pilifer* on the basis of Lindberg's (1957) key. However, the specimens do not conform to Lindberg's (1949) original description of that species in other respects. Both Hill's specimens and *H. pilifer* are readily distinguishable from *H. dedeckeri* on the basis of the female genital spines. *H. denticulatus* Kiefer is known from Inhaca Island, Mozambique (Wells 1967), in addition to its type locality on Madagascar. It lacks the genital somite spines and bears particularly long spinous processes on the posterior dorsal margin of the pre-anal somite. *H. pondoensis* Wooldridge was described from Msikaba and Mbotyi estuaries on the Transkeian coast. It also lacks the genital somite spines. Unusual features include several hair-like structures on the proximal part of the P4 enp 1 seta and the male P5 seg 2 bearing 2 spines and 3 setae rather than the usual 3 spines and 2 setae (Wooldridge 1977). Wooldridge (pers. comm.) has recently encountered yet another *Halicyclops* species in southern African estuaries. However, its identity has not been established.

Named species in which the female bears a chitinous spine on each side of the genital double-somite now number four: *H. thermophilus* Kiefer, 1929 (type locality, Java), *H. spinifer* Kiefer, 1935 (type locality India, near Calcutta), *H. venezuelaensis* Lindberg, 1954 (type locality Lake Maracaibo, Venezuela), and the new species from Cape Town. In *H. venezuelaensis* the spines are very blunt and are directed (in dorsal view) as much laterally as posteriorly; in the other three species the spines are sharper and are directed (in dorsal view) more posteriorly (Lindberg 1954; Kiefer 1936).

Although published descriptions and illustrations of *H. thermophilus* (Kiefer 1929a, 1929b, 1936; Heberer & Kiefer 1932; Lindberg 1952) and *H. spinifer* (Kiefer 1935, 1936; Lindberg 1941) are not complete, they are adequate to permit a clear distinction between those two species and *H. dedeckeri*. The most salient difference lies in the nature of the two setae of the P4 enp 3 in both sexes. In *H. dedeckeri* the more distal of the two setae is normal, i.e., plumiform, and considerably longer than the spine next to it; the more proximal of the two setae is spiniform, and nearly the same length as the just-mentioned spine (Figure 15). This feature was present in all 12 females and six males dissected. In the case of *H. thermophilus* from Java and Madagascar, both of the setae are spiniform (Kiefer 1929a; Lindberg 1952); in the case of *H. spinifer*, both of the setae are normal (Lindberg 1941). *H. higoensis* Ito has a similarly modified seta on the P4 enp 3. The species lacks genital somite spines, however, and the proximal seta of the P2 and P3 enp 3 is apparently normal (Ito 1958).

One can discern several other differences between the new species and published descriptions and illustrations of *H. thermophilus* and *H. spinifer*, but with limited information on the extent of individual variation in the latter two species, these differences should perhaps not be overly stressed. (i) The relative lengths of the 3 spines of the male P5 seg 2: In *H. thermophilus* from Java (Kiefer 1929a, figure 3) and in *H. thermophilus* from Madagascar (Lindberg 1952, figure 1e) the three spines are of somewhat similar length (the shortest is about 85% and 75%, respectively, the length of the longest). In *H. dedeckeri*, the shortest spine is only 55 – 68% (mean 67%) the length of the longest. The same spines figured by Lindberg (1941, figure 2g) for *H. spinifer* are similar to those of *H. dedeckeri*. (ii) The relative lengths of the three spines of the P4 enp 3: Lindberg (1941, table 1) gave ratios of the longest spine to the shortest in *H. spinifer* in the range 1,3 – 1,6. In *H. dedeckeri* the ratio ranges from 1,8 – 2,3, which is closer to the ratio (1,74) reported for *H. thermophilus* from Madagascar (Lindberg 1952) and to that of Kiefer's (1936, figure 40) illustration of *H. thermophilus* from Java (*ca.* 1,8). Kiefer (1929a) reported a ratio of about 1,5, however, in his text description. (iii) The lengths of the furcal setae: The length of the innermost seta in female *H. spinifer* ranged in Lindberg's (1941, table 1) material from 20 – 38 μm (mean 30 μm) as opposed to 48 – 62 μm in *H. dedeckeri* females of comparable size. The outermost seta is also much shorter in female *H. spinifer* (13 – 17 μm) than in *H. dedeckeri* (24 – 32 μm). In *H. spinifer*, the longest furcal seta is less than twice the length (1,8) of the second longest; in *H. dedeckeri* it is almost exactly twice the length. *H. thermophilus* (Madagascar) also appears to have shorter inner and outer furcal setae (25 μm and 11 μm, respectively) than *H. dedeckeri*; the ratio of the longest seta to the second longest appears to be higher (2,4) than that in *H. dedeckeri* (Lindberg 1952: 58).

Information presently available on *H. thermophilus* and *H. spinifer* does not preclude the possibility that the two forms are conspecific, nor does it preclude the possibility that *H. thermophilus* from Java, *H. thermophilus* from Madagascar, and *H. spinifer* all represent distinct species. Lindberg (1952) considered both of these possibilities and, somewhat hesitatingly, chose to (i) raise *spinifer* to species rank (previously considered a subspecies of *H. thermophilus* by Kiefer (1936) and by Lindberg (1941), himself), and (ii) identify his Madagascar specimens with *H. thermophilus*, altough he was not in a position to personally examine *H. thermophilus* from the type locality and that species was rather poorly described. In the 30 years since Lindberg's paper was published, no additional information has come to light that might serve to resolve these questions. (Wilson (1958) listed the specimens from India and Iran originally identified by Lindberg (1941) as *H. thermophilus spinifer*, later (Lindberg 1952, 1957) as *H. spinifer*, in synonomy with *H. thermophilus* Kiefer. She did not place Kiefer's (1935, 1936) *H. thermophilus spinifer* from India in synonomy with *H. thermophilus*, however, and the fact that she gave no explanation in the text leads one to suspect

that the synonomizing of Lindberg's material was not intentional.)

Acknowledgements

I thank T. Wooldridge and A.H.B. De Decker for their assistance with literature and museum specimens necessary for the preparation of this paper.

References

HEBERER, G. & KIEFER, F. 1932. Zur Kenntnis der Copepodenfauna der Sunda-Inseln. *Arch. Naturgesch. Zeit. wiss. Zool. Abt. B*, n. ser., 1: 225 – 274.

HERBST, H.V. 1962. Marine Cyclopoida Gnathostomata (Copepoda) von der Bretagne-Küste als Kommensalen von Polychaeten. *Crustaceana* 4: 191 – 206.

HILL, B.J. 1966. A contribution to the ecology of the Umlalazi Estuary. *Zool. afr.* 2: 1 – 24.

ITO, T. 1958. Groundwater copepods from south-western Japan. *Hydrobiologia* 11: 1 – 28.

KIEFER, R. 1929a. Neue Ruderfusskrebse von den Sunda-Inseln. (1. Mitteilung über die Copepoden der Sunda-Expedition Rensch-Heberer). *Zool. Anz.* 84: 46 – 49.

KIEFER, F. 1929b. Crustacea Copepoda. II. Cyclopoida Gnathostoma. *Das Tierreich* 53: 1 – 102.

KIEFER, F. 1935. Zur Kenntnis der Halicyclopen (Crustacea Copepoda). *Zool. Anz.* 110: 10 – 13.

KIEFER, F. 1936. Freilebende Süss- und Salzwassercopepoden von der Insel Haiti. Mit einer Revision der Gattung *Halicyclops* Norman. *Arch. Hydrobiol.* 30: 263 – 317.

LINDBERG, K. 1941. Cyclopides (Crustacés copépodes) de l'Inde. V. Contribution à l'étude du genre *Halicyclops* Norman. *Rec. Indian Mus.* 43: 1 – 7.

LINDBERG, K. 1949. Contributions à l'étude des cyclopides (Crustacés copépodes) 1. Le genre *Halicyclops* Norman. *K. Fysiograf. Sallsk. Lund Fordhandl.* 19(7): 98 – 121.

LINDBERG, K. 1952. Cyclopides (Crustacés copépodes) de Madagascar. Troisième note. *Mém. Inst. scient. Madagascar*, sér A. 7(1): 53 – 67.

LINDBERG, K. 1954. Cyclopides (Crustacés copépodes) de l'Amérique du Sud. *Ark. Zool.*, ser. 27(11): 193 – 222.

LINDBERG, K. 1957. Cyclopides (Crustacés copépodes) de la Côte d'Ivoire. *Bull. Inst. francais Afr. noire*, sér. A 19: 134 – 179.

MILLARD, N.A.H. & SCOTT, K.M.S. 1954. Ecology of South African estuaries. Part VI. Milnerton Estuary and the Diep River. *Trans. roy. Soc. S. Afr.* 34: 279 – 323.

MONCHENKO, V.I. 1974. (A new species of the genus *Halicyclops* (Copepoda) from the Danube delta.) *Zool. Zh.* 53(8): 1155 – 1160. (in Russian).

WELLS, J.B.J. 1967. The littoral Copepoda (Crustacea) on Inhaca Island, Mozambique. *Trans. r. Soc. Edin.* 67(7): 189 – 358.

WILSON, M.S. 1958. The copepod genus *Halicyclops* in North America, with description of a new species from Lake Pontchartrain, Louisiana, and the Texas coast. *Tulane Stud. Zool.* 6: 176 – 189.

WOOLDRIDGE, T. 1977. A new species of *Halicyclops* (Copepoda, Cyclopoida) from estuaries in Transkei, southern Africa. *Ann. S. Afr. Mus.* 73(10): 361 – 371.