

MORPHOLOGICAL AND ECOLOGICAL STUDIES ON A CYCLOPOID COPEPOD, *MESOCYCLOPS NOTIUS* KIEFER IN A SUBTROPICAL CHINESE LAKE*

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Abstract

This paper reports morphological and ecological studies on *Mesocyclops notius* Kiefer from a subtropical Chinese lake. Morphological characters of this species from Lake Biandantang were compared with Kiefer's and Van de Velde's studies on Australian specimens. In Lake Biandantang, *M. notius* associated with *Thermocyclops taihokuensis* Harada and *T. brevifucatus* Harada, dominated the planktonic Cyclopoida in the spring and the summer, while *Cyclops vinctinus vinctinus* Uljanin dominated in the winter.

Key words Planktonic Copepoda, Subtropical Chinese lake, *Mesocyclops notius*, Morphological and ecological studies

The genus *Mesocyclops* occurs worldwide, and it is successful in the tropics and subtropics and marginal in temperate and arctic regions, and the most frequently cited taxa are *Mesocyclops leuckarti* (Van de Velde, 1984). After the revision of *Mesocyclops* by Kiefer (1981) using new criteria, the peculiar form of the front part of the receptaculum seminis and the structure of its porus area, it is clear that the geographical range of *M. leuckarti* (Claus) is restricted to Europe and the western part of Northern Asia (Kiefer, 1981). In China, only three species were reported, *M. leuckarti*, *M. pehpeiensis* Hu, *M. guangxiensis* Rad & Kay (Shen, 1979), and the most frequently cited *Mesocyclops* in lakes along the middle and lower basins of the Chang Jiang River were *M. leuckarti* e.g., in Lake Donghu (Chen, 1965), Lake Wuli-Hu (Shen & Tai, 1962), Lolee Hongze (Chen, 1993), Lake Honghu (Zhang, 1995).

In a recent study on the ecosystem structure of Lake Biandantang, after reference

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to Kiefer's (1981) revision of *Mesocyclops*, it was recognized that *Mesocyclops* in this lake presents affinities with *M. notius* which is, until now, only reported from Australia. The present paper is thus to report morphological and ecological studies on this copepod in Lake Biandantang.

1 Material and methods

Lake Biandantang, $30^{\circ}15'N$, $114^{\circ}23'E$, is on the alluvial plain of the middle basin of the Chang Jiang River. It is one part of Lake Baoan which was divided into several small lakes by artificial dikes decades ago. Lake Baoan is connected with the Chang Jiang River through a small Channel. Lake Biandantan is a small lake with a surface area of 3.3 km^2 and an average depth of 1.90 m. It is a macrophytic lake with a coverage rate of submerged macrophytes as high as 75% of the total lake area (Su et al., 1995). The average chlorophyll a amount of phytoplankton is only about $2.4\mu\text{g/L}$ (Wang & Liang, 1995). Water temperature is between $5-34^{\circ}\text{C}$, and the monthly average is above 20°C during April to October (Zhang & Liu, 1995).

Copepod samples were taken at monthly intervals from four sampling stations across the lake from April 1996 to March 1997. The samples were taken using a 5L modified Patalas' bottle sampler. Each sample was the mixture of several subsamples collected from the surface to the bottom at 0.5 m intervals, and 25—50 L of the lake water was strained through a $60\text{ }\mu\text{m}$ mesh plankton net. The samples were fixed with 4% formalin. Specimens of Cyclopoids were dissected under a binocular microscope in glycerine, and drawings were made using a camera lucida.

2 Results

2.1 Morphometric measurements

2.2 Redescription of female

Length. 1.01mm(excluding furcal setae)(range: 0.98—1.05mm, mean: = 1.01, n = 10).

Antennule. Composed of 17 segments, reaching to the middle of the third thoracic somite. **Antenna.** Segmented as in all *Mesocyclops*. Structure of basipodite illustrated as in Figs. 1—2. Based on Van de Velde's (1984) terminology, on frontal side, longitudinal row of spines composed 23—25 spines and proximal row of spines of 9—10 spinules; and on caudal side, longitudinal row composed of 11—12 spinules with 1—3 spinules separated from the others and proximal row of 3—4 spinules, a small group of 9—11 minute spines situated distally on basipodite, and a line of 17—20 minute spinules place obliquely near internal edge of segment.

P1. Inner distal margin of basipodite without a spine.

P4. Structure as illustrated in Fig.6. Enp, 2.99 (2.73—3.20) times as long as wide.

Length of inner apical spine 1.26 (1.21—1.30) times that of outer apical spine. Length of inner apical spine almost equal to that of segment.

Tab. 1 Morphometric measurements of *M. notius* found in Lake Biandantang on May 19, 1996. Sd=Dorsal seta, Se=External seta, SPi=Internal apical spine, SPe=External apical spine, Se-T.P5=Terminal segment of P5, S1=Seta of first segment, S2=Lateral seta of terminal segment, S3=Apical seta of terminal segment, SP1=External seta, SP2=Median seta, SP3=Internal spine.

No. examined	Total length (mm)	Furcal rami L:W	Furcal rami Sd:Se	Enp3P4 L:W	Enp3P4 SPi:SPe	Se-T.P5 L:W	P5 S2:S3	P5 S1:S2	P6 SP1/SP2/SP3(μm)
1 F(ovigous)	1.00	2.92	1.16	2.73	1.29	2.57	0.81	0.70	
2 F(ovigous)	1.03	3.09	1.26	3.00	1.29	2.25	0.83	0.70	
3 F(ovigous)	0.98	2.92	1.27	3.00	1.30	2.57	0.82	0.67	
4 F(ovigous)	1.00	3.00	1.24	3.10	1.24	2.25	0.83	0.69	
5 F(ovigous)	0.98	3.09	1.46	2.90	1.29	2.25	0.86	0.71	
6 F(ovigous)	1.00	3.18	1.24	3.00	1.21	2.29	0.72	0.63	
7 F(ovigous)	1.05	3.09	1.20	3.00	1.23	2.25	0.85	0.70	
8 F(ovigous)	1.00	3.18	1.40	3.20	1.24	2.25	0.81	0.70	
9 F(ovigous)	1.03	3.09	1.26	2.82	1.23	2.25	0.79	0.79	
10 F(ovigous)	1.00	3.24	1.26	3.10	1.28	2.38	0.74	0.74	
Average	1.01	3.08	1.28	2.99	1.26	2.33	0.81	0.70	
1 (Male)	0.67	3.00	—	2.86	1.40	2.40	0.65	0.71	67/26/19
2 (Male)	0.68	2.88	—	2.93	1.29	2.40	0.62	0.59	64/25/19
3 (Male)	0.68	2.80	—	3.00	1.31	2.40	0.66	0.72	67/26/17
4 (Male)	0.68	3.07	—	2.86	1.25	2.17	0.61	0.73	71/26/17
5 (Male)	0.70	2.88	—	3.00	1.31	2.17	0.66	0.74	71/28/19
Average	0.68	2.93	—	2.93	1.31	2.31	0.64	0.70	68/26/18

P5(Fig. 4). Terminal segment 2.33(2.25—2.57) times as long as wide. Length of lateral spinous seta 0.81 times that of apical seta of terminal segment, and length of seta of first segment 0.70 times that of apical seta of terminal segment. Apical seta reaching distal margin of genital somite.

P6(Fig. 5). Composed of 2 internal, small spines and a long seta.

Last thoracic segment (Fig.4). Two rows of setules present along sides of segment

Receptaculum seminis. As illustrated in Figs. 3—4. Lateral arms slightly curved backwards. Posterior margin of proximal part slightly V-shaped from copulatory pore. Copulatory pore horseshoeshaped. Pore—canal curved to the right, as a long comma.

Furca. Furcal rami 3.08(2.92—3.18) times as long as wide, not pilose on inner margin. Dorsal and ventral sides covered with minutes spines (Fig. 7.). Dorsal seta and external terminal setae with minute spines at their base.

2.3 Description of male

No description is given by Kiefer (1981) and Dussart et al. (1988). The following description is based on specimens from Lake Biandantang.

Mean total body length 0.68 mm ($n = 5$). In contrast to female, last thoracic segment naked (Fig. 8). Structure of P_1 — P_4 as in female. Enp3 of P_4 2.93 times as long as wide, and length of inner apical spine 1.31 times that of outer apical spine. P_6 composed of one spine and two setae. Furcal rami 2.93 times as long as wide ($n = 5$). Mean lengths of external seta, median seta, and

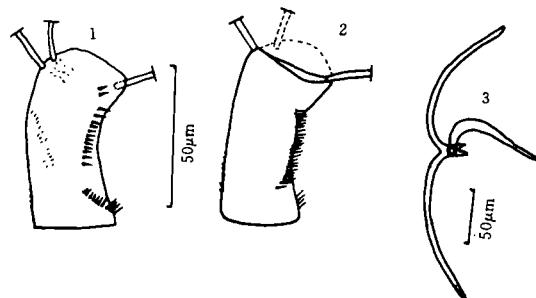


Fig. 1—3 *M. notius* Kiefer from Lake Biandantang, China, Female 1 Basipodite A2, caudal side; 2 Basipodite A2, frontal side; 3 Receptaculum seminis

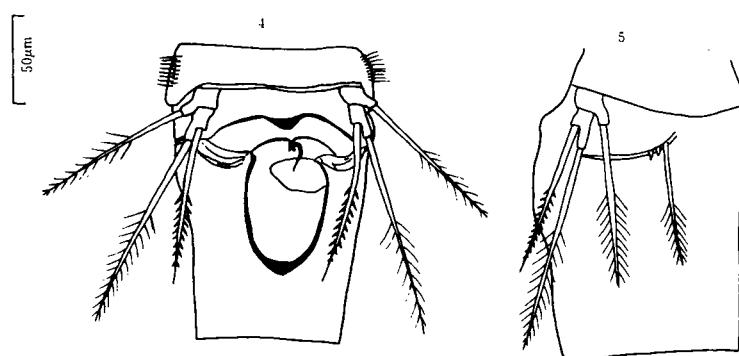


Fig. 4,5 *M. notius* Kiefer from Lake Biandantang, China. Female 4 Last thoracic segment and genital segment, 5 P5 and P6.

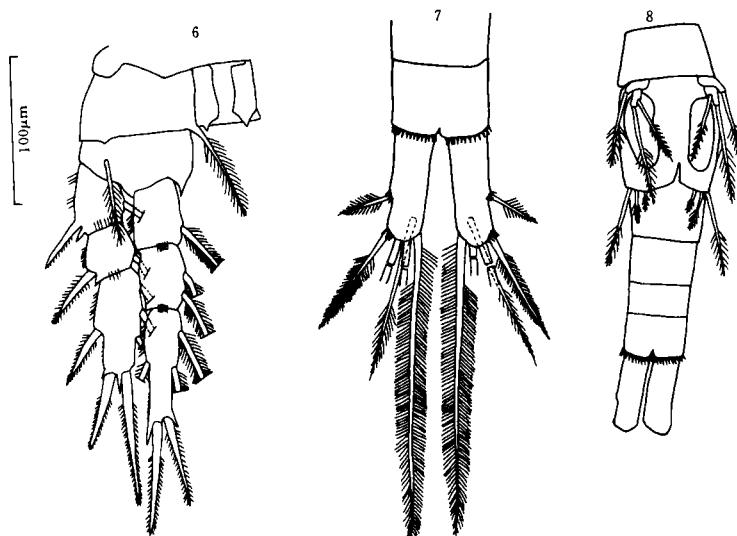


Fig. 6—8 *M. notius* Kiefer from Lake Biandantang, China. 6 Female, P4; 7 Female, furcal rami; 8 Male, last thoracic segment and abdomen

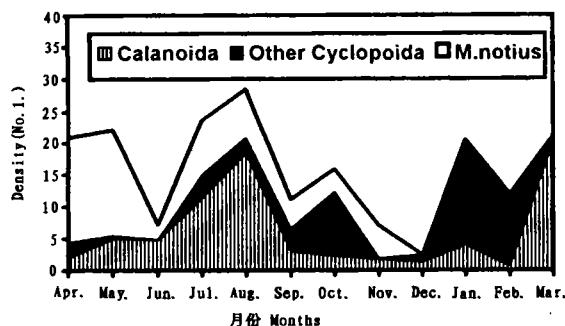


Fig.9 Seasonal dynamics in abundance of *M. notius* Kiefer in Lake Biandantang

maximum density was 16.65 No. / 1 in May. In terms of annual average density, *M. notius* (5.48 No. / L) constituted 55.8% of the total Cyclopoida.

3 Discussion

M. notius was first described by Kiefer (1981) from New South Wales, Australian; and redescribed from 1' Apex Lake, Queensland by Dussart et al. Specimens from Lake Biandantang present affinities with previous descriptions on *M. notius* in the following respects: the structure of the receptaculum seminis, the structure of the precoxal plate of P4, the absence of a spine at the inner margin of the basipodite of P1, the spines present at the base of the lateral and external furcal setae, and the general pattern of spines on frontal side of basipodite of the antennae. Based on the general similarity of the structure of the receptaculum seminis, specimens from Lake Biandantang are identified to be *M. notius*. However, specimens from Lake Biandantang differ from the Australian specimens by other characters: the spine pattern on caudal side of basipodite of the antenna, setule pattern on lateral sides of last thoracic segment. The morphometric measurements listed in Table 2. Obviously, some morphological characters such as spine patterns on the basipodite of A2, length-width ratio of furcal rami, the ratio of dorsal seta to external seta of furcal rami are too

Tab. 2 Comparison of morphometric measurements of *M. notius* given by Kiefer and from the present study

Source	Length (μm)	Morphometric parameters			
		Total	Enp3.P4	Enp3.P4	Furcal rami
Kiefer 1981	840 (750—900)	3.19		1.37 ⁽¹⁾	2.1 ⁽²⁾
Dussart & Fernando 1988	810	3		?	?(3.3—3.8)
Present study	1010(980—1050)	2.99(2.73—3.20)	1.26(1.21—1.30)	3.08(2.92—3.24)	1.28(1.16—1.46)

(1)—(2): Measured from Kiefer's (1981) Fig.6:8 and Fig.6:6, respectively.

internal spine 68μm, 26μm, 18μm, respectively (n = 5).

2.4 Population dynamics

Figure 9 shows the seasonal dynamics in abundance (average density of four sampling stations, excluding nauplius) of *M. notius* in Lake Biandantang. It occurred during the warm seasons (from March to October) with peaks in spring and summer, and the

variable for characterization of the species.

The genus *Mesocyclops* tend to replace the species of *Cyclops* as the chief planktonic Cyclopoida in subtropical and tropical regions and often in the summer in temperate latitudes (Hutchinson, 1957). In Lake Biandantang, *Cyclops vincinus vincinus* Uljanin dominated in the winter (December–February), while *Mesocyclops notius* associated with two *Thermocyclops* species, *T. taihokuensis* Harada and *T. brevifurcatus* Harada (both species slightly smaller than *M. notius*), dominated the planktonic Cyclopida during the spring and the summer, and the other associated Cyclopoida were *M. albidus* (Jurine), *M. varicans* (Sars), *Eucyclops macruroides denticulatus* (Graeter), *Ectocyclops phaleratus* (Koch), and *Neoergasilus* sp. In terms of abundance, *M. notius* is of considerable ecological importance in Lake Biandantang.

Based on the new criteria on *Mesocyclops* by Kiefer, we found that *Mesocyclops* in Lake Donghu, which was considered to be *M. leuckarti* by Chen, also belongs to *M. notius*. This species also dominates the planktonic Cyclopoida in Lake Donghu in the spring and the summer (Chen, 1965; Xie and Takamura, 1996).

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亚热带湖泊中一种剑水蚤——*Mesocyclops notius* Kiefer 的形态及生态学研究

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提 要

本文报道了对一亚热带湖泊中的 *Mesocyclops notius* 的形态及生态学研究。将从扁担塘采得的标本形态学特征与 Kiefer 和 Vande Velde 从澳大利亚的标本的形态学特征进行了比较。在扁担塘, *M. notius* 与 2 种温剑水蚤——*Thermocyclops taihokuensis* Harada 和 *T. brevifurcatus* Harada 为春季和夏季剑水蚤的优势种, 而 *Cyclops vinctinus vinctinus* Vljanin 为冬季的优势种。

关键词 浮游剑水蚤, 亚热带湖泊, *Mesocyclops notius*, 形态及生态学研究