A redescription of *Microcyclops varicans* (G.O. Sars, 1863) (Crustacea: Copepoda: Cyclopidae)

Iskandar M. Mirabdullayev[1*], Danielle Defaye[2]

[1] Tashkent State Agrarian University, Tashkent 100140, Uzbekistan.
E-mail: mirabdullayevi@umail.uz
[2] 27, rue Gaston Charlet, 87000 Limoges France. E-mail: ddefaye@mnhn.fr
**Correspoding author: mirabdullayevi@umail.uz*
Iskandar Mirabdullayev: ORCID 0000-0002-2533-2875

ABSTRACT: Female of *Microcyclops varicans,* the type species of the genus *Microcyclops* Claus, 1893 is redescribed and information on the male morphology is given. It is mainly characterized by: ornamentation of the anal somite (posterior margin bearing a row of spinules of different size); by its caudal rami 3.5 times as long as wide, and heteronomous setation of the inner and outer median terminal caudal setae; by the endopodite 2 of P4 2.3 times longer than wide with thick apical spines; by the absence of spinules at the insertions of Te and Me; by the shape of the P5 (cylindrical); by presence of 9 setae on the third segment of A2. Confirmed records of *M. varicans* are from Norway, Sweden, The Netherlands, England, Germany, Italy, northwestern Russia, and Ukraine. It is probably that *M. varicans* inhabits waterbodies in North Asia.
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KEY WORDS: *Microcyclops varicans*, Copepoda, Cyclopidae, redescription, taxonomy, distribution, variability.

Переописание *Microcyclops varicans* (G.O. Sars, 1863) (Crustacea: Copepoda: Cyclopidae)

Искандар М. Мирабдуллаев[1], Даниель Дефо[2]

[1] Ташкентский государственный аграрный университет, Ташкент 100140, Узбекистан.
E-mail: mirabdullayevi@umail.uz
[2] 27, rue Gaston Charlet, 87000 Limoges France. E-mail: ddefaye@mnhn.fr

РЕЗЮМЕ: Переописана самка *Microcyclops varicans*, типового вида рода *Microcyclops* Claus, 1893, и приведены некоторые сведения о морфологии самца. Этот вид в основном характеризуется: орнаментом анального сомита (задний край несет ряд разноразмерных шипиков); его каудальные ветви в 3,5 раза длиннее ширины, с гетерономным расположением; эндоподитом 2 P4 в 2,3 раза длиннее ширины с относительно тонкими апикальными шипами; отсутствием шипиков в местах прикрепления Te и Me; по форме P5 (цилиндрическая); по наличию 9 щетинок на 3A2. Подтвержденные находки из Норвегии, Швеции, Нидерландов, Англии, Германии, Италии, северо-западной России и Украины. Вероятно, *M. varicans* обитает в водоемах Северной Азии.
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КЛЮЧЕВЫЕ СЛОВА: *Microcyclops varicans*, Copepoda, Cyclopidae, переописание, таксономия, распространение, изменчивость.

Introduction

Microcyclops varicans (Sars, 1863) is the type species of the genus *Microcyclops* Claus, 1893. The genus *Microcyclops* is mainly characterized by in female the 10 to 12 segmented antennule in female, long caudal rami, legs 1 to 4 with two-segmented rami and with P4 endopodite bearing 2 well developed apical spines, P5 composed of outer seta inserted on the fifth pedigerous somite and a small segment bearing a terminal long seta and a tiny spine inserted at inner margin of the segment. It is presently composed of more than 50 species widely distributed in the world. *M. varicans* has often been considered as a cosmopolitan species (Rylov, 1948; Monchenko, 1974; Reid, 1992; Dussart, Defaye, 2006). Described by G.O. Sars (1863) from Norway, it was later reported from other European countries, Africa, Madagascar, Asia, and South, Central and North America. Several authors consider that this species is probably a group of closely related species (Dussart, Defaye, 2006). Dussart & Defaye (2006) concluded that further studies would be necessary to test this hypothesis.

Studying species of the genus *Microcyclops* from Europe (Germany, England, Russia, Norway, Sweden, Italy), Asia (Uzbekistan, Kazakhstan, China, Japan, Bangladesh, India, Thailand, Iran, Yemen, Oman, United Arab Emirates), Africa (Uganda, Namibia, Guinea, Zimbabwe, Nigeria, Cameroon, Ivory Coast, Lesotho), Madagascar, Mauritius, North America (USA), we found that all *Microcyclops* specimens from tropical and subtropical Asia, America, Africa, Madagascar, and Mauritius that were ascribed to this species differed from the species in Europe. Obviously, it is necessary to redescribe the "true" *M. varicans* (Sars, 1863).

Here, we redescribe the female of *M. varicans,* adding some data on the morphology of the male.

Material and methods

All drawings were made by using a drawing tube.

The following material was studied: 1 ♀, a slide (poor condition) from Norway, from G.O. Sars' collection in Oslo (Norway); 1 ♀ from a pool in the vicinity of Saint Petersburg, Russia (Ghent University collection); 1 ♀, a slide #2495 in F. Kiefer's collection, from Germany; 1 ♀ from Uppsala, Sweden, collection of the Natural History Museum, London (identification by R. Gurney); 1 ♀ from Sutton, England, collection of the Natural History Museum, London (identification by R. Gurney); 6 ♀♀ from Mindelsee, Germany, U. Einsle collection in the University of Oldenburg, Germany (identification by U. Einsle). For the redescription, a female from Russia (a pool in the vicinity of Saint Petersburg) was used. For data on the male, a specimen (slide) from the U. Einsle collection in the University of Oldenburg, Germany was used.

ABBREVIATIONS, following Dussart & Defaye (2001). 3 A2 — third segment of antenna 2; enp — endopodite; Fu — caudal ramus; Me — marginal (external) caudal seta; P1–P4 — swimming legs 1 to 4; Sd — dorsal caudal seta; Te — outer terminal caudal seta; Ti — inner terminal caudal seta; Tme — outer median terminal caudal seta; Tmi — inner median terminal caudal seta (Fig. 3).

Results

Subclass Copepoda Milne-Edwards, 1840
Order Cyclopoida Burmeister, 1835
Family Cyclopidae Rafinesque, 1815
Microcyclops varicans (G.O. Sars, 1863)

Cyclops varicans G.O. Sars, 1863
Cyclops (*Mikrocyclops*) *varicans* — Claus, 1893
Cyclops (*Microcyclops*) *varicans* — Kiefer, 1929; Gurney, 1933
Microcyclops s.str. *varicans varicans* — Monchenko, 1974
Microcyclops varicans — Einsle, 1993
Microcyclops varicans varicans — Walter, Boxshall, 2021

FEMALE

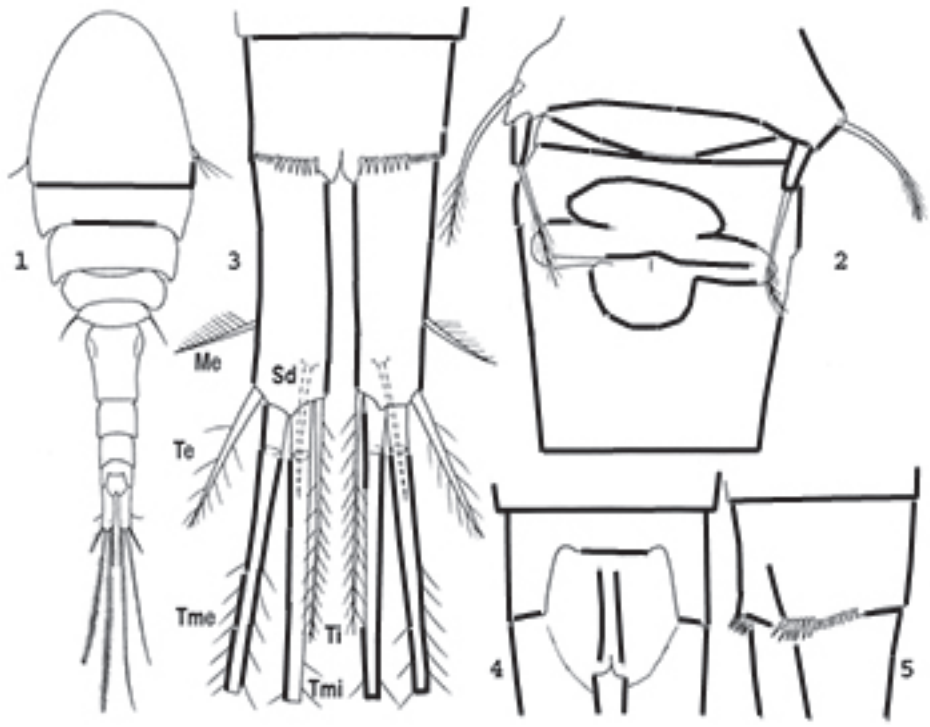
Body length: 720 μm, widest at cephalothorax (Fig. 1).

Last thoracal somite (pediger 5): Lateral margins devoid of spinules (Figs 1, 2).

Genital double-somite: Expanded anteriorly, with rounded lateral sides, about 1.2 times as long as wide in ventral view (Figs 1, 2).

Seminal receptacle: composed of rounded anterior and posterior parts and lateral arms; anterior margin of anterior part slightly flattened; posterior part slightly smaller that anterior one.

Anal somite: Posterior margin with 5–7 large spinules at base of each caudal ramus on ventral side



Figs. 1–5. *Microcyclops varicans* (G.O. Sars, 1863) ♀. 1 — habitus; 2 — last thoracic and genital-double somites; 3 — anal somite and caudal rami, ventral side; 4 — anal somite, dorsal side; 5 — anal somite, lateral side.

Рис. 1–5. *Microcyclops varicans* (G.O. Sars, 1863), ♀. 1 — общий вид; 2 — последний грудной и генитальный двойной сегмент; 3 — анальный сомит и фурка, брюшная сторона; 4 — анальный сегмент, спинная сторона; 5 — анальный сомит, вид сбоку.

and 10 much smaller spinules on lateral sides (Figs 3–5). Caudal rami: parallel, 3.5 times as long as wide. No spinules at insertion of outer terminal caudal seta (Te), or at insertion of marginal (external) caudal seta (Me). Plumage of Tmi and Tme setae heteronomous (Figs 1, 3). Ti slightly shorter than caudal rami and more than 1.5 times as long as Te and Sd (Table 1).

Antennule: 12-segmented, relatively short, not reaching posterior margin of cephalothorax. Armed as follows (segment number in Roman numerals, setal number in Arabic numerals, sp — spine, aesth — aesthetasc): I(8), II(4), III(2), IV(5?), V(4), VI(1+sp), VII(2), VIII(3), IX(2+aesth), X(2), XI(2), XII(7+aesth). First segment with 2 rows of spinules (Fig. 6).

Antenna. Coxobasis bearing 3 setae, outer (lateral) seta about as long as 2 inner (medial) setae, caudal side with 2 rows of spinules. Endopodite composed of three segments, second segment bearing 9 setae (Fig. 7).

Mandible: Gnathobase with 8 teeth and 1 naked seta. Palp with 3 setae (two long and one short) and curved row of spinules present proximally on coxopodite (Fig. 9).

Maxillule: As in Fig. 10. Maxillulary palp naked.

Maxilla: As in Fig. 11, inner claw-like seta of basis bearing 4 strong teeth on inner margin.

Maxilliped: As in Fig. 12. Ornamentation (groups of spinules) on basipodite and syncoxopodite.

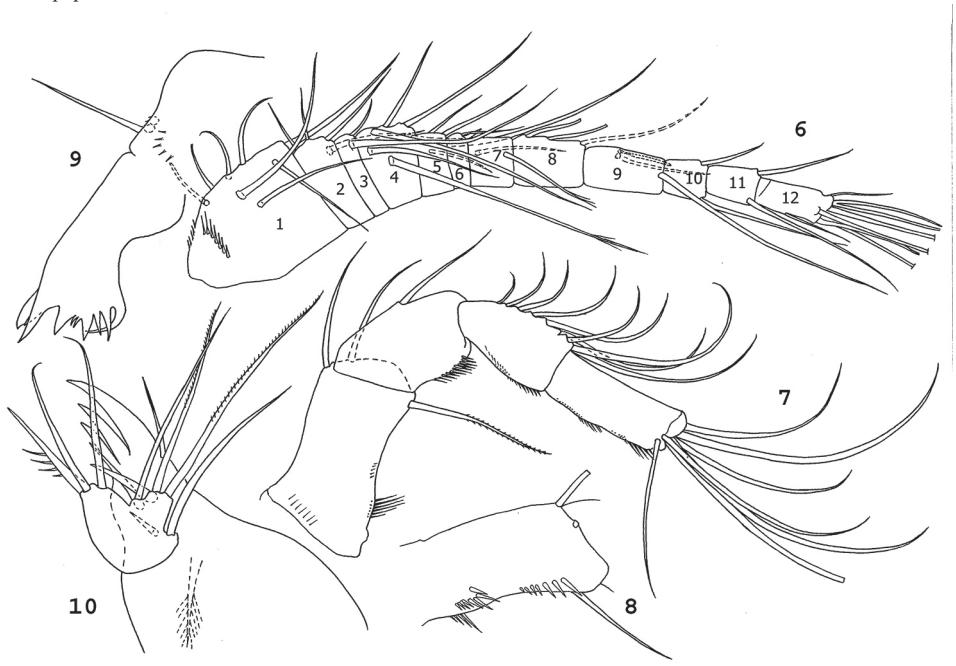
Swimming legs with two-segmented rami; formula of exopodites 2 spines: 3.4.4.3 (Table 2). Inner margin of P1 basipodite with long spine reaching middle of P1 enp2. Intercoxal plates of P1–P4 without ornamentation on both anterior and posterior surfaces (Figs 13, 14, 16). Round prominences on free margin of intercoxal plate pronounced in P1, and barely developed in P2–P4. Coxa of P4 bearing 6–8 strong spinules on inner distal corner of frontal side, and 5 rows of spinules on caudal side (Fig. 16). Inner margins of basipodites of P1–P3 with setules, those of P4 with spinules (Fig. 16). Outer margins of exopodites of P1–P4 smooth. P4 enp2 2.3 times

Table 1. Measurements of *Microcyclops varicans* (G.O. Sars, 1863) female, proportion data are given in %).

Таблица 1. Данные измерений самок *Microcyclops varicans* (G.O. Sars, 1863). Пропорции даны в процентах.

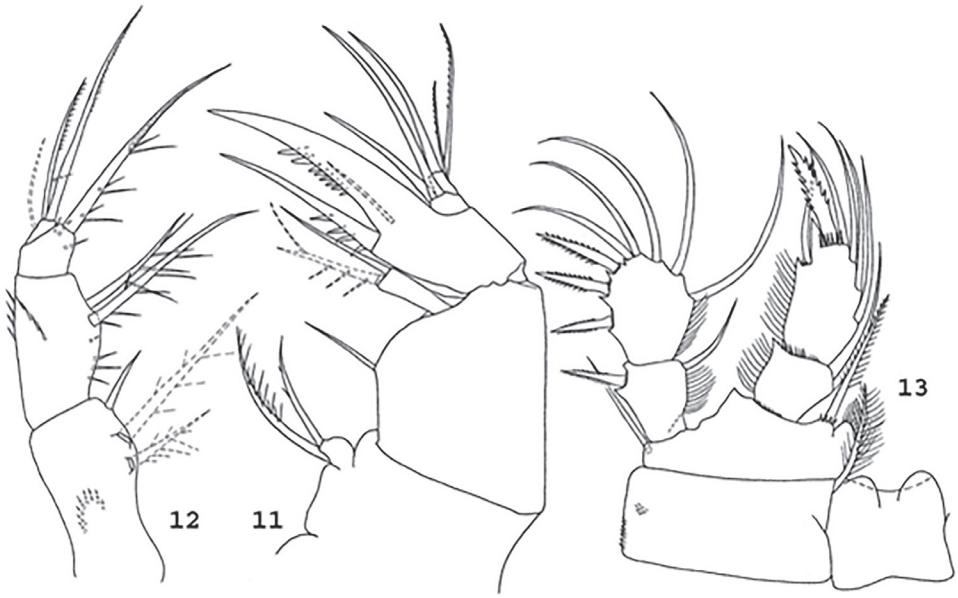
	Russia, SPb n=1	Sweden, Uppsala n=1	Germany, Mindelsee n=6	Germany, FK #2495 n=1	Norway, Oslo n=1	England, Sutton n=1
Anal somite*	7/7	7/8	5–6/?	6/?	5/5	–
Fu L:W	350	368	320–348	306	342	–
Ti : Fu L	96	85	93–100	–	–	–
Ti : Tmi	20	23	20–21	–	–	–
Ti : Tme	27	31	27–31	–	–	–
Ti : Te	160	140	170–187	–	–	–
Ti : Sd	164	–	–	–	–	–
P4enp2 L : W	230	242	222–260	270	–	–
P4enp2 int.sp. : L	100	80	84–90	85	–	94
P4enp2 int.sp. : ex. sp.	125	136	139–146	144	–	150
Mx**	4	3	4	4	–	–
A2***	9	9	9	–	–	9
Coxa P4****	8	–	6	8	–	7
P5 L:W	320	425	330–380	360	–	–

* number of large ventral spinules on urosomite; ** number of strong teeth on seta of basis of maxilla; *** number of setae on second endopodite of A2; **** number of spinules on inner distal corner of frontal side of coxa P4; FK — F. Kiefer copepod collection in Karlsruhe.



Figs. 6–10. *Microcyclops varicans* (G.O. Sars, 1863) ♀. 6 — antennules; 7 — antenna, frontal side; 8 — basipodite of antenna, caudal side; 9 — mandible; 10 — maxillule.

Рис. 6–10. *Microcyclops varicans* (G.O. Sars, 1863), ♀. 6 — антеннула; 7 — антенна, фронтальная сторона; 8 — базиподит антенны, каудальная сторона; 9 — мандибула; 10 — максилула.



Figs. 11–13. *Microcyclops varicans* (G.O. Sars, 1863) ♀. 11 — maxilla; 12 — maxilliped; 13 — P1.
Рис. 11–13. *Microcyclops varicans* (G.O. Sars, 1863), ♀. 11 — максилла; 12 — максиллипед; 13 — P1.

Table 2. Spine and setal formula of legs 1–4 of *Microcyclops varicans* (G.O. Sars, 1863) female.
Таблица 2. Формула шипов и щетинок плавательных ног 1–4 пар самок *Microcyclops varicans* (G.O. Sars, 1863).

	Coxa	Basis	Exopodite	Endopodite
Leg 1	0–1	1–I	I–1, III–2–3	0–1, 1–I+1–3
Leg 2	0–1	1–0	I–1, III–I+1–4	0–1, 1–I+1–4
Leg 3	0–1	1–0	I–1, III–I+1–4	0–1, 1–I+1–4
Leg 4	0–1	1–0	I–0, II–I+1–4	0–1, 1–II–3

longer than wide, inner spine about as long as segment and 1.25 times longer than outer spine (Table 1).

P5: Free segment (exopod) long and truncate, bearing long apical seta and tiny spinule at middle of inner margin (Fig. 2). Lateral seta (dorsal seta of basis) inserted on pediger 5 as long as or slightly longer than terminal seta (crown seta of exopod) of P5.

MALE

Caudal margin of anal somite with many uniformly sized spinules. Insertions of Me and Te caudal setae provided with spinules.

P6 consist of three appendages, one spine, two setae. Outer seta of P6 about 3 times as long as inner spine.

REMARKS. For a long time *Microcyclops varicans* (G.O. Sars, 1863) has been considered as a cosmopolitan species (Rylov, 1948; Monchenko, 1974; Reid, 1992; Dussart, Defaye, 2001). However, specimens identified as "*M. varicans*" from Asia (Kiefer, 1929; Shen, Tai, 1979; Dussart, Fernando, 1985; Chang, 2013, etc.), Americas (Reid, 1992) and Africa (Kiefer, 1952; Defaye, 1988, Baribwegure, Dumont, 2000, etc.) differ from the true European *M. varicans* in one or more of the following features: the ornamentation of the anal somite (posterior margin bearing a row of uniformly sized spinules), a longer P4enp2, thick apical spines of the P4enp2, number of setae on 3A2, the presence of spinules at the insertions of Te in female, and the shape of the P5 (conical). These specimens probably belong to *Microcyclops* cf. *pachyspina* (Lindberg, 1937), the *pachyspina* species complex at least.

We checked several zooplankton samples from Africa, America, tropical and subtropical Asia, Japan and have never found *M. varicans* sensu str. there.

Gutiérrez-Aguirre and Cervantes-Martínez (2016) have recently studied American microcy-

Figs. 14–16. *Microcyclops varicans* (G.O. Sars, 1863) ♀. 14 — P2; 15 — P3 enp; 16 — P4.
Рис. 14–16. *Microcyclops varicans* (G.O. Sars, 1863), ♀. 14 — P2; 15 — P3 enp; 16 — P4.

clopses and concluded that *M. varicans* absent in fauna of Americas.

M. varicans is probably relatively rare in Eurasia.

Confirmed records are from Norway, Sweden, The Netherlands, England, Germany, Italy, northwestern Russia, Belarus and Ukraine. It is probably that *M. varicans* inhabits waterbodies in North Asia.

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