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# Систематика, морфология

## On the taxonomy of the *Acanthocyclops robustus* species complex (Copepoda, Cyclopidae)

### 1. *Acanthocyclops robustus* (G.O. Sars, 1863) and *Acanthocyclops trajani* n. sp.

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

[1] Institute of Zoology, Tashkent, UZBEKISTAN
[2] Musйum national d'Histoire naturelle, Paris FRANCE

### Introduction

The freshwater cyclopid genus *Acanthocyclops* (Kiefer, 1927) has a world-wide distribution and comprises about fifty species and subspecies. It is important in ecological respect since most of the species inhabit continental waterbodies, as well as being components of the plankton as well as of the benthon and in some cases subterranean biotopes. The genus has been the subject of numerous papers, especially concerning two widespread species, *Acanthocyclops vernalis* (Fischer, 1853) and *Acanthocyclops robustus* (G.O.Sars, 1863). Their identification long remained problematic and has been largely discussed during the last decades because of ecological variability of the morphological characters used for their identification. Initially diagnosed by the spine formula of the exopodites of the swimming legs and the setation of the Enp3P4, their definition was improved in Kiefer's (1976) revision of the group, in which additional characters were added, particularly the shape of the genital somite and the shape of the first endopodite of P4. The genital somite is characterised by an anterior enlarged part with lateral angles in *Acanthocyclops vernalis*, whereas the edges are rounded in *Acanthocyclops robustus* (sensu lato). Enp1P4 always has a strongly marked depression on the internal edge in *A. robustus*, while it is weak or absent in *A. vernalis*. However, the distinction based on the shape of the genital segment is now considered problematic. If this character is diagnostic for European *Acanthocyclops* of the *vernalis-robustus* group, it appears less reliable for North American species, leading to the hypothesis that this species complex is represented by different species in North America (Einsle, 1992; Dodson, 1994).

The importance of the variability of these two "phenotypically plastic" species, in terms of size, furcal index, relative length of furcal setae, ornamentation of setae and spines of the natatory legs, and even spine formula has been recorded by different authors, both in field and laboratory studies (Kiefer, 1976; Dodson, 1994; Einsle, 1994; Lescher-Moutouй, 1996). Einsle (1992, 1996) pointed out the need to take into account all these morphological characters with critical attention, as well as the usefulness of other characters, such as the number of chromosomes. Hence, there is an abundant literature on the *Acanthocyclops vernalis-robustus* problem (from Lowndes, 1928; Sramek-Husek, 1954; Dussart, 1969; Monchenko, 1961, 1974; Petkovski, 1975; Kiefer, 1976, 1978; Fryer, 1985; Dussart & Fernando, 1990; Dodson, 1994; Einsle, 1993).

After re-examining a number of specimens identified as *A. robustus*, we came to the conclusion that it was also necessary to re-examine specimens of the taxa considered as its synonyms: *A. robustus f. limnetica* Petkovski, 1975 and *A. americanus* (Marsh, 1873) (Kiefer 1978; Dussart & Defaye, 1985). *A. brevispinosus* (Herrick, 1894) has been recognised by Dodson (1994) as a valid species and carefully redescribed by Dahms & Fernando (1997) and should no longer be considered as a synonym of

*A. robustus* or *A. vernalis*. Although it has a laterally rounded genital segment, it differs from *A. robustus* by several characters, particularly the setation pattern of the proctodeum and the spatulate spines on P3 and P4. *A. americanus* have been generally identified considering specimens of *robustus*-like *Acanthocyclops* showing a rounded genital segment and characteristics of the furca and the endopodite of P4 (Lowndes, 1926; Gurney, 1933; Rylov, 1948; Dussart, 1969; Monchenko, 1974; Alekseev and Kosova, 1975; Alekseev, 1995, etc.).

Kiefer (1976), in comparing specimens of *A. robustus* from G.O. Sars's collection with those identified by C.D.Marsh as *A. americanus* concluded that these forms were conspecific. He established then also that, in fact, there were two different species (both determined as *A. americanus*) in Marsh' s collection, one with rounded genital segment (*robustus*-like) and other with laterally angled genital segment (*vernalis*-like). Kiefer's synonymy of *A. americanus* Marsh with *A. robustus* Sars has been accepted by most copepodologists (Petkovski, 1975; Fryer, 1985; Defaye and Dussart, 1985; Kawabata and Defaye, 1994; Dodson, 1994; Einsle, 1997; Dahms and Fernando, 1997).

Studying *Acanthocyclops robustus* from waterbodies of Yugoslavia, Petkovski (1975) described a new form – *A. robustus f. limnetica*. He thought that this form differed only slightly from the typical form, mostly by characters of Enp3P4: the ratio between the length of inner apical spine of Enp3P4 and the width of Enp3P4 which is over 2.00 (2.10-2.40), compared with only 1.40-1.60 for the typical form. Enp3P4 of the limnetic form is also thinner, with L:W over 2.30 (2.31-2.40), whereas in the typical form, it is significantly lower (1.95-2.30) (Petkovski, 1975).

In studying specimens identified as *A. robustus* from waterbodies of Europe, Asia, America and North Africa, we also could distinguish two forms, corresponding to Petkovski's forms. Detailed study has revealed additional characters which allow the unambiguous separation of these forms and support their separation as valid species. The comparison of these species with specimens from G.O.Sars's collection have unexpectedly revealed differences, which require a revision of the whole group.

In this paper, we redescribe *Acanthocyclops robustus* (Sars, 1863) and describe *A. trajani* n. sp.

Abbreviations

Fu, furca; L, length; W, width; Me, lateral furcal seta; Ti, innermost apical furcal seta; Tmi, inner medial apical furcal seta; Tme, outer medial apical furcal seta; Te, outermost apical furcal seta; Sd, dorsal furcal seta; Mxp, maxilliped.

Results

***Acanthocyclops robustus* (G.O. Sars, 1863)**

(Figs. 1-23)

Synonymy

*Cyclops robustus* Sars, 1863.

*Cyclops robustus* Sars, 1913.

*Acanthocyclops robustus* (Sars, 1863): Kiefer 1976 (*part.*) Figs. 1-23.

*Acanthocyclops sp.* Einsle 1992 (*part.*) Figs. 10, 11M, 13.

**Material examined.**

•Norway: G.O.Sars Coll. # F15778.

•Sweden: Lappland; F.Kiefer Collection # 296. 6 females, 3 males; Lappland. U.Einsle Coll. # 480. 1 female.

•Belgium: Tournout. Leg Dr F. Fiers. 1 female.

•Canada: Ontario, Waterloo, 22.06.1992, 10 females. Leg. Dr H.-U.Dahms; British Columbia. U.Einsle Coll. # 3807, 3 females.

•USA: Montana. U.Einsle Coll. # 4156-4157. 2 females; Dakota. U.Einsle Coll. # 4184. 1 female.

**Types.** The original type material (collected from Lake Maridaslvandet, near Oslo, Norway) of G.O.Sars has been lost (Dr. I.Wilhelmsen, Oslo, pers. comm.). In 1976, Prof. F.Kiefer chose lectotype (slides n° F15778b and n° F15778c, Oslo Museum) from Lake Mjosa near Oslo, identified as *A. robustus* by G.O.Sars. Below, we describe the specimens from the Lake Mjosa (ethanol sample n° F15778).

**Female.**

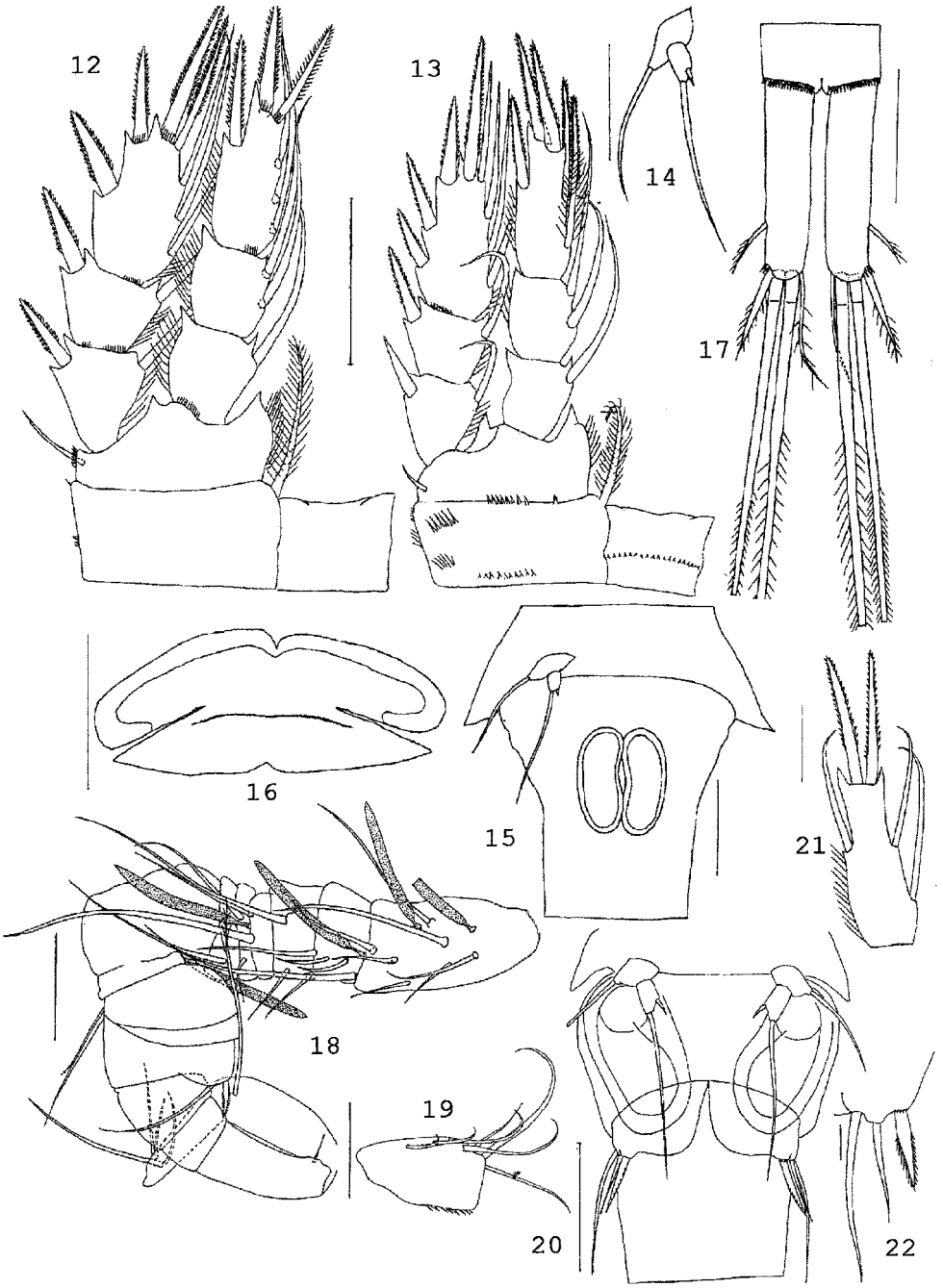
Body length (furcal setae excluded): 1025-1215 μm.

Antennule short, not reaching distal margin of first thoracic somite, 17-segmented, setal armature as follows: 8, 4, 2, 6, 4, 1+spine, 2, 1, 1, 0, 1, 1+aesth., 0, 1, 2, 2+aesth, 7+aesth. Extremity of aesthetasc on 12th segment reaching distal margin


**Figs. 1-11.** *Acanthocyclops robustus* (Sars, 1863), female. Lectotype, Norway. 1. antennule; 2. antenna, caudal side; 3. basipodite of antenna, frontal side; 4. labrum; 5. mandible; 6. maxillule, 7. palp of maxillule; 8. maxilla; 9. maxilliped; 10. P1, frontal side; 11. P2, caudal side (scales: 1, 8-11: 50μm; 2-7: 50 μm).

of 14th segment. Aesthetasc on penultimate segment usually reaching middle of ultimate segment. First segment bearing a row of spinules (Fig.1).

Antenna as in Figs. 2-3. Ornamentation of basipodite as follows. Caudal side: spinules of longitudinal row, thin and oriented at a sharp angle to axis of basopodite (Fig. 1), in two groups (d=7 and c=5 spinules, respectively, nomenclature of rows




**Figs. 12-22.** *Acanthocyclops robustus* (Sars, 1863), female. Lectotype, Norway. 12. P3; 13. P4; 14. P5; 15. genital segment; 16. seminal receptacle; 17. furca. Figs. 18-22. *A. robustus* (Sars, 1863), male. Lappland. F.Kiefer Collection # 296. 18. antennule; 19. third segment of antenna; 20. first and second abdominal segments; 21. Enp3P4; 22. P6. (scales: 12, 13, 15, 17: 100 μm; 14, 16, 18-21: 50 μm; 22: 10 μm).

follows Defaye & Dussart, 1995); a lateral row of 6 spinules present near external distal setae of the basipodite (Fig. 2, arrow). Frontal side: a longitudinal group of a few small spinules near insertion of the exopodal seta and medially, near the same margin, a small group of these spines in two rows (Fig. 3). Endopod 3-segmented; first segment armed with 1 inner seta inserted at midlength and a row of spinules along the outer margin. Second segment of endopodite bearing 9 setae, third segment bearing 7 setae terminally and a discontinuous row of spinules on external margin.

Labrum with 12 teeth (Fig. 4). Mandible as in Fig. 5. Maxillule (Fig. 6) with palp without setal ornamentation, bearing one spine and 6 setae (Fig.7).

Maxilla with praecoxopodite, coxopodite, basipodite and 2-segmented endopodite (Fig. 8). Praecoxopodite bearing a single endite with 2 setae. Coxopodite with 1 seta and endite which bears a claw-like distal and a second smaller subdistal setae; basipodite drawn out into a large distal endite bearing 2 claw-like setae distally and 1 seta subdistally. Inner claw-like seta usually smooth. Endopodite 1 with 3 smooth claw-like setae; endopodite 2 bearing two setae terminally.

Maxilliped with syncoxa, basipodite and 2-segmented endopodite (Fig. 9). Syncoxa armed with 3 spinulose setae. Two strong setae on basipodite, 4-6 strong spinules and 2 rows of spinules on the posterior face. Endopodite 1 with one long seta and 3-4 posterior spinules inserted near base of this seta; endopodite 2 with 3 setae; length ratio of two shortest setae: 1.29-1.33.

Natatory legs. Spine formula of exopodites P1-P4. (Figs. 10-13): 2.3.3.4 on the figured lectotype; another specimen from the same sample from Lake Mjosa has 2/3.4.4.4, three others 3.4.4.4; 5 specimens checked from Lappland (Kiefer's collection n°296).

General armature of figured lectotype as follows (nomenclature following Sewell, 1949: spines in roman numerals, setae in arabic numerals; the number between square brackets indicates a spiniform seta or a seta with an asymmetric ornamentation):

| | Coxopodite | Basipodite | Endopodite | Exopodite |
|---|---|---|---|---|
| P1 | 0-1 | 1-I | 0-1;0-2;1,I,4 | I-1;I-1; II, [1],3 |
| P2 | 0-1 | 1-0 | 0-1;0-2;I,I-[1],3 | I-1;I-1; II,I-1,3 |
| P3 | 0-1 | 1-0 | 0-1;0-2; I,I-[1],3 | I-1;I-1; II,I[1],3 |
| P4 | 0-1 | 1-0 | 0-1;0-2; I,II,[2] | I-1;I-1; III,I-1,3 |

Intercoxal plate of P1 mostly without ornamentation, but some specimens have 2 groups of setules. Intercoxal plates of P2-P3 without ornamentation, intercoxal plate of P4 with row of spinules on caudal side. Coxopodites of P1-P3 with a group of 4-5 long spinules on caudal side. Coxopodite of P4 with rows of shorter spinules near distal and proximal margins and 2 rows of longer and thinner spinules near lateral margin. Inner edge of basipodites P1-P4 with setules. Apical inner edge of basipodite P1 with a long spine of homonomous ornamentation, reaching half-length of Enp3. Enp1P4 with a developed notch on the outer margin. Enp3P4 2.21-2.67 times as long as wide. Inner apical spine 0.71-0.86 times as long as segment and 0.99-1.11 times as long as outer spine. Outer lateral spine situated at 0.65-0.71 of the segment length.

P5 consisting of 2 segments. Basal segment with long outer seta. Free segment with long apical seta and short inner subapical spine (Fig. 14).

Genital double-segment broadly rounded in its anterior part. Seminal receptacle poorly visible in specimens from Norway, but clearer in specimens from Canada, Ontario (Fig. 16), consisting of a broad anterior part and a narrow posterior part.

Anal segment (Fig. 17) with spinules (larger on ventral side) along its whole distal margin. Proctodeum with a single row of setules on either side.

Furcal rami parallel, without hairs on inner margin, 4.17-5.45 times as long as

wide (Fig. 17). Implantation of outer apical furcal seta (Te) provided with spinules. Implantation of lateral furcal seta (Me) not provided with spinules. Setation of terminal furcal setae variable: heteronomous in specimens from Norway and Canada, homonomous in specimens from Lappland. Ti/Tmi=0.15-0.19; Ti/Tme=0.22-0.32; Ti/Te=1.24-1.68; Ti/Sd=1.10-1.50.

**Male.** Samples from the G.O. Sars's collection do not contain any males. For description of males we used specimens from Lappland from F. Kiefer's collection.

Length (furcal setae excluded): 875 µm. Antennule with three aesthetascs on segment 1, one aesthetasc on segment 4, and one aesthetasc on segment 8 (Fig. 18). Third segment of antenna with 7 setae (Fig. 19). Ornamentation of basipodite of A2, morphology of the buccal appendages, P1-P5 segmentation and armature as in female (Fig. 20). Apical spines of Enp3P4 relatively longer than in female (Fig. 21). P6 with inner spine slightly shorter than middle seta and half length of outer seta (Fig. 22). Furcal rami 4.0-4.1 times as long as wide. Insertion of Me and Te provided with spinules (Fig. 23).

**Variability.** Measurements of specimens from different populations are given in Table 1. The most remarkable variability concerns the spines formulae as noted in the description. Most specimens studied had 3 spines on Enp3P4. The intercoxal plate of P1 of some specimens bears 2 groups of setules on frontal side, the ornamentation of the furcal setae can be heteronomous or homonomous.

**Table 1.** Measurements of *Acanthocyclops robustus* (G.O.Sars) (adult females)

| | Sars's specimens n=18 | | Canada n=10 | | Lappland n= 6 | | USA: Arizona n=5 | | USA: Montana n=3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | x | min-max | x | min-max | x | min-max | x | min-max | x | min-max |
| Body length, µm | 1130 | 1025-1215 | 1065 | 1050-1175 | 1155 | 1100-1175 | - | - | - | - |
| Fu L/W | 4.48 | 4.17-5.45 | 5.05 | 4.55-5.65 | 4.32 | 4.00-4.70 | 4.26 | 4.11-4.40 | 4.58 | 4.20-4.85 |
| Ti / Fu L | 0.63 | 0.55-0.72 | 0.56 | 0.50-0.66 | 0.75 | 0.73-0.79 | 0.69 | 0.64-0.73 | 0.79 | 0.73-0.88 |
| Ti / Tmi | 0.17 | 0.17-0.19 | 0.16 | 0.15-0.18 | 0.17 | 0.16-0.18 | 0.17 | 0.15-0.18 | 0.20 | 0.19-0.21 |
| Ti / Tme | 0.28 | 0.26-0.32 | 0.25 | 0.22-0.29 | 0.28 | 0.27-0.30 | 0.27 | 0.26-0.29 | 0.32 | 0.30-0.35 |
| Ti / Te | 1.38 | 1.24-1.52 | 1.40 | 1.29-1.51 | 1.29 | 1.27-1.31 | 1.54 | 1.37-1.68 | 1.61 | 1.47-1.70 |
| Ti / Sd | 1.41 | 1.30-1.50 | 1.24 | 1.10-1.40 | 1.31 | 1.20-1.40 | - | - | 1.67 | 1.65-1.68 |
| Mxp. ap. set. ratio | 1.31 | 1.29-1.33 | 1.40 | 1.30-1.53 | 1.23 | 1.18-1.33 | - | - | - | - |
| Enp3P4: | | | | | | | | | | |
| L/W | 2.38 | 2.21-2.67 | 2.34 | 2.00-2.67 | 2.33 | 2.05-2.40 | 2.26 | 2.14-2.35 | 2.30 | 2.15-2.46 |
| Inn. sp./L | 0.78 | 0.71-0.86 | 0.83 | 0.79-0.92 | 0.82 | 0.78-0.93 | 0.86 | 0.83-0.92 | 0.75 | 0.72-0.79 |
| Inn.sp./ W | 1.87 | 1.71-2.00 | 1.94 | 1.81-2.09 | 1.84 | 1.74-2.00 | 1.99 | 1.86-2.15 | 1.72 | 1.70-1.75 |
| Inn.sp./ outer sp. | 1.05 | 0.99-1.11 | 0.98 | 0.93-1.06 | 1.07 | 1.05-1.11 | 1.03 | 100-113 | 1.06 | 1.00-1.13 |
| Lat. set. position | 0.67 | 0.65-0.71 | 0.65 | 0.63-0.69 | 0.64 | 0.62-0.67 | 0.67 | 0.65-0.69 | 0.63 | 0.60-0.65 |

**Differential diagnosis.** *Acanthocyclops robustus* differs from all species of the *A. vernalis-robustus* species complex by the ornamentation of the basipodite of antenna which has spinules near the exopodal seta. *A. robustus* differs from *A. vernalis* (sensu European form) in the shape of the genital segment and the apical spines of Enp3P4, which are always shorter in *A. vernalis.*

**Distribution.** *Acanthocyclops robustus* inhabits waterbodies of Scandinavia, Canada and northern regions of the USA. Records of this species from northern Russia are to be expected.

**Ecology.** Probably a planktonic species.

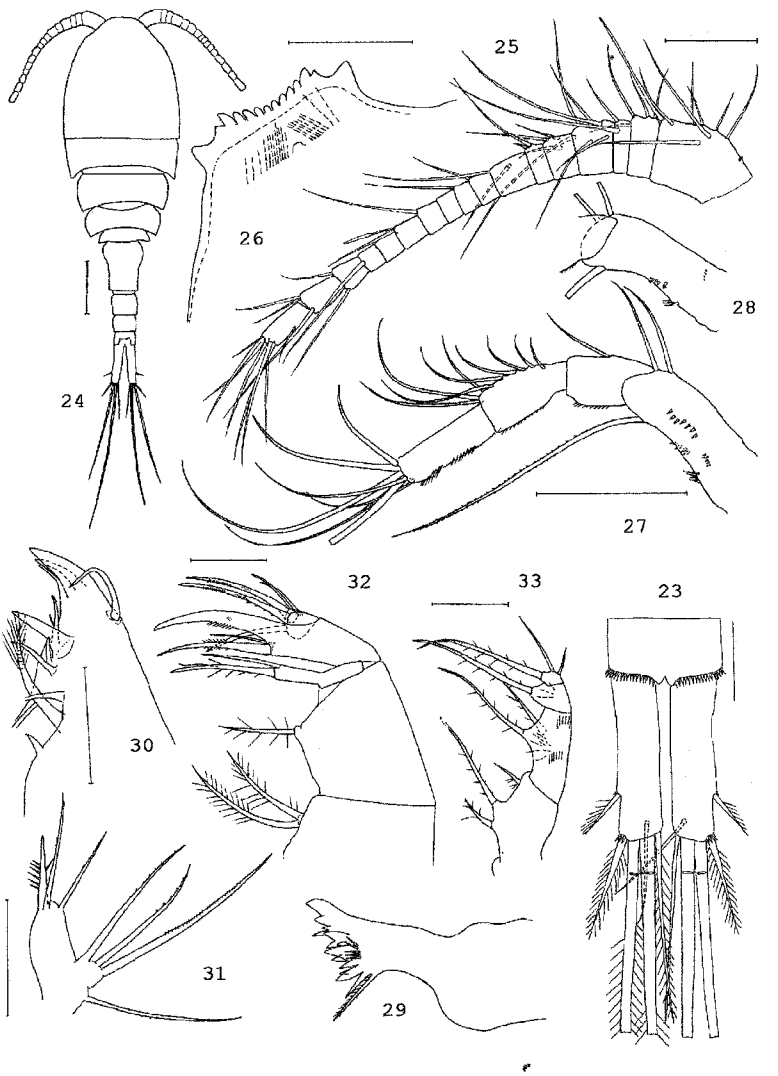
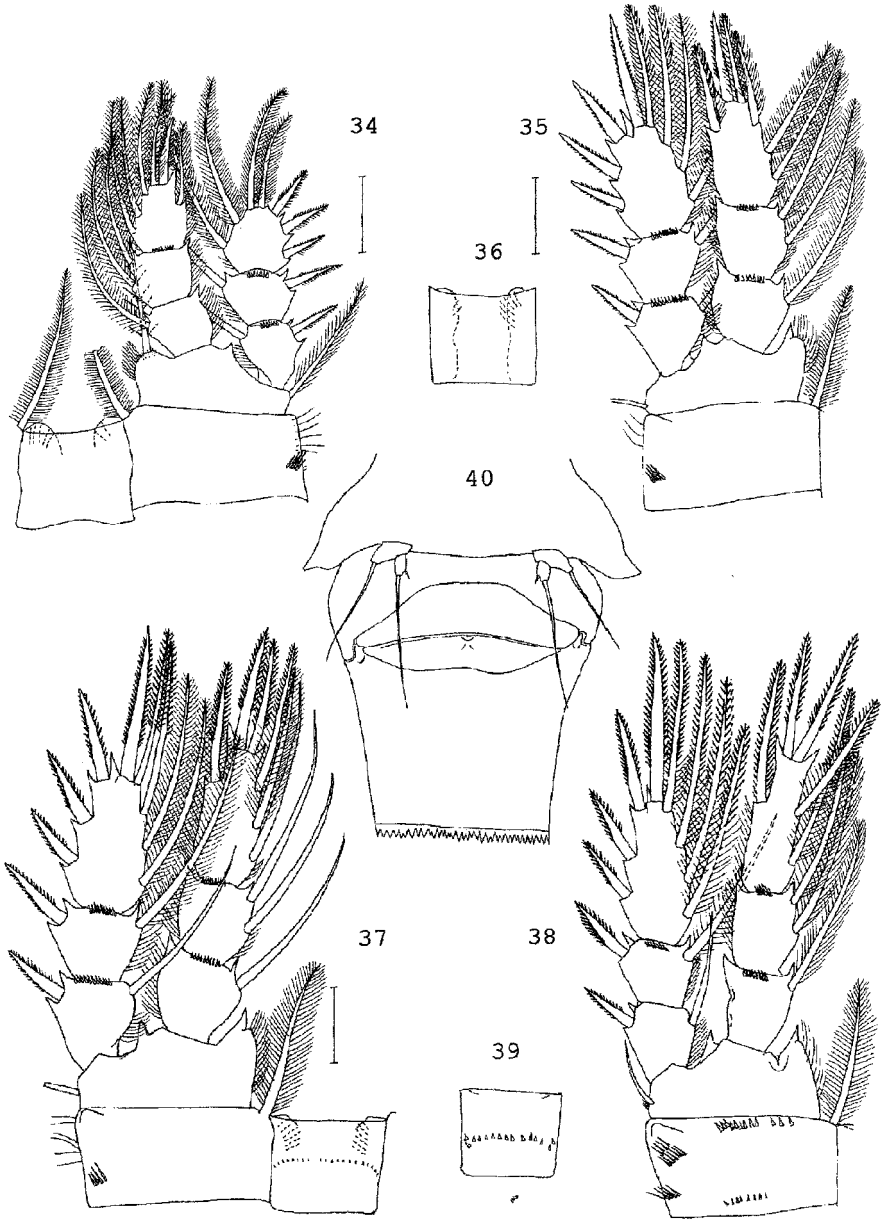



**Fig. 23-33.** *Acanthocyclops robustus* (Sars, 1863), Lappland, furca of male. (scales: 50 μm). Figs. 24-33. *Acanthocyclops trajani* n. sp., female. Holotype, France, vicinity of Paris, Etang de Noes. 24. habitus; 25. antennule; 26. labrum; 27. antenna, caudal side; 28. basipodite of antenna, frontal side (paratype). 29. mandible (paratype); 30. maxillule; 31. palp of maxillule; 32. maxilla; 33. maxilliped (scales: 23, 27, 28, 30-33: 50 μm; 26: 20 μm; 24, 25: 100 μm).

## *Acanthocyclops trajani* n.sp.
## (Figs. 24-44)

**Synonymy.**

*Acanthocyclops robustus f. limnetica* Petkovski, 1975; Mirabdullayev and Dahms, 1999.s




**Figs. 34-40.** *Acanthocyclops trajani* n. sp., female. Holotype, France, vicinity of Paris, Etang de Noes. 34. P1, frontal side; 35. P2, frontal side; 36. intercoxal plate of P2, frontal side; 37. P3, frontal side; 38. P4, caudal side; 39. intercoxal plate of P4, caudal side; 40. last thoracic and genital somites (scales: 50 μm).

*Acanthocyclops robustus* (G.O. Sars, 1863), Dussart *et al.* (1966), part., Figs. 10, 11, 13; Kiefer (1976), part.: Figs. 24-43, 48-53; Purasjoki & Viljamaa (1984); Fiers & Van de Velde (1985); Dodson (1994), groups 3a and 3b; Lescher-Moutouй (1996); Einsle (1996), part., Fig. 53 OS; Caramujo & Boavida (1998).

*Acanthocyclops americanus* (Marsh, 1893): Lowndes (1926), Rylov (1948), Dussart (1967), Dussart (1969), Monchenko (1961, 1974); Alekseev & Kosova (1976); Alekseev (1995).

**Material examined.**

•France: many specimens from 4 ponds and lakes in vicinities of Paris, June 1997 and from 4 park ponds in Bordeaux, November 1997, coll. I. Mirabdullayev.

•England: Marlborough, Kiefer's coll 667, 687-690; 4 females.

•Germany: channel in Oldenburg; 30 July 1996, many specimens.

•Spain: Canara Islands, Tenerife, Kiefer's coll. 9648, 1 female; Las Marismas, 9.05.1965, Dussart coll. MNHN 799. 1 female.

•Romania: Lake Suithiol, Constanza, Aug. 1973, Kiefer's coll. 9973, 1 female.

•Hungary: Szarvas, fishpond, 29.05.1992. 4 f., Leg. Dr. M. Holynska.

•Greece: Lake Laughada, Saloniki, 08.08.1925. Kiefer's coll. 8805-8806. 1 female.

•Russia: fishpond, Rybnoe, Moscow Region, many specimens.

•Iran: Lake Karadjstan, 22.02.1968; Kiefer's coll. 8616-8617. 1 female.

•Uzbekistan: many specimens from 12 localities.

•Kazakhstan: many specimens from 7 localities. Leg. T.S.Stuge and E.Krupa.

•Tunisia: Sidi Salem, 1990, U.Einsle Coll. 3525-3527. 3 females; Bir m'Cherga, March 1999, S.Turki Coll., several females and males.

•Canada: Waterloo, Ontario, 15.05.1975; 2 f., Leg. H.-U.Dahms.

•USA: Kansas, 18.06.1925, Marsh Coll., USNM 62637. 3 females; Kansas, alkali-marsh, 18.06.1925, Kiefer Coll. 10155-10158, 4 females.

**Types:**

Holotype: a dissected female, from Etang de Noes, in vicinity of Paris, 31.05.1997, mounted on slide and deposited in the Musйum National d'Histoire Naturelle, Paris (MNHN-Cp1870).

Paratypes: a dissected female, mounted on slide and deposited as the paratypes (MNHN-Cp1871); 2 dissected females, mounted on slides (Royal Belgian Institute of Natural Sciences); 2 dissected females, mounted on slides, deposited at the Institute of Zoology, Tashkent, Cp111; 10 females and 5 males, ethanol preserved (MNHN-Cp1872); 10 females and 5 males, ethanol preserved, deposited at the Institute of Zoology, Tashkent (Fr-10).

**Etymology:** named in honour of Dr. Trajan K. Petkovski.

**Female.**

The description and figures are of the female holotype.

Body length (furcal setae excluded): 1350 μm.

Antennule short, reaching distal margin of first thoracic somite (Fig. 24), 17-segmented, with setae armature as follows: 8, 4, 2, 6, 4, 1+spine, 2, 1, 1, 0, 1, 1+aesthetasc, 0, 1, 2, 2+aesthetasc, 7+aesthetasc. Aestetasc on 12th segment of antennule passing through distal margin of 14th segment. First segment bearing a few spinules (Fig.25).

Antenna: Ornamentation of basipodite as in Figs. 27-29. Spinules of longitudinal row are strong and oriented at a right angle to axis of basipodite. Third segment of antenna bearing 9 setae.

Labrum with 12 teeth (Fig. 26). Maxillule as in Figs. 30, 31.

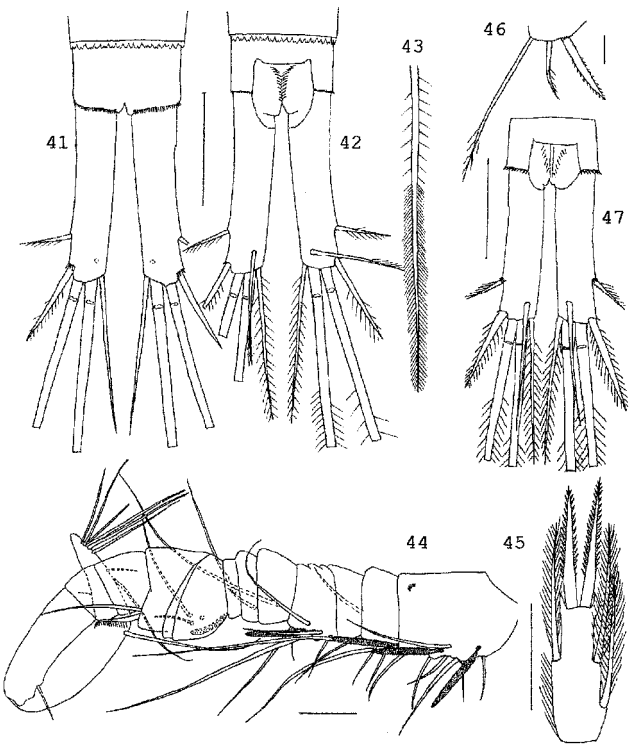
Maxilla. General shape as in *A. robustus*. Inner distal claw-like seta of basipodite with row of spinules on outer and, sometimes, on inner side (Fig. 32, arrow).

Maxilliped. General shape as in *A. robustus*. Length ratio of two shortest apical spinules 2.00 (Fig. 33).

Natatory legs : Spines formula of exopodites of P1-P4: 3.4.4.4 (usual formula). General armature as follows:

| | Coxopodite | Basipodite | Endopodite | Exopodite |
|---|---|---|---|---|
| P1 | 0-1 | 1-I | 0-1; 0-2;1,I-1,3 | I-1; I-1; III,[1],3 |
| P2 | 0-1 | 1-0 | 0-1; 0-2;1,I-1,3 | I-1; I-1; III,I-1,3 |
| P3 | 0-1 | 1-0 | 0-1; 0-2; [1],II,[2]-1 | I-1; I-1; II,I,[3]1 |
| P4 | 0-1 | 1-0 | 0-1; 0-2; [1],II,[2] . | I-1; I-1; III,I,[1]-3 |

Intercoxal plate of P1 usually with 2 groups of thin setules near distal margin (Fig. 34). Intercoxal plate of P2 and P3 are either smooth or bear a row of spinules or two groups of setules near distal margin of plate (Figs. 35-37). Intercoxal plate of P4 with row of spinules on caudal side (Fig. 38-39). Coxopodite of P1-P3 with group of 4-5 long spinules on caudal side. Coxopodite of P4 with rows of shorter spinules near distal and proximal margins and 2 rows of longer and thinner spinules near lateral margin. Lateral inner edge of basipodites of P1-P4 with setules. Apical inner edge of basipodite P1 with a long spine with symmetrical ornamentation, passing the base of Enp3. Enp1P4 with a developed notch on outer margin. Enp3P4: 2.58 times as long as wide; inner apical spine 0.89 times as long as segment and 1.12 times as long as outer seta; outer lateral spine situated at 0.61 of the segment length.




**Figs. 41-47.** 41-42. *Acanthocyclops trajani* n. sp., female. Holotype, France, vicinity of Paris, Etang de Noes. 41. furca, ventral side; 42. furca, dorsal side; 43. Tmi. Figs. 44-47. male. 44. A1; 45. Enp3P4; 46. P6; 47. furca (scales: 41-42: 100 μm; 44, 45, 47: 50 μm; 46: 10 μm).

P5 consisting of 2 segments. Basal segment with long outer seta. Free segment with a long apical seta and a short inner subapical spine (Fig. 40).

Genital segment broadly rounded in its anterior part. Seminal receptacle (Fig. 40) resembling that of *A. robustus*, but anterior margin of anterior part regularly concave.

Anal segment with a continuous row of small spinules (larger on ventral side) on its distal margin. Proctodeum with a single row of setules on each side.

Furcal rami parallel, without hairs on the inner margin, 4.80 times as long as wide. Implantation of Te provided with spinules. Implantation of Me not provided with spinules (Figs. 41-43). Setation of furcal setae usually homonomous. Ti relatively long, 0.94 times as long as furca. Ti/Tmi=0.25; Ti/Tme=0.37; Ti/Te=2.00; Ti/Sd=1.80.

**Male.** Body length (furcal setae excluded): 740-1000 μm (n=11). Antennule with three aesthetascs on segment 1, one aesthetasc on segment 4, and one aesthetasc on segment 8 (Fig. 44). Third segment of antenna with 8 setae. P1-P5 segmentation and armature identical with those of female. Apical spines of Enp3P4 are relatively longer than in female (Fig. 45). P6 with inner spine longer than the middle seta and half length of than outer seta (Fig. 46). Fu: furcal rami relatively shorter than in female, 3.85-4.65 times as long as wide. Implantation of Me and Te provided with spinules (Fig. 47).

**Table 2.** Measurements of *Acanthocyclops trajani* n. sp. (adult females)

| | Germany, Oldenburg, channel, | | France, Etang de Noes, pond | | Russia, Rybnoe, fishpond | | Kazakhstan, Chilik, fishpond | | Uzbekistan, Kashkadarya, Reg., fishpond | | USA, Kansas, C.Marsh' Coll | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n=10 | | n=10 | | n=10 | | n=10 | | n=10 | | n=3 | |
| | x | min-max | x | min-max | x | min-max | x | min-max | x | min-max | x | min-max |
| Body length, μm | 1270 | 1110-1375 | 1377 | 1300-1425 | 1129 | 1025-1225 | 1437 | 1350-1600 | 1358 | 1225-1450 | 1267 | 1225-1325 |
| Fu L/W | 5.05 | 4.60-5.80 | 4.62 | 4.32-5.10 | 5.07 | 4.73-5.70 | 5.16 | 4.83-5.60 | 4.86 | 4.58-5.25 | 4.47 | 4.33-4.70 |
| Ti / Fu L | 0.91 | 0.86-0.96 | 0.91 | 0.84-1.00 | 0.99 | 0.96-1.04 | 0.91 | 0.81-1.00 | 0.91 | 0.85-0.96 | 0.94 | 0.91-1.00 |
| Ti / Tmi | 0.25 | 0.23-0.27 | 0.26 | 0.25-0.29 | 0.25 | 0.23-0.26 | 0.26 | 0.24-0.28 | 0.27 | 0.25-0.29 | 0.27 | 0.27-0.28 |
| Ti / Tme | 0.37 | 0.35-0.39 | 0.38 | 0.35-0.42 | 0.37 | 0.34-0.39 | 0.37 | 0.35-0.39 | 0.39 | 0.37-0.41 | 0.39 | 0.36-0.41 |
| Ti / Te | 1.81 | 1.60-2.16 | 1.87 | 1.67-2.20 | 1.73 | 1.62-1.83 | 1.61 | 1.45-1.70 | 1.67 | 1.56-1.79 | 1.73 | 1.67-1.80 |
| Ti / Sd | 1.67 | 1.58-1.73 | 1.71 | 1.48-1.80 | 1.67 | 1.60-1.71 | 1.64 | 1.45-1.70 | 1.65 | 1.53-1.79 | 1.73 | 1.61-1.88 |
| Mxp. ap. set. ratio | 2.00 | 1.86-2.15 | 1.96 | 1.72-2.15 | 1.97 | 1.78-2.15 | 1.97 | 1.70-2.25 | 1.90 | 1.71-2.00 | 1.92 | 1.85-2.00 |
| Enp3P4: | | | | | | | | | | | | |
| L/W | 2.60 | 2.42-2.90 | 2.45 | 2.25-2.68 | 2.87 | 2.67-3.10 | 2.62 | 2.49-2.90 | 2.51 | 2.40-2.64 | 2.29 | 2.28-2.30 |
| Inn. sp./L | 0.85 | 0.80-0.89 | 0.88 | 0.82-0.96 | 0.86 | 0.81-0.90 | 0.83 | 0.77-0.89 | 0.84 | 0.80-0.94 | 0.86 | 0.79-0.91 |
| Inn.sp./W | 2.21 | 2.04-2.55 | 2.16 | 2.10-2.26 | 2.46 | 2.30-2.61 | 2.16 | 2.00-2.27 | 2.11 | 1.90-2.27 | 1.97 | 1.82-2.02 |
| Inn.sp./outer sp. | 1.09 | 1.04-1.19 | 1.08 | 1.04-1.15 | 1.13 | 1.08-1.22 | 1.21 | 1.13-1.29 | 1.17 | 1.08-1.25 | 1.20 | 1.18-1.22 |
| Lat. set. position | 0.59 | 0.55-0.63 | 0.63 | 0.61-0.66 | 0.59 | 0.56-0.64 | 0.60 | 0.58-0.65 | 0.61 | 0.59-0.63 | 0.59 | 0.58-0.61 |

**Variability.** Measurements of specimens from different populations are given in Table. 2. First segment usually devoid of spinules, rarely bearing a few spinules or a row spinules. Most of the populations studied had 3 spines on Enp3P4, which corresponds to the description of "*A. americanus f. spinosa* Monchenko, 1961" and that of the "cold-water form" of "*A. robustus*" distinguished by Dodson (1994). There are always some intrapopulational variability in the ornamentation of the intercoxal plates of P1-P3. Very rarely, there is no ornamentation. Usually, setules or spinules are present on one or several of these intercoxal plates. Setules are organised in two groups near the distal margin of the plates. Spinules are situated in a transverse row in the median part of the plate. Sometimes, setules and spinules are present on the same plate. Spinules arranged in a row have never been observed on the intercoxal plate of P1, which, however almost always bears setules. In contrast, rows of spinules are more usual on the plate of P3. Variability has also been observed for the ciliature of the furcal setae (Tme and Tmi), which are homonomous or heteronomous.

**Differential diagnosis.** *Acanthocyclops trajani* n.sp. differs from *A. robustus* mainly by the different ornamentation of the basipodite of antenna and the longer Ti. It also differs by the spinulated claw of the basipodite of maxilla, the length ratio of the two apicalmost setae of maxilliped, the length ratio Ti/Te and the shape of the anterior part of the seminal receptacle.

**Distribution.** *Acanthocyclops trajani* n. sp. inhabits waterbodies of Eurasia (not recorded in Scandinavia), North Africa and North America.

**Ecology.** *Acanthocyclops trajani* n. sp. prefers ponds (including fishponds), lakes and reservoirs, often rich in phytoplankton. It was recorded also from ricefields in Uzbekisan. Most studies on the ecology of "*Acanthocyclops robustus*" seem to concern, in fact, this species (Einsle, 1977; Purasjoki & Viljamaa, 1984; Lescher-Moutouй, 1996; Caramujo & Boavida, 1998).

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## Резюме

*Мирабдуллаев И.М., Дефайе Д.* Таксономия комплекса видов *Acanthocyclops robustus* (Copepoda, Cyclopidae). 1. *Acanthocyclops robustus* (G.O. Sars, 1863) и *Acanthocyclops trajani* sp.n.

*Acanthocyclops robustus* (Sars) переописан по материалам коллекции Г.О.Сарса. Показано, что *A. robustus* ограничен в распространении Скандинавией, Канадой, севером США. Вид ранее ошибочно идентифицировавшийся как *A. robustus* (*sensu* Kiefer, 1976, Einsle, 1997, Petkovski, 1975, и др.) и *A. americanus* (sensu Dussart, 1969; Монченко, 1974; Алексеев, 1995, и др.), описан в качестве нового вида *A. trajani sp. n.* Приведены данные по распространению и изменчивости.

Мирабдуллаев И.М.: Институт зоологии АН РУз., ул. Ниязова 1, Ташкент, 700095, Узбекистан. E-mail: iskandar@mail.tps.uz

Defaye D.: Musйum national d'Histoire naturelle, Laboratoire de Zoologie-Arthropodes, 61, rue de Buffon F75005 Paris FRANCE. E-mail: ddefaye@cimrs1.mnhn.fr