



UDC 595.34

***Eucyclops delongi* sp. nov. (Cyclopiformes: Copepoda: Crustacea) from the River Lena delta, Polar Eastern Siberia, Russia**

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ABSTRACT

A new species of *Eucyclops* (Cyclopiformes: Copepoda: Crustacea) is described from a bog-lake on the top of a hill near Titary fisherman village in the top of The River Lena delta, Eastern Siberia, Russia. *Eucyclops delongi* sp. nov. belongs to the *speratus* group of species and can be clearly separated from other related species by a combination of characters that include smooth hyaline membrane on 3 distal segments of antennule, missing of long hairs on antenna basipodite posterior surface (on the top), presence of several long setules on the distal side of the caudal rami (saw), homogeneous hair row on both sides of inner coxal spine in 4th swimming legs, relatively short caudal rami (length/width ratio less than five), clearly seen difference in caudal saw denticles on lateral edge, very long innermost caudal seta subequal to ramus length, inner spine of distal segment of endopodite 4th swimming leg 1.1 times as long as segment itself. Male of new species can also be separated from other species by a combination of the following characters: antenna basipodite on posterior surface without groups of long hairs (on the top), coxal spine of 4th swimming legs homogeneously covered with long hairs, rudimental 5th legs with relatively short inner spine similar in length to segment itself, rudimental 6th legs with 3 appendages including strong inner spine reaching the middle of the next segment, outer seta as long as spine, middle seta is shorter than spine. This species is suggested to be an endemic of Arctic zone in Eastern Siberia (Beringia), which is well known as a Pleistocene refuge during glaciation in North-East Asia.

Key words: Copepoda, description, Eucyclopidae, new species, Siberia

***Eucyclops delongi* sp. nov. (Cyclopiformes: Copepoda: Crustacea) из дельты реки Лена, Восточное Заполярье России**

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РЕЗЮМЕ

Описывается новый вид рода *Eucyclops* (Cyclopiformes: Copepoda: Crustacea) из небольшого заболоченного озера на вершине холма рядом с рыбацким поселком Титары в верхней части дельты Лены, Восточная Сибирь (Россия). *Eucyclops delongi* sp. nov. относится к группе видов *speratus* и отличается от сходных по морфологии видов сочетанием признаков, включающих присутствие гладких гиалиновых мембран на трех конечных члениках первых антенн, отсутствие на задней поверхности базиподитов вторых

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антенн длинных волосков (наверху), наличие длинных зубчиков на латеральной стороне дистальной части каудальных ветвей, равномерное опушение из волосков на внутреннем коксальном шипе 4-й пары плавательных ног, укороченная фурка с отношением длины к ширине меньше 5, заметное различие в длине зубчиков по наружному краю каудальных ветвей, очень длинная их внутренняя щетинка, равная длине фурки, а также длина внутреннего шипа дистального членика эндоподита 4-й пары плавательных ног, в 1.1 раза превышающая длину самого членика. Следующая комбинация признаков отличает самца вновь описанного вида от других представителей рода: отсутствие на задней поверхности базиподитов вторых антенн длинных волосков (наверху), шип (щетинка) коксального членика 4-й пары плавательных ног равномерно покрыт волосками со всех сторон, рудиментная 5-я пара ног имеет относительно короткий внутренний шип, сравнимый по длине с члеником, рудиментная 6-я пара ног с тремя придатками: длинным и мощным внутренним шипом, достигающим середины следующего сегмента, и двумя тонкими щетинками, из которой наружная равна шипу по длине, а средняя заметно его короче. Описываемый вид, возможно, является эндемиком Арктической зоны Восточной Сибири (Берингии), участка Северо-Восточной Азии, известного как район выживания водных организмов во время плейстоценовых ледниковых периодов.

Ключевые слова: Соперода, описание, Eucyclopidae, новый вид, Сибирь

INTRODUCTION

This study aims at the taxonomy of the cyclopoid fauna in the river Lena delta in order to find endemic species in Eastern Siberian region Beringia. Main attention was paid to the genus *Eucyclops* Claus, 1893, which was recently revised for European and North American species (Alekseev et al. 2006; Alekseev and Defaye 2011). Asian and Australian fauna of this genus still need an adequate study and revision.

MATERIAL AND METHODS

The River Lena delta is one of the largest in the World with the total area of 45 000 sq. km. It takes the second place in area after The River Mackenzie delta and almost completely situated in The Polar Circle area.

In August 2016 in the very top of the delta near Titary village in a small hill area (about 200 m above sea level) in a small-sized bog-lake about 60 sq. m and maximal depth 1.5 m two zooplankton samples were collected in a near-shore area.

A handle net with mesh size 100 µm was used for filtering about 100 L of water. Samples were preserved and stored in 85% ethanol. The samples were analyzed in the laboratory under a dissection microscope "Olympus" immediately after collection. Before dissection, adults of cyclopids were measured with an ocular micrometer (5 µm maximum resolution) and photographed with a digital camera. After

dissection they were placed on slides in pure glycerol, and covered with a cover slip ringed with Canada balsam. These slides were then observed at maximum magnification of 1000× (objective 100×, oil immersion) under a compound microscope Zeiss Imager equipped with Nomarski optics and a drawing tube. Some pictures were done from photographs and corrected under direct microscope vision. Initial drawings were converted to digital ones with resolution of 1500 dpi, and reorganized with "Adobe Photoshop 7" program. Abbreviations used: A1, antennule; A2, antenna; END, endopodite; EXP, exopodite; BAS, basipodite; P1–P4, swimming legs 1–4; P5–P6, rudimentary legs 5 and 6.

We collected 6 females and 1 male of new species.

SYSTEMATICS

Order Cyclopiformes Starobogatov, 1991

Family Cyclopidae G.O. Sars, 1913

Genus *Eucyclops* Claus, 1893

***Eucyclops delongi* sp. nov.**

(Figs 1–3)

Type material

Holotype: ZIN RN 55456, female dissected on 1 slide; Titary hill bog-lake, the River Lena delta, Siberia, Russia (71°58'01"N, 127°05'20"E). Coll.: V. Alekseev, 2016.

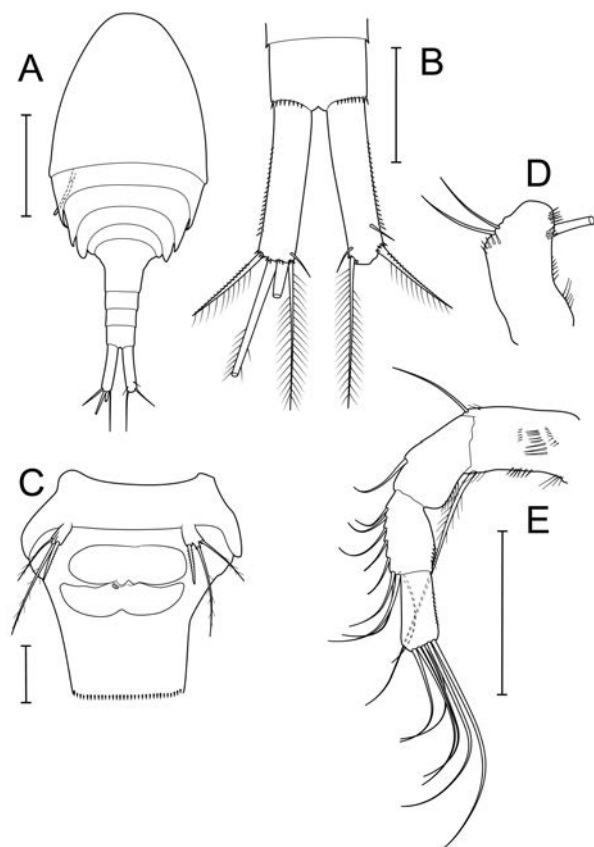


Fig. 1. Female holotype of *Eucyclops delongi* sp. nov.: A – habitus, dorsal; B – caudal rami, ventral; C – posterior thoracic and genital double somite, ventral; D – antenna basipodite, anterior; E – antenna, posterior. Scale bars: A – 300 μ m; B, D, E – 100 μ m; C – 50 μ m.

Paratype: ZIN RN 55457, male dissected on 1 slide; two more dissected females and one undissected female from the same site. Coll.: V. Alekseev, 2016.

Holotype and paratypes are deposited in the Zoological Institute of the Russian Academy of Sciences (St. Petersburg, Russia).

Etymology. Named in honor of polar researcher the Capitan George Washington De Long (22.08.1844–30.10.1881) who tried to reach the North Pole but his yacht “Lisetta” was crashed by ice. On his returning way in the River Lena delta in the vicinity of Titary he and his followers lost their life. During this expedition De Long discovered several arctic islands and remains of his ship were found after two years near Greenland, which confirmed his idea about over-polar movement of ice shield in Arctic.

Diagnosis. The new species differs from all other species of the genus by a combination of characters

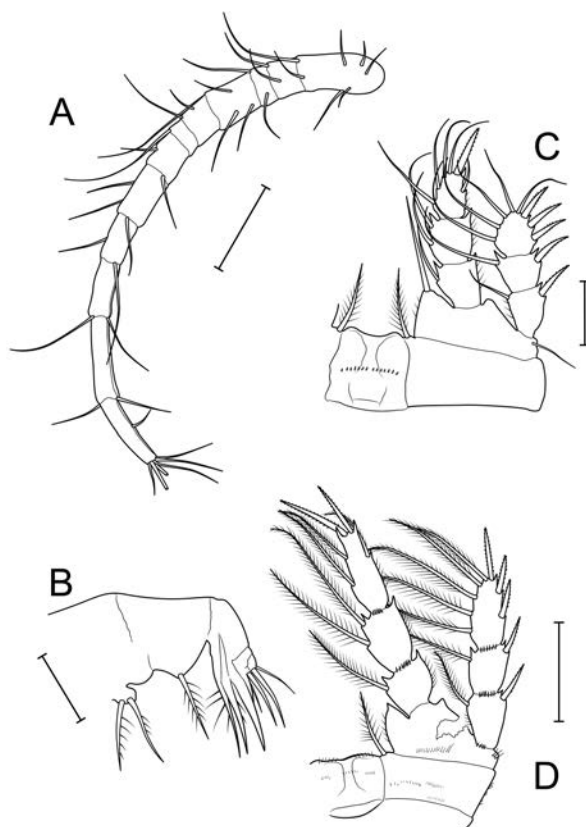


Fig. 2. Female holotype of *Eucyclops delongi* sp. nov. (cont.): A – antennule; B – maxilla; C – P1; D – P4. Scale bars: A, C – 100 μ m; B, D – 50 μ m.

in the female, that include: dense saw on lateral side of caudal rami with 4–5 longer spinules on its distal side, outermost caudal seta longer than ramus length, smooth hyaline membranes on 3 distal segments of the antennules, missing of long setules on posterior surface of antenna basipodite, the ornamentation of the inner coxal spine in 4th swimming legs. In male this combination includes: antenna basipodite on posterior surface without groups of long hairs (on the top), coxal spine of 4th swimming legs homogenously covered with long hairs, rudimental 5th legs with relatively short inner spine similar in length to segment itself, rudimental 6th legs with three appendages including strong inner spine reaching the middle of the next segment, outer seta as long as spine, middle seta is shorter than spine.

Description. Female (Figs 1, 2). Body yellow-orange, genital double-somite yellowish or red. Body length without caudal setae 1125 μ m (Fig. 1A). Vari-

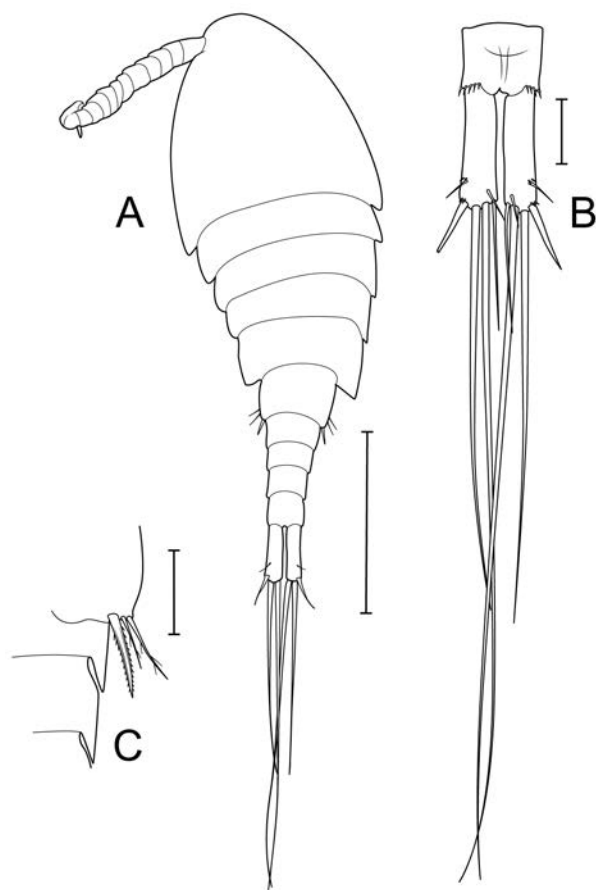


Fig. 3. Male paratype of *Eucyclops delongi* sp. nov.: A – male habitus, dorsal view; B – male caudal rami, dorsal; C – male P6, ventral view. Scale bars: A – 300 μ m; B, C – 50 μ m.

ation among 4 females measured: full body length without caudal setae 1080–1150 μ m, with caudal setae 1434–1620 μ m. Cephalothorax about as long as wide, with maximum width close to posterior end. Last thoracic somite with group of hair-like setae on lateral margin. Genital double-somite as long as broad, with seminal receptacle of regular shape.

Caudal rami (Fig. 1B) clearly divergent, less than 5 times as long as broad, lateral margins with not long saw (about half of ramus length); saw teeth rather short and setiform, only in the distal part 3–5 distal teeth longer than previous ones. Variation among 4 females measured: length/width proportion 4.5–4.7; 3–5 distal long teeth on caudal ramus. Length proportions of terminal setae, beginning from outermost caudal seta: 1.0/3.75/>6(broken)/1.73. Dorsal seta 0.65 and lateral seta 0.45 of length of outermost seta.

Innermost seta as long as ramus length, lateral seta not longer than ramus width.

Antennules with 12 segments, reaching the middle of first free thoracic somite, last three segments with well-developed smooth hyaline membrane (Fig. 2A). Setation of segments beginning from first: 8/4/2/6/4/2/2/3/2/2/3/7+I. First segment with row of rather long denticles at its basis.

Antenna 4-segmented, with seta number and length similar to other members of genus (Fig. 1D, E). Antennal basipodite micropatterns: anterior surface with 3 parallel rows of spinules placed diagonally on central part, 2 groups of long spinules on the outer and 2 groups of shorter spinules on inner lateral sides; posterior surface without long hairs on top near lateral setae, with strong spinules in centre of distal part and with several groups of small spinules on central part.

Mandible (not shown) typical for genus, with 6 teeth distally, rudimentary endopod with 2 long and 1 short setae.

Maxillula (not shown) comprising precoxa with 6 strong teeth and 2 strong setae; 2-segmented palp, distal segment with 3 long hair-like setae and proximal segment with 4 strong setae subequal in length and without spinules on lateral surface. Maxilla as shown in Fig. 2B. Mouth appendages without conspecific peculiarities.

P1–4 with 3-segmented rami (Fig. 2C, D); spine (Arabic)-seta (Roman) formula of EXP/END P1–4 as follows: 3V/1V–4V/1V–4V/1V–3V/2V. Distal segment END P4 elongated, 2.2 times as long as broad, with two strong spines distally, inner spine shorter than segment and 1.3 times as long as outer spine. Variation among 4 females measured: ENDP4 2.1–2.24 as long as broad, inner spine 1.2–1.4 times as long as outer spine and 1.1 as long as joint. Distal spines of P4 EXP about half of nearest seta and about 2/3 of distal segment length. Inner edge of basipodites P1–4 with long hairs. Basipodite of P1 with relatively short spine on inner process, reaching distal end of second segment of END. Intercoxal sclerite P1 with row of small spinules in middle part and without hairs on free edge.

Intercoxal sclerites of P2–3 with groups of hair-like setules on free edge. Intercoxal sclerite P4 practically not curved, with short hairs on its free edge, with 2 other groups of long hairs as shown in Fig. 2D. Coxa P4 with strong spine bearing dense hairs on both sides. Caudal side of coxa P4 with se-

veral groups of spinules and hairs (A–E, H; F groups of setae – missing or presented with tiny spinules on lateral margin).

Rudimentary P5 1-segmented, with long but not broad inner spine twice longer than segment itself and with 2 setae, outer seta clearly longer than spine, middle seta about 2 times as long as spine (Fig. 1C).

Male (Fig. 3). (Slide ZIN RN 55458) Body length 820 µm, with caudal setae 1100 µm, in live and freshly conserved specimens yellowish in colour, genital somite orange. Cephalothorax 1.2 times as long as broad, maximum width close to caudal end. Last thoracic somite without setae on lateral margin. Caudal rami about 4 times as long as broad, without setules on lateral edge, inner seta about twice as large as outer seta and longer than ramus length. Lateral seta placed on dorsal side, with several spinules at its base. Dorsal seta placed near insertion of innermost seta, about as long as outermost seta (Fig. 3B).

Antennule 14-segmented, setation (Arabic)-aesthetic (Roman) formula of segments beginning from first: 4–IV/3–I/2/1–I/1/II/1/3/2/2/5–I. First segment with row of long setules at its basis as in female. Antennal basipodite without long hairs on posterior side, other groups as in female with same 3 rows of spinules in central part.

Mouth appendages and P1–4 basically as in female. Distal segment END P4 2.3 times as long as wide, with inner spine 1.2 times as long as segment and 1.3 times as long as outer spine. Inner edge of basipodite P4 with short, hair-like setae, coxa of P4 with strong inner spine with long hairs on both sides. Intercoxal sclerites of P4 with strong hairs on free edge and several groups of hairs on surface (anterior side), similar to female.

Rudimentary P5 with long spine and 2 setae, similar to female. Outer seta 1.2 times longer than spine, middle seta 1.8 times as long as spine. Rudimentary P6 with short inner spine and 2 short setae, middle seta about half of spine length and outer seta as long as spine (Fig. 3C).

Comparison. *Eucyclops delongi* sp. nov. (A1, CR, P1–P4, rudimentary P5 construction and armament) belongs to the *serrulatus*-group rich with species within the genus *Eucyclops* (Alekseev and Defaye 2011). This group now includes more than 40 species and has to be organized as a subgenus (Alekseev, unpublished).

Within this group on micro characters (A2 basipodite ornamentation and P4 coxal spine con-

struction) it belongs to the *speratus* tribe. In Russia only *E. speratus* has a similar combination of micro characters (no gaps in hairs in coxal spine on outer edge and missing groups of hairs in N1, 2 positions in antennal basipodite). But it differs from the new species by much longer usually parallel caudal rami with very small equal in size denticles in the caudal lateral saw. Only a few species of the World fauna have a similar construction of caudal rami to *E. delongi*, but all of them belong to the tropical fauna. *E. bondi* Kiefer, 1934 with much shorter caudal rami (up to 3.5 as long as wide) was described from Haiti and inhabits North America. *E. dumonti* from Mongolia and China has even shorter caudal rami ($L/W = 3$ and less in females).

Another Eurasian species of *speratus* tribe *Eucyclops dumonti* Alekseev, 2000 described from Mongolia, recently was also found near Baikal Lake (Alekseev, unpublished), but it has very short caudal rami with L/W ratio less than 3.

Close to *E. delongi* sp. nov is *E. vandouweii* (Brehm, 1909), which inhabits equatorial Africa. From the last one the new species *E. delongi* can be easily separated by a longer spine in P5 that is twice as long as the P5 segment (in *E. vandouweii* the spine and the segment are almost equal in length), by a shorter outermost caudal seta that is about 1.5–1.7 times as short as caudal rami (in *E. vandouweii* this seta and rami are subequal in length). In *E. vandouweii* the distal segment of exopodite P2 has a reduced spine, and there is no such spine reduction in *E. delongi* sp. nov. The new species is distinguishable from other congeners by a combination of characters that includes group of long spinules on the distal outer side of the caudal rami, smooth hyaline membrane on the 3 distal segments of the antennules, a unique combination of groups of hairs and spinules on both sides of the antennal basipodite, and long hairs on both edges of the coxal spine in P4. *Eucyclops delongi* sp. nov. is possibly one of the endemics of the Beringia area in Eastern Siberia that was never covered with glaciers during the Pleistocene. In this area endemics are also known among decapods, mollusks and fishes (Chereshnev 2001).

ACKNOWLEDGEMENTS

This study was partly supported by a Biodiversity program from the Presidium of the Russian Academy of Sciences, by RFBR grant 17-04-00027 and by Government Program No. AAAA-A19-119020690091-0. The Federal Zoological Collection No. 96-03-16.

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Submitted April 14, 2019; accepted August 16, 2019.