

Morphological and ecological variability in *Eucyclops*
(*Speratocyclops*) *arcanus* sensu lato (Copepoda: Cyclopiformes)
with description of *E. (S.) a. arcticus* ssp.n. from tundra bog
in European Arctic

Морфологическая и экологическая изменчивость *Eucyclops*
(*Speratocyclops*) *arcanus* sensu lato (Copepoda: Cyclopiformes)
с описанием *E. (S.) a. arcticus* ssp.n. из тундрового болота
Европейской Арктики

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КЛЮЧЕВЫЕ СЛОВА: арктические веслоногие, переописание, новый таксон, ракообразные, зоология водных беспозвоночных.

ABSTRACT. *Eucyclops* (*Speratocyclops*) *arcanus arcticus* ssp.n. is described from the arctic swamps of the Bolshezemelskaya tundra that were frozen for 9 months. From nominative form known from Eastern Siberia new taxon is separated by combination of following characters: modified shape of *receptaculum seminis*; elongated setae in distal segments of legs 4 and shorten inner spine in rudimental leg 5. Ecologically, the new form appears to be able to survive frozen in ice for up to 9 months as an adult fertilized female with eggs, similar to some arctic harpacticoid species.

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РЕЗЮМЕ. Описывается *Eucyclops* (*Speratocyclops*) *arcanus arcticus* ssp.n. из арктических болот Большеземельской тундры, промерзающих на протяжении 9 мес. От номинативной формы, известной из Восточной Сибири, новый таксон отличается сочетанием следующих признаков: видоизмененная форма *receptaculum seminis*; удлиненные щетинки на дистальных сегментах 4 пары ног и укороченный внутренний шип на 5-й рудиментарной паре ног. Экологически новая форма, по-видимому, способна выживать в замороженном виде во льду до 9 месяцев в виде взрослой оплодотворенной самки с яйцами, подобно некоторым арктическим видам гарпактицид.

Introduction

Eastern Siberia, untouched by glaciers for the last million years, appears to be an important and little-studied center of copepod biodiversity in the Palearctic. Along with the highly endemic cyclopid fauna of Lake Baikal, several species of *Eucyclops* new to the country and science have been recorded from this region in recent decades. One of the first, *Eucyclops arcanus* Alekseev, 1990 was described from small Lake Saga-Nuur in southeastern Siberia and from a tiny tundra bog in the European Arctic [Alekseev, 1990]. Later, this form was reported from the lakes of Kamchatka [Ishida, 2003] and the delta of the Lena River [Alekseev *et al.*, 2019]. Recently, after a more detailed re-examination of morphological characters, taxonomic variations in the taxon have been found that allow for the rise the question of a new subspecies of *E. arcanus*.

Material and Methods

For this study, type specimens of *E. arcanus* s.lat. from Lake Saga-Nuur in southeastern Siberia and from tundra bog in the European Arctic were re-examined. The type material is deposited in Zoological Institute, St-Petersburg (ZIN). Morphological structures were observed under Zeiss Axis compound microscope. Abbreviations: Enp, Exp — endopodite, exopodite; P1–P4 — swimming legs 1–4.

Results

Most classical morphological features such as body shape and length, relative length of antennule reaching first free

Table. Morphological indexes in *Eucyclops (Speratocyclops) arcanus arcticus* ssp.n. (1) and nominative species *E. (S.) arcanus* Alekseev, 1990 (2) from their type localities (from Alekseev 1990, with changes).
Таблица. Морфологические параметры *Eucyclops (Speratocyclops) arcanus arcticus* ssp.n. (1) и номинативный вид *E. (S.) arcanus* Alekseev, 1990 (2) из типовых местонахождений (из Алексеев, 1990, с изменениями).

Morphological indexes	1, M±m	2, M±m
Caudal rami L/W	3.440±0.050	3.450±0.043
Caudal seta Innermost/outermost	1.085±0.059	1.113±0.021
Innermost caudal seta/ramus length	0.810±0.027	0.807±0.015
Outermost caudal seta/ramus length	0.795±0.021	0.726±0.013
Caudal seta medial inner/outer	1.560±0.018	1.664±0.021
Leg 4 Endopodite 3 L/W	2.250±0.056	2.320±0.028
Leg 4 Endopodite 3 spines inner/outer	1.260±0.011	1.186±0.003

thoracic somite, P4Enp3 length-to-width ratio and distal spine proportions, caudal rami L/W ratio and terminal setae proportions do not separate these taxa, or difference are not significant (Table). Also several value micropatterns such as basipodite A2 ornamentation (missing groups N1 and N2 on caudal surface); coxal seta homogeneously plumose and reaching above basipodite inner outgrowth in P4; coxopodite P4 ornamentation on caudal surface (all groups present except F) were similar in specimens from both localities.

At the same time at least several widely used new morphological characters were different in females from European Arctic tundra (1) and southwestern Baikal region lake (2) that included: A) shape of *receptaculum seminis* with enlarge upper part in (1) while both parts subequal in (2) (Fig.); B) in P4 Enp3, distal setae elongated and nearly reaching tips of nearest spine (1) versus shorten ones in (2); C) in P4 Exp3, distal seta longer than largest spine (1) and subequal in length in (2); D) in P5 inner spine more than twice shorter than medial seta (1) and less than twice longer (1.5–1.7 times) in (2). Construction of rudimental P6 in male similar in both taxa. Observed morphological similarities and differences in these two forms of *Eucyclops* let separate them and define specimens from European Arctic as a new subspecies.

Taxonomy

Order Cyclopiformes Starobogatov, 1991
Family Cyclopidae Rafinesque, 1815
Genus *Eucyclops* Claus, 1893
Subgenus *Speratocyclops* Alekseev, 2019
Eucyclops (Speratocyclops) arcanus arcticus ssp.n.
Fig.

Synonyms: *Eucyclops arcanus* (part.) Alekseev, 1990.

TYPE. Holotype ♀ (N54970), dissected, permanent slide, and paratypes 20♂♂ and 22♀♀, undissected, vials with formalin, under the same number (ZIN). Small tundra bog in vicinity of the Vorkuta town (67°29'N 64°02'E) in the European part of Russia.

DESCRIPTION. FEMALE (holotype; Figure): Body length except caudal setae 1020 µm; prosome widely oval; urosome less than half of body length. Last thoracic somite with dense long setules laterally, genital double somite as long as broad with mouth-shaped *receptaculum seminis* bearing enlarge upper part, anal somite slightly longer than previous segment. Caudal rami slightly bent and very short about 3.4 as long as broad with lateral *serra* occupied nearly 70% of external edge; terminal setae ratio beginning with

outermost: 1.0/4.5/9.2/1.1; dorsal seta about twice shorter than outermost seta.

Antennule just reaching middle of first free somite, 12 segmented, 3 distal segment with smooth narrow hyaline membrane. Antenna 4-segmented; basipodite caudal surface without groups of hairs or denticles in distal position N1 and N2. Mouth parts typical for genus. Swimming legs basically as in nominative taxon but with elongated setae in distal segments. Rudimental P5: segment as long as broad; inner spine rather weak and less than twice longer than segment, slightly shorter than outer seta and significantly shorter than median seta; length ratio beginning with spine: 1.0/2.2/1.3.

MALE. Body slender than in female; length excepting caudal seta nearly 700 µm; antennule 14-segmented; caudal rami shorter than in female with L/W nearly 3; terminal seta ratio similar to female. Swimming legs and rudimental P5 as

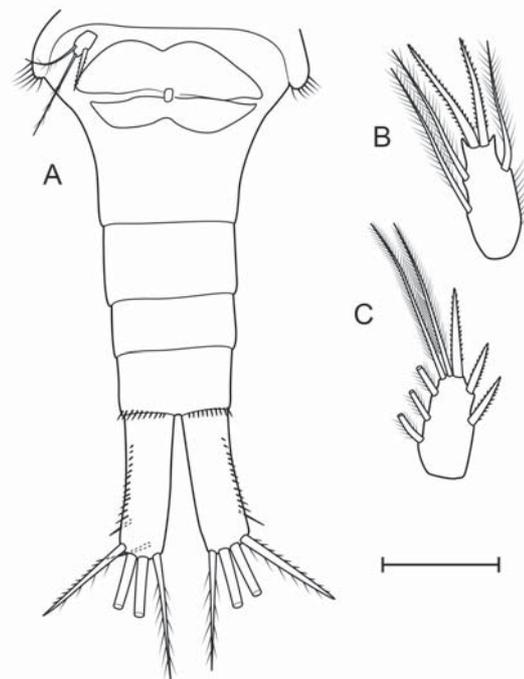


Fig.. *Eucyclops (Speratocyclops) arcanus arcticus* ssp.n. Female holotype, A — abdomen, ventrally; B — Enp3 P4; C — Exp3 P4. Scale bar: A — 100 µm; B, C — 75 µm.

Рис. *Eucyclops (Speratocyclops) arcanus arcticus* ssp.n. Самка, голотип, А — abdomen, вентрально; В — Enp3 P4; С — Exp3 P4. Масштабная шкала: А — 100 µm; В, С — 75 µm.

in female. P6 with long inner spine subequal in length to outer seta, median seta weak and about half of outer seta length.

DISTRIBUTION. Definitely known only from the type locality, but probably widespread in tundra pools along all Eurasia.

ECOLOGY. This form survives as adults frozen in ice within 9–10 months and possibly has one or two generations in July–August under temperature below 15 °C.

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