Record of the Far Eastern species *Nordodiaptomus siberiensis* (Wilson, 1951) (Copepoda: Calanoida) in the European Part of Russia

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ABSTRACT: We found the Far Eastern species *Nordodiaptomus siberiensis* (Wilson, 1951) in the European part of the Palearctic (the Sura River floodplain, Middle Volga region). A brief diagnosis and illustrations of the species are provided and we discuss some differences between the European and the Far Eastern populations.
How to cite this article: Podshivalina V.N., Sheveleva N.G. 2018. Record of the Far Eastern species *Nordodiaptomus siberiensis* (Wilson, 1951) (Copepoda: Calanoida) in the European Part of Russia // Invert. Zool. Vol.15. No.3. P.292–298. doi: 10.15298/invertzool.15.3.07

KEY WORDS: Copepoda, Calanoida, *Nordodiaptomus siberiensis*, morphology, zooplankton, alien species, bioinvasions.

Находка дальневосточного вида *Nordodiaptomus siberiensis* (Wilson, 1951) (Copepoda: Calanoida) в Европейской части России

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РЕЗЮМЕ: В Европейской части Палеарктики (пойма р. Сура, Среднее Поволжье) обнаружен дальневосточный вид *Nordodiaptomus siberiensis* (Wilson, 1951). Представлены его краткое описание и иллюстрации, выявлены некоторые отличия этой популяции от дальневосточных популяций.
Как цитировать эту статью: Podshivalina V.N., Sheveleva N.G. 2018. Record of the Far Eastern species *Nordodiaptomus siberiensis* (Wilson, 1951) (Copepoda: Calanoida) in the European Part of Russia // Invert. Zool. Vol.15. No.3. P.292–298. doi: 10.15298/invertzool.15.3.07

КЛЮЧЕВЫЕ СЛОВА: Copepoda, Calanoida, *Nordodiaptomus siberiensis*, фауна, морфология, зоопланктон, чужеродные виды, биоинвазии.

Introduction

Nordodiaptomus siberiensis was first described as *Diaptomus rylovi* Smirnov, 1930. As this was a junior homonym of *D. rylovi* Kharin, 1928, Wilson (1951) suggested a replacement name for this taxon while moving it to the subgenus *Nordodiaptomus* Wilson, 1951, now regarded as a full genus.

The species was first time found in a small lake on the bank of the Zeya River (Smirnov, 1930) and subsequently in water bodies near Kjusjur, on the right bank of the Lena River in the Arctic zone of Yakutia (Smirnov, 1931). In 1981–1985 *Nordodiaptomus skabitschewskyi* sp.n.? (Sokolova, 1987) was found in the lower Lena River basin, which is most probably a junior synonym of *N. siberiensis*. *Nordodiaptomus siberiensis* was subsequently found in the Kolyma River basin (defined as *Hesperodiaptomus rylovi*, see Smirnov, 1930; Streletskaya, 1975), in Mayorskoye lake and in some thermokarst lakes in the Anadyr River basin (Streletskaya, 2010). It was recently reported from a small lake Tekekol' in Kazakhstan (Baymukanov, 2016). According to online databases, this species occurs in Poland (Boxshall, Defaye, 2013; de Jong *et al*., 2014), however this record was never confirmed by any publications. At the same time, *N. siberiensis* has not been found in Western Siberia to date. Phylogenetic relationships in *Nordodiaptomus* are studied insufficiently, but there is some evidence that its distribution is associated with the former Beringia zone and adjacent areas (Streletskaya, 1986a, b).

In 2016 we found *Nordodiaptomus siberiensis* in two localities in the lower Sura River basin (the Middle Volga Region). A brief diagnosis and illustrations of these populations are provided herein.

Material and methods

Nordodiaptomus siberiensis was discovered in two small rivers, tributaries of the Sura River, Middle Volga Region, the Prisurskiy State Nature Reserve in June 2016 (Table 1). In both cases the animals were found in slow running river portions (about 0.3 m/c): a whirlpool portion in the Ljulja river (N 54°56′45″, E 46° 42′50″) and in a pond (ca 100 m^2) dammed by a beaver family (3 specimens) in the Atratka river (N 54°59′38″, E 54°59′38″). It is the first record of this taxon for the region and for European Russia.

The samples were obtained by filtering the water through an Apstein plankton net (70 μm) and fixed in 4% formaldehyde. Adult males and females were selected from samples for morphological study under a binocular microscope. Images were taken using a digital camera attached to the optical microscope Olympus CX 41 and a scanning electron microscope Philips 525 XM. For study under the scanning electron microscope, specimens were transferred to pure methanol for an hour and then to hexamethyl disilazane for a day and air dried.

Results

Female. The total length of the preserved specimens measured about 2.4 mm. Cephalothorax slightly narrowing posteriorly. Genital segment oblong, asymmetrical: its right side

Table 1. Environmental parameters of *N. siberiensis* habitats in the Sura river basin.
Таблица 1. Условия обитания *N. siberiensis* в Присурье.

Object	Location	Oxygen concentration (mg/l, %)	Water temperature in June (°C)	*pH*	Mean depth, m
Ljulja	54°56'45" N 46°42'50" E	7.6 76	15.6	6.6	2.0
Atratka	54°59'38" N 46°35'41" E	1.9 18	18.5	6.3	0.7–0.8

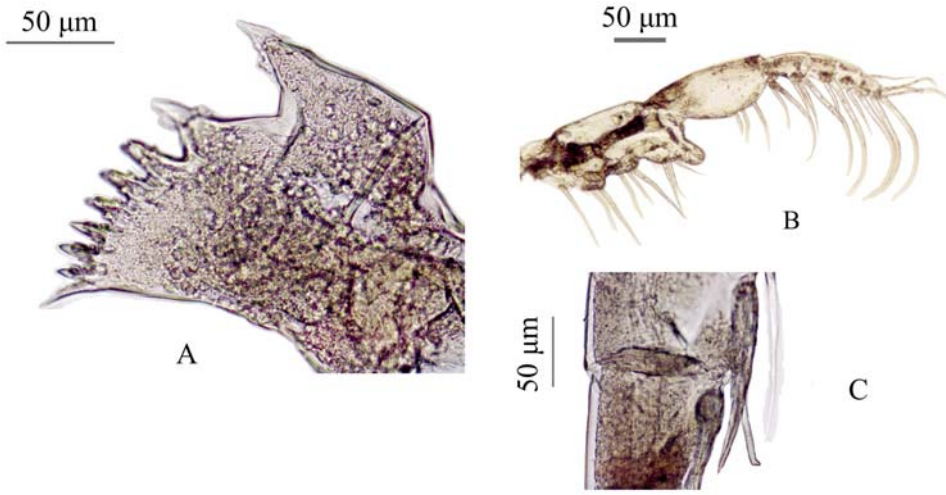

Fig. 1. *Nordodiaptomus siberiensis* (Wilson, 1951), female. A — mandibula; B — maxilliped; C — antennule, segments 11–12.
Рис. 1. *Nordodiaptomus siberiensis* (Wilson, 1951), самка. A — мандибула; B — максиллипед; C — 11–12-й членики антеннулы.

slightly larger than the left one. Caudal rami short, with hairs on the distal portion of the inner margins. Antennules reach tips of thoracic wings, the seta of segment 1 long, its tip reaches distal ends of 11th to 13th segment. Mandibula with one-vertex, caniniform acute ventral tooth, seven central teeth and a bristle (Fig. 1A). Ventral tooth is separated by a deep diastema from other teeth, there is also a deep diastema between the ventralmost central tooth and six other teeth which have one vertex, acute, with a narrow basis each. Such features are inherent to the mandibula of carnivorous crustaceans (Monakov, 1998). Maxilliped rather large, transformed into a prehensile device, its setae wide, large, slightly plumose (Fig. 1B).

Fifth leg exopod short, with a small projection, which is about 1/7 of its length. Basipod length approximately equal to coxopod length. Exopod first segment rectangular, without a seta (Fig. 2A–B), exopod second segment cone-shaped (its width decreasing distally), slightly curved, with a setae on each side. Exopod third segment clearly separated from the second one, its width equal to length; it has two setae, the inner setae stout, elongated, infrequently jagged on both sides, almost reaches the end of exopod second segment, three times longer than internal setae (Fig. 2C). Endopod definitely consist of two segments, with a long spiniform seta and small spinules on its basis (Fig. 2D), the setae length approximately equal to endopod length.

Male. The length of the preserved specimens is about 1.9 mm. Abdomen symmetrical. Tips of spines on 10th, 11th, 13th segments of right (geniculate) antennule (Fig. 3A) bifurcated (Fig. 1C, 3B). Right leg 5 (Fig. 3C) with exopod first segment rectangular, without inner corner, its length larger than width (Fig. 3D), second segment with parallel margins. Lateral spine located slightly distally the middle of inner margin; it is straight, long, and becomes thinner towards the tip, sometimes dentate. The claw is very long, strongly curved distally to its middle (Fig. 3D). Endopod unisegmented, very short, rarely reaches exopod second segment basis. The left leg with basipod large, with undulate inner margin. Exopod first segment rather long, narrowed distally, with a maximum width in its middle (Fig. 3E). Exopod second segment also rather long, elongated, with two flattened pads (Fig. 3F). The proximal pad with

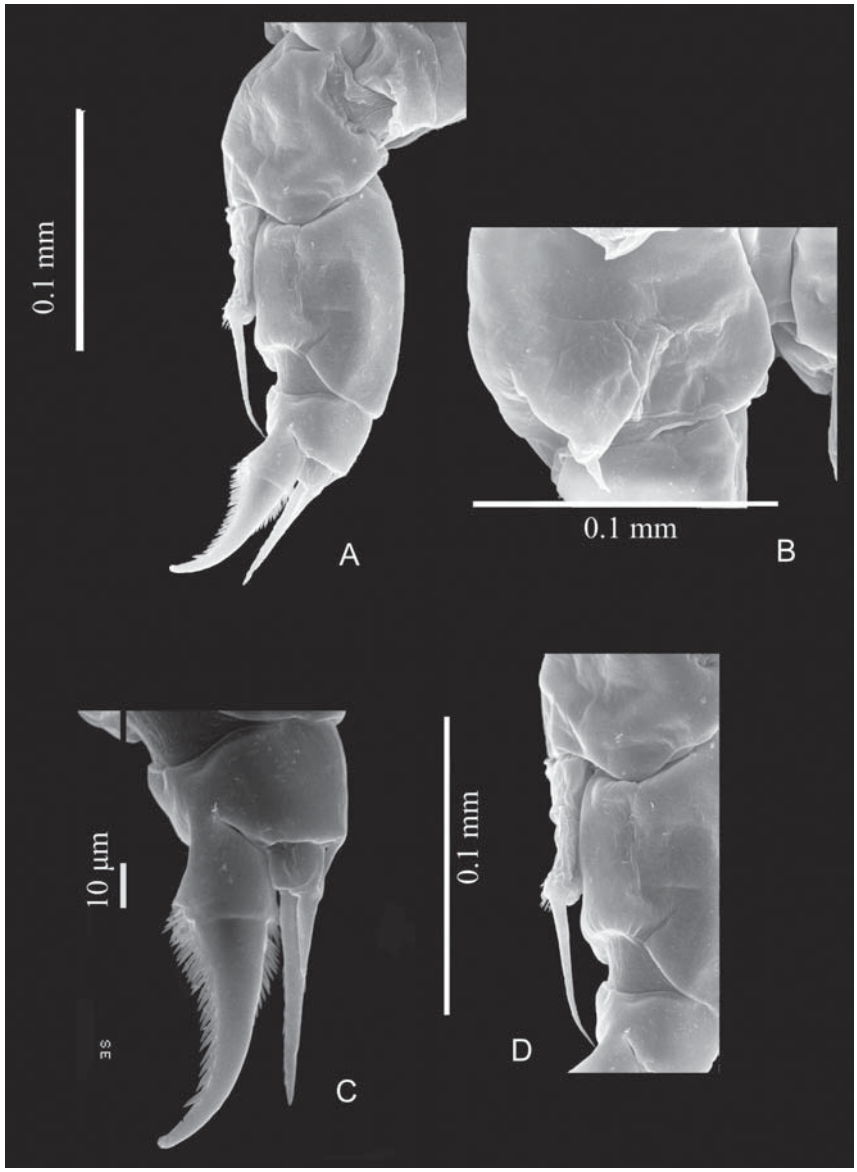

Fig. 2. *Nordodiaptomus siberiensis* (Wilson, 1951), female. A — leg 5; B — leg 5, coxopod; C — leg 5, exopod segments 2 and 3; D — leg 5, endopod.
Рис. 2. *Nordodiaptomus siberiensis* (Wilson, 1951), самка. A — 5-я пара ног; B — коксоподит 5-й пары ноги; C — 2-й и 3-й членики экзоподита 5-й пары ноги; D — эндоподит 5-й пары ноги.

long fine hairs, the distal pad with short stout hairs (denticles) on its margin and with nipple-like outgrowths on its surface (Fig. 3F). Distal process of exopod second segment short, broad, reaches middle of inner process which is long and thin. Endopod unclearly bi-segmented, its tip reaches middle of the exopod second segment (Fig. 3E).

Notes on the Population. This taxon prefers large lakes (Smirnov, 1930, 1931; Streletskaya, 2010), but in the Sura River basin it was found in the smaller slow-running river

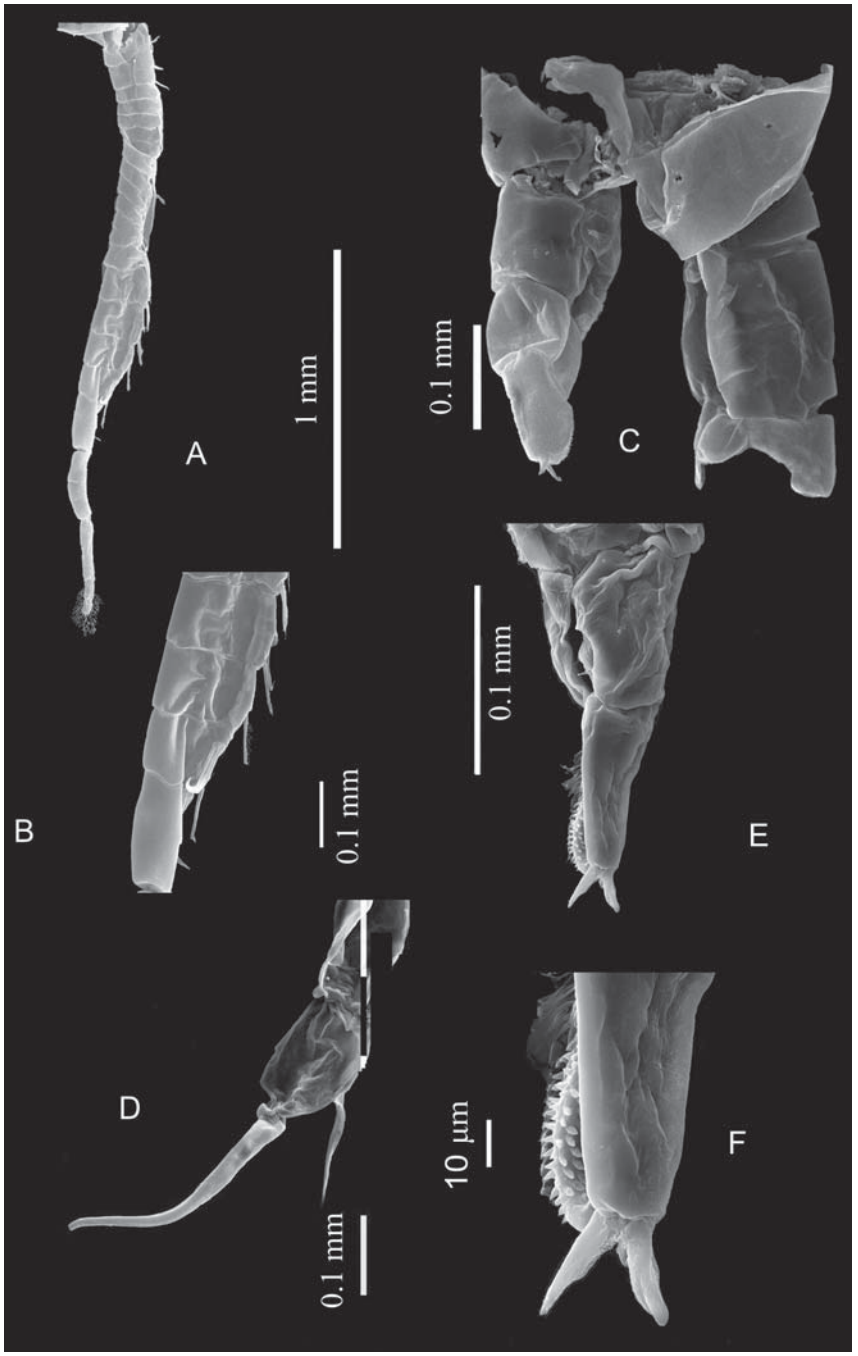

Fig. 3. *Nordodiaptomus siberiensis* (Wilson, 1951), male. A — antennule; B — antennule, segments 10–13; C — leg 5; D — leg 5 right, exopod segment 2; E — leg 5 left; F — leg 5 left, exopod segment 2.
Рис. 3. *Nordodiaptomus siberiensis* (Wilson, 1951), самец. A — антеннула; B — 10–13 членики антеннулы; C — 5-я пара ног; D — 2-й членик экзоподита 5-й пары правой ноги; E — левая нога 5-й пары; F — 2-й членик экзоподита 5-й пары левой ноги.

Table 2. *N. siberiensis* population abundance (ind./m^3) in the Sura river basin (June, 2016).
Таблица 2. Численность популяции (экз./м^3) *N. siberiensis* в Присурье (июнь 2016 г.).

Object	Females	Males	Juvenile
Ljulja	260	60	260
Atratka	60	20	80

portions. In the beginning of June the population contained adult and juvenile specimens (Table 2), with prevalence of the females (more than 75% of a total number). In the beaver pond, the population was less abundant (Table 2). Such a pattern may have been determined by a low oxygen concentration in the latter (Table 1).

Discussion

We did not see any strong morphological differences between the Sura populations and the Eastern populations. At the same time, the caudal rami of specimens from the Sura basin have hairs only on the distal part of their inner margins. The same pattern was observed in the population from the Kolyma River basin (Streletskaya, 1975). In contrast, the rami of the specimens of the Zeya River basin (type locality) have hairs along the entire inner margin (Smirnov, 1930; Borutsky *et al*., 1991).

There is no maxilliped description or illustration in Smirnov (1930). Furthermore, the characters of these appendages given in the subgeneric diagnosis of *Nordodiaptomus* are based on information derived from *D. alaskaensis* (Wilson, 1951) (at present *N. alaskaensis*). At the same time, *N. siberiensis* has: "*maxilliped not enlarged; the endopod is about half the length of the basipod, its setae is slender and nonprehensile*" (Wilson, 1951: 168). In our populations, the maxilliped is rather large, transformed into a prehensile device, its setae wide, large and slightly plumose (Fig. 1B).

The mandibula and maxilliped of *N. siberiensis* is described and illustrated here for the first time.

Acknowledgements

We thank A.N. Aleksandrov for his valuable logistic support in collecting this material, two anonymous referees for valuable comments and Dr. K. Van Damme for linguistic corrections of earlier draft. The work was made using the equipment in the Center "Electronic microscopy" (Limnological Institute, Siberian Branch of Russian Academy of Sciences). The study was supported by the Russian Foundation for Basic Research and the government of the Chuvash Republic (grant 16-44-210356 p_a).

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Responsible editor A.A. Kotov