

First European Record of *Paramecium septaurelia* and the Discovery of New European Habitats of *P. pentaurelia* and *P. sexaurelia* in Russia (Astrakhan and Volgograd Regions)

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The presence of several species of the *P. aurelia* complex was revealed in the studied regions. In the Volgograd region *P. primaurelia*, *P. biaurelia*, *P. triaurelia*, and *P. novaurelia* were recorded. In the Astrakhan Nature Reserve *P. primaurelia*, *P. pentaurelia*, *P. sexaurelia*, and *P. septaurelia* were identified. Among these species, *P. septaurelia* was recorded for the first time in Europe, known before only from the territory of the USA. *P. pentaurelia* and *P. sexaurelia* are species rare in Europe. The studied regions are very rich in species of the *P. aurelia* complex and worthy of future studies.

Key words: *Paramecium aurelia* species complex, distribution of species, species competition.

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Among 15 species of the *Paramecium aurelia* complex known world-wide (SONNEBORN 1975; AUFDERHEIDE *et al.* 1983) 8 have been found in Europe (i.e., *P. primaurelia*, *P. biaurelia*, *P. triaurelia*, *P. tetraurelia*, *P. pentaurelia*, *P. sexaurelia*, *P. novaurelia*, and *P. tredecaurelia* (cf. SONNEBORN 1975; PRZYBOŚ 1993; PRZYBOŚ & FOKIN 2000). Of these, *P. primaurelia*, *P. biaurelia*, and *P. novaurelia* are common in Europe. The occurrence of some species, such as *P. triaurelia*, *P. tetraurelia*, and *P. pentaurelia* seems to be limited to certain environments, and in the case of *P. tredecaurelia* even to habitats. The frequency of species occurrence in Europe was estimated on the basis of the number of investigated clones and habitats as well as the ratio value (r.v.), i.e. the number of habitats for a defined species to the total number of habitats in the area (country or zone) (PRZYBOŚ & FOKIN 2000). *P. novaurelia* is a dominant species (r.v. 0.39, found in 178 habitats among 459 studied), *P. biaurelia* is a frequent one (r.v. 0.33, in 151 habitats), and *P. primaurelia* (r.v. 0.22, in 103 habitats) is also characteristic but less frequent. In turn, other species are rather rare, i.e. *P. tetraurelia* (r.v. 0.05, in 25 habitats), *P. triaure-*

lia (r.v. 0.04, in 17 habitats) or very rare as *P. pentaurelia* (r.v. 0.007, in 5 habitats), and *P. tredecaurelia* (r.v. 0.002, in 1 habitat).

In the European part of Russia the following species have been recorded: *P. primaurelia*, *P. biaurelia*, *P. novaurelia* in Moscow, *P. primaurelia* with *P. novaurelia* in St. Petersburg or its vicinity (KOMALA & DUBIS 1966), and *P. biaurelia* in Stary Peterhof, St. Petersburg neighbourhood (PRZYBOŚ & FOKIN 1996). The presence of *P. triaurelia* has been recorded in the Volga River (Astrakhan Nature Reserve) together with *P. novaurelia* (cf. KOŚCIUSZKO 1985), and *P. pentaurelia* in the Belgorod region (FOKIN & OSSIPOV 1986). However, data on the occurrence of species of the *P. aurelia* complex in Russia are still scarce. The present paper deals with the occurrence of species of the *P. aurelia* complex in the Astrakhan Nature Reserve and in Natural Reserve Complex Volga-Ahtuba flood lands, Volgograd region. These regions are biologically very interesting. The Astrakhan Nature Reserve is situated on islands in the delta of the Volga River; hundreds of small rivers, canals and eriks (temporary streams) make this territory a perfect place for bird nesting and fish

spawning. In turn, eutrophic water creates good conditions for plankton development. 250 species of birds have been registered in the Astrakhan Nature Reserve, species seasonally migrating for long distances may enrich of the protozoan communities.

Material and Methods

Water samples (15-40 ml each) were collected in habitats typical for the occurrence of *Paramecium* (Table 1). The same day that water samples were collected, paramecia were isolated from the whole sample volume, and clones were established. Samples (different bottles) often were collected at a very short distance from each other (from bow to

stern of small standing boat). In these cases paramecia from the different samples were considered as the same population. The strain index includes letters (AZ for Astrakhan Nature Reserve or V for Natural Reserve Complex Volga-Ahtuba) and numbers, the first number represents the population and the second number (after the dash) represents the paramecium cell. E.g., AZ11-13 means strain number 13 collected in Astrakhan Nature Reserve, population 11.

The strains designated AZ were collected in Astrakhan Nature Reserve near Damchik (45.83 N/47.85 E) and at the Caspian coast (45.7 N/47.9 E). The coast is a zone between the Volga River and the Caspian Sea where many islands are scattered in a vast fresh water area.

Table 1

Occurrence of species of the *Paramecium aurelia* complex and characteristics of examined habitats

Strain index (number of population and number of isolated cell)	Species of the <i>P. aurelia</i> complex	Sample index	Characteristics of the habitat	Other ciliates present in the sample
AZ3-1	<i>P. septaurelia</i>	195	Canal Koklyuy, dike from trees	
AZ6-23	<i>P. septaurelia</i>	223	River Bystraya, Lotus field	<i>P. caudatum</i>
AZ6-24	<i>P. pentaurelia</i>			
AZ8-20	<i>P. septaurelia</i>	233	Coast, lotus field	
AZ9-3	<i>P. primaurelia</i>	235	Coast, rotting grass	<i>P. caudatum</i> , <i>P. bursaria</i>
AZ9-4	<i>P. pentaurelia</i>			
AZ9-6	<i>P. sexaurelia</i>			
AZ11-13	<i>P. primaurelia</i>	240		<i>P. caudatum</i> , <i>Didinium</i> sp., <i>Euplotes</i> sp.
AZ11-28	<i>P. sexaurelia</i>			
AZ11-14	<i>P. sexaurelia</i>	241	Coast, duckweed	<i>P. caudatum</i> , <i>P. bursaria</i>
AZ11-25	<i>P. sexaurelia</i>	242		
AZ11-26	<i>P. sexaurelia</i>			
AZ12-19	<i>P. primaurelia</i>	244	Coast, slime	<i>P. bursaria</i>
AZ13-3	<i>P. pentaurelia</i>	246	Bay of a small island, duckweed grass	<i>P. caudatum</i> , <i>P. bursaria</i> , <i>Stylonychia</i> sp., <i>Tetrahymena</i> sp.
AZ15-3	<i>P. primaurelia</i>	251	Small island at the Caspian coast, grass, slime	<i>Tetrahymena</i> sp.
AZ15-8	<i>P. primaurelia</i>			
AZ17-19	<i>P. pentaurelia</i>	259	Outfall of a canal, water chestnut and other water plants	<i>P. caudatum</i> , <i>P. bursaria</i>
AZ17-38	<i>P. pentaurelia</i>			
V1-3	<i>P. biaurelia</i>	302	Canal Verblud, duckweed	<i>P. bursaria</i>
V1-4	<i>P. biaurelia</i>			
V3-1	<i>P. triaurelia</i>	316	Isolated pool, duckweed	<i>P. caudatum</i> , <i>Stylonychia</i> sp., <i>Hypotrichida</i>
V7-6	<i>P. primaurelia</i>	335	Pond in a fish-farm	<i>P. caudatum</i>
V7-8	<i>P. triaurelia</i>			
V7-11	<i>P. triaurelia</i>			
V10-6	<i>P. triaurelia</i>	344	Lake in flood-lands, reeds	<i>P. caudatum</i> , <i>Dileptus</i> sp.
V10-7	<i>P. triaurelia</i>			
V9-1	<i>P. novaurelia</i>	340	Pond in Sukhodol village	<i>Stentor</i> sp., <i>Stylonychia</i> sp., <i>Didinium</i> sp., <i>Loxophillum</i> sp., <i>Dileptus</i> sp., <i>P. caudatum</i>

The strains designated V were collected in the Natural Reserve complex Volga-Ahtuba flood lands, Volgograd region (approximately 48.7N/44.7E).

Paramecia culture and identification were performed according to SONNEBORN (1970). The paramecia were cultivated on a lettuce medium inoculated with *Enterobacter aerogenes*. The species of the *P. aurelia* complex were identified by mating the investigated strains with mating types of standard strains of the particular species. The following standard strains were used:

- P. primaurelia* strain 90,
- P. biaurelia* strain from Rieff, Scotland,
- P. triaurelia* strain 324,
- P. tetraurelia* strain from Sydney, Australia,
- P. pentaurelia* strain 87,
- P. sexaurelia* strain 159,
- P. septaurelia* strain 38,
- P. octaurelia* strain 138,
- P. novaurelia* strain 510.

The other species of *Paramecium* and ciliates present in the water samples were also identified (Table 1).

Results and Discussion

The presence of several species of the *P. aurelia* complex was revealed in the studied regions.

In the Volgograd region *P. primaurelia*, *P. biaurelia*, *P. triaurelia*, and *P. novaurelia* were recorded.

Namely:

P. primaurelia (strain V7-6), together with *P. triaurelia* (strains V7-8, V7-11), in sample number 335 taken from a pond in a fish-farm;

P. biaurelia in sample number 302 taken from canal Verblud (strains V1-3, V1-4);

P. triaurelia in sample number 316 (strain V3-1) taken from a small isolated pool, in sample number 344 (strains V10-6, V10-7) taken from a lake in flood-lands, and in sample 335 (strains V7-8, V7-11). *P. triaurelia*, a species not very common in Europe, appeared there already in three samples (numbers 316, 335, and 344).

P. novaurelia was found in sample 340 (strain V9-1).

In the Astrakhan Nature Reserve the presence of four species, namely *P. primaurelia*, *P. pentaurelia*, *P. sexaurelia*, and *P. septaurelia* of the *P. aurelia* complex, was recorded. *P. septaurelia* was recorded for the first time in Europe, it was known

before (SONNEBORN 1975) only from the territory of the USA; *P. pentaurelia* and *P. sexaurelia* are species rare in Europe, only *P. primaurelia* is a common species (PRZYBOŚ & FOKIN 2000). The water environment at these sites seemed to be eutrophic enabling the occurrence of different species at a small distance.

P. primaurelia, together with *P. pentaurelia* and *P. sexaurelia*, were recorded in sample number 235, taken from the coast (strains AZ9-3, AZ9-4, AZ9-6). Interestingly, three species were found to exist in one microhabitat. *P. primaurelia* alone was identified in sample 244 (strain AZ12-19), in sample 251 (strains AZ15-3 and AZ 15-8), and in sample 240 (strain AZ11-13).

P. pentaurelia was recorded in sample 223 (strain AZ6-24) together with *P. septaurelia*. *P. pentaurelia* appeared also in sample number 246 (strain AZ13-3), and in sample 259 (strains AZ17-19, AZ17-38). The species appeared together with *P. primaurelia* and *P. sexaurelia* in sample number 235 (strain AZ9-4).

P. septaurelia, new to Europe, was revealed in sample 195 (strain AZ3-1), sample 223 (strain AZ6-23) together with *P. pentaurelia*, strain AZ6-24), and in sample 233 (strain AZ8-20).

P. sexaurelia was found in samples 235 (strain AZ9-6), and in three samples from the same population number 11: in sample 240 (strain AZ11-28), sample 241 (strain AZ11-14), and sample 242 (strains AZ11-25 and AZ11-26).

The studied regions are very rich in species of the *P. aurelia* complex and worthy of future studies.

The present paper is the first in a series presenting the results of studies on the distribution and occurrence of species of the *P. aurelia* complex in these regions.

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