

New Stands of Species of the *Paramecium aurelia* Complex (Ciliophora, Protozoa) in the Mediterranean Region (Italy, Greece, Morocco)

Ewa PRZYBOŚ and Maria RAUTIAN

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New stands of species of the *Paramecium aurelia* complex are presented in the paper, *P. primaurelia* recorded in Italy (Pisa) and in Morocco (Marrakesh), *P. biaurelia* in Italy (Calabria), *P. triaurelia* in Morocco (Ifrane), *P. pentaurelia* in Greece (Kastorya), and *P. dodecaurelia* in Italy (Padua).

Key words: *Paramecium aurelia* species complex; distribution of species; different levels of sampling.

Ewa PRZYBOŚ, Department of Experimental Zoology, Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Stawkowska 17, 31-016 Kraków, Poland.

E-mail: przybos@isez.pan.krakow.pl

Maria RAUTIAN, Faculty of Biology and Soil Science, St. Petersburg State University, St. Petersburg 198504, Oranienbaumskoye shosse 2, Russia.

E-mail: mrautian@mail.ru

At present 15 species of the *Paramecium aurelia* complex are known world-wide (SONNEBORN 1975; AUFDERHEIDE *et al.* 1983). Some are considered cosmopolitan such as *P. primaurelia*, *P. biaurelia*, *P. tetraurelia*, and *P. sexaurelia* (cf SONNEBORN 1975; PRZYBOŚ & FOKIN 2000; PRZYBOŚ & SURMACZ 2010), whereas others were recorded only in a few (as *P. tredecaurelia* and *P. quadecaurelia*) or in single habitats, e.g. *P. sonneborni* (AUFDERHEIDE *et al.* 1983). However, various parts of the world have not been studied or sampling was done only occasionally. Central and South America, Australia, Africa, and some regions of Asia have been studied at a very inconsiderable level. In North America only the USA was studied carefully (SONNEBORN 1975) where the majority of species of the complex were recorded. The largest dataset on the distribution and frequency of occurrence of species of the *P. aurelia* complex concerns Europe in which 531 habitats were studied (cf PRZYBOŚ *et al.* 2010). A different number of habitats was studied in particular zones of Europe, i.e. 102 in northern, 55 in

southern, and 374* in the central zone (PRZYBOŚ & SURMACZ 2010) and mainly in Poland (218 habitats among 374) (data in PRZYBOŚ *et al.* 2011).

The most common species in Europe is *P. novaurelia* followed by *P. biaurelia* and *P. primaurelia*, while the occurrence of some species, such as *P. triaurelia*, *P. tetraurelia*, *P. pentaurelia*, *P. sexaurelia*, and *P. septaurelia* seems to be limited to certain climatic zones, already proposed by SONNEBORN (1975); some species (*P. octaurelia* and *P. tredecaurelia*) were recorded only in single habitats, others are rare (*P. decaurelia* and *P. dodecaurelia*) (PRZYBOŚ 2005; PRZYBOŚ *et al.* 2008; PRZYBOŚ *et al.* 2010).

Investigations in the southern zone of Europe in which only 55 habitats were studied seem very interesting and may bring new data on the occurrence and distribution of the *P. aurelia* spp. complex in Europe. In this zone sampling was done in several countries, i.e. Spain, Italy, Croatia, Greece, Bulgaria, and Romania (cf PRZYBOŚ *et al.* 2008; PRZYBOŚ & SURMACZ 2010), however, different numbers of habitats were studied. The following

* Two more strains were recently identified as *P. triaurelia* (strains CKV 8-22 and CKV 8-28, Czech Republic, Karlove Vary, coll. N. Lebedeva, 2011), PRZYBOŚ unpublished.

species were recorded there (in parenthesis number of recorded habitats for particular species):

P. primaurelia (21), *P. biaurelia* (18), *P. triaurelia* (5), *P. tetraurelia* (8), *P. pentaurelia* (5), *P. sexaurelia* (5), *P. novaurelia* (9), and *P. dodecaurelia* (2) (cf PRZYBOŚ *et al.* 2010).

Data concerning the occurrence of species of the *P. aurelia* complex in Africa are extremely rare, *P. sexaurelia* was recorded in Kenya, *P. octaurelia* in Uganda (SONNEBORN 1975), and *P. quadecaurelia* in Namibia (PRZYBOŚ *et al.* 2003).

The present paper presents new stands of species of the *P. aurelia* complex in southern Europe (Italy, Greece) and in northern Africa (Morocco), recorded recently.

Material and Methods

Material

The studied strains are presented in Table 1.

Below, some remarks about collecting sites in Greece and Morocco.

Lake Kastoria (or Lake Orestiada) is a lake in Macedonia, northwestern Greece. It is a shallow karstic basin at an altitude of 630 meters above sea level (a.s. l.), it was formed 10 million years ago; the lake covers an area of 30 square kilometers, has maximum depth of 9.1 m and mean depth estimated as 4.4 m.

Marrakech in Morocco is situated at the foot of the High Atlas, the highest mountainous barrier in

North Africa, at an altitude of 600 meters a. s. l. The mean yearly temperature in Marrakech is 27°C, while the highest annual temperature is 36-37°C in July and August.

Ifrane is located in the Middle Atlas mountains of Morocco at an elevation of about 1,650 meters a. s. l. It has a mild Alpine climate with average high temperature 17°C and highest annual temperature 28-29°C.

Methods

Culture and identification of paramecia were performed according to SONNEBORN (1950, 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 particular species. The following standard strains were used:

P. primaurelia, strain 90 (Pennsylvania, USA); *P. biaurelia*, strain Rieff Scotland; *P. triaurelia*, strain 324 (Florida, USA); *P. pentaurelia*, strain 87 (Pennsylvania, USA); *P. dodecaurelia*, strain 246 (Mississippi, USA).

The studied strains were identified as *P. primaurelia*, *P. biaurelia*, *P. triaurelia*, *P. pentaurelia*, and *P. dodecaurelia* on the basis of conjugation between the complementary mating types of the strains under examination with the corresponding ones of the particular species. The survival of hybrids was examined in F1 and F2 generations, according to SONNEBORN's (1975) recommendation.

Table 1

New stands of the *Paramecium aurelia* species complex in the Mediterranean region

Strain index	Geographic origin	Collector's name, year of collection	Species
BL1	Italy, Pisa	A. POTEKHIN, I. NEKRASOVA, 2010	<i>P. primaurelia</i>
BL2			
FGC1	Italy, Calabria	S. GALATI, 2009	<i>P. biaurelia</i>
Ipa	Italy, Padua (Botanical Garden)	A. PERESWIET-SOLTAN, 2010	<i>P. dodecaurelia</i>
Ipb			
Ipc			
GLK 2-22	Greece, Kastorya Lake	M. RAUTIAN, 2010	<i>P. pentaurelia</i>
GLK 2-27			
Mif 13-1	Morocco, Ifrane (creek)	M. RAUTIAN, 2011	<i>P. triaurelia</i>
Mif 13-2			
Mif 13-3			
Mif 13-4			
Max 7-2	Morocco, Marrakech (pond)		<i>P. primaurelia</i>
Max 7-3			
Max 7-9			

Results and Discussion

New stands of species of the *P. aurelia* complex are presented in Table 1. *P. primaurelia* was recorded in Italy (Pisa) and in Morocco (Marra-kech), *P. biaurelia* in Italy (Calabria), *P. triaurelia* in Morocco (Ifrane), *P. pentaurelia* in Greece (Kastorya), and *P. dodecaurelia* again in Italy (Padua).

In Italy the presence of *P. primaurelia*, *P. biaurelia*, *P. tetraurelia*, *P. pentaurelia*, and *P. dodecaurelia* have been recorded previously (cf data in PRZYBOŚ *et al.* 2010). At present, we found new stands of *P. primaurelia*, *P. biaurelia*, and *P. dodecaurelia*. Among species of the *P. aurelia* complex, *P. primaurelia* and *P. biaurelia* are cosmopolitan (SONNEBORN 1975).

Recording *P. pentaurelia* in Greece seems interesting, as until now only *P. primaurelia* and *P. sexaurelia* were found there (cf PRZYBOŚ & SURMACZ 2010).

P. primaurelia and *P. triaurelia* were found in Morocco, which is the first record of any species of the *P. aurelia* complex in this country and in northern Africa. Little information is available on the *P. aurelia* species complex in Africa: the presence of *P. sexaurelia*, *P. octaurelia*, and *P. quadecaurelia* was recorded previously (SONNEBORN 1975; PRZYBOŚ *et al.* 2003), and *P. primaurelia* and *P. triaurelia* at present. Investigations in Africa are still very limited.

Further sampling, especially in southern Europe and in the southern hemisphere, may put forth new data on the occurrence of species of the *P. aurelia* complex.

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