

Distribution of Species of the *Paramecium aurelia* Complex in Israel

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Summary. The presence of *P. primaurelia*, *P. biaurelia*, *P. tetraurelia*, and *P. octaurelia* of the *Paramecium aurelia* complex was revealed in Israel. The last species was recorded for the first time in Asia.

Key words: ciliate biogeography, *Paramecium*, *P. aurelia* species complex.

INTRODUCTION

At present 15 species of the *Paramecium aurelia* complex are known world-wide (Sonneborn 1975, Aufderheide *et al.* 1983). Some species are cosmopolitan (*P. primaurelia*, *P. biaurelia*, *P. tetraurelia*, and *P. sexaurelia*), while others have been found only in single localities (e.g., *P. quadecaurelia*). Studies concerning their distribution, however, were carried out unevenly in different areas. For instance, many collections were made first in North America (mainly in the USA, cf Sonneborn 1975) and later in Europe in numerous habitats (cf Przyboś 1998, Przyboś and Fokin 2000).

The sampling in Asia was carried out in Japan, Russia (Far East), Vietnam, Thailand, India, Turkmenia, Georgia, Turkey, Lebanon, and Israel but all samplings were rather accidental. The presence of the following species of the *P. aurelia* complex was recorded in Asia: *P. biaurelia* (14 habitats), *P. primaurelia* (9 habitats), *P. tetraurelia* (5 habitats), *P. sexaurelia* (4 habitats), and *P. novaurelia* (1 habitat) (cf Przyboś and Fokin 2000, 2001).

Studies on the occurrence of species of the *P. aurelia* complex in Israel (Przyboś 1995, Przyboś and Fokin 1999) revealed the presence of *P. primaurelia* in the River Jordan at Qasr el-Yehud near of Jericho, *P. tetraurelia* in the Sea of Galilee at Tabgha (Przyboś 1995), and again *P. primaurelia* in Jerusalem (channel) (Przyboś and Fokin 1999). However, both papers were based only on occasionally collected samples. As "Israel is distinguished by an extraordinary biotic diversity, due to the combination of its geographical position at a

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Table 1. Occurrence of species of the *Paramecium aurelia* complex, *Paramecium multimicronucleatum* and *P. caudatum* in the studied sampling places in Israel

Locality	Habitat / pH of water	Species of the <i>Paramecium aurelia</i> complex	Other <i>Paramecium</i> species
Kiryat Motzkin	Na'aman Canal / pH = 7.0		<i>P. multimicronucleatum</i>
Ein Afek	Fish pond No. 1 / pH = 7.5	<i>P. tetraurelia</i>	
Ein Afek	Fish pond No. 2 / pH = 7.4	<i>P. octaurelia</i>	
Na'aman Canal	Water canal / pH = 7.1		<i>P. multimicronucleatum</i>
Neighbourhood of Akko	Canal connecting fish ponds / pH = 7.7		<i>P. multimicronucleatum</i>
Nahal Alon, Carmel National Park, Mt. Carmel	Fish pond / pH = 6.8		<i>P. caudatum</i> , <i>P. multimicronucleatum</i>
Neighbourhood of fortress Atlit	Fish pond / pH = 7.1		<i>P. multimicronucleatum</i>
Gid'ona	Fish pond / pH = 7.1		<i>P. multimicronucleatum</i>
Neighborhood of the Sheikh Hussein Bridge	Fish pond / pH = 7.4		<i>P. multimicronucleatum</i>
Yehudiya Junction	Fish pond / pH = 7.1	<i>P. primaurelia</i>	<i>P. multimicronucleatum</i>
Neighbourhood of Neot Mordechai	Fish pond / pH = 7.4		<i>P. multimicronucleatum</i>
Dan	Tributary of Jordan River / pH = 7.1	<i>P. biaurelia</i>	
Nahal Guvta	Stream / pH = 6.8		<i>P. caudatum</i> , <i>P. multimicronucleatum</i>

continental crossroads, its great physical variety, and rich paleobiological history" (Yom-Tov and Tchernov 1988), it seemed worth while to make there more intensive investigations on the distribution and occurrence of the *P. aurelia* spp. complex in that country. It seemed probable that the species of the *P. aurelia* complex that have not been observed in Israel before would be found here. The present paper reports the results of studies on the occurrence of the *P. aurelia* spp. based on material collected in many places in Israel.

MATERIALS AND METHODS

The water samples (45 ml) with plankton organisms were collected in April 2001 from 29 sampling places, 24 of which situated in the northern part of Israel, and 5 on the territory of the Negev Desert.

The water was taken from the surface and the littoral part of the water bodies. Ambient temperature and the pH and water temperature were also measured during sampling. Lettuce medium inoculated with *Enterobacter aerogenes* (Sonneborn 1970) was used for cultivation of paramecia.

Paramecium species were identified on the basis of analysis of the type and number of their micronuclei (Vivier 1974) on the slides stained by acetocarmine or by Feulgen reaction (after fixation and hydrolysis, cf Przyboś 1978).

Identification of the established clones of the *P. aurelia* spp. complex was carried out according to Sonneborn (1950, 1970). Species of the complex were determined by mating the investigated reactive (mature for conjugation) clones with the reactive mating types of the standard strains. The following standard strains were used: strain 90 of *P. primaurelia* (Pennsylvania, USA), the strain from Rieff, Scotland, of *P. biaurelia*, the strain from Sydney, Australia of *P. tetraurelia*, and the strain 138 of *P. octaurelia* (Florida, USA). The species were determined on the basis of 95-100% conjugation between the complementary mating types of the examined clones with the appropriate standard ones.

RESULTS AND DISCUSSION

The presence of *P. primaurelia*, *P. biaurelia*, *P. tetraurelia*, and *P. octaurelia* was revealed in Israel by the present study (Table 1).

Paramecium primaurelia (seven clones) was identified in the sample (pH 7.1) collected from a pond at Yehudiya Junction, situated east of the Sea of Galilee (Jordan Valley). *P. multimicronucleatum* appeared in the same sample.

Paramecium biaurelia (three clones) was found in the sample (pH 7.1) collected from a tributary of the upper River Jordan in Dan (Upper Galilee, Valley). It is the first record of the species in Israel. *P. biaurelia* was found earlier in the adjoining Lebanon (Sonneborn 1974).

Paramecium tetraurelia (three clones) was identified in the sample (pH 7.5) collected at Ein Afek (east of Haifa, Northern Coastal Plain) from a pond (designated as No. 1). It appeared together with *P. multimicronucleatum*.

Paramecium octaurelia (three clones) was identified in the sample (pH 7.4) collected from a pond designated as no 2 at Ein Afek. It is the first record of its presence in Asia. Previously, *P. octaurelia* was known mainly from the USA but was also recorded in Panama and Uganda (Sonneborn 1975). In Sonneborn's opinion "This species is ... common in the tropical and subtropical Americas and may also be common around the world". The present studies showed that Sonneborn's supposition was correct. *P. octaurelia* was also recorded in Europe by Stoeck and Schmidt (1998) in a water sample collected in southwest Germany. The present findings of *P. octaurelia* in Israel modify our knowledge concerning the range of the species in the world. However, it is difficult to determine the conditions specifically suitable for the appearance of the species.

Among the species recorded at present in Israel *P. primaurelia*, *P. biaurelia*, and *P. tetraurelia* are cosmopolitan (Sonneborn 1975).

The species of the *P. aurelia* complex appeared mainly in the northern part of Israel (Northern Coastal Plain and Jordan Valley) in waters characterized by

neutral pH, ambient and water temperatures during samplings being 22 to 25°C.

As concerns the other *Paramecium* species, *P. multimicronucleatum* was recorded in 10 sampling places, in two of them with *P. caudatum*. *Paramecium* spp. appeared in 13 out of 29 places, mainly in ponds and canals connected with fishponds.

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