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Diaphanosoma macedonicum Korovchinsky et Petkovski, 2014 (Crustacea: Cladocera: Sididae) в Охридском озере

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KEY WORDS: *Diaphanosoma macedonicum,* description, Lake Ohrid, endemicity, biological invasion.

КЛЮЧЕВЫЕ СЛОВА: *Diaphanosoma macedonicum,* описание, озеро Охрид, эндемичность, биологическая инвазия.

ABSTRACT. The endemic Balkan species *Diaphanosoma macedonicum* Korovchinsky et Petkovski, 2014 is found in ancient Lake Ohrid, previously lacking the representatives of the genus, for the first time. Their morphological features are briefly described and compared with those of other populations of the species inhabiting the neighbouring lakes Large Prespa and Dojran. The recent invasion of the representatives of the genus in Lake Ohrid probably was possible due to its ongoing eutrophication, especially in areas of high human activity.

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РЕЗЮМЕ. Эндемичный балканский вид *Diaphanosoma macedonicum* Korovchinsky et Petkovski, 2014 впервые обнаружен в древнем озере Охрид, где прежде представители данного рода отсутствовали. Его морфологические признаки кратко описаны и сравнены с таковыми представителей других популяций вида, населяющих соседние озера Большое Преспа и Дойран. Недавнее вселение представителей рода в озеро Охрид, вероятно, стало возможным благодаря его продолжающейся эвтрофикации, особенно в местах высокой антропогенной активности.

Introduction

The ancient Balkan lake Ohrid is studied for a long time [Stanković, 1960; Albrecht, Wilke, 2008; Wagner *et al*., 2017], in particular, the species composition of its pelagic zooplankton had become known since the end of XIX – beginning of XX century [Richard, 1892; Georgevitch, 1907]. In respect of Cladocera, it was quite simple being represented by only two species, *Daphnia pulicaria* Forbes, 1893 and *Bosmina longirostris* (O.F. Müller, 1776) [Hrbaček, 1987; Korovchinsky, 2000; Gušeska *et al*., 2005, 2019; Tasevska *et al*., 2017].

The representatives of the genus *Diaphanosoma* were not known in lake Ohrid until the 1990s when new invaders, *D. birgei lacustris* Kořinek and *Leptodora kindtii* (Focke), have been recorded there [Gušeska *et al*., 2005; Tasevska *et al*., 2017]. Generally, the available literature data convince that the identification of the lake *Diaphanosoma* is tentative, pointing to either *D. birgei lacustris* [Gušeska *et al*., 2005, 2014, 2019] or *D. brachyurum* [Kostoski *et al*., 2010; Tasevska *et al*., 2017].

The examination of a sample collected in the North Macedonian part of Lake Ohrid has revealed the recently described, endemic Balkan species *Diaphanosoma macedonicum* Korovchinsky et Petkovski, 2014, the representatives of which deserve further attention and comparative description.

Study area, material and methods

In the central part of the Balkan Peninsula, there is a belt of ancient lakes, consisting of two different principal lake groups [Cvijic, 1911]. The western of them belongs to the South Adriatic-Ionian Sea Basin and consists of three water bodies, the largest and deepest Lake Ohrid (Ohridsko Ezero), Large Prespa (Prespansko Ezero, Megali Prespa), and Small Prespa (Mikri Prespa), the two latter of them are connected by a canal. These lakes are the remnants of the vast Palaeolake Dessaret [Albrecht, Wilke, 2008].

Lake Ohrid is the oldest lake in Europe and one of the oldest in the world being created some millions of years ago, in its *de novo* phase established between 1.9 and 1.3 Ma [Wagner *et al*., 2017]. It is situated in the south-western part of North Macedonia and partly in Albania and has a surface area of c. 358 km^2 and a maximum depth of c. 289 m. It hosts a high biodiversity richness, including many (at least

Table 1. Measurements of body and body parts of adult females (n = 17) of *Diaphanosoma macedonicum* from Lake Ohrid (in each column from top to bottom: range, mean (M), standard deviation (SD), coefficient of variation (CV)) (abbreviations see below).

Таблица 1. Измерения тела и его частей у взрослых самок (n = 17) *Diaphanosoma macedonicum* из озера Охрид (в каждом столбце сверху вниз: разброс данных, средняя (M), среднее квадратичное отклонение (SD), коэффициент вариации (CV)) (расшифровку сокращений см. ниже).

BL, mm	HL : BL, %	HH : BL, %	DE : BL, %	AnL : BL, %	UB : AnL, %	Number of denticles on posteroventral valve margins
0.77–0.99	31.4–38.5	20.0–23.1	5.8–7.5	70.8–83.3	44.9–56.4	17–28
0.87	35.0	21.7	6.7	75.3	49.2	24.3
	2.1	0.88	0.56	3.8	3.4	
	6.0	4.0	8.4	5.0	6.9	

212) endemic species and in terms of endemic biodiversity, this lake is probably the most diverse lake in the world, taking a comparatively small surface area into account [Albrecht, Wilke, 2008].

The material was collected by Dr Charo Lopez-Blanco (Justus-Liebig-Universität, Giessen, Germany) on August 13, 2017, in the North Macedonian part of Lake Ohrid in front of Ohrid town, in its pelagic zone with plankton net through its stretching from 50 m depth to surface, and fixed in alcohol. In general, the sample contained 19 adult females, three juveniles, and four deformed specimens. Only 17 adults were suitable for morphometric measurements (Table 1).

Specimens were examined under a dissecting microscope Lomo MBS-20 and a compound microscope Olympus BX-41 with *camera lucida.* Measurements of bodies and body parts were made according to Korovchinsky [2004].

Abbreviations: AnL — antennal length, BL — body length, DE — diameter of eye, HH — head height, HL — head length, UB — length of the upper antennal branch.

Brief description of *D. macedonicum* Korovchinsky et Petkovski, 2014 from Lake Ohrid

Data on body and body parts measurements are shown in Table 1.

Body conically elongated, slightly narrowing anteriorly, with a head of comparatively large or medium size (length 31.4–38.5% and height 20.0–23.1% of body length, respectively), having rather strongly developed dorsal part, the shape of which may vary in preserved specimens (Fig. 1a, b), also due to deformation. Eye comparatively small (5.8–7.5% of body length) and situated closer to the ventral side or anteroventral corner of the head. Antennules are small with nine small aesthetasks and a rather long sensory seta.

Swimming antennae long (70.8–83.3% of body length), with the upper branch (44.9–56.4% of antennal length) almost reaching or reaching the posterior valve margin (Fig. 1a). Their basipodite is massive, with a small, sharp spine on the outer side of its apical end closer to the base of the upper branch (Fig. 1c). The proximal segment of the upper two-segmented antennal branch bears conspicuous apical spine dorsally and outgrowth of slightly varied shape laterally (Fig. 1d). Formula for antennal seta 4–8 / 0–1–4.

Shell with slightly arched dorsal side and conspicuous dorsoposterior angle (Fig. 1a). Valves with rather high posterior margin (33.3–44.3% of body length) connected with ventral margin at some angle. Posteroventral margin (Fig. 1e, f) armed with a row of 17–28 quite small, sometimes sparsely situated denticles having thin setules between them (Fig. 1e, f). Posterior valve margin with row of marginal and submarginal densely situated spinules and few setules in its lower part. Inner thorn near posterior valve margin is absent.

Postabdomen comparatively narrow with slightly prominent dorsal side and long postabdominal setae (Fig. 1g). Terminal claws with three basal spines, the distal of which is longest (Fig. 1g) whereas proximal one may be rather small. Rows of spinules are situated distally along the outer lateral side of claws.

Body length 0.77–0.99 mm. Gamogenetic females and males have not been obtained.

Discussion

Morphologically, the studied specimens of *D. macedonicum* from Lake Ohrid are quite similar to those from two previously investigated lakes, Large Prespa and Dojran (see Korovchinsky & Petkovski [2014]), differing from them only in minor features. The former ones are smaller and their integument lacks reinforced chitinization, denticles of posteroventral margin, on average, are more numerous. In general, morphological parameters of Lake Ohrid's specimens are closer to those of Lake Large Prespa which is understandable because these two lakes are situated nearby.

The available morphological differences of the representatives from Lake Ohrid, the probable recent invaders of the lake [Gušeska *et al*., 2005, 2014; Tasevska *et al*., 2017], haven't any taxonomic significance and only demonstrate the intraspecific variability. Despite the lake being a hot spot of endemic biodiversity [Stanković, 1960; Albrecht, Wilke, 2008], only two cladoceran endemics, *Phreatalona smirnovi* (Petkovski et Flössner) and *Coronatella begoniae* (Sinev et Lopez-Blanco, 2018) are known from it and the neighbouring springs [Petkovski, Flössner, 1972; Albrecht, Wilke, 2008; Sinev, Lopez-Blanco, 2018; Sinev, 2020].

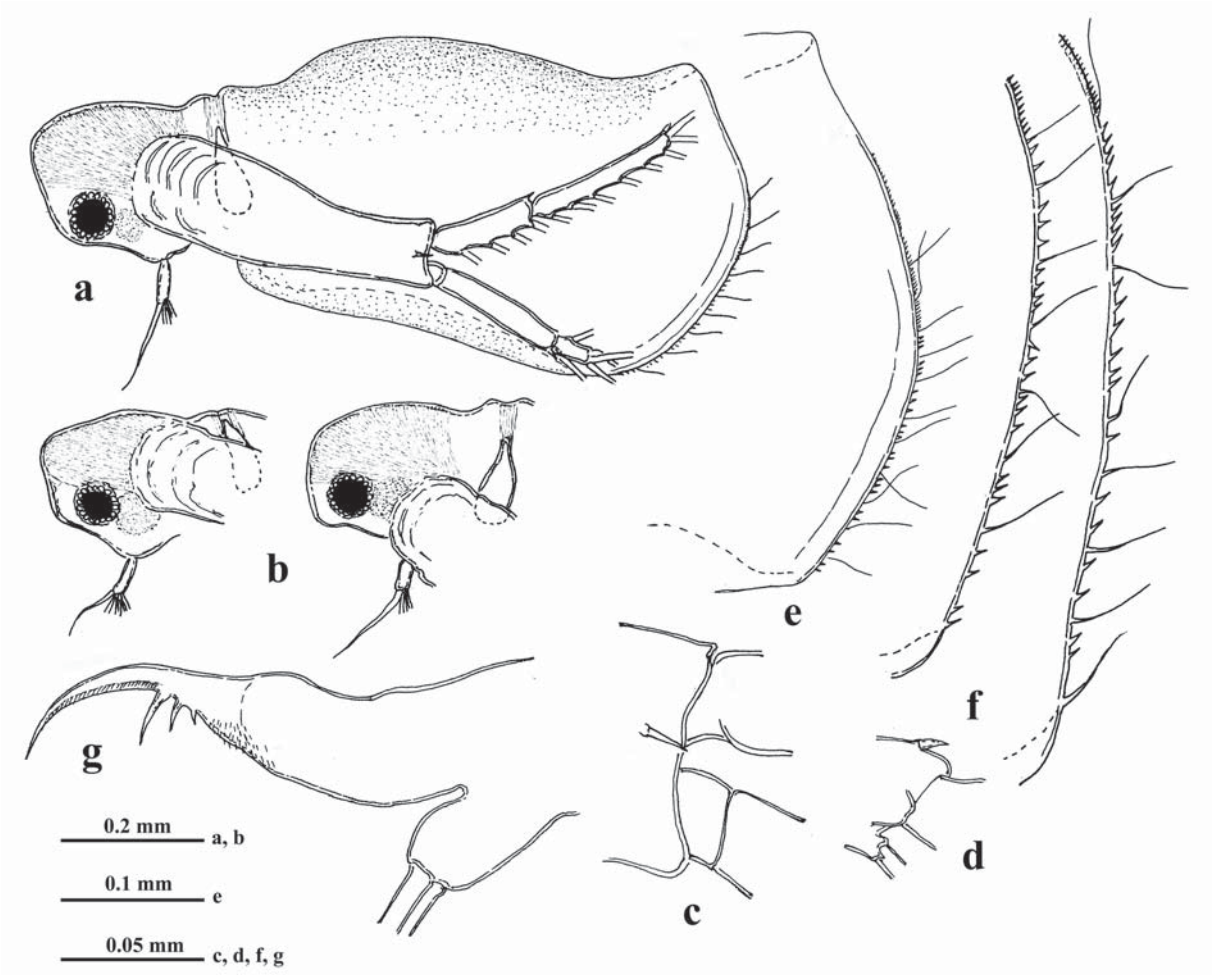

Fig. 1. *Diahanosoma macedonicum,* females, Lake Ohrid, 13.08.2017. a — general lateral view, b — variations of head shape, c — distal part of antennal basipodite, outer side, d — distal part of the proximal segment of the upper antennal branch, e — posterior and posteroventral valve margins, f — armament of posteroventral valve margins, g — postabdomen, lateral view.

Рис. 1. *Diahanosoma macedonicum,* самки, озеро Охрид, 13.08.2017. a — общий вид сбоку, b — вариации формы головы, c — дистальная часть базиподита антенны, внешняя сторона, d — дистальная часть проксимального членика верхней ветви антенны, e — задний и задне-нижний края створок, f — вооружение задне-нижних краев створок, g — постабдомен, вид сбоку.

Other cladocerans have not been examined in detail whereas more studied copepods demonstrate a higher level of endemicity [Albrecht, Wilke, 2008].

The lack of *Diaphanosoma* in Lake Ohrid in the past is probably connected with its uniqueness, large age, geological and limnological history, and physiography, which distinguishes it from the neighbouring, also rather old Balkan lakes populated by these crustaceans. Their recent invasion in Lake Ohrid might be caused by its ongoing eutrophication (see Albrech & Wilke [2008]; Kostoski *et al*. [2010]; Hampton *et al*. [2018]), especially in areas of high human activity like that one near the Ohrid town, the point of the species collection.

It is not known whether *D. macedonicum* is the only representative of the genus in Lake Ohrid misidentified before or it co-occurs with other congeners as it was found in Lake Dojran [Korovchinsky, Petkovski, 2014]. Only further detailed examination of more abundant material from different parts of the lake can resolve this question.

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