

INFLUENCE OF ISOLATION AND PECULIAR ECOLOGICAL PROPERTIES ON BIODIVERSITY AN EXAMPLE OF MARINE LAKE ZMAJEVO OKO NEAR ROGOZNICA (ADRIATIC SEA)

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Abstract

In a small marine lake Zmajev Oke (Dragon's Eye) near Rogoznica (middle Dalmatia, Croatian coast of Adriatic Sea) upper water layer is in contact with surrounding coastal sea through fissures in karstic rocks, so tides are noticeable but reduced. Almost permanent water column stratification (temperature, salinity, oxygen concentration, presence of H₂S) is present in the lake. We investigated biological properties of the lake several times in period from 1993 to 1996. Benthic communities in the lake differ from communities that can be found in surrounding coastal sea. In Zmajev Oke fewer species with denser populations were observed and some common species were not observed at all. We discuss possible reasons for such situation. Proper evaluation of scientific and natural values of this rare karstic phenomenon of our coast should be done.

Key-words : zoobenthos, stratification, Adriatic Sea

Introduction

A marine lake Zmajev Oke (Dragon's Eye) is located on Gradina Peninsula near village of Rogoznica, about 30 km SE from Sibenik on the Croatian coast of Adriatic (Fig. 1). It is a small body of sea water, 150 x 70 m in size, maximum depth 15 m, surface of which is estimated to be 5300 m² (1). There is no visible contact with surrounding coastal sea but tides are present in the lake (although they are reduced). The lake is surrounded by vertical karstic rocks from up to 4 m high (on its northern side) to up to 24 m high (on its southern side) above the water level. Vertical rocks continue into the water, where on depths from 1 to 7.5 m sediment bottom begins. The bottom is then gradually sloping towards the deepest part of lake on 15 m.

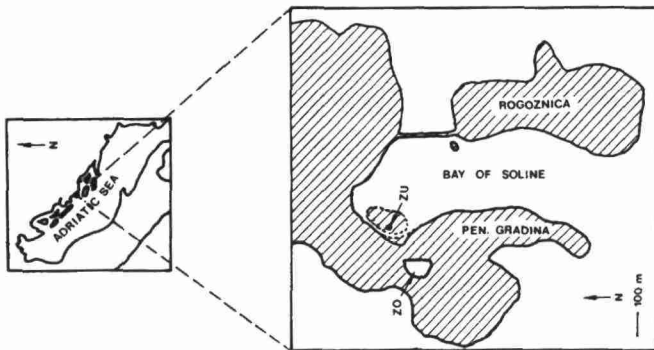


Figure 1 : Location of the marine lake Zmajev Oke (ZO ; Dragon's Eye) on Gradina Peninsula near Rogoznica. Building of nearby nautical centre threatens to endanger this rare karstic phenomenon of Croatian Adriatic coast. Broken line shows approximately the position of already finished artificial island (which is a part of the mentioned nautical centre). Location of already endangered sunken marine cave Zmajev Uho (ZU ; Dragon's Ear), which is now in the middle of the artificial island, is also shown.

A geological origin of the lake is thought to be connected with a collapse of the roof of primary underground cavity formed by palaeostreams. Due to postglacial sea level rise, it was filled with seawater through underground fissures (2).

Water column stratification in the lake with regard to temperature, salinity, density, oxygen concentration and presence of hydrogen sulfide is almost always present (3, 4, 5). A high primary production on the basis of chlorophyll a distribution was noted in the lake. Namely, 2-3 times higher chlorophyll a concentrations was present in the lake in comparison to surrounding coastal sea (6).

Sediment in the lake is characterised as an authigenic carbonate sediment of mainly biogenic origin belonging to the anoxic-sulfidic sedimentation environment. Sedimentation accumulation rate was estimated to be 0.093 gcm⁻² per year (approx. 4.5 mm per year) which can be considered quite high in comparison to surrounding coastal area (2).

Recently, the building of a nautical centre in nearby Soline Bay stirred up a lot of public discussions about natural value of this rare karstic phenomenon. In spite of a wide public action aimed towards the protection of Zmajev Oke it was not possible to achieve its classification in one of the natural protection categories regulated by law.

Methods

In period from 1993 to 1996 we have dived ten times in the lake, in irregular intervals, but mostly during winter because of better visibility. We used standard SCUBA equipment and strong underwater lights. We took photos with underwater camera (Nikonos V; objectives 28, 35 and 80 mm). Quantitative biological samples of benthos we collected from 50x50 cm squares and weighted them on simple household scale.

Results and discussion

Stratification of water column in the lake was so strong that it was possible to note it even without special instruments, not only visually and thermally but olfactory as well. Namely, smell of hydrogen sulfide is passing through a diving mask. During research period, only in November 1993 layer with hydrogen sulfide was not present in the lake. At all the other occasions when we have dived, layer was present from the bottom to up to 8 meters of depth (in January 1993).

A very narrow supralittoral zone is present in the lake. A dark green zone (from blue-green algae in/on the rocks) is wide only up to 20 cm. In that zone we noticed isopod *Ligia italica* Fabr.

In a shallow zone down to 2m on the northern side of lake (which is more exposed to sunlight) green algae *Codium tomentosum* Stackhouse and *Cladophora* sp. were more often present. A red alga *Antithamnion* sp. was also present there as well as on rocky walls along the southern side of the lake (which is in a shadow considering sunlight due to high rocks around the lake on that side). A very dense population of little mussel *Mytilaster* sp. (somewhere up to 4000 individuals per m²) was also present in that shallow zone. On the rocks, all around in the lake, consequences of boring activity of sponge *Cliona celata* (Grant) and bivalve *Petricola lithophaga* (Retzius) could be seen. Rocks around fissures through which water in lake communicates with surrounding sea (7) and rocks along the southern (shaded) side of the lake (on depths from 2 to 4 m) were completely covered with ascidian *Pyura dura* Heller, another frequent organism in the lake. Settlements of these animals in such areas could reach population density of up to few hundreds of individuals per m² and an average wet biomass of up to 10 kg per m².

Different animal groups were noticed in the lake: jellyfish *Aurelia aurita* Lam., echiuran *Bonellia viridis* Rolando; gastropods: *Gibbula divaricata* (L.), *Trunculariopsis trunculus* (L.) (empty shells only), *Gourmya rupestris* (Risso), *Berthella aurantiaca* (Risso); bivalves: *Mytilus galloprovincialis* Lam., *Ostrea edulis* L.; crustaceans: *Palaemon* sp., *Homarus gammarus* (L.), *Palinurus elephas* (Fabr.), *Xantho poressa* (Olivi); fishes: *Conger conger* (L.), *Dicentrarchus labrax* (L.), *Chromis chromis* (L.), *Blennius pavo* Risso, *Oligopus ater* Risso, *Gobius bucchichii* Steind., *Gobius* sp., *Mugil* sp., *Tripterygion* sp. Their distribution in the lake as well as their relative abundance is shown on Table 1. A few collected species of sponges, polychetes and bryozoans are not determined yet.

On the sediment bottom, we did not notice any of common macrobenthic organisms. We noticed only a dense population of prawns *Palaemon* sp., which was present from the water surface all the way down to anoxic water layer.

In small caves (up to 8 m long) and crevices in the lake, we noticed a rich living community. Different species of sponges which overgrew each other dominated in the entrance part while deeper, in darker part of the caves, the ascidian *Pyura dura* prevail. Ascidians in the caves were regularly developed and without fouling, on the contrary to those