

THE RECENT INVESTIGATIONS OF THE SEA WATER QUALITY IN THE MONTENEGRIN COASTAL SEA

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Abstract

The recent results from the Montenegrin coastal sea were realized by measuring of some parameters known as main indicators of eutrophic level and microbial pollution. The obtained data have shown that eutrophication has progressed mostly in the inner and middle parts of the Boka Kotorska Bay, as in front of the Bojana river mouth. The situation is better outside the Bay, where the influence of the open waters of the Southern Adriatic is stronger. Bacterial (sanitary) quality is mostly satisfying, yet. From 55 localities, 30% of them in Boka Kotorska and 50% outside the Bay were the first category (up to 500 TC 100 ml⁻¹ of the sample).

Keywords: sea-water eutrophication, microbial pollution

The Montenegrin coastal waters are very precious resource of Montenegro and whole Yugoslavia. Suitable for tourism, fisheries, mariculture, maritime transport etc., they are simultaneously exposed to all human activities from the land. As 25% of Montenegrin inhabitants live at 293.5 km long coast-line, increased number of inhabitants throughout summer and yet unsolved problem of waste-waters (1) have already caused anthropogenic eutrophication (2, 3, 4). Microbial pollution also appeared, from time to time. For all reasons mentioned above, investigations of this precious area have been started again in 1995. Material was collected from 28 localities in the inner, middle and outer parts of the Boka Kotorska Bay, 26 outside the Bay, along the Montenegrin coast, and one in the Bojana river mouth (Fig. 1).

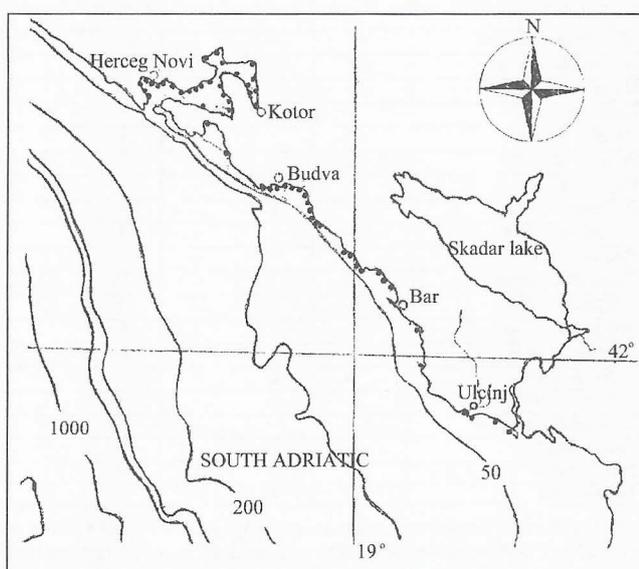


Fig. 1 The investigated area

The samples were taken most intensively throughout summer, during calm, hot weather (when the number of inhabitants was many a time higher), and some of them were taken during colder periods, as a control.

Due to natural characteristics (position, shape, freshwater springs and river mouths, rain, wind, sea-water dynamics) the basic hydrographic factors oscillated a lot throughout the year in Boka Kotorska Bay, while in the Bojana river mouth, and outside the Bay, especially, these oscillations were smaller, because of stronger influence of the open Southern Adriatic (2).

Having in mind classification of eutrophic levels (5), the results about transparency, sea water color, oxygen saturation, nutrients, composition and density of phytoplankton and zooplankton and density of heterotrophic bacteria will be presented, firstly.

So, oxygen saturation at the sea-surface oscillates from 95.08 to 162.65 % O₂ in the Boka Kotorska Bay, between 54.89 and 158.82 % outside the Bay and from 79.50 to 127.97 % in the Bojana river mouth, which indicates that all area is eutrophic.

Transparency is between 3 and 6 metres in the Bay, from 10 to 11.5 m outside the Bay (1 NM from the coast), and about 2 m in the Bojana river mouth. All these values are typical for eutrophic areas, too.

Sea-water color (in comparison with Forell-Uhle scale) is usually changed at some localities in the inner (Kotor Bay) and middle (Tivat Bay) parts of Boka Kotorska to greenish, yellowish or even brownish, as in the Bojana river mouth. Such frequently changes indicate to eutrophication, too. Outside the Bay, sea-water color is changed very rarely.

Maximal quantity of phosphates is measured in the Kotor Bay. This value of 9.34 mmol l⁻¹ is found near the outfall and it characterizes extremely eutrophic areas.

In 1995 – 1998 period, phytoplankton investigations have shown the prevailing of microphytoplankton biomass (which prefers areas rich in nutrients) in the Boka Kotorska Bay. Microphytoplankton density was up to 1.7x10⁶ cells dm⁻³ in Kotor Bay, with high dominance of *Chaetoceros affinis* and *Skeletonema costatum* throughout summer, especially. Besides them, the presence of another 12 species-indicators of eutrophication (6) was confirmed in the Bay during recent investigations. Simultaneously, maximal microphytoplankton density was 9.8x10⁴ cells dm⁻³ outside the Bay, with lower percentage of dominant species. At the Bojana river mouth microphytoplankton density reaches 3.93x10⁵ cells dm⁻³ and *Cyclotella striata* was dominant between other species with percentage of 15%. So, we can conclude that only in the Boka Kotorska Bay the obtained results on the microphytoplankton density exceed 10⁶ cells dm⁻³ – a value established for eutrophic areas. Besides, the biomass of phytoplankton has shown third – unusual summer maximum, with even higher values then in spring and autumn (5).

Investigations of copepods, dominant net zooplankton group (with the percentage of 90% among other groups), show some changes, too. Besides, rather high values of their density in Boka Kotorska Bay and in the Bojana river mouth (up to 6x10⁴ m⁻²), unusual summer maximum appears at the same areas from the beginning of ninetieths, together with high percentage of two or three dominant species.

All these changes are the most visible in the closest part of the Bay – Kotor Bay, which is not so shallow, but by reason of its shape and position, is exposed to the strongest impact of the land and freshwater.

Bacterial contamination (sanitary quality) has been studied out at the very same 55 well-known beaches of the Montenegrin coast, using the method of membrane filtration. The first category of the sea-water quality (up to 500 TC 100 ml⁻¹ of the sample) was found at about 30% of the localities in the Boka Kotorska Bay, and at about 50% of the investigated stations outside the Bay. In 1995-1998 period, five stations at the Bay and three outside the Bay sometimes exceeded allowed criterion.

In general, we can conclude that some changes were found in non-living and even living components of marine ecosystem of the Montenegrin coastal sea, caused by human impact from the land (in the inner and middle parts of Boka Kotorska Bay and in the Bojana river mouth, predominantly).

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