

SOME INDICATORS OF ANTHROPOGENIC POLLUTION OF SEA WATER IN KOTOR AND RISAN BAYS

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ABSTRACT

Microbiological analysis in Kotor and Risan bays between 1996 and 2000 showed that the quality of sea water (17 locations) was satisfactory only in 1999. During other years, the number of locations with unsatisfactory quality of sea varied from 18% to 45%. Coliform bacteria are used as indicators of bacterial pollution of the sea. The reasons for these results are the so-called dispersed pollutants that are grouped mostly along the coast. It has been observed that wastewaters from them are released without previous treatment into the coastal waters. However the result is pointing to the fact that the ability of marine ecosystem to receive the income of these wastewaters is weaker, what can be easily noted by sight and smell in the extreme cases.

Key words: sea, dispersed pollutants, wastewaters, coliform bacteria

NEKI POKAZATELJI ANTROPOGENOG ZAGAĐIVANJA MORSKE VODE U KOTORSKOM I RISANSKOM ZALIVU

REZIME

Bakteriološka kontrola morske vode u Kotorskom i Risanskom zalivu od 1996. do 2000. godine pokazala je da samo u posljednjoj godini njen kvalitet na ispitivanim lokalitetima (17) bio kako treba. U ostalim godinama lokaliteti sa nezadovoljavajućim kvalitetom mora varirali su od 18% do 45%. Za indikatore bakterijskog zagađenja priobalnog mora uzete su koliformne bakterije. Razlog za gore navedeno su takozvani rasuti zagađivači, koji su grupisani pretežno uz morsku obalu. Konstatovano je da se otpadne vode iz ovih zagađivača ispuštaju u more bez predhodnog prečišćavanja. Međutim, dobijeni rezultati ukazuju na činjenicu da morski ekosistem sve teže podnosi ulivanje tih otpadnih voda, što se u ekstremnim slučajevima lako uočava čulima vida i mirisa.

Gljučne riječi: more, rasuti zagađivači, otpadne vode, koliformne bakterije

INTRODUCTION

The inner part of Boka Kotorska Bay, more precisely the Kotor bay and Risan bay is extremely enclosed comparing to the rest of the Montenegrin coast. This part of the Boka Kotorska Bay is connected to the rest of the Bay and the open sea by a sea passage Verige wide at the most narrow spot 340 meters.

The area of Kotor and Risan Bay is 24.267 km², and of the total volume of the Boka Kotorska Bay the Kotor and Risan Bay take up the 26.7%. The average depth of Kotor Bay is 27.0 m, and of Risan Bay is 25.7 m. The sea bottom of these bays is made mostly of clay with some sandy clay around the town of Risan. The sea bottom sediment analysis showed its terigenous origin

Hydrography of Kotor and Risan Bay is characterized by frequent inflow of fresh water that is of seasonal character. This inflow of fresh water into the sea is done through smaller number of continuous tributaries with changeable flow dynamics, by many smaller torrents and by numerous up wells. Due to this inflow of fresh water in Kotor and Risan Bays is characteristic that some hydrographic parameters (temperature, salinity, transparency and colour) vary periodically what has its impact on autochthonous living system in the sea.

However the earlier and more recent (1996-2000) research showed that in the seawater do exist also some allochthonous living organisms. In this research certain saprophyte bacteria are taken into account through the analysis of the amount of total coliform bacteria in the sea, which are the indicators of anthropogenic pollution.

RESULTS AND DISCUSSION

In this research the anthropogenic factor is taken as the dominant cause of the seawater pollution. This biotic factor has an enormous influence on the purity of the sea, especially during summer months.

In the hinterland of Kotor and Risan Bay, along the coast there are 12 settlements (Kostanjica, Morinj, Risan, Strp – Lipci, Perast, Orahovac, Dobrota, Kotor, Muo, Prčanj, Stoliv) that have a direct influence on the sea and in which, according to the most recent data (1995 –1996) lives 17608 inhabitants.

Living units in these settlements are treated as dispersed polluters for the purpose of this research.

For nine larger settlements with more than 100 living units, data is presented separately. Here we are talking about percentage of quantitative analysis of the living units in settlements and comparing of the number of inhabitants in them. Considering that in three settlements (Kostanjica, Strp – Lipci, Orahovac) the number of inhabitants is less than 100, the data was treated jointly in the section »Others« (Fig. 1. and 2.).

Some indicators of anthropogenic pollution

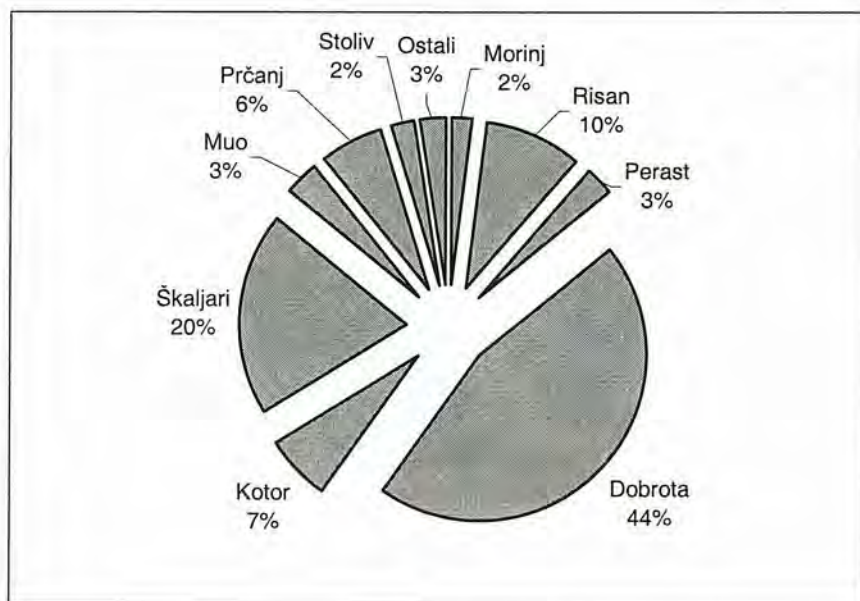


Figure 1. Percentage of living units in settlements

From the figures it can be seen that with the exception of Prčanj and Risan that are a bit distant, other larger settlements are placed very close to the town of Kotor. The Old town of Kotor is not the largest according to all parameters taken into account in this research.

Besides this, the presentation of percentage of inhabitants per settlements in most part corresponds to the presentation of this percentage of number of inhabitants per living units. Exception to this is Kotor (Stari grad), Risan and Prčanj. The case of Kotor and Prčanj relating to Risan is that Kotor and Prčanj have twice less living units and twice more inhabitants. Moreover, Risan has notably more living units comparing to the number of inhabitants, which is not the case in other settlements (Fig. 1. and 2). The most probable reason for this is that most of the living units are used as so-called weekend living units.

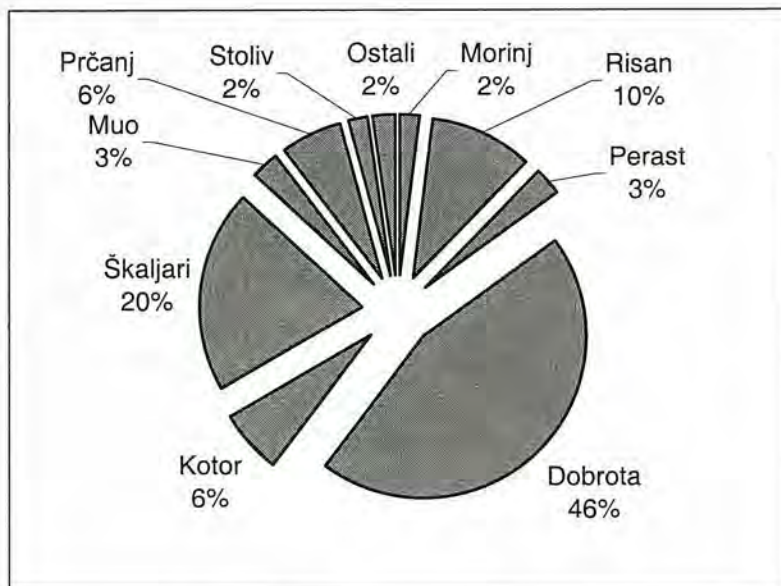


Figure 2. Percentage of inhabitants in settlements

The total number of inhabitants that live in these settlements is mentioned earlier (17608), and the total number of living units is 5681. The wastewaters except from their kitchens are also from 9121 bathrooms and 9765 toilets. For the assessment of the disposal of wastewater, considering that there was no measurement of the flow, it needs to be taken into account that in all of these settlements there are a certain number of weekend living units. In all cases the impact on the marine ecosystem, is the largest during the summer months.

These urban wastewaters from the so-called dispersed polluters (living units) are discharged into the sea in several ways.

One way is the discharge through the limited number of smaller wastewater systems that end up with underwater outlets. These wastewater systems and underwater outlets are managed by the »Water and wastewater« public enterprise from Kotor, and so far the registered number is 35 of them.

In the most inner part of the Kotor Bay, between Kotor and Peluzica there is 5 registered wastewater outlets. Along the eastern coast, between the open swimming pool and Orahovac there are 14 underwater outlets. Along the western coast there are only 6 registered outlets between Prčanj and Stoliv. Between Lipci and Risan there are 9 registered wastewater outlets.

The way of management of these wastewater systems and outlets is not at the level it should be, so the functioning of the most outlets is not known. The characteristic length of these outlets is between several meters up to the

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maximum of 150 m. These outlets do not have diffusers at the end and they end at shallow depths, up to 20 meters. Besides, none of these infrastructure objects do not have the wastewater treatment before the discharge in the natural recipient, the coastal sea in this case.

Other way of wastewater discharge from the households is through no registered smaller underwater outlets that were placed illegally, and the owners of living units on the coast usually place them. There are a great number of such illegal outlets, and the number is increasing.

The third way of wastewater discharge is over septic tanks from which, by infiltration from the land or by overflow channels are discharged into the sea.

BACTERIAL POLLUTION OF THE SEA

The data presented above are reflected through the state of water quality for swimming and recreation in Kotor and Risan bays (17 locations).

The quality of seawater (according to number of total coliform bacteria) at these locations for swimming and recreation is given in Figure 3. In the five years of monitoring, only in the year of 1999, there were no locations with unsatisfactory water quality (above II class). In other years the percentage of unsatisfactory water quality varies between 18 % – 45 %. The favourable fact is that there are locations with the water quality of I class (between 17 – 47%), which is not required for the Boka Kotorska Bay.

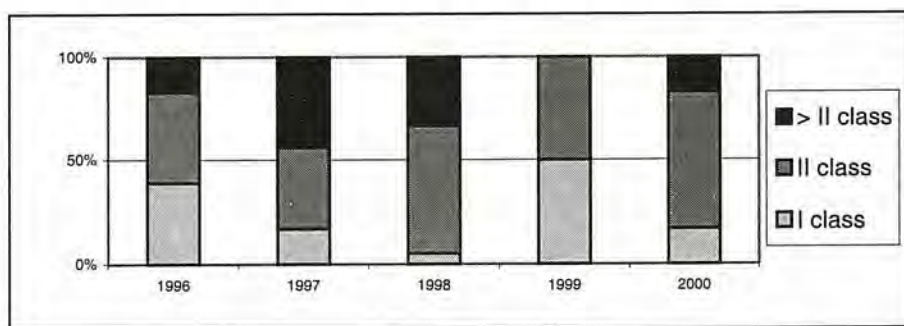


Figure 3. Seawater quality classification in municipality of Kotor

CONCLUSIONS

The data shows that the settlements along the coast are greatly affected by both analysed parameters. That, and the fact that the accumulated

wastewaters are not treated before discharge into the sea results in the great influence of organic waste on the marine ecosystem

The fact that there are locations with the water quality of I class resembles the fact that the ecosystem has possibility of self-purification. However, due to the short period in which the monitoring is done (only during summer months) is hard to estimate how great is this possibility of self-purification.

Considering the fact that the seawater pollution is increasing, it is necessary to implement the wastewater treatment plants into the existing wastewater systems and to treat the wastewaters before its discharge into the natural recipient.

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