

Sanitary Quality of the Adriatic Sea on the Croatian Coastal and Islands Area

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Besides climate-related elements, geographic characteristics, tourist facilities and traffic, cleanness of the sea plays the decisive role in choosing a destination at which to spend a holiday. Visual impression of the sea quality at bathing facilities is usually left to our subjective evaluation, but what one can actually find in the sea, and how dangerous it can be for us, we usually do not notice and are relatively unfamiliar with it. In a matter of fact, what we are so neglectful about, are microorganisms that can have serious impacts on our health. In other words, quality of the bathing seawater primarily depends on their multitude.

This paper contains a review of sanitary quality of seaside beaches, carried out in 1997 along coast and on the islands in Croatia, according to requirements stated by the World Health Organization (WHO) and the Decree of the Government of the Republic of Croatia.

Key Words: sanitary, quality, sea, bacterial pollution, beach, coast, and islands, Croatia.

Sanitarna kvaliteta Jadranskog mora na hrvatskom priobalnom i otočnom području

Pored klimatskih elemenata, geografsko prostornih karakteristika, prometa te turističke ponude uopće, odlučujuću ulogu u pogledu izbora odmorišne destinacije čini čistoća mora. Vizualni dojam o kvaliteti mora na kupalištima obično prepuštamo našoj subjektivnoj procjeni, ali ono što se nalazi u moru i koliko je to opasno po nas to uglavnom ne vidimo i relativno slabo poznajemo. A zapravo radi se o mikroorganizmima koji mogu imati ozbiljne posljedice za naše zdravlje. Od njihove množine primarno ovisi kvaliteta mora za kupanje.

U radu je prikazana sanitarna kvaliteta morskih plaža provedena tokom 1997 godine, na obali i otocima Republike Hrvatske, a prema zahtjevima koje propisuje svjetska zdravstvena organizacija (WHO) World Health Organization i Uredba Vlade Republike Hrvatske.

Ključne riječi: sanitarna, kvaliteta, mora, bakterije, plaže, obala, otoci, Hrvatska.

INTRODUCTION

Tourism at the Adriatic Sea has a hundred-years-old tradition. From the 1960's on it became a mass movement, on the east and west coast equally.

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Of all the countries gravitating towards the Adriatic Sea, Croatia has the longest and the most attractive coast.

Croatia is par excellence a marine country with almost 718 islands. Only 150 are inhabited. The territorial part of the coast is 1778 km long, while islands are distributed at a length of 4012 km. Besides Greece; Croatia has the most indented coast in Europe. Surface area of the sea belonging to Croatia amounts to 62% of the territorial part (56 538 km²).

Average temperature of sea water in July and August is 23.3° C, and average air temperature is 24° C. Differences between sea water temperatures in north and south Adriatic are negligible, on the east and west coast alike Sekulić and Pećar - Ilić (1997).

Croatia, especially the coastal area, has enormous tourists potential. A unique coast with a great number of bays and beaches, pleasant, climate, high number of sunny hours (over 2600 per year), well developed infrastructure and tourist facilities, natural and cultural heritage, easily accessible and sheltered ports and marinas, and clean sea water makes Croatian coast an ideal place for relaxation and recreation.

Before the Serbia war attack on Croatia, for instance in 1986, Croatia had an impressive number of 63.5 million night accommodations during summer. Foreign tourists' share was 63%. Almost half a million tourists were coming from Great Britain (4.1 million night accommodations) and 2 million guest from Germany (17 million night accommodations). Last year, 1997, there were 28.5 million night accommodations, which is two times more than two years before!

Tourism is explicitly seasonal. Out of the total number of stays during one year, over 60% are realized in July and August. Average duration of stay is c/a 6.7 days (SGH, 1991); (DSZ, 1997); Sekulić and Pećar - Ilić (1997).

CONTRIBUTION OF THE REPUBLIC OF CROATIA TO PROTECTION OF THE ADRIATIC SEA AND ITS SURROUNDINGS

Cleanliness and rational utilization of biological resources of a closed aquatorium, such as the Adriatic Sea, are the responsibility of all countries that gravitate towards that area (Slovenia, Bosnia and Herzegovina, Montenegro and Albania, and particularly Italy and Croatia), that own the greatest part of the coast and the economies of which have the most significant benefits from that area, especially regarding tourism.

All countries, within their economic capabilities, carry out a continuous monitoring of research and control of this aquatorium, so that a huge material on the Adriatic Sea has been collected up to now.

From the 1970's until today, a huge number of papers, studies and scientific theses covering all aspects of research and protection of the Adriatic sea have been published in bibliographies (UNEP, 1981 and UNEP, 1993). Naturally, a large number of these works refers to the sanitary quality of the sea.

The first strategy of environmental protection of the Adriatic area in the Republic of Croatia was elaborated in 1976; the next one was issued in 1986, and the last one, in 1996, puts a special emphasis on research and protection of the Adriatic Sea in compliance with provisions of the London Convention, 1972, Barcelona Convention on Protection of Mediterranean, 1976 and 1980, and the UNEP Programme (United Nations Environment Programme) on protection of regional seas, 1974. Besides these docu-

ments and programs, the newest document on preservation of biological diversity, created as the result of the UNCED International Conference (United Nations Conference on Environmental Diversity), held at Rio de Janeiro in 1992, should be pointed out. All these international acts that Croatia has signed, besides a number of other provisions in the field of research and protection of the Adriatic Sea, are the constituent part of guidelines for Croatian strategy and its obligation to implement them.

In November 1993, in Malta Croatia received a Clean Seas reward (gold medal).

The results acquired by the study of sanitary quality of the sea, carried out at the end of 1997, prove that the reward went into the right hands (DUZO, 1977).

Ecological quality of the Adriatic aquatorium is presently evaluated to be at an enviable level. Inputs of hydrocarbon and heavy metals have been significantly reduced. Treatment of wastewaters on the land, before discharge into the recipient, becomes a necessity, not only in big towns, but also in minor settlements that must maintain an adequate quality level of their aquatorium because of tourism. Significant investments have been made for acquisition of ships and equipment for the purpose of assistance in the event of accidents at sea, and special services for surveillance of safety and providing help to navigation experts.

SETTLEMENTS AND THEIR IMPACT ON ECOLOGICAL QUALITY OF THE SEA

There are 290 settlements, with a total of 920 000 inhabitants, along the coast and on the islands. More than 65% of inhabitants live in 6 major coastal towns (Pula, Rijeka, Zadar, Šibenik, Split and Dubrovnik). The remaining 280 000 inhabitants live in the 284 settlements. These data most clearly lead to conclusion about the main sources of pollution of the Croatian part of the Adriatic Sea. Therefore, out of total input of various substances into the sea, almost 70% belong to these 6 towns.

Total inflow of substances by natural waters, as well as human-induced input of all substances into this aquatorium is presented in the papers by Sekulić (1996) and Sekulić & Vertačnik (1997).

Although the strongest emphasis has been put on its northern, the most endangered part, it must be pointed out that although the quantities in question are not small, they are nevertheless far from being disastrous for the Adriatic Sea.

It is true that rivers Po and Adige are the main sources of input of organic substances and pollutants into the northern Adriatic, but recent research indicate that a huge quantity of sediments and suspended matter brought into the sea by these rivers is the main barrier for further distribution of pollutants and that more than 95% of substances remain in the narrowest littoral zone. As a result of that, even at points of largest inflows, the concentration level in the sea for particular chemical parameters does not show increased concentrations (Sekulić, 1996).

PHILOSOPHY OF ECOLOGY AND ENVIRONMENT PROTECTION IN TODAY'S WORLD

Although seas and oceans remain the main recipients of all human-induced and natural inflows of substances, one must be aware of the fact that the receiving capacity of the recipient (seas and oceans) is for orders of magnitude higher than total inflow of

substances created by the civilization up to now. It does not mean that anything can be dumped into the sea uncontrolled, and at any place, but the most important fact is that with the aid of contemporary technologies it is possible to reduce all waste to legally accepted quantities and concentrations, so that effects of inflows would be acceptable at local levels as well. Of course, that requires significant financial means.

Governments of all countries in the world, particularly the ones whose economic growth up to now was based on the principle of profit at any cost, must understand now that preservation of the environment costs as well, and that much bigger financial resources must be allocated for this purpose than it was the case up to now. When at least one-third of financial resources presently used for armament be allocated for environmental protection, situation on micro, medium and macro levels of environment will start to improve, along with quality of our awareness.

Because of the pressure made by the public opinion and warnings of scientists, situation on global, and even on local levels is gradually changing, but huge damages done to the environment as a result of ruthless race for profit are unfortunately still present and it will take significant knowledge, financial means, good will and time to solve this problem.

Unfortunately, environmental protection programs of the biggest and the most developed countries in the world partially cover less than 20% of their territories, to say nothing of developing countries and undeveloped countries, from which the "big ones" during the last 50 year have been taking immense natural resources!

Homo Sapiens must finally understand that nature is not a playground for his senseless games. It is eternal, and human beings are it's ephemerally!

BACTERIA IN THE SEA

It is well known that waste waters of antropogenous origin, and natural waters (rivers, underground waterflows and surface washing) bring from the land into the sea various substances: nutrients, carbon oxides, detergents, pesticides, heavy metals, suspended matters, but also a huge quantity of fecal microorganisms of human or animal origin. Quantities of these pollutants in the sea depend on technology of purification of these waters on land. Furthermore, it is well known that the quality of coastal sea is largely dependent on whether these substances are discharged into the sea-recipient through adequately placed underwater discharge systems with diffusers, where effluents are evenly dispersed by sea currents, or through discharges placed directly on the coast. According to that, one can expect higher or lower pollution of the coastal water, especially beaches.

Although there is a huge number of microorganisms in the sea, the so-called marine heterotrophic bacteria that have an important role in organic carbon cycle, their presence is not a threat for people.

In surface layer of northern Adriatic and in closed aquatoriums where organic substance inflow is significant, their abundance ranges between hundred of thousands to million cells in 1 ml of seawater (Karner at al., 1992). The abundance of marine heterotrophic bacteria gradually is reduced with depth, depending on quantity of organic substance present in the watercolumn, as well as on sea currents (Valiela, 1995; UNEP, 1988).

Presence of pathogenic bacteria originating from human and warm-blooded animal feces (e. g. strains of *Salmonella*, *Shigella*, *Leptospira*, enteropathogenic *Escherichia coli*, *Vibrio*, *Pasteurella*), as well as human enteric viruses, in the seawater are more significant for sanitary quality of the coastal waters. However, the isolation and identification of pathogenic organisms (a threat to the bathers and swimmers on the beaches) remain too cumbersome for routine control of sanitary quality of recreational waters. Therefore, the World Health Organization introduced - indicators of fecal pollution (e. g. bacteria named as: total coliforms, fecal coliforms and fecal streptococci) in the assessment of the sanitary quality of recreational waters (UNEP/WHO, 1983) and recommended the maximum allowed levels of the indicators as a standard of quality of sea beaches. Following WHO/UNEP (1983) recommendations and EEC (1976) standards, the Republic of Croatia also established standards for sanitary quality assessment of seawater at beaches by the federal law (NN, 1996).

Thus the legal Decree stipulates criteria that must be met by all local administration bodies regarding control and protection of bathing facilities on the coast, see Table 1.

Table 1. Requirements for sea quality at beaches regarding the number of enteric microorganisms in the seawater samples

Total quantity of coliform bacteria in 100 ml	500 (in 80% of samples) 1000 (in 20% of samples)
Fecal coliform bacteria in 100 ml	100 (in 80% of samples) 200 (in 20% of samples)
Fecal streptococcus in 100 ml	100 (in 80% of samples) 200 (in 20% of samples)
Enteroviruses	0
Salmonellae	0

Source: NN (1996)

See Table 3. and Figure 1.

N. B. Besides above listed criteria, the Decree stipulates all other indicators of seawater quality at bathing facilities (beaches), such as the visible color, clearness, visible mineral fats, suspended waste substances, opacity, pH, liquefied oxygen, nitrogen, enteroviruses and Salmonellae. Furthermore, the law prescribes basic meteorological conditions that must be fulfilled at collecting samples and registering general appearance of the sea.

Enteric bacteria that are either pathogenic or used as sanitary indicator organisms (coliforms, streptococcus) are not well adapted to conditions within aquatic systems. As such, the transient or allochthonous microbiota are more susceptible to the ambient physical and chemical factors than autochthonous aquatic microorganisms that are adapted within some aquatic environment (Valiela, 1995). Potential stress's include a range of environmental factors, e. g. temperature and organic matter (Fuks and Devescovi, 1989), light irradiation (Fuks et al., 1989; Davies-Colley et al., 1994), salinity and pH (Carlucci and Pramer, 1959), or combined effects (Šolić and Krstulović, 1992). Furthermore, dilution of sewage discharged into coastal waters can reduce bacterial contamination. However, the fecal bacteria, including pathogens, as well as enteroviruses, may survive for days, months, or longer (Fuks and Devescovi, 1984) in an adjacent coastal waters.

Although the tests for detection of fecal pollution indicator presence in the seawater are standard, they are nevertheless subject to certain limitations regarding indication of actual pathogen presence in the same samples. In spite of the fact that waste

waters of human origin contain a far greater number of nonpathogenic *Escherichia coli* (indicator organism) than pathogenic organisms, it is essential to periodically control the quality of water by tests for detecting pathogenic forms of microorganisms, particularly *Salmonella typhimurium*, since it survives more than one day in seawater. A case typhoid epidemic in California 1965, when quantities of *Salmonella* were even 10 times greater than *E. coli* can serve as an appropriate illustration (Simić, 1988).

Therefore, the relevant provisions in Croatia stipulate a regular control of content of pathogenic microorganisms at beaches, if the number of indicator bacteria exceeds the prescribed limits.

SANITARY QUALITY OF THE SEA IN THE REPUBLIC OF CROATIA

Quality control of seawater at beaches is carried out at the entire Adriatic coast by competent authorities. Frequency of sampling is 5 to 10 times a year.

In compliance with provisions of the Decree, all meteorological and hydrological parameters are taken into account at sampling, and the number of collection points grows every year. A significant improvement of water quality at beaches has been noticed as compared with the previous seasons (Table 2). These improvements resulted mainly due to partly or complete (e. g. Split area) restoration of sewage discharge systems and/or more efficient treatment of wastewater on land, before releasing into the recipient. If one compares results from 1980's (Table 2), according to one of the most sensitive indicators applied in 1997. Quality assessments (see Table 1), they show significant improvement of sanitary quality of seawater at the beaches, see Table 3.

Table 2. Sanitary quality of the coastal sea at selected settlements from 1983. to 1986. year

Year	1983.		1984.		1985.		1986.	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Rovinj	23.3	1.6	19.6	1.8	15.3	3.6	14.3	3.6
Pula	N. D.	N. D.	7.3	0.0	23.6	6.4	13.6	7.9
Rijeka	N. D.	N. D.	39.4	33.3	30.0	6.1	30.3	9.1
Šibenik	N. D.	N. D.	13.0	0.0	26.4	9.4	18.8	3.1
Split	32.3	18.9	32.7	20.0	42.3	17.3	80.9	69.1

Source: UNEP (1988.)

N. D. = no data

Samples (%) exceeding: (1) 100 fecal coliform bacteria and
(2) 1000 fecal coliform bacteria in 100 ml of seawater.

During 1997. more than 85 beaches on the coast and on the islands were inspected, and c/a 7200 samples were collected therein.

Table 3. Provides a list of settlements and beaches, respectively, from northern to southern part of Croatian coast. Besides the list of settlements, the Table 3. contains the total number of night accommodations realized during last year and number of native inhabitants.

Quality level of bathing facilities is classified in categories I to VI depending on percentage of samples that do not comply with standards stipulated by the Decree.

Table 3. Sanitary quality of seawater at beaches along the Croatian Adriatic coast in relation with percentage of seawater samples which do not satisfy the Standards set by the Decree

Number of Settlements	Settlements (beaches)	Number of samples	Number of samples which do not satisfy the Decree standards	% of samples which do not satisfy the Decree standards	Quality class 0.0-0.9%=I 1.0-5.0%=II 5.1-10%=III 10.1%-15%=IV 15.1-20%=V over 20%=VI	Total number of night accommodations in 1997. (in thousands)	Number of inhabitant in the settlements (1991)*
1	Umag	310	7	2.3	II	636	4838
2	Novigrad	110	0	0	I	412	2522
3	Poreč	300	5	1.7	II	2261	7585
4	Vrsar	170	2	1.2	II	1245	1624
5	Rovinj	310	13	4.2	II	1763	12910
6	Pula	170	2	1.2	II	922	62378
7	Medulin	290	2	0.7	I	733	1885
8	Mošćenička Draga	24	0	0	I	133	472
9	Lovran	48	3	6.3	III	131	3640
10	Opatija	184	27	14.7	IV	753	9073
11	Rijeka	168	36	21.4	VI	211	167964
12	Kostrena	32	0	0	I	17	1350
13	Kraljevica	72	3	4.2	II	107	2987
14	Crikvenica	176	6	3.4	II	475	5673
15	Novi Vinodolski	77	3	3.9	II	242	3851
16	Mali Lošinj	129	4	3.1	II	865	6566
17	Cres	86	1	1.2	II	272	2234
18	Krk	35	1	2.9	II	394	3022
19	Punat	35	1	2.9	II	396	1696
20	Baška	30	0	0	I	575	816
21	Malinska	36	1	2.8	II	318	999
22	Omišalj	44	0	0	I	112	1554
23	Rab	110	3	2.7	II	226	592
24	Senj	188	3	1.6	II	24	5998
25	Karlobag	65	0	0	I	35	467
26	Novalja	207	2	1	II	280	1912
27	Pag	25	0	0	I	105	2421
28	Vir	19	0	0	I	24	860
29	Privlaka	9	0	0	I	27	2988
30	Nin	55	1	1.8	II	17	1692
31	Ražanac	43	0	0	I	13	1039
32	Zadar	178	2	1.1	II	226	76343
33	Preko	37	0	0	I	19	1759
34	Kali	8	0	0	I	6	2245
35	Kukljica	8	0	0	I	5	868
36	Sali	44	0	0	I	23	1190
37	Sukošan	9	0	0	I	39	2275
38	Sv. Filip Jakov	198	0	0	I	77	1645
39	Biograd n/m	24	0	0	I	200	5315
40	Pakoštane	32	0	0	I	160	2155

Number of Settlements	Settlements (beaches)	Number of samples	Number of samples which do not satisfy the Decree standards	% of samples which do not satisfy the Decree standards	Quality class 0.0-0.9%=I 1.0-5.0%=II 5.1-10%=III 10.1%-15%=IV 15.1-20%=V over 20%=VI	Total number of night accommodations in 1997. (in thousands)	Number of inhabitant in the settlements (1991)*
41	Pašman	25	0	0	I	35	452
42	Tkon	9	0	0	I	4	752
43	Pirovac	30	2	6.7	III	53	1513
44	Tisno	110	5	4.5	II	75	1431
45	Vodice	100	5	5	II	229	5050
46	Šibenik	166	3	1.8	II	163	41012
47	Primošten	40	0	0	I	186	1745
48	Rogoznica	30	1	3.3	II	26	825
49	Marina	30	0	0	I	10	879
50	Seget Donji	9	0	0	I	205	2334
51	Trogir	150	0	0	I	32	10266
52	Kaštel Stari	99	1	1	II	23	5354
53	Split	180	1	0.6	I	110	189388
54	Dugi Rat	70	2	2.9	II	2	3164
55	Omiš	86	1	1.2	II	46	6079
56	Brela	30	1	3.3	II	202	1483
57	Baška Voda	50	4	8	III	275	1609
58	Makarska	43	4	4.7	II	367	11743
59	Tučepi	20	0	0	I	168	1760
60	Podgora	40	2	5	II	126	1452
61	Gradac	39	2	5	II	138	1196
62	Komiža	21	0	0	I	40	2032
63	Vis	30	0	0	I	42	1932
64	Maslinica	20	0	0	I	60	69
65	Milna	20	1	5	II	13	875
66	Sutivan	20	1	5	II	17	641
67	Supetar	60	0	0	I	230	2568
68	Postira	44	0	0	I	22	1287
69	Pučića	20	1	5	II	3	1706
70	Selca	50	4	8	III	18	1117
71	Bol	56	2	3.6	II	286	1478
72	Hvar	90	2	2.2	II	302	3643
73	Starigrad	40	2	5	II	76	1836
74	Jelsa	30	1	3.3	II	139	1792
75	Vela Luka	40	5	12.5	IV	138	4464
76	Smokvica	10	0	0	I	16	1125
77	Korčula	80	5	6.3	III	203	3232
78	Lastovo	40	2	5	II	3	734
79	Orebić	40	3	7.5	III	208	1489
80	Govedari	70	3	4.3	II	36	179
81	Ploče	20	4	20	V	6	6332
82	Slivno	40	4	10	III	29	512

Number of Settlements	Settlements (beaches)	Number of samples	Number of samples which do not satisfy the Decree standards	% of samples which do not satisfy the Decree standards	Quality class 0.0-0.9%=I 1.0-5.0%=II 5.1-10%=III 10.1%-15%=IV 15.1-20%=V over 20%=VI	Total number of night accommodations in 1997. (in thousands)	Number of inhabitant in the settlements (1991)*
83	Ston	70	1	1.4	II	44	581
84	Dubrovnik	300	23	7.7	III	551	49728
85	Cavtat	50	1	2	II	160	1930

Source: (DUZO, 1997).

* Census of inhabitant (1991) Republic Department for statistics, Documentation 881, Zagreb, 1992.

Level of quality: See Table 1. and Fig. 1.

I the sea with a high quality for bathing

II - III the sea is very good for bathing

IV - V the sea is goog for bathing

VI the sea is not for bathing

Data in Table 3. clearly show that sanitary quality of beaches in settlements on Croatian coast is at enviable level. Almost 39% of beaches satisfy standards for highest degree of cleanness of seawater, 47% is classified as very good, and only 14% falls into the category of good beaches. Only in Rijeka it was found out that more than 20% of total number of samples does not satisfy the standards set by the Decree. (See Table 1).

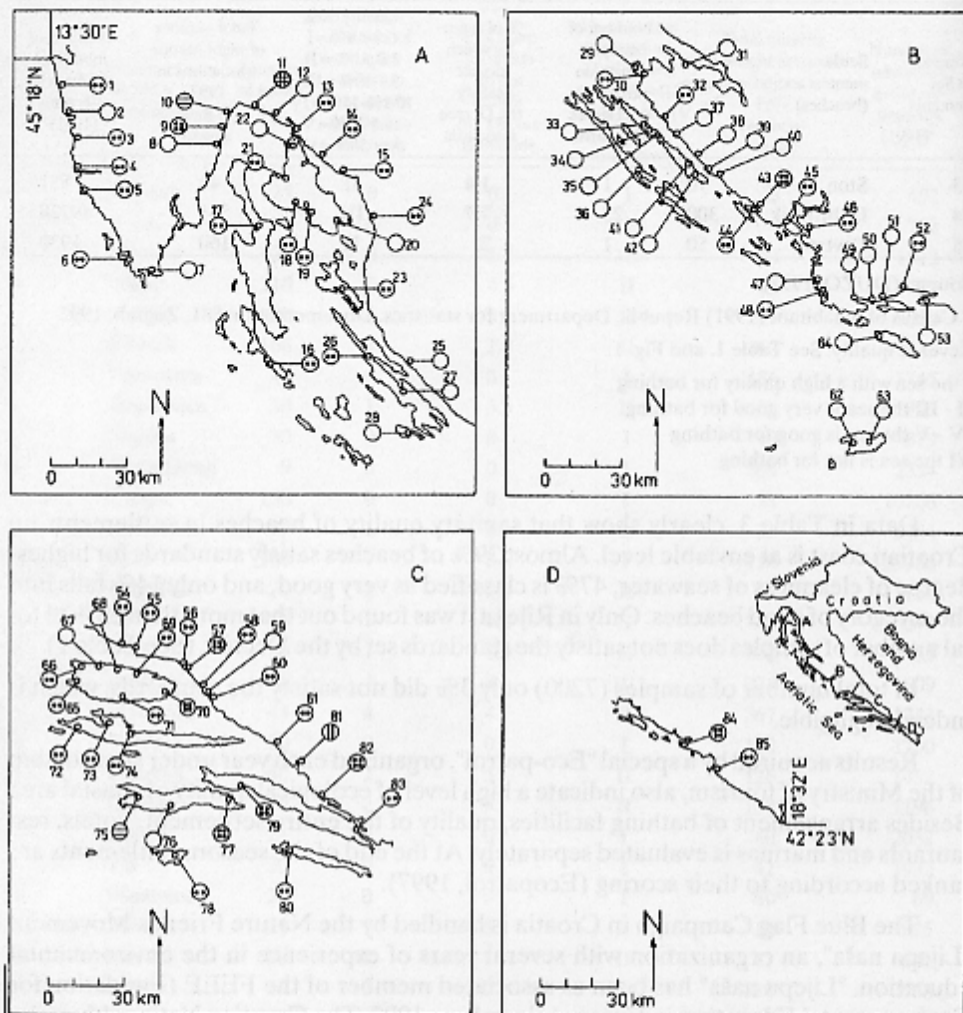
In total number of samples (7200) only 3% did not satisfy the standards, which is indeed negligible.

Results acquired by a special "Eco-patrol", organized each year under sponsorship of the Ministry of tourism, also indicate a high level of ecological quality of coastal area Besides arrangement of bathing facilities, quality of the entire settlement, hotels, restaurants and marinas is evaluated separately. At the end of the season, settlements are ranked according to their scoring (Ecopatrol, 1997).

The Blue Flag Campaign in Croatia is handled by the Nature Friends Movement "Lijepa naša", an organization with several years of experience in the environmental education. "Lijepa naša" has been as associated member of the FEEE (Foundation for Environmental Education in Europe) since June 1997. The Croatian National Jury decided to nominate three beaches: Crikvenica, Brela and Baška and two marines: ACI Split and Punat (island of Krk), for the European Jury. Criteria for the Blue Flag is broad and very strict. Sanitary quality is very important, but there are only one of them. The international standard will be dictating, in future, a long way for entirely environmental quality for our beaches!

Physical distribution of sanitary quality levels of seawater at beaches along the coast and on the islands in given in Figure 1.

It should be pointed out that this review of sanitary quality at beaches is not constant. It varies depending on place and time of sampling. Although the main cause of bacteriological seawater pollution is mainly due to inadequately established distribution of waste water of human origin, it should be pointed out that other factors are responsible for quality of beaches as well: total number of domicile inhabitants, crowdedness of bathing facilities, prevention of bringing pets to beaches, adequate



Percentage of the samples of coliforms in the sea and the quality of water

%	CATEGORY	SIGN	LEVEL OF QUALITY
0.0 - 0.9	I	○	<i>excellent</i>
1.0 - 5.0	II	⊙	<i>between excellent and very good</i>
5.1 - 10.0	III	⊕	<i>very good</i>
10.1 - 15.0	IV	⊖	<i>between very good and good</i>
15.1 - 20.0	V	⊗	<i>good</i>
> 20.0	VI	⊕	<i>over regulation</i>

Fig. 1. Sanitary quality of the Adriatic Sea on the beaches of Croatia in 1997 year (See Table 1. and Table 3.)

Sl. 1. Sanitarna kvaliteta Jadranskog mora na obalama Hrvatske 1997. godine (Vidi Tab. 1. i Tab. 3.)

number of soundly built sanitary systems at beaches, sudden summer showers that can input a significant quantity of organic pollutants into the water and a number of other factors.

All public bathing facilities should have an easily noticeable sign, providing information on quality of seawater from microbiological aspect. Thus, just as each hotel is given a certain number of stars, according to its quality, beaches should also be classified according to equipment and sanitary quality of the sea. Why? Because we visually notice macro details in our environment and make our subjective judgment on their harmfulness, while we are neither able to neither notice microbiological parameters nor make a rational conclusion on them, but we can nevertheless bear consequences of their presence.

CONCLUSION

For each country, sea is one of the most precious natural resources. Among other benefits, tourism is certainly one of most important ones. After the World War II, it became a mass movement, gathering people from all around the world in search of fun and relaxation. It is estimated that, in Mediterranean region alone, more than 1.0 billion night accommodations are realized annually.

Tourists' requirements for quality environment, including clean beaches, get stronger every year. The Blue Flag, introduced as an awarded for beaches and marinas in 19 European countries, for examples.

Croatia has a small share of global tourist distribution, but it nevertheless makes a huge contribution regarding protection of the sea. As a result of these efforts, Croatia was awarded a golden medal in Malta, 1993 ("Clean Seas", 1993). This paper gives a review of sanitary quality of seawater at our coast, which clearly shows that sea in Croatia is of high quality and that it should be, as such, protected from all forms of pollution.

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SAŽETAK

Sanitarna kvaliteta Jadranskog mora na hrvatskom priobalnom i otočnom prostoru

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Više od 60% svjetske populacije živi u obalnoj zoni širokoj nekoliko desetaka kilometara od mora. Ovaj broj do 2020. godine narast će na gotovo 70%. S druge strane, preko 70% zagađenja mora dolazi od strane kopnenih izvora što za najuži litoral predstavlja strahovito opterećenje i opasnost. SAD unaša u priobalno more 20⁹ m³ otpadnih voda godišnje (dvadeset milijardi)! Što je 27 puta više nego li cjelokupni godišnji unos u Jadran (zapadna i istočna obala)! Stoga nije čudo da je tokom 1995. godine u Sjedinjenim državama zatvoreno 3500 plaža jer su iste postale neupotrebive za kupanje.

Ljeto je godišnje doba kada najveći broj ljudi izabire plaže kao mjesto odmora. Sanitarna kvalitetna plaža ovisi prvenstveno o kvaliteti ispusta otpadnih voda s kopna, iako su za kvalitetu mora na plažama odgoverni i drugi faktori: čistoća okolnog prostora, unos zagađivala u more od strane površinskog spiranja s kopna, donos otpada s otvorenog mora te konačno zdravstveni status samih kupaca. Od goleme količine otpada koji svake godine završi u moru oko 180 tisuća dobrovoljaca sa oko 3100 naselja duž obale SAD pokupi s plaža oko 1750 tona otpada svake godine. Po jednoj miljii prikupi se oko 5 tona otpada! Ovaj primjer mogli bi slijediti i mi za našu obalu, a uvelike bi pridonio poboljšanju oko svijesti naših mladih i kvaliteti očuvanja okoliša.

Sanitarna kontrola kvalitete naših plaža i marina obavlja se desetljećima. Ona je jedan od bitnih indikatora zdravstvene sigurnosti kupaca. Tako se i u ovom radu daje pregled provedene sanitarne kvalitete mora tokom 1997. godine obavljen od strane znanstvenih institucija, a pod pokroviteljstvom Državne uprave za zaštitu okoliša Republike Hrvatske (Odjela za zaštitu Jadrana - Rijeka). Sanitarna kvaliteta obavljena je na 85 plaža duž naše obale pri čemu je obrađeno oko 7200 uzoraka. Obradeni rezultati ukazuju na visoku sanitarnu kvalitetu mora. Samo 3% od ukupnog broja uzoraka ne odgovara standardima sanitarne kvalitete plaža ili 20% uzoraka na datom lokalitetu ima više od 200 fekalnih streptococa u 100 ml morske vode. U radu se sugerira da pored analize indikatorskog organizma *Escherichie coli*, sanitarnu kvalitetu mora trebalo bi provoditi i na patogene organizme s obzirom na njihovo znatno duže preživljavanje u moru u odnosu na coli bakterije.

Iako najveći broj naših priobalnih naselja nemaju adekvatno riješenu distribuciju otpadnih voda ipak se stvari u zadnjih par godina počinju mijenjati, na bolje! Jadran je proglašen najčišćim morom na Mediteranu! Njemačkom automobilskom organizacijom ADAC potaknuto je niz akcija u vezi kvalitete mora (plaža i marina) u smislu dobijanja plave zastave, najviše ocjene tzv. plavog turizma. Sve ovo upućuje da se pristup eko kvaliteti, ne samo mora već i okolnog prostora popravija.

Poticaž za očuvanjem okoliša osobito plaža i marina dala je DUZO (Državna uprava za zaštitu okoliša) Republike Hrvatske putem udruge Pokreta prijatelja prirode "Lijepa naša" Zagreb, koja je lipnja 1997. godine postala članom FEEE (Foundation for Environmental Education in Europe). Propozicije za ovu golemu akciju diljem 19 evropskih država utvrdila je FEEE. Iste su svrstane u četiri kategorije kojima trebaju udovoljavati sve plaže i sve marine koje se natječu za plavu zastavu. Kategorije uključuju: obrazovanje i informiranje o okolišu, gospodarenje okolišem, kakvoću vode-mora te sigurnost i usluge. Svaka kategorija ima nužna i preporučena mjerila kako za plaže tako za marine. Godine 1998 tri plaže: Crikvenica, Brela i Baška (na Krku) te marine: ACI Split i Punat (na Krku) ispunili su FEEE uvjete te dobili plavu zastavu! Ove godine nacionalni ocjenjivački sud Hrvatske kojeg čine predstavnici Pokreta prijatelja prirode "Lijepa naša", Ministarstva prostornog uređenja, Agencije za posebni otpad te INE predložio je, poštivajući navedene kriterije FEEE, pet plaža te osam marina za plavu zastavu (uključujući prošlogodišnje nosioce plave zastave). Međunarodni ocjenjivački sud može jednom dobijenu plavu zastavu oduzeti, ako iduće sezone nisu zadovoljeni svi kriteriji. Dakle, jednom dobijenu zastavu svaka plaža i marina mora svake turističke sezone opravdati održavanjem postignute kvalitete u okolišu!

Akciju koju provodi FEEE za 19 evropskih zemalja za svaku je pohvalu. Time se želi zaštititi okoliš i dati dodatna sigurnost turistima, uključujući jasno, sanitarnu kvalitetu voda-mora. Želimo li opravdati naziv najčišćijeg mora na Mediteranu trebamo doista puno poraditi na adekvatnoj distribuciji otpadnih voda i saniranju svakojakog otpada kako bi broj plavih zastava na našim plažama i u marinama bio čim veći.

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