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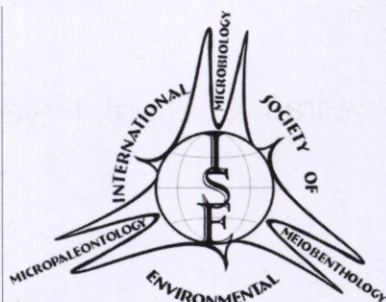


# The Fifth International Conference “Environmental Micropaleontology, Microbiology and Meiobenthology”

EMMM'2008

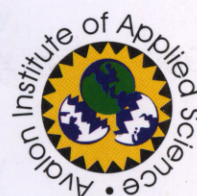
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## REGARDING DEGRADATION OF THE BACTERIONEUSTON IN THE BLACK SEA

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### INTRODUCTION

The Black Sea was exposed to extremely intensive pollution in the 70–80th years of the 20th century. The surface of the sea, especially in the Black Sea ports, has been most strongly subjected to the influence of various kinds of pollution, and mainly, crude oil. So, for example, dumping of crude oil and other polluting substances from the ships and the coastal drains were constantly observed in Sevastopol Bay. The crude oil spread on the surface when it hit the water, and, hence, changed the physical structure and chemical compound of the surficial film and its tension. Pollution of the surface of the sea was commonplace in the Haliç's areas of the Black Sea and at the coast of the Crimea peninsula. However, the level of pollution of the central part of the sea was sometimes less than in the bays and the coastal areas (Gubanov, Klimenko, 1996). As a whole, the pollution rendered a negative influence on the bacterioneuston reducing the number and a variety of kinds (Zaitsev, Polikarpov, 2002). As it is known, the bacteria living in the superficial microlayer (SML), represent the most numerous bacterial population of reservoirs (Krasilnikov *et al.*, 1973; Tsyban, 1970). Microbiological researches in the northwest part of the Black Sea in 60th years of XX century were made by Tsyban (1970). The author has shown the total abundance of bacteria on an interface of the sea – and atmosphere (bacterioneuston) in comparison with water thickness (bacterioplankton). Researches have not revealed the maximal number of bacterioneuston in the northwest part of the Black Sea at the beginning of 1990th years (Teplinskaya, Kovaleva, 2006). The authors have not found the other data concerning the research of the Black Sea on the given problem. The purpose of the study is to show evidence of the degradation of the bacterioneuston in the Black Sea.

### METHODOLOGY

The study of the abundance of the marine bacteria in the Black Sea (Figure 1), including research in Sevastopol Bay, was carried out during the period from 1979 to 1991; in Kazachya Bay in 2004.

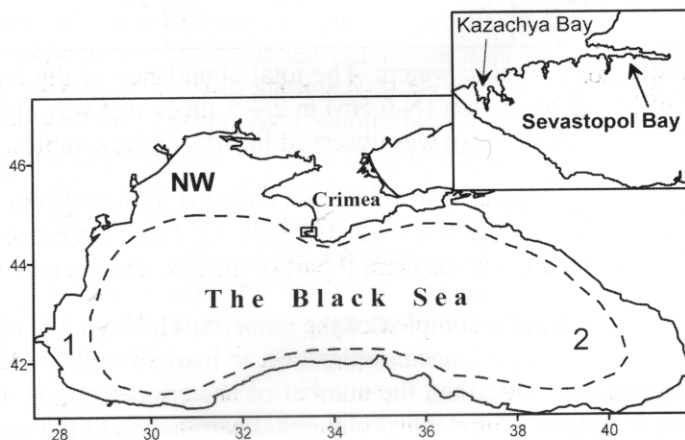


Figure 1. The Black Sea: NW- north-western part, 1-coastal part, 2-central part.

The total abundance of bacteria (TA), the abundance of heterotrophic bacteria, and the various groups of hydrocarbon-oxidize bacteria have been determined. The TA was carried out by Razumov's direct method, and the abundance of heterotrophic and hydrocarbon-oxidize bacteria

was determined by the method of the limit dilution (Management on methods of the biological analysis of the sea water and the ground adjournment, 1980). The analytical volume was 1321 samples. The samples of sea water were selected from the SML (150 – 200  $\mu$ m), superficial (0 – 0.5 m) and benthic horizon. A winx bathometer was used for sampling bacterioplankton, and a special network was applied for sampling bacterioneuston. The network had a frame and a kapron fibre cable. First the network touched the surface of the water. Then it was lifted, at the same time a kapron fibre cable was grasped and one corner of the frame was vertically raised upwards. When the cells of a net in the top corner were released from the water, a bottle received the sample of the water. Thus, for accuracy of the analysis, the net portion of the sea water was selected, and the water from a framework was removed (Belayeva, 2003). Statistical processing was conducted using the program “STATISTICA”.

## RESULTS

Results of the research of the central part of the Black Sea show that the TA varied from  $0.34 \times 10^6$  cells/ml up to  $2.9 \times 10^6$  cells/ml, and on the average was  $1.6 \times 10^6$  cells/ml (Table 1).

**Table 1. The bacterial abundance and a correlation of the number of the samples of the bacterioneuston and the bacterioplankton in the Black Sea in 1979 - 1991**

Black Sea	Index	Bacterial abundance (N), cells/ml	Correlation of number of samples, %			Number of samples
			$N_{sml} > N_{0.5m}$	$N_{sml} < N_{0.5m}$	$N_{sml} = N_{0.5m}$	
Central part	TA	$0.34 \times 10^6$ $2.9 \times 10^6$ $1.6 \times 10^6$	70	27	3	290
Coastal part	TA	$0.5 \times 10^6$ $7.16 \times 10^6$ $1.35 \times 10^6$	42	45	13	290
	Abundance of heterotrophic bacteria	$10^3 - 10^6$ $10^3 - 10^4$	30	20	50	316
	Abundance of oil-oxidize bacteria	$0 - 10^5$ $10^2 - 10^3$	26	34	40	206
	Abundance of polychlobyphenil-oxidize bacteria	$0 - 10^3$ $10^2$	35	28	37	134
	Abundance of nathtaline-oxidize bacteria	$0 - 10^3$ 10	10	28	62	59

Such TA is characteristic for eutrophic waters. The total abundance of the bacterioneuston ( $N_{sml}$ ) exceeded the number of bacterioplankton ( $N_{0.5m}$ ) in 2 – 5 times that was observed in 70% of the research samples. An inverse relationship was observed in 27% of the samples.

The total bacterial abundance in coastal part of the sea changed in limits from  $0.5 \times 10^6$  cells/ml up to  $7.16 \times 10^6$  cells/ml and on the average was  $1.35 \times 10^6$  cells/ml. Thus, the range of fluctuation of the abundance of bacteria was more than in the central part of the sea, and average value was less.

It specified an unstable condition of a complex of the bacteria. The high TA of the bacterioneuston in comparison with the number of the bacterioplankton is marked only in 42% of samples. The number of bacterioplankton was more than the number of bacterioneuston in 45% of samples. The percentage parity of the samples with the equal numerical parameters of the specified groups of the bacteria in the coastal part of the Black Sea was 13%. In the central part this parameter was only 3%.

The abundance of the heterotrophic bacteria varied in limits between 103 cells/ml and 106 cells/ml, and on the average was 103 - 104 cells/ml in the coastal part of the Black Sea. The abundance of



the bacterioneuston was more than the abundance of the bacterioplankton in 10 - 100 times and it was observed only in 30% of samples. In 60th years of XX century in the northwest area of the Black Sea the most eutrophic part of the sea, the abundance of the heterotrophic bacterioneuston was in 10 - 1000 times more than in a water thickness and it was marked in 60% of samples (Tsyban, 1970). Thus, for the period from 1960 to 1990 the number of the compared samples has decreased in two times. It is necessary to note, that in 1990th the number of the bacterioneuston and the bacterioplankton had identical values in 50% of samples.

Microorganisms took part in the biological selfpurification of the sea waters from the various chemical compounds coming into the water area of the sea. A study has been made on the number of the bacteria decomposing the various natural and non natural compounds. In the coastal part the amount of the oil-oxidize bacteria averaged 102 - 103 cells/ml. The increased number of bacterioneuston is marked in 26% of the samples. The number of the polychlorbyphenil-oxidize bacteria in average was 102 cells/ml, the naphtalin-oxidize bacteria - 10 cells/ml. Excess content of the bacterioneuston is marked accordingly in 35% and 10% of samples.

A comparative analysis for the samples selected in SML and the benthic horizon in the Sevastopol Bay was carried out. The TA and the abundance of the heterotrophic bacteria, the oil-oxidize bacteria, the polychlorbyphenil-oxidize bacteria and the naphtalin-oxidize bacteria in the SML was more than in the benthic horizon (8 - 20 m) accordingly in 58%, 46%, 25%, 45% and 45% of the samples.

Results of the study of a level of number of the bacteria in the Kazachya Bay in 2004 are submitted in Table 2. Research was carried out in the area of a bay where the storm drains strongly polluted with crude oil acted. Stations 1-3 were situated in the western coast of the bay and the distance between them was 160 m. As a whole, the TA varied from  $1.21 \times 10^6$  cells/ml up to  $5.18 \times 10^6$  cells/ml. The highest values of TA were observed in tests enriched with detritus while the complex of bacterioneuston was in the aggregated condition. The average value of the bacterioneuston was  $2.98 \times 10^6$  cells/ml, the bacterioplankton -  $2.0 \times 10^6$  cells/ml. Thus, the density of the bacterioneuston on average value of the TA number was 1.5 times more than the TA of the bacterioplankton. However, actually, in the same samples (03.07.04) the number of the bacterioneuston was in 1.3 - 2.5 times more than the number of the bacterioplankton, in others (17.08.04) was 1.2 - 1.5 times less. The average abundance of the heterotrophic bacterioneuston varied in limits from 95 cells/ml up to  $9.5 \times 10^2$  cells/ml, the heterotrophic bacterioplankton - from 95 cells/ml up to  $1.5 \times 10^3$  cells/ml. The number of the oil-oxidize bacteria was 10 - 100 times less than the number of the heterotrophic bacteria and made from 0 up to 15 cells/ml. The Kazachya Bay is one of the cleanest bays of Sevastopol. Apparently from the aforesaid, process of the reorganization of the bacterial complex took place in the Kazachya Bay.

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**Table 2. The abundance of bacteria in the Kazachya Bay in 2004**



Station	Date	Horizon, m	TA $\times 10^6$ , cells/ml	Abundance of bacteria, cells/ml	
				Heterotrophic bacteria	Oil-oxidize bacteria
1	03.08.2004	SML	3.42	$9.5 \times 10^2$	0
1	-“-	0-0.5	2.52	$4.5 \times 10^2$	4.5
2	-“-	SML	2.41	-	-
2	-“-	0-0.5	2.45	-	-
3	-“-	SML	5.18	$2.5 \times 10^2$	0.9
3	-“-	0-0.5	2.10	$1.5 \times 10^3$	0
1	17.08.2004	SML	2.39	95	4.5
1	-“-	0-0.5	1.21	$2.5 \times 10^2$	15
3	-“-	SML	1.50	95	4.5
3	-“-	0-0.5	2.24	95	4.5

## CONCLUSIONS

As a whole, results of the research have confirmed the fact of the degradation of the bacterioneuston in the Black Sea during the chronic pollution. It has been established that the high contents of the bacterioneuston were discovered only in 40% samples of the coastal zone. Decrease of frequency of occurrence of the samples with high numerical values of bacterioneuston in the areas of the sea subjected to technogenic pollution is confirmed on the basis of the comparative statistical analysis. The results of the research in the central part of the Black Sea have shown rather high frequency of occurrence of the samples in which the abundance of the bacterioneuston was more than the abundance of the bacterioplankton – 70%. Obviously, in the high sea and in its central part, the degradation of a complex of the bacterioneuston passed more slowly than in most eutrophic coastal areas.

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