

VARIATION OF CERTAIN ENVIRONMENTAL FACTORS IN THE ZONE INHABITED BY MARINE BENTHIC ALGAE ON THE ROMANIAN SHORE OF THE BLACK SEA

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ABSTRACT

The paper presents the results of the observations on certain environment factors, during 1971 in a zone with macrophytic associations on the Roumanian Black Sea shore. The following measurement data are included: light, suspended matter, water temperature, salinity, organic matter, dissolved oxygen, phosphates, and biochemical oxygen demand. All these measurements and observations, correlated with certain data on the biology of some marine benthic algae, particularly of the Cystoseira sp., showed that during 1971, particularly favourable conditions were prevalent on the Romanian sea shore for the increase of the marine benthic algae stock.

The zone populated by marine benthic algae on the rocky infralittoral of the Romanian Black Sea shore, is situated between the Cap Midia and Vama Veche, occupying a strip the width of which is variable while the depth reaches sometimes down to 23 m. This shallow rocky zone represents the preferred habitat of numerous vegetals organisms, with annual or perennial life cycles. The main species of this zone is Cystoseira barbata the brown algae which is preponderant within the association.

In order to learn as much as possible as detailed as possible

about the ecological factors determining the installation of algal populations, of the rhythm of growth and reproduction of this algae, as well as in order to learn the conditions under which the substances of economic value produced by these algae attain their maximum concentrations, during 1971 a series of optical, hydrological and chemical investigations and determinations of the sea water were made.

Materials and methods

The water samples were collected, and the respective analyses of light and temperature measurements were performed monthly on a network of stations at Cap Midia, Constantza, Agigea, Costinești, Mangalia

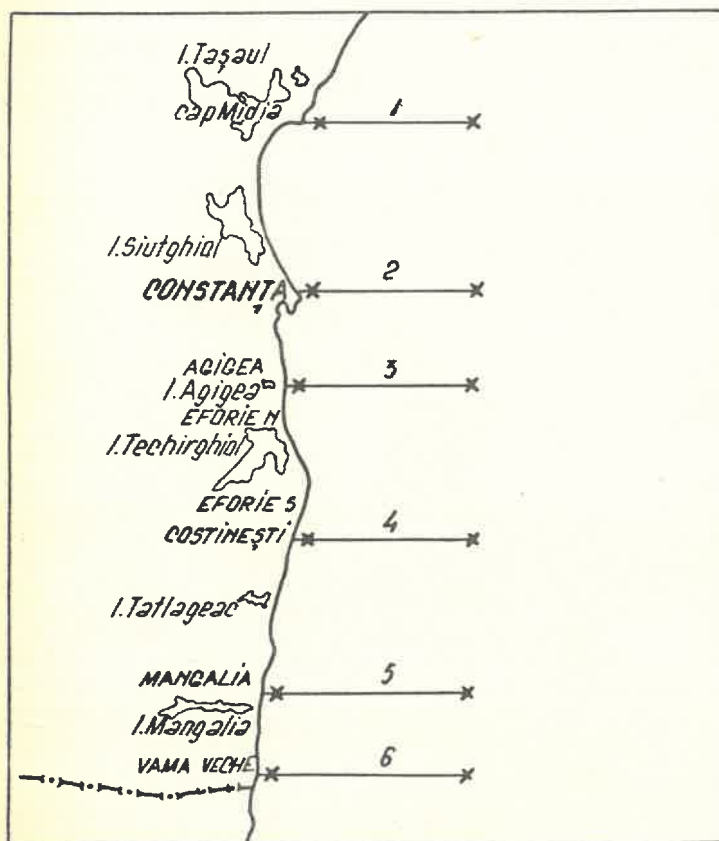


Fig. 1 - Map showing the rocky bottoms along the Romanian Black Sea coast and the localities where samples have been collected

and Vama-Veche, at depth of 5 and 11 m. phytoplankton, 0.031 which greater surements and observations were made at two layers: 0 m and 11 m. (tab. 1).

Table 1

Monthly sea water temperature ($^{\circ}\text{C}$) as recorded along the Midia (1), Constantza (2), Agigea (3), Costinești (4), Mangalia (5) and Vama Veche (6) profiles

Profile	Depth	Month									
		II	IV	V	VI	VII	VIII	IX	X	XI	XII
1	0	4.5	13.00	18.8	18.0	25.0	20.4	16.8	13.0	9.1	5.8
	0	4.5	13.00	18.2	16.8	23.0	20.4	17.2	13.1	9.0	5.3
	10	4.5	11.00	17.0	13.2	23.0	20.5	17.9	14.2	8.8	5.2
2	0	4.5	12.6	17.1	14.8	24.0	20.4	16.9	12.9	9.1	5.6
	10	4.5	11.8	15.8	12.6	20.0	20.4	17.4	13.6	9.2	5.3
3	0	4.5	10.3	17.0	14.6	23.5	20.3	16.8	13.0	8.9	5.5
	0	4.8	10.3	17.0	12.1	23.5	20.4	17.1	13.0	8.9	5.5
	10	4.8	10.3	16.7	12.2	23.0	20.1	17.3	14.0	9.1	5.2
4	0	4.5	10.5	17.1	12.0	24.0	20.5	16.8	13.1	9.3	5.7
	0	4.5	11.1	17.1	12.0	24.0	20.3	17.2	13.0	9.2	5.8
	10	4.6	10.7	16.9	13.0	23.1	20.1	17.4	12.9	9.3	5.5
5	0	4.5	10.5	-	-	23.0	20.1	14.3	13.0	9.3	5.9
	10	4.5	10.0	-	-	23.0	20.1	16.9	14.0	9.3	5.8
6	0	4.5	-	18.0	11.1	-	20.1	14.5	12.3	9.4	5.6
	0	4.5	-	18.0	11.1	-	20.0	14.6	12.3	9.4	5.6
	10	4.6	-	15.5	10.9	-	19.7	17.0	13.5	9.4	5.7

The analyses and measurements performed referred to the following: light, solar radiation ($\text{cal}/\text{cm}^2/\text{month}$), suspended matter (the samples were filtered through ultrafilters with $0,7\mu$ pores), water temperature, salinity, organic matter (determinations were made by the oxidation method with KMnO_4 in neutral medium), dissolved oxygen, phosphates and BOD_5 . Knowing the brackish character of the sea-shore water, the above mentioned chemical analyses were used together with the standard methods of analysis (GENOVESE, E., MAGAZZU G., 1969). For colorimetric measurements the Lange type photocolormeter was used.

Measurements were also carried out on the rate of growth of Cystoseira barbata, as well as tests on how these algae install themselves on the surface of rock boulders placed in the sea.

Light

On the optical properties of the Romanian shore water, a series of papers were published, discussing aspects as: extinction coefficient light penetration into the sea water, transparency and colour (SKOLKA H., 1968; SKOLKA H., & VASILIU FL., 1969). Also interesting correlations were made between the amount of existing caloric energy on the sea surface, the development of phytoplankton, and the thermal regime of the water, between the mass of water and the value of the extinction coefficient (SKOLKA H. 1967, 1969. SKOLKA H., & SELARU O. 1966).

The data comprised in the present paper are supplementing a part of the above aspects for a lesser studied zone, i.e. for the upper, rocky infralittoral zone.

The light extinction coefficient is characterized along the entire interval analyzed by values comprised over a quite large range, from 0,031 to 0.610. These values were frequently encountered also at shallow depths (10-30 m.) along the entire coast (VASILIU FL., 1969). The highest values of the factor, between 0.463 and 0.610, were measured in February, June and July, in the stations off Cap Midia, Constantza, and Agigea. These high values are the results of an increased suspended matter in the respective periods (tab.2). As a consequence of the high suspended matter in such conditions, between 1.4 and 6.0% of the total amount of light which reached the surface of the sea, penetrated down to a depth of 5 m.

In the water of the extreme South of the Romanian coast, i.e. at Costinești, Mangalia, and Vama-Veche, the value of the extinction coefficient was comprised between 0.031 and 0.249. These values are common also for waters situated at a greater distance from the coast (SKOLKA H., 1968; SKOLKA H., & VASILIU FL., 1969). Also the light penetration is neatly different. Thus, at the same depth of 5 m., up 71% of the light which reached the surface of the water, was measured.

All these values explain to a large extent the causes why at the extreme South, at depths down to 10-20 m, we frequently find individual benthic algae as Phyllophora nervosa, Antithamnion cruciatum - an

Table 2

Average values of suspended matter (mg/l) to Midia (1), Constantza (2), Agigea (3), Costinești (4), Mangalia (5) and Vama Veche (6)

Month Profile	II	IV	V	VI	VII	VIII	IX	X	XI	XII
	1	30.0	13.0	18.0	18.3	34.0	21.6	12.3	10.3	22.3
2	28.5	13.0	14.0	15.5	30.5	24.0	15.0	12.5	16.5	10.5
3	23.6	10.3	11.7	10.3	28.7	15.3	12.3	9.7	17.6	8.6
4	29.7	12.6	9.0	14.0	23.3	14.3	12.3	11.0	15.0	12.6
5	30.5	14.4	-	-	35.5	21.5	16.5	15.0	17.3	10.0
6	21.6	-	4.3	8.0	-	14.7	10.3	9.0	11.5	8.5

aspect which is never met in the North, although the rocky substratum is sometimes extending much deeper (MULLER G.I., SKOLKA H., BODEANU N., 1969).

The total amount of solar energy which reached the surface of the sea in 1971 was higher than that of the previous year (table 3).

Table 3

Total amount of solar energy expressed in cal/cm²/month, during 1970 and 1971

Month	Solar energy	
	1970	1971
I	2,746	2,988
II	4,125	4,494
III	8,990	8,497
IV	12,099	12,558
V	14,556	15,000
VI	18,282	17,772
VII	17,629	17,019
VIII	14,830	16,213
IX	11,130	10,494
X	7,443	7,632
XI	3,921	4,221
XII	2,721	2,948
Total	118,482	122,036

From table 3 it may be seen that during the cold months of the biological season, the amount of radiation existing on the surface of the sea is higher. As results from a series of works published on the optimum conditions of photosynthesis of brown algae of the genus Cystoseira, presents in the Black Sea (IATENKO G. K., 1962) the most favourable radiations under optimum temperature conditions (16-18°C) are these comprised between 0.14 and 0.20 cal./cm²/min. From our measurements in the year investigated, down to a depth of 5.5 m - where exemplars of Cystoseira reach down to, 10-20% of total amount of radiation is penetrating, i. e. about 0.09-0.60 cal/cm²/min. Starting from these values and correlating them with those obtained by the Soviet authors mentioned and with our own measurements of the rate of growth of Cystoseira, the conclusions may be drawn that the year 1971 was particularly favourable for the increase of the stock of these algae.

Thus, during the interval October 1970 - October 1971 the algae exemplars spontaneously installed on 0.25 m² concrete areas, reached a height of the thallus of up to 25.5 cm. These are large dimensions, particularly when we compare them with values given by SABININA and SCEAPOVA (1953). From their measurements in certain zones of the Soviet shore, such dimensions are reached by the algae only after 2-3 years. These authors however do not exclude the possibility that under particularly favourable conditions the algae may attain these dimensions also in shorter intervals of time.

Suspended matter

Along the Romanian shore in the shallow water zones, the amount of suspended matter contained in the sea water varies, both with the geographical location of the various sectors analysed (table 2). The lowest values were recorded during May and December.

During May it was found that in the zone under investigation the amount of suspended matter contained in the sea water is gradually decreasing along the shore from North (Cap Midia - 18.3 mg/l) to South (Vama-Veche 4.3 mg/l), the amplitude amounting to 14.0 mg/l.

In December the minimum value measured was 8.5 mg/l at Vama-Veche, while the amplitude of the variation of the suspended matter content along the shore, was much lower, i. e. only 4.1 mg/l.

Other wise, if we analyze the annual average suspended matter from each station, the general tendency to decrease from North to South may be observed. Always, the lowest value were recorded in the extreme South of the Romanian shore.

The maximum content in suspended matter was measured in July, at Mangalia. During the same month, in the other zones the suspensions amounted to 23.3-34.0 mg/l. The amounts of suspended matter in littoral zones (down to 10 m) are exceeding considerably the values measured farther off the coast. Thus, at a distance of about 5 nautical miles,

the maximum amount of suspended matter was 19.2 mg/l (VASILIU FL. 1969), a value representing nearly half of the maximum contents recorded in the littoral zones.

It is known that frequently, in some zones of the Romanian coast, at Constantza, Agigea, Comorova, Vama-Veche, the Sarmatian bottom rocky exceeds 10 m, in depth, thus offering a substratum for the installation of Cystoseira exemplars. Nevertheless, the maximum depth at which such algae were encountered, was 5.5 m., which is a much lesser depth than down to what they reach along the Soviet shore. In this situation, when the temperature of the 0 - 10 m. water column is quite uniform, while nutrients and dissolved gases are abundant, it must be presumed that the high suspended matter content is indirectly limiting the penetration to greater depths of these light-loving algae. Such suspended particles represent a penetration-limiting screen across the path of the light.

Water temperature

An ecological factor of great importance, coordinating and releasing the essential biological processes also in the life of plants, the temperature shows frequent variations with rather high amplitudes in the waters of the littoral zone. Such fluctuations are dependent on the amount of solar radiation which reached on the water surface, on winds and the air temperature.

During the winter months of 1971, the water temperature were higher than in precedent years (SERPOLIANU GH. 1965). Thus, in February, along the six profiles investigated, there were no values lower than 4.5°C, while in 1970, for instance the minimum frequently were as low as 2.0°C. The daily average of temperatures measured at Constantza, Agigea, and Mangalia were between 7.0 - 7.8°C (according to A. MACHITESCU'S unpublished data). The high winter temperatures facilitated, as was observed also at Agigea, a quite intensive photosynthesis of Cystoseira barbata. In December, the temperatures recorded were generally equal to those recorded in other years (CHIRILA V., 1965; SERPOLIANU Gh., and CHIRILA V. 1958), varying, as may be seen from the table 1, between 5.2 and 5.9°C. In their papers M. BACESCU and his collaborators (1967) mentioned by the interval 1961 - 1965, for December an average multiannual figure of 6.59°C.

It is also worthwhile to mention, that the sea surface temperatures are higher than at the 10 m. level, indicating the presence, for December, the period of the measurements, of air masses with quite increased temperatures.

For the spring months (table 1) the water temperatures featured a rising tendency, the temperatures in May reaching as much as 18.8°C (Cap Midia, 0 m.). These high temperatures both in the mass of water and at the surface favoured the accumulation through photosynthesis, of vegetal matter, thus enriching the algae stock on the upper rocky infra-littoral.

An interesting problem worthwhile to be mentioned, is the role of the winds in the dynamics of the water masses in the shallow littoral zones. If we take, for instance as example, the water temperatures recorded during the expedition of June 23, we can observe this decisive role of the winds in the zone under investigation; they favour the transport of near-shore, freshened and warmer water to the open sea, and in stead, from the open sea there are colder amounts of water coming near the coast, featuring higher salt concentration. If, on the profile, off Cap Midia, at 0 m., the water temperature was 18.0°C and 13.2°C at a depth of 10 m., on the last profile, off Vama-veche, after a time of approx. 8 hours, temperatures of 11.1°C and 10.9°C were measured at the surface and at a depth of 10 m. respectively.

Salinity

The non-uniform aspect of the salinity dates from one month to the next, and from one profile to the another, is determined on the one hand by the position of the respective zone under the influence of continental water being discharged into the sea, and on the other hand by the dynamics of the winds causing frequent modifications in the pattern of various types of water masses.

During 1971, the lowest salinity of 9.7 g S‰ was recorded in April (Cap Midia). As a matter of course in April and May, the values representing salinity were the lowest over recorded in the entire period investigated (table 4). In this respect our data are very similar to those recorded in precedent years (CHIRILA V. 1965) for the waters situated between Cap Midia and Constantza. We want to point out that the lowest salinity over recorded during the last ten years was 4.83 g S‰ at Mamaia on April 24, 1963 (BACESCU M, et al., 1967). These low values of the salinity are registered only at the time when the maximal rise of the Danube's water level and the inflow from the coastal freshwater lakes are superposed with the strong north and north - east winds.

The highest salinity of 19.47 g S‰ was found at a depth of 10 m, during June, off Agigea. In the same month, on the other profiles also high salinities were measured, which are ranging between narrow limits of 18.21, and 19.47 g S‰.

High salinity values at the same time more homogeneously distributed, were encountered during October, between 17.25 and 18.58 g S‰, during November, between 17.70 and 18.22 g S‰ and December, between 17.25 and 18.50 g S‰.

With very few exceptions, the salinities measured in the southern part of the coast during all months of the year, were higher than those measured in the North (table 4). These high salinities associated with other ecological factors cause also differences in the distribution of vegetal organisms, macrophytes and microphytes. This is how the presence of certain of Corynophlae umbellata, Corallina mediterranea, Ulothrix pseudoflaccida may be explained, which were identified by Romanian authors

Table 4

Salinity (g S‰) variations as recorded monthly to Midia (1), Constantza (2), Agigea (3), Costinești (4), Mangalia (5) and Vama Veche

Profile	Depth	Month	II	IV	V	VI	VII	VIII	IX	X	XI	XII
1	0		11.38	9.74	11.38	19.22	14.27	17.59	14.87	17.25		17.25
	0		12.65	11.28	13.71	18.40	14.52	17.32	15.12	17.50		17.77
	10		13.41	12.03	15.77	18.95	14.79	17.59	15.12	17.76		18.04
2	0		13.91	10.77	11.91	18.40	14.79	17.85	15.37	18.53	17.43	18.04
	10		14.65	11.28	15.52	18.34	15.12	18.12	15.63	18.76	17.70	18.04
3	0		10.88	11.00	12.94	18.40	14.79	17.59	15.63	18.58	17.70	17.77
	0		11.89	11.00	12.67	18.95	14.52	18.12	15.12	18.28	17.95	17.52
	10		13.15	11.51	13.96	19.47	15.12	18.12	15.63	18.28	17.95	17.52
4	0		12.14	11.28	13.46	18.46	14.79	17.85	15.37	18.03	17.70	17.77
	0		12.90	11.51	13.19	18.21	15.12	18.12	16.15	17.76	17.70	17.77
	10		13.66	13.06	15.26	18.98	17.11	18.64	16.15	18.28	17.95	18.04
5	0		12.14	12.81	-	-	16.30	17.85	16.02	18.28	17.70	18.04
	10		12.39	13.06			16.60	17.85	16.03	18.28	18.22	18.30
6	0		12.14	-	12.85	18.46	-	17.32	14.61	17.50	17.70	17.77
	0		12.14		13.19	18.71		18.12	15.37	18.28	17.95	17.77
	10		13.18		15.52	19.24		18.12	15.63	18.28	18.22	18.04

(SKOLKA H., 1969) in the perimeter comprised between Constantza and Vama-veche. Also the presence of unicellular planktonic algae is specific to waters with various salinities and such algae move about together with those waters under the action of the above mentioned factors.

Organic matter

In the investigations made so far (VASILIU FL. 1969, 1971), the distributions and dynamics of organic matter in the waters beyond the 10 m. contour line was studied. For the shallow zone the minimum amount

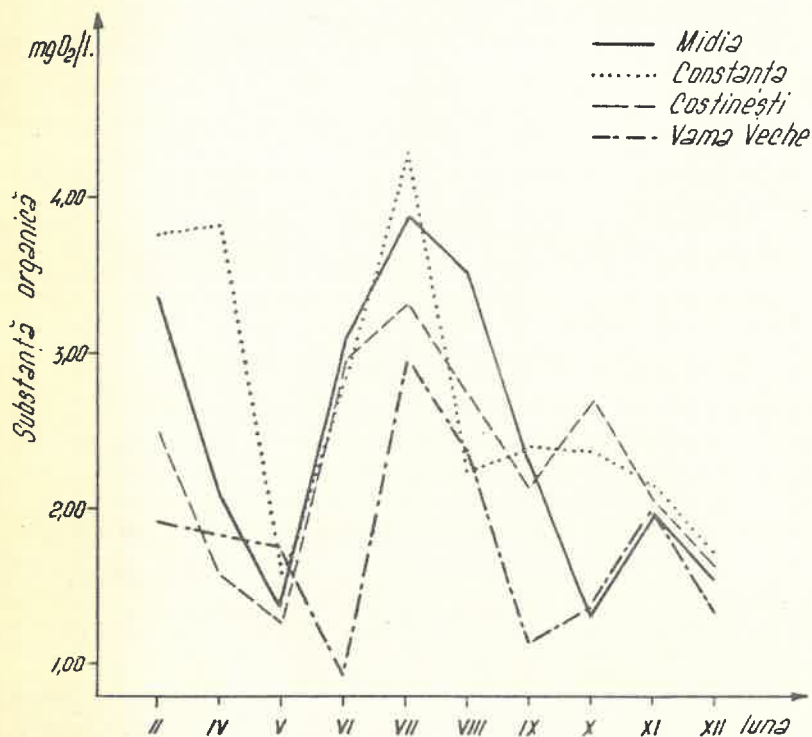


Fig. 2 - Distribution of organic matter during the year investigation

of organic matter was 1.18 mg. O₂/l in June (fig. 2) which is an extremely low figure for this month, and is specific only for open sea waters. (ROJDESTVENSKI V.A. 1961, VASILIU FL. 1970). This value may be explained by the meteorological conditions mentioned, when the temperature and salinity were discussed. With the exception of the above situation, the organic matter content is low during the autumn months and particularly during the winter months (fig. 2). For December it also must be noted that the distribution of organic matter is rather uniform among both northern and southern profiles, the values ranging between 1.37 and 1.69 mg O₂/l.

From an analysis of the results a maximum organic matter content of 4.32 mg O_2/l . in July must be stressed out. The average values of the four places analysed in the graphic ranged between 2.97 and 4.32 mg O_2/l . This is the month when, owing to environment conditions (adequate light, optimum temperature, abundant of nutrients) the unicellular algae represented particularly by peridinaea supply significant amounts of biomass, an aspect frequently encountered along the Romanian shore (SKOLKA H. 1967 and 1969, BODEANU N. 1969). As in the case of the other factors discussed, the amounts of organic matter are different along the northern and southern profiles, and they decrease from Cap Midia towards Vama-Veche.

Dissolved oxygen

The chemical element so much necessary to all vital processes of all animal or vegetal organisms, is abundantly present in the zone under investigation (table 5).

Its presence is in principle in accordance with the temperature values for waters with particularly strong hydrodynamism in the littoral zone, with certain meteorological aspects (pressure, humidity) and only sometimes with the biological processes of the water masses. And this is one of the main objections against evaluating the productivity of algae in these zones, by variations in the oxygen contents of the sea water (DATKO V.G. 1950).

During winter, with higher atmospheric pressure and lower water temperatures, and with the intense agitation of the sea, the oxygen content values may reach figures as high as 15.06 mg. O_2/l , with a saturability of more than 133 %, as encountered at Vama-Veche.

The high values (table 5) of the oxygen content, between 11.20 and 13.14 mg O_2/l , and of the saturability 110.7 - 126.2% during April along any of the profiles, are surprising. These values, although they are not much different from those recorded in other years by Romanian authors (BACESCU M, CHIRILA V. 1967) are, in comparison with other months of the year, rather higher.

The lowest values were measured in June and July, i. e. 3.97 - 5.81 mg. O_2/l , and respectively 4.75 - 8.81 mg. O_2/l . These are the months when the oxygen solubility in sea water is minimum.

Phosphates

In the tone under investigations, owing to its position near the discharge of continental and household waters, permanently there is an excess of nutrients and, organic elements ensuring abundant materials for the primary production.

The values of the phosphate content measured during 1971 are within the ranges determined also in other years (CHIRILA V. 1965) only for the period from February till October, featuring the same seasonal or even monthly variations (table 6). The lowest content was measured in

Table 5

Monthly record of the amount of oxygen dissolved in sea water (mg O₂/l) along the profiles Midia (1), Constantza (2), Agigea (3), Costinești (4), Mangalia (5), and Vama Veche (6)

Profile	Month Depth	II	IV	V	VI	VII	VIII	IX	X	XI	XII
1	0	9.40	11.68	8.56	4.43	6.39	8.90	8.71	7.97	-	12.00
	0	9.77	11.89	9.57	4.93	4.75	9.60	9.61	8.63	-	12.02
	10	9.43	12.63	6.52	3.97	8.13	10.60	11.93	10.14	-	12.02
2	0	9.54	12.89	12.24	5.81	7.14	8.82	8.58	7.60	10.88	12.72
	10	9.40	13.14	8.80	4.96	6.30	9.53	8.76	4.05	9.61	11.70
3	0	9.40	12.26	9.86	4.42	6.10	6.11	9.88	8.90	13.18	12.27
	0	10.57	12.42	9.17	4.42	5.98	8.66	7.45	9.75	10.83	-
	10	9.18	11.65	6.82	4.50	7.14	8.13	8.59	9.00	10.86	11.98
4	0	9.50	13.09	9.48	5.36	6.35	10.55	8.37	6.07	9.43	14.54
	0	10.12	12.37	6.94	5.04	6.14	10.24	7.45	8.75	10.76	11.46
	10	9.22	11.20	9.45	4.68	8.81	9.16	8.00	9.84	10.35	14.56
5	0	9.85	11.96	-	-	7.14	9.43	9.15	8.53	8.92	14.58
	10	9.35	11.78			8.00	9.31	9.20	8.31	10.37	10.48
6	0	9.65	-	8.60	5.40	-	7.24	6.44	8.49	9.14	15.07
	0	9.25		9.75	5.11		8.61	8.37	8.74	8.71	11.66
	10	9.40		7.49	4.66		8.40	10.16	9.15	8.11	10.89

Table 6

Phosphates content (mg/m^3) of sea water as determined monthly on the profiles Midia (1), Constantza (2), Agigea (3), Costinești (4), Mangalia (5) and Vama Veche (6).

Profile	Month Depth	II	IV	V	VI	VII	VIII	IX	X	XI	XII
1	0	20.1	4.5	45.7	8.9	5.2	112.0	60.0	71.3	216.1	350.3
	0	27.0	4.2	46.8	5.1	7.5	10.5	11.2	83.9	200.3	50.6
	10	12.9	5.0	30.4	10.3	7.5	5.0	16.0	71.3	174.5	38.9
2	0	13.9	4.0	35.3	5.1	17.4	15.1	10.6	90.5	289.0	-
	10	38.4	11.0	45.6	5.3	13.1	8.6	10.6	83.4	262.0	99.9
3	0	25.8	5.0	67.7	4.0	5.2	5.0	12.1	62.4	220.5	17.5
	0	33.2	5.0	55.3	5.7	8.0	13.2	13.1	71.3	219.2	17.3
	10	29.8	4.5	25.0	5.1	6.2	13.2	13.7	71.3	201.6	33.1
4	0	42.4	4.0	50.4	10.9	8.1	13.3	26.2	27.4	8.2	32.8
	0	44.3	6.0	67.6	9.4	7.6	37.8	21.8	63.7	27.8	29.7
	10	42.4	5.5	56.2	6.3	8.0	5.0	13.8	25.0	64.3	58.9
5	0	47.3	7.5	-	-	11.2	6.3	92.5	18.9	61.7	19.5
	10	59.0	7.5			4.5	5.0	20.6	29.1	106.4	8.1
6	0	20.6	-	38.1	5.7	-	5.7	17.1	34.3	472.9	20.2
	0	19.9		34.4	6.3		13.3	13.6	29.4	106.5	13.5
	10	21.3		30.0	15.2		4.4	10.1	37.1	80.0	12.1

the period between April and August, being as low as 4.0 mg P/m³. In no instants during the year, complete depletion of this nutrients, was observed which fact certifies the permanent existence of a certain excess, a situation which does not apply to the open sea (BACESCU M. 1967., VASILIU Fl. 1969). What, however is different, are the extremely high values (up to 472.9 mg P/m³, at Vama - Veche during November) during November and December. By comparing these values with the figures quoted in the literature for the Romanian shore (CHIRILA V. 1965., BACESCU M. 1967., VASILIU Fl. 1969), we note that such high values as shown in table 6 were never encountered in precedents.

Biochemical oxygen demand

The zone investigated extending over about 37 nautical miles may be affected by a series of polluting agents resulted from the harbour, industrial or daily human activities, and which are evacuated into the sea.

As indicators for the degree of pollution we investigated the Biochemical oxygen demand, the organic matter and the dissolved oxygen content.

The data specified in the table 7 illustrate the accentuatedly polluted character of the water near the ports of Constantza and Mangalia during the majority of the months of the year, where the BOD₅ values

Table 7

Average values of the BOD₅ as determined from the two stations off the places : Midia (1), Constantza (2), Agigea (3), Costinești (4), Mangalia (5), Vama Veche (6)

Month Profile	II	IV	V	VI	VII	VIII	IX	X	XI	XII
1	3.73	3.77	1.45	1.45	2.15	1.39	3.21	1.06	2.76	2.19
2	3.13	3.83	2.01	1.97	2.02	2.48	1.63	2.38	2.60	1.19
3	3.13	3.50	1.12	1.55	2.41	1.97	1.49	1.60	2.73	3.22
4	2.87	3.06	1.44	0.57	1.52	1.09	0.95	1.26	2.60	0.66
5	4.61	3.49	-	-	1.52	3.03	2.86	1.98	2.30	1.40
6	2.46	-	1.54	0.43	-	0.89	1.86	0.96	1.00	0.61

reach up to 3.83 mg O₂/l and respectively to 4.61 mg O₂/l. We must assume that a major contribution to these particularly high values is from the harbour activities. Laboratory tests carried out by ALYACRINSKALA (1969) showed the increase of BOD₅ also against the higher content of oil products at certain temperatures, Thus at a concentration of 0.5 ml/l, a

BOD₅ of 3.6 mg O₂/l, and at 10 ml of oil products per litre, a BOD₅ of 5.40 mg O₂/l, both at a temperature of 16°C was measured.

In sea water, the action of such pollutants manifested itself also by the prevention of the gas exchange between atmosphere and water, or by the considerable reduction of the percentage of lux reaching various depths of water.

Very low BOD₅ values were measured at Vama-Veche, both during the cold and hot seasons. During for months, these values were less than 1.0 mg O₂/l, while in December only 0.61 mg O₂/l were measured.

Some unicellular or pluricellular algae may be considered as typical indicators for the pollution degree of the habitat. As has been shown by SKOLKA H. (1969), the total number of species which can be encountered in polluted waters amounts to about 20, particularly represented by the Chlorophyceae (Enteromorpha intestinalis, E. linza E. prolifera, Ulva lactuca), by the Phaeophyceae (Ectocarpus confervoides), and from among the Rhodophyceae, CELAN M. (1966) quotes the species Poly-siphonia variegata, featuring wide ecological valences and tolerances against pollutants.

A special case of pollution is the water blooming phenomenon, the frequency of which is increasing in recent years (SKOLKA H. 1972). In July 1972, a strong blooming of the peridineum Exuviaella cordata took place, according to the PIA MIHNEA'S unpublished data. The biomass of this peridineum reached up to 3018 mg/m³ in a station situated at one nautical mile off the coast. This blooming was followed by a mass mortality of the benthic fauna - an aspect known also as a result of other such blooming phenomenon.

In such conditions a massive organic impurification took place followed by complex aspects in the chemical water, as pH values decreased to 7.4; oxygen saturation ability decreased to 57.6 %; organic matter content of 4.32 mg O₂/l. At the same time it must be assumed that also a toxic action resulted from higher amounts of metabolites, both during the summer and also after the death of the organisms (HAILOV K. M. 1970).

Conclusions

On the Romanian Black Sea coast, the zone populated by benthic marine algae, although not very long (37 nautical miles) is characterized by the presence of continuously oscillating and highly varying ecological factors. These particularities are due both to the geographical position of the zone under investigation, and as well, to local factors as; shape of the coast, harbour constructions, pollution sources, etc.

The light extinction coefficient varied between 0.031 and 0.610, these values being characteristic both of the superficial open sea waters as well as of freshened waters along the littoral. The light penetration at a depth of 5 m. varied between 1.4 and 71% of the total light at the surface of the sea.

The water temperature was characterized by high values during the winter months, which ever decreased below 4, 5°C. During summer, they generally temperatures common to the entire Romanian shore were recorded.

The salinity presented considerable variation, ranging between 9.47 g S‰ in April and 19.47 g S‰ in June. The salinity depends on the direction of the prevailing winds and may change within a few hours.

The suspended matter showed extremely high amplitudes, between 4.3 mg./l and 35.5 mg/l. At Vama - Veche, during all month of the year, the suspended matter is the lowest.

The organic matter content was highest (4.32 mg O₂/l in June. Beginning with the autumn months, the above value decreases, the lowest values being recorded during winter.

The dissolved oxygen showed a seasonal and even monthly re-partition common to all shallow areas, the maximum content during winter being 15.06 mg O₂/l with a saturation ability of 133,90 %, while the minimum oxygen content during summer was 3,96 mg O₂/l, with a saturability of 46,60%.

Phosphates are abundant during the year and, unlike to the regions of the open sea, they never got depleted, not even during the summer months. In autumn and winter months (October - December) the phosphates content reached the highest values recorded along the Romanian shore (472,9 mg P/m³).

Through its maximum values of 3,83 - 4,61 mg O₂/l, the BOD₅ indicates the waters from the vicinities of the harbours of Constantza and Mangalia as being the most polluted regions.

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