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SOME PROBLEMS CONCERNING ACTUAL ECOLOGICAL CHANGES IN THE BLACK SEA

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ABSTRACT:

The paper briefly presents the main ecological events present in the last years in the coastal ecosystems of the north-western part of the Black Sea (the increasing eutrophycation/pollution and their consequences, the appearance of new species etc.). The author points out the necessity of continuing and amplifying the researches for a better understanding of the evolution of ecosystems.

The complex problems concerning the ecological changes that may occur in the marine ecosystems - although they are not new any longer - represent a challenging and permanently actual subject of discussion. We consider that the very concept of ecosystem includes in itself the endless change, slower or faster of all its component elements. Every moment, the ecosystem is the same and still different; its ecological equilibrium is a relative one, a dynamic one. The numerous interacting factors which define the biotope and the community of organisms permanently pass through qualitative and quantitative changes.

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The steady state of a community of organisms, characterized by its own internal changes is but a transitory phase of longer or shorter life; both the interspecific and intraspecific interactions as well as those occurring between biotic and abiotic environment lead at one time to the change, succession and the reaching of a new steady state.

Normal ecological changes have always existed; they have been the result of the appearance of some natural phenomena. Nowadays increasing artificial anthropic factors overlap more and more the disturbing natural factors of the ecological balance so that the changes appearing in ecosystems are more spectacular and occur more frequently. Man's interference in the marine environment, whether direct or indirect, conscious or unconscious, slow or rapid, but permanently amplified during the past decades, represents today the main cause of all the disturbances in the ecosystems.

In all the seas and oceans of the world, without exception, especially in coastal waters, there occur more and more ecological changes, most of them negative ones. It is really difficult to foresee the evolution of ecosystems, the qualitative and quantitative changes of their structural and functional elements. An ecosystem cannot be modelled in its totality and complexity even if the ecological conditions are normal.

To know and better understand an ecosystem, its structure and behaviour it is necessary to dissect this ecosystem and study its components; the resulting data are used as the basis for building up the mathematical model. Unfortunately, up to the present, no mathematical model has fully satisfied as concerns the prediction of the evolution of an ecosystem under the conditions of man's interference whether by harvesting the resources, introducing the pollutants or changing some physical features of the environment.

The "pathological" ecological conditions existent nowadays in marine ecosystems - ecosystems which will be increasingly exploited for their high potential of food, raw materials and energy - create numerous surprises and make possible the appearance of unexpected ecological events. Therefore, the behaviour of the actual ecological balance can be understood only through

a complex study, through a stronger link between theoretical and practical ecology.

The Black Sea long considered to be "unicum hydrobiologicum" on account of its unique features in the world has passed in the past 10-15 years through important changes similar to those occurring in all the other seas and oceans.

Which are the main disturbing factors implicated in the actual ecological changes in the Black Sea in general and in its north-western part - where the Romanian littoral lies - in particular?

Besides natural factors, which have always existed, such as exceptional fresh water flow of tributary rivers or unusual decreases of sea water temperature down to the appearance of frost on the shallow waters, in the past decades the decisive factors in the ecological changes are the result of the human activity. Playing a more or less important role, acting directly or indirectly, these man-made factors overlap the natural ones amplifying the effects. Let'us mention some of the factors:

- change of chemical composition of fresh water flowing into the sea;
- development of maritime navigation by increasing exchange of vessels between seas and by building new harbours;
- local discharge of sewage and industrial wastes through the own canals;
- coastal engineering works to consolidate and protect the shores;
- development of fishing in general and of bottom trawl fishing in particular;
- exploitation of the sand from the beaches.

These disturbing factors can be found not only in the Black Sea, but in all the seas, where ecological changes have been recorded.

We must mention you that the geographical position of the Black Sea - a basin practically closed by land, having very weak connections with other seas - represents a natural factor of ecological risk. It is obvious that any ecological pression from the surrounding land is thus reflected directly or indirectly, into the sea.

Table 1

Hydrobiological balance of the Black Sea

Values of positive components of the balance	km^3	Values of the negative components of the balance	km^3
River contribution	336	Evaporation	340
Inflow through Kerch strait	53	Outflow through Kerch strait	32
Inflow through Bosporus strait	123	Outflow through Bosporus strait	260
Rainfall	120		
TOTAL:	632	TOTAL:	632

Among the disturbing factors mentioned above, the most important one can be considered the new quality of fresh waters flowing into the sea. If we refer to the hydrological balance of the Black Sea (34) we can observe that in an average year a great volume of waters (0.11 % of the basin volume) is recirculated (Table 1). Recirculation affects however only the surface layer of the sea, the one populated by plant and animal organisms, about 200 m thick, so that the influence of water exchange upon the ecosystem is amplified. Furthermore, the normal ecological pressure is exerted unequally and irregularly on the surface of the Black Sea, the highest tensions in the relationship sea-land being situated in the north-western part. In this zone, having an area of 63,900 km^2 (15 % of the sea surface) and a volume of 1,910 km^3, a zone which includes the Romanian littoral too, there flows almost 80 % (2) of the whole river contribution of fresh water in the Black Sea (Table 2).

Table 2

River contribution to the Black Sea

Zone	km^3	%
North-Western Coast:	267	78
- the Danube	201	59
- the Dniepr	52	15
- the Dniestr	10	3
- the Bug + small rivers	4	1
Crimean coast (Karkinitsky Bay - Kerch strait)	5	2
Caucasian coast (Kerch strait - Gonia Cap)	41	12
Anatolian coast (Gonia Cap - Stephanos Cap)	25	7
Western coast (Stephanos Cap - the Danube)	3	1
	341	100

In normal conditions the fresh water from the land induces variations of the sea water salinity. These variations, however, do not produce major changes in the ecosystem because the greatest part of the plant and animal organisms of its composition are euryhaline.

In the new "pathological" conditions of today, when fresh water is charged with numerous allochthonous substances, toxic or non-toxic, resulting from human activity, the ecological pressure increases and the disturbing factors of the ecosystem multiply. We can imagine which is the new quality of the fresh waters flowing into the Black Sea if we take into consideration the fact that their hydrographical basin having an area of 2,405,00 km^2 (nearly six times larger than that of the collecting basin) stretches across 13 countries (Table 3 - after 6, with completion) in which industry and agriculture are generally greatly developed and the number of inhabitants is high. Only the Danube, the Dniepre and the Dniestre, the main rivers flowing into the North West of the Black Sea, have a hydrographical basin of 1,393,1oo km^2, that is 22 times larger than the area it influences directly by an annual average volume of more than 26o km^3 (14% of the volume of north-western sea waters).

Table 3

Country distribution of the surfaces
of the hydrographical basin of the Black Sea

Countries	Proportion			Population million inhabitants
	km^2	% of the basin surface	% of the country surface	
USSR	1,372,5oo	57.1	6	256.67
Turkey	249,7oo	1o.4	32	4o.16
Romania	226,3oo	9.4	95	21.66
Yougoslavia	186,ooo	7.7	73	21.56
Hungary	93,ooo	3.9	1oo	1o.6o
Austria	83,ooo	3.4	99	7.51
Czechoslovakia	71,5oo	3.o	56	14.92
Bulgaria	62,ooo	2.6	56	8.76
West Germany	58,5oo	2.4	24	59.76
Switzerland	1,7oo	o.o7	4	6.35
Italy	3oo	o.o1	o.1	56.19
Poland	3oo	o.o1	o.1	34.36
Albany	1oo	o.o1	3.5	2.55
TOTAL:	2,4o5,ooo	1oo.oo		54o.85

I should like to review now some of the ecological modifications registered in recent years in the Black Sea, especially in its north-western part where intense researches have been carried out by the Soviets, Romanians and Bulgarians for a long time.

EUTROPHICATION OF THE BLACK SEA

The most important ecological event in recent years is the increase of the degree of eutrophication, particularly in the littoral zones.The eutrophication of the Black Sea is pointed out by numerous chemical and biological data obtained in the past lo years.

In 1957-1958 the Danube - the most important factor enriching the continental shelf with nutrients - transported into the sea only 9o7-3,698 tons of phosphorus (11); between 1974-1977 the quantities were 5-8 times larger, rising to 29,3oo tons (29). Between 1958-1959 the contents of nitrates in the Danube water at its entrance into the sea were of o - 1,7oo µg/l (14) and between 1977-1978 of 45o-3,ooo µg/l, zero values being absent (37). It is easy to understand that the high contents of nutrients and other substances in rivers, the result of the diverse utilization of fresh waters, are also reflected into the sea. Thus, the dynamics of the phosphates and silicates in the surface waters of the Constantza zone (situated far from the direct influence of the Danube) in the period covering the years 1959-1975, shows that beginning with the year 1969 these two nutrients have registered very important increases; the maxima of the average annual values for 1959-1968 were 11.8 µg P/l (1962) and 1,3o8 µg Si/l (1964), and those for 1969-1975 were 3o2.6 µg P/l (1975) and 1,857 µg Si/l (12).

The eutrophication of the Black Sea is also proved through the increase of the primary production. For instance, at the Soviet littoral,the maximum biomass of phytoplankton in 1961-1965 did not exceed 52 g/m^3 (23) and in 1975 it was more than 42o g/m^3 (28). At the same time, the dominant species of diatoms were replaced by dinoflagellates. This substitution of the autotrophic species by the mixotrophic ones represents one more proof for the eutrophication of the Black Sea. A similar situation was

registered on the Romanian littoral. Thus, the researches carried out in 1972-1977 with regard to phytoplankton (5) showed:

- in comparison with the last decade, the biomasses have increased 5-10 times;
- the number of fresh water origin species in the structure of algoflora has increased (from 1/4 to 1/3 of total);
- the specific diversity has also increased on account of the penetration of new species from the Mediterranean sea;
- the role of dinoflagellates as compared to that of the diatoms has increased in the qualitative and quantitative structure of the phytoplankton.

One of the most important features of the phytoplankton of the Black Sea in recent years is the amplification and rapid succession of blooming phenomena - red tide. The dinoflagellate Exuviaella cordata OSTF. is today the species with the most frequent blooming, but with negative consequences in the ecosystem (18). In the last decade the densities of this species were small - usually under 10 mil.cells/l; nowadays, values exceeding 100 mil. cells/l - up to 280 mil.cells/l have been registered (4, 28, 37 etc).

The excessive development of Exuviaella has determined the appearance of some immediate events such as: a decrease in the oxygen content of the sea water down to lethal values, important increases of the quantities of organic matter, a decrease in water transparence and finally the starting of mass mortality of some marine benthic organisms (4, 18, 35).

The red tides - common phenomena in the Black Sea in recent years - represent a source of secondary pollution of the Sea, at the time when mass mortality of dinoflagellate cells begins. Catabolits and the lack of oxygen lead to the disappearance of organisms species, to mass mortality. Hypoxy and especially anoxy cause the death of all benthic and nectobenthic organisms which cannot take refuge in zones rich in oxygen. Beginning with 1973, mass mortality has been registered in extensive zones especially in the north-western part of the sea. Here populations have been decimated to a great extent, such as Mytilus galloprovincialis and Mya arenaria, shrimps and crabs, the populations from the thickets of Phyllophora (18, 33, 37). The polychet worms were more resistant, their populations being quite abundant.

Table 4

Total biomass (g/m^2) of the benthic organisms in Constantza zone before and after Exuviaella blooming

Date	St.1	St.2	St.3	St.4	St.5
April 24,1975	1,936.5	7,281.5	47.9	1,o15.9	5o.5
September 26,1975	116.2	1.3	2.2	2.1	79.5

We give an example here about the powerful influence of Exuviaella cordata blooming in the summer of 1975. In Constantza zone, in 5 stations on a perpendicular transect on the shore down to 5o m depth,28 types of organisms were registered in the benthic communities in spring, their biomasses being fairly high (35). In autumn, after the blooming, only 5 types of organisms survived, worms especially; the diminishing of the biomasses occurred in proportion up to 99.98% (Table 4). The cause of all mortalities was the diminishing of the oxygen quantities, especially in the profundal horizons; in certain periods concentrations of O_2 approached zero (Table 5).

Table 5

Quantities of O_2 (cm^3/l) in the water layer above the bottom in Constantza zone in the summer of 1975

Month	St.1	St.2	St.3	St.4	St.5
June	4.49	5.84	6.41	5.85	6.7o
July	1.87	2.21	3.o8	3.42	3.98
August	o.33	o.88	1.55	3.o8	-
September	5.44	o.32	o.51	1.61	2.o3

Mortalities affected molluscs,crustaceans,sponges,etc., particularly filtering organisms. In exchange, the polychets have thriven. For instance, the polychet worm Melinna palmata was a rare species at the Romanian littoral in the last decade (1); nowadays it forms extremely abundant populations, characterizing a community on an area of over 38o km^2 at depth of 15-3o m.

We try to continue presenting briefly other ecological events that have appeared in the Black Sea in recent years,events which are closely linked with eutrophication, pollution and mass mortalities.

IMPOVERISHMENT OF THE BLACK SEA BIOLOGICAL FUND

For the Black Sea, except the Anatolian coast, there is a complete inventory of flora and fauna. Thanks to the intense Soviet, Romanian and Bulgarian researches, the species from the composition of phytoplankton, zooplankton, nekton, plant and animal micro- and macrobenthos, are very well known today. Furthermore, all the associations of organisms have been thoroughly studied. At present there is a great volume of information for reference concerning both the qualitative and quantitative aspects of ecosystems. Consequently, at the present moment we can firmly affirm which species disappeared, which ones have reduced their areals of distribution or which populations have diminished their effectives.

One of the most important characteristics of the continental platform in the north of the Danube mouths and at the same time one of the most particular features of the Black Sea in general is the presence of a vast zone of 10,925 km^2 covered by the populations of red algae of the genus Phyllophora, which shelter a rich fauna coloured in red. Initially, the stock of Phyllophora was estimated to 8-10 mil.tons (38). Recent soviet data (24) show that today the stock of these algae is of only 1.5 mil.tons; parallel to the reduction of the algae stock, their characteristic rich fauna has disappeared too, so that the famous "red jungle" of the Black Sea has been considerably impoverished.

Likewise, the macroflora in the rocky zones of shallow depths, so diverse and so abundant some time ago, has diminished very much, both with regard to quality and quantity. The marine phanerogams (eelgrass) Zostera marina and Z.nana and some macrophyte algae have disappeared or considerably diminished the areal of distribution. At the Romanian littoral for instance red algae such as: species of Laurencia, Dasya pedicellata (AG.)AG., Chondria tenuissima (GOOD.et WOOD.)AG., Lomentaria clavellosa (TARN.)GAIL., Antithamnion cruciatum (AG.)NAEG., Cruriopsis rosenvingii BÖRG., Peyssonnelia dubyi CROUAN., etc. have disappeared totally or almost totally; Polysiphonia elongata (HUDS.) HARV., P.opaca (AG.)ZANARD., P.subulifera (AG.)HARV., etc. have become rare or very rare (10). Perennial brown alga Cystoseira barbata once very abun-

dant in the rocky bottom zones, where it formed vigorous popula - tions capable of sheltering a rich fauna and supporting a diverse plant and animal epibiosis, has deeply suffered in the past 1o years. After a hard winter when the sea froze, the ice floes destroyed the populations of Cystoseira, their recovery could not take place normally because of the new unfavourable conditions, an increase of water turbidity especially. In 1979 the stock of Cystoseira at the Romanian littoral represented only 3% (viz.12o tons) of the stock estimated in 197o-1971 (VASILIU FL., personal com - munication).

Simultaneous with the qualitative and quantitative losses of the principal algoflora, the development of seasonal species occurred, which are considered to be pollution-resistant (Enteromorpha, Cladophora, Ceramium).

Concerning the animal organisms we mention that 5o years ago, among other species existing at the Romanian littoral, the following species were quoted: Ostrea sublamellosa MIL. and O.s.rumanica BORCEA (oysters), Lucernaria campanula LAM. (Scyphozoa), Phassianella (Tricolia) pontica MIL. and Gibbula divaricata (L.) (Gastropoda)(7). These species were no longer met in the 6o' and 7o' decades and can be considered as definitively extinct from the Romanian littoral.Oysters have also disappeared from the Soviet littoral (26). Other species, quite frequent in shallow water zones only 1o-15 years ago have also disappeared completely or they are quite rare, such as: Ophelia bicornis SAV. and Arenicola marina (Polychaeta), Petricola lithophaga (RETZIUS), Irus irus L.,Tellina donacina L.,Solen vagina L.,Donax trunculus (L.), Loripes lacteus (L.) etc. (Bivalvia), than the crustaceans Chthamalus stellatus (POLI),Eriphia verrucosa (FORSK.),Upogebia pusila (PETAGNA), Mesopodopsis slabberi VAN BENEDEN,etc. The list of the extinct or rare species is very long and it has been completed to a small extent (19, 22).

Some species that are still present in the Black Sea have today less and less populations (Table 6).An obvious example is the bivalve Corbula mediterranea (COSTA). In the last decade the stock of this bivalve was estimated at 112,ooo tons/658 km^2 (17) and at 47o tons/46o km^2 in 1979, hence the population has diminished nearly 24o times (2o).

Table 6

The stocks (thousand tons) of some molluscs from the sedimentary beds of the Romanian Black Sea littoral, in the years 1976-1979

Species	1976	1977	1978	1979
TOTAL MOLLUSCS:	986	968	905	654
Mya arenaria	600	790	650	580
Cardium edule lamarcki	86	67	59	19
Corbula mediterranea	4	1,6	4,5	0,5
Spisula subtruncata	1	1	18,2	3,0
Mytilus galloprovincialis	282	38	137	48
Syndesmia fragilis	3,4	1,7	3,0	0,7
Cardium paucicostatum	1,4	0,0	2,4	0,5
Abra - 2 sp.	2,5	1,0	2,5	0,7
Paphia rugata	0,9	3,9	0,5	0,0
Nassarius reticulatus	2,9	4,2	3,7	0,5

Table 7

Dynamics of fish catch (in tons)

Species	Romania			Bulgaria		
	1950-54	1965-69	1970-74	1950-54	1965-69	1970-74
Sturgeons	259.4	205.8	168.4	?	48.2	22.6
Sprat	1,220.0	1,495.6	1,676.2	808.2	847.8	2,938.6
Anchovy	443.4	925.2	1,706.8	203.6	116.2	135.4
Horse mackerel	302.6	845.6	834.4	566.6	246.0	974.4
Blue mackerel	68.6	13.0	0	869.0	277.4	0
Bonito	19.0	4.4	0	628.2	1,606.0	22.8
Turbot	354.4	129.4	70.2	161.6	313.0	245.2

Important changes have also been registered in fish fauna. A mere look through the fish-catch statistics (Table 7) makes us conclude that the valuable fishes as Scomber scomber L. (blue mackerel) and Sarda sarda BLOCH (bonito) disappeared from the Black Sea in the last decade; sturgeons and turbots are caught in smaller quantities than in the last decades (9). The stocks of blue mackerel and bonito, migratory fishes into the Black Sea, have been considerably reduced because of the unfavourable conditions (pollution) for the reproduction and nourishement of the

populations in the Marmara Sea and also in Bosporus zone. The reduction or the increase of the stocks of fishes living in the Black Sea are correlated with all the ecological modifications that have appeared in this basin.

When presenting the impoverishment of the Black Sea biological fund I should like to add some more information. Nowadays it is very difficult to identify the major communities of benthic organisms described in the last decade (1). We can affirm that within the assemblages of benthic macrofauna, represented by molluscs, there is a tendency to biocenotic uniformization, illustrated by the low values of the diversity and evenness indices of the sediment-dwelling molluscs communities. This indices are reduced just because of the numerical and ponderal dominance of the soft-shell clam Mya arenaria and of the disappearance or impoverishment of other species. However, we cannot conclude that in the zone where once there were 4-5 distinct communities, today there is a single "continuum", a single association dominated by Mya arenaria and comprising some "noda". The mosaic of assemblages in shallow waters, especially on the sedimentary bottoms, proves an ecological balance very labile at the benthic level, a weak stability of the filtering-feeders macrobenthic populations in time. Therefore, in future we can expect new changes in the structure and functioning of the benthic communities, the more so as disturbing factors amplify.

ENRICHMENT OF THE BLACK SEA BIOLOGICAL FUND

In spite of the numerous ecological barriers for the penetration of new organisms into the Black Sea, the immigration phenomenon is still actual today. It can be very well observed in the zone lying in close vicinity of the Bosporus strait. Here, the profundal current with Mediterranean waters (123 km^3 a year) allows the survival of more than 100 benthic species, which represent a real reservoir of Mediterranean elements waiting for favourable conditions in order to advance along the coast and conquer the whole Black Sea.

The Mediterranization process of the Pontic basin, mentioned by various authors (8, 16, 32) cannot be considered a closed one. However, we find today that the enriching of the biological

fund of the Black Sea occurs with some species having distant geographical origins, beyond the limits of the Mediterranean Sea.

The development of sea navigation, the increase of vessel exchange among seas, have created the possibility for the penetration of new species into the Black Sea (especially as larvae in the ballast water of the ships). Thus we can explain why in the last years some new animals have been registered, mostly in the neighbourhood of harbours: Polidora ciliata limicola (Polychaeta), Mya arenaria (Bivalvia), Callinectes sapidus (blue crab) and before Rapana thomasiana (Gastropod) (3,13,15,21,25,30, 36,37 etc.).

Among the new forms having penetrated into the Black Sea, Mya arenaria and Rapana thomasiana have the most spectacular evolution with remarkable ecological consequences.

Table 8

The stock (thousand tons) of Mya arenaria of the Romanian Black Sea littoral

Years	Total	Depth			
		1,5-6m	6-10m	10-20m	20-30m
1973	950	40	90	510	310
1974	1,140	30	100	750	260
1975	450	20	20	150	260
1976	600	40	90	210	260
1977	790	20	30	380	360
1978	650	2	18	280	350
1979	580	10	20	330	220
Average:	737	23	52	373	288
Km^2	1,765	155	174	780	656

For instance in the sedimentary beds of the Romanian littoral, down to a depth of 40-50 m, Mya arenaria has become in the past 10 years a mass form whose quantities predominate over the other molluscs (Table 6). It is particularly interesting to show now the stocks of this bivalve evolved in recent years (Table 8). In a relatively short period, populations of Mya, having suitable conditions for food and substrate, have developed explosively, forming extremely high densities and biomasses (in some places more than 2,700 inds./m^2 and about 1,000 g/m^2).

The penetration of the soft-shell clam Mya arenaria into the Black Sea represents a positive ecological event, of great importance; this species, which also presents an economic interest, contributes to the increasing of the biological productivity of the zones in which it has settled, although the new immigrant has excluded here competitively the aboriginal mass form Corbula mediterranea.

On the contrary, the penetration of the predator gasteropod Rapana thomasiana represents a negative ecological event; this, because after destroying completely the oyster beds on the Caucasian coast, the place where it first settled, the gastropod began moving quickly forward along the shores, reaching from 1947 till 1963 the Romanian littoral where it threatens with the destruction of mussels and other species. Rapana, being a voracious predator, has rapidly spread first in search of food. We mention that this species has no natural enemy in the new environment, so that the lack of competition with other species has assured it a good development, not only on the rocky bottoms with mussels but also on the sandy bottoms with Mya arenaria. It is obvious that the presence of a predator in the ecosystem is an element that produces disturbances.

MASS DEVELOPMENT OF THE JELLY-FISH Aurelia aurita (L.)

In the previous studies concerning the zooplankton of the Black Sea there are few data about the jelly-fish Aurelia aurita. The populations of Aurelia have long been considered as having minor importance in the structure and functions of the pelagial ecosystem. Only in recent years it has been observed that this species forms extremely abundant populations in the whole of the Black Sea and nearly in all the seasons; this fact must be considered as an ecological event of great importance.

In 1959-1962 the total biomass of this jelly-fish in the whole sea, in the water mass o-80 m, was of 93 - 1,600 thousand tons, on an average of 670 thousand tons (27). In 1978, according to the Soviet calculations (37) only in the water layer o-100m there were 47 million tons of Aurelia. This means that if in the past there was one jelly-fish each 160 m^3 water, nowadays this species has at its disposal less than 4 m^3 water.

Based on our observations carried out in 1978 on board the R/V "VITJAZ" we have estimated a total biomass (wet weight) of 300–450 million tons of Aurelia aurita for the whole basin of the Black Sea (423,000 km^2).

It is interesting to mention also the fact that numerous specimens of Aurelia having abnormal symmetry have been observed. Besides normal individuals, with 4-lateral symmetry, there have been found individuals with 2, 3, 5, 6 and 7-lateral symmetry. The number of these abnormal individuals has increased sensibly in the north-west zone of the sea where it amounts to more than 10% of the total of Aurelia (37). It must be established whether these mutations represent the result of some changes occurring in the life conditions in the sea.

For the present, the increase in the number of Aurelia aurita in the Black Sea can be related to:

- the development of the primary trophic basis, as a result of eutrophication; and
- considerable reduction of the number of some plankton-feeders, trophic competitors of the jelly-fish and even some species such as blue mackerel, consumer of Aurelia aurita.

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The ecological changes in the Black Sea, mentioned above shortly and surely incomplete, are not yet catastrophic. The biological productivity of the zones lying under the direct, fertilizing influence of the Danube is still high (31). But what will happen in future? It is difficult to answer this question now, difficult to make a confident prediction. The important fact is to continue and amplify the researches for a better understanding of the ecosystem. A large volume of information is necessary in order to know better the mechanisms leading to ecological modifications, to manage the resources in a better way. Man's interference in the Black Sea will increase and consequently ecology will have greater tasks for controlling, protecting and improving the quality of marine environment.

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