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THE DISTRIBUTION OF THE BIVALVE MYA ARENARIA L. ON THE ROMANIAN SHORE OF THE BLACK SEA

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A b s t r a c t

On the basis of 590 samples collected during 1970 and 1971 from the superior infralittoral strip - to the depth of 10 m, in a network of 105 stations, the qualitative and quantitative spreading of the bivalve Mya arenaria L. on the Romanian shore is established, the species having recently penetrated into the Black Sea. The registered densities and biomasses show that, during the last 4-5 years, Mya settled perfectly off the Romanian shore in fine sediment zones (sand, muddy sand and sandy mud), in some places reaching values of over 8,000 specimens/m^2 and 16,000 g/m^2. It has been noticed, on the basis of obtained data, that the setting of Mya off the Romanian shore is still a developing process.

In the last decade, the Black Sea fauna was enriched with a very valuable element - the bivalve Mya arenaria L. Accidentaly penetrated into the Pontic basin, where it found convenient conditions, the species perfectly acclimated, developing itself overabundantly. This fact is well reflected especially in the structure of the thanatocoenosis from some beaches, where the shells of Mya, big and white, represent today a predominant element keeping the attention at first sight.

In the Black Sea, Mya arenaria was first reported in 1966 off the Soviet littoral, near Odessa, then in the zones in front of the Dnieper and the Bug rivers (BESHEVLY & KOLYAGVN, 1967)

Some small specimens of the species were found off the Romanian shore in 1967, in the Zăton zone at then off 4 to 8 m and in the Tomis harbour - Constanza (GOMOIU & PORUMB, 1969).

The species, with a Boreal - Atlantic origin and a circumpolar distribution, is found in all the littoral shallow water zones of Northern Atlantic, in some of northern seas, then off the Pacific coasts to the San Francisco Gulf and from the Kamchatka Peninsula to the southern region of Japanese islands. The center of the maximum distribution of Mya arenaria, where the population densities are very high and where the species represents a natural resource intensively exploited, is found off the Altantic littoral of USA (DOW & WALLACE, 1957, HANKS, 1963; WALLACE, HANKS, PFITZENMEYER & WELCH, 1965). We mention that the species is absent in the Mediterranean Sea.

At present there is a rich literature regarding the biology of Mya arenaria (PFITZENMEYER & SHUSTER, 1960), because the species was intensively studied in all zones where it is spread. From the numerous studies concerning the problems of morphology, physiology, growth and development, dynamics of populations, we come to the conclusion that the species biology presents a series of differences in different geographical zones, the differences being signaled even to the populations from the Atlantic coast of USA (HANKS, 1963, PFITZENMEYER, 1962, 1965 ; PFITZENMEYER & DROBECK, 1963, 1967 ; WALLACE, HANKS, PFITZENMEYER & WALCH, 1965). There are still many lacks in the knowledge of Mya arenaria ecology, despite a huge item of information resulted from the researches made till now.

The penetration itself and the rapid installation of Mya arenaria in the Black Sea creates many problems requiring to be solved. The researches are still at the beginning, the element being a new one of the fauna in the Pontic basin. The published papers (BESHEVLY & KOLYAGYN, 1967 ; GOMOIU & PORUMB, 1969 ; IVANOV, 1969 ; SAVCHUK, 1969, 1970) referred to the presence of Mya in some areas in the north-western part of the Black Sea, gave some ecological elements and, in the same time, showed the necessity of detailed studies for the

biology of the species in the new environment. In the study of the ecology of Mya arenaria in the conditions of the Romanian littoral of the Black Sea, the first problem which we concentrated our attention on was the knowledge of the spreading areas and of the quantitative values of the species abundance.

The researching results of the submerged beach, obtained during the summer periods of 1970 and 1971 gave us the first elements of the quantitative distribution of the species along the Romanian littoral, the first elements of dynamics and structure of populations on length classes, elements which we expose in the present paper.

The material and the working method

To know the spreading of Mya arenaria off the Romanian littoral, our researches have been restric to the superior infralittoral strip, off the coast, bounded to the 10 m - isobath, because the species is living in shallow water zones, especially in regions with tide (DOW & WALLACE, 1957).

Were made, on this littoral strip 105 stations distributed on 26 profiles, most of them being to the north of Constantza (Fig. 1). The stations were made on each profile at the depths of 9, 4, 3 m and also in the supralittoral zone. As a rule, a diver, tugged on a boat, made continous observations of the whole zone, from 3 m deep to the shore.

The samples were collected by diving with a simple device. hand - sound. In most of stations, 5 - 6 samples were collected, 1 - 2 meters from one another and the diver made detailed observations.

During 1970, 247 samples were collected, and during 1971, 343. The collected quantitative material was measured and weighed (during 1970, biometric measurements on 4,447 specimens and in 1971, on 3,019 specimens), were made and then, based upon obtained data, the density (individuals/m^2), the biomass (g/m^2) and the structure of populations on length classes were established for each station.

We mention that one part of our material was used for several physiological and biochemical studies, the first for Mva from the

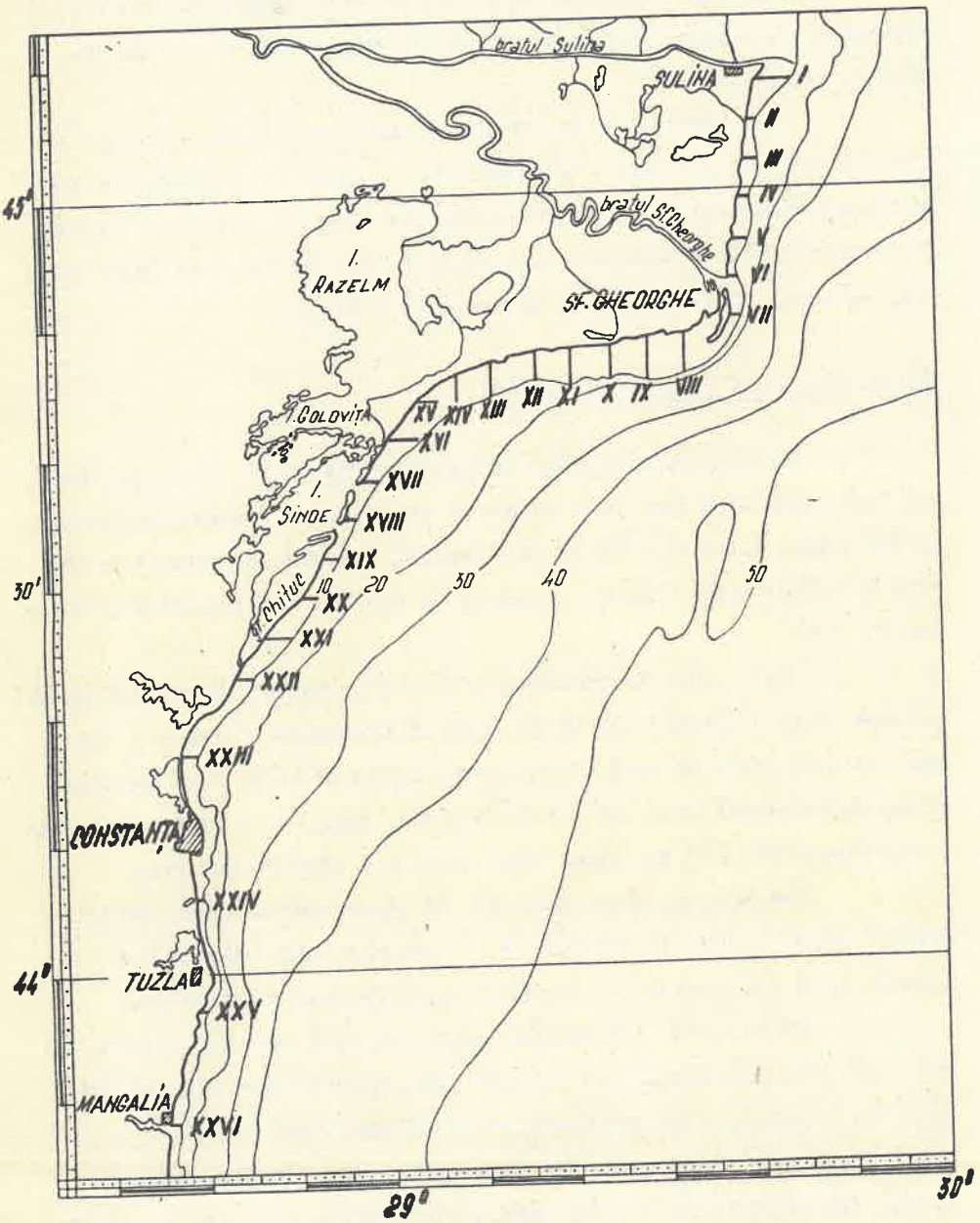

Fig. 1 – Romanian Black Sea Littoral: the profiles where stations for determining the Mya arenaria bivale distribution were made

Black Sea (MIRZA, 1972 ; TELEMBICI & DIMOFTACHE, 1972).

Discussion of results

During a very short period of only three years from the first recording of Mya arenaria on the Romanian littoral (GOMOIU & PORUMB, 1969), the species spectacularly settled in sandy littoral shallow water zones, in some places reaching uncommon densities and biomasses, to 8,418 samples/m^2 and 16,940 g/m^2 (table 1)..

The settlement and the spreading of Mya took place in accordance with the spreading of fine sediments : sands, muddy sands and sandy mud, these being the substrata preferred by the species. We mention that this substratum, the medium in which the species lives, influence the aspect of shells. In fine sand zones they have a beautiful white colour, in deeper zones, with muddy sands, containing numerous ferrum oxides, they have a red-rusty colour ; the shells of Mya samples, living in sandy muds where decomposition processes take place, in sheltered zone with stiller waters, like Midia harbour, a biotop with a prosperous numerous population - are hard blackened.

The researches carried out in fine sandy-sediment zones, the spreading of which is known off the Romanian littoral (GOMOIU, 1969), showed that Mya arenaria is found in a nearly continous strip between the Danube mouths and Constantza (submerged beaches from depths of 3 to 10 m); to the south to Constantza, the bivalve have a quite insular spreading, limited to some zones with fine sediments accumulated between stone platforms (Agigea, Mangalia, etc.).

From these two year researches resulted that the species has an uneven distribution ; it lives in small agglomerations, real "nests" In sheltered zones from Midia, Tomis - Constantza, Mangalia harbours, these small agglomerations are found even in waters with depths of few centimeters, sometimes being found even "on land", like in tide-zones. Differently, on open beaches, along the shore, it was found only from depths of 2-3 meters, to 10 m. Some soundings carried out in deeper waters have indicated the presence of species to 32 meters ; the small

Table 1

The densities (specimens/m^2 = ex./m^2) and biomasses (g/m^2) of the Mya arenaria bivalve from tehe Romanian littoral of the Black Sea

Depths :	3 m				4 m				9 m			
Years :	1970		1971		1970		1971		1970		1971	
Profiles :	ex/m^2	g/m^2	ex/m^2	g/m^2	ex/m^2	g/m^2	ex/m^2	g/m^2	ex/m^2	g/m^2	ex/m^2	g/m^2
I	x[1)]	-	816	312	84	42	260	712	28	3	1075	289
II	-	-	96	43	56	6	480	5020	11	2	1875	1425
III	-	-	3336	1140	168	655	540	4888	-	-	-	-
IV	-	-	336	9121	-	-	720	2432	-	-	13	6
V	-	-	-	-	1	8	3200	3910	-	-	140	108
VI	-	-	432	672	-	-	2560	6846	-	-	24	56
VII	-	-	-	-	-	-	-	-	-	-	40	54
VIII	-	-	-	-	-	-	2200	160	x	-	246	614
IX	140	10	2088	480	84	6	2420	1142	x	-	73	96
X	336	31	1040	300	280	20	-	-	364	10	1040	2510
XI	108	1080	-	-	782	5681	-	-	1050	1246	1500	1620
XII	36	804	-	-	138	1339	-	-	8418	2360	3960	4771
XIII	1190	9765	132	22	x	-	638	2549	4692	775	4692	4425
XIV	-	-	-	-	-	-	616	1643	7770	2835	2024	5515
XV	432	5760	132	694	1050	16940	440	4136	2660	1358	484	1969
XVI	28	4	-	-	140	753	400	855	700	1918	1900	5855
XVII	364	1593	22	70	700	3433	154	1441	200	588	88	354
XVIII	448	1980	169	1722	1260	3512	1300	10940	1204	1942	500	3140
XIX	-	-	-	-	702	2036	400	1737	36	18	1100	3520
XX	-	-	160	1844	2	3	140	686	-	-	20	36
XXI	252	244	380	170	28	7	1240	2148	28	10	80	82
XXII	-	-	-	-	-	-	308	5537	-	-	-	-
XXIII	144	351	600	240	234	515	620	3166	180	607	30	5

x) [1] The sign "x" indicates that only empty Mya shells were found in the samples.

specimens found here show that the spreading process of populations is going on, that the species is reaching new areas.

Analysing the quantitative distribution of Mya arenaria populations in the northern part of the Romanian littoral, from the beginning we found that the abundancy of the species, expressed by densities and biomasses, is different from one zone to an other, depending on the physio-geographical features of each zone. Thus a first individual zone is before the mouths of the Danube (Fig. 1), profiles I-VI). Here, where there are "open" submerged beaches with eastern exposing, swept by the winds from north-eastern sector, where the salinity is enough variable and where the alluvial-deposition process is extremely active, Mya arenaria recorded, during 1970, very small densities, the species being absent even at the depths of 2-3 meters. The greatest density recorded for this zone was of 168 specimens/m^2. The biomasses obtained in all the stations made in the Danube mouths zone were extremely small (normally 2-42 g/m^2), because the present individuals were of a small sizes (+ 10 - + 40 mm, but the class of + 10 mm is predominant).

From the researches made during 1971 we found that the species has extended its spreading area and, at the same time, its densities and biomasses grew very much. Thus, at small depths, of 2-3 m, where Mya wasn't found in 1970, in 1971 there were found hundreds and thousands of specimens per m^2.

Also, on the places, where, in 1970 densities of 1-168 specimens/m^2 were registred, the values grew much, oscillating between 260-3,200 specimens/m^2, by the contribution of new generations.

During 1971 important growings of the biomass took place in front of the Sulina arm, on the bathymetric curve of 4 m, where the medium length of Mya samples doubled (from 10 mm to 20 mm - table 2). If in 1970 the common biomasses were between 8-48 g/m^2 (exceptionally 655 g/m^2), in 1971 they were of the order of thousands of grams per square meters (in this zone the maximum biomass was of 6,846 g/m^2).

During 1971 was signalled the settlement of the species and a remaekable growth of its densities and biomasses also at the depth of 9 m, where their values were still smaller than those at 4 m. The highest

biomass is 1,425 g/m^2 (table 1). The intensive alluvial deposition which takes place in the Sfintul Gheorghe arm zone (Fig. 1, profile VI) can explain that neither during 1970 nor during 1971 we found no livind specimens of Mya arenaria. The shells of Mya from the beach deposits are transported and settled in this zone by the strong existing dynamic factors, streams and waves.

The submerged beaches in Sahalin-Perişor zone (fig. 1, profiles VIII-XIV) are generally sheltered from the action of winds, which are predominant from the north-eastern sector. This zone being a more sheltered one, we found here in 1970 a Mya population well settled even at a small depth (to 1,190 specimens/m^2 at a depth of 3 m), where there were also recorded great biomasses, to 9,765 g/m^2; the specimens of this population were exclusively from the class of length of + 50 - + 60 mm.

During 1970, because of the heavy storms which have dislocated and laid down on the land the populations from small depth, Mya was absent in some stations made on the bathymetric curves of 3 and 4 meters. However, in some stations the species is found in a greater number of individuals. For exemple, on the 9-th profile, at a depth of 3 m, during 1970, 140 specimens per m^2 were registered and in 1971, 2,088 specimens/m^2. These high densities are due to young individuals, from the new generation (predominant is the length class smaller than 10 mm).

At the depth of 9 m, the great densities of 1970 also maintained in 1971. The recorded biomasses were higher, being given by the individuals of a greater size. The comparative analysis of the medium lrngths shows an important growrh in 1971, from 10 mm to 23 mm (table 2).

The middle zone of the littoral, placed between Perişor and Constantza (fig. 1, profiles XV-XXIII), contains the regions where Mya arenaria reached the greatest densities and biomasses at the Romanian coast of the Black Sea. The species was found at any depth, in hundreds or thousands of specimens per square meter, the maximum density being of 7,770 individuals/m^2, and the maximum biomass of 16,940 g/m^2. During 1971, in all the stations made in this zone, on the bathymetric curve of 9 m, the Mya specimens with a medium length of 20-34 mm, havenot given biomasses smaller than 2,000 g/m^2. Only in the sector of Midia-

Mamaia were recorded smaller densities and biomasses ; here, during both years, Mya was absent either at a depth of 3 m, or at 9 m.

Table 2

Medlun lengths (mm) of Mya arenaria samples collected at Romanian Black Sea littoral, in 1970 and 1971

Depths :	0 m		3 m		4 m		9 m	
Years :	1970	1971	1970	1971	1970	1971	1970	1971
Profiles								
I	24	47	-	10	10	20	10	11
II	28	42	-	10	15	24	10	12
III	30	54	-	10	27	12	-	-
IV	34	63	-	53	-	9	-	
V	36	70	-	-	-10	7	-	
VI	48	63	-	12	-	14	-	
VII	40	45	-	-	-	-	-	15
VIII	R)[1]	39	-	-	-	8	-	20
IX	-	45	-10	7	-10	7	-	20
X		49	-10		-20	-	-10	18
XI	42	49	40	-	35	26	14	18
XII	28	44	55	-	45	-	10	14
XIII	38	43	46	10	35	30	-10	12
XIV	38	45	-	-	-	21	-10	23
XV	39	52	49	10	45	10	14	23
XVI	38		10	-	29	18	20	24
XVII	32	48	30	30	23	34	24	23
XVIII	30	49	28	42	28	45	21	34
XIX	30		-	-	24	40	10	29
XX	31	50	-	31	20	12	-	20
XXI	35	47	11	10	10	13	10	18
XXII		42	-	-	-	42	-	-
XXIII	22		20	8	22	23	28	10

[1] R = Rare

The high values of Mya arenaria density and biomass, recorded off the Romanian littoral of the Black Sea, greatly exceed the maximum values found till now in the Pontic basin. On the Soviet littoral, for example, the greatest recorded values were 376 specimens/m^2 for densities and 4,456 g/m^2 for biomasses, in Suhoi Liman zone (SAVCHUK, 1970).

The observations of the supralittoral thanatocoenosis as well as the biometric analyses made on the whole collected material, gave us some elements of the species ecology which are mentioned below.

The storms are the mean destructive factor for the organisms inhabiting shallow water areas at the Romanian shore (GOMOIU, 1968)the waves, streams and swell agitate the bottom sediments, dislocating them from the substrate, transporting and depositing on the beaches important quantities of benthontes. As we already showed, in the supralittoral thanatocoenosis the shells of Mya arenaria are predominant today comparative to those of psammobionthic species, which were common formerly (Corbula mediterranea (COSTA), Chione gallina L., Tellina tenuis (COSTA), Cardium edule lamarcki (REEVE, Cyclope neritea (L), Nassarius reticulatus (L) etc.)

From one estimation made on a distinct part of beach of only 5 km resulted that, as an effect of a heavy storm, can be thrown on the shore more than 117 millions of Mya individuals, representing almost 1,900 tons. As a result of the storms, the most affected are, as usual, the Mya specimens with great size which being dislocated from the substrate cannot easily bury themselves in and then are transported and deposited on the shore. This explains the fact that in Mya deposits on the beach the big size specimens are dominant.

Comparatively analysing the medium lengths of Mya from different depths we note that both in 1970, and in 1971, the greatest values belong to the specimens from the deposits on the beach (table 2). The general medium lengths of the analysed individuals-of these two years vary as follows ; 33,8 - 49.3 mm at 0 m ; 28.1 - 18.7 mm at 3 m ; 23.4 - 21.7 mm at 4 m and 14.3 - 19.1 at 9 m.

The structure of Mya arenaria populations on classes of length from different zones of the Romanian shore is enough heterogenous,

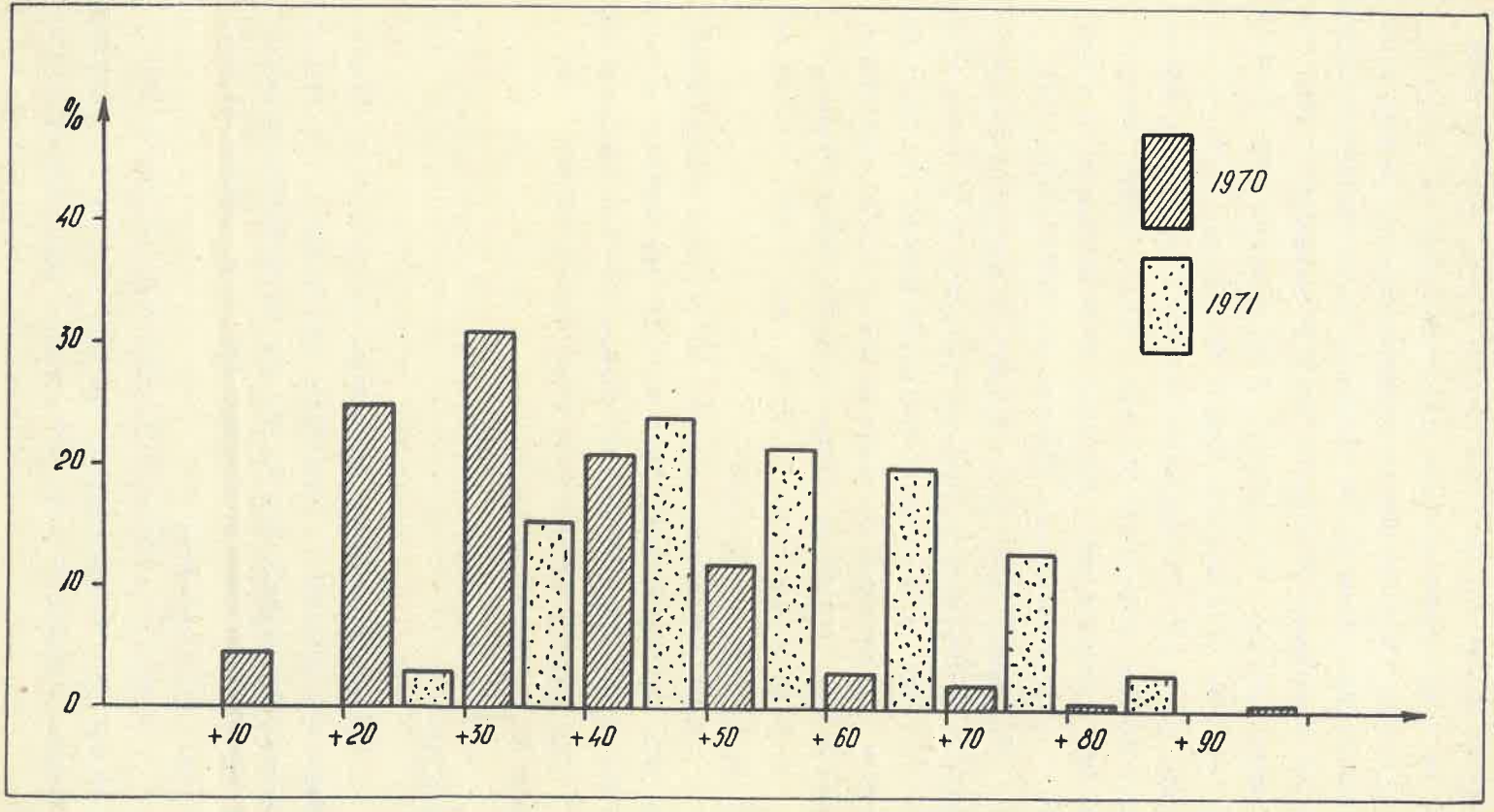

Fig. 2 - The hystograms of medium frequency of bivalve Mya arenaria length classes in the deposits of the beach, in 1970 and 1971

firstly proving that the species didnot instaled at once on all the sandy bottoms, but it has conquered and is still conquering progressively the biotop. It is very difficult to draw a conclusion from the analysis of the composition in size classes for the populations in the infralittoral because the process of settlement is going on. But it is interesting to notice that a comparative analysis, even summary, of the specimens from the beach deposits, can offer us at least one element of dynamics for the two years of studying. So, in 1970 the Mya individuals have smaller sizes than in 1971 (33.8 mm and, respectively 49.3 mm - medium length). We can consider that, during one year, Mya grew, on an overage, by 15.5 mm, a value comparable with the literature data (NEWCOMBE, 1935).

The general aspect of the structure of populations analysed in 1970 and 1971 is illustrated by frequency hystograms of the length classes (fig. 2). If in 1970, on 10 of the 17 investigated beaches, the small specimens from + 10 mm class are maximum 27% of deposit, they havenot been found in 1971. In 1970 the classes having the highest frequences were : + 20 (25.21 %) and 30 mm (31.28 %), and, in 1971, + 40 (24.00%) + 50 (21.45 %), + 60 mm (19.85 %).

During 1970 the specimens of + 90 mm class werenot found, while in 1971 they are, however, found (0.25 %). The frequency is higher in 1971 than in 1970 also for the other classes. All these changes concerning the Mya arenaria composition on length classes indicate the growths of the species during one year.

Conclusions

The researches made during these two years in the littoral small depth-zone indicated first of all, that the process of installation of the bivalve Mya arenaria is going on, and its populations are extending, at the Romanian shore of the Black Sea, both towards the small depth zones, the deeper ones.

The species developed exuberantly, from the first recording on our littoral untill nowadays that is in a short couple of years reaching, on an average, a density of 1,037 individuals/m^2 and a biomass of 1.936 g/m^2.

The distribution quantitative data recorded in 1970 and 1971 indicate densities and biomasses much higher than those recorded at the Soviet littoral. The density of populations grew in 1971, as a rule, and the individual growths contributed important additions to the biomass.

The presence of such high quantities at the Romanian littoral can be due to explosive phenomenon of Mya arenaria development, phenomenon which can occur when a species conquers a new area, during the first years of installation.

It is known that the evolutions, in time, of a population in a new area, can occur following two ways. Euther the population is increasing yearly, reaching a relative stability level after some time, or the population is growing explosively to a limit and afterwards begins to decrease.

We consider that Mya arenaria is in full progress of installation, at the Romanian littoral and that is the reason why all changes in its population should be studied from now on.

Mya arenaria being settled in the Romanian sandy infralittoral resulted in the increase of the trophycity of this zone. The big benthos production here, given by the organisms from the coenoses dominated by the bivalve Corbula mediterranea, is made much bigger by the new species, which found here a free ecological niche.

Taking into account that Mya arenaria isnot only a new element in the Black Sea fauna, which must be known in all its aspects, but it is also a new natural resource with revaluation possibilities, extensive researches are necessary in the future to elucidate the species ecology and especially its dynamic aspects in the Pontic basin.

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