

Cercetări marine	I. R. C. M.	Nr. 4	153-167	1972
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ECOLOGIC OBSERVATIONS ON THE FAUNA ASSOCIATED TO THE CYSTOSEIRA BELT ALONG THE ROMANIAN BLACK SEA COAST

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ABSTRACT

The data reported concern the composition, distribution and monthly variation of the invertebrate fauna associated to the alga Cystoseira barbata Ag. along the Romanian Black Sea coast. The study was carried out during summer season, (May to November). The results were compared with the data in the literature referring to other areas of the Black Sea.

Introduction

Algae represents a substrate with a particular structure populated by a great number of animals. The mass of these phytophil organisms brings a marked contribution to the raise of the productivity of the sea-coast. Thus in the Cystoseira stricta (Mont.) Sauv. thickets of the Mediterranean, the biomass of the fauna is of about 4 kg/m^2 (BELLAN-SANTINI 1963) and in Cystoseira crinita Bory of 2 kg/m^2 (BELLAN-SANTINI, 1964). In the Black Sea, the biomass of the fauna associated with the Cystoseira barbata Ag. belts in the Bay of Sevastopol reaches $1,5 \text{ kg/m}^2$

(Makraveeva, 1959), and on the Romanian coast, according to our data reaches up to 3 kg/m^2 .

Along the Romanian coastline, the thickets of the Cystoseira barbata are characteristic of the superior rocky infralittoral south of Constantza, in depths ranging between 0,5 and 5 m. North of Comorova one can only speak of patches of these algae, but to the south of this locality there are two larger fields. The first at the southern extremity of Comorova, from 1,5 to 2, m deep, where there is a area of compact vegetation, the first tufts appearing here at 1 m and the last disappearing at 4 m depth. The second field which is still larger and more compact lies at the level of Vama Veche beach between 0,5 and 2 m deep. Below this depth the Cystoseira population becomes much rarer and disappears completely at 5 m.

The compact aspect of the two fields determined us to choose them for our investigations.

In comparison with the quantitative study of the fauna of other biotopes on the Romanian continental shelf (BACESCU et al., 1971) as well as with the investigations on the fauna associated to the fields along the Soviet coast (MAKKAVEEVA, 1959, 1961, 1964, 1967; MILOVIDOVA, 1969), the fauna of the Cystoseira fields along the Romanian coast has been little investigated (MÜLLER et al., 1969).

Working method

Our investigations were carried out in the fields of Vama Veche and Comorova in the months of May to November. The samples were collected quantitatively from depths of 1-3 m. The tufts chosen as samples were covered with plastic bags and cut at the base.

Preservation was done with 4% formaldehyde. In the laboratory the samples were washed in order to separate the animals and the resulting water filtered through three granulometric screens with diameters of 1 mm, 0,25 mm, 0,12 mm. The sorting of the animals was done under the stereoscopic microscope. The washed algae were also examined under

Table 1

The average value of the monthly density and biomass of the main groups of organisms in the Cystoseira belt of Vame Veche (specimens/kg moist algae and g/kg moist algae)

Month Group	May				June				July				August				November			
	No. of spec.	%	Biomass	%	No. of spec.	%	Biomass	%	No. of spec.	%	Biomass	%	No. of spec.	%	Biomass	%	No. of spec.	%	Biomass	%
Hydrozoa	+	-	+	-	6.863		-	-	1.272		-	-	-		-	-	-		-	-
Turbellaria	432	0,1	0,0495	0,05	4.464	2,7	0,1786	1	2.226	1,6	0,0890	0,05	3.276	1,1	0,1310	0,02	4.579	3	0,1830	0,3
Nematoda	8.209	13,3	0,0039	0,004	2.604	1,6	0,0013	0,006	2.735	1,9	0,0013	0,0007	1.794	0,7	0,0012	0,0002	101	0,0002	0,0002	0,0004
Polychaeta	1.221	2,6	0,9542	0,9	800	0,5	0,2845	1,6	2.172	1,5	3,2201	1,7	2.691	1,2	4,5448	0,7	454	0,3	0,3467	0,7
Olygochaeta	26	0,06	0,0196	0,02	-		-		-		-		-		-		-		-	
Vermes	8.871	19,4	1,1622	1	8.073	5,9	0,4849	2,8	7.324	5,2	3,3295	1,8	7.761	3,4	4,6770	0,7	5.130	3,5	0,5299	1
Gastropoda	192	0,4	0,2363	0,2	149	0,09	0,3725	2	498	0,3	1,4512	0,8	1.222	0,5	0,9750	0,2	111	0,06	0,4590	1
Bivalvia	9.287	20	86,9685	80	763	0,4	1,8984	11,1	2.289	1,6	137,3830	75	5.913	2,6	535,717	86,7	2.990	2	28,9001	59
Copepoda	4.004	8,6	0,0680	0,07	99.045	61	1,2243	7,1	38.011	26,9	0,2919	0,1	2.236	0,9	0,0447	0,006	121.997	83	0,6232	1,2
Ostracoda	1.303	2,8	0,0847	0,07	1.172	0,7	0,0762	0,5	22.518	8,8	0,8137	0,4	8.490	4,3	0,6167	0,1	7.928	5,4	0,5153	1
Isopoda	38		0,4154		19		0,0513		923	0,6	8,7293	4,7	2.627	1	27,0491	4,3	1.463	1,0	8,6356	17,6
Amphipoda	1.218	2,6	0,3026	0,3	13.709	8,4	3,0507	18	56.721	40	13,4731	7,3	46.723	20,4	16,0433	2,5	5.797	3,9	8,6638	17,6
Crustacea	6.627	14,3	1,3626	1,2	113.982	70,2	4,4782	2,6	112.191	79,5	31,9666	17,4	63.791	27,8	45,2553	7,3	137.183	93,3	18,4379	37,4
Halacartida	20.395	43,7	1,4267	1,3	32.141	19,8	8,2499	13	17.151	12,1	1,2006	0,6	147.281	64,5	10,3167	1,5	1.464	1	0,1025	0,2
Chironomida	541	1,1	13,8403	12,7	279	0,1	7,1982	42,3	318	0,2	8,2044	4,4	806	0,4	20,7948	3,3	-		-	
Ova var.	121	0,2	0,0125	0,01	-		-		-		-		-		-		20	0,01	0,0020	0,003
Pontae var.	245	0,5	0,0245	0,02	208	0,1	0,0208	0,1	-		-		-		-		71	0,05	0,0071	0,01
Total	46.580		109,0965		162.250		6,6821		141.276		183,5502		228.995		617,9529		146.969		49,3411	

the microscope in order to note the sessile fauna not detached by washing. The animals were counted and the biomass of the animals smaller than 1 mm was determined using the table of weights, and of those larger than 1 mm by weighing on an analytical balance.

The density and biomass of the animal population was referred to 1 kg of moist algae.

The Ostracoda, Halacarida, Nemertea and Polychaeta species were determined by Dr. A.E. CARAION, A. IONESCU, Dr. G.I. MULLER and D. MANOLELI, whom I have to thank for their competent assistance.

Thanks are also due to the management of the Romanian Marine Research Institute and to Dr. G.I. MULLER for his generous help in the course of our research work.

Sessile fauna

Qualitatively, the sessile fauna is very poor, being represented by 8 species. In our samples, Mytilaster lineatus (Gmelin) had a frequency of 100 per cent and was closely followed by Mytilus galloprovincialis Lam. The other sessile species Aglaophenia pluma L., Spirorbis sp., Balanus improvisus Darwin, Schizoporella auriculata Hassal and Lepralia pallasiana (Moll.) appeared only sporadically in our samples.

The most important species from the quantitative point of view is also Mytilaster lineatus. Although as density it only represents 5 per cent of the total number of organisms, with a maximum of 9000 specimens/kg in May and 6000 specimens/kg in August (table 1), its biomass represents 67 per cent of the mean total biomass. In spite of its great frequency, Mytilus galloprovincialis is much scarcer quantitatively.

It is worth noticing the fact that the great majority of the Mytilaster and Mytilus specimens were very young, measuring 1-3 mm, and such playing a very important trophic role for fish.

The great density of Mytilaster lineatus on Cystoseira thalli may be attributed to its greater resistance (as compared to Mytilus) to the mechanical action of water (BACESCU et al., 1971), resistance

which allows it to profit of the favourable conditions provided by the substrate.

Vagile fauna

In contrast to the sessile fauna, the vagile fauna is much richer both qualitatively (table 3) and as regards density (table 1).

The most important group in regard to density is represented by Crustacea which form 51% of the total number of organisms. Among them the Copepoda and Amphipoda are dominant.

The number of Copepoda ranges fairly large limits depending on the month of the year and especially on the presence or absence of epiphytic algae on the thallus of Cystoseira. Thus, the minimum ranges between 893 specimens/kg in May on a Cystoseira bosporica Sauv. thallus, free of any epiphytes, and 9941 specimens on a Cystoseira barbata thallus slightly loaded with epiphytes and detritus. The maximum reaches 100,000 specimens/kg in June and 122,000 specimens/kg in November on C. barbata richly covered by Chaetomorpha crassa (Ag.) Kütz. The mass species among the Copepoda are Harpacticus gracilis (Claus.), Scutellidium longicauda (Phillipi) and Mesochra pygmaea (Claus.).

The Amphipoda were numerous throughout the interval studied. Maximum density was found in June and especially July and August (table 1) and minimal density in May, ranging between 86 and 26,000 specimens/kg. This group represent 28% of the density of the Crustacea.

There were encountered 14 Amphipoda species (table 3), the tubicolous species being dominant as they can easily rest upon the flexible thallus of the algae. Dominant as density, was Erichtonius difformis M.Edw., representing an average of 76% of the total number of the group. E. difformis was followed quantitatively by Jassa ocla (Bate), Chorophium acherusicum Costa and Amphithoe vaillanti Lucas. Among the non tubicolous Amphipoda, Apherusa bispinosa (Bate) appears in great number a species strongly tending to concentrate in the phytal layer. It also dominates, according to our observations the compact Phyllophora field on the mobile substrate, although the ecologic conditions here are very

different from those met in the Cystoseira field. Among the other species of Amphipoda encountered Stenothoe monoculoides (Montagu) can reach more important density (In August 572 specimens/kg), whereas Dexamine spinosa (Montagu) and Hyale pontica (Rathke) appear fairly constant in the samples but in small number (12-20 and respectively 13-15 specimens/kg).

The populations of the mass species include a very high proportion of young and juvenile forms throughout the interval studied, that being a proof of a continuous reproduction during the summer season.

With Erichtonius difformis the proportion of young specimens is of 30-50% in May and exceeds 75% in summer. With Jassa oia the number of young and juvenile specimens falls below 50% only in November (40%). The same stands true for Amphitoe vaillanti, Corophium acherusicum and Apherusa bispinosa.

Ostracoda, present in all the samples, were represented by 4 species. The densities recorded in May ranged between 46 and 3925 specimens/kg ; maximum values being found in July and August (table 1). The dominant species was Xestoleberis decipiens G.W. Muller, a Mediterranean immigrant which found optimal ecologic conditions in this area of more stable salinity. The other species, Loxoconcha pontica Klie and Eucyterura bulgarica Klie, prefer a rocky-seaweed habitat, and Paradoxostoma simile G.W. Muller is lithophil but its presence at this depth can be considered accidental (CARAION, 1971)

The Isopoda are less dense, their numbers varying from one sample to another, with minimal values in May (from 8 to 121 specimens/kg) and maxima in July and August (Table 1). The dominant species is Naesa bidentata (Adams), followed by Idotea baltica Audouin. Synisoma capito Rathke appears in great numbers only in August (800 specimens/kg).

Specimens belonging to the other orders of Crustaceans were found only in some samples and in small number. Among them mention can be made of Cumella limicola G.O.S., probably linked to the presence of larger amounts of detritus, Leptochella savignyi (Kröyer), Tanais cavonit Mil. Edw., Palaemon elegans Rathke and Xantho poressa (Oliv.)

In spite of their great density the biomass of the Crustacean

is rather small not exceeding 13,2% of the total biomass. This is due both to the dominance of the small sized species and to the very high proportion of young specimens. The highest values were recorded in August and the lowest in May (Table 1). The most important weight of the Crustaceans is that of the Isopoda and Amphipoda, representing 2,9 and respectively 2,6% of the total biomass. The maximum biomass of both groups is reached in August (table 1).

The Copepoda, small in size, have a low biomass that does not exceed 1,4 g/kg. with an average of only 0,26 g/kg. Neither does the biomass of the Ostracoda exceed 0,8 g/kg.

The next group from the point of view of density is that of the Halacaridae. Their density is constantly high, without marked variations; however, a peak is registered in August and a minimum in November (table 1). The dominant species is Rhombognathus magnirostris ponticus Motaş and Soarec, followed by Halacarus basteri affinis Trouess. and Copidognathus magnipalpus ponticus Viets. Being very small in size the biomass of the Halacaridae is constantly low.

In the Cystoseira field of Vama Vechê the proportion of ... is less important i.e. only 9% of the total number of organisms. The most numerous are the Nematoda whose density in some samples may reach 12,000 to 14,000 specimens/kg. Their monthly variations are not significant. Their number is very great in the May 1970 samples and very low in the May 1971 samples. This might be due to the amount of detritus and epiphytes covering the thalli.

The density of the Turbellaria and Polychaeta is almost the same, i.e. 3280 specimens/kg of the former and 2700 specimens/kg of the latter. The Turbellaria register an evident peak in summer months (June, July, August) (table).

Most of the Polychaeta belong to the species Platynereis dumerilii (Audouin et Mil.-Edw.), with a marked phytophilia. In some samples there were also numerous the specimens of Fabricia sabella (Enrenberg), Grubea clavata (Claparède) and Nereis zonata Malmgren.

The Nemertea appear in the phytal layer only sporadically and

do not exceed 20 specimens/kg. The rocky-dwelling species, Tetrastemma coronatum (Quatrefages) and T. melanocephalum Johnston) appear more often, being migrated here from the rocky substrate.

The biomass of the worms does not exceeded 1 % of the total biomass. Although they vary from month to month a maximum is reached in July-August (table 1). The dominant group in the biomass of them is that of the Polychaeta, the biomass of the other groups being less important.

Chironomida larvae were present in all the samples, their biomass representing an average of 8% of the general biomass.

The results discussed above refer to the field of Cystoseira of Vama Veche. At Comorova the samples were only collected in May and June. In May from a qualitative point of view the samples did not differ essentially from those collected at Vama Veche, the differences being only quantitative.

In both fields, in May, the dominant group was that of the Halacaridae prevalently observed at Comorova (tables 1 and 2), and the bivalves prevalent at Vama Veche (but according to their weight they are also dominant at Comorova where they represent 93% of the total biomass). Among the Crustaceans there was a dominance of the Amphipoda over the Copepoda, in contrast to the situation at Vama Veche. The Amphipoda species were same, but there were no young forms observed probably because the samples were collected two weeks earlier than at Vama Veche and because the temperature was lower : 12°C as compared to 17°C at Vama Veche.

In June the difference between the two fields is more marked owing to the numerical predominance of Crustaceans at Vama Veche (70,2%) and of the Nematoda at Comorova (32%) (Table 2). The difference is also due to the increased turbidity of the water, with large silt deposits which have favoured the spreading of Nematoda.

As regards the monthly variations ; we can also mention : the presence of Hydrozoa almost exclusively in summer and autumn months (Aglaophenia pluma) a greater number of Nematoda in May and the

numerical explosion of Crustaceans during the summer months, when new generations appear and keep occurring up to November. There are nonsignificant variations to be recorded with the rest of the groups. Taking into account the total number of organisms, we can assume that the density in summer months (June, July, August) as compared to May, increased by 3 to 4 times.

Table 2

The average value of the monthly density and biomass of the main groups of organisms in the Cystoseira belt of Comorova

Month Group	May				June		
	No. of spec.	%	Biomass	%	No. of spec.	%	Biomass
Hydrozoa	4	0,01	-		V 18	V 0,32	-
Turbellaria	431	1,14	0,0172	0,03	6.219	10,90	0,2488
Nematoda	2.623	6,95	0,0014	0,003	18.252	32,00	0,0116
Polychaeta	240	0,63	0,1420	0,27	6.789	12,00	8,7249
Oligochaeta	24	0,06	0,0055	0,01	-	-	-
Vermes	3.318	8,80	0,1661	0,31	31.260	54,84	8,9853
Gestropoda	31	0,08	0,0488	0,09	2.024	3,55	1,2037
Bivalvia	2.124	5,60	48,2666	92,11	36	0,06	1,1340
Molusca	2.155	5,70	48.3154	92,20	2.060	3,61	2,3377
Copepoda	1.493	3,96	0,0286	0,05	6.919	11,35	0,1211
Ostracoda	650	1,70	0,0422	0,08	1.398	2,45	0,0909
Isopoda	55	0,12	0,0373	0,07	147	0,25	0,0147
Amphipoda	2.108	5,60	0,9062	1,73	5.113	8,96	1,4321
Crustacea	4.306	11,40	1,0143	1,93	13.577	23,81	1,6588
Halacarida	25.604	67,95	1,8155	3,46	9.274	16,26	0,6493
Chironomida	33	0,09	0,8633	1,64	405	0,71	10,4490
Ova	2.183	5,80	0,2183	0,42	-	-	-
Pontae	73	0,20	0,0073	0,01	424	0,74	0,0424
Total	37.676	100%	52,4002	100%	57.018	100%	24,1225

List of species found in the algae fields of Vama Veche and Comorova

- Obelia loveni Allman
Aglaophenia pluma (L)
 Hydrozoa var.
 Turbellaria var.
 Nematoda var.
Amphiphorus lactifloreus Johnston
Tetrastemma coronatum (Quatrefages)
T. melanocephalum (Johnston)
T. peltatum Bürger
Phyllodoce rubiginosa Saint-Joseph
Fulafia sanguinea (Oersted)
Harmothoe reticulata Claparède
Exogone gemmifera Pagenstecheri
Sphaerosyllis bulbosa Southern
Grubea clavata (Claparède)
Nereis zonata Malmgren
Platynereis dumerilii (Audouin et M-Edw.)
Capitomastus minimus (Langerhans)
Fabricia sabella (Ehrenberg)
Spirorbis sp.
 Oligochaeta var.
Chiton marginatus Pennant
Rissoa splendida (Eichwald)
Hydrobia ventrosa (Montagu)
Limapontia capitata (O. F. Müller)
Mytilus galloprovincialis (Lam.)
Mytilaster lineatus (Gmelin)
Cymbasoma longispinosum (Bourne)
 Copepoda var.
Eucytherura bulgarica Klie

Xestoleberis decipiens G.W. Müller
Loxoconcha pontica Klle
Paradoxostoma simile G.W. Müller
Balanus improvisus Darwin
Cumella limicola G.O. Sars
Palaemon elegans Rathke
Xantho poressa (Oliv)
Tanais cavolini Mil.-Edw.
Leptochelia savignyi (Kröyer)
Eurydice racovitzai Băcesco
Idotea baltica Audouin
Synsoma capito (Rathke)
Naesa bidentata (Adams)
Stenothoe monoculoides (Montagu)
Apherusa bispinosa (Bate)
Nototropis guttatus (A. Costa)
Gammarus insensibilis Stock
G. marinus Leach
Dexamne spinosa (Montagu)
Hvale pontica Rathke
Amphithoe vaillanti Lucas
Microdeutopus damnoniensis (Bate)
Jassa oia (Bate)
Erichtonius difformis Mil.-Edw.
Corophium crassicorne Bruzellus
C. acherusicum Costa
C. bonelli (Mil.-Edw.)
Rhombognathus magnirostris ponticus Motaş et Soarec
Halacarus basteri affinis Trouess
Copidognathus magnipalpus ponticus Viets
Lepralia pallasiana (Moll)
Schizoporella auriculata Hassall
 Bryozoa var.

Discussion of results

Comparing our data with those obtained by BACESCU et al. (1963) and data referring to the fauna associated to the Cystoseira fields of Comorova, Tăbăcărie and Tuzla (MULLER et al., 1969) it can be seen that the fauna of the Cystoseira field of Vama Veche differs very little qualitatively but presents marked quantitative differences. The density of the organisms in the field of Vama Veche is far greater than that found on a rocky substrate. The mean density during the summer months at Vama Veche is of 177,507 specimens/kg. The amount of Cystoseira per m^2 in this zone ranges, according to G. I. MULLER (investigations carried out in 1970), between 3 and 7 kg/m^2 . On referring the density of the animals per m^2 , values of 532,500 specimens/ m^2 and 1,242,500 specimens/ m^2 will be obtained. These values exceeds by far the density recorded on a rocky substrate (115,000 up to 432,400 specimens/ m^2 in July).

Great differences can be noted as regards the density of the fauna of the fields north of Comorova (21,435 up to 48,977 specimens/kg) (MULLER et al., 1969). Thus, the values recorded by us at Vama Veche exceed these figures by 3 to 8 times.

There are hardly any qualitative differences, except for the absence of the species Pleonexes gammaroides Bate from our samples. The quantitative differences between the different species are of greater importance. On a rocky substrate (BACESCU et al., 1963) and in the algae belt north of Comorova (MULLER et al., 1969), among the Amphipoda the species of Corophium, and especially C. acherusicum, are dominant (representing 78 and 52% of the number of Amphipoda), followed by Pleonexes gammaroides and Amphithoe vaillanti. The net dominance of Erichtonius difformis (76% of the Amphipoda) appears to characterize only the algae belts south of Comorova.

The differences are more important if we compare our data to those referring to the Cystoseira fields in the north-western and north-eastern zones of the Black Sea (MAKKAVEEVA, 1959, 1961, 1964, 1967; MILOVIDOVA, 1969). There, the Cystoseira fields are in sheltered bays

and far more developed reaching down to 20 m depth. The main features of the fauna in these belts is that the Molluscs are dominant numerically as well as in weight. Gasteropoda that are very numerous there, appear in small amounts only along our shores, the main species being the same: Rissoa splendida (Eichwald). Among the bivalves there is a net dominance of Mytilaster lineatus too which are very dense in the northern parts of the Black Sea, whereas at Vama Veche they only represent 5,3% of the total number of organisms. The absence of sheltered bays, the spread of the Cystoseira barbata field only down to at most 5 m and, consequently, the accentuated hydrodinamism proper of our shoreline, does not permit the settlement of the mollusc larvae in large amount as on the Soviet shores.

The same cause, to which there may be added the differences in salinity and temperature, determines the absence of sponges, Hydrozoa, Polychaeta Sperpulidae and Bryozoa in the algae belts of the Romanian littoral.

Some differences may also be noted in the group of Crustaceans which although numerous along our coastline are represented by fewer species. For instance, Leptochelia sawigny is very dense in Soviet waters (MAKKAVEEVA, 1961) but is fairly rare in our waters. Among the Amphipoda of the Soviet shores Amphithoe vallanti and Caprella acanthifera Leach are dominant yet the latter was practically absent in our samples. Of the typically phytophil Decapoda species, Hyppolite longirostris (Czern.) and Macropodia longirostris are absent on the Romanian shores.

Conclusions

1. The main features of the fauna associated to Cystoseira fields south of Comorova are the following :
 - the most characteristic species is the amphipod Erichtonius difformis, which registers a maximum concentration in this biotope ;
 - the qualitative and quantitative scarcity of the sessile fauna,

which is due to the strong movement of the water in these areas, movement that prevents massive settlement of the larvae of these animals ;

- the fauna is almost exclusively formed of micro- and mesobenthic organisms able to maintain themselves upon the thallus of the algae;

- the great density of the fauna, comparable and sometimes exceeding that of the Cystoseira belts in the north-west of the Black Sea.

2. The macrophytic substrate, due to its height and complex structure, considerably increases the surface at the disposal of the benthic organisms. At the same time it permits distribution of these organisms in some instances within a layer of water of over 50 cm. This explains the huge density of 532,000 up to 1,242,500 specimens/m² which exceeds by far not only that found on a rocky substrate but more often exceeds that registered on many other substrates of our continental shelf. The biomasses found during the summer months are also fairly high ranging between 1200 and 2800 g/m².

3. This fauna is almost entirely represented by trophic forms playing an important role for fish, either directly or at different levels of the trophic chain. At least, in some periods of the year a number of fishes populate the macrophyte thickets. Many Labridae, Blennidae and Gobiidae find shelter and food in the algae belts along the coast, being even adapted to this biotope by homochromy.

4. The great majority of the fauna of this biotope is represented by filter-feeding organisms whose activity, added to the massive oxygenation of the water in this zone due to photosynthesis of the algae, plays an important role in cleaning the littoral waters.

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