

## **A NEW TYPE OF MACROZOOBENTHIC COMMUNITY FROM THE ROCKY BOTTOMS OF THE BLACK SEA**

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### **ABSTRACT**

Although the presence of the reef building polychaete *Ficopomatus enigmaticus* (a neozoon) in the Black Sea has long been known to marine biologists, up to now no one has performed a detailed analysis of the macrozoobenthic community established within *Ficopomatus* reefs. As a contribution to the knowledge of the ecological role of this neozoon, this paper aims to demonstrate that, although restricted in range, the *Ficopomatus* community has a clearly distinct individuality. We conducted a comparative analysis of both taxonomic structure and functional feeding structure of two types of macrozoobenthic community (*Ficopomatus* –dominated vs. *Mytilus*-dominated).

### **INTRODUCTION**

Prior to 1970, Băcescu (Băcescu et al., 1971) described several subtypes of the *Mytilus*-dominated macrozoobenthic community that covers the rocky bottoms of the Romanian Black Sea shore. While mussels cover almost all rocky bottoms and are of enormous ecological importance for Romanian marine waters, we discovered the existence of another, completely different, type of community. This community develops on hard substrata and it is edified by a neozoon, the reef-building polychaete tubeworm *Ficopomatus enigmaticus* (Fauvel 1923) syn. *Mercierella enigmatica* Fauvel 1923.

In Europe, *Ficopomatus enigmaticus* was first noticed in northern France (Caen, Normandy) in 1921 (Fauvel, 1923). It was first recorded from London docks in 1922 (Monro, 1924). The origin of this species is not clear, as it occurs in waters of variable salinity in temperate or warm temperate areas of both northern and southern hemispheres. According to Rullier (Rullier, 1966), it originates in the coastal lagoons of India and was transported to Europe on the hulls of English warships during World War I. More recently, it was believed to have been introduced from Australia (Zibrowius & Thorp,

1989). However, recent Australian literature lists *Ficopomatus enigmaticus* as an introduced species, and the best conclusion is that it is clearly southern hemisphere in origin.

In the Black Sea it was first recorded from the brackish Paleostomi Lake in Georgia (Annenkova, 1929). Until the mid-sixties it became established in several other brackish and oligohaline locations along the Black Sea coasts (Zaitsev & Ozturk, 2001). Today it has a disjunct distribution along the Romanian shore, in confined and oligohaline waters like harbours and lagoons.

*F. enigmaticus* prefers brackish waters, including estuaries, this species is ideal for transport on ships' hulls (most major ports are sited on estuaries) and commercial molluscs that are usually farmed in stagnant brackish lagoons. Worldwide, its disjunct distribution suggests spread by long-range dispersal of mobile adults (on ships' hulls). It is thought to be at, or close to, its temperature minimum for maintaining populations and successful reproduction along the 45° northern latitude parallel (Zibrowius & Thorp, 1989; Thorp, 1994). More northerly populations survive owing to artificially raised water temperatures (Naylor, 1959, 1965). In addition, successful reproduction is considered to be limited to waters of variable salinity.

Within relatively confined waters of variable salinity, *F. enigmaticus* suffers little competition from other serpulids. Such estuarine and lagoonal environments are characteristically areas of high productivity and so filter-feeders such as *Ficopomatus enigmaticus*, which are able to stand considerable variations in salinity, are well placed to reap the benefit. High fecundity, allied with larval retention within semi-enclosed waters, facilitates a rapid increase of numbers and hence the build up of reefs (Dixon, 1981). It thrives exactly in the areas that are most stressing and unsuitable for the majority of other marine biota.

In the Romanian Black Sea, sparse and short-lived *Ficopomatus* individuals may be encountered at open locations, but persistent colonies and compact reefs are present only in sheltered areas, like harbours and lagoons. In such protected waters *F. enigmaticus* covers the entire hard substratum with a mass of erect, contiguous and intertwined calcareous tubes (up to 20 cm long). Successive generations of worms may raise the thickness of this reef up to more than 50 cm. Perhaps the most important characteristic of *F. enigmaticus* is that the reefs it builds constitute a highly tridimensionally complex biotope, unique in the Black Sea and harboring a diverse fauna.

This paper aims to demonstrate that, although restricted in range, the *Ficopomatus*-community has a clearly distinct individuality. We conducted a comparative analysis of both taxonomic structure and functional feeding structure of the two types of macroinvertebrate community (*Ficopomatus*-dominated vs. *Mytilus*-dominated).

## **MATERIAL AND METHODS**

Our study was carried out inside the Constanta Sud – Agigea harbour (3 sampling stations) and the Belona marina, Eforie Nord (2 sampling stations), positioned as shown on the map. All stations were similar up to a point, the difference consisting mostly in water movement intensity. Samples were taken in March and May 2002.

At each station, all samples were taken from hard substratum (rock or concrete) at the same depth (1.5–2 m), to eliminate confusion due to faunal differences that are depth-dependent. Sampling was done by the author by SCUBA diving, this being the only method that allows for highly accurate, implicit error - free sampling (Flemming & Max, 1996). Diving also allowed for in-situ observations that proved invaluable for later interpretation of the data. In order to solve several questions that arose while processing the samples, we conducted extensive dives, to a depth of 22 m.

Three replicates (625 cm<sup>2</sup>) were collected at each station by scraping to the bare rock and then sieved through 1 mm size mesh. The material retained was immediately preserved in 5% buffered formalin. To ensure consistency of the data set, in view of later statistical analysis requirements, all organisms were identified down to species level.

Both numeric abundance and biomass were calculated for each species. Biomass was determined as dry weight by drying the organisms to constant weight (at 105 °C for 7 days).

Two-way ANOVA suggested that the differences (in total abundance per replicate) between sampling periods and sites were not significant ( $P < 0.05$ ), so we calculated Shannon diversity and evenness and McNaughton dominance.

Dominance (relative abundance, rA), constancy and ecological significance (W) were calculated both as numeric (using abundance) and gravimetric (using biomass) values.

Dissimilarity of species abundance between samples was calculated using the Bray – Curtis coefficient. As mentioned afore, a two-way ANOVA suggested that total abundance did not differ significantly ( $P < 0.05$ ) between sites and sampling dates, so we could safely avoid data standardisation that would have led to loss of valuable biological information (Clarke & Warwick, 1994).

We used Bray Curtis - based principal coordinates analysis (PCO) and principal components analysis (PCA) to estimate dissimilarities between communities.

To reveal differences in the functional groups that convey energy fluxes of the two communities, macroinvertebrates were classified in five functional feeding groups: passive filter-feeder, active filter-feeder, deposit feeder, shredder, predator. Species which may use several ways of

feeding, depending on opportunities, were classified according to the prevalent feeding strategy. Species abundance was quantified as biomass (dry weight).

We used Morisita's modified coefficient to assess similarity in functional feeding group composition of the two communities and Bray – Curtis based PCO to estimate dissimilarities.



Figure 1. Location of sampling sites

## RESULTS AND DISCUSSION

Situated 50 m downstream of the Danube – Black Sea Canal locks, **Ecluza** sampling site has highly variable salinity and exposure to waves caused by ships transiting the locks. The mussel-dominated epibiosis forms a continuous layer, 10-15 cm thick, on the concrete walls. The sparse algal cover (*Enteromorpha*, *Cladophora*, *Ceramium*) is replaced by *Obelia* colonies and *Aurelia* polyps (in winter) as depth increases. *Ficopomatus* forms rare, small arborescent colonies. Wave disturbance prevents it from forming reefs.

Shannon diversity and evenness have moderate values (1.77 and 0.38, respectively) due to the relatively high number of species present, but McNaughton dominance is high (0.81) owing to the great abundance of *Mytilus*, *Mytilaster* and *Balanus*.

Numerical analysis shows 15 constant species, of which 3 are dominant (*Mytilus*, *Balanus* and *Ficopomatus*). The constant presence of many rarer species indicates a diverse, healthy community.

Biomass analysis overthrows the dominance of *Ficopomatus*, which becomes insignificant, and shows a clear dominance of the community by *Mytilus* and *Balanus*.

Table 1. Abundance, dominance and diversity of macrozoobenthic species (rA = relative abundance)

Nr.	Specia	Ecluză		Gura Canal		Dana 137		Belona M		Belona F	
		ind/m <sup>2</sup>	rA	Ind/m <sup>2</sup>	rA	ind/m <sup>2</sup>	rA	ind/m <sup>2</sup>	rA	ind/m <sup>2</sup>	rA
1	<i>Obelia longissima</i>	16	0.014	20	0.041	36	0.35				
2	<i>Aurelia aurita</i>	1000	0.868								
3	<i>Aiptasiamorpha luciae</i>			24	0.049			64	0.24	560	0.189
4	<i>Stylochoplana taurica</i>			8	0.016	117	1.15	32	0.12	112	0.038
5	<i>Empectonema gracile</i>							16	0.06		
6	<i>Neanthes succinea</i>	184	0.160	1704	3.481	708	6.96	528	1.94	3456	1.165
7	<i>Syllis gracilis</i>									16	0.005
8	<i>Ficopomatus enigmaticus</i>	13480	11.707	640	1.308	260	2.56	13648	50.18	245250	82.651
9	<i>Corambe obscura</i>							80	0.29	144	0.049
10	<i>Anadara inaequalvis</i>	400	0.347	476	0.972	88	0.87				
11	<i>Mytilus galloprovincialis</i>	69456	60.321	29424	60.113	1636	16.09	1664	6.12	1171	0.395
12	<i>Mytilaster lineatus</i>	1404	1.219	4364	8.916	2160	21.24	4128	15.18	544	0.183
13	<i>Musculista senhousia</i>	4	0.003								
14	<i>Cerastoderma glaucum</i>	16	0.014			12	0.12			80	0.027
15	<i>Parvicardium exiguum</i>	24	0.021	8	0.016						
16	<i>Papillicardium papillosum</i>					4	0.04				
17	<i>Spisula subtruncata</i>					4	0.04				
18	<i>Abra ovata</i>			24	0.049						
19	<i>Mya arenaria</i>	1672	1.452	1320	2.697	144	1.42				
20	<i>Balanus improvisus</i>	23280	20.218	10208	20.855	4152	40.83	4464	16.41	35088	11.825
21	<i>Palaemon elegans</i>	24	0.021			16	0.16	160	0.59	160	0.054
22	<i>Palaemon adspersus</i>	16	0.014			16	0.16	160	0.59	160	0.054
23	<i>Athanas nitescens</i>			16	0.033	88	0.87				
24	<i>Pontophilus fasciatus</i>					8	0.08				
25	<i>Pisidia longicornis</i>	32	0.028	68	0.139	24	0.24	16	0.06		
26	<i>Rhitropanopeus harrisi</i>	136	0.118	340	0.695	664	6.53	704	2.59	528	0.178
27	<i>Pilumnus hirtellus</i>			4	0.008	4	0.04			16	0.005
28	<i>Xantho poressa</i>									32	0.011
29	<i>Pachygrapsus marmoratus</i>							16	0.06	32	0.011
30	<i>Chaetogammarus placidus</i>									192	0.065
31	<i>Iphigenella andrusowii</i>							16	0.06		
32	<i>Dikergammarus villosus</i>							16	0.06		
33	<i>D. haemobaphes</i>									176	0.059
34	<i>Pontogammarus crassus</i>									112	0.038
35	<i>Orchestia mediterranea</i>									384	0.129
36	<i>Orchestia montagui</i>	8	0.007					16	0.06		
37	<i>Microdeutopus gryllotalpa</i>	568	0.493	20	0.041	4	0.04	784	2.88	592	0.200
38	<i>Microdeutopus stations</i>	104	0.090								
39	<i>Microdeutopus anomalus</i>	64	0.056								
40	<i>Amphithoe vaillanti</i>	8	0.007								
41	<i>Sphaeroma pulchellum</i>			68	0.139			464	1.71	4928	1.661
42	<i>Idothea baltica</i>							176	0.65	2992	1.008
43	<i>Tanais cavolinii</i>	16	0.014	180	0.368						
44	<i>Clunio marinus</i>			32	0.065			48	0.18		
45	<i>Molgula manhattensis</i>					16	0.16				
46	<i>Styela clava</i>					4	0.04				
47	<i>Neogobius melanostomus</i>	16	0.014								
48	<i>Proterorhinus marmoratus</i>					4	0.04				
49	<i>Scorpaena porcus</i>									3	0.001
	TOTAL	115144		48948		10169		27200		296728	

<b>H(S)</b>	<b>1.77</b>	<b>1.82</b>	<b>2.51</b>	<b>2.33</b>	<b>0.99</b>
<b>E</b>	<b>0.38</b>	<b>0.42</b>	<b>0.55</b>	<b>0.53</b>	<b>0.22</b>
<b>I<sub>DC</sub></b>	<b>0.81</b>	<b>0.81</b>	<b>0.62</b>	<b>0.67</b>	<b>0.94</b>

**Gura Canal** sampling site is positioned where the brackish part of the Danube – Black Sea Canal enters the Constanța Sud – Agigea seaport. This area is exposed to waves driven by the prevailing NNE winds. Epibiotic cover on the limestone rocks is reduced. At depth, the mussel layer becomes compact, covered by sparse *Obelia longissima* colonies. Underlying sediment accumulations are inhabited by *Abra ovata*.

Shannon diversity and evenness have medium values (1.82 and 0.42, respectively) due to the relatively high number of species present, but McNaughton dominance is high (0.81) owing to the greater abundance of *Mytilus* and *Mytilaster*.

Numerical analysis indicates 10 constant species, of which 2 are dominant (*Mytilus*, *Balanus*). The constant presence of many rarer species indicates a diverse, healthy community. Gravimetric analysis confirms the clear dominance of *Mytilus* and *Balanus*.

**Dana 137** sampling site is a dock inside the Constanța Sud – Agigea seaport, about 3 km away from the initial shoreline. Byssus-attached bivalves (*Mytilus*, *Mytilaster*, *Anadara*), bivalves living in the sediment (*Mya*, *Parvicardium*, *Spisula*) and urochordates (*Molgula* and *Styela*) cover the 17 m high concrete seawall with a thin epibiosis.

Shannon diversity and evenness attain the highest values (2.51 and 0.55, respectively) here. Although total abundance is smaller than at other sites, the number of species has increased, especially that of the urochordates and decapod crustaceans. McNaughton dominance is decreasing (0.62).

Numerical analysis indicates 9 constant species, of which 3 are dominant (*Mytilus*, *Balanus* and *Mytilaster*). Twelve accessory and accidental species, with low ecological significance, are not characteristic for hard substratum or shallow water. Biomass analysis emphasizes the importance of urochordates and *Anadara*, owing to their high individual biomass.

**Belona Mytilus** sampling site is situated on the northern and eastern seawalls (4 m high) of the Belona marina, exposed to direct action of waves coming from the south. A thin (5 cm) mussel epibiosis covers the concrete. *Ficopomatus* is present in higher numbers, but it does not form colonies. There are juvenile tube agglomerations inside empty mussel shells, but most of them do not survive to adulthood.

Shannon diversity and evenness are still high (2.33 and 0.53, respectively), while McNaughton dominance increases slightly (0.67).

Numerical analysis indicates 16 constant species, of which 3 are dominant (*Ficopomatus*, *Mytilaster*, *Balanus*). The constant presence of many rarer species indicates a diverse, healthy community. Gravimetric analysis indicates the insignificance of *Ficopomatus*, the dominant species

being *Mytilus* and *Mytilaster*. Decapod crustaceans gain importance due to both the high individual biomass of large crabs and the increased numbers of small crabs and shrimp.

**Belona Ficopomatus** sampling site is situated on the western and southern seawalls of Belona marina, sheltered from both prevailing NNE winds and direct action of waves. Here, *Ficopomatus* builds compact reefs (50 cm thick in places), covering the entire surface of the walls, from the bottom up to the waterline. The calcareous tubes are erect, contiguous and intertwined, forming a complex, sponge-like structure. The apertures of the tubes are welded together in a compact surface.

Normally, there are no live bivalves on a *Ficopomatus* reef, as the fast-growing tubes entwine around the valves, overgrow and finally smother them. Mussel juveniles sometimes attach themselves on the surface of the reef, but they never survive to adulthood. Thus, the worm eliminates competition for space and food. The only mussels that do survive are those littering the floor of the complex network of crevices and tunnels that large crabs are digging in the reef. Constant movements of crabs and fishes (*Scorpaena*, *Gobiidae*) through these narrow spaces prevent settlement of *Ficopomatus* larvae and destroy the tubes of juveniles that however manage to settle.

Shannon diversity and evenness are at their lowest (0.99 and 0.22, respectively) here. The number of species did not decrease (on the contrary, it increased slightly as compared to neighboring Belona *Mytilus* site), but their abundances are very unevenly distributed. The community is overwhelmingly dominated by *Ficopomatus*, as shown by the high (0.95) McNaughton dominance.

Numerical analysis indicates 2 dominant (*Ficopomatus* and *Balanus*) and 19 constant but subprecedent species, suggesting a healthy, diverse community that is strongly dominated by the leading species. Biomass analysis confirms the dominance of *Ficopomatus* and *Balanus*. Numeric and gravimetric subdominance is attained by a group of species that never held this status in *Mytilus*-dominated communities: *Palaemon*, *Xantho*, *Orchestia* and *Sphaeroma*.

Although a distance of less than 100 m separates the Belona *Mytilus* and Belona *Ficopomatus* sites, the macrozoobenthic communities differ markedly. *Ficopomatus* is present at all sites, but only here, in sheltered waters, can it develop into a reef and radically change the biotope and the taxonomic structure of the community.

The macrozoobenthic communities that inhabit the other four sites (Ecluză, Gura Canal, Dana 137, and Belona *Mytilus*) are just variations on the theme of the rocky bottom mussel community, as it was described by Băcescu (Băcescu et al., 1971).

Clustering (Figure 2) resulted in three site groups. Belona *Ficopomatus* was in a group all by itself, being 92.6% dissimilar to the other four sites. Ecluză and Gura Canal were least dissimilar

(0.46), as both had roughly the same environmental conditions, which favored the highest abundance of *Mytilus*, *Mytilaster* and *Balanus*. Between Belona Mytilus and Dana 137 there was a dissimilarity of (0.63), mainly due to a slightly different species composition. Between the last two groups there was a dissimilarity of 0.78, which can be attributed to a difference in salinity levels that tend to be lower and highly variable at Ecluza and Gura Canal stations.

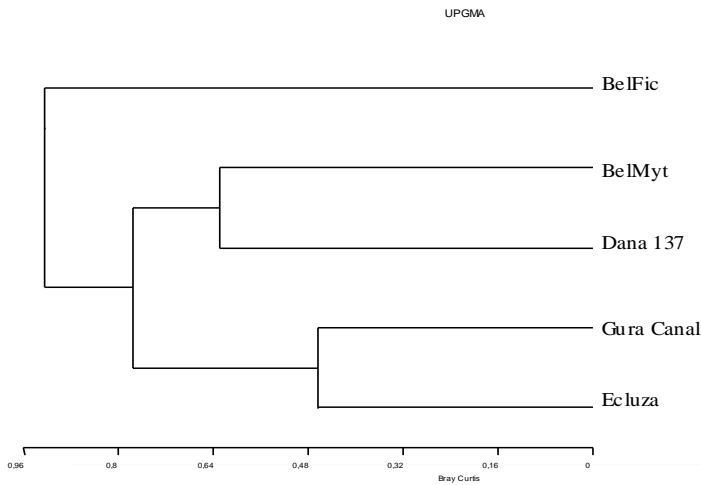


Figure 2 Dendrogram of the between-sites Bray-Curtis dissimilarity

Both PCO and PCA (Figure 3 and Figure 4, respectively) analyses reveal the greatest distance between the *Ficopomatus* community and the other four *Mytilus*-dominated communities, which are more or less (tightly, in the case of PCA) grouped together. The *Ficopomatus* reef is singled out as a clearly different type of macrozoobenthic community, in both species composition and the abundances these attain.

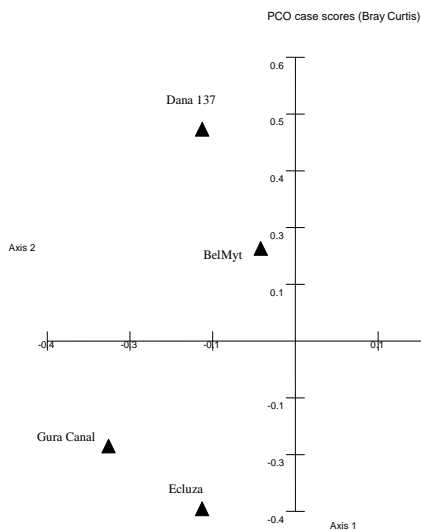


Figure 3 Principal Coordinates Analysis ordination of sites based upon taxonomic community structure



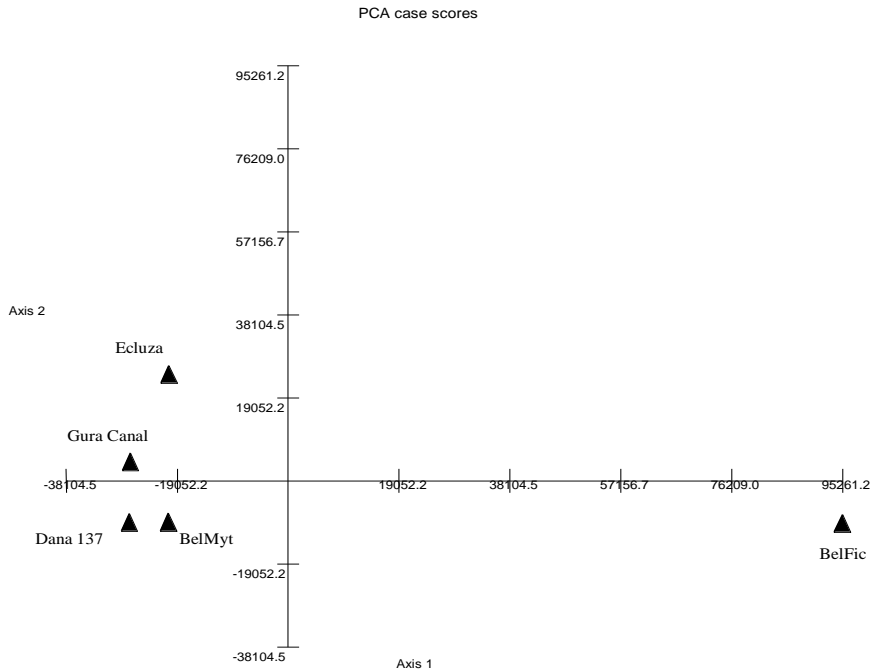


Figure 4. Principal Components Analysis ordination of sites, based upon taxonomic community structure

To see the difference, not only in taxonomic structure but also in the workings of the cenose, we used multivariate analysis to compare the functional feeding group (quantified as biomass, as listed in Table 2) structures of the two types of macrozoobenthic community.

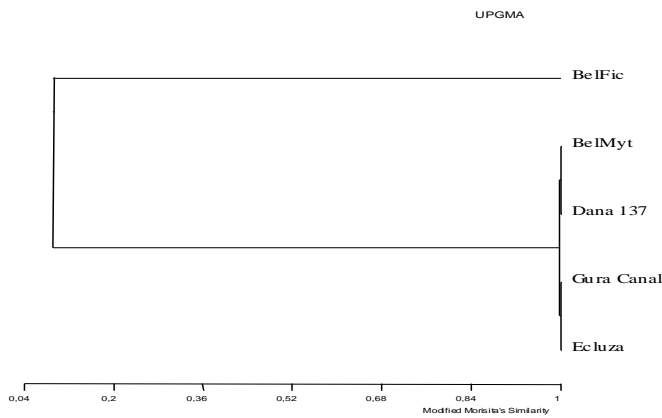


Figure 5. Dendrogram of the between-sites Modified Morisita's similarity

Two-way ANOVA suggested that there is no significant ( $P < 0.05$ ) difference in the total biomass abundance of the replicates, between sites and periods.

Clustering (Figure 5) resulted in extreme differentiation. While the four sites with *Mytilus*-dominated communities had 100% similarity, their similarity, as a group, with the *Ficopomatus* reef site was of only 0.93%.

Table 2. Biomass and composition of functional feeding groups (g DW / m<sup>2</sup>)

	Ecluză	Gura Canal	Dana 137	Belona M	Belona F
<i>Obelia longissima</i>	1.92	2.4	4.32	0	0
<i>Aurelia aurita</i>	12	0	0	0	0
<i>Aiptasiamorpha luciae</i>	0	0.288	0	0.768	6.72
<i>Ficopomatus enigmaticus</i>	15.224	0.704	0.286	15.013	269.78
<b>Passive filterfeeder</b>	<b>29.144</b>	<b>3.392</b>	<b>4.606</b>	<b>15.781</b>	<b>276.5</b>
<i>Anadara inaequalis</i>	60.16	71.59	13.24	0	0
<i>Mytilus galloprovincialis</i>	3710.1	1350.4	182.3	4471.8	23.317
<i>Mytilaster lineatus</i>	134.88	160.67	171.6	829.28	13.317
<i>Musculista senhousia</i>	0.332	0	0	0	0
<i>Cerastoderma glaucum</i>	0.9088	0	0.572	0	4.544
<i>Parvicardium exiguum</i>	1.1448	0.3816	0	0	0
<i>Papillicardium papillosum</i>	0	0	0.191	0	0
<i>Spisula subtruncata</i>	0	0	4	0	0
<i>Mya arenaria</i>	18.006	7.0838	3.617	0	0
<i>Balanus improvisus</i>	1657.8	726.81	96.01	317.84	810.53
<i>Molgula manhattensis</i>	0	0	91.2	0	0
<i>Styela clava</i>	0	0	22.8	0	0
<b>Active filterfeeder</b>	<b>5583.3</b>	<b>2316.9</b>	<b>585.5</b>	<b>5618.9</b>	<b>851.71</b>
<i>Neanthes succinea</i>	3.9616	7.029	2.887	0.9424	3.0096
<i>Abra ovata</i>	0	4.32	0	0	0
<i>Clunio marinus</i>	0	0.0006	0	0.0009	0
<b>Deposit feeder</b>	<b>3.9616</b>	<b>11.35</b>	<b>2.887</b>	<b>0.9433</b>	<b>3.0096</b>
<i>Chaetogammarus placidus</i>	0	0	0	0	13.44
<i>Iphigenella andrusowii</i>	0	0	0	1.12	0
<i>Dikerogammarus villosus</i>	0	0	0	1.12	0
<i>D. haemobaphes</i>	0	0	0	0	12.32
<i>Pontogammarus crassus</i>	0	0	0	0	0.784
<i>Orchestia mediterranea</i>	0	0	0	0	46.08
<i>Orchestia montagui</i>	8	0	0	1.92	0
<i>Microdeutopus gryllotalpa</i>	0.1306	0.0046	9E-04	0.1803	0.1362
<i>Microdeutopus stations</i>	0.0239	0	0	0	0
<i>Microdeutopus anomalus</i>	0.0147	0	0	0	0
<i>Amphithoe vaillanti</i>	0.0072	0	0	0	0
<i>Sphaeroma pulchellum</i>	0	0.5156	0	1.9328	29.754
<i>Idothea baltica</i>	0	0	0	0.864	11.502
<b>Shredder</b>	<b>8.1765</b>	<b>0.5202</b>	<b>9E-04</b>	<b>7.1371</b>	<b>114.02</b>
<i>Stylochoplana taurica</i>	5.52	0.24	3.51	0.96	3.36
<i>Emplectonema gracile</i>	0	0	0	0.56	0
<i>Syllis gracilis</i>	0	0	0	0	0.0006
<i>Corambe obscura</i>	0	0	0	2.4	4.32
<i>Palaemon elegans</i>	4.8	0	3.2	32	32
<i>Palaemon adspersus</i>	4	0	4	40	40
<i>Athanas nitescens</i>	0	1.6	8.8	0	0
<i>Philocheras fasciatus</i>	0	0	0.8	0	0
<i>Pisidia longicornis</i>	0.96	2.04	0.72	0.48	0
<i>Rhitropanopeus harrisi</i>	3.4768	5.6623	7.12	8.3312	13.178
<i>Pilumnus hirtellus</i>	0	0.1	0.1	0	0.4
<i>Xantho poressa</i>	0	0	0	0	38.4
<i>Pachygrapsus marmoratus</i>	0	0	0	160	320
<i>Tanais cavolinii</i>	0.0064	0.072	0	0	0
<b>Predator</b>	<b>18.763</b>	<b>9.7143</b>	<b>28.25</b>	<b>244.73</b>	<b>451.66</b>

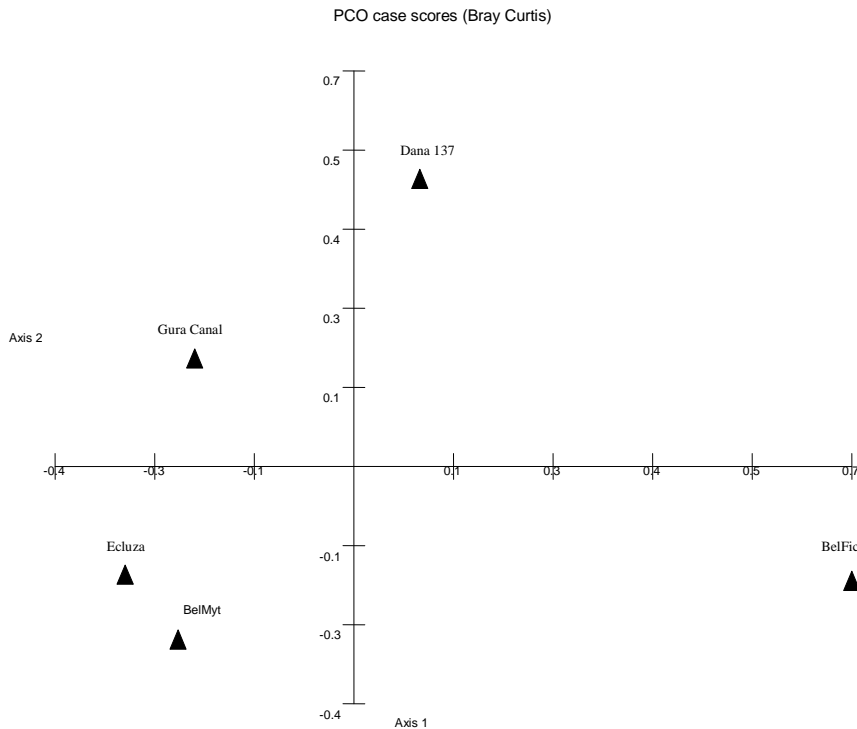


Figure 6. Principal Coordinates Analysis ordination of sites based upon functional feeding group structure

PCO (Figure 6) analysis reveals the greatest distance between the *Ficopomatus* community and the other four *Mytilus*-dominated communities, which are more or less grouped together. The *Ficopomatus* reef is singled out as a clearly different type of macrozoobenthic community.

Inside the Belona marina the two types of community closely coexist, still they maintain their distinct individualities through time, a proof that differences between them cannot be attributed to chance.

We established that two different macrozoobenthic communities, *Mytilus* – dominated and respectively *Ficopomatus* – dominated, are present in the sheltered brackish waters of the Romanian Black Sea, with large differences in species composition, functional feeding-group structure and biodiversity.

Although present at all sites, *Ficopomatus* gains ecological significance and creates a distinct community only there, where environmental conditions allow for building of reefs. Both *Ficopomatus* and *Mytilus* thrive in turbid waters with high organic particulate loads. Both are eurytherm and euryhaline species, *Ficopomatus* being actually the more euryhaline, with a salinity tolerance range of

0 - 55‰ (Dimov et al., 1970). But, while *Mytilus* thrives at exposed sites, for *Ficopomatus* current speeds over  $0.4 \text{ ms}^{-1}$  are a limiting factor (Dimov et al., 1970), hindering the calcareous tube construction. Thus, the essential environmental factor that dictates the distribution of *Ficopomatus* reefs is water movement intensity.

Ability to modify the biotope through reef building is the key feature of *Ficopomatus*, which leads to the onset of a new type of community.

The question arises whether this type of community, established by a neozoon, poses any threat to native species. Its effects on native species are more likely to be beneficial than problematic. This species favors waters which present some degree of stress to most open-shore marine organisms. Its requirement for variable-salinity water in which to spawn ensures that the major populations do not interfere with most indigenous species.

While *Ficopomatus enigmaticus* can be a fouling nuisance, it can also benefit the waters it invades. As Keene (1980) and Davies et al. (1989) have shown, the presence of large numbers in enclosed waters including marinas, where they would be considered a fouling nuisance, has had very beneficial effects on water quality, reducing suspended particulate loads and improving both the oxygen and nutrient status. Thomas & Thorp (1994) have also shown that a large population of *Ficopomatus enigmaticus* can remove material from suspension and thus have a very beneficial effect on other benthic species within enclosed or semi-enclosed waters.

## CONCLUSIONS

We defined a new type of rocky substratum macrozoobenthic community for the Black Sea, edified by the polychaete neozoon *Ficopomatus enigmaticus* Fauvel 1923 (syn. *Mercierella enigmatica* Fauvel 1923). We established the distinct individuality of this community using many ways of data interpretation and multivariate analysis, for more accuracy and self-verification.

Ability to modify the biotope through reef building is the key feature that enables *Ficopomatus* to create this new type of community. This, in turn, depends on water movement intensity as the essential environmental factor.

The *Ficopomatus* reef community clearly differs from those described up to the present from the Black Sea (dominated by one or more of the following species: *Mytilus galloprovincialis*, *Mytilaster lineatus*, *Balanus improvisus*, *Actinia equina*, *Lepidochiton cinereus*), both in taxonomic and functional feeding group structure.

Due to their special environmental requirements, *Ficopomatus* reefs are bound to exist only in limited and disjunct areas. Thus, as a neozoon, *Ficopomatus* does not have an invasive behaviour and does not pose a threat to native species. Quite the opposite, in our opinion the *Ficopomatus* reefs are a positive contribution to the biodiversity of the Romanian Black Sea.

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