STRUCTURE AND DISTRIBUTION OF THE MAIN MOLLUSCS FROM THE ROMANIAN MARINE AREAS DESIGNATED FOR THEIR GROWTH AND EXPLOITATION

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ABSTRACT

The paper presents characteristic elements of main molluscs' distribution in the Romanian marine area in four areas designated for their growth and exploitation according to EU Directive 79/923 (Shellfish Directive), based on samples collected in 2006. Mollusc populations' structure in the summer season has been used for the assessment of their ecological state under present environmental conditions, with populations more or less stable, according to the area's characteristics. Thus, near Danube mouths, at less than 20 m depths (area 1), on mobile sediments, dominant species are *Anadara inaequivalvis* and *Rapana venosa*. South from Portita, molluscs become more diverse, but mussels (*Mytilus galloprovincialis*) are dominant.

KEY WORDS: marine molluscs, Shellfish Directive, spatial distribution

INTRODUCTION

Molluscs are considered as organisms of high ecological importance for the Black Sea. Among these, mussel (*Mytilus galloprovincialis*) is widely and continuously distributed on the Black Sea shelf, mainly between 20 and 55 m depth, having abundant populations and high biomasses. In the last century, numerous scientific papers on their distribution, population's characteristics, and economical importance have been published (BACALBASA-DOBROVICI, 1959, BACESCU *et al*., 1971, BORCEA, 1926, GOMOIU, 1965, 1968, 1971, 1984). Taking into account mussels' economical and

ecological importance, and their potential commercial exploitation, between 1970 and 1984, and 1994-1995, their stock has been assessed (GOMOIU, 1984; ABAZA, 1996/97). Another important mollusc, *Mya arenaria*, signalled at the Romanian littoral in the early '60ies, drew the attention of scientists. As new comer, at that time it was important to assess, it's spreading and its potential impact on the native molluscs, as well as how *Mya* shells will contribute to sand composition, and how stable this sand will be with time (GOMOIU, 1976, 1981, 1983; GOMOIU and PETRAN, 1973). *Rapana venosa* was only occasionally studied (GOMOIU, 1972), but at present, this gastropod deserved increased attention.

An important condition for Romania to join European Union was to implement European Directives. One of them, Shellfish Directive recommend to the member states to designate the marine areas for molluscs growth and exploitation and to monitor the physical and chemical parameters of the seawater to insure optimal conditions for molluscs. Present study's aim is to analyse the status of the main mollusc populations in the four areas designated for their growth and exploitation according to Directive 79/923.

MATERIAL AND METHODS

For the present study, 39 samples have been collected in summer 2006 from 10m, 20m, and 30m depth between Sulina and Vama Veche from the four areas designated for molluscs' growth and exploitation in the Romanian marine sector, according to EU Shellfish Directive (79/923) (Fig. 1). In 2009 only depths of 20 m have been used for comparison. Sea bottom at the above mentioned depths has been sampled using the dredge of 60 cm and 100 cm opening onboard research vessel "Steaua de mare 1". Molluscs have been washed, sorted by species, counted and weighted onboard and subsequently in the laboratory in order to establish their distribution on size classes and for the quantitative assessment. Abundance and biomass of *Mytilus galloprovincialis*, *Rapana venosa*, *Mya arenaria* and *Anadara inaequivalvis* as the main potentially exploitable molluscs have been estimated. Distribution maps for each of the four molluscs based on their abundance have been drawn.

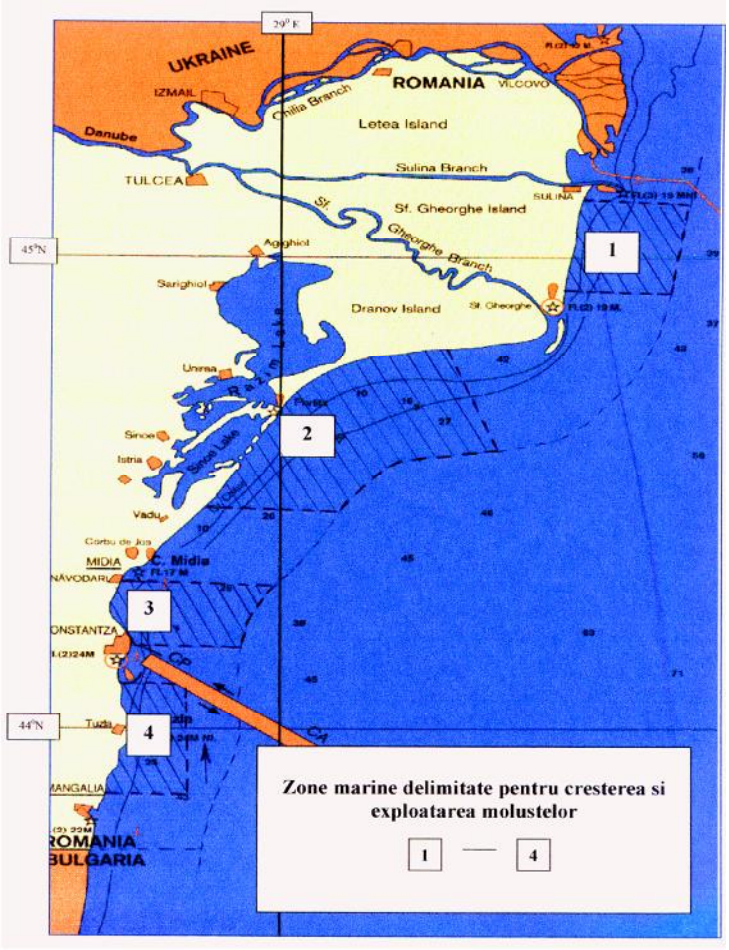

Fig. 1 – The four areas designated for the molluscs' growth and exploitation in the Romanian marine sector, sampled in 2006 and 2009

RESULTS AND DISCUSSIONS

Mytilus galloprovincialis (mussel) is the most important mollusc in the Romanian marine area, known as mass species and marine bio-resource potentially exploitable for human consumption. The surveillance carried out in 2006 showed that between Sulina and Vama Veche on mobile sediments (sand, muddy sand and mud); at depths of 10 to 30 m this mollusc was quantitatively dominant. This species was relatively homogenously distributed in the four areas, except for area 1 (Sulina - Sf. Gheorghe). The mean

abundance ranged between 125 ind/m^2 in area 3 and 239 ind/m^2 in area 2, while in area 1, the mean value of abundance was 2 ind/m^2 (Fig. 2).

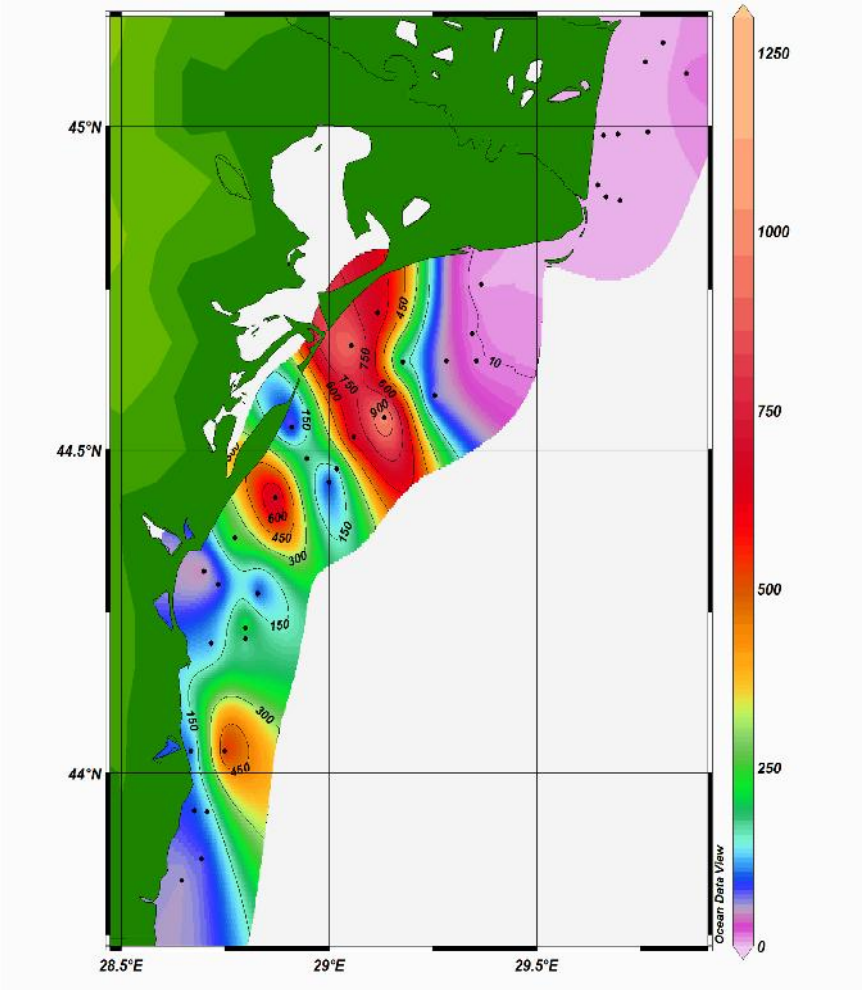

Fig. 2 – Distribution of *Mytilus galloprovincialis* populations in areas designated for molluscs (10 – 30 m depth) based on their abundances in 2006

The mean biomass ranged between 2.56 g/m^2 in area 1 and 1207.07 g/m^2 in area 4. Low values of abundance and biomass registered in area 1 are due to the strong influence of the Danube and the freshwater inflow. Although area 1 for molluscs' growth and exploitation has been established in the limits of the 10 to 30 m isobaths, at the depths shallower than 30 m, only

exceptionally, mussels can be identified. In this area with substrata dominated by the fine fractions (especially mud and very fine sand), *Mya arenaria* and even *Anadara inaequivalvis* endured better life conditions than *Mytilus*. That is why mussel's abundance did not exceed 13 ind/m^2, and corresponding biomass 13.4 g/m^2 (Sulina 30 m depth). The obtained results are in line with those found in 1995 in the same area and at same depths (2 to 9 ind/m^2 and 3.2 to 13.3 g/m^2) (ABAZA, 1996/97). Biomass values were differently distributed, maximum values being recorded in the southern Romanian sector, area 4 (Fig. 3).

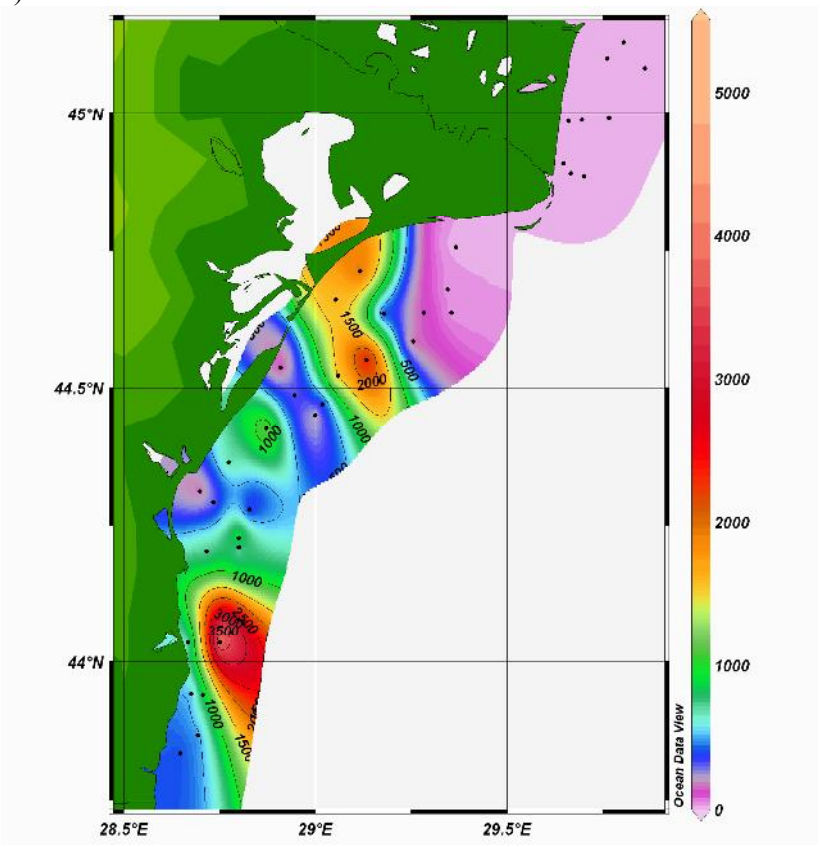

Fig. 3 – Distribution of *Mytilus galloprovincialis* populations in areas designated for molluscs (10 – 30 m depth) based on their biomass in 2006

Analysis of the mussels' population structure on size classes based on samples collected in 2006 showed in all areas a good development potential, individuals belonging to a large spectrum of size classes (14 – 16), except again for area 1, where mussels belonged only to 8 size classes. The influence of freshwater occurring in area 1 can be noticed as well in the population

structure. Thus, in this area located near Danube mouths, 47% of mussel population was young (5 to 20 mm), 53% were of 20 – 50 mm, and less than 1% exceeded 50 mm, which means that in this area under Danube influence, at depths under 30 m mussels cannot survive more than 3-4 years. Toward south, mussel's size classes became more diverse, and big size individuals accounted to 9% of the population (in area 3, located between Navodari and Constanta) (Fig. 4).

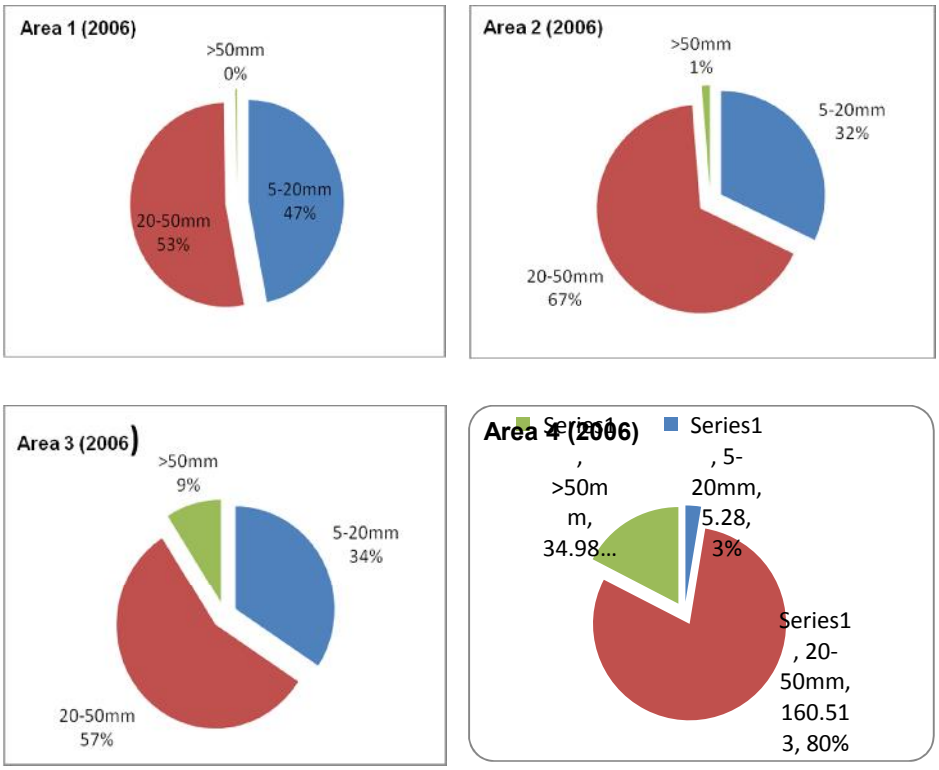

Fig. 4 – Mussel's population structure on size classes in areas designated for molluscs in 2006

In order to check the mussel's population structure, a set of samples from each area has been collected in 2009. In area 1 no mussel could be found in the sampling site. The results of the analysis of mussels on size classes were different in areas 2 and 3, and very similar in area 4. For example, in area 2, 30% of mussels were very young (5 – 20 mm) as compared to 32 % in 2006, 51% of mussels were of 20 – 50 mm, compared to 67% in 2006, and 19% over

50 mm compared to only 1% in 2006 (Fig. 5). In area 3, the mussel's population consisted mainly from mature and old individuals of over 50 mm length.

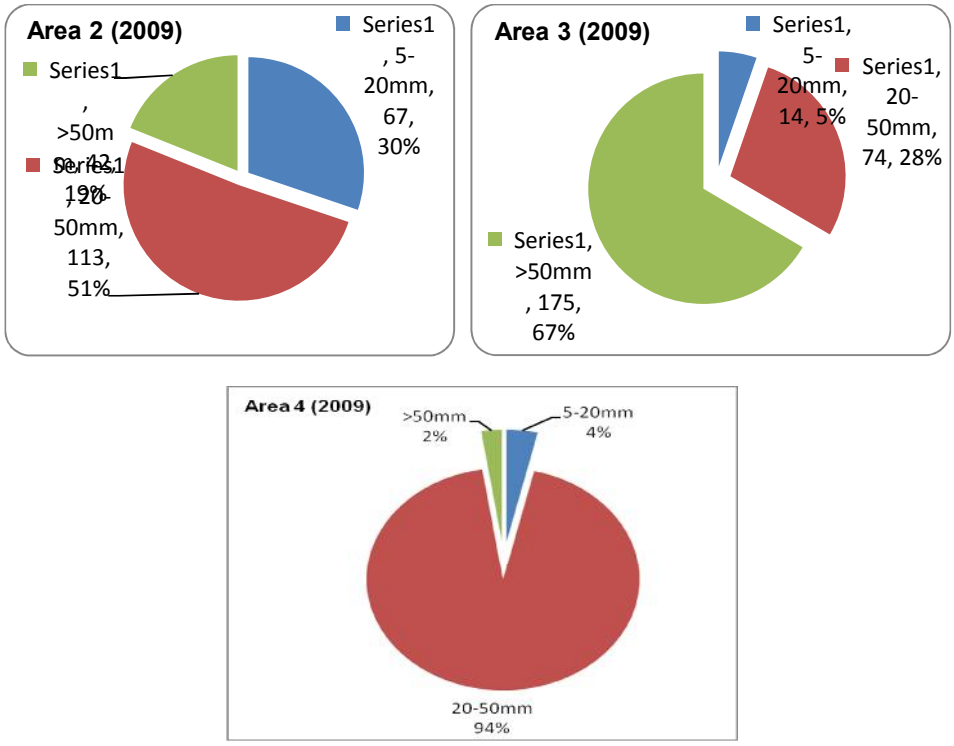

Fig. 5 – Mussel's population structure on size classes in areas designated for molluscs in 2009

Rapana venosa (veined whelk or Asian rapana whelk) is known in Romanian marine waters for over 50 years, but is still considered an alien species of highly invasive potential. It has a very strong impact on native molluscs, especially on bivalves. It was suspected to eliminate the native oyster (*Ostrea edulis*) from the Romanian marine waters and subsequently changed its diet, preying especially on mussels. In the last years, this snail can be found in all Romanian marine sectors, not only in the communities dominated by mussels, but by other molluscs. It is capable to use for food other molluscs, too. *In situ* and laboratory observations showed that *Rapana* can feed on Cardiidae, *Anadara inaequivalvis*, or even small fish. Because of its population's development, *Rapana* is lately considered as potential source of economic interest, many countries from the Black Sea area exploiting it by different means, some of them destructive for marine ecosystems.

Samples collected in 2006 from the four areas designated for molluscs showed that *Rapana* occurred in all areas. Quantitatively, in area 1 and 4 *Rapana* occurred in small number (mean abundance 1 ind/m^2, mean biomass between 0.13 and 19 g/m^2), and only in areas 2 and 3 was better represented, and well correlated with mussel's population distribution (Fig. 6 and 7). Fig. 6 shows that *Rapana* registered the highest values of abundance in the same areas as mussels.

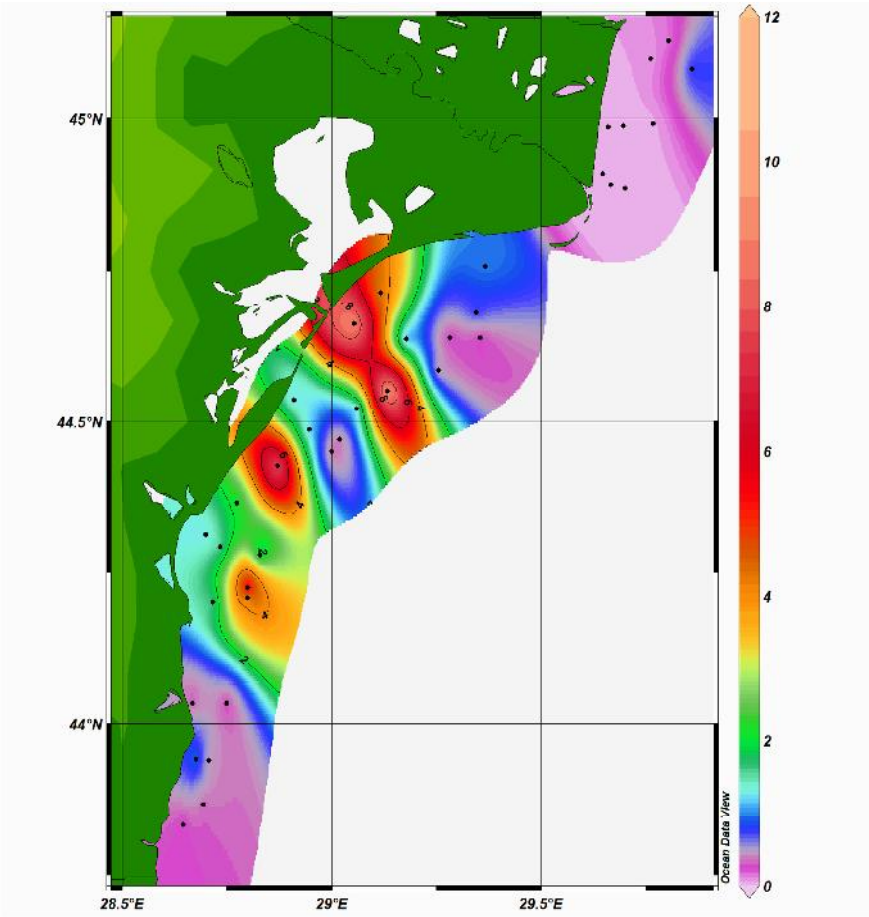

Fig. 6 – Distribution of *Rapana venosa* population in four areas designated for molluscs in 2006 based on their abundance

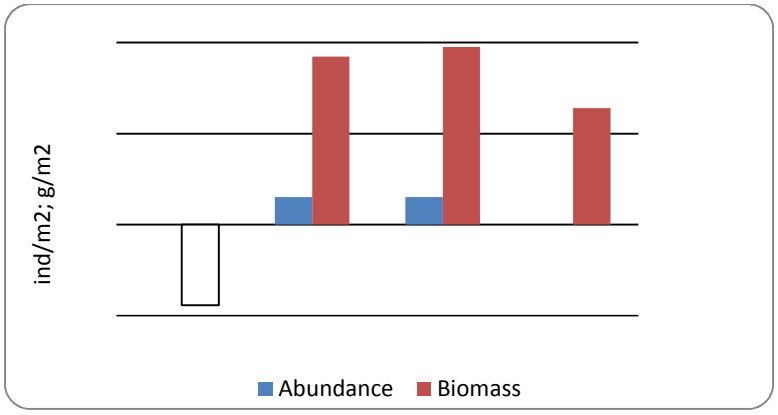

Fig. 7 - Distribution of quantitative parameters (abundance – ind/m^2 and biomass - g/m^2) of *Rapana venosa* in areas designated for molluscs in 2006

Rapana's distribution on size classes, analysed on the samples collected in 2006, showed heterogeneity in the areas 2 and 3, while in area 4, all identified individuals being over 60 mm length, meaning they were mature (Fig. 8).

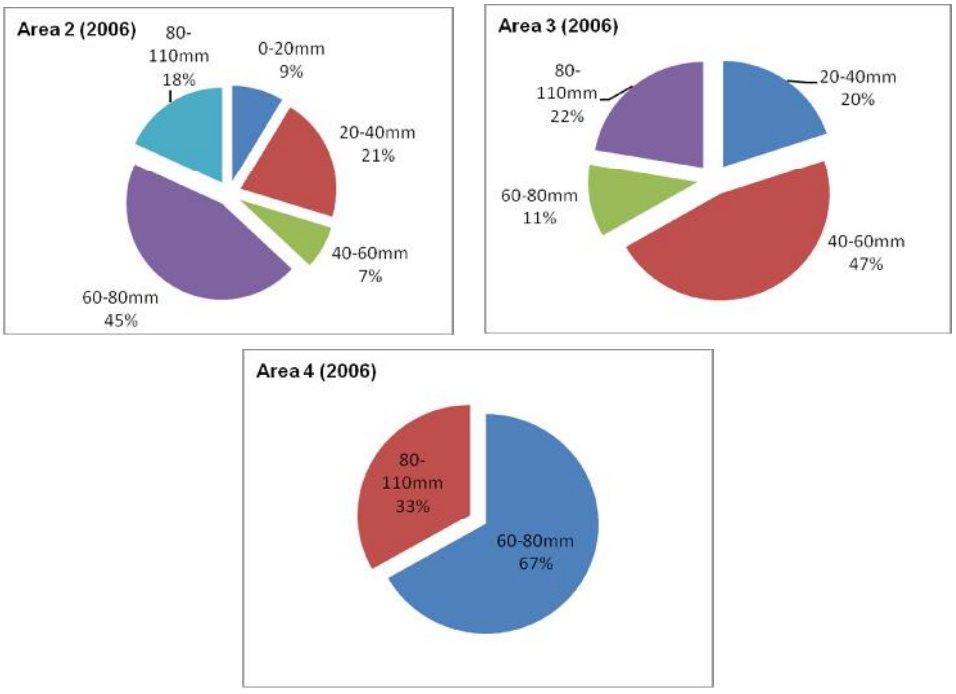

Fig. 8 – *Rapana venosa* population structure on size classes in areas designated for molluscs in 2006

After its penetration and over development in the Romanian waters in the early '60ies, ***Mya arenaria*** (soft-shelled clam) populations reached equilibrium with the native bivalve *Lentidium mediterraneum* and the other alien bivalve *Anadara inaequivalvis*. Even at present, in the Black Sea this species is not exploited for commercial purpose, it was considered as marine resources potentially exploitable, taking into consideration that in other seas, this species is consumed by humans.

Analysing the data obtained from the samples collected in 2006, some observations regarding quantitative distribution and population structure in the areas designated for molluscs growth and exploitation result. Its distribution was correlated to the sediment structure. Near Danube area with very fine sand and high fraction of mud seems to be the habitat preferred by *Mya*, illustrated by the highest mean biomass registered in the area 1, and showing decreasing trend towards south. Abundances varied in the same manner in areas 1 and 2 (between 1 and 7 ind/m^2), and were lower in the area 3 (1 to 2 ind/m^2). Biomasses ranged between 0.5 and 47 g/m^2, with mean values of 7.56 g/m^2 in area 1, 6.68 g/m^2 in area 2 and 3.76 g/m^2 in area 3. In area 4, *Mya* was not identified in 2006 (Fig. 9 and 10).

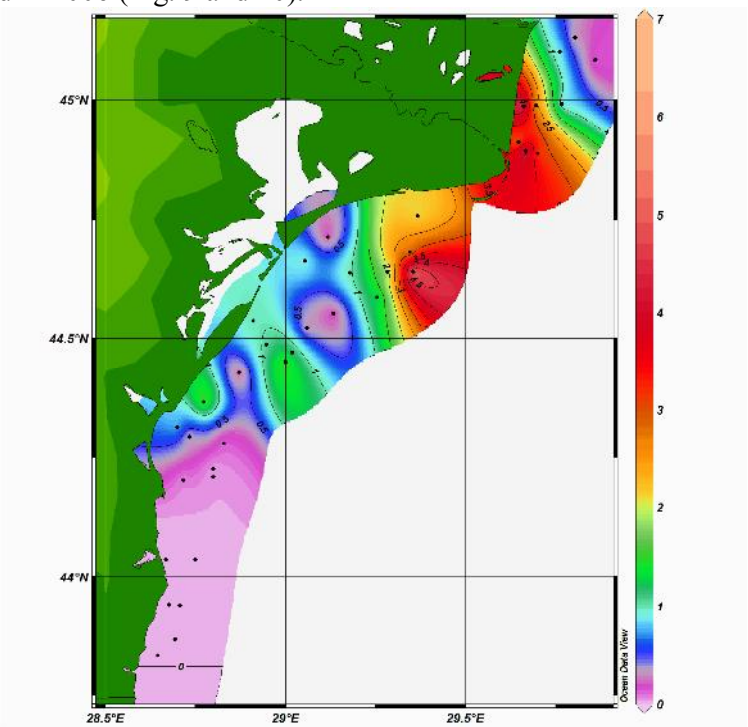

Fig. 9 – Distribution of *Mya arenaria* population in areas designated for molluscs in 2006 based on their abundance

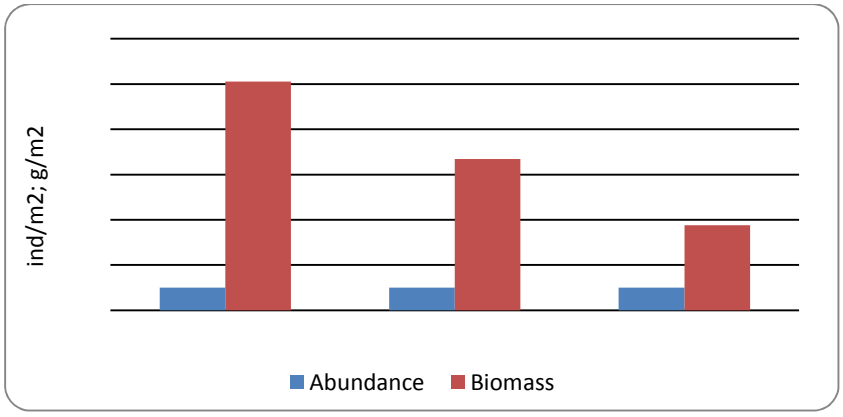

Fig. 10 - Distribution of quantitative parameters (abundance – ind/m^2 and biomass - g/m^2) of *Mya arenaria* in areas designated for molluscs in 2006

Population structure analysis showed the dominance of mature individuals in three areas designated for molluscs. In area 1, 80% of *Mya* population consisted of individuals of 30-50 mm length and only 19% were younger (20-30 mm). In area 2, 26% of the population were very young (5-30 mm), while individuals over 50 mm length ranged 5%. In area 3, the great majority of population were over 50 mm, showing a lower potential for new population recruitment (Fig. 11).

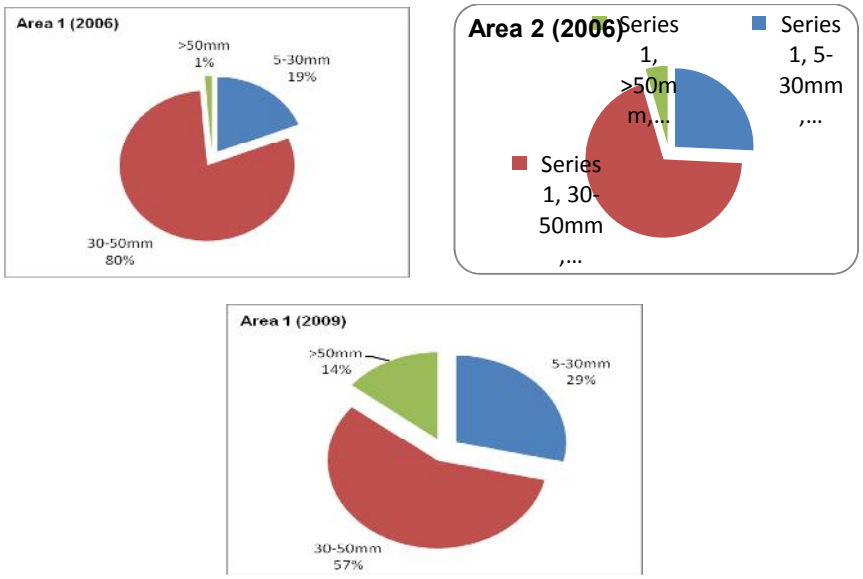

Fig. 11 – *Mya arenaria* population structure on size classes in the designated areas for molluscs in 2006

Anadara inaequivalvis (arc clam) is an endemic species of the Indo-Pacific region and is estimated to have been introduced to the Black Sea unintentionally in the ballast tanks of commercial vessels. At the Romanian littoral it was first signalled in 1984 (GOMOIU, 1984). It seems to be well adapted and distributed throughout the continental shelf of the Black Sea, but it has not reached commercial size as in other seas from tropical, subtropical and warm temperate areas. Nevertheless, *Anadara* is considered as potential resource to be exploited in the future for commercial purpose.

Anadara is an indicator for eutrophic waters, very resistant to hypoxia; due to these features it rapidly spread on sedimentary bottoms (sand and mud), becoming extremely common in Romanian waters.

Analysing the samples collected by dredging in 2006 from the four areas designated for molluscs, some considerations can be made on this species. Thus, its distribution along the above-mentioned areas was discontinuous. The mean abundance and biomass presented an increasing trend from north to south (Sulina – Constanta) (Fig. 12). In the area 4, located

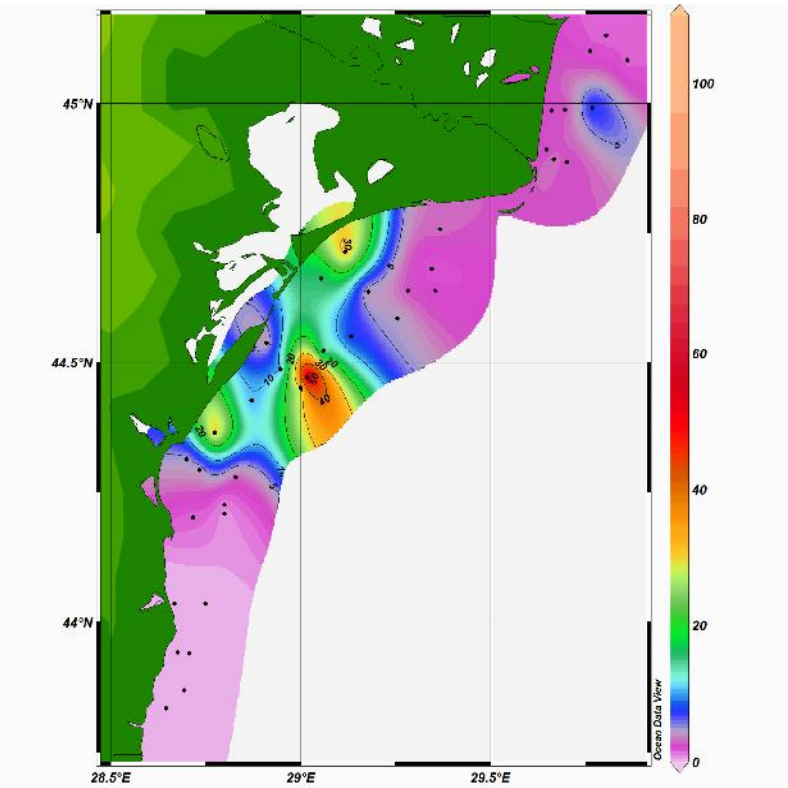

Fig. 12 – Distribution of *Anadara inaequivalvis* population in areas designated for molluscs in 2006 based on their abundance

in the southern part of Romanian littoral between Eforie Nord and Mangalia) *Anadara* has not been identified in the samples. Abundances were very low, and ranged between 1 and 41 ind/m^2 in all areas, with mean values of 3 ind/m^2 in the first area, 5 ind/m^2 in the second area, and 7 ind/m^2 in the third one. Biomasses were also reduced only occasionally reaching over 50 g/m^2. Generally, biomass values ranged between 0.3 and 218.8 g/m^2, with mean values of 11.6 g/m^2 in area 1, 28.6 g/m^2 in area 2, and 34.8 g/m^2 in area 3 (Fig. 13).

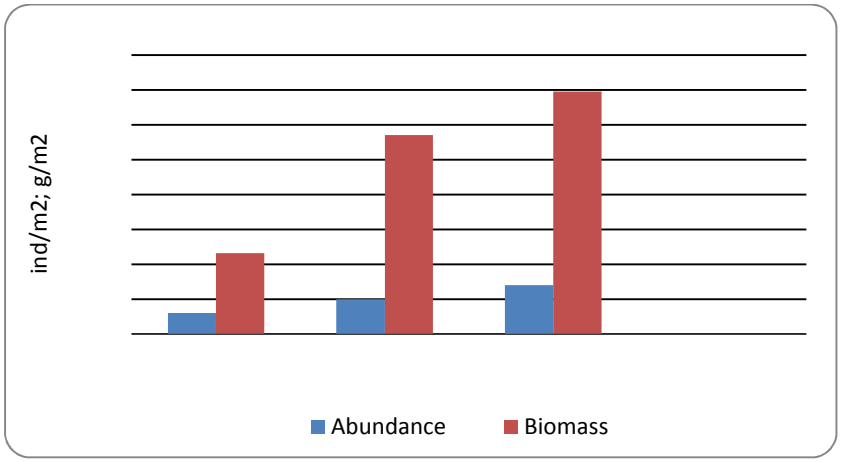

Fig. 13 - Distribution of quantitative parameters (abundance – ind/m^2 and biomass - g/m^2) of *Anadara inaequivalvis* in areas designated for molluscs in 2006

In the area 1 (Sulina – Sf. Gheorghe), *Anadara* registered a frequency of 100%, its population being structured in eight size classes. Dominant were young individuals belonging to size classes 20-30 mm (29%) and 30-40 mm (30%). Those individuals' age was estimated at 1- 2 years (ŞAHIN *et al*., 1998). Individuals under 20 mm length accounted 40% and could insure the population development in the next years (Fig. 14).

In area 2, *Anadara* registered also a frequency of occurrence of 100%, but it was better represented on the profiles Zaton and Vadu, where 67% of the population was constituted mainly by young individuals (20-40 mm). 14% of the population was represented by very young individuals (10-20 mm) and 19% of mature individuals (over 50 mm length) (Fig. 14). In the 3, its frequency was 71%, the species being patchy distributed and concentrated in its northern part. Individuals of 20-30 mm were dominant (81%) in the population.

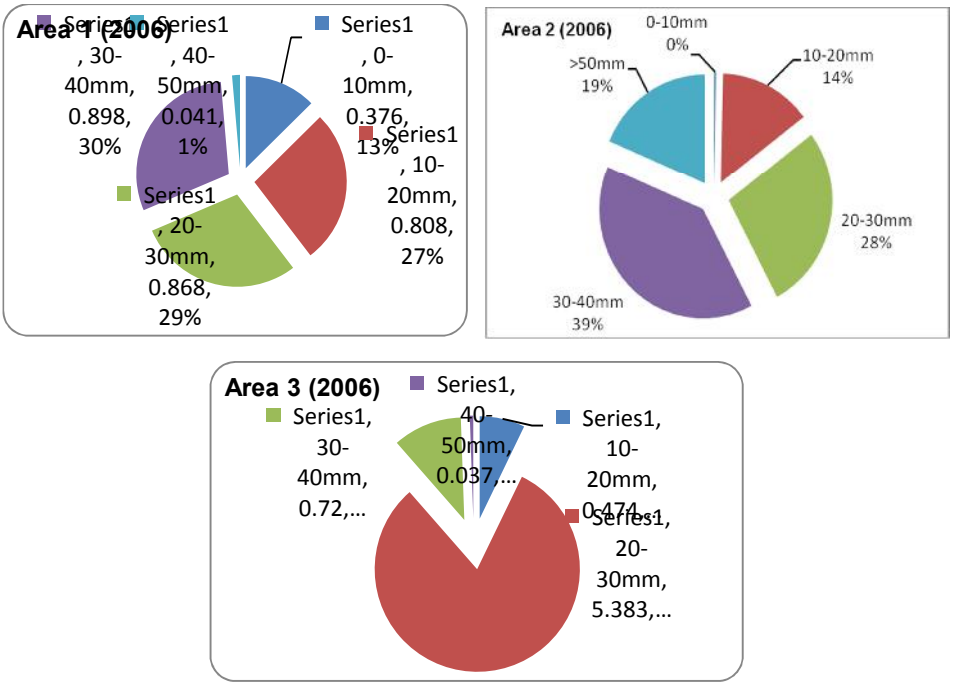

Fig. 14 – *Anadara inaequivalvis* population structure on size classes in areas designated for molluscs in 2006

CONCLUSIONS

Following the studies carried out in 2006 on the quantitative distribution and the population structure of the main four species of molluscs from the areas designated for their growth and exploitation according to the EU Shellfish Directive (79/923), it resulted:

- Among the four molluscs, ***Mytilus galloprovincialis*** was dominant in all analysed areas, being relatively uniformly distributed;
- Mussel populations from sedimentary areas between 10 and 30 m depth were dominated by young individuals in three of the four areas for molluscs, proving a good recruitment rate, over 60% of individuals having under 25 mm length. Exception was area 1, located near Danube mouths, where both low salinity and substrate instability can affect mussel's recruitment and their subsequent survival. Analysis of samples collected in 2009 showed the

dominance of mature individuals, the young ones dominating only area 2;

- Quantitatively, mussels registered the highest values of abundance and biomass in areas 2 and 4, reaching maximum 1,201 ind/m^2 and respectively, 2,833.2 g/m^2 in area 2;
- As compared to the '90ies, no quantitatively differences have been noticed in mussel populations in the studied sectors;
- ***Rapana venosa*** population distribution followed the mussels' distribution, their main food source. Their biomass registered an increasing trend from north to south at the same abundance values, due to their greater body size. The population structure has been better balanced in area 2, young co-existing with the mature individuals, capable of reproduction;
- Taking account of its increasing population, *Rapana venosa* can be harvested in specific periods of the year;
- ***Mya arenaria***, due to its habit to live deep in the mobile sediment, has not been very present in the samples collected using dredge. Quantitatively, it was better represented in the areas 1 and 2, where the sediment structure seems to be favourable for its development. Also, the population structure was dominated by young individuals in the same areas 1 and 2;
- ***Anadara inaequivalvis*** showed the same quantitatively trend as *Rapana*, even its population has a very heterogeneous structure. A good recruitment was registered in the area 3, where 81% of the population were represented by young individuals (20-30 mm).

The present results can contribute to the establishment of the development trend on medium term of these valuable molluscs, and also to identification of the necessary measures for their protection in the Romanian marine sector, and the insurance of the proper quality for molluscs of commercially interest, according to EU requirements.

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