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CONTRIBUTIONS TO THE KNOWLEDGE OF THE PRESENT STATE OF THE VAMA VECHE - 2 MAI MARINE RESERVE BENTHIC HABITATS

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ABSTRACT

The reserve Vama Veche - 2 Mai (the only one on the Romanian littoral) represents an almost unique combination, presenting a variety of habitats for the sessile species. Allowing them a wide range of development, so that the entire area is constituted as a true "mosaic". Through its geographical location - the South of the Romanian littoral down to the Bulgarian border - the reserve presents a special, scientific and socio-economic importance. The paper underlines the results of investigations, with the aim of establishing the actual state of the benthic habitats under anthropic influence, despite the declaring of the protected area as marine reserve.

KEY WORDS : marine reserve, benthic habitat, benthic biocenosis, anthropic influence

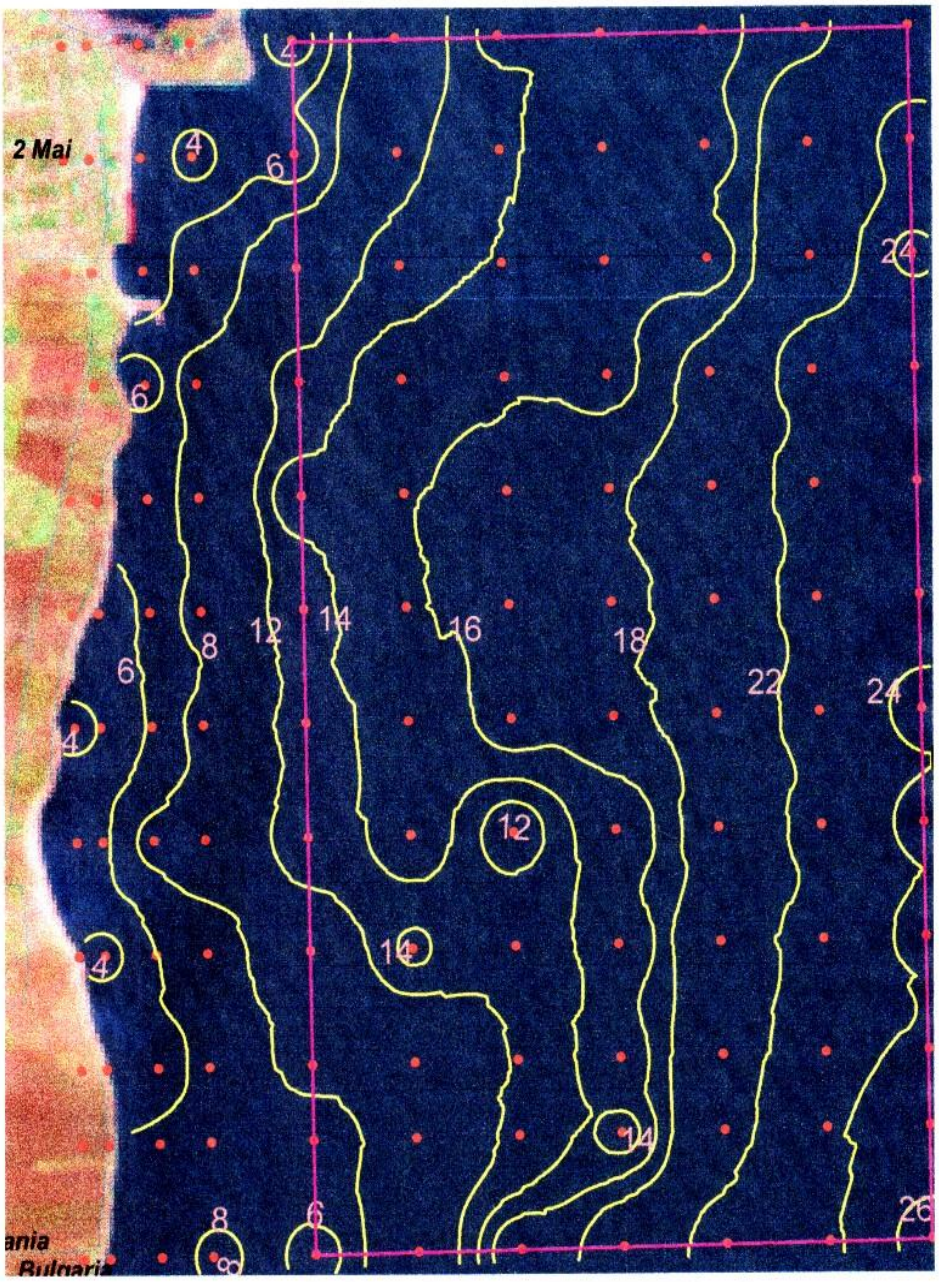

Fig. 1

Bathymetric map of the Littoral Marine Vama Veche-2 Mai Reserve
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INTRODUCTION

Founded through Decision No.31/1980 of the County Council Constantza, "The Littoral Marine Vama Veche - 2 Mai Reserve" was confirmed as a protected area by Law No. 5/2000, code 2.345, being administratively localized in the commune Limanu, the village Vama Veche.

The geographical delimitation of the reserve is:

- NW: $43^0$47'5" N and $28^0$35' E,
- NE: $43^0$47'5" N and $28^0$38' E,
- SW: $43^0$44'3" N and $28^0$35' E,
- SE: $43^0$47'3" N and $28^0$38' E.

The reserve has a surface of 5,000 ha along 7 km of coastline, between the settlement of 2 Mai and the Bulgarian border (Fig.1).

Due to its location down to the Bulgarian border, a better protection would be realized by the transborder extension of the reserve, as the Romanian-Bulgarian Committee for environmental protection signed at 12/9/1991 in Sofia and applied at 9/23/1992 for Romania and 2/21/1992 for Bulgaria.

The importance of transboundary waters was revealed in the "Convention regarding the protection and the use of the transboundary waters and of the international lakes", adopted in Helsinki, in March, 1992 and signed by the governmental councilors on water and environmental issues. This convention aims at the national and international increase of actions with the goal of protecting and ecologically administrating of transboundary waters.

The paper states the results of research regarding the benthic habitats and biocenosis in the reserve proceeded in 2001 and 2002.

MATERIAL AND METHODS

The present study was realized by:

a) **Field work**

A network of stations, uniformly spread throughout the entire reserve (on 11 profiles of 9 prevailing points each - a total of 99 stations + 6 extra stations outside the perimeter, but important for interpreting the data) was established (Fig.1), where from samples of sedimentary substrate were taken. In addition, beach net fishing was done in the area, so as to

establish the structure of the ichtyofauna. With the same purpose, data referring to the stationary shallow water fishing in the zone were collected from local fishermen.

The collecting of the benthic samples was realized in two ways:

- by using a special collector (bodengreifer Van-Veen, which collects substrate from a surface of 600 sqcm - 20x30 cm);
- by dragging with a special device, maneuvered by divers, from a surface of 20x30 cm.

The preservation of the samples was done with formaldehyde (4%).

b) **Processing the data in specialized laboratories (NIMRD Constantza)**

The processing of benthic samples was realized according to the usual methods: washing through a set of metallic-wired sieves for the granulometric analysis, microscopic examination, calculation of density and biomass.

c) **The transposal of the data** regarding the benthic habitats and biocenosis of the reserve was realized in GIS format, with two maps in Gauss Kruger projection emerging.

d) **Data interpreting** was realized according to the European and international requests. For establishing the endangerment category of the plant and animal species the *IUCN Red List of Threatened Animals* from 1990 and 1994 was used:

- Ex (extinct): species not definitely located in the wild, after many consecutive surveys. The surveys have been made in the areas they have former been recorded or in the areas assumed as former habitat;
- Ex ? : 50 years have passed from the last recording of the species, the possibility off the species to be recorded in the future still exists;
- E (endangered) : species in danger of extinction and whose survival is unlikely if the causal factors continue operating. Including populations whose numbers have been reduced to a critical level;
- V (vulnerable) : species are decreasing, they are likely to move into the □endangered□ category if the causal factors continue operating;
- R (rare) : species that are not present □endangered□ or □vulnerable□ but are at risk, because they are usually localized within restricted geographical areas or habitats, or might be thinly scattered over a more extensive range;
- I (indeterminate) : species known as □endangered□, □vulnerable□ or □rare□ but where there is not enough information to say which of the mentioned category is appropriate.

It has been used especially for those species, which have been seen in the past, but were not located during the last surveys. Certain (unofficial) recording still exist;

- ? : species mentioned as previously recorded, not located at present, whose presence is uncertain, determination errors are suspected;
- K (insufficiently known) : species suspected, recorded during the last surveys, but not definitely known to establish the threatened category;
- Nt (not threatened) : species threatened only at European level, not endangered on the territory of the reserve, being frequent and abundant;
- O (out of danger) : species threatened in the past, but, at the moment, out of danger.

In addition, for the assessment of the habitats, the Habitats Directive 92/43/CEE and the stipulations of the following resolutions of the Permanent Committee of the Bern Convention were taken into account.

RESULTS AND DISCUSSION

In all prevailing stations, on ship or boat, when benthic samples were collected by single divers, there were noted down details not only about the nature of the floor (the type of the sediment, the colour, the consistence, the smell), but also about the living fauna (specific mollusks, in general) and the thanatocenosis. In addition, the divers explored the whole area to establish the length and width of the habitats and filmed where the transparence and luminosity of the water allowed them.

By its position inside the stated perimeter, the reserve is located on the infralittoral . The infralittoral cenose of the Black Sea, due to their components and rich meroplankton, are used as food not only be the benthic, but also by the planktonic fish species.

1. The benthic habitats in the Littoral Marine Vama Veche - 2 Mai Reserve: present state and charting

The reserve is located on the southern sector of the Romanian littoral, with an abrasive nature, made up of grit stone cleaves and Sarmatic limestone, covered in a thick layer of loess deposits. The Sarmatic limestone is continued down into the sea, forming a true underwater floor.

Taking strictly into account only the declared surface of the reserve, this is found on the infralittoral, which corresponds to those sea floor sections between the superior level, permanently flooded or only exceptionally flooded by the sea waters, going down to the depth of about 25 m.

The supralittoral (the area of humidification which is sprinkled by the waves breaking at the superior limit of the sea level, in contact with the coastline) and the mediolittoral floor

(the narrow stretch of wave breaking) are specific for the bathing area, not included in the reserve.

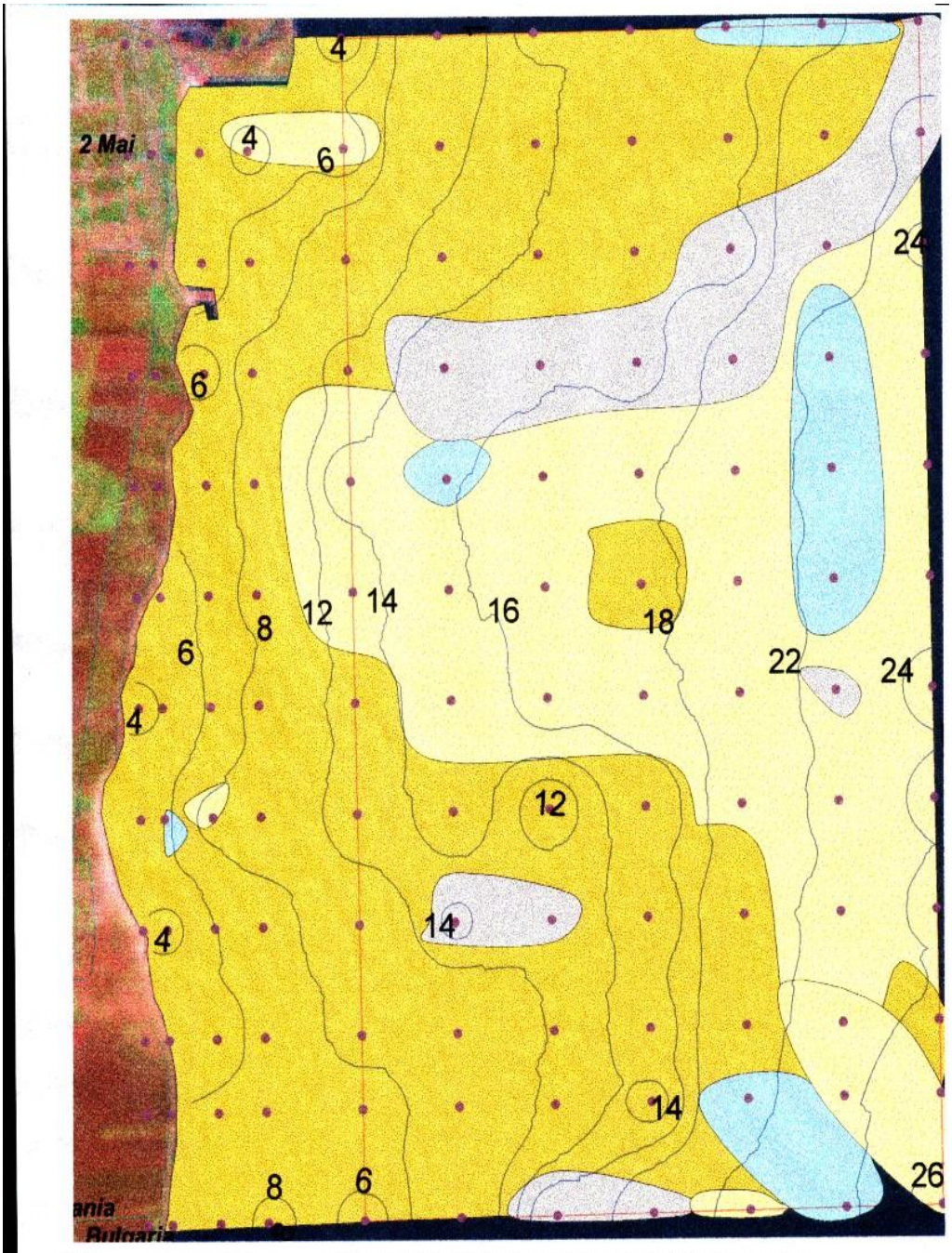

Fig. 2 Benthic habitats map of the Littoral Marine Vama Veche-2 Mai Reserve

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The variety of habitats found in the Vama Veche - 2 Mai reserve was restricted to the following bas ic types (Fig.2) :

- **sandy habitat** : formed of mobile granulated sediments, rough when touching and non-adherent, with few colloidal particles, which do not interfere with the interstitial water. On the territory of the reserve, this type of habitat occupies about 29,4 % of the bottom surface, especially in the eastern and central sides (Photo 1);

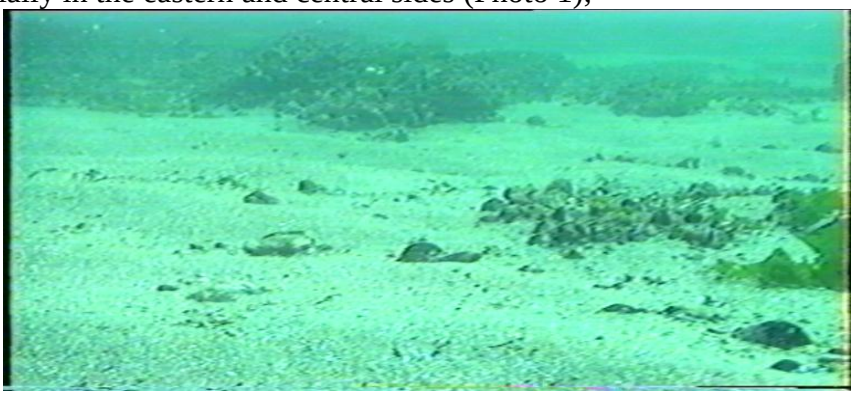

Photo 1 - Sandy habitat (underwater - original)

- **muddy habitat** : formed of mobile, adherent sediments, with sand grains and mud in proportion of about 15-25 %. It occupies only 9.6 % of the reserve bottom, with the display oriented towards NE and isolated islands on the surface of the reserve;

- **sandy-muddy habitat** : formed of mobile sediments with distinct grains mixing with mobile adherent sediments. It occupies only 6% of the reserve surface, on isolated islands, especially in the eastern area;

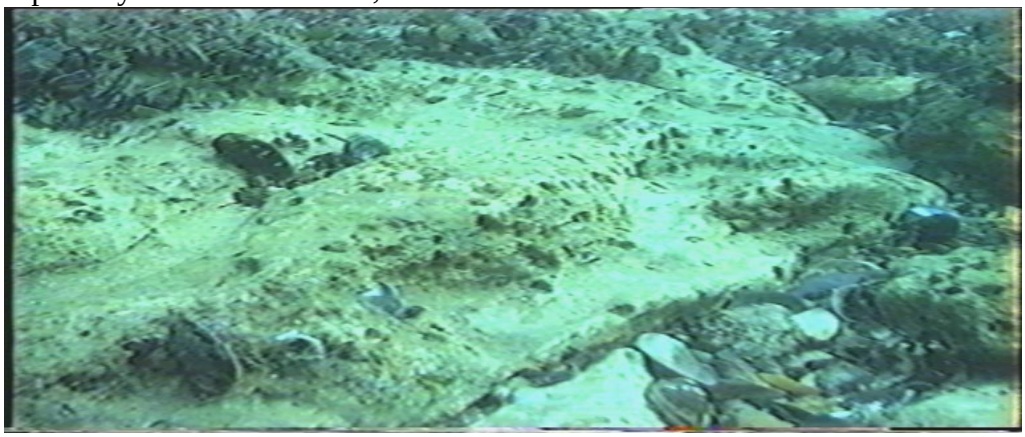

Photo 2 - Rocky habitat (underwater - original)

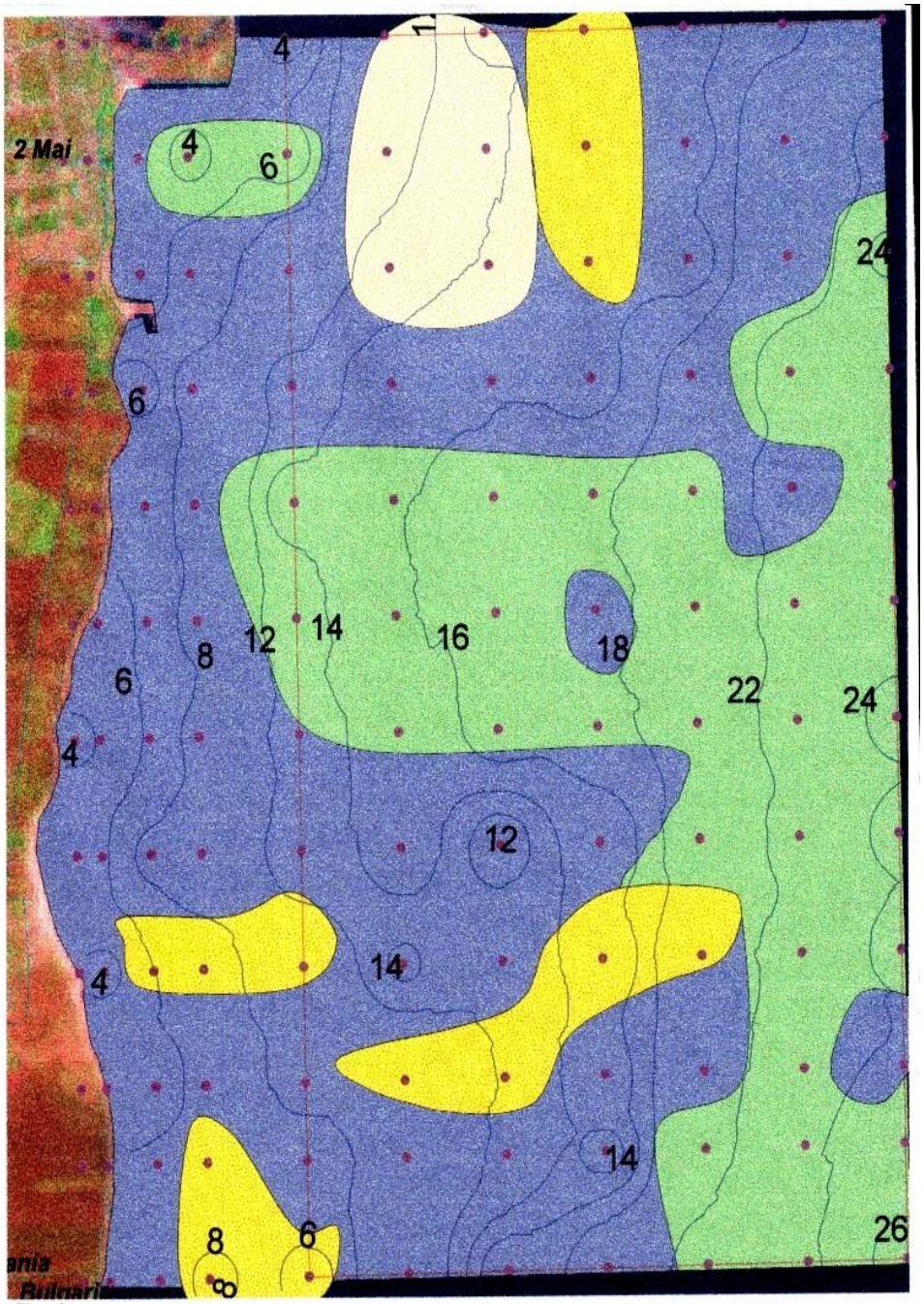

Fig. 3

Benthic biocenosis map of the Littoral Marine Vama Veche-2 Mai Reserve

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- **rough habitats** : represent more than half of the surface of the reserve (about 55%), having an uniform display in the north, south and west. The rocky bottom of the area generally consists of Sarmatic limestone or rocks with the same origin, which are continuous between the coastline and depths down to 12-18 m (Photo 2).

Sediments generally coming from substance deposits in the water, but also generated by the mineral and organic charge (through the interference between water and sediment) were analyzed from the chemical and biochemical point of view (Table 1).

Table 1

The variation limits of the chemical and biochemical parameters
of the sediments in the Vama Veche - 2 Mai Reserve
(Annual Reports NIMRD)

Chemical and biochemical parameter / unit of measurement	**Variation limits**
pH	7.3 - 8.3
Salinity g/l	1.05 - 1.76
Dry substance %	61.20 - 91.74
Mineral residuum % SU	57.92 - 91.53
Organic substance % SU	5.10 - 23.63
$P\text{-}PO_4^{3-}$ µg/g	0.43 - 5.15
$N\text{-}NO_2^-$ µg/g	0.09 - 62.56
$N\text{-}NO_3^-$ µg/g	0 - 51.52
$N\text{-}NH_4^+$ µg/g	2.56 - 17.20
Proteins µg/g	25.42 - 36.69
Glucides µg/g	76.36 - 115.53
Lipids µg/g	0.88 - 1.64

When distributing the values of the analyzed parameters, the morphology of the bottom substrate had a crucial role. In the reserve, there are substrates with a different consistence, with different depositing of the mineral and organic substance tendencies. In addition, there is also the movement of the water, which concentrates or spreads the substances, realizing a permanent transfer. In general, the samples, which were analyzed, came from stations collecting bottom substrates with a muddy, sandy or combined consistence.

Usually, the greatest capacity of chemical and biochemical substances retention is proved by the supports with the finest granulation (mud, sand, mud-sand), even if it is expected that this lack of morphological homogeneity would allow the development of chemical and biochemical processes in a differential way, with the sediments being continuous sources of mineralization of the water environment. When speaking about the derivatives of

the nitrogen, the ammonia is best represented, being the result of microbiological mineralization process. Its value has ranged between large limits, from 2.56 to 17.20 µg/g, values that indicate extremely diverse microbiological activities.

The organic components (proteins, glucides and lipids) had a non-uniform distribution, being linked mainly to the activity of the organisms in the environment, but also to the external contributions.

2. The benthic biocenosis in the Marine Littoral Vama Veche - 2 Mai Reserve: present state and charting

Regarded from the point of view of the biocenosis the reserve has a mosaic-shape aspect (Fig.3), on a relatively restricted area which gives the organisms populating it a high biodiversity character.

The strong and determining bound between the substrate and the species populating it must be clearly stated from the beginning. The importance of one species or another inside the biocenosis depends, first of all, on this determinating and limitative factor. Practically, there is only a limited number of species characteristic for a given biotope. Consequently, the definition of the characteristic species must stress the preferential behaviour towards the biotope. The general spread as a continuous population, the qualitative and quantitative dominants are compulsory framed by the limits of the substrate type that designates the specific category of the biotope (BACESCU, MULLER, GOMOIU, 1972; PETRANU, 1997).

The species which are found in a biocenosis only sporadically, without being a current presence in the analyzed stations, as their normal spread is conditioned by other factors than those of that biotope, are regarded as accidental.

The *Spisula* subcenosis is characteristic for the sandy and sandy-muddy bottoms, which are component parts of the psammobiontic biocenosis from the infralittoral that lead to the deep mussel biocenosis, but also of the sandy enclaves formed on the rocky substrate with the conglomeration of the sand moved by the marine currents. These biotope are populated by psammobiotic species such as: *Spisula subtruncata triangula*, *Chione gallina*, *Lentidium mediterraneum* and *Parvicardium exiguum*. Of all these, *Spisula subtruncata triangula* (Photo 3) is dominating, fact that determined the nomination of the subcenosis populating 31,88 % of the surface of the reserve as *Spisula*. In the area of *Spisula* sands, the faunistic spectrum is rich from the qualitative point of view (19 species of mollusks, 13 of polychetes and five of crustaceans), but also from the qualitative one (densities exceeding 35,000 pieces/sqm and biomasses of about 600 g/sqm).

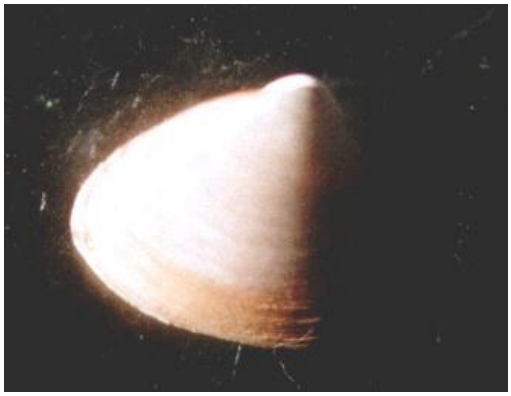

Photo 3 - *Spisula subtruncata triangula*
(original)

In comparison with 20-30 years ago studies, when *Spisula* was mainly found on the Romanian littoral on a relatively narrow stretch comparing to *Mytilus* or *Modiolus*, in present days one can remark an increase of its spread, reaching densities of about 30,000 pieces/sqm; it now represents an important food supply for the benthic fish, especially for the turbot, an extremely valuable species.

Spisula subtruncata triangula is considered specific for the shores between 20 and 30 m deep, and together with other elements, forms different local associations: *Corbula - Spisula, Spisula - Abra - Cardium, Spisula - Mytilus, Spisula Paphia*. Other such associations are also known, for example *Abra - Spisula - Pitar, Chione - Divaricella - Spisula*, associations that are found in other sectors or in restricted fields of the Romanian littoral.

The spread of *Spisula* alearly indicates the bottom limit of the sands in sediment dominance. Beginning with the inferior limit of the sand, *Spisula* forms continuous populations between the mouths of the Danube and the Kaliakra Cape, even if this continuity does not always match the numerical and ponderal dominant of the species within the macrobenthos. But, where the continuity is not associated with the dominant, the macrobenthos species that accompany and dominate it by the number of species or biomass present much more spatially limited populations, with a local and discontinuous character. In conclusion, *Spisula* imposes itself in the instable muddy but with stable infralittoral population.

The epibenthic character of *Spisula* must be stressed, because in the context of reduced consistence sediments, the criterion of the *Balanus* epibiosis also interferes as a selective factor. The abundance of *Balanus* larvae in the meroplankton of these waters determines a strong and permanent epibenthic mollusks epibiosis. That is the reason why often *Spisula*

cannot survive within the cenosis, because the *Balanus* epibiosis pushes it to the botoom of the sediment with its weight, suffocating the young mollusks on the seafloor. As a consequence, in the thanatocenosis small dimension (3-4 mm) *Spisula* valves can be found with 2 or 3 *Balanus* attached.

Photo 4 - *Rapana venosa* - laying

Photo 5 - *Rapana venosa* - grown up

The measurements made in 100 stations and more of the reserve indicate an interpenetration of many characteristic elements for the sandy substrate (*Chione, Cardium*) with other characteristics for the muddy or sandy-muddy with shells substrate (*Spisula* - the spread of *Spisula* clearly indicates the bottom limit of the sands in sediment dominance. Beginning with the inferior limit of the sands, *Spisula* forms continuous *Pectinaria, Nereis*).

The *Mytilus* subcenosis. The abundance of the large *Mytilus* mollusks and also the moderate dynamics of the water have offered the intruder *Rapana venosa* (Photos 4-5) a favourable ecological niche. This great predator was detected in Romanian coastal waters in 1964; today, it is present along the entire rocky infralittoral, strictly located within the limits of typical *Mytilus* subcenosis (Photo 6).

Photo 6 - Mussels *Mytilus galloprovincialis* (underwater - original)

Along with the mussel, another bivalve is present in all the analyzed stations, that is *Mytilaster lineatus* (which reaches extremely high densities of 48,800 pieces/sqm with impressive biomasses of 6.4 kg/sqm), plus many other organisms.

The numerous rocky cracks, the dark holes under the rocks and all the other hideaways shelter a series of superior crustacean species (especially missides and decapodes). *Melita palmata, Microdeutopus gryllotalpa* and *Pilumnus hirtellus* must be remembered, as this is their specific biotope.

The vertical and strongly inclined surfaces, especially the ones with many cracks and rough nesses, only partially covered by mussels, offer the favourite biotope of the rocky shrimp (*Palaemon elegans*). There is no characteristic crab species for this subcenosis; even so, during summer *Pilumnus hirtellus* seems to be concentrated at these depths.

The sessile element with the highest frequency is *Balanus improvisus*, even if other sessile faunistic elements may appear, as the *Dysidea fragilis* spongiae, with a constant presence proved by its blue colonies. Particularly between depths of 12 to 18 m, within the limits of the moderate level variations of the platform, *Dysidea* forms special conglomerations,

being able to cover the rocky bottom, including the mussel colonies, on large surfaces. The covering degree varies between 10 and 80 % on surface of tens up to hundreds of square meters, with the highest expansion in October.

Of all the species found there, the *Pilumnus hirtellus* crustacean (included in the *Black Sea Red Data Book*) must be mentioned, a frequent species on the Romanian littoral until the 1980's, but now with a diminishing population, having the "vulnerable" statute.

The shells is represented by agglomerations of actual marine mollusks valves (especially *Mytilus galloprovincialis*) or by the paleoscradys and is present on about 10% of the reserve surface) (Photo 7).

Photo 7 - Shells (mussel' valves - underwater - original)

The denudated areas represented by the rocky platform in the north of the reserve make up about 5% of the reserve surface and matches the current tendency of rocky habitats to the Romanian littoral denudation, presently specific. Situated near the port of Mangalia and influenced by pollution, it is a "monn-like" landscape, lacking epibiontic organisms. The lack of the natural biofilter influences also the quality of the water by the growth of the eutrophication.

The presence of such an area in the reserve should trigger an alarm, and only an appropriated management of the reserve could stop the extension of this denudation tendency.

The maintenance of the diversity of the area, on the matter of the habitats and the organisms populating it is a priority in elaborating the integrated management of the coastal line of the southern Romanian littoral.

3. The structure of the benthic ichtyofauna

The amateur fishermen prefer the area of the Marine Littoral Vama Veche - 2 Mai Reserve, but the professionals do, too. By the diversity of its habitats, it offers a diversified ichtyofauna.

Due to the rugged nature of the bottom, stationary fishing is practiced. In the reported period, in the perimeter of the reserve there were fixed four pound nets (two on floats and two on poles, at depths between 9 and 16 m).

By consulting the local fishermen, amateur and professional, by doing experimental fishing with the beach net and underwater dives with scuba divers, the ichtyofauna of the benthic habitats in the perimeter of the reserve was qualitatively evaluate.

Species that normally live at depths in the mytiloido-phasseolinoid area, such as the picked dogfish *Squalus acanthias* (V) and *S. blainvillei*, the thornback *Raja clavata* and the catfish *Dasyatis pastinaca* were found, together with stor sturgeon *Acipenser stellatus* pieces (DUMONT, 1999).

Between the algal bushes on the seafloor, representatives of the Syngnatide family are found, without any economic importance, but highly esthetical, as the seahorse *Hippocampus ramulosus*, together with the pipe fish (*Sygnatus typhe* (V), *S. variegatus* (V), *Nerophis ophidion* (V)).

Very spectacular is the presence of the greater weever *Trachinus draco* (R) and of the stargazer *Uranoscopus scaber* (R), which prefer the sandy bottoms where they hide and mess with the pound nets of the fishermen, sometimes even hurting them.

The various species of gudgeon, characteristic for the rocky bottoms (*Mesogobius batrachocephalus* (V), *Neogobius cephalarges* (V)), but also for sandy bottoms (*N. melanostomus* (V), *Pomatoschistus microps* (R), *P. minutus* (R) have the widest spread.

The turbot *Psetta maeotica* (V), the flounder *Platichtys flesus luscus* (V) and the sole *Solea nasuta* (Nt.) are the economically most valuable species.

CONCLUSIONS

1. The study represents the logistic, scientific and practical support for including the area in the functioning regime specific for the natural reserves, being the only underwater reserve on the Romanian littoral. With the present data, a map of the habitats and biocenosis in the reserve was realized by transferring the data into GIS format.

2. Due to its geographical position down to the Bulgarian border, and also to its diversity of habitats and species populating it, the declaring of the area as transboundary reserve, together with Bulgaria, is highly desirable.

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