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The characterization of the main habitat types populated by the Black Sea Turbot in its different stages of development

[1]Victor Niţă, [1]Ştefan Diaconescu, [2]Tania Zaharia, [2]Valodea Maximov, [1]Carmen Nicolae, and [2]Dragoş Micu

[1]University of Agronomical Sciences and Veterinary Medicine, Bucharest, Romania; [2]National Institute for Marine Research and Development, Constanta, Romania. Corresponding author: V. Niţă, victor_nicolae@yahoo.com

Abstract. The turbot *Psetta maeotica* (Pallas, 1814) is a demersal species that populates the Romanian Black Sea's continental shelf and is an important segment of the regional fishing potential under the aspect of market demand, both on the national and international level. Being a migratory species (short, coast - perpendicular migrations, made for reproduction) it uses during its complete biological cycle various habitat types, among which we mention: reproduction habitats (coastal waters, down to 30 meters depth), growing habitats (close to the sea bottom, down to 50-60 meters depth), wintering habitats (close to the sea bottom, down to 60-80 meters depth). The turbot populates almost all the habitat types present down to these depths, but it prefers the sandy and muddy ones, that are found especially in the Central and Northern part of Romanian littoral. The physical, chemical and biological characterization of these habitats revealed an improving tendency, that appeared on the bases of economical activities restructuring, the growing of the exigencies in implementing the environmental policies, the setting-up of marine protected areas and also the new reglementations regarding the marine resources exploitation.

Key Words: turbot, habitats, environmental conditions.

Riassunto. Il rombo *Psetta maeotica* (Pallas, 1814) è una specie demersale che popola la piattaforma continentale rumena, costituendo un segmento importante del potenziale regionale di pesca per quello che riguarda la richiesta sul mercato interno oppure internazionale. Essendo una specie migrante (migrazioni brevi, perpendicolari sulla costiera, per riprodursi), il rombo ne fa uso, durante l'intero ciclo biologico, di una moltitudine di habitat, dai quali accenniamo: habitat di riproduzione (le acque costiere, fino a 30 metri di profondità); habitat di crescita (vicino al fondo del mare, a profondità fino a 50-60 metri); habitat in svernamento (vicino al fondo marino, a profondità fino a 60-80 metri). Il rombo popola quasi tutti i tipi di habitat presenti fino alle profondità nominati, mostrando comunque una predilezione per quelli sabbiosi e melmosi, rappresentati soprattutto nella zona centrale e nordica del nostro littorale. La caratterizzazione fisica, chimici e biologica di questi habitat ha dimostrato un miglioramento delle condizioni, che è apparso come conseguenza della ristrutturazione delle attività economiche, l'aumento delle esigenze di politica ambientale, l'istituzione di zone marine protette e l'emergere di nuove regole sullo sfruttamento delle risorse marine.

Parole-chiave: rombo, habitat, condizioni ambientali.

Rezumat. Calcanul *Psetta maeotica* (Pallas, 1814) este o specie demersală care populează platoul continental românesc al Mării Negre, fiind un segment important al potenţialului pescăresc regional sub aspectul cererii atât pe piaţa internă cât şi pe cea internaţională. Fiind o specie migratoare (migraţii scurte, perpendiculare pe coastă, făcute în vederea reproducerii) specia foloseşte de-a lungul întregului ciclu biologic o multitudine de habitate, dintre care menţionăm: habitate de reproducere (apele costiere, de până la 30 de metri adâncime), habitate de creştere (aproape de fundul apei, la adâncimi de până la 50 – 60 de metri), habitate de iernat (aproape de fundul apei, la adâncimi de până la 60 – 80 de metri). Calcanul populează aproape toate tipurile de habitate prezente până la adâncimile menţionate, manifestând totuşi preferinţe pentru cele nisipoase şi mâloase, reprezentate îndeosebi în zona centrala şi nordica a litoralului nostru. Caracterizarea fizică, chimică şi biologică a acestor habitate a relevat o tendinţă de îmbunătăţire a condiţiilor, care a apărut pe baza restructurării activităţilor economice, a creşterii exigenţelor politicilor de mediu, instituirii de arii marine protejate şi apariţiei noilor reglementări privind exploatarea resurselor marine.

Cuvinte cheie: calcan, habitate, condiţii de mediu.

Introduction. Among all demersal species, the turbot has a special importance because it is suitable for the practicing of a specialized, industrial fishing, and through a good exploitation management and a good capitalization of the catches it can ensure the economical re-launch of the national marine fisheries, determined by the offering on the market of some valuable fishing products, whose demand is not satisfied at this moment.

Since 1979 FAO pinpoints about the fact that turbot stocks have been excessively exploited, despite the measures adopted by riparian countries for maintaining the stocks. FAO accepted at that time the necessity of knowing the turbot stocks identity, distribution and migration, but until today these aspects have not been solved. The identification, description and good management of the turbot's specific habitats is part of this strategy because the maintaining of the habitats in a favorable state significantly contributes to the improvement of the turbot stocks.

The scientific research of the marine habitats at the Romanian Black Sea shore is a recent activity at the National Institute for Marine Research and Development Constanţa (NIMRD), started off especially in the context of the Implementation of the Habitats Directive (92/43/EEC) in the Romanian marine areas. The dramatic decline of many species is determined by the deterioration of the necessary habitats for their survival. In a few decades, the intensification of many human activities – agriculture, forestry, industry, energy, transport, tourism etc. led to loss or fragmentation of the natural habitats. By implementing the Habitats Directive we contribute to the conservation of the biodiversity by protecting the natural habitats and the wild flora and fauna of Romania, as a member state of the European Union. According to the Directive, an ecological European network was formed, under the name „NATURA 2000", comprising special areas for conservation. This network will ensure the maintaining and the re-establishing of all natural habitat types, in a favorable conservation state. From this point of view, the Romanian littoral is a real „mosaic" of habitats, with a national network of protected areas, very well organized and representative for every type of habitat (Zaharia et al 2008, 2009).

Material and Method. The research was made based on sea expeditions, S.C.U.B.A. Diving and sampling campaigns made between 2008 and 2010. The samples were provided by S.C.U.B.A. Divers, on characteristic profiles, and constituted of sediments and water, that were chemically, bio-chemically and biologically analyzed in the special NIMRD laboratories.

For the characterization of the coastal water quality, samples were taken from the integrated monitoring network, and they were processed and interpreted according to international methodology by specialists.

For recording the marine habitats images and films, the Divers used Olympus underwater camera and video camera. The processing of the images was made within the IT department, on computer.

The interpretation of the results was made according to the Habitats Directive (92/43/EEC) (Annex 1), and its Modifications made accordingly to the amendments of Romania and Bulgaria. We also used the European Union Manual for Habitats Interpretation (EUR 25, 2003) and we also took into consideration the correspondence with the Palearctic Habitats Classification (Devillers-Terschuren & Van der Linde 1996).

Results and Discussion. For describing the turbot's specific habitats, it is necessary first to present the biology, ecology and ethology of this species, because it reveals some particularities that influence the habitat choice. In Table 1 are presented the scientific synonyms of the species according to Fishbase (Froese & Pauly 2011) and WoRMS (Bailly 2011).

Dimensions: maximum – 100 cm and 10 kg; average – up to 50 cm and 3–3.5 kg.

Spreading: Black Sea and Azov Sea. It can be found all over the Romanian littoral, especially in the sector between Agigea and Vama Veche (see Photo 1). In the North Europe Seas exists the species *Psetta maxima* (small turbot).

Table 1

P. maeotica (Pallas, 1814) - Family *Scophthalmidae*

Synonym	*Author*	*Status*	*Valid*	*Synonymy*	*Combination*
Pleuronectes maeoticus	Pallas, 1814	synonym	No	senior synonym	original combination
Psetta maeotica	(Pallas, 1814)	accepted name*	Yes	senior synonym	new combination
Psetta maxima maeotica	(Pallas, 1814)	synonym	No	senior synonym	new combination
Rhombus maeoticus	(Pallas, 1814)	synonym	No	senior synonym	new combination
Scophthalmus maeotica	(Pallas, 1814)	synonym	No	senior synonym	new combination
Scophthalmus maeoticus	(Pallas, 1814)	synonym	No	senior synonym	new combination

*according to http://www.marinespecies.org/

Photo 1. The turbot (*P. maeotica*) (original photo).

Bio-ecology: marine benthonic species, prefers soft bottoms. The juveniles can be found near the shore, on sandy bottoms, and as they grow they retreat to bigger depths. The adults can be found during winter at a 60-70 m depth, in the *Phaseolinus* facies zone. In spring (March - April) they come close to the shore, at depths of about 18 - 30m (at the inferior limit of the *Corbulomya* facies), but not everywhere, only in specific locations, where they crowd for reproduction. They reproduce along the entire Black Sea littoral, from the end of March until July, close to the shore, at depths down to 40 m. After reproducing, they spread and retreat to bigger depths. The characteristics of the reproducing areas are not well defined for the Romanian littoral. The reproducing takes place at low water temperatures, between 8-12°C. The water temperature variations in the reproducing areas are very important. The salinity of these sectors varies between 16.29 and 19.3‰.

The sexual maturity is reached at 7 years by males and at 9–11 years by females. The sex ratio varies considerably, so in the first years of life the males dominate (65%), and, beginning with the fifth year, the two sexes are equally represented.

The larvae are pellagic and they feed with nano- and microplankton, the juveniles eat crabs and mollusks, *Idotea*, *Nereis*, shrimps and fish juveniles, and, starting with the fourth year, fish become the main food source.

Even if the turbot is one of the prolific fish species (between 3 and 13 mil. eggs), the losses are enormous during the ontogenetic development, so we can appreciate that only 2% reach sexual maturity.

By studying the ecology of turbot reproduction, it was established a connection between the productivity of various generations and the water circulation under the aspect of winds. In the North-Western part of the Black Sea, a growing of the turbot generations number was recorded in the years dominated by South winds. The smallest number of offsprings was recorded in the years with winds from North and North-East.

The young individuals are very eurythermal (they live in summer at 26°C and in winter at 0 - 1°C) and euryhaline, tolerating waters with 6 ‰ salinity. The adults are more sensible at the modifications of the environment conditions.

In the Romanian waters, the turbot spawn was found in the last years at low densities, sub-unitary, and this is a good trace regarding the state of this species population in the Romanian areas (Radu et al 1995).

The growth rate is low: at 3 years the average length (without caudal) of 17.3 cm and biomass of 170 g are reached; after 5 years - 31.8 cm and 1.15 kg, after 10 years - 55 cm and 3.10 kg and at 23 years - 70 cm and 6 kg. According to Cărăuşu (1952), the growing rhythm for turbot is that from Table 2.

Table 2

Growing rhythm for turbot (Cărăuşu 1952)

Age	*3*	*5*	*8*	*10*	*12*	*15*	*20*	*23*
Length (cm, without caudal)	17.3	31.8	48.3	55.0	59.6	64.1	69.1	70.1
Average biomass (kg)	0.17	1.15	2.10	3.10	3.30	4.40	5.50	6.00

The commercial importance: white meat, very tasty, especially before the reproduction period. It can be commercialized and consumed in fresh state (whole, portioned, fillet), frozen (whole, portioned, fillet) and canned.

The problem of turbot habitats is complex, and requires a detailed study, considering the migratory character of the species. In the identification of these habitats we took into account the turbot's particularities: mostly benthonic species (that uses the sea bottom for living and feeding) but which has pellagic spawn, so the embryo development takes place in the water column, near the shore (Figure 1).

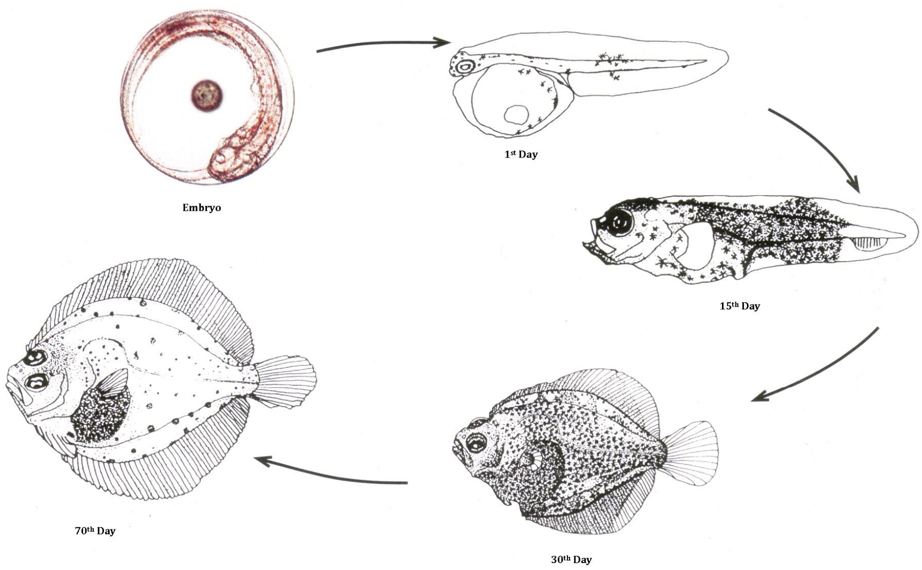

Figure 1. Turbot's complete metamorphosis scheme (from Zaharia 2002).

We can appreciate that, for its complete life cycle, the turbot uses the following habitats: reproduction habitats (coastal waters, down to 30 meters depth), growing habitats (close to the sea bottom, down to 50-60 meters depth), and wintering habitats (close to the sea bottom, down to 60 - 80 meters depth). These habitats are localized along the entire Romanian littoral. On our littoral, the largest turbot crowds in the Black Sea can be found. Also, the largest reproduction crowds can be found on the Romanian shore (Figure 2).

Figure 2. Turbot distribution in the Black Sea.

Generally, the turbot can be found in all habitat types, but it prefers the sandy substrates, that are especially found in the Central and Northern part of our littoral. The research revealed the existence of eight substrate types at the Romanian Black Sea shore.

Fine sand sedimentary substrate:

Found at Vadu (at depths of 5 – 10 m), Midia (5 – 10 m), Constanta (15 m) and in the Northern part of the littoral. The crustaceans are predominant, especially at Vadu, the amphypode *Ampelisca diadema* reached densities of 4,784 ex./m^2. The worms are also present in high densities, of 118,965 ex./m^2 (Vadu, 10 m), the polychaets are predominant, with over 80%. The bivalves have high densities at Vadu and Midia, up to 11,585 ex./m^2, only the species *Cardium edule*, *Corbula mediterranea* and *Mya arenaria* being found here.

The marine pre-deltaic area, with sandy bottoms, is characterised by the presence of *Pontogamarus* and *Corbula* biocoenoses. At 2 m depths, in front of Sahalin Island, *C. mediterranea*, *M. arenaria* and *C. edule* are found, but at low densities, of 20 to 40 ex./mp. The worms are very numerous, *Polydora ciliata* being the dominant species. From the fish species, the endemic ones are recorded here: *Acipenser gueldenstaedtii*, *A. nudiventris*, *A. stellatus*, *A. sturio*, *Huso huso*. Flat fish can be also found here: *Scophthalmus maeoticus*, *Platichthys flesus luscus*, *Solea solea* and *Pegusa nasuta*.

Brutish sand sedimentary substrate:

Found at Vadu (15 m), Costinesti (5 m) and Mangalia (10 - 15 m), but also in the Northern part of the littoral. It is characterized by the presence of worms in high densities (144,305 ex./m^2– Vadu, 15 m), of crustaceans only at Mangalia 15 m (105 ex./m^2) and bivalves (between 35 and 1400 ex./m^2). The bivalves are represented by endopsamic species *Cardium edule*, *Corbula mediterranea*, *Spisula subtruncata*, *Chione gallina*, *Mya arenaria* and *Politapes aurea*.

Muddy sand sedimentary substrate:

Found at Midia (15 m) but also in the Southern littoral, in isolated areas. The worms are dominant (29,820 ex./mp), followed by crustaceans (1,505 ex./m²) and bivalves, with only 350 ex./m² (Figure 3).

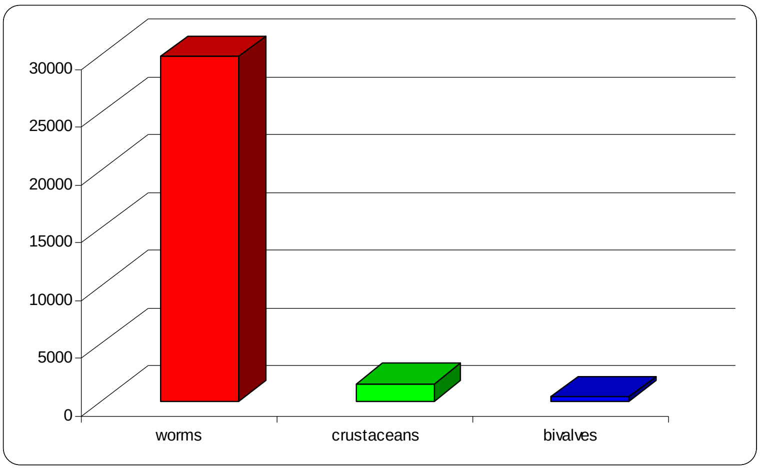

Figure 3. The average densities (ex./m²) of the main organisms found at Midia (15 m).

Among the worms, the polychaets are dominant - *Capitella capitata* (4,305 ex./m²) and nematods (8,400 ex./m²). Among the crustaceans, the amphypodes (*Pontogammarus* sp. – 875 ex./m²) and copepods (*Canuella* sp. - 630 ex./m²) are the most important species. The bivalves are represented by the endopsamic species *Corbula mediterranea* (105 ex./m²) and *Mya arenaria* (245 ex./m²).

At Zaton (on 10 m isobath) the bivalve *Mytillus galloprovincialis* was identified, with densities of 2,300 ex./m² and biomasses of 891,376 g/ m². Here, the sediments are very similar to the ones found in „sandy bottoms" habitats. The „new income" *Scapharca inaequivalvis* is very well accommodated here, reaching densities of 660 ex./m², and high biomasses, of about 8,067 g/m².

Muddy sedimentary substrate:

It was explored in the Northern part of littoral, but also at Mangalia (5 m), only worms being present, in high densities (97,160 ex./ m²). Among them, the nematods are predominant (88,200 ex./m²). From the polychaets, we found *Capitomastus minimus*, *Harmothoe reticulata*, *Neanthes succinea*, *Nerrine cirratulus*, *Polydora ciliata*. We also found bivalves, crustaceans (*Ampelisca diadema*, *Balanus improvisus*, both in low densities) and some fish species - *Benthophilus stellatus*, *Ponticola kessleri* etc.

Shell rests sedimentary substrate:

Found at Constanta (10 m), it is dominated by the presence of worms and crustaceans. The bivalves are represented only by one species, *Mytilaster lineatus* (Figure 4). The worms are represented by polychaets (10,640 ex./m²), nematods (26,600 ex./m²) and oligochaets (1,400 ex./m²).

Sand and shell rests sedimentary substrate:

Explored in the Southern littoral, at Vama Veche (15 m), presents a big dominance of the worms (473,060 ex./m²), followed by crustaceans (89,950 ex./m²) and bivalves (10,360 ex./m²) (Figure 5).

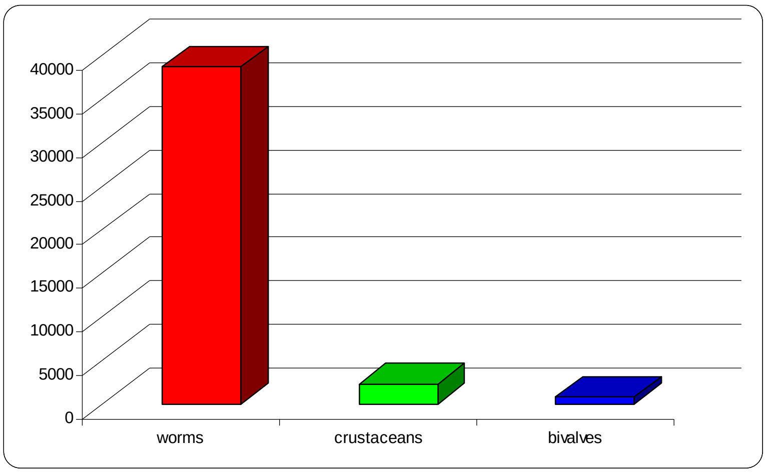

Figure 4. The average densities (ex./m²) of the main organisms found at Constanta (10 m).

Among the polychaets we mention: *Polydora ciliata*, *Spio filicornis*, *Nereis* sp. The crustaceans found were *Cannuella* sp., *Corophium* sp., *Microdeutopus gryllotalpa*. The most important bivalves proved to be *Mytilaster lineatus* (6,370 ex./m²) and *Mytillus galloprovincialis* (3,990 ex./m²) (Niţă 2008; Niţă & Ursache 2010).

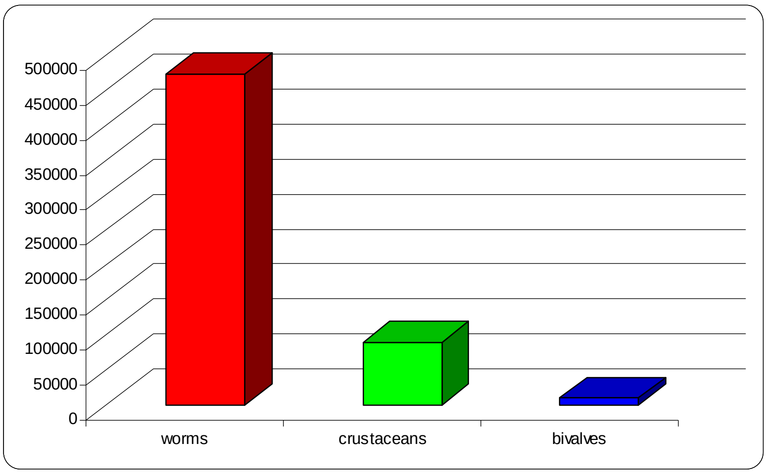

Figure 5. The average densities (ex./m²) of the main organisms found at Vama Veche (15 m).

Rocky substrate:

Found only in the Southern littoral, on every profile South from Constanta: Agigea 5 m, Tuzla 10 and 15 m, Costinesti 10 and 15 m, Vama Veche 5 and 10 m. This is the habitat with the highest biodiversity (6 groups of organisms - cnidarians, worms, crustaceans, hydracariens, chironomides and bivalves). The highest density belongs to bivalves (Constanta 5 m - 154,770 ex./m²), followed by worms (maximum density at Costinesti 15 m - 125,335 ex./m²). The other groups appear in lower densities. Vama Veche area has the greatest biodiversity (the only place where all 6 groups of organisms were found).

Muddy substrate with *Modiolus phaseolinus*:

This habitat is situated at depths from about 50 - 60 m down to 120 - 130 m. *Modiolus phaseolinus* was found in association with *Amphiura* and *Leptosynapta* (Echinodermata), *Sycon* (Spongiers), *Cerianthus* (Coelenterate), *Abra* and *Trophon*

(Bivalves), *Terrebelides* and *Exogone* (Polychaeta). A decline of this habitat is possible, because of the eutrophycation process that determined the growing of the polychaet *Mellina palmata* density.

Concerning the physical, chemical and biological characterization of the turbot's specific habitats on the Romanian shore, it was compiled based on the Marine Environment State Reports (NIMRD 2000 – 2008, 2009).

Sea water temperature at Constanta had major seasonal variations, from 0.5°C in February to 25.8°C in August, according to the oscillations of the air. We have to mention that, in 2007, in the conditions of a mild winter; the sea water temperature did not reached negative temperatures. The situation is well evinced by the monthly average values that, with a few exceptions, were equal or higher than the monthly multi-annual ones in the past 10 years. The annual average, of 13.1°C, joins the slight growing tendency in the last years, and this could be due to the global climate changes (Figure 6).

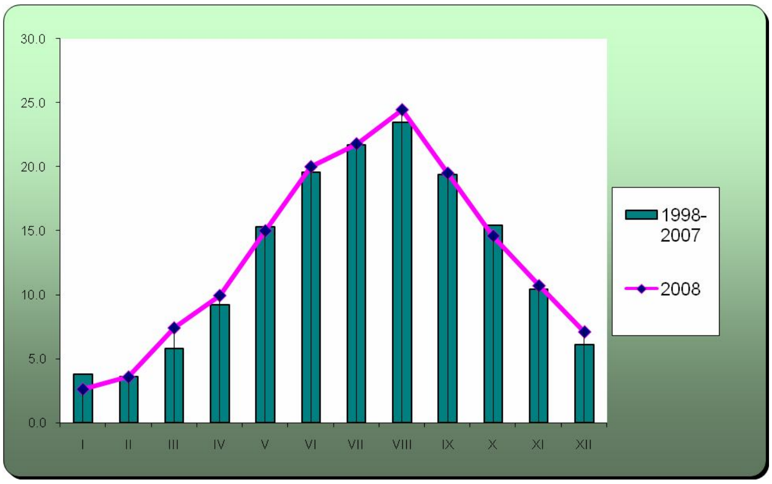

Figure 6. The coastal water temperatures at Constanta in 2008 (°C), compared to the 1998 - 2007 interval.

The salinity oscillated in natural limits for the area, between 9.40 g/L in August (because of an important fresh water income from the Danube) to 19.42 g/L at the end of March. The monthly averages of the salinity were situated below the multi-annual ones of the past 10 years, having small differences due to the variations of Danube's inputs. We can notice March, when the salinity grew with 2.64 g/L compared to the multi-annual average for the 1959 - 2007 interval (Figure 7). The annual average, of 14.63 g/L, was smaller than the multi-annual one between 1959 and 2007, which was of 15.11 g/L.

The dissolved oxygen recorded important seasonal variations determined both by sea water temperature evolution and the complexity of biological processes. The highest level was reached in March, when, because of the low temperature of water, the value of 529.6 µM/L was recorded. The lowest value, of 205.8 µM/L, was evinced in September, when the temperature average was 18.9°C. Compared to the multi-annual average situation between 1959 and 2007, in 2008, the coastal waters of the Romanian Black Sea were well oxygenated during the entire year (Figure 8). No hypoxia phenomena were recorded.

Total inorganic nitrogen had an evolution marked by a big / significant growth in April, when the monthly average was 26.99 µM/L. In the rest of the year, the monthly averages varied around the multi-annual averages between 1998 and 2007 (Figure 9).

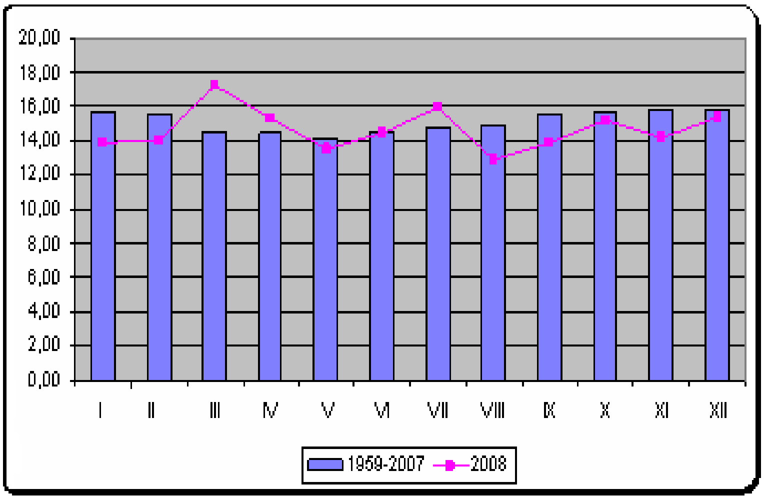

Figure 7. The evolution of coastal water salinity at Constanta in 2008 (g/L) compared to the 1959 - 2007 interval.

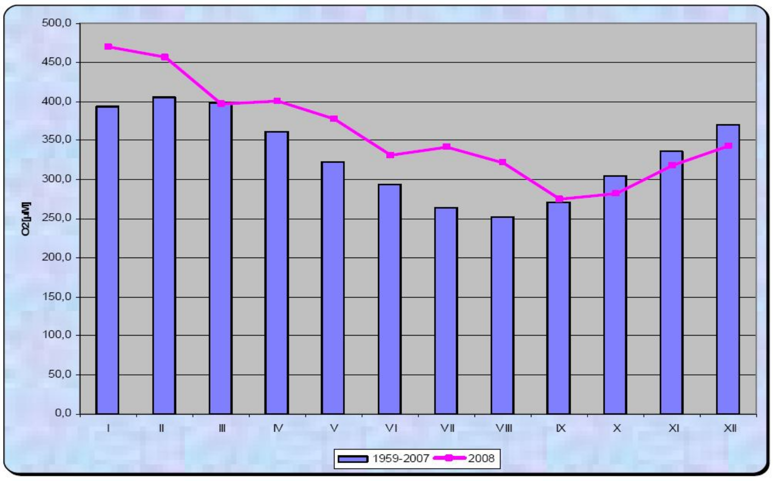

Figure 8. The evolution of the dissolved oxygen at Constanta in 2008 (µM/L) compared to the 1959 - 2007 interval.

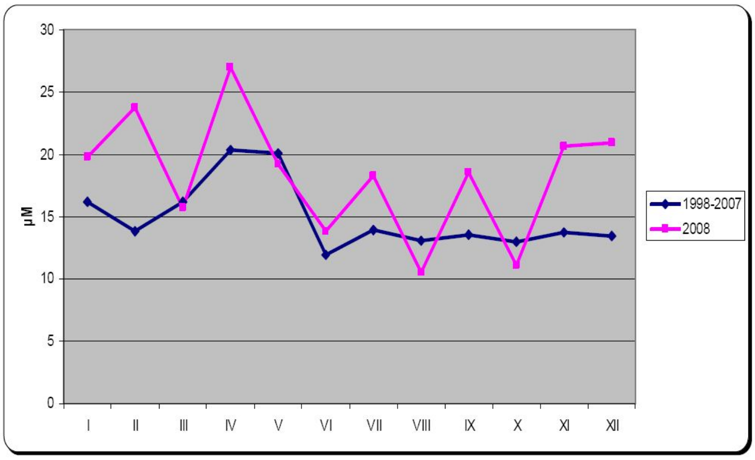

Figure 9. The evolution of the inorganic nitrogen at Constanta in 2008 (µM/L) compared to the 1998 - 2007 interval.

The dissolved phosphates reached both values of 1.92 µM/L in August and values situated below the method's detection limit of 0.01 µM/L in May. The monthly averages in 2008 were within the general decreasing tendency of the phosphates in the past few years (Figure 10), except for the months of January, April and August, as a follow-up of the big increase of fresh waters input.

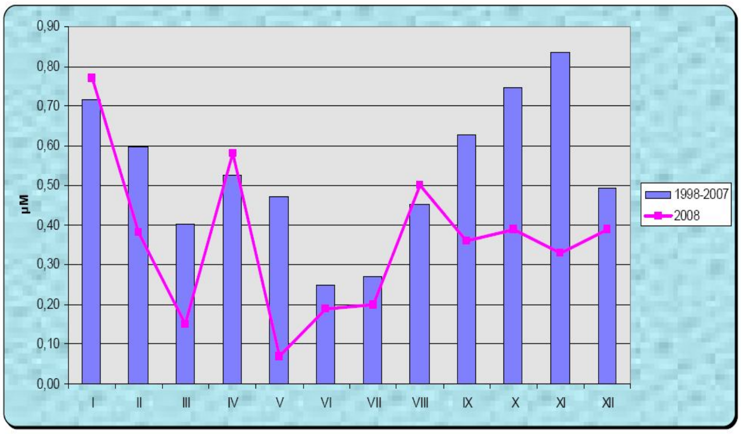

Figure 10. The evolution of the dissolved phosphates at Constanta in 2008 (µM/L) compared to the 1998 - 2007 interval.

The silicates reached high rates in January, 50.5 µM/L, and this month is important also because of the average value, 32.3 µM/L, close to the concentrations specific for the 1960's. The minimum value, 1.8 µM/L, was recorded in September, probably because of a consumption specific for the warm season and the low fresh water inputs (Figure 11).

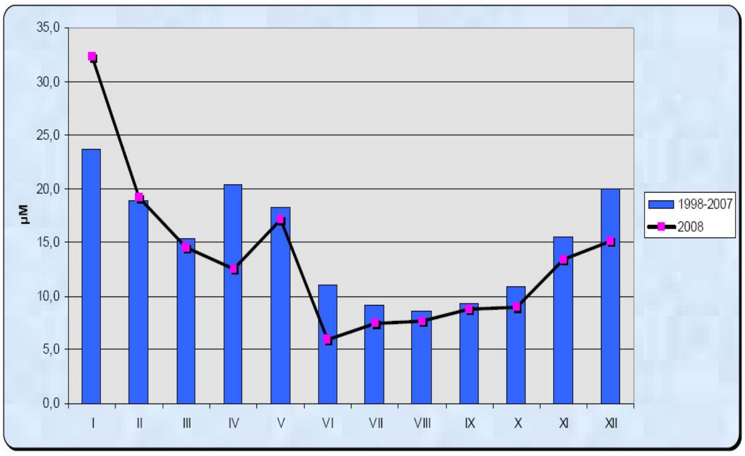

Figure 11. The evolution of the silicates at Constanta in 2008 (µM/L) compared to the 1998-2007 interval.

The quantity of „a" chlorophyll measured at Constanta, at shore, varied between 0.12 and 32.46 µM/L, the maximum value being reached in October. The monthly averages of „a" chlorophyll concentration were situated between 1.00 and 9.71 µM/L, the highest averages being recorded in August and October, as a follow-up of big algal blooms. Also, a high concentration was recorded in February (7.04 µM/L) because of a big development of diatomeae algae, a natural phenomenon in this time of the year (Figure 12). The dropping of the annual average concentration of „a" chlorophyll occurred due to the diminishing tendency of the eutrophycation process.

Figure 12. The seasonal variations of „a" chlorophyll concentrations (µM/L) at Constanta, in the year 2008.

The Phytoplankton:

The identification of the qualitative and quantitative structure of the phytoplanktonic component, as an indicator of the eutrophycation state, was realized by processing the samples collected along the entire littoral, on 5, 20 and 30 m isobaths. After analyzing the 236 samples (109 collected at the Casino - Mamaia site), 200 algal taxons were identified, that belong to 7 taxonomic groups (Bacillariophyta, Dinoflagellata, Chlorophyta, Cyanobacteria, Chrysophyta, Euglenophyta and Cryptophyta). From the biodiversity point of view, the dominance belongs to Bacilariophyta, which constitutes 40% from the total identified species, followed by Chlorophyta with 24% and Dinoflagellata with 18% (Figure 13). The marine species represent 52.5% from the total, and the fresh water ones, 47.5%.

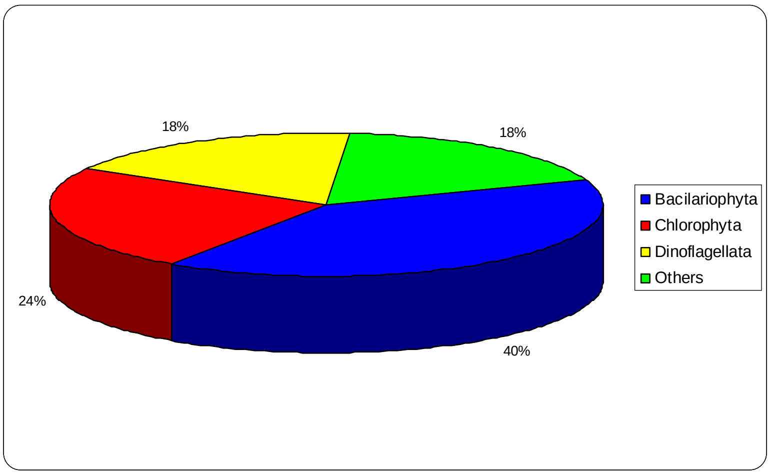

Figure 13. The structure of phytoplanktonic groups at the Romanian Black Sea shore in 2008.

The Zooplankton:

By analyzing the data obtained between 2000 and 2007, we can appreciate that the number of identified species varied between 16 (in 2003) and 30 (in 2005). Among the species included in the Black Sea Red Book, the only species found were *Centropages ponticus*, *Pontella mediterranea* and *Anomalocera patersoni*.

The two exotic ctenophore species, *Mnemiopsis leidyi* and *Beroe ovata,* reached an equilibrium, the developing of the first one being controlled by the second one. The trophic zooplankton biomasses on the Romanian littoral join the multi-annual and seasonal tendencies.

The Macrophytobenthos:

The macrophytobenthos development on our seashore continues explosively, for example, in 2008, the collected quantities on the littoral were of 25.040 m^3 (according to Romanian Waters National Administration, Dobrogea-Littoral Waters Direction). This is a natural process, with positive ecological connotations. The major causes of this phenomenon are waters transparency, high water temperatures in shallow areas and the large quantities of nutritive substances (N and P) in marine waters.

Normally, the developing peaks of the vegetation are in spring (April - May) and autumn (September - October). The agitation state of the sea detached the algal biomasses from the rough substrate, forming huge deposits, especially on the Southern littoral beaches.

The Zoobenthos:

As an indicator of the eutrophycation state of marine costal waters (5 – 20 m), the zoobenthos presented restoring signs concerning the diversity of the species, the qualitative evaluation leading to the recording of 52 species, compared to 48 - 50 species identified between 2005 and 2007. By comparing today's state of the benthal fauna to the one in 1990, when the evaluations evinced maximum 28 species, we can talk about the maintaining of a good qualitative structure of the specific diversity.

The evaluation of Northern littoral macrozoobenthos to an average of 425 g/m^2 was close to the results in 2005 – 2007. A clear growing situation was recorded in the Central part of our seashore, where the average biomasses were three times bigger than in the mentioned previous period.

Marine Habitats:

The diversity of marine habitats, characterized by using the EUNIS (the European Nature Information System of the European Environment Agency – EEA) classification system, evinced the presence of 2 types of habitats in the water column and about 150 types of benthal habitats. We can appreciate that, among these, five types are still in a critical state: infralittoral hard substrate with *Pholas dactylus*, infralittoral rocky substrate with *Petricola litophaga*, infralittoral sands with *Donax trunculus*, *Zostera* meadows and infralittoral *Cystoseira* belts (Zaharia et al 2009). All these habitats have national importance. Until today, their surface was not completely estimated.

The number of European importance habitats (defined in the Habitats Directive 92/43/EEC) was evaluated to 8 types, (Donita et al 2005; Donita et al 2005 - modifications), some of them characterized in the following pages. They have 28 sub-types. In 2008 we discovered 2 new types of European importance habitats, both having a high conservative value: 1110-8 and 1110-9, described below. Generally, the surfaces represented by these European importance habitat types have a few tens of square km's. The following types/sub-types has the highest conservative value (according to Micu et al 2007):

Type 1110 - sand banks permanently covered by sea water;

Sub-type 1110-1 - fine sands, clean or muddy, with *Zostera* (Photo 2); sands situated at 1 - 10 m depth, characterized by sediments stability, mud composition and the presence of indicative species *Zostera marina*, *Z. noltii* and *Zanichellia*. The meadows can be found at Mangalia, Sahalin, Musura.

Photo 2. Fine sands, clean or muddy, with *Zostera* (photographer D. Micu).

Sub-type 1110-3 – shallow water fine sands (Photo 3); terrestrial fine sands in the North (between Sulina and Constanta) or biogenic in the South (Eforie, Costinesti, Mangalia, 2 Mai, Vama Veche), mixed with shell rests and gravel, disposed from the shore to 3 - 4 m isobath.

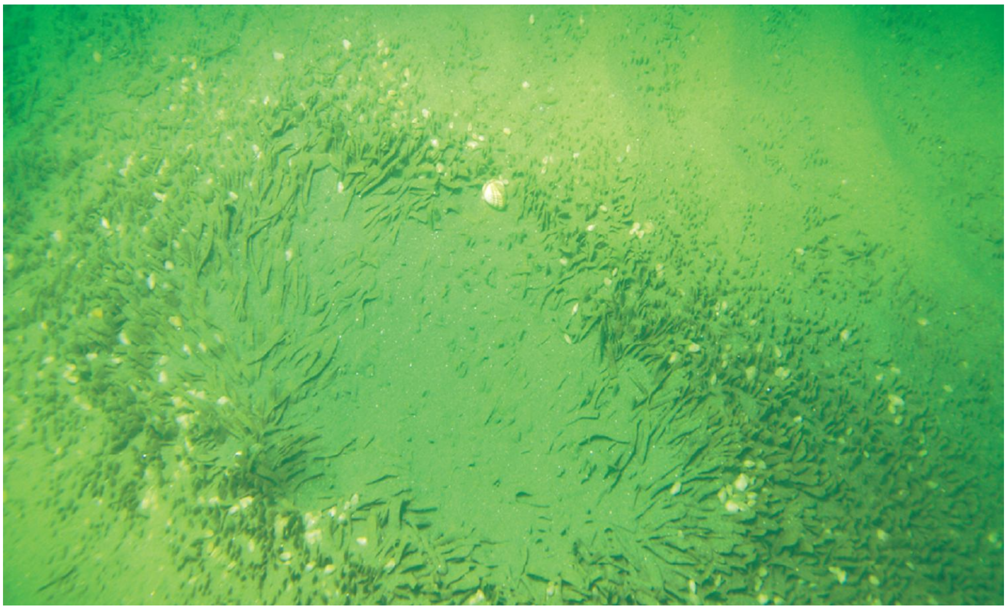

Photo 3. Fine shallow water sands (photographer D. Micu).

Sub-type 1110-4 - well calibrated sands (Photo 4); this habitat is well represented in the sandy areas of the Southern littoral (Eforie, Costinesti, Mangalia).

Photo 4. Well calibrated sands (photographer D. Micu).

Sub-type 1140-8 – sands turbinated by *Arenicola* worm and *Callianassa* (Photo 5); with a fragmented distribution on the submerged beaches South of Cape Midia, at 3 - 7 m depths.

Photo 5. Sands turbinated by *Arenicola* and *Callianassa* (photographer D. Micu).

Sub-type 1140-9 – muddy sands, turbinated by the *Upogebia* crustacean (Photo 6); forms a continuous belt along the Romanian coast, at 10-30 m depths, on muddy sands.

Photo 6. Muddy sands, turbinated by *Upogebia* (photographer D. Micu).

Type 1130 - estuaries; found at the Danube outfalls up to 20 m isobath (Photo 7).

Photo 7. Estuarine waters at the Danube's outfalls (Google Earth print screen).

Type 1150 – coastal lagoons; today this habitat is modified through hydro technical works, and because of this phenomenon, the typical lagoon conditions are found especially in Sinoe lagoon. Here the salinity is very variable and the division line between fresh and salty waters can be displaced by hundreds of meters, a few times a day, depending on winds.

Type 1170 – reefs;

Sub-type 1170-2 – biogenic reefs formed by *Mytilus galloprovincialis* (Photo 8); made of mussel banks, whose shells accumulated in time, forming a rough substrate in the middle of surrounding sediments (mud, sand or mixture), on which living mussel colonies are found.

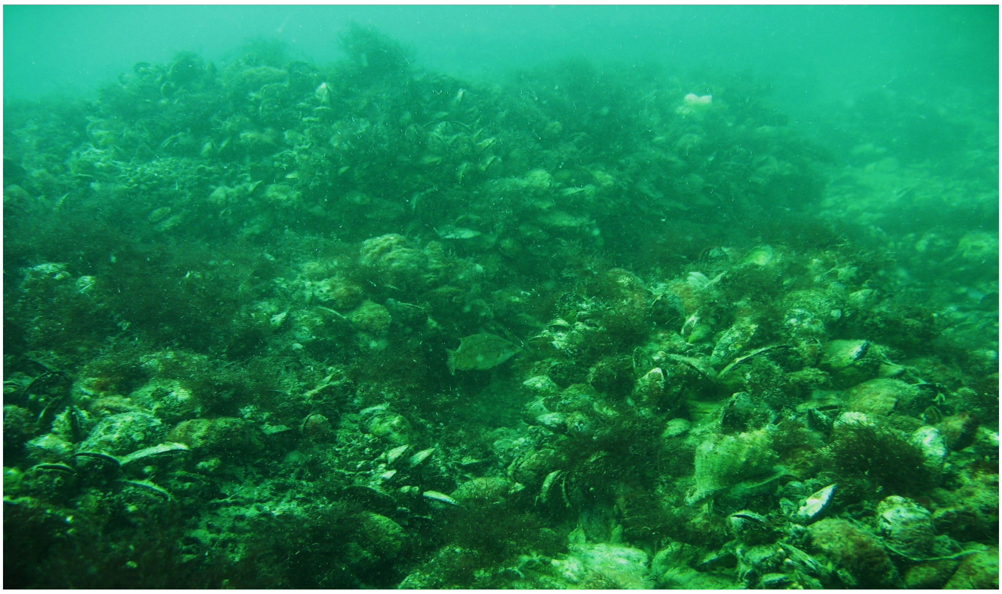

Photo 8. *Mytilus galloprovincialis* biogenic reefs (photographer D. Micu).

Sub-type 1170-8 – infralittoral rock with photophylle algae (Photo 9); comprehends a lot of aspects (including sites with *Cystoseira barbata* and *Corallina officinalis*) and has a great algal and faunistic diversity. This habitat is the richest and most diverse of all types.

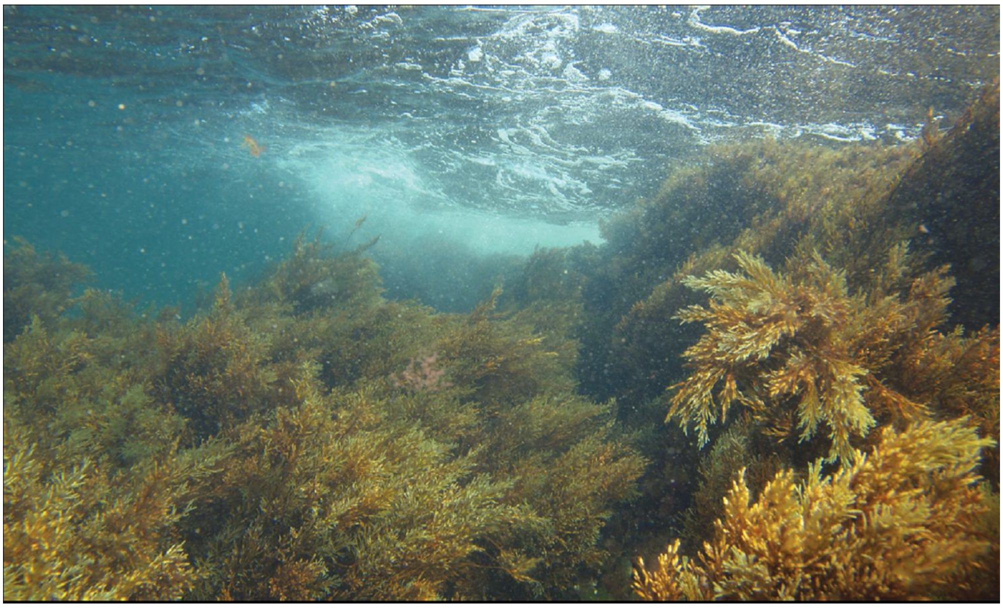

Photo 9. Infralittoral rock with photophylle algae (photographer D. Micu).

Type 8330 – underwater marine caves, totally or partially submerged (Photo 10); underwater caves, with the opening at least partially flooded by the sea. The ceiling and walls shelter marine invertebrates communities and some algae.

Photo 10. Underwater cave (http://www.allposters.com – photographer Raul Touzon).

Conclusions. The turbot (*Psetta maeotica*) is a demersal species that populates the Romanian Black Sea's continental shelf and is an important segment of the regional fishing potential under the aspect of market demand, both on the national and international level. Being a migratory species (short, coast - perpendicular migrations, made for reproduction) it uses during its complete biological cycle various habitat types, among which we mention: reproduction habitats (coastal waters, down to 30 meters depth), growing habitats (close to the sea bottom, down to 50 - 60 meters depth), wintering habitats (close to the sea bottom, down to 60 - 80 meters depth). The turbot populates almost all the habitat types present down to these depths, but it prefers the sandy and muddy ones, that are found in the Central and Northern part of our littoral. The physical, chemical and biological characterization of these habitats revealed an improving tendency, that appeared on the bases of economical activities restructuring, the growing of the exigencies in implementing the environmental policies, the setting-up of marine protected areas and also the new reglementations regarding the marine resources exploitation.

The main reasons that led to the improvement of the situation after 1990 can be summarized as follows:

- The quantity dropping by 50% of the nutrients transported by Danube (nitrogen and phosphorus salts) because of the drastically diminishing of synthetic fertilizers used in agriculture;
- The increase of the epuration capacities of the settlements along the Romanian littoral; only for purification stations and pipes in Constanta North and South, Eforie South and Mangalia, over 100 millions Euro were invested; for over 8 years the main indicator, the microbiological load, reached values below the E.U. reglementations;
- The hydrocarbons pollution is reducing constantly, despite some accidental situations that appear in the Danube's basin;
- We can appreciate that the marine ecosystem, although following the trajectory of a slow recovery, is in an ecological moment that can be

- assimilated to a convalescence state. Under these circumstances of fragile equilibrium, it becomes vulnerable to anthropogenic impacts, ecological accidents and global climate changes;
- The continuity of the natural recovery process of the sea's health state depends on the continuity and fermity in implementing the measures for conservation, protection and sustainable development of the marine environment, both on national and international level.

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Authors:
Victor Niţă, University of Agronomical Sciences and Veterinary Medicine, Faculty of Zoology, Romania, Bucharest, Marasti Blvd., 59, victor_nicolae@yahoo.com;
Ştefan Diaconescu, University of Agronomical Sciences and Veterinary Medicine, Faculty of Zoology, Romania, Bucharest, Marasti Blvd., 59;
Tania Zaharia, National Institute for Marine Research and Development „Grigore Antipa", Living Marine Resources Department, Romania, Constanta, Mamaia Blvd., 300, zaharia_tania@yahoo.com;
Valodea Maximov, National Institute for Marine Research and Development „Grigore Antipa", Living Marine Resources Department, Romania, Constanta, Mamaia Blvd., 300, maxi@alpha.rmri.ro;
Carmen Nicolae, University of Agronomical Sciences and Veterinary Medicine, Faculty of Zoology, Romania, Bucharest, Marasti Blvd., 59; carmennicolae19@yahoo.com;
Dragoş Micu, National Institute for Marine Research and Development „Grigore Antipa", Living Marine Resources Department, Romania, Constanta, Mamaia Blvd., 300, ddrraaggoossmm@yahoo.com
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