FIRST TRAINING SCHOOL FOR THE PROMOTION AND APPLICATION OF EU MARINE ENVIRONMENTAL POLICY FRAMEWORKS IN NON-EU MEDITERRANEAN AND BLACK SEA COUNTRIES
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"Marine environment pressure in the NW Black Sea – Romanian littoral system: past, present, perspectives, strategies and policies"

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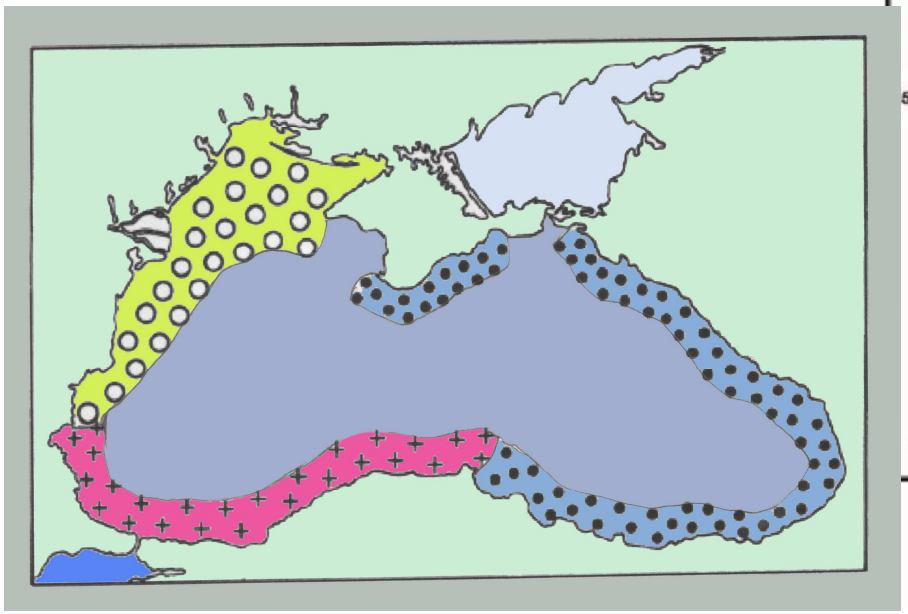
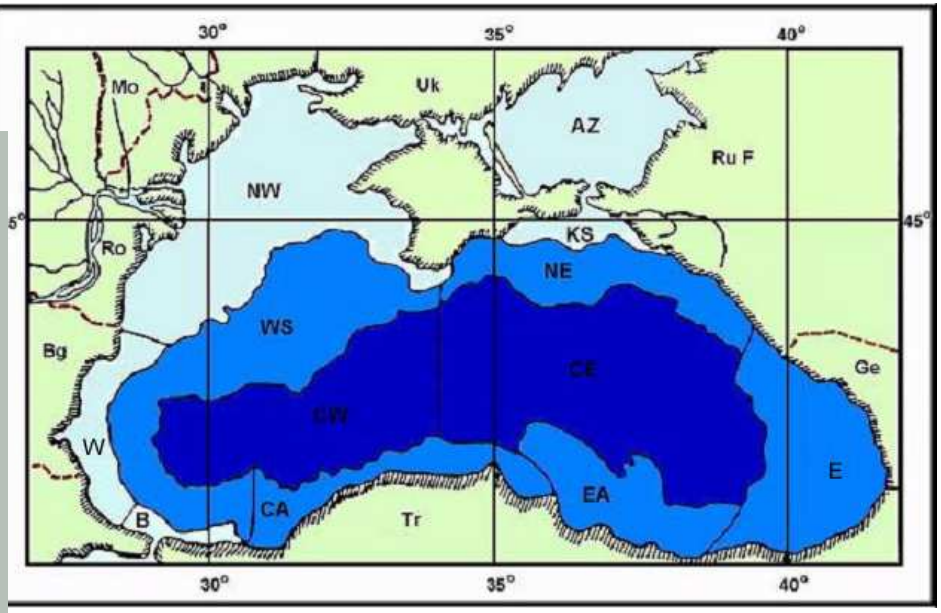
Benthic ecological zonation



Yakubova "clasic" map.



Sketch-map for the ecological zoning of the Black Sea (Eco-Regions): NW – North-West Shelf Zone; W – West Shelf Zone; B – Pre-Bosphorus Zone; CA – Central – South Zone (Anatolian Coast); E – East Zone (Batumi); KS – Kerci Shelf Zone; AZ – Sea of Azov; NE – Eastern Slope of the Shelf; WS – Western slope of the Shelf; CW – Western deep sea Zone; CE – Eastern deep sea Zone.

Black Sea - one of the most productive seas in the 60's

Base line reflecting a "round - cyclical" function of the ecosystems at all trophic levels:

- **high biodiversity;**
- **luxuriant development of both pelagic and benthic life;**
- **a vast distribution of *Phyllophora* red algae and good state of *Zostera* and *Algae* associations;**
- **a remarkable abundance of bottom filter-feeders (*Mytilus*, *Modiolus* and other species);**
- **an ideal feeding ground for many commercial fishes;**
- **rich and valuable developed fisheries – sturgeons, anchovies, turbot, sole fish, gray mullet, mussels etc.**

A naked truth: The Black Sea Ecosystem Crisis

- **After '70 until '90, the Black Sea ecosystem has suffered a severe and almost continues degradation of all its components, includind natural resources.**

- **Increased loads of nutrients from rivers and together with direct discharged waist and industrial waters caused an overproduction of phytoplankton, which in turn blocked the light reaching the sea macrophyta algae, essential components of the sensitive ecosystem of the north-western shelf.**

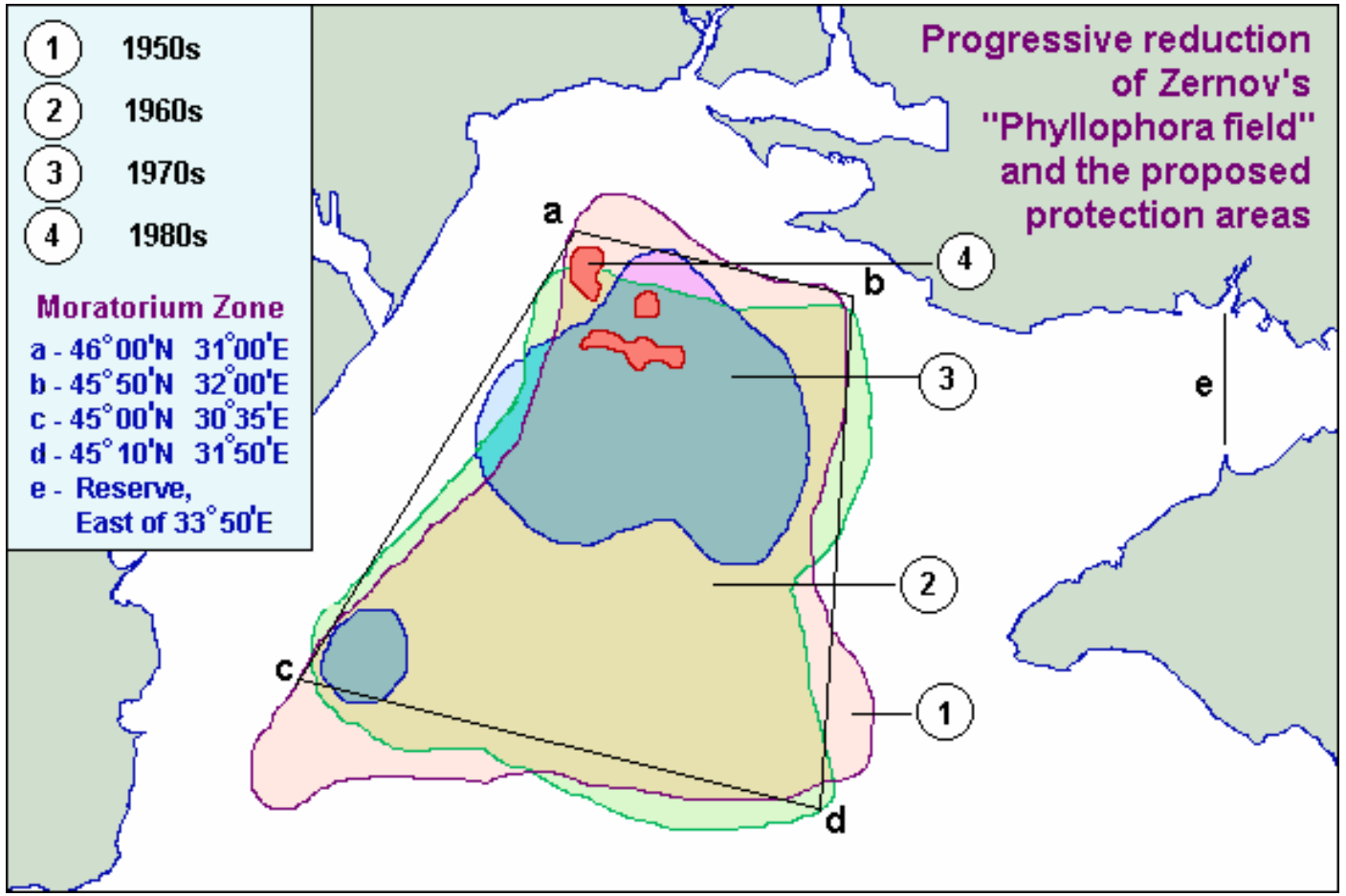
Land based sources has to be coupled with pollution and irrational exploitation of fish stocks, opened a catastrophic decline in fisheries resources

The entire ecosystem began to collapse.

Worsening the situation:

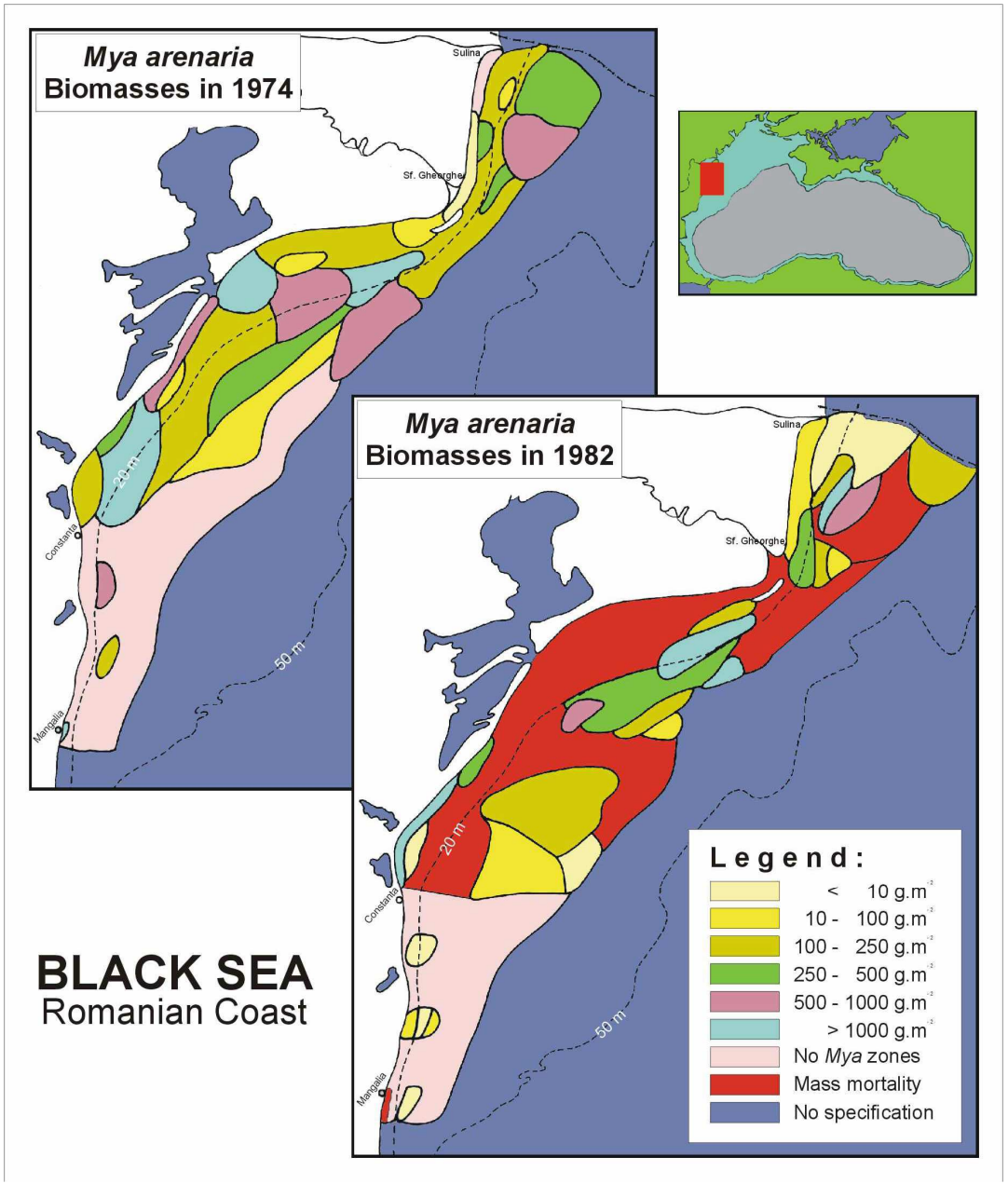
- ***Mnemiopsis leidyi* invaded the Black Sea**
- **Uncontrolled sewage pollution**
- **Solid waste dumped directly into the sea**
- **Oil pollution by tanker accidents and operational discharges**
- **Black Sea countries in economic and social transition, unable to take the necessary urgent remedial actions**
- **Unsustainable exploitation of the Black Sea's resources in the past few decades**

The ecosystem of the Black Sea has deteriorated dramatically in terms of its biodiversity, habitats, fisheries resources, aesthetic and recreational value and water quality.



Phyllophora represented a keystone species for the entire NW shelf ecosystem. ***Source:*** *Biolological Diversity in the Black Sea, BSEP Series Vol.3.*

Mass mortality of benthic organisms – *Mya arenaria* case



To a simple, less diverse and productive, unstable ecological system under the stress of the global changes.

Degradation of the Black Sea ecosystems under the pressing of:

- pollution/eutrophication by tributary rivers and effluents;
- coastal urban and industrial development;
- hydro-technical works for coastal defense or harbor facilities;
- development of maritime ships exchange between the Black Sea and the other seas and oceans;
- Invasion of alien species and their naturalizations in the new Pontic habitat;
- practice of bottom-trawl fishing;
- sand mining in the beach zone, etc.

Reduction of species diversity - major consequence of the disturbing factors:

- general or local extinction of some species;
- threatening populations with disappearance;
- increasing vulnerability of some forms;
- reduction populations size of many species;
- changes of taxonomic or/and ecologic structure populations in the communities;
- reduction the ecosystem resilience.

State of NW Black Sea benthic ecosystems

New line to compare the trends in ecosystem recovery:

- **drastic decrease of the specific diversity;**
- **simplification of communities structures – biocoenotic homogenizing;**
- **decrease of the numeric abundance and biomass of benthic populations;**
- **diminution of the biofilter strength by reduction of the filter – feeder populations;**
- **qualitative and quantitative worsening of benthic biological resources;**
- **thriving of opportunistic forms (worms causing sediment bioturbation) and,**
- **temporarily, some exotic species recently pervading Black Sea;**
- **great quantitative fluctuations of all benthic populations.**

Requirements/issues for the Black Sea benthic studies in actual post-eutrophication period:

- **Benthic assemblage's identification**
- **Species composition and abundance assessment**
  - **Number of species**
  - **Numerical density**
  - **Biomass**
  - **Size structure**
- **Assemblage segregation by reflected differences in salinity and sediment-types .**
- **Impacted and non impacted assemblages identification**
- **Species and/or higher taxa designation as indicators**
- **Meaningful proportion between the abundance of different taxa as indices for the assessment of ecological state of the ecosystem**

Indicators for benthic fauna.

Benthic community structure has been said and proved to be a reliable measure of ecosystem 'health'.

Monitoring of benthic ecosystems, although it may be time consuming, has often been applied in environmental impact studies (fisheries, domestic/industrial effluent, dumping of solid waste, etc.). The Water Framework Directive (EU, 2000) states that information is also needed on some benthos quality variables in coastal waters. Historically, knowledge of the marine benthic community structure and its functioning have relied upon the most widely used benthic parameters:

Indicators for benthic fauna.

- **number of species (S);**
- **abundance (N) or population numerical density expressed as number of individuals per m2, or biomass density as weight of individuals in grams per m2;**
- **community diversity using the Shannon-Wiener index (Shannon and Weaver, 1963) or other indices;**
- **ecological identity of the dominant species, the so-called 'key species';**
- **trends in benthic parameters.**

Indicators for benthic fauna.

Benthic community structure has been said and proved to be a reliable measure of ecosystem 'health'.

Macro-zoobenthos is an important link in food-web chains, meaning that the diversity of macro-zoobenthos (determined with the Shannon-Wiener index) may be used as an indicator of the ecological quality. Oxygen deficiency may result in loss of diversity and biomass. Other human activities like bottom trawl fisheries and water pollution also affect macro-zoobenthos.

Ecological Trend in the NW Black Sea

The ecological state of the coastal waters of the Western Black Sea has improved significantly since the late 1980s and early 1990s. The improvements are based on:

- **Reduced nutrient inputs which have led to reduced eutrophication and fewer algal blooms [The current relatively low inputs of nutrients to the Black Sea are partly due to the economic recession affecting the former communist countries, which has resulted in:**

  1. dramatic reductions in the application of mineral fertilizers

  2. closures of large livestock farms (point sources of agricultural pollution)

  3. closures in fertilizer -discharging industries]

- **Slightly recovery of animal populations on the seafloor, and**

- **an improved regeneration of macrophytes.**

Ecological Trend in the NW Black Sea

- **Rrecovery of the benthic system is rather weak, although there are some slight signs of betterment of the ecological situation along the near-shore and, particularly, the existence of two-year old mussels seems promising and contrasts with the situation in the late 1980s when all new recruits were killed by the annual appearance of the periodic anoxic waves.**

- **There are still uncertainties and it is too early to draw a high confidence conclusion on the recovery;**

- **Evaluation of the Black Sea ecosystem state represents a complex, laborious, time consuming and rather imprecise process for the moment.**

Signals of ecological recovery

►**Reappearance of species absent in the samples collected in the period 1970 -1990/95 is a promising signal.**

Recurrence of species extinct in the last 20-30 years may be considered a good signal, but there are also questions:

- **Were they really missing in the last 20-30 years?**
- **How often do these species appear?**
- **Do they occupy a large area?**
- **Are they abundant?**
- **Are they important in the ecosystem and for human economy?**
- **What are the trends of their evolution?**

Signals of ecological recovery are fragile and few:

► What happens, however, with commercial fish populations at the Romanian coast in these environmental conditions of the decrease in the ecological pressure caused by fishing?

►Although the pressure of the Danube River and other rivers chemical discharges has decreased obviously, water blooming events still occur, hypoxia is still present from time to time and there are mass mortalities of fish and other benthic organisms. Why?

►The recovery signs should be considered cautiously and uncertainties could be solved only in a longer time by increasing our scientific efforts.

Signals of ecological recovery are fragile and few:

The occurrence of explosive events with a random character: sudden warming and cooling of water, sudden episodic freshening of water, large variations in gradients of state parameters, blooming, emergence of hypoxia, mass mortalities of fish and benthic organisms, raises many question marks.

Certainties

- **Reduction of environmental pressures:**

  - **Decreased pollutant discharges / nutrients from the Danube**
  - **Reduced quantity of domestic wastewater from coastal towns**
  - **Improved waste water discharged into the sea by sewage plants**
  - **Reducing the active bottom trawling fishing**

- **Adopting and implementing a series of national / international regulations on marine environment**
- **Adopting regulations for protection against pollution in marine economies: transport / shipping, travel / thalassotherapy**

Uncertainties:

- **Difficulties in assessing the future - Missing the capacity in preventing the future**
- **Evolution of climate changes - Insufficient knowledge concerning the consequences of global changes in the Black Sea;**
- **Scarcity of long series of data concerning ecological pressures;**
- **Perspectives in the development of aquaculture in coastal zone.**

The roots of uncertainties concerning the signs of the Black Sea ecosystem recovery :

Research efforts are spent at random:

- **Unevenly distributed spatially and temporally;**
- **Non-standardized and non-calibrated to be used in comparative studies;**
- **Based on the "hunt" of exotic / non-native species or absent after 1970;**
- **Scientific information from literature superficially used;**
- **Superficial knowledge of literature, of "gray" literature, including the absolute ignorance of papers written in a language outside the international use;**
- **Small number of samples per station;**
- **Lack or scarcity of data concerning offshore deep areas or the cold seasons;**
- **Use of non-standardized devices.**

The optimistic signals on the Black Sea ecosystem's recovery should not hinder the pursuit of existing problems. The Black Sea is still a sea in trouble:

algal blooms are still heavy and pollution - although localized - affects the biological communities.

The so call "restoration" of Zernov's *Phyllophora* Field will take a long time and the outcome is uncertain; on the other hand, can we speak about "recovery"? Our mission is more realistic if we can reduce or eliminate the ecological pressures impacting the ecosystems.

Fish stocks of commercially valuable species, such as sturgeons and turbots - demersal species, suffer from illegal fishing and from pollution and destruction of their habitats, their feeding grounds or their reproductive shelters.

The process of recovery of the Black Sea will take a long time and will require the implementation of all measures envisaged by the Black Sea Strategic Action Plan as well as some future provisions.

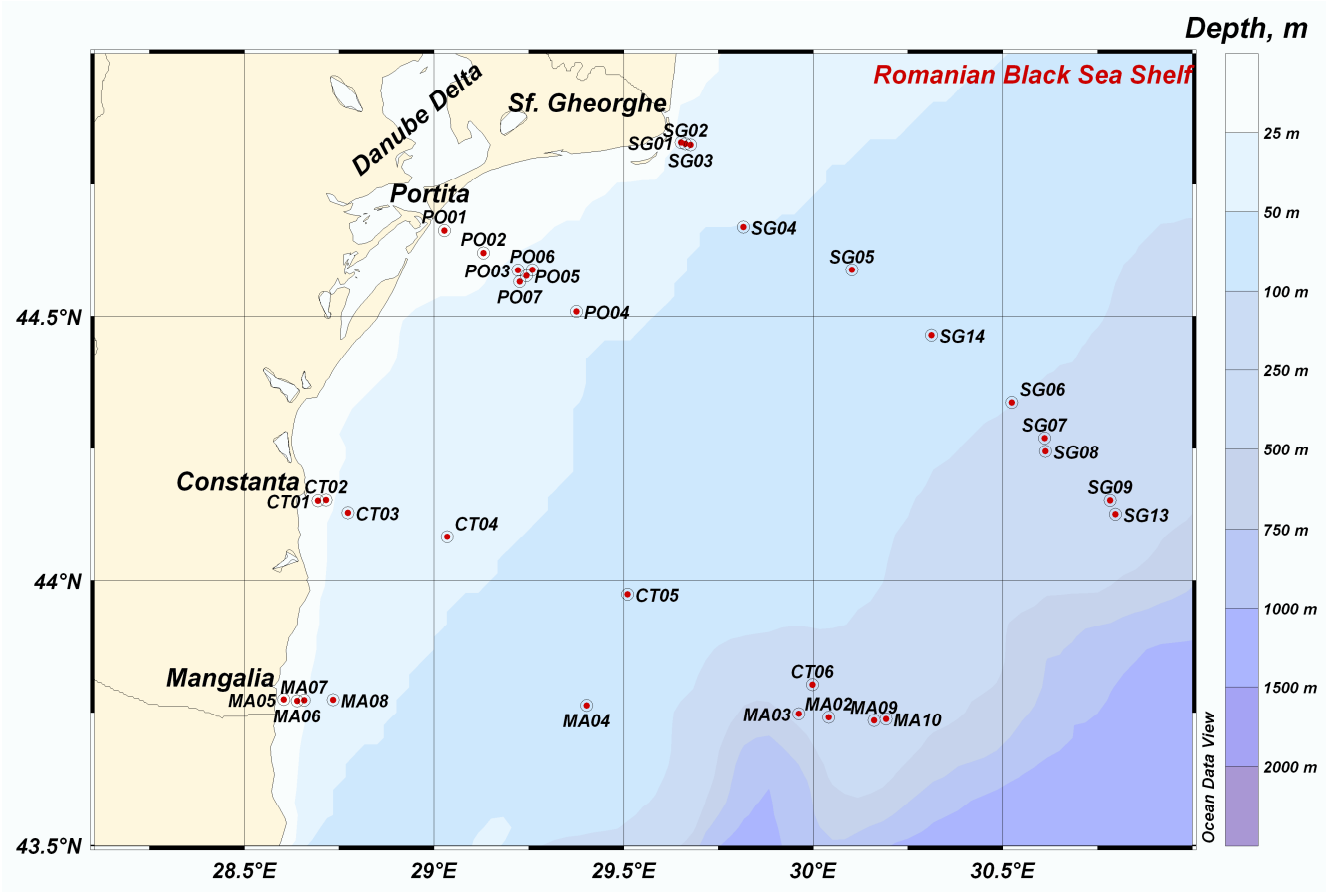
The process will be further complicated by the fact that scientific knowledge and information on many processes and phenomena, which are needed for policy and decision making, are missing.

The data from national monitoring programs are unsatisfactory and the assessment of the ecological state of the Black Sea Environment is difficult to be achieved without adequate equipment.

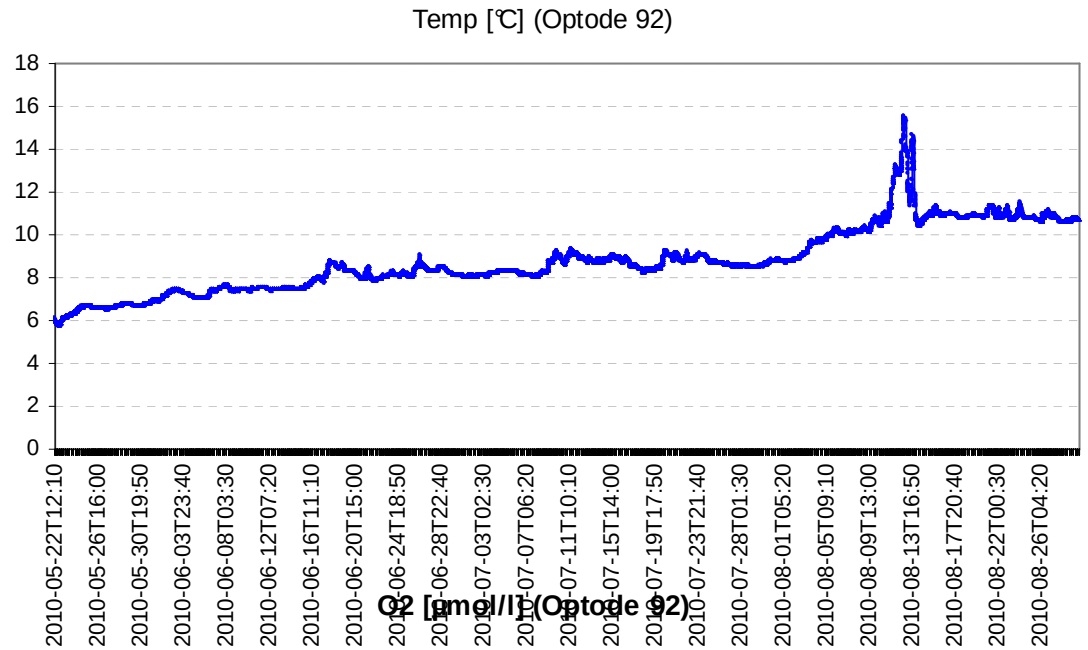
The cooperative regional efforts of the states in the Black Sea Basin are seen as a guarantee that the Black Sea ecosystem will be sustained and rehabilitated and that the strategic and intermediate targets developed jointly by the EU, Black Sea Commission, ICPDR and other organisations by the political will, scientific cooperation, stakeholder understanding and social welfare should be achieved.

Thank you for attention !

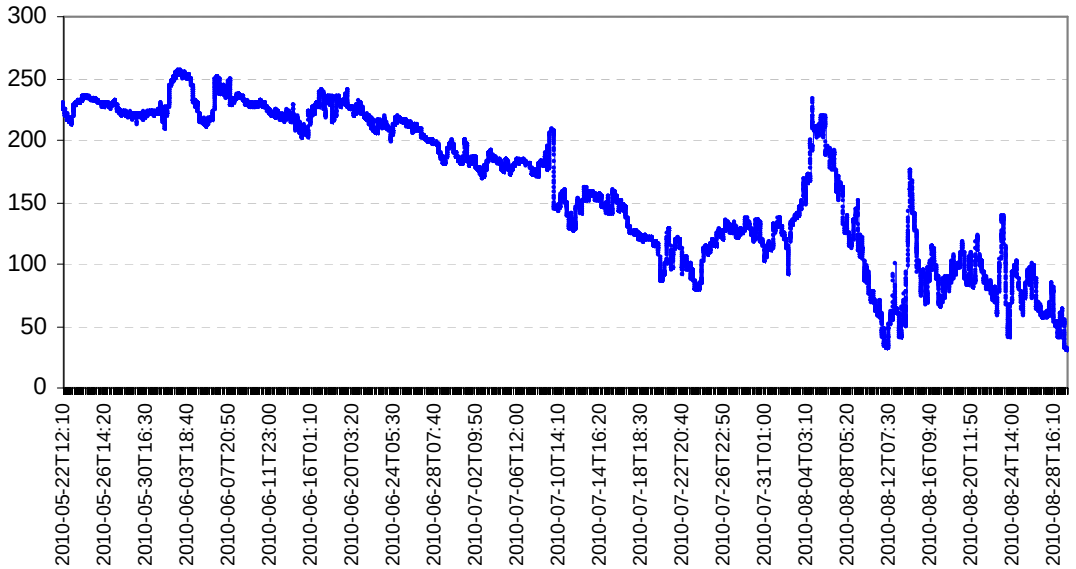
Studying the Romanian Shelf benthic community in HYPOX Project



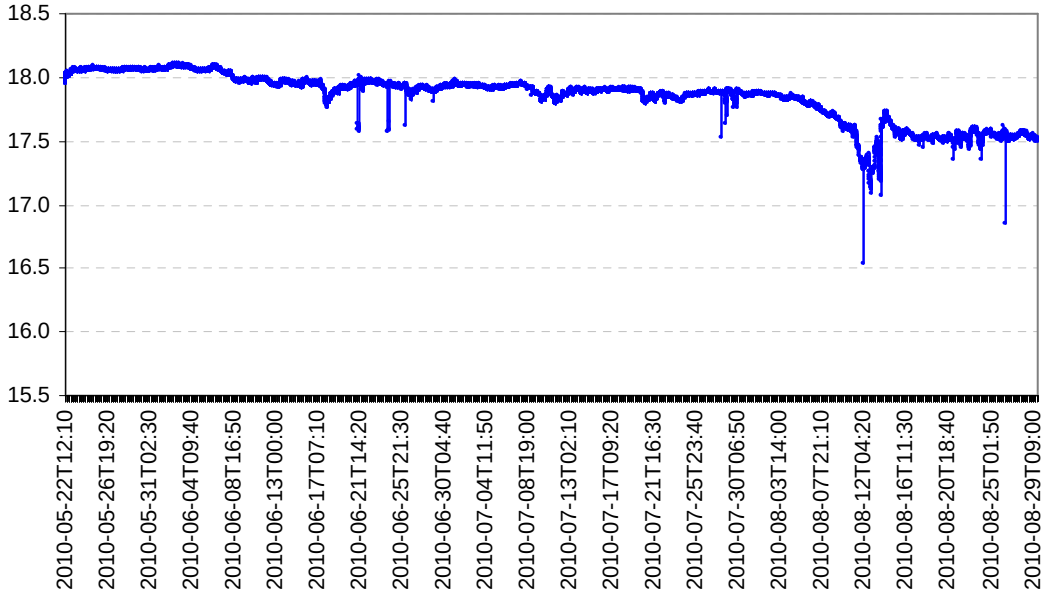
Seawater Temperature



Oxygen



Salinity


Salinity
18.5
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17.5
17.0
16.5
16.0
15.5
2010-05-22T12:10
2010-05-26T19:20
2010-05-31T02:30
2010-06-04T09:40
2010-06-08T16:50
2010-06-13T00:00
2010-06-17T07:10
2010-06-21T14:20
2010-06-25T21:30
2010-06-30T04:40
2010-07-04T11:50
2010-07-08T19:00
2010-07-13T02:10
2010-07-17T09:20
2010-07-21T16:30
2010-07-25T23:40
2010-07-30T06:50
2010-08-03T14:00
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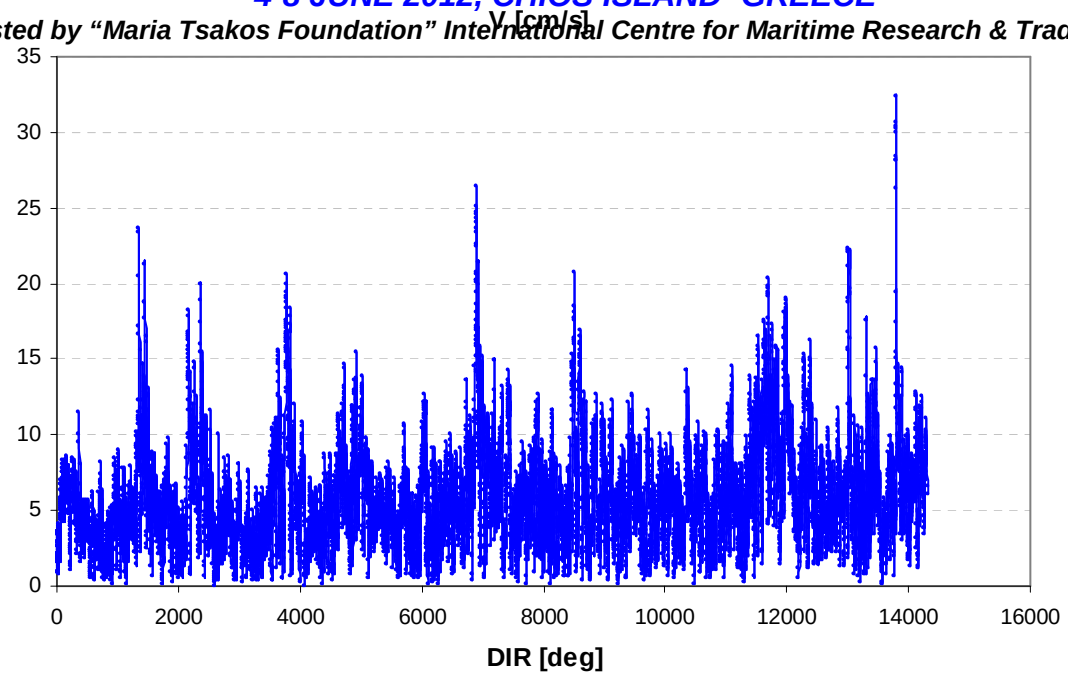
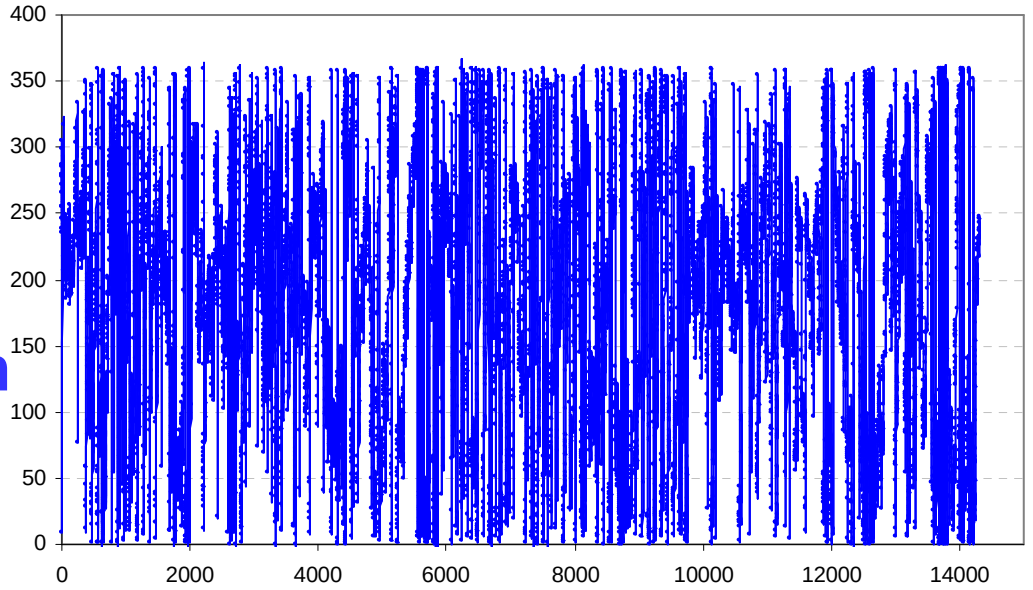
2010-08-12T04:20
2010-08-16T11:30
2010-08-20T18:40
2010-08-25T01:50
2010-08-29T09:00

Current velocity

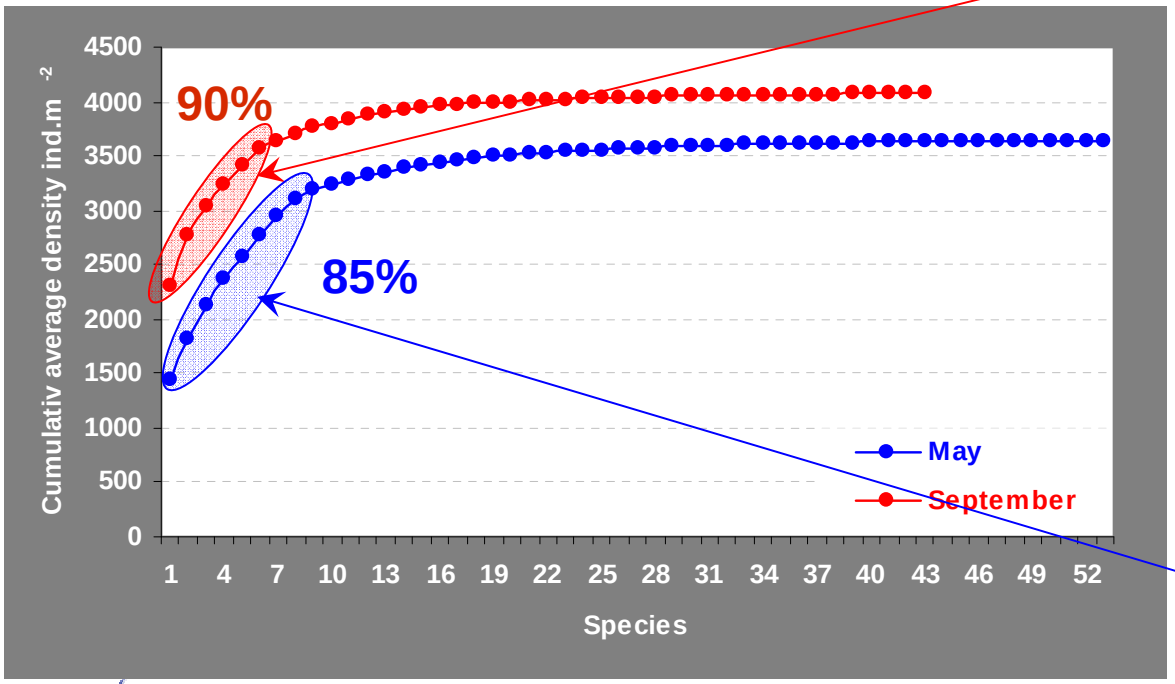


Current direction



PORTITA: Changes of macrobenthos density (indvs.m^{-2})

Dominant – oportunistic and tolerant species



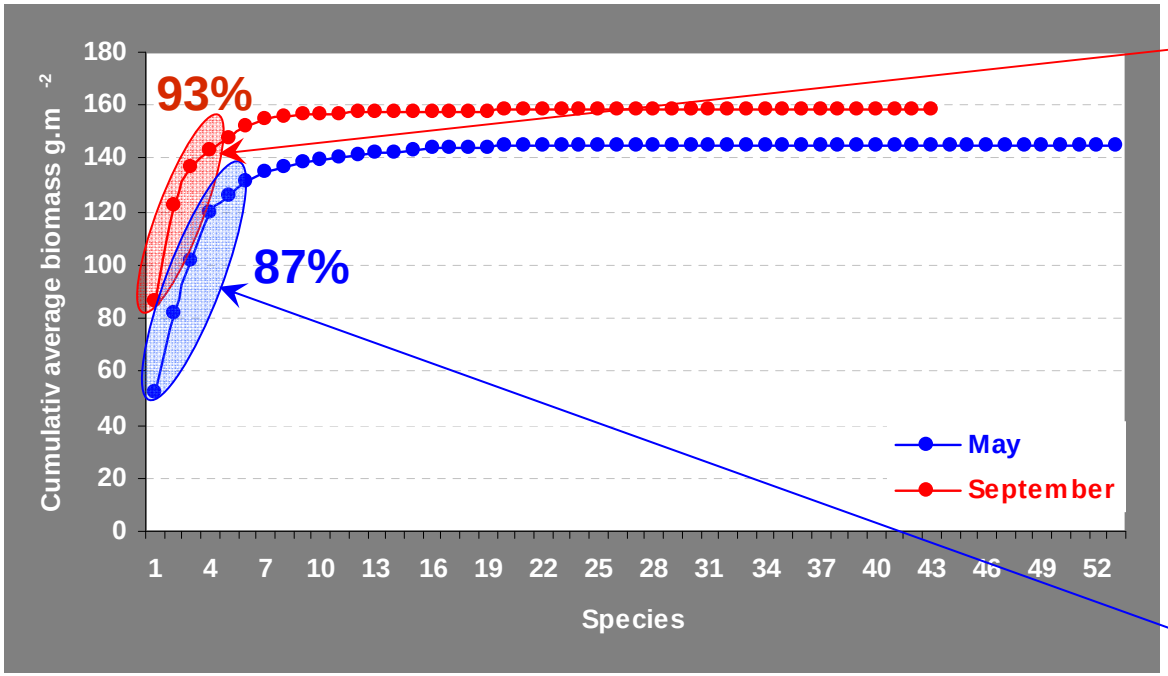
SEPTEMBER

1. *Melinna palmata*
2. Oligochaeta
3. *Abra prismatica*
4. *Nephtys hombergii*
5. *Phoronis euxinicola*
6. *Heteromastus filiformis*
7. *Pusillina lineolata*

MAY

1. *Melinna palmata*
2. Oligochaeta
3. *Heteromastus filiformis*
4. *Phoronis euxinicola*
5. *Nephtys hombergii*
6. *Anadara transversa*
7. *Abra prismatica*

PORTITA: Changes of macrobenthos - Increasing the biomass (g m^{-2})



SEPTEMBER

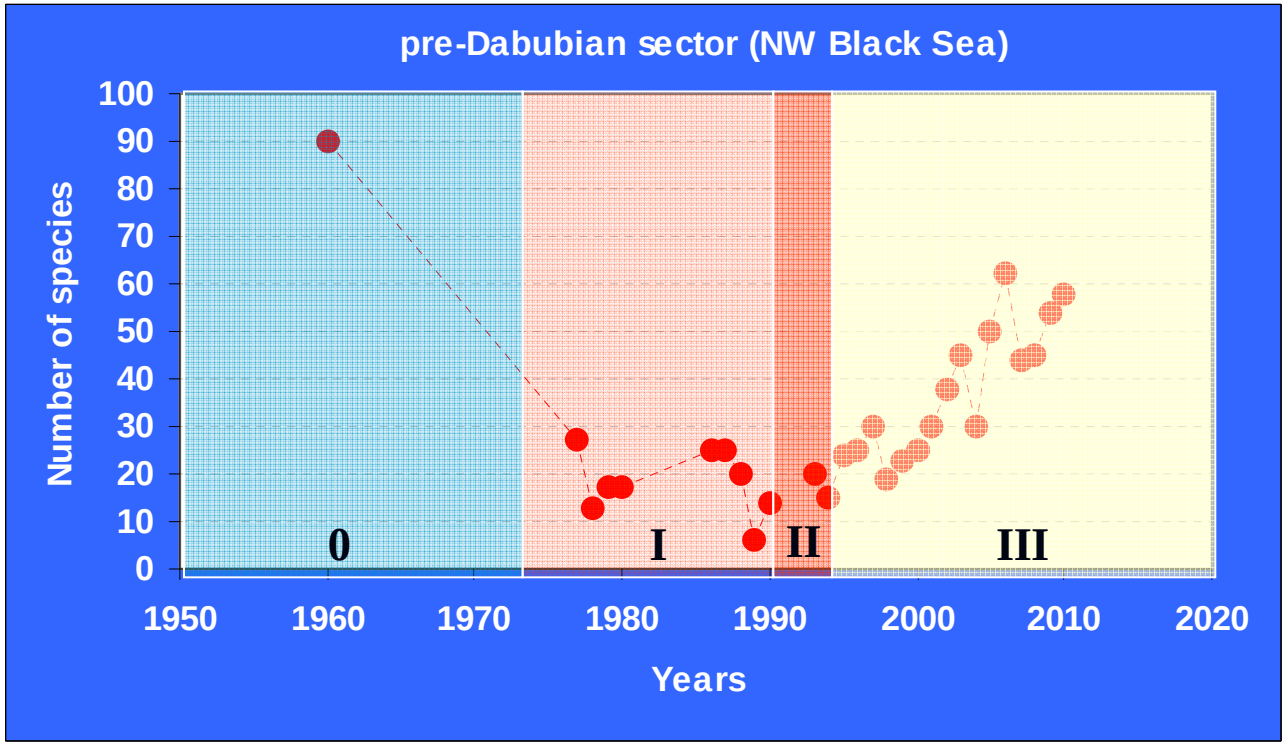
1. *Mya arenaria*
2. *Melinna palmata*
3. *Mytilus galloprovincialis*
4. *Nephtys hombergii*
5. *Abra prismatica*

MAY

1. *Mya arenaria*
2. *Melinna palmata*
3. *Mytilus galloprovincialis*
4. *Nephtys hombergii*
5. *Rapana venosa*

Suddenly worming of seawater as well as hypoxic events were followed by mass mortality of fishes

Temporal changes in species diversity of total macrobenthic community in the Romanian pre-Danubian sector



0 – Relative stability – natural induced by eutrophication

I – man-induced eutrophication /pollution

II – Increasing ecological pressures

III – Present

Available data for the Romanian pre-Danubian sector suggest a slightly improvement of macrobenthic community structure in terms of species number during the last 10 years.