Commission on the Protection of the Black Sea Against Pollution

Ministry of Environment and Climate Change, Romania

NIRDEP - National Institute for Marine Research and Development, Romania

ABSTRACTS BOOK

The 4th Bi-annual Black Sea Scientific Conference
28 - 31 October 2013, Constanța, Romania

Black Sea - Challenges Towards Good Environmental Status

BS-GES 2013

Jointly organized by

- The Commission on the Protection of the Black Sea Against Pollution (Black Sea Commission)
- Ministry of Environment and Climate Change of Romania
- NIRDEP - National Institute for Marine Research and Development "Grigore Antipa" (NIMRD), Constanța, Romania

Back-to-back events

- Celebration of the International Black Sea Day - 2013
- International Symposium "Protection and Sustainable Management of the Black Sea - 3rd Millennium Imperative"- 6th Edition

CONSTANȚA, 2013

SCOPE

To continue the concerted efforts initiated by the previous BSC scientific conferences to use science and information technology to understand and deal with the environment problems of the Black Sea, to strengthen science/policy interface and regional cooperation towards better governance of environment protection to preserve the Black Sea ecosystem as a valuable natural endowment of the region, while ensuring the sustainable use of its marine and coastal resources for the economic development, well-being, health and security of the population of the Black Sea coastal States.

The Conference will take place back-to-back with the Black Sea Day - 2013 and the NIMRD International Symposium "Protection and Sustainable Management of the Black Sea Ecosystem - 3rd Millennium Imperative" - 6th edition.

OBJECTIVES

Provide the opportunity to the scientific community to meet and to discuss their achievements in order to improve scientific basis for the implementation of the Black Sea Strategic Action Plan.

Update the knowledge on the Black Sea ecosystems identifying the gaps in the scientific data/information; revise the environment priorities and way forward to achieve good environmental status of the Black Sea.

Discuss and assess the climate forcing mechanisms of physical, biological and biogeochemical processes at various time-spatial scales.

Review the decision-support tools available in the Black Sea region and give recommendations for further developments and their use in the implementation of the BS SAP.

Continue the integration of science in decision-making in the field of marine environment protection.

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CONFERENCE SESSIONS

- Marine industries and urban development
- policy and management options for recovery of the Black Sea resources

Session 4: Integrated Coastal Zone Management

Topics:

- Maritime spatial planning
- State of the Black Sea coast
- Marine and coastal protected areas
- Coastal erosion

Session 5: Climate change and its impact on marine ecosystems

Topics:

- Change in CO_2 fluxes, carbon sequestration, biogeochemical cycles, acidification, hydrology, hydrophysics

Session 6: Ecosystem modelling

Topics:

- Recent ecosystem modelling activities in the Black Sea region
- All sessions
- Information gaps - identification of gaps in knowledge, policy, legislation
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- Celebration of the International Black Sea Day - 2013
- Protection and Sustainable Management of the Black Sea Ecosystem- 3rd Millennium Imperative - International Symposium, 6th Edition

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Plenary Session

The Support of PERSEUS Project in Achieving Good Environmental Status in the Black Sea Basin

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Keywords: Good Environmental Status, MSFD, PERSEUS, Black Sea

The pressures in the marine environment especially in enclosed Seas, like the Mediterranean and the Black Seas can have different origin (natural (e.g. from

climatic variability) and anthropogenic (e.g. fast population growth in coastal areas, pollution, overfishing, etc). However their management needs to be dealt mainly through common policy actions and decision-making based on scientific knowledge.

At a European Level a new approach in EU legislation started in 1994 when the concept of the ecological quality was commonly developed by scientists and policy makers and first introduced integrated in the Water Framework Directive (WFD), adopted on 2000. Following the implementation of WFD, the "Marine Strategy Framework Directive" (MSFD) was adopted in 2008 having as target the "Good Environmental Status" (GES) of marine water bodies by 2020. To achieve its objectives, the role of major EU projects is essential as they can provide the scientific support needed particularly at regional level as it required in MSFD.

PERSEUS (Policy-oriented marine Environmental Research in Southern EUropean Seas) Project is an FP7 EU project that started in January 2012 and will finish at the end of 2015. PERSEUS tries to assess and forecast the combined effects of human and natural pressures on the Mediterranean and Black Seas, assess their impact and, using the objectives and principles of the MSFD, to design an effective and innovative research governance framework. All the new scientific knowledge and tools, which will be developed under PERSEUS, are blended with socio-economic analysis to produce concrete recommendations and tools. The latter is valid especially for the policy-makers in view of achieving GES, thereby taking a step towards the sustainable development of the Mediterranean and Black Sea basins. PERSEUS is taking the next step, to implement the principles and objectives towards GES and promote them across the SES with emphasis on non-EU countries.

Scientific research is carried out from basin to coastal scale, while the surfacing of new knowledge advances our current understanding on the selection and application of the appropriate indicators of the MSFD based on a gap analysis and risk assessment of non-achieving the GES. Similarly, new tools (namely upgraded monitoring capacity and modelling) help to evaluate the current environmental status, upgrade the observing capacity towards a long term monitoring strategy to cover the needs of GES and create more accurate and dynamic forecasting of possible policy based risk scenarios. Using these inputs, combined with socio-economic analysis, PERSEUS develops a scenario-based framework of adaptive

policies and management schemes (Adaptive Policy Framework-APF) in order to support an ecosystem-based approach to management with a view to achieving GES in the Black Sea as well as in the Mediterranean basin. Within the Project, Stakeholder platforms have been developed, with relevant experts and decision-makers involved from the onset in the construction process. This component of the project synthesises the results for communication and integration among the main actors and infrastructures that promote Sustainable Development of the Southern European Seas (SES). Furthermore, PERSEUS has accomplished the review of the Integrated Assessments, which can be considered as the first step to identify, develop and promote tools and methods to assess the environmental status across the different sub-basins. Of course at this stage the emphasis is also given on non-EU countries, in accordance with the principles and objectives of the MSFD and, with the help of the Black Sea Commission (member of the Advisory Board of PERSEUS), PERSEUS hopes to contribute to the monitoring strategies and policy frameworks in the Black Sea.

Finally, PERSEUS will ensure that several steps are taken to propose multiscale management strategies and adaptive policies at basin scale and create an impact on policy-makers, from national to International levels, involving, in an interacting way, stakeholders/decision makers and scientists from EU and non-EU countries throughout the process.

Promoting the EU Marine Strategy Framework Directive in non-EU study areas: Identification of the elements for basin-wide environmental status assessments in the South European Seas

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Keywords: Perseus, MSFD, descriptor, South European Seas, environmental status

PERSEUS, a FP 7 project, has as scientific objectives to identify the interacting patterns of natural and human-derived pressures on the Mediterranean and Black Seas, to assess their impact on marine ecosystems in relation to Good Environmental Status (GES) as foreseen by the Marine Strategy Framework Directive (MSFD), and to design an effective and innovative research governance framework. Basin-wide promotion of MSFD principles is the main objective of Work Package 5 of the PERSEUS project, which aims to strengthen networking and increase the South European Seas (SES) capacity for ecosystem state assessment, definition of GES, monitoring and management based on the eleven MSFD descriptors, and to provide tools for the application of MSFD principles in non-EU countries of the SES. Together with WP6, WP5 provide decision makers with a scientific basis needed in order to set common environmental targets for the SES ecosystems. WP5 work includes the identification of MSFD assessment elements in EU case study areas, highlighting knowledge/data gaps, which are tackled by subsequent activities of the scientific work packages of the PERSEUS project, and will be applied for marine environmental status assessment within non-EU study

areas. From the set of identified assessment elements in EU areas, decision trees are developed reflecting the process of environmental status assessment from input to output (assessment at chosen level of MSFD "hierarchy", i.e. indicator, descriptor, etc.). This analysis presents, for each of the eleven MSFD descriptors, the methodologies used in the Initial Assessments (IAs) and GES draft reports of the Mediterranean and Black Sea countries. Then on the basis of the outcome of the decision trees, elements derived from harmonized methodologies are identified and will be used to conduct environmental status assessments in the non-EU study areas. A wide range of local key stakeholders will be consulted to ensure interaction and proceed with possible adaptations in order to adequately fulfill the requirements of assessing the environmental status in the SES.

JPI Oceans - Joint Programming Initiative Healthy and Productive Seas and Oceans

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Keywords: Joint Programming Initiative, Seas, Oceans

Abstract

The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) is a coordinating and integrating long-term platform at European level, open to all EU Member States and Associated Countries who invest in marine and maritime research.

Joint Programming is a concept introduced in 2008 in order to increase the value of relevant national and EU research & development and infrastructure investments. In its role as a high-level coordination platform, JPI Oceans will focus on making better and more efficient use of national research budgets, which represent 85% of the marine-maritime funding within Europe.

How: Member States and Associated Countries are expected to coordinate national research activities in the broadest sense, group resources, benefit from complementarities and develop common research and innovation agendas, as a basis for long-term cooperation in order to face grand societal challenges.

While bringing together the interested Member States and Associated Countries JPI Oceans aims to add value by:

- avoiding fragmentation and unnecessary duplication
- planning common and flexible initiatives
- facilitating cooperation and foresighting
- establishing efficient mechanisms for interaction and knowledge transfer between the scientific community, industry & services, and policy makers at high level to more effectively solve the grand challenges.
- cooperating on initiatives which go beyond the capacity of a single member country

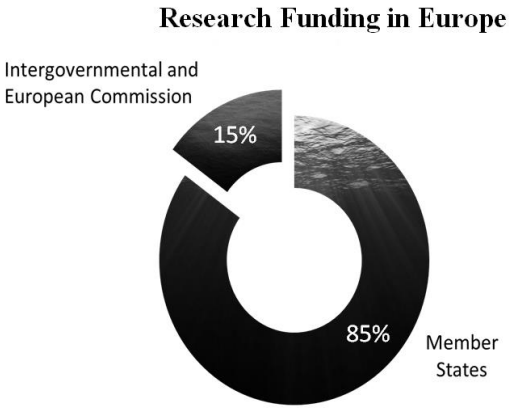

Fig. 2 *– Diagram illustrating that 85% of European public research funding is invested in programmes conceived, developed and implemented at a national level without any transnational coordination or competition. Only 15% is invested through intergovernmental organisations (such as CERN) or programmes (such as EUREKA), or through the European Commission's Framework Programme*

"Integrated Regional Monitoring Implementation Strategy in the South European Seas – IRIS-SES": A new Pilot Project to support MSFD for the management of human activities in the sea

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Keywords: MSFD, Mediterranean Sea, Black Sea, monitoring,

Abstract

The aim of the IRIS-SES project is to develop a new concept and decision-making tools for integrated environmental monitoring for MSFD and other environmental legislation to support management of human activities and their effects in selected EU pilot regions, as in the Mediterranean and Black Sea.

IRIS-SES project is structured in five main Activities. Activity 1 (Analysis of the monitoring programs carried on the framework of European/Regional /National legislation in relation to MSFD requirements) will prepare a comprehensive analysis of the existing monitoring programs related to European Directives and other national/international programs, including assessment of programs described to meet MSFD needs. Activity 2 (Integrating scales of monitoring with those of processes to be monitored) will include the assessment of opportunities in developing multi-disciplinary programs (including platforms, surveyors on ship of opportunity, spare capacity, etc), the development of these programs across states (EU/non EU), within the regions/subregions of Mediterranean and Black Sea, joint planning/implementation, as well as the recognition of relevant gaps and needs. Activity 3 (Adaptation and development of intelligent tools) will include the development of tools, (software/GIS) for planning and optimization of resources and monitoring requirements, as well as decision-making tools. Activity 4 (Optimization and adaptation to MSFD requirements of ongoing joint marine monitoring in the Mediterranean and Black Sea) will integrate all previous to develop strategies for the joint monitoring programs within a marine region or sub-

region, to forge synergies within and between Member States for monitoring and assessing pressures and impacts from human activities, based on the design and implementation of common protocols and the creation of coordination mechanisms which ensure the standardization of sampling strategies and methodologies, sample and data analysis. Finally, Activity 5 (Coordination and Management, Dissemination and Sustainability) will focus mainly on project management and implementation, actions for monitoring/supervision of the operation and any risks involved in its implementation, dissemination of results and sustainability of the project's achievements.

The IRIS-SES Project (www.iris-ses.eu) consortium consists of nine institutions: HCMR/Greece, NMRD/Romania, IO-BAS/Bulgaria, IOE/Spain, TUBITAK/Turkey, Univ. Salento/Italy, Blue Plan/France, ISOTECH Ltd/Cyprus and Univ. of Athens/Greece. HCMR is the Coordinator of the Project (Dr Kalliopi Pagou). IRIS-SES is supported by UNEP/MEDPOL, Black Sea Commision, GFCM and other organizations and EU projects as PERSEUS and MISIS.

Session 1 - Pollution and Eutrophication

Topics:

- **Oil pollution and oil spills**
- **Land based sources of pollution**
- **Eutrophication**
- **Contamination of water, sediments and biota (reference conditions, target levels)**
- **Methodologies for water quality towards Good Environmental Status**
- **Environmental aspects of shipping**

Heavy Metal Concentrations in Sediment from Sinop Coast of the Black Sea, Turkey

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Keywords: sediment, heavy metal, Sinop coast, Black Sea

Abstract

The concentrations of some heavy metals in sediment from the Sinop coasts of the Black Sea have been measured for monitoring metal pollution in 2012 and 2013. The results were compared with previous studies and discussed.

The "Hot Ecological Spots" in the Crimean Coastal Zone

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Keywords: hot spots, sand development, bottom trawling, fish kill, Dnepr water, pollutants, Crimea

Abstract

The special attention has been given to the Black Sea and the Sea of Azov ecology in context of the growing anthropological pressure recently. It is wide-known that high variability of biotopes is typical for the Crimean coastal zone. This phenomenon stipulates considerable biological diversity and productivity in the regional aquatorium. The Crimean shelf is the main fishing region of Ukraine. And numerous recreation complexes are located on the shore fronts of the peninsular.

Session 1 - Pollution and Eutrophication

Types of the anthropogenic activities, the most dangerous for the environment, which have local affect as well as more large-scale negative one on the Black and Azov seas ecosystems are described. Mass death of hydrobionts of the different trophic levels, biocenosis degradation, decrease of species diversity and fish production, reduce of the possible natural biological purification of waters and Crimean coastal zone recreation potential is the consequence of this affect.

Exploitation of the sand underwater deposits, according to the commonly held opinion, is one of the most dangerous types of the anthropogenic pressure, affecting negatively the marine ecosystems as well as coastal zone. The sand development is being produced along the great part of the Black Sea coastal zone of Crimea and this activity has been intensified for the past decade. 1) Physical extermination of hydrobionts, which influxed by pumps of the line tube together with the sand; 2) avalanching the bottom hydrobionts by the different fractions of the ground, thrown off the board; 3) light fraction of the bottom sediments, which can cause silting and death of the bottom hydrobionts are thrown off while washing. As well they can precipitate on the larvae, integuments and gills of fish larvae and juveniles, chock up filter apparatus of plankton crustaceans and cause mass death of hydrobionts on the square of thousand km^2; 4) disturbance worsen the water transparence and causes the macrophytes depression; 5) microbe habitants "sleeping" in the ground comes to pelagial. The second pollution by the different pollutants occurs, and increased concentration of the biogenic elements provoke vivid development of microalgae; 6) the hydrogen sylphide set up is observed in the pits formed as a result of the sand development; 7) vanishing of the sand beaches and provoking the landslides of the abrupt shores occurs. These are the main negative factors of sand development.

Bottom trawling leads to the bottom biocenosis degradation on the great part of the Crimean shelf in the depths range from 30 to 130 m. The main negative factors of the bottom trawling are: a) direct catch of the trade species of pelagic, near-bottom and bottom fish species, benthos invertebrates and macrophytes; b) benthic life is exterminated by the heavy structural pieces of the trawl; and c) the sea bed muddying by fine sediment (pelitic silt fraction) first stirred up and then settled extensively.

Fish kills have always been a characteristic feature of the Sea of Azov. The rise of economical activity in the recent decades has substantially increased organic substance inflow into the Sea of Azov and made fish kills in the heavily eutrophicated sea more frequent.

Mass Dnepr water disposal from the Severo-Krymsky Channel into the Karkinitsky Gulf and eastern Sivash causes considerable desalinization, silting and contamination by pesticides, biogenic conjunctions and heavy metals of the coastal waters.

Bottom sediments of the Sevastopol bay, Feodosiya gulf, Kerch strait other Crimean ports are heavily **polluted with oil hydrocarbons and heavy metals**.

European Approach to Marine Litter in the Romanian Black Sea Waters

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Keywords: marine litter, plastic, monitoring, ecosystem management

Abstract

Marine litter is widely recognized as a threat to Europe's marine ecosystems. It is a major societal challenge because it impacts the vast natural marine capital that supports economies, societies and individual well being. Marine litter, of which plastic is a main component, is explicitly identified as a descriptor for determining the Good Environmental Status (GES) under the Marine Strategy Framework

Directive (MSFD). Europe aims to achieve GES by 2020 and NIMRD is involved in European projects that analyse the marine litter. **CLEANSEA** will provide a comprehensive characterization and analysis of the marine litter problem (biological, chemical, social, economic, legislative and policy-oriented) in the EU's four marine regions, propose innovative monitoring tools and standard protocols to facilitate monitoring marine litter in a harmonized way and present management measures and policy options to meet MSFD and other international objectives regarding marine litter. The unique combination of disciplines integrated within the project will be able to provide knowledgeable input into a European roadmap for marine litter reduction. **PERSEUS**, through an innovative combination of natural and socio-economic science, aims to design an effective and resourceful research governance framework, based upon newly collected, sound scientific knowledge in order to promote better governance and achieve Good Environmental Status across the Southern European Seas (SES). The project aims to assess the current environmental status of the Mediterranean and the Black Seas, in a coherent and integrated manner, fill the existing scientific knowledge gaps and then design and support an ecosystem-based approach to management so that the EU goal of Clean Seas by 2020 can become a reality, while conserving the surrounding marine environment.

These projects' outcomes will bring benefits not only to the MSFD, but to various EU directives and strategies, including the Europe 2020 Strategy.

Results of Water and Bottom Sediments Pollution Studies in the Zmiinyi Island Area of the Black Sea in 2011-2012

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Keywords: Black Sea, Zmiinyi Island, TPHs, OCPs, PAHs, TM, PCBs

Abstract

Pollution of marine environment has been one of the main Black Sea problems controlled by all the Black Sea countries in the framework of the Convention on the Protection of the Black Sea Against Pollution. The aim of our studies has been to investigate the current state of marine water and bottom sediments' pollution with total petroleum hydrocarbons (TPHs), trace metals (TM), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs) in the Zmiinyi Island area, which according to our previous studies is the area with practically natural conditions [1]. During 2011-2012 the Research Station of Odessa National I.I.Mechnikov University continued the water and bottom sediments sampling programme. Analyses of sea water and bottom sediments have been carried out in accordance with the national methods and the methods recommended by the ISO in the laboratory of the Ukrainian Scientific Centre of the Ecology of Sea. The results are being regularly included into the Ukrainian National Reports for the Black Sea Commission Secretariat.

The data on coastal sea waters and bottom sediments pollution for 2011-2012 with TPHs, OCPs, PCBs, TM and PAHs are being analyzed in details. It is shown that the sum of TPHs and concentrations of trace metals in all water samples did not exceed the MPC. It has been revealed that out of 11 OCPs only in 2012 the contents of Lindane (λ-HCH) exceed the MPC several times. PCBs concentrations were lower

than the MPC. Out of 16 PAHs analysed, only for 3 (phenanthrene, fluoranthene, benz(a)anthrecene) 10-20 times' excisions of MPCs have been revealed. However, compared to 2009-2010, when 8 PAHs with concentrations exceeding the MPCs were registered, the situation in 2011-2012 has improved. Analyses of the results of bottom sediment samples have shown that the content of TPHs and TMs exceeded the MPCs 2-4 and 1.5-3 times respectively. The MPC of total PCBs concentration was exceeded twice in 40% of samples. Concentrations of other organic toxicants in bottom sediments were lower than the MCPs. It means that toxicity of bottom sediments in 2011-2012 decreased compared to previous years [1]. The origin of pollution in coastal waters and sediments near the Zmiinyi Island is being discussed. It is shown that concentrations of six TMs (arsenic, cadmium, cobalt, copper, mercury, lead and zinc) in the sea water and bottom sediments are not exceeding MPCs and range from 0 to 0.4 MPCs for different metals, i.e. no problem of TMs accumulation in the bottom sediments had been revealed. The main conclusions of our studies during 2011-2012 are the following: the levels of pollution for all toxicants are lower than in previous years [1]; the results of comparison with the other Ukrainian areas of the Back Sea has shown that the Zmiinyi Island area could be used as a reference area for analysis of the BSIMAP monitoring data. The study has been carried out in the framework of research activities funded by the Ministry of Education and Science and Ministry of Ecology and Natural Resources of Ukraine and as a contribution to the European FP7 project PERSEUS.

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Some Aspects Concerning Polymer Bicomponent Membranes for Sea Water Pollution Prevention

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Keywords: acrylonitrile, vinyl acetate, membrane, water ultrafiltration

Abstract

Nowadays, Black Sea deals with a serious problem because of its high pollutants level. These pollutants rise mostly from hotel wastes and lead to eutrophication. So, it is necessary to remove these pollutants. Filtration, achieved using polymer membranes may represent a way of purifying sea water. It is well known that polyacrylonitrile and its copolymers may be used for membranes preparation [1].

The aim of the present work was to go further in the field of polymer membranes and to prepare ultrafiltration bi-component polymer membranes based on mixtures consisting of acrylonitrile-vinyl acetate (AN-VA) copolymer and polyvinyl alcohol (PVA).

Two monomers: acrylonitrile (AN) and vinyl acetate (VA), (Merck) were distilled to remove the inhibitor. The solvent: dimethyl sulfoxide (DMSO) and the non-solvent: isopropyl alcohol (IsOH), (both Merck), were used without further purification.

Three AN-VA copolymers (C), with different AN content were synthesized. Solutions were prepared dissolving C together with PVA in DMSO. Each solution was casted on glass plate. Then, the plate was immersed in various water- IsOH mixtures for phase inversion.

It was intended to prepare membranes for ultrafiltration of waste water coming from the hotels which are spread on the Black Sea coast.

The membranes ability to perform filtrations has been checked by measuring the flow of water through various membrane samples prepared under different

conditions. It was, also, investigated the membranes chemical composition, by Fourier Transform Infrared spectrometry (FTIR).

FTIR spectra revealed the peaks characteristic to AN, to AV and to PVA. The membranes were able to perform filtrations. An increase in the content of AN leads to a porosity enhancement, so water leakage occurs faster.

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Recent State of Varna Bay

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Keywords: Varna Bay, oxygen, nutrients

Abstract

This paper presents the seasonal distribution of the main chemical parameters in Varna Bay and assessment of water quality within the 2008-2011 period. The study is based on data from bimonthly monitoring of salinity, nutrients (nitrogen, phosphorous) and dissolved oxygen (DO) in the Varna Bay during 2008-2011period. The samples was collected from surface waters and analyzed by standard methods.

Seasonal dynamics of DO and saturation (OS) is characterized by seasonal maximum in spring and minimum in summer- autumn. An oversaturation in spring was established in Varna Bay and this reflects on higher average spring values. It is characterized with very high OS in entire May-June period (OS>120%) and low OS (64 -84%) in the end of the summer. Seasonal nutrients distribution in Varna Bay is characterised by high concentrations during autumn – winter period. The connection between Varna Bay and Varna Lake determines the ecological conditions in bay waters, since the water exchange contributes to the nutrients and pollutants transport from the lakes to the bay.

Compared to another years 2010 is distinguished as a year of high variability of physical-chemical parameters. Extreme climatic conditions in 2010 were a key factor for significant impact on hydrochemistry of the bay. Abnormal high temperature (29-30.5ºC) and salinity (<12‰) were recorded. A low salinity and higher nutrients content measured in bay waters was a consequence of intensive precipitation and increased rivers discharge.

Oil Polluted and Pristine Black Sea Coastal Sediments: Comparative Molecular Analysis of Inhabiting Bacterial Communities

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Keywords: Bacterial communities; oil pollution; 16S rRNA gene; sediment; PAH degradive potential; ARDRA

Abstract

The aim of the study was to provide data on the diversity and putative oil biodegradive potential of bacterial communities inhabiting pristine and chronic oil polluted Black sea coastal sediments. We tested also the hypothesis of community shift over time proposed by Röling [1].

We applied molecular methods to reveal the composition, variety and biodegradive potential of natural bacterial communities. We used 16S rRNA gene retrieval, Amplified Ribosomal DNA Restriction Analysis (ARDRA) and direct sequencing to compare main bacterial groups in polluted with pristine sites and to target a gene

for enzymes, involved in the initial step of the aerobic metabolism of polycyclic aromatic hydrocarbons (PAH).

A functional bacterial community was found in the Sozopol harbor sediments where PAH levels were above the permissible concentrations. The PAH contamination was consistent with the established presence of bacteria suited to degradation of aromatic hydrocarbons in the harbor sediments. In addition, we expand current data favoring the hypothesis about an existing link between the dominance of α-*Proteobacteria* on one side and chronic oil pollutions on the other, which is supported also by other studies on bacterial community succession following oil spill evolution.

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BlackSeaTrack Web as Decision-Support Operational Tool for the Black Sea Environmental Safety

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Keywords: oil spill, operational oceanography, oil drift model

Abstract

The Black Sea basin during the last decade became the area of increased sea-borne transportation of not only general goods and passengers, but also raw oil and refined petroleum products has taken place and is predicted to continue in the near future. This increase enhances the risk of serious accidents at sea that could have dramatic impacts on the fragile marine environment of the Black Sea. Remote

sensing data show that the majority of oil spills occur along major shipping routes, suggesting that shipping, rather than land-based oil installations have been the principal cause of concern. A single large spill from ships, platforms or land-based oil installations could severely impact biota and the economies of all coastal countries and could produce significant damage of the Black Sea ecosystem and fishing. Also, due to the semi-enclosed character of the basin, an oil spill will definitely pollute the coastline of the basin incurring great losses to the recreation industry and potentially threatening human health. Fighting oil pollution in the Black Sea is a great challenge which is likely to become even greater in the future as maritime traffic is expected to increase over the next few years, making offences and accidents more likely. The risk of shipwrecks and resulting catastrophic oil spill necessitates the use of the modern technologies based on operational oceanography to effectively protect the marine environment.

The creation of the Black Sea Monitoring and Forecasting Centre (MFC) has made it possible to transfer such cost-efficient technologies to the region for addressing oil pollution and for search and rescue. Regular high quality operational products provided by the Black Sea MFC enabled to work out decision-support operational tools for the prediction of oil spill evolution and for the planning of the life-saving in case of a shipwreck. One of such tool is the BlackSeaTrack Web system which has been developed in the framework of the EU funded the MONINFO project led by the Black Sea Commission. The system is based on the Seatrack Web (STW) model developed by a consortium of Baltic countries for the Baltic Sea. It has been adapted to the configuration of the Black Sea observation system and is implemented according to the regional contingency plans.

The BSTW system consists of three parts:

- forcing in the form of forecasted operational data of stratification, sea currents and wind fields, which is provided by the Black Sea MFC located at MHI in Sevastopol. The Black Sea MFC is the MyOcean regional marine forecasting center. It runs operationally and produces weather and ocean forecasts;
- an oil drift model jointly developed by the Swedish Meteorological and Hydrological Institute (SMHI) and the Royal Danish Administration of Navigation and Hydrography and which takes into account and

adequately describes almost all physical and chemical processes affecting an oil spill;

- a graphical user interface developed by SMHI and based on open source GIS-server technology.

The BSTW system is available via the Internet, fully operational 24 hours a day and user friendly. It allows for immediate access to the latest forecasts that drives the system. In addition, it can also be used for various floating objects and backtracking.

Some examples of the use of BSTW to real events showed that this system is a useful operational tool for solving various problems of safety in the Black Sea.

EnviroGRIDS Final Report on Present State and Future Scenarios in the Black Sea Catchment

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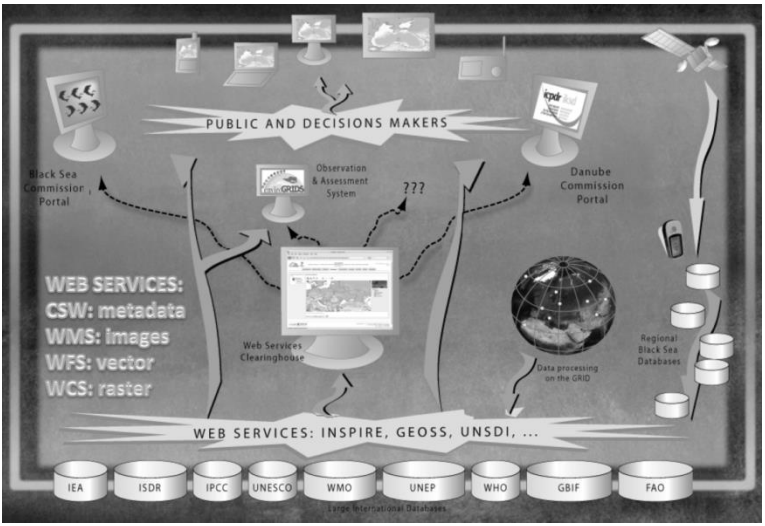
Keywords: Black Sea catchment, hydrology, climate, land cover, demography, scenarios, data sharing, GEOSS

Abstract

With 30 partners from 15 countries, the enviroGRIDS project aimed at building capacity on data sharing on Earth Observation in the Black Sea catchment to contribute to the Global Earth Observation System of Systems (GEOSS). In collaboration with the Black Sea Commission and the International Commission for the Protection of the Danube River, the project focused on water resources by modeling the hydrology of the entire Black Sea catchment with the Soil Water Assessment Tool (SWAT). It also explored the plausible futures of this region by

building climatic, demographic and land cover change regional scenarios with the Metronamica application.



Exchanging global and regional data through standard web services to serve the BSC and ICPDR commissions, and to inform a wider public and decision makers on the state of the environment

Even though the amount and quality of available meteorological and hydrological data was limited in some countries, it was possible to calibrate a hydrological model for the first time, to build future scenarios and to assess water resource vulnerability. EnviroGRIDS clearly promoted the benefit of data sharing in this region and the results of this large integrative project are now freely available for all end users to continue the effort of building a sustainable and needed Black Sea Catchment Observation System (geoportal.envirogrids.net).

Organochlorine Compounds in Tissues of the Black Sea Turbot from Sevastopol Coastal Area in 2008, 2009 and 2013

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Keywords: Black Sea turbot, polychlorinated biphenyls, DDT, DDE, DDD

Abstract

Despite the worldwide reduction in utilization of organochlorine compounds (OCs), they are still a problem for the aquatic environment. The Black Sea is still being polluted with persistent chemicals, including OCs. The OCs content in the tissues of males and females of the adult *Psetta (Scophthalmus) maxima maeotica,* Black Sea turbot, further, BST, has been studied during the spawning seasons in 2008, 2009 and 2013. The level of total lipids, seven congeners of polychlorinated biphenyl (CB 28, 52, 101, 138, 153, 180, 209) and organochlorine pesticide dichlorodiphenyl-trichloroethane (p,p′- DDT) including its metabolites (p,p′- DDE and p,p′- DDD) were measured in liver, red and white muscles and gonad tissues of males and females of BST. Lipids were n-hexane extracted and determined gravimetrically. OCs were measured using the methods GC-ECD (Gas Chromatography with Electron Capture Detector). The concentrations of ΣPCB and ΣDDT and its metabolites in BST were similar to those found for other fish species from other areas of the Black Sea. In BST tissue, ΣDDT ranged from 2.5 to 223.9 ng·g^{-1} w.w. and ΣPCB_7 had an overall range 4.3-234.3 ng g^{-1} w.w. (table) where hexa-CB 138 and 153 were the dominant components. The main DDT compound detected in BST was the metabolite p,p′-DDE (the sum of p,p′-DDE and p,p′-DDD was 83% of DDT) indicative of old DDT residues. OCs concentrations positively correlated with extractable lipid content in BST tissues (fig.). Sex-related level of OCs accumulation in the tissues of BST has been found. On average, OCs concentration (wet weight

basis) in male livers was twice higher than that in female while PCBs and DDT concentrations in male gonads were lower than those in female gonads (table).

Table 1. Mean level of n-hexane extractable lipids (n-HEL, %), ΣDDTs and ΣPCB_7 concentrations (ng g^{-1} wet weight) in the tissues of males and females of BST in 2008, 2009 and 2013

Year	Concentrations in the tissues of males											
	Liver			White muscles			Red muscles			Gonads		
	HEL, %	Σ PCB7	Σ DDT	HEL, %	Σ PCB7	Σ DDT	HEL, %	Σ PCB7	Σ DDT	HEL, %	Σ PCB7	Σ DDT
2008	14.5	137.3	223.9	0.6	4.3	6.2	4.0	51.9	50.8	1.1	8.1	6.7
2009	13.1	128.7	162.3	0.4	5.4	2.5	4.9	81.7	108.6	1.5	11.9	7.8
2013	25.3	234.3	111.6	1.0	17.2	6.8	4.0	42.7	40.2	2.3	26.2	9.1
Concentrations in the tissues of females												
2008	5.5	54.4	104.7	0.4	5.9	8.1	3.9	31.4	72.7	2.5	27.0	50.4
2009	7.7	68.3	104.7	0.3	6.1	3.9	4.1	29.0	49.3	1.4	13.2	16.4
2013	8.1	78.3	85.4	1.0	15.1	5.4	6.7	89.3	81.3	4.7	31.7	37.5

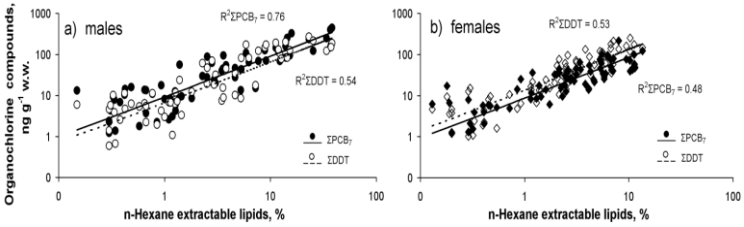

Figure 1. *Correlation between ΣPCB_7, ΣDDT and n-hexane extractable lipids in the tissue of BST in 2008, 2009 and 2013: males (a) and females (b)*

Recent Investigations of Radioactivity and the Current State of Background Radiation in the North-Western Black Sea

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Keywords: radioactivity, doses, Black Sea, environment

Abstract

The Project "*Radiation background of Black Sea coastal environment*", RACE, granted in the frame of BS-ERA.NET Pilot Joint Call 2010/2011, allowed the development of several field campaigns, both on land and at the sea.

The results obtained during 2011-2013 campaigns include measurements of the specific radioactivity of marine ecosystem components (abiotic: water, sediment and biota: algae, molluscs, fishes), of the sand beach as well as the determinations of background radiation at sea level.

The sample measurements were performed by using high resolution gamma spectrometry in ultralow radiation background and are in good correlation with

dose rates measured with a dosimeter equipped with a CsI detector and the cosmic ray contribution. Also, Tritium in water samples was analyzed by an ultra low level liquid scintillation spectrometer.

All results indicate no risk of exposure for humans, and, at the same time, could contribute to a better understanding of marine processes and anthropogenic environmental impact.

Radioactivity and radiation exposure remain both human and environmental health indicators as long as there are nuclear activities.

Nitrogen Problem for the Black Sea Ecosystem

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Keywords: Black Sea, Nitrogen cycling, Zmiinyi Island, balance, atmospheric input

Abstract

It is known that Nitrogen (N) problem has been getting more and more important and urgent year after year as N is a key nutritional element for any living form both on land and in sea. Many efforts of scientific society were made during past decades to investigate N cycling with peculiarities of different ecosystems around the globe, determinate main sources, sinks, crucial N species, label main threads to develop basic ways to mitigate an impact of N to the environment and humans, especially for marine ecosystems [1]. Periodical eutrophication events, which occurred on huge areas of the Black Sea in the past, were directly connected with N surplus.

The aim of the report presented was development of a comprehensive scheme of balance and biogeochemical N cycling for the Black Sea: discussion of exchange of N, its main sources/sinks and the processes involved: identify weak under-studied

points and uncertainties, to which the Black Sea countries' research community should pay attention and focus its efforts immediately.

The balance and N cycling scheme for the Black Sea with main external sources from rivers, coasts, atmosphere, shipping and secondary pollution sources from sediments and damping, involving internal processes of N transformation and emissions to the atmosphere using the historical published by the Black Sea Commission (BSC) data and our own recent data [2] were presented.

The results of the Black Sea balance development and biogeochemical N cycle were discussed taking into account the unique peculiarities of this ecosystem, connected with biological processes' vertical partitioning. It was shown that to compose detailed N balance and cycle for the whole sea the processes in three parts of the Sea had to be consider: coastal (shallow) water up to 80-100 m deep (ca. 10% of the whole Black Sea area) and two parts of open waters (over 80-100 m deep): layer from the surface to 80-100 m (productive zone without H_2S) and the layer with oxygen minimum zone (OMZ) or without oxygen (H_2S zone) over 80-100 m deep, where biogeochemical processes of N transformation were very different. Special attention was paid to the anammox process in the OMZ/H_2S zones of the Black Sea and the sink of N to the atmosphere. External inputs of N into the Black Sea: riverine, coastal, dumping and shipping and especially the atmospheric one were estimated. The role of each input into the three proposed blocks of balance scheme was analyzed. The significance of organic N in atmospheric fluxes, which according to our observations in 2010 – 2013 on the Zmiinyi Island made ca. 63±13% was discussed. It was shown that the main external N sources for the Black Sea were the atmosphere (50%), rivers (40%) and coasts and shipping (10%), which agreed with Moore et al. [3] data, who estimated that 60.9% of N comes from atmosphere for the globe ocean area. It was concluded that the atmospheric N input for the Black Sea especially for its open waters was likely the main source. Paying more attention to the sea-atmosphere N exchange study and including these investigations into BSIMAP for all the Black Sea countries were recommended. The study has been carried out as a contribution to the European FP7 projects No. 282910 ECLAIRE and No. 287600 PERSEUS.

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Results of Hydrobionts Pollution Studies in the Zmiinyi Island Area of the Black Sea in 2011-2013

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Keywords: Black Sea, Zmiinyi Island, OCP, TM, PCB

Abstract

Pollution of marine hydrobionts is the problem being one of main topics of the Convention on the Protection of the Black Sea Against Pollution and the EU Marine Strategy Framework Directive.

The aim of our studies has been to investigate the current state of hydrobionts (fish and mussels) pollution with trace metals (TM), organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) in the Zmiinyi Island area, which according to our studies of water and bottom sediments pollution is the area with

practically natural conditions. During 2011-2013 the Research Station of Odessa National I.I.Mechnikov University carried out fish and mussels sampling programme. Analysis of samples of hydrobionts tissues have been carried out in accordance with the national methods and the methods recommended by the ISO in the laboratory of the Ukrainian Scientific Centre of the Ecology of Sea. The data on hydrobionts pollution for 2011-2013 with 11 OCPs, 18 PCBs and TMs are being analyzed in details. The levels of pollution for fish species and for mussel species are presented in table 1.

Table 1. The limits and average values of concentrations [mkg/kg] of selected pollutants in fish (6 species) and in mussels (2 species) in the Zmiinyi Island coastal waters

Pollutant	**Concentration in Fish dry tissues**		**Concentration in Mussels' dry tissues**	
	Limits	Average	Limits	Average
As	1.18-19.3	5.15±2.87	0.38-11.3	6.81±3.36
Cd	0.03-0.17	0.07±0.02	0.42-1.98	1.84±0.79
Hg	0.24-0.62	0.41±0.06	0.037-0.60	0.68±0.11
Pb	0.69-3.42	1.33±0.42	0.89-5.56	9.73±5.80
Zn	36.4-103	71.0±13.3	21-149	73.7±39.3
Fe	47.3-112	73.3±10.8	129-878	384±251
Mn	0.3-37.8	12.0±5.7	6.69-43.3	46.5±24.4
Sum of PCB	68.3-201	168±24	9.56-25.8	21.4±4.4
α-HCH	<0.05	<0.05	0.05-0.35	0.20±0.15
β-HCH	0.78-5.99	3.26±0.73	0.05-14.0	7.03±7.02
λ-HCH	0.05-0.29	0.15±0.04	0.11-0.55	0.33±0.22
DDE	0.12-2.09	1.00±0.38	0.44-0.65	0.54±0.10
DDD	0.08-0.69	0.35±0.11	0.10-0.43	0.26±0.17
DDT	0.18-0.45	0.28±0.04	0.53-0.57	0.55±0.02

Dependence of the TMs, PCBs and OCPs concentrations on fish and mollusk species is discussed. Coefficients of pollutants accumulation in fish and mollusk tissues have been calculated and are discussed using the data on the pollutants' concentration in water.

It is proposed to study the levels of TMs, OCPs and PCBs accumulation in hydrobionts in more details depending on the age of hydrobionts (fish and

mollusks) and, first of all, on the peculiarities of their food chains, from which accumulation of toxicants in their tissues takes place.

The study has been carried out in framework of National research projects and as a contribution to the European FP7 project PERSEUS.

Composition of Microflora of the Upper Respiratory Tract of the Black Sea Bottlenose Dolphin (*Tursiops Truncatus*) in Captivity Condition

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Abstract

As a rule in the dolphinarium microbial pollution and species composition of microorganisms of the environment (water, air and other objects) are above and different than in natural areas of dwelling of wild cetaceans. Therefore even clinically healthy and adapted dolphins are exposed to risk of occurrence of infectious diseases. It is known that the specific composition of microbial associations in animal and human organisms is directly dependent on physiological state of macroorganism. So it is necessary to studying the consist of microflora of the upper respiratory tract of the Black Sea bottlenose dolphins containing in the captivity conditions for an estimation of their status of health. But now the species composition of normal microflora of the organisms of the different cetaceans is studied insufficiently. Therefore investigation of structure of microbial associations of upper respiratory tract of clinically healthy adapted animals containing in the

captivity condition and definition of sanitary-indicative microorganisms of water and air for dolphinariums were our primary goals.

Materials and methods. In August 2009 we surveyed 8 Black sea bottlenose dolphin (*Tursiops truncatus*) in the Odessa Dolphinarium. For microbiological investigations we took smears from the upper respiratory tracts of the animals by sterile swabs and water samples. For hematological and immunological researches we took blood samples.

Results. From each animal we isolated from 3 to 5 different species of microorganisms. These bacteria were identified before at genus level. Such as: *Escherichia, Providencia, Enterobacter, Proteus, Enterococcus, Pseudomonas, Staphylococcus*.

Conclusions

1. From each dolphin there were isolated 3 – 5 different species of microorganisms belonging to the following genuses: *Escherichia*, *Providencia*, *Enterobacter*, *Proteus*, *Enterococcus*, *Pseudomonas*, and *Staphylococcus*.

2. All isolated microorganisms did not have pathogenic factors and all dolphins had normal physiology indexes.

3. The sanitary-indicative microorganisms for water of a dolphinarium were defined considering besides *Escherichia coli* and *Enterococcus* the hemolytic bacteria *Staphylococcus* and *Streptococcus,* too.

Assessment of Modern Ecological and Contamination State of Ecosystem of the Black Sea (according to the results of YugNIRO research on nature conservation)

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Keywords: anthropogenic factors, ecosystem, heavy metals, petroleum products, chlorine organic compounds, aquatic environment, aquatic organisms

Abstract

In recent decades, the changes of the ecosystem state of the Black Sea are conditioned not only by usual natural factors, but also by constantly increasing anthropogenic ones – the rivers of reception basin are being polluted, insufficiently cleaned industrial and household effluents are being discharged, intensification of sea utilization for transportation and recreational purposes, for marine gas-extraction and biological resources exploitation is happening, and that leads to irrecoverable extinction of numerous marine faunal and floral forms. At the same time, the Black Sea annually receives significant amount of various chemical compounds. And the most dangerous contaminants affecting ocean ecosystem due to poisonous, mutagenic or cancerogenic effect on aquatic organisms are petroleum products, heavy metals and chlorine organic compounds. The Black Sea, being an inland water body, has limited assimilation capacity, and due to that fact, any anthropogenic press conditioned by effluents from numerous rivers, household and industry effluents, intensive navigation, dumping, etc. can have disastrous consequences for its ecosystem. Intensive oil and gas extraction in the north-western shelf of the Black Sea became an addition to all the above-listed factors, and for that reason, the development of hydrocarbon resources, constructing and operation of fixed offshore platforms can be of a severe ecological danger in the not so far future.

The aim of the study is the assessment of quality of aquatic environment of the Black Sea under conditions of natural and anthropogenic changes for the perspective of ecosystem suitability for regular living of commercial aquatic organisms and their nutritive base.

Development of set issues was exercised on the basis of the data of long-term ecological YugNIRO researchs in the Black Sea areas that are the most exposed to anthropogenic press: the north-western shelf of the Black Sea (NWBS) in the area of hydrocarbon extraction, the area of dumping of dredging soils in the Kerch pre-strait zone, coastal waters of the South Coast of the Crimea, the Bay of Sevastopol and the Bay of Feodosia. During the monitoring, hydrochemical research of bottom sediments and water was carried out (content of heavy metals, petroleum products, chlorine organic compounds is identified), as well as a toxicological study of fish. The state of the studied areas of the Black Sea differ significantly, being conditioned by both natural and anthropogenic factors. Marine environment of the SCC (the region of Yalta city) is the least polluted with heavy metals – 0.45 TLV (threshold limit value) - "clear water"; in the Black Sea pre-strait zone in dumping area – up to 1.11 TLV, in the NWBS – up to 1.28 TLV, in the Bay of Feodosia in the area of port operation – up to 2.22 TLV. Exceeding of the levels of geochemical background of mercury, cuprum, lead, cadmium and zinc that are standard for the Black Sea bottom sediments is typical for water areas of the Sevastopol and Feodosia Bays and in the area of gas extraction in the NWBS. In the studied water area, the greatest content of petroleum products in aquatic environment was detected in the area of hydrocarbon extraction – up to 14 TLV (TLV equals 0.05 mg/l). Nevertheless, it is to be noted that such high concentrations were recorded only during the initial period of developing reserves at the stage of prospecting drilling. At the modern stage, the average concentrations of petroleum products in aquatic environment of this region do not exceed, as a rule, 2 TLV; and the waters of the Bay of Feodosia and the Kerch pre-strait zone are contaminated to a lesser extent – up to 3 and 4 TLV in some years. The content of petroleum products in the bottom sediments of all studied sea areas (except for the SCC and dumping area), as a rule, exceeded the value of 1 mg/g of solid, that corresponds the III level of contamination – the level, when the degradation of bottom biocoenoses starts. The greatest content of petroleum products in the bottom sediments is detected in the vicinity of fixed offshore platforms in operation. The level of

contamination with chlorine organic compounds of aquatic environment of studied water areas differs significantly. Nevertheless, the decrease of pesticide (DDT and HCH) and polychlorinated biphenyl share in contamination of the Black Sea aquatic environment is a common pattern. However, in some years DDT concentration in the water increased by 2-3 orders in comparison with background values: DDT concentration was 0.450 μg/l in the water of the Kerch pre-strait zone in 2001, and 248.4 ng/l in the NWS in 2005, which, apparently, was resulted from washout of the pesticide repository sites situated in southern Ukraine. Content of heavy metals and chlorine organic compounds in commercial aquatic living organisms can be viewed from two angles: with the aim of assessment of their nutritive qualities and the state of their habitat. Research detected that the concentration of heavy metals and chlorine organic compounds in muscular tissue of turbot, flounder, so-iuy mullet, picked dogfish, anchovy and red mullet was lower than threshold limit values for food object. The increased content of zinc and lead was detected in 14% of studied fish, of cadmium and cuprum - in 0.5%, and of lead – in gonads of 0.5% of studied fish.

Understanding of "Good Environmental Status" for Turkish coastal and marine environment

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Abstract

The MSFD (2008/56/EC) has a holistic approach for the protection, sustainable use and management of coastal and marine waters *via* the definition of "good environmental status" and setting "environmental targets" for quality assessments and controlling the planned actions and measures. The MSFD, including a regional cooperation dimension for the management of marine areas, is even beyond the European legal framework and its ecosystem-based management perspective is currently being studied by the surrounding states of the Mediterranean and the Black Sea in specific regional projects, within the working programmes of regional seas convention and also with national programmes and projects.

One example of such a national project, supported by the Ministry of the Environment and Urbanization and under the leadership of TUBITAK (the Marmara Research Centre), is titled 'Determination and Classification of Quality Status of Marine and Coastal Waters (Dec. 2011-Dec.2013)". Universities, governmental agencies, local authorities and NGO's are contributing with both data and expertise to this project the cover the entire Turkish coastal and marine areas. This project is aimed to enhance information and tools for the monitoring, assessment and management of marine waters (including the interactions with the coastal

systems). In this context: (a) identification of coastal waters, their typologies and classification according to the ecological (and chemical) status in the frames of WFD, (b) identification of "good environmental status" and to propose targets and indicators, where possible, for marine waters in the frame of MSFD, and (c) to propose an integrated monitoring system for marine and coastal waters to be implemented by 2015 and beyond were aimed to be studied.

Since substantial amount of data and expertise are required for the achievement of such a scope, it is first aimed to collect all data previously obtained from national scale projects and, at smaller/local scales, the long-term data sets collected by the coastal municipalities and research institutes. Based on the available information/data and ecosystem quality indicators adopted/recommended by the EC and the regional conventions, different expert groups evaluated the existing data producing assessment and classification tools, or identified the gaps and the monitoring and research needs for future studies. Definition of "good environmental status" and setting targets for them were also discovered. Different descriptors of GES; such as, biodiversity, pollution, eutrophication, marine litter, living resources, food webs and sea bottom integrity have been worked out with available data and expertises whereas large knowledge gaps were identified for habitat distributions and conditions, levels and impacts of underwater noise and marine litter. With this communication, it will also be presented the level of information and data on the pollution and eutrophication indicators and the expert views and recommendations on environmental objectives and future studies.

Seasonal Variability of Suspended Matter's Content and Rate of Its Sedimentation in Photic Layer of Black Sea Waters

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Keywords: Black Sea, sediments, pollutants, integral indexes of pollution of ground sediments

Abstract

Large-scale measurements of suspended organic matter's (SOM) content in different seasons of one year are carried out with the use of detritus traps during the unique experiment organized by Ukrainian Research Center of Ecology of Sea in 1992-1993 [1]. Main part of marine total suspended matter (TSM) is account clay fraction (so called "pelith") (from 70 to 90%) in the Black Sea conditions. The SOM contents in different seasons of the year are conformed to the concept of seasonal succession of planktonic community: from May to November, 1992 the SOM concentration went down from 2.03 mg dry weight*l^{-1} in 3 times synchronously with phyto-bacterio-nano-heterotrophic plankton, and in February, 1993, it decreased in 4 times. In the prevailing occurrences the SOM share in TSM was within the limits of 40-60% at the extreme meanings from 25 to 80% [2]. The comparatively high rates of the TSM and its organic faction's sedimentation in the three regions of the sea, related to its plenty, seasonal changeability and hydrodynamic conditions in the points of measurements, are established (Table).

Table1 Rates of TSM and SOM sedimentation ($g*m^{-2}*day^{-1}$) in the Black Sea

№ stations and its coordinates	May			July			September		
	Depth of measurement H, m	Rates of sedimentations		H, m	Rates of sedimentations		H, m	Rates of sedimentations	
		TSM	SOM		TSM	SOM		TSM	SOM
23 45.5o N 31o W	18 26 38	1.28 0.83 1.20	0.80 0.49 0.49	12 25 -	1.13 0.24 -	0.79 0.16 -	18 30 40	1.20 0.67 0.36	0.60 0.31 0.22
55 43.5oN 34o W	11 24 64	0.96 1.03 0.51	0.76 0.45 0.40	12 25 65	4.57 4.21 2.18	2.40 2.71 1.00	19 26 65	0.18 0.25 0.27	0.11 0.17 0.12
96 42.5o N 40o W	6 25 63	1.57 1.15 1.13	1.05 0.74 0.62	82 66 5	1.20 1.79 1.41	0.66 1.19 0.72	19 35 65	0.33 1.02 0.32	0.19 0.65 0.20

The results of the rates of TSM and SOM sedimentation, received by ours direct measurements, well agree with data of measurements by ^{234}Th [3], carried out by the researchers of IBSS in centre of the western cyclonic vortex of the Black Sea during the period of our investigations.

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Level of Pollution of Sediments in Coastal and Oceanic Regions of the Black Sea

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Keywords: Black Sea, sediments, pollutants, integral indexes of pollution of ground sediments

Abstract

The results of the four cruises in 1992 on the common net of the stations during complex seasonal surveys (March, May, July and September) on the vessels of the Ukrainian Research Center of Marine Ecology in the north part of the Black Sea, overcoming economic zones of Ukraine, Russia and Georgia, was served by basic data [1] .

Priority pollutants in ground deposits on depths from 9 to 2195 m, the registered concentrations of which exceeded maximum allowable concentrations (MAC) adopted from [2], were total petroleum hydrocarbons (TPHs), chlorine organic compounds (DDT and its products, hexachlorcyclohexan HCCH and polychlorinated biphenyls PCB). The seasonal dynamics of pollution level of the ground deposits was determined by not only seasonal variability of outflow of rivers and water

change through the Kerch channel but also presence of powerful convergences and downwellings.

Contents of TPHs exceeded MAC from 2 to 8 times along Crimean peninsula from the mouth of Dniester, in the Kerch channel and in all oceanic (deep-water) part of the sea. Total concentrations DDT and its metabolites were minimum in the East coastal region and maximal (1.6 MAC) in the North-Western and Central deep-water regions. Contents of HCCH were maximal in the coastal region of North-Western part of sea, at the coast of Crimea, at the Kerch channel and in the waters of major ports of the Caucasian coast. The maximal concentrations of HCCH exceeded MAC in 1.6 and 2.3 times.

Contents of heavy metals (Hg, Zn, Ni, Cu, Pb, Cr, Cd, Fe) in the ground deposits on the shelf and in deep-water part of the sea nowhere did not exceed MAC. Copper and mercury predominated among them. Cadmium in the ground deposits in all surveyed waters found in concentrations larger than the average content of this metal in soils [3] unlike other trace metals.

The raised indexes of complex pollution [4] in the Central deep-water part of the Black Sea, stipulated by maximal concentrations of TPHs, probably, can be related to the specific geomorphologic conditions of deep-water bottom, and also low rates of processes of self-purification (by comparison to shallow regions).

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Application of Nematode/Copepod Index in the Black Sea: Any Indication for Use in Monitoring of Organic Pollution?

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Keywords: Index, meiofauna, environmental parameters, pollution

Abstract

Many univariate indexes are used widespread for pollution studies and their use as management tools is necessary to implement the European Water Framework Directive (WFD, 2000/06/EC). However, these indices are mostly used to evaluate macrobenthic communities and meiobenthos has not been taken into consideration. Nematode/Copepod index was suggested three decades ago by Rafaelli and Manson [1] as a fast way to investigate the effect of organic pollution. Time consuming identification of nematodes and copepods made this index more suitable to use. The advantage of these two taxa was that the copepods are more sensitive to environmental stress compared to nematodes; hence a higher N/C might indicate a polluted site. Also abundance of nematodes can decrease following a pollution event but they have the ability to survive for long periods [2]. However, possibly due to the influence of sediment grain size on N:C values and the ability of epibenthic harpacticoid copepods to swim from the sediment surface to water column or to interstitial area, contradictory results have been obtained by different authors and quite a number of studies strictly criticized its use and [3] declared that the oversimplification of meiobenthic structure to a single ratio should not be regarded as a reliable tool. On the other hand, Warwick [4] suggested using the nematode trophic group of 2A which is a feeding type comparable to those of harpacticoid copepods. So the aim of this study is to evaluate the Nematode/Copepod index based on total abundance of nematodes and also calculate it considering just the 2A group of nematodes. Meiobenthic material was collected along Sinop coasts by Scuba divers (3 and 10 meters) from soft bottoms

via stainless steel tube corers at 8 stations as 3 replicates monthly from August 2009 to July 2010. N:C ratio was applied to total nematode and copepod abundance data and also calculated based on 2A group of nematodes. As far as we know, this is the first attempt in Black Sea to investigate the use of Nematode/Copepod index in monitoring studies.

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Assessment of Pollutants Input from Land-Based Sourses into the Bulgarian Coastal Area

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Keywords: river discharge, WWTPs, pollutants load, LBS

Abstract

This paper presents the evaluation of pollutants and nutrients input of Land-based sources (LBS) in the frame of the prepared by Institute of Oceanology Initial Assessment of Marine Environment (Art 8 of MSFD 2008/56/EC). Industry, tourism,

urbanization, navigation and port activity are the main human activities, which impact on the marine environment. The pathways of the anthropogenic pollutants into sea ecosystem are different. Many pollutants are restricted to zone in the vicinity of large cities, estuarine areas of the large rivers and industrial places. The aim of the paper is: identification and evaluation of the LBS input for the period 2006 -2011.

The data were provided by BSBD and other institutions responsible for the water management. Pollutants inputs to the sea, either directly or via riverine inputs, can originate from either point (e.g. waste discharges) or diffuse sources (e.g. atmospheric, leaching from surrounding land). Point sources are localized and they are easier to monitor and control, while diffuse sources are much more difficult to regulate. Gap of data for pollutants loads from livestock and agriculture was established. The number of Waste water treatment plants (WWTP) directly discharging into the sea is 11. They provide 68% of total nitrogen load, 15% of total phosphorus load and 47% of BOD load. Additionally, 5 sewages discharge into the sea. Some of the municipal WWTPs indirectly impact the Water Quality (WQ) of the sea because their significant pollutants load. The more significant share of rivers load belongs to the Kamchia River, the biggest Bulgarian river flowing into the sea. The industrial waste waters runoff discharging directly into the sea is less in comparison with the rivers runoff and WWTPs discharge. The available data analysis reveals two sites as areas with high anthropogenic impact -Varna bay and Burgas bay, owing to the direct or indirect influence of the industrial and municipal runoff, port operations and marine transport.

Seasonal Variability of Western Black Sea Hydrochemical Structure (Bulgarian Part)

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Keywords: nutrients, oxygen, vertical structure, seasonal variability

Abstract

Features of spatial-temporal variability of hydrochemical structure of the Western Black Sea are revealed through the analysis of collected data in the frame of National monitoring program by the R/V Akademik over the Bulgarian shelf and open area (transect c. Galata) in 2012. The samples were collected by rosette sampling bottles system. Temperature and salinity "in situ" data was obtained by SBE 911 sond. Dissolved oxygen (DO) was analysed by Winkler method. Nutrients (phosphates, silica, nitrates, nitrites and ammonia were measured on board by standard spectrophotometric methods.

The obtained results reveal high oxygen saturation (OS) in the upper layer in spring (113-122%) and lower during the autumn (96-101%). Oxygen vertical distribution is characterized by maximum (10.52 -10.85 mg/l) at depth 10 -25m in correlation to the fluorescence maximum location and temperature vertical changes. The lowest DO content in bottom waters (D>90m) in shelf area was measured in summer-autumn (<3mg/l) corresponding to the saturation 17 -23%. Seasonal nutrients changes are characterized with high values in spring in upper layer. Vertical distribution shows nitrate maximums in Cold intermediate layer (CIL) and phosphate maximums in redox layer and anaerobic zone. Hydrogen sulphide (H_2S) appears at the depths corresponding to dencity σ=16.1. The deepest horizon of H_2S appearance at the station located in the slope area was established. Its content varies in range 0.93-1.23mg/l at 200m depth.

Comparison with the previous periods reveals a slight increasing trend for nitrogen content in spring. In contrast it decreases in summer. OS does not exceed the average value from the period 2000-2005.

Chemical Status of Varna Bay - Research of Coastal Water Quality

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Keywords: chemical status, coastal water quality, environmental monitoring, Varna bay, water quality parameters

Abstract

The current paper presents the results of systematic measurements of some coastal waters quality indicators. The sampling was made in Varna bay. The observation was made on physical and chemical coastal waters quality parameters: total nitrogen, nitrite, nitrate, ammonium nitrogen, total phosphorus, phosphates, dissolved oxygen, total dissolved solids, salinity, active reaction, conductivity, temperature. Some of above mentioned parameters are monitored on daily basis. Data accumulation is a result of a scientific project implementation. The collected data were analyzed and the results related to chemical status of Varna bay are presented.

Marine Litter Quantification in the Black Sea - A Pilot Assessment

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Keywords: marine litter, MSFD, Black Sea

Abstract

According to "Marine Litter, an analytical overview" (UNEP, 2005) about 6.4 million tons of marine litter are disposed in the oceans and seas every year, some 8 million items are dumped in oceans and seas every day, approximately 5 million of which (solid waste) are thrown overboard or lost from ships, over 13,000 pieces of plastic litter are floating on every square kilometer of ocean today. Various programmes and organizations (IMO, UNEP, IOC-UNESCO, FAO) and recently the EU MSFD (Descriptor 10) recognized marine litter as an issue of global threat. Among the efforts to combat the problem application of harmonized methodological approaches for quantification is still a challenge.

The paper presents the results of a pilot assessment of bottom marine litter in the Black Sea employing some of the methods recommended by MSFD GES Technical Subgroup on Marine Litter (TSG-ML) Monitoring Guidance 2013. The study was conducted during the MISIS Project Joint Black Sea Cruise (22-31 July 2013) along 3 transects in the NW Black Sea (Romania, Bulgaria and Turkey). Marine litter was collected by beam trawl (dredge of 5 mm mesh size) and ROV "Diablo" (Mariscope) and the items sorted by type of the material and size per km^2 to comply with the classification system in the manual. The results reveal a high variety among which plastics dominated the marine litter in all sampling sites. The applicability of ROV is discussed along with some practical recommendations.

Use of Idexx Quanti-Tray System for Rapid Assessment of Faecal Indicator Bacteria (Fib) in the Coastal Black Sea Surface Waters

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Keywords: microbial indicators, comparing water quality microbiological methods, multiple-tube (MPN) fermentation technique, Quanti-Tray, Black Sea

Abstract

Protection of coastal environments from microbial contamination is an important environmental and public health priority worldwide and increasingly requires new powerful tools for monitoring of faecal contamination and detection of potentially pathogenic enteric bacteria in seawaters.

Microbiological quality of the Romanian Black Sea coastal waters has been traditionally assessed through conventional and standard culturing dependent techniques based on culturable FIB, such us Multiple Tube Fermentation (MPN) technique. Although the multiple tube fermentation is one of the most popular techniques to determine the number of FIB in aquatic environments, it is laborious, time-consuming and tends to be relatively inaccurate in detection of these indicator microorganisms. Therefore, new methods for detection of enteric pathogens in coastal Black Sea waters are needed.

The enzyme substrate MPN (Quanti-Tray) test, is a new international standard method widely recognized as an alternative to the reference Multiple Tube Fermentation (MPN) technique for microbiological analysis of water, and to be easier, more sensitive and reliable and quicker than traditional multiple tube technique. Despite of becoming one of the most frequently method for detection

and quantification of FIB in environmental water worldwide including 19 European countries, the Quanti-Tray MPN technique has never been used for Romanian seawater until now.

This study provides the first investigation of FIB (coliforms, *Escherichia coli* and enteroccoci) in the Romanian Black Sea waters by using Quanti-Tray/2000 MPN test (Collilert-18 and Enterolert E, IDEXX Laboratories). The study was conducted in spring 2013 in a number of sampling points along the Romanian coastline, covering both unpolluted and polluted areas. The obtained results were compared with data resulted through multiple tube fermentation MPN technique. In addition the two methods were analysed in order to evaluate the suitability of Quanti-Tray system in assessment of FIB in Black Sea waters and possibility of its implementation as standard method.

Distributions of Anionic Surfactant in Sea Water and Total Organic Carbon in Bottom Surface Sediment Along the Turkish Coast of the Black Sea

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Keywords: Detergent, TOC, pollution, anthropogenic, terrestrial

Abstract

The aim of this work is to determine the distributions of anionic surfactant (AS) in seawater, total organic carbon (TOC) in bottom surface sediment, and to make an assessment of the organic matter pollution. Seawater samples for AS in autumn 2010 - winter 2011 and bottom surface sediments for TOC in autumn 2010 were collected from the Black Sea coastline of Turkey. Generally, winter values of AS were higher than autumn at the nearest distance of east and central coast of the Black Sea. Maximum concentrations of AS were measured at surface seawater of

Ordu and at bottom seawater of Şile in autumn, while winter concentrations of AS were high at surface and bottom seawater of Bafra. Also, highest concentrations of AS in both seasons at Yenice river mouth showed the influence of the river. According to the results the concentrations of AS in sea water varied with the seasons, regions and distance of the anthropogenic sources including industrial, domestic discharges. On the other hand, the maximum amount of TOC was obtained in the sediment of İğneada (9.73%) and the C/N ratios indicated that organic matter in the sediments are originated mostly from terrestrial source. AS concentrations are directly related to total suspended matter (r=0.8-0.9), but the inverse relationships between AS concentration and pH (r=0.6-0.4), dissolved oxygen (r=0.96-0.87) were detected at surface seawaters of the nearest coast stations.

Assessment of Metal Pollution in Seawater and Suspended Particles Along the Turkish Coast of the Black Sea

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Keywords: Seasonal, regional, suspended particulate matter, anthropogenic, erosion

Abstract

The concentrations of selected metals (Al, Cd, Cu, Pb, Hg) were measured, and metal distributions in seawater and suspended particulate matter (SPM) were investigated along the Turkish coastline of the Black Sea. Generally, the amounts of metals in both samples were changed with seasonal and regional variations. In sea water, autumn average concentrations were higher than winter measurements for cadmium and copper but lower than winter for aluminium and lead. The maximum metal concentrations in sea water were measured at depth 11 m of Samsun Bay

(Al, Cd); 75 m of Ordu (Pb) in autumn, and at 10 m of Giresun (Al, Pb), 5 m of Ordu (Cd), 0.5 m of Trabzon (Hg) in winter. The copper content of surface seawater at both seasons was high at Yenice river-end. Also, autumn average concentrations of particulate aluminium, cadmium, lead were higher than winter while particulate copper, mercury were lower than winter. The maximum particulate metal levels were measured at 10 m of Hopa (Al), Samsun (Cd, Hg), Ordu (Cu), Ereğli (Pb) in autumn, and at 10m of Giresun (Al), 0.5 m of Giresun (Cd); 100 m of İğneada (Cu), 75 m of Zonguldak (Pb), 100 m of Hopa (Hg) in winter. Results indicated that variations in metal concentrations and pollution are caused by natural weathering of rocks, erosion and/or anthropogenic sources derived from mining, industrial, domestic and agricultural activities near river and coastline.

Oil Polluted and Pristine Black Sea Coastal Sediments: Comparative Molecular Analysis of Inhabiting Bacterial Communities

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Keywords: Bacterial communities; oil pollution; 16S rRNA gene; sediment; PAH degradive potential; ARDRA

Abstract

The aim of the study was to provide data on the diversity and putative oil biodegradive potential of bacterial communities inhabiting pristine and chronic oil polluted Black sea coastal sediments. We tested also the hypothesis of community shift over time proposed by Röling [1].

We applied molecular methods to reveal the composition, variety and biodegradive potential of natural bacterial communities. We used 16S rRNA gene retrieval, Amplified Ribosomal DNA Restriction Analysis (ARDRA) and direct sequencing to compare main bacterial groups in polluted with pristine sites and to target a gene for enzymes, involved in the initial step of the aerobic metabolism of polycyclic aromatic hydrocarbons (PAH).

A functional bacterial community was found in the Sozopol harbor sediments where PAH levels were above the permissible concentrations. The PAH contamination was consistent with the established presence of bacteria suited to degradation of aromatic hydrocarbons in the harbor sediments. In addition, we expand current data favoring the hypothesis about an existing link between the dominance of α-*Proteobacteria* on one side and chronic oil pollutions on the other, which is supported also by other studies on bacterial community succession following oil spill evolution.

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Emodnet Chemistry from the Pilot Project to the Second Phase

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Keywords: chemical oceanography, good environmental status, data management, eutrophication, contaminants.

Abstract

EMODnet Chemistry pilot project was born as a pilot component for a European Marine Observation and Data Network. The aim was to assemble fragmented and inaccessible marine data into interoperable, continuous and publicly available data streams for complete maritime basins. It was focused on the chemical group of marine data required for the monitoring of the Marine Strategy Directive: pesticides, antifoulants, pharmaceuticals, heavy metals, radionuclides, fertilizers, organic matter, hydrocarbons including oil pollution. It concerned the following geographical regions: North Sea, Black Sea and 5 spots of the Mediterranean Sea.

The services developed, the experience and the lessons learned during the three year pilot project are the base for the continuation of the development of the infrastructure, planned for the second phase, recently started. A significant increase of the partnership to fulfill the request to cover all the European waters, new parameters to collect and the efforts to keep an open dialogue with the Marine Conventions are some of the key features of this second phase. Furthermore, this second phase will focus on the MSFD descriptors "Eutrophication" and "Contaminants", essential elements for the definition of the good environmental status, which is a substantial goal shared by both EU and not-EU countries (as may be the case of the Mediterranean and Black Sea areas).

Session 1 - Pollution and Eutrophication

EMODnet Chemistry was developed according to the principle of adopting and adapting SeaDataNet, the pan-European Infrastructure for Ocean and Marine Data Management. SeaDataNet is, in fact, acting as a "de facto" European standard that gives access to a continuously increasing number of data centres across different sectors (from physical to chemical oceanography, from geology to geophysics, covering in-situ and remote observations of the seas and oceans) and countries, increasingly meeting the requirements needed for INSPIRE compliance.

The major outcomes of EMODnet Chemistry activities are the commonly agreed procedures to manage the data complexity and heterogeneity, concerning 8 groups of compounds measured in three matrices (sediment, water column and biota) and presenting a high heterogeneity in the sampling methods, in the data distribution and in the analytical protocols. Further heterogeneity issues concern the geographical distribution of the target species and the different quantity and kind of data available in the considered regions. Complexity and heterogeneity are faced at several levels.

From the data management point of view, SeaDataNet infrastructure is adapted to fit the needs of the chemical data management which requires a more detailed metadata description.

From the products generation point of view, suitable data products were defined to represent the features of the data collected. Data with a homogeneous distribution in time and space, collected at basin level, were used to generate seasonal and annual interpolated maps for nutrients, metals and radionuclides in the North Sea, in the Black Sea and in selected areas of the Mediterranean Sea. Data collected at coastal stations repeated in time, were used to generate time series plots for hydrocarbons, pesticides, metals, fertilizers over more than 160 stations.

Synergetic Impact of Pollution and Climatic Changes in the Mediterranean Region

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Keywords: Marine pollution, climate change, Mediterranean region

Abstract

From ancient years until our days, one of the most significant places around the world for trades, cultural and societies development is the Mediterranean Sea. Mediterranean came from Latin word mediterraneus, meaning "inland" or "in the middle of the land" (from medius, "middle" and terra, "land"). Covers more than 2.5 million km^2, with a 46,000 km coastline and its average depth is just 1500 meters. Furthermore, is one of the richest biological diversity sea in the world: 7.5% of all animal species, 18 % of all marine floras, represents only 0.7% of the total surface of the oceans. Mediterranean countries have a population of nearly 425 million, with an additional 170 million tourists per year. Total renewing of the seawater of the Mediterranean Sea occur every 80 – 100 years. The last one was finished in 1940. From the ship navigation, hundreds of tons of wastes, including petroleum residues, are daily accumulated in the Mediterranean Sea. It has been calculated that from the global pollution, which derives from navigation, the 25% belongs to the Mediterranean Sea. The most significant forms of pollution are: Chemical Contamination- including persistent toxic substances (PTS), Pollution from Organic and Pathogenic micro-organisms, Hazardous solid waste and Eutrophication. In fact, every year, 150,000 tons of mineral oil, 15,000 tons of phenols, 80,000 tons of detergents, 31,000 tons of zinc, 150 tons of mercury, 4,800 tons of lead, 2,800 tons of chromium, 400,000 tons of phosphorus and 100,000 tons of nitrogen accumulate to the Mediterranean Sea. The Global Warming Heat Waves due to the climatic changes are producing drought floods, storms and

tropical cyclones which are all likely to increase, and with them the amount of economic losses. Over 80% of arid and dry areas in the Mediterranean coastal region are already affected by desertification. Protected areas of global importance are likely to suffer severe losses of both areas and species. Mediterranean species will be at increased risk of extinction. To put it in a nutshell, the Mediterranean sea a great source for the region, but with low-levels of exploitation.

Heavy Metals in Water and Bottom Sediments of Odessa Region of the Black Sea

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Keywords: Black sea, Odessa region, water and bottom sediments, pollution

Abstract

The main sources of pollution of the Odessa region of the Black Sea are the major sea ports (Odessa, Illychevsk, Yuzhnyi), waste water of three treatment plants, drainage and rain waters, flow waters from Danube, Dniestr and Dniepr. Since 1988 to present (except years from 1999 to 2004) Odessa Branch Institute of Biology of Southern Seas has been carrying out the pollution monitoring in Odessa Region of NWBS.

Table 1 shows the average and maximum values of heavy metals over the entire study period. The minimum metal content is zero, except for the dissolved form of *Cu* in the bottom layer (0,02 мкg·dm^{-3}).

The annual average concentration of heavy metals in sediments for the entire study period showed a tendency to decrease the content of *Cu, Zn* and *Cd* and content of *Ni* to grow in 2009. In 2010 the content of heavy metals flowing from rain waters into the waters of the Odessa Region of the Black Sea has increased dramatically due to the precipitation of a record rainfall (740 mm per year, that was twice the norm) (Fig. 1).

Table 1. Average and maximum content of heavy metals in water of the 'Odessa region of the Black Sea' polygon for the period from 1988 to 2011

	The dissolved form, мкg·dm-3				**Weighted form, мкg·dm-3**			
	Cu	Zn	Ni	Cd	Cu	Zn	Ni	Cd
Surface horizon								
max	36.37	111.60	11.10	45.40	43.35	121.38	28.81	18.10
Cp.	1.86	10.30	1.143	0.67	0.73	7.20	1.08	0.23
Bottom horizon								
max	26.65	211.12	21.42	17.54	19.98	131.94	29.38	
Cp.	3.03	14.76	2.25	0.32	1.60	9.04	1.40	0.19

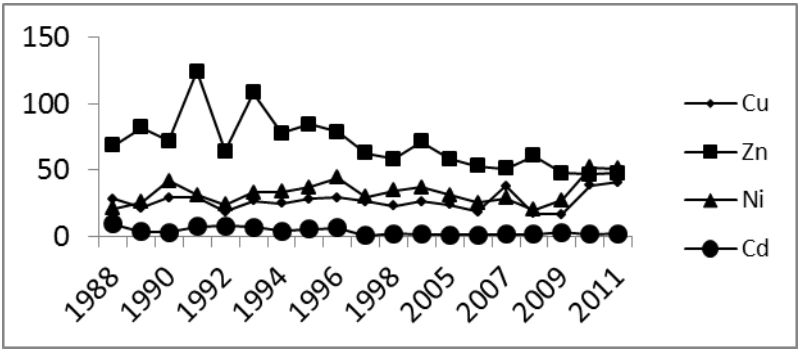

Fig. 1 Variability of annual average content of heavy metals in bottom sediments (mkg·g^{-1} of solid matter) for the entire study period

Dinoflagellate cysts in the Mediterranean and Marmara Sea as proxies of eutrophication and HAB appearance

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Keywords: Dinoflagellate cysts, eutrophication, blooms, indicators, Mediterraean, Black Sea

In coastal waters, many planktonic organisms produce resting cysts that have the potential to remain viable in the sediments for decades. These cysts probably derive from bloom processes and are able to refuel new blooms. A qualitative and semi- quantitative study was performed in three eutrophicated Gulfs in the Mediterranean (Saronikos and Maliakos Gulf) and Marmara Sea (Gulf of Gemlik) in order to characterise cyst assemblages, relate cysts to physico-chemical conditions and use them as bioindicators of eutrophication and HAB appearance. Total cyst density varied from 1726–146400g-1dry sediment in the Mediterranean with fifty-two cyst types, whereas 2172–108000g-1dry in the Marmara Sea with 30 different cyst morphotypes identified. Several features of dinoflagellate assemblages reflected a signal of eutrophication or industrial pollution - very high values of cyst concentrations probably correlated to an increase in phytoplankton production - dominance (>50%) of one group (Scrippsiella) - significant amounts of specific cyst types such as Lingulodinium polyedrum, Zygabigodinium lenticulatum (extreme nutrient impact), Polykrikos kofoidii (hyper-eutrophication), Protoperidinium conicum (industrial pollution, significant presence of diatoms). Cysts of potentially toxic species, causing Paralytic Shellfish Poisoning (PSP), such as Alexandrium cf. tamarense, A. cf. affine, A. cf. minutum, as well as Gymnodinium catenatum, were

detected in the cyst survey. However, more information from regional surveys should be collected in order to study whether the distribution of dinoflagellate cysts correlates with available environmental data and define certain cyst groups/species as proxies of different environments.

Session 2 Biodiversity and Ecosystem Functioning

Topics:

- **Plankton and benthic populations: long-term changes, distribution patterns and trends**
- **Non-native species: trends in occurrence, spatial and temporal distribution**
- **Food webs structure and functioning; long-term changes and trends**
- **Marine habitats: present status and trends; habitats classification and mapping**
- **Reference conditions and environmental targets**

- **Biodiversity indicators development towards good environmental status of the Black Sea**

Floristic Classification of the Russian Black Sea Shelf Bottom Vegetation

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Keywords: bottom phytocenoses, vegetation classification, Brown-Blanquet method, the Black Sea, Russian shelf

Abstract

In order to classify marine habitats with seaweeds and higher aquatic plants, a floristic classification of the Russian part of the Black Sea has been done. For the classification of marine communities, the Brown-Blanquet approach was used [1]. Based on the syntaxonomic analysis of geobotanical material (325 descriptions for Russian shelf of the Black Sea), 15 bottom vegetation communities were designated for Russian shelf of the Black Sea, which combined in 4 classes, 6 orders and 6 alliances. Among them, 8 communities were previously described as associations and subassociations in the Mediterranean Sea and some other water bodies of the Atlantic Ocean. 7 communities are new ones, most of them, according to preliminary data, are associations or subassociations [2].

The designated communities of the Black Sea have been ordinated using multifactor statistical analysis. Two complex gradients (CG1 and CG2) were revealed, which determine the distribution of bottom vegetation communities on

the shelf. CG1 includes the following components: distance from the shoreline, depth increase and correlated decrease of light, decrease in water mobility, saprobity and stabilisation of typical marine salinity. The soft bottom communities of vascular plants are distributed along CG2, directed from shallow, closed, well-warmed and muddy sea lagoons to normal coastal sea biotopes. CG2 includes salinity increase, intensification of water mobility, decrease the fluctuation of temperature, change in bottom substrate towards the increase on fraction size, decrease in saprobity.

The majority of associations are narrowly distributed along the shores of Taman and Abrau peninsulas of the Black Sea. Also, key botanical areas and rare communities (*Phyllophora crispa-Codium vermilara, Sphacelaria cirrosa-Cladostephus spongiosus,* ass. *Cystoseiretum crinitae,* ass. *Zosteretum marinae* subass. *Zosteretum noltii typicum*) were revealed for the investigated areas.

According to the results, using the system of habitats, which was developed for the Mediterranean, is not relevant at least for the Russian shelf of the Black sea.

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Non-Native Species of the Black Sea

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Keywords: alien species, invaders, Black Sea, origin, naturalization.

Abstract

According to the decision of the 17 meeting of Advisory Group on Conservation of Biological Diversity of Secretariat of the Commission on the Protection of the Black Sea (BS) Against Pollution it was decided to summarize the activity connected with preparation of the details list of the BS alien species.

This work started in 2005 with the help of 37 experts from all BS countries and includes information till July 2013. The list contains information about the year and the area of the first registration of alien species in national waters of all BS countries, based on 179 local and international publications.

The list of alien species consists of two parts: marine alien species (268) and excludes species (97). The last group of organisms includes: 1) fresh and brackish water species; 2) phytoplankton species that have been registered only as cysts: 3) cryptogenic species, or the species that have been identified as the progress in systematic investigations (as the rule it is small organisms with not clear systematic position, or hardly identifiable); 4) native species for the BS, that were first identified in different areas; 5) occasionally registered (mostly plankton organisms, that appear with ballast water and not survive with time); 6) mistaken

identification. Marine alien species in BS comprise: 10 species of marine fungi, 65 - phytoplankton, 35 - zooplankton; 5 - microphytobenthos, 50 - macroalgae, 65 - zoobenthos, 25 - fishes, 2 - reptiles, 5 - mammals, 6 - parasites. The alien contingent comprises 22% of casual species, 30% of successfully naturalized (established) and 58% of questionable status. According to the list, the total number of alien species in different national waters of BS countries comprises: 80 species in Bulgaria, 28 - Georgia, 79 - Romania, 51 - Russia, 94 - Turkey, 148 - Ukraine. This distribution is not only due to the position of different countries along the BS coast (length of shore line, or total square of the shelf area), but first of all to the number of experts involved in this work. Considering the BS alien species from the point of view of their origin, it follows that more than 90% (from total number of registered species - 268) of aliens are connected with the Mediterranean-Atlantic, 18-27% - originate from Indian and Pacific Oceans, 16-25% - originate from Northern Atlantic inhabiting the coastal area of North Europe or America.

An Adaptation of the EEI-C Ecological Status Evaluation Method - Results from an Experimental Study of the Eutrophication Impact on Macroalgal Communities in the SW Black Sea

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Keywords: Black sea, macroalgae, *Cystoseira* spp.,WFD, ecological status, eutrophication, EEI-c

Abstract

The aim of this study is the adaptation of the macroalgae-based EEI-c index, developed by [1] in the E Mediterranean, to the environmental conditions of the W Black Sea and the specific changes in the structure of the local perennial

Cystoseira barbata and *C. bosphorica*-dominated macroalgal communities under eutrophication pressure. We evaluated the applicability of this new WFD approach to the specific hydrochemical and geomorphological conditions of the basin as well as the method's sensitivity to the observed changes in physico-chemical and biological parameters of the study area (Burgas Bay, Bulgaria). For these purposes, a two year experimental in-situ study of infralittoral macroalgal communities was carried out within a gradient of anthropogenic eutrophication, where conditions changed from highly degraded (inner Burgas Bay) to a referent zone in a good state (Maslen Nos area). The seasonal sampling of macroalgae (destructive sampling and digital photo sampling) was combined with a continuous monitoring of temperatures, nutrient concentrations, water transparency and PAR. The established significant correlations between levels of eutrophication impact ($[NH_4]$, $[PO_4]$,$[NO_3]$, [seston], $\%PAR_{surf}^-$) and quantities of dominant macroalgae were used for their classification in the EEI-c's morpho-functional categories (IA,IB,IC,IIA,IIB), with results similar to those suggested by [1].The observed increase in the values of ECS(in the range 2 – 10) and improvement of environmental status within the study area, corresponded well with the gradual decrease in nutrient concentrations (2-3 fold for $[NH_4]$ and $[PO_4]$), improvement in water transparency (average Secchi depth from 3.8 m to 7.1 m) and Kd (from -0.48 to -0.26), as well as the improvement of the state of *Cystoseira* spp. communities (descriptors -species composition, population structure, depth penetration, biomass). The applied DistLM modeling reviewed significant influence of geomorphology (wave-exposure, bottom inclination, orientation of coastline) and natural seasonal variations (light availability, average and extreme winter and summer water temperatures) on community structure and the resulting seasonal values of EEI-c, stressing the importance of the careful selection of sampling season and location for distinguishing eutrophication impact from natural changes in the studied communities. The ECSs calculated from destructive samples and digital photo sampling had similar values and correlated well (R^2=0,85 for EEI-c), indicating that the developed digital photo methodology can be integrated in future monitoring activities, ensuring a faster and more objective in-situ collection of data on macroalgal communities structure and state.

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Checklist of Sevastopol Coastal Zone (Black Sea) Dinoflagellates

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Keywords: Black Sea, dinoflagellates, Sevastopol bay, species composition

Abstract

Despite more than a century of phytoplankton research in the Sevastopol coastal zone (Black Sea), there are significant differences both in the quantity of species and in the species composition listed in different sources, which requires further clarification for a correct assessment of the phytoplankton species diversity in the region. The first information about microalgae taxonomic composition of the Bay of Sevastopol and nearest sea area is given by Pereyaslavtseva (1886) (27 species). Morozova-Vodjanitskaja (1948) made the first retrospective analysis of the Black Sea phytoplankton and presented a list of species including 79 dinoflagellate species for the Sevastopol Bay. During the following years these studies were

continued by the scientists of IBSS and for the last twenty years the monitoring of the Sevastopol Bay and the nearest zone has been carried out on a regular basis. Nowadays the most complete list of the Sevastopol Bay dinoflagellates species includes 92 nominal species and is based on the studies of Senicheva M. I. in 1983-2006. According to the observations made by Manzhos in 2001-2002 and 2006-2007, the list of Sevastopol coastal zone Dinoflagellates consists of 62 and 54 nominal species respectively (including species identified at genus level). As the result of monthly ecological monitoring of the Sevastopol Bay, performed by the biophysical ecology department of the IBSS NASU since November 2008, in phytoplankton samples 79 dinoflagellate species were identified (12 were identified at genus level). The most speciose genera were: *Protoperidinium* Berg (14), *Dinophysis* Ehrenberg (8), *Gymnodinium* F. Stein (7), *Prorocentrum* Ehrenberg (7) and *Gonyaulax* Diesing (7). In this article we present for the first time the check-list of the dinoflagellate species for the Sevastopol coastal zone, based on comparative analysis of historical and modern data. This list consists of 151 species and intraspecies taxa, including nomenclature species type, related to 49 genera, 13 to families and 7 to orders.

It might be interesting to see how many species are present throughout the investigated period, how many have been found only recently, how many were found in the past and are not being found now (or since how long).

Phytoplankton Population Structure Dynamics in the Coastal Waters of the Zmiinyi Island in the Black Sea (2004-2012)

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Keywords: phytoplankton, coastal water, Zmiinyi Island, Black Sea

Abstract

Long-term studies of phytoplankton community structure with the main natural and anthropogenic factors' simultaneous registration are the important stage of research into the reasons and consequences of eutrophication, which quite often occurs in the North-Western Black Sea [1-3].

Our study assesses the long-term changes and trends in the structure of phytoplankton population for the coastal waters of the Zmiinyi Island in the Black Sea.

Marine phytoplankton has been sampled in the Zmiinyi Island area by the staff of Marine Research Station (MRS) "Zmiinyi Island" of Odessa National I.I. Mechnikov University in 2004-2012. Phytoplankton samples were taken regularly every 5 days (2005 – 2008) and every 10 days (2009 – 2012) from two horizons (0 and 8 m) 100 m far from the island coastline. Taxonomic identification of phytoplankton was done using National and International guidelines.

We have analyzed the temporal distribution of biomass average monthly values (B), number (N) and quantity of species (n), as well as taxa number (S) for the entire phytoplankton community comprising 11 taxa (*Bacillariophyta, Dinophyta, Chlorophyta, Cyanophyceae (Cyanobacteria), Cryptophyta, Haptophyta, Dictyochophyceae, Chrysophyceae, Euglenophyceae, Ebriophyceae, Craspedophyceae (Choanoflagellatea)*. Mean values of B, N and n for the whole period of studies were 3940±2800 $mg \cdot m^{-3}$ and 2850±1900 $mg \cdot m^{-3}$; 4440±2440 $mg \cdot m^{-3}$and 3160 ±1180 $cells \cdot 10^{6} \cdot m^{-3}$; 18 ±4 and 15 ±3 species for surface and

bottom horizons respectively. At that, maximal values of B=65760 $mg \cdot m^{-3}$ (in surface layer) and 11790 $mg \cdot m^{-3}$ (in bottom horizon) have been registered in May, 2009; N= 91335 $cells \cdot 10^6 \cdot m^{-3}$ (May, 2009) and 46690 $cells \cdot 10^6 \cdot m^{-3}$ (April, 2009); n=49 (June, 2005) and 32 species (November, 2012).

The results of temporal distribution of each taxon (Bacillariophyta, Dinophyta, Chlorophyta, Cyanophyceae, Cryptophyta, Haptophyta, Dictyochophyceae, Chrysophyceae, Euglenophyceae, Ebriophyceae, Craspedophyceae), total values of B and N and the trends of their changes during 9 past years are discussed in detail.

It has been proposed to use ratios of biomass and number of separate taxa to reveal long-term changes in the ecosystem of the Zmiinyi Island coastal waters.

The study has been carried out in the framework of National research activities founded by Ministry of Education and Science of Ukraine and as a contribution to the European FP7 projects ENVIROGRIDS and PERSEUS.

We also would like to thank the staff of the Regional Centre for Integrated Environmental Monitoring and Ecological Studies of the Odessa National I.I. Mechnikov University for field sampling and observations at the MRS "Zmiinyi Island".

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The Changes in the Diversity and Abundance of the Harpacticoid Copepods (Crustacea) Distributed in the Upper-Infralittoral Zone of the Black Sea (Sinop, Turkey)

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Keywords: Harpacticoida, copepod, diversity, abundance, environmental parameters

Abstract

Harpacticoid copepods were studied monthly on soft bottom substrates of the Sinop Peninsula coast of Turkey (Black Sea) from August 2009 to July 2010. Copepod samples were collected by using a tube sediment corer with a mouth area of 12.56 cm^2 from 8 stations from 3 and 10 m. Some physico-chemical parameters of seawater and sediment were measured at each station. Univariate and multivariate analysis of harpacticoid copepod community structure were conducted using the PRIMER 5 software package (Clarke and Warwick, 2001). The significance of differences in community structure across the sations was assessed using a series of one way analysis of similarities (ANOSIM). A total of 2834 harpacticoid copepod specimens belonging to 21 families were examined. The mean abundance in different months was highest in Jun. 2010 (42984 ind./m^2) and was lowest in Feb. 2010 (6368 ind./m^2), whereas for stations it was highest at C2 (72834 ind./m^2) and the lowest at D2 (2658 ind./m^2). The highest diversity and evenness were found at station C2 (H′ =0.96, J′=0.97) and the lowest at station D1 (H′=0.29, J′=0.63). However, harpacticoid copepods abundance and diversity were different among stations and among sampling period. According to Bray–Curtis similarity values, the samples collected from the same station tended to join with each other, suprsingly the D1 and D2 stations with fine to very fine sands with high amount of silt were separated from the others. It can be a possible response of harpacticoid copepod distribution to environmental differences imposed by

different environmental factors. Sheltered beaches consist of fine or silty sands and thus reflect low energy conditions. Besides, the low density/diversity of harpacticoid copepods in these stations can be impact of nitrite, nitrate and phosphate levels. The majority of the community in these stations were characterized by a mixture of fusiform interstitial species (*Ectinosoma*, *Halectinosoma*) and large burrowing forms (*Canuella*, *Harpacticus*) which have the ability to move from the disturbed surface sediment to interstitial area.

Annual Vegetation Along the Shorelines (the Habitat 1210) in the Coastal Area of Danube Delta Biosphere Reserve

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Keywords: annual vegetation, shoreline, habitat 1210, Black Sea coast, Danube Delta Biosphere Reserve.

Abstract

The Danube Delta Biosphere Reserve has a coastal area 164 km long and is delimited at north by Gulf Musura and at south by Cape Midia. On the wide beaches of the Danube Delta and Razelm-Sinoe lagoon complex, the annual shoreline vegetation (habitat code 1210) is well represented, especially between mediolittoral and embryonic shifting dunes zone. Specific plant associations of the habitat 1210 can also be found in some cases on the lower mobile dunes, especially on their eastern slopes.

The coastal habitat "Annual vegetation along the shoreline" includes annual or annual and perennial plant communities belonging to the class *Cakiletea maritimae* R. Tx. et Prsg. 1952 and it generally develops on coarse sand, slightly salty, rich in nitrogenous organic matter.

The identification of the habitat 1210 along the coastal area between Sulina and Cape Midia was achieved on the base of characteristic species and typical plant associations of the habitat.

The specific plant associations of this type of habitat in the coastal area of the Danube Delta are the following: *Salsolo ruthenicae-Xanthietum strumarii* Oberd et Tx. 1950, *Cakilo euxinae-Salsoletum ruthenicae* Vicherek 1971, *Lactuco tataricae-Glaucietum flavae* Dihoru et Negrean 1976, *Argusietum (Tournefortietum sibiricae)* Popescu & Sanda 1975, *Crambetum maritimae* (I.Şerbănescu 1965) Popescu & al. 1980, *Convolvuletum persici* (Borza 1931) Burduja 1968.

The following information will be given for each plant communities of the habitat 1210: occupied surface, distribution along the seacoast of the Danube Delta Biosphere Reserve, floristic composition emphasizing rare plant species, conservation status, short and long term trends of plant associations, the main pressures and vulnerabilities which threaten these psammophilous plant associations.

The Black Sea Microalgae and Cyanobacteria in Human Affairs

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Keywords: microalgae, cyanobacteria, agriculture, biocidal activity, deterrent action, herbivorous organisms, Black Sea.

Abstract

The role of cyanobacteria (*C*) and microalgae (*Ma*) and their biocidal substances in the Black Sea coastal ecosystems has no complete explanation; especially it relates to active and mass *C* and *Ma* species in salt and brackish-water habitats and in the

gulfs, bays, estuaries and other frontier areas. Experimental data give evidences of high *C* and *Ma* ecological and biological importance in nature thanks to many-sided activity of their biocidal metabolites as a part of the complex co-evolutionary process. Our conception evaluates *C* and *Ma* as a source of new selective and prophylactic preparations for agriculture and medicine in the sphere of biological pathogen and pest control. We conducted long-term investigations of different aspects of interrelations between *C* and *Ma* laboratory cultures and strains and natural isolates on the one hand, and herbivorous organisms, *e.g.* nematodes and arthropods on the other hand. The *C* and *Ma* groups include dinoflagellates, Chlorophyceae, Xanthophyceae, *C* and their natural associations, some mixed cultures, lysates, individual cultural fractions (supernatant, sediment, etc.) and isolated substances (terpenes, lipids, pigments, etc.). Test objects include root-knot nematodes and herbivorous arthropods (Colorado potato beetle, fall webworm, lackey and brown-tail moth, etc.). Life histories, growth, metamorphosis, nutrition, survival rates are observed at different life stages within the radius of laboratory and field experience during 10-30 days. The results of experiments bring information about various sides of *C* and *Ma* biocidal activity including inhibition of vital functions, distortion of life cycle and low viability. Biocidal effects demonstrate selectivity in dependence on the state of *C* and/or *Ma* culture and its fractions, chemical nature of active compounds, specificity of test object, age of its larval stage, type of nutrition, time of exposure of treated feeding, and way of its treatment, etc. In particular, the different types of inhibition of vital functions can take place - feeding distortion: repellent action during 3-5 days, and concentration of insect larvae away from treated leaves (dinoflagellates and lackey moth larvae); long-term deterrent activity – 3.0-5.0% only vs. control version (water treatment) (*C*/*Ma* species and fall webworm larvae), and short-timed deterrent action (brown-tail moth in the most cases of tests); inhibition of the fat synthesis in larval stages of lackey moth (in 50.0%), fall webworm (in 29.0-68.0%), and Colorado potato beetle (in 48.5-63.5%); distortion of metamorphosis, e.g., low per cent of pupation and imagination; lethal effect in all of life stages during 10-20 days as a result of these events: lackey moth (95.0%), fall webworm (100.0%), and Colorado potato beetle (84.4-100.0%). Prolongation of exposure time of treated feeding leads to increase of mortality. Meanwhile biocidal activity of *C* and *Ma* includes not only toxic action. It is complex, multiple and many-sided challenge, which is very close to the plant-herbivorous interrelations in terrestrial habitats. Multilateral and

selective characteristics of *C* and *Ma* biocidal activity and controlled cultivation of target species can contribute to the creation of new agricultural preparations for plant protection and pest-pathogen control.

Effects of the Trophic Valuable Components and Toxic Components of Dissolved Organic Matter on the Growth of Dinophytes Microalgae

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Keywords: *Prorocentrum cordatum*, growth intensity, mussel's hydrolysate, phenol.

Abstract

Mechanisms of microalgae resistance during the eutrophication and anthropogenic pollutions are of great interest for ecological rehabilitation. Dinophyta are abundant in the Black sea, playing a considerable role in the marine ecosystem. The effects of toxic organic pollutants, for example phenols, as well as trophically valuable components dissolved in the sea water on the microalgae are unknown.

A reason of the poor knowledge about these microalgae seems to be linked to peculiarities of their cultivation and metabolism. For instance, dinoflagellates turn on the heterotrophic metabolism under factors negatively influencing photosynthesis and in the presence of organic compounds in cultural medium. It is well known that phenols influence the autotrophic and heterotrophic metabolism in different ways, making experiments difficult.

The purpose of this work is the investigation of toxic organic pollutants and trophically valuable components on the growth of marine dinophyta.

Experiments were performed on the clean cultures of *Prorocentrum cordatum* (Ostenfeld, 1901; Dodge, 1975) obtained from the collection of the Department of the Algae Ecological Physiology, Institute of Biology of the Southern Seas, NAS, Ukraine.

We used the alkaline mussel's hydrolysate as a model of the trophycally valuable organic compounds which imitated the dissolved organic substance of dyed organisms coming into water during the destruction and physico-chemical leaching. The groups of organic compounds with a trophycal value in the hydrolysate include aminoacids, peptides, derivatives of carbohydrates and lipids, etc. The concentration of nitrogen recounted to the common protein ranged from 0.05 to 0.5 $mg \cdot l^{-1}$ of medium, which is close to the brine of organic substances in summer. These concentrations did not affect the photocolorimetry procedure.

To simulate the toxic organic substances dissolved in the brine, we used various phenol compounds. Microalgae were cultivated on the grid under luminescent lamps or in complete darkness. The light intensity was from 1000 lk (17 mkE $m^{-2}c^{-1}$) to 6000 lk (100 mkE $m^{-2}c^{-1}$) during 6 hours. The culture was kept under natural light on the rest of time. Temperature varied from +18 to +26°C.

We observed both the stimulating as well as suppressing effects of phenol on *P.cordatum* in the mussel's hydrolysate. The duration in the algae growth during cultivation in darkness depended on the concentration of trophically valuable dissolved organic matter in the medium. It has been shown that the low concentrations of the trophically valuable dissolved organic substances could be used as an effective nutrition medium under the light conditions. Such growth stimulation of *P. cordatum* under light intensity of 17 mkE $m^{-2}c^{-1}$ and 100 mkE $m^{-2}c^{-1}$ can be explained by the mixotrophy in these algae.

Finally, it has been experimentally proved that phenol in concentrations from 0.25 to 10 $mg.l^{-1}$ stimulated the growth of *P. cordatum*. The mechanism of this effect is still unclear.

New Data on the State of the Phytoplankton Community in the Ukrainian Black Sea Waters

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Keywords: phytoplankton, algae bloom, new species of the diatoms and golden algae, the northwestern Black Sea, Odessa Bay.

Abstract

We studied the phytoplankton of Odessa Bay in 2008–2012.

Microalgal communities included from 146 (in 2010) to 219 (in 2011) species and supraspecific taxa. Decreasse of biodiversity by 1.5 times in 2010 were associated with frequent cyanobacterial blooms, which resulted in the elimination of other species. The diatom-dinoflagellate complex was found in 2008–2010, and the diatom-chlorophyte complex in 2011 and 2012. In microalgal communities the diatoms took from 34% to 46%, the percentage of the dinoflagellates decreased from 28% in 2008 to 14% in 2012. The percentage of chlorophytes increased from 15% in 2008 to 23% in 2011. On the contrary, the percentage of cyanobacteria decreased from 11% in 2010 to 8% in 2012. In the coastal zone, the percentage of chrysophytes increased by 2.4 times, from 5% in 2010 to 12% in 2012.

The coastal zone of the Odessa Bay was mainly mesotrophic during the five-year period of research. It was turning into hypereutrophic on July 12, 2010 during a bloom of the toxic cyanobacteria *Nodularia spumigena* (10 kg/m^3) at salinity of 14.5‰ and sea temperature 25.0°C.

During the five-year period, 12 microalgal species caused blooms in 25 cases. The intensity of *Skeletonema costatum* blooms, an indicator species, decreased from 4 to 1 or 2 blooms in a year. In addition, the abundance of *S. costatum* during its maximal propagation in February decreased from $9.8 \cdot 10^6$ cells/l in 2008 to $2.33 \cdot 10^6$ cells/l in 2012.

The maximum of blooms occurrence was recorded in 2010: eleven blooms, with seven of them caused by cyanobacteria, from July to September: *N. spumigena* (10 kg/m^3)*, Anabaena flos-aquae* (108 · 10^6 cells/l; 19 g/m^3)*, Aphanizomenon flos-aquae* (10.1 · 10^6 cells/l; 7,8 g/m^3)*, Oscillatoria kisselevii* (24.7 · 10^6 cells/l; 1,0 g/m^3)*, Spirulina laxissima* (4.2 · 10^6 cells/l; 1,5 g/m^3) and *Microcystis aeruginosa* (115 · 10^6 cells/l; 11.7 g/m^3). The bloom of *Chaetoceros curvisetus* (2.3 · 10^6 cells/l; 3.6 g/m^3) was observed in May 2009. In August 2009, for the first time since 54 years, the bloom of *Proboscia alata* (644 · 10^3 cells/l; 5.4 g/m^3) was observed in the Odessa Bay [1]. The bloom of a freshwater dinoflagellate *Peridiniopsis penardii* (1.3 · 10^6 cells/l; 9.4 g/m^3) was recorded in March 2011 firstly for the northwestern Black Sea. The bloom of *Emiliania huxley* (1.05 · 10^6 cells/l) was recorded in July 2012, at the sea temperature of 24.88 °C and salinity of 14.83 ‰.

Using phase contrast microscopy, during the five-year period we recorded three new chrysophytes for the Black Sea: Ollicola vangoorii, Dinobryon faculiferum (a solitary species of chrysophyte flagellates) and the very rare Chysochromylina pringsheimii; and in addition, a filose amoeba Paulinella ovalis. Also two small Chaetoceros diatoms were firstly recorded in the northwestern Black Sea: Chaetoceros minimus and Chaetoceros throndsenii.

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Reaction of the Tiligulskiy Liman Macrophytes to Abnormal Climatic Conditions

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Keywords: macrophytes, ecological activity, climatic anomalies

Abstract

The long-term response of the Tiligulskiy Liman macrophytes community, triggered by a set of anomalous climatic conditions of 2010-2012, is analysed. Macrophytes and phytoplankton have been considered from a morphofunctional viewpoint, the two autotrophic link components having precisely the opposite intensity of functioning. Phytoplankton species are characterised by high ecological activity; specific surface of their populations (S/W_p) are within 250 – 3000 $m^2 \cdot kg^{-1}$. The ecological activity of Liman macrophytes, on the contrary, occupies the lower range of autotrophs' functioning intensity (S/W_p being within 15 – 250 $m^2 \cdot kg^{-1}$).

Anomalies of air temperature exceeding monthly average values of 2.8 C° in July and 4.9 C° in August 2010, as well as precipitation exceeding the average rainfall 200% have created in the Tiligulskiy Liman ecosystem advantages for the development of phytoplankton communities that have high ecological activity. In August 2010 a big bloom of the Dinophyte *Prorocentrum micans* Ehrenberg. was observed, whose ecological activity made about 300 $m^2 \cdot kg^{-1}$. At the end of August, during the peak of blooming, the biomass of *P. micans* reached 135 $g \cdot m^{-3}$ (dosage less than 1 $g \cdot m^{-3}$). The phytoplankton's Index Surface grew up to 42 units (norm being 2-5 units) (Zotov, 2010). At that, benthic macrophytes, whose ecological activity at that time made 18-60 $m^2 \cdot kg^{-1}$, were suppressed significantly, due also to lack of light due to intensive phytoplankton blooming.

Structural and functional parameters of the Tiligulskiy Liman phytoplankton have returned to regional norm within two months following the outbursts in August 2010. At that, large-scale processes of fixation of big quantities of nitrogen and

phosphorus compounds took place in the Liman ecosystem . Low temperatures during winter 2011-2012 have caused long freeze-up. Thickness of ice all over the Tiligulskiy Liman water area exceeded 30 cm.

Probably the sequence of stressful climatic conditions resulted into long-term positive restructuring of macrophytes communities. The springs of 2011 and 2012 were characterised by untypically high development in the coastal zone of the brown algae *Ectocarpus siliculosus var. siliculosus* (Dillwyn) Lyngb.*, Punctaria latifolia* Grev. and *Scytosiphon lomentaria* (Lyngb.) Link., being indicators of good environmental state of ecosystem. In spring period of 2013 mass development of new for the Tiligulskiy Liman ecosystem brown algae with low ecological activity (S/W_p ca 20 $m^2 \cdot kg^{-1}$) has been revealed: *Leathesia difformis* (L.) Aresch (first found in the liman in 2004 by F.P.Tkachenko) and *Liebmannia leveillei* J. Agardh (new species both for the Tiligulskiy Liman and the North-Western Black Sea).

Crimean Ichthyocoenoses and Problems of Their Preservation

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Keywords: ichthyocoenosis, biotope, anthropogenic factor, coastal zone, the Crimea

Abstract

Ichthyofauna monitorings have been conducted since the end of 1990-ties to present in the coastal zone of the Crimean peninsula. 142 fish species were registered and 5 main marine coastal ichthyocoenoses and 1 local estuarine one, which are the fish communities being the part of self consistent biocoenosis, definite biotopes, were described.

Ichthyocoenose of the rocky-stone landscapes treed by *Cystoseira* spp, which usually stretches from the shore line to 8 – 15 m depth in average, and developed foremost along the southern coast of Crimea and Tarkhankut cape, are notable for their great species diversity. Representatives of the families *Labridae, Blenniidae, Sparidae, Pomacentridae, Sciaenidae* and others are the most numerous contributors to species diversity.

The biotope of calciferous plates, characterized by macrophytes and spots of shell sand is related to the shallow-water spots of the open coast of the peninsula. The presence of many hiding places contributes to the maximal species diversity of families *Gobiidae* and *Blenniidae*; families *Labridae, Sparidae, Scorpaenidae* are numerous here as well.

The biotope of the surf zone solid grounds (deposit of the smoothed stones and pebble) occupies the narrow coastal zone up to 0,5 – 1,0 m depth. Its ichthyocoenose is characterized by a small amount of bottom fishes of the families *Gobiesocidae, Gobiidae Blenniidae,* which can attach to the smooth stones by the surculuses. The biotope of the soft grounds (sand, silt sand, shell-sand) borders the whole peninsula. It stretches to the depth of 30 m and even more, starting at the coast or at the lower border of the rocky-stone landscapes. Bottom species of the families *Mullidae, Ammodytidae, Trachinidae, Uranoscopidae, Callionymidae, Dasyatidae Bothidae, Scophthalmidae*, *Soleidae*, gobies of the family *Pomatoschistus* are predominant.

The ichthyocoenose of the sea grasses is located in the shallow-water spots of gulfs and bays, covered from the heave. And considerable seasonal fluctuations of the temperature and salinity are typical for such spots. Representatives of the families *Gobiidae, Syngnathidae* characterize the community, together with the less abundant *Mugilidae, Labridae, Blenniidae*.

The local estuarine ichthyocoenoses are in the estuaries and fresh waters outflow channel, being different from the main ichthyocoen. Five – six fresh-water species (from the family *Cyprinidae* mainly) are in their composition, besides the marine and brackish-water fishes.

The negative anthropogenic factors for the Crimean coastal ichthyocoenoses include: siltation as a result of the sand under-water deposits development and

bottom trawling; physical extermination under the hydro-building and dumping; pollution by oil products, heavy metals and high eutrophication degree (the Karkinitsky Gulf, the Azov Sea); development of recreation sites on the narrow coastal zone; local throw off of the Dnepr waters from the Severo-Crymsky channel (the Karkinitsky Gulf, the Eastern Sivash).

Evaluating the Ecological State of Shallow Coastal Habitats in the Southwestern Black Sea (Sozopol Bay, Bulgaria): Level of Agreement of Different Macrobenthic Indices

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Keywords: macrozoobenthos, ecological state assessment, biotic indices, AMBI, M-AMBI, Bentix, BOPA, UK index, Shannon-Wiener diversity H', shallow coastal habitats, Bulgarian Black Sea

Abstract

The implementation of the Water Framework Directive and the Marine Strategy Framework Directive requires the evaluation of the ecological status of benthic communities in coastal marine systems. A variety of indices and metrics have been developed in recent years in order to achieve that.

This study aims to compare different types of macrobenthic metrics in order to choose the most suitable ones for the assessment of the ecological state of macrozoobenthos in shallow (up to 10m depth) soft-bottom coastal habitats of the Bulgarian Black Sea. The used dataset was the result of sampling conducted in July

2012 in Sozopol Bay, in two subhabitats of type 1110 (according to the Habitats Directive): vegetated sands covered with seagrass (*Zostera* spp.), and bare unvegetated sands. Three types of biotic indices were compared: diversity-based (Shannon-Wiener diversity H'), based on ecological groups of organisms (AMBI, BOPA, Bentix), and multimetric (M-AMBI, UK index).

Ecological state evaluations varied strongly both among types of indices and among indices of the same type. Multimetric indices and Shannon-Wiener diversity produced the worst evaluations (predominantly poor or moderate state), while the other indices all tended to evaluate the state of the communities in the bay as predominantly high and good. The low level of agreement between indices is probably due to problems with the definitions of the limits between ecological states and the reference conditions, the higher natural patchiness of the benthic habitats in the coastal zone, as well as the particularities of the indices themselves, such as the high sensitivity of H' to dominance patterns of species, the exclusion of oligochaetes (an opportunistic group) from the calculation of BOPA, etc.

Additional work taking into account the properties of the different indices is needed in order to successfully apply them in the assessment of the shallow coastal marine habitats in the southwestern Black Sea. This could be achieved through wider-range studies including more sites and types of habitats. Functional indices should also be tested and applied in combination with the others to obtain a fuller picture of ecosystem functioning and state, in particular for the requirements of the Marine Strategy Framework Directive.

Long-Term Changes of Taman Bay Macrozoobenthic Communities

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Keywords: macrozoobenthos, ecosystem structure, long-term dynamic, environmental factors.

Abstract

Taman bay is a shallow water basin with no river discharge. It opens up into the Kerch strait and is delimited by two spits – Chuska in the north-western part and Tuzla in south-western part. The salinity in the bay depends on the evaporation intensity and varies from 14 to 19 ‰. At the beginning of the XX century, Tuzla spit was connected with the mainland and blocked up the incoming Black Sea current. In 1925 part of Tuzla spit adjacent to the mainland has been destroyed by a heavy storm. This resulted in the formation of Tuzla channel 2 m deep and 4 km wide. During winter 2003-2004 the Tuzla Dam has been built to connect Tuzla Island with the mainland. As a result, the currents' structure in the bay has dramatically changed twice within the recent 100 years. At the beginning of the XX century in the eastern part of the bay, wide *Zostera marina* meadows were found as well as muddy shelly bottom sediments at the center of the bay [1]. In 1955, after the formation of the channel, Nesis (1956) observed an ubiquitous biocenosis with dominant *Nephthys hombergii* (Polychaeta) at 4-5 m depths that also included the bivalve *Cerastoderma glaucum* in the eastern part of the bay [2]. All subsequent studies did not include the dynamic analysis of macrozoobenthos. The present work aims at the analysis of the Taman bay benthic communities' structure in 2008, comparison with the 1955 data and the definition of the possible factors that determined these changes. This work is based on 2008 and partly 2013 sampling data. The abundance of macrozoobenthos in 2008 was found to be similar to the Nesis data (Table). However, in 2008, the average biomass was 10-times

higher than in 1955 (Table). Species number in 2008 was also at least twice as high (Table). Such differences resulted from changes in domination structure: in place of nephthys biocenosis, in 2008 biocenosis of large bivalve *Cerastoderma glaucum* with gastropod *Bittium reticulatum* as subdominant has been observed. Nephthys has been found at most of the stations where it was not even subdominant: the abundance did not exceed 842 spec/m^2 (less than 7.5%), and biomass was less than 3.13 g/m^2 (less than 0.6%). Furthermore in the central part of the bay new biocenosis with dominant invasive species *Anadara kagoshimensis* (Bivalve) has been found. In 2013 this species replaced autochthonous cerastoderma and bittium in the central and southern parts of the bay. Owing to hemoglobin with its capacity for oxygen stocking this species may live in anoxic water [3], so its mass spreading presumably indicates the formation of stable stagnant regions in the bay. Thus, within 50 years since the recent study of the fauna of the bay, drastic changes in domination structure of macrozoobenthic communities has been found. The said observations appear to be the result of changes in hydrological structure.

Table. Quantitative parameters of the Taman bay ecosystems in 1955 and 2008

Sampling year	1955			2008		
Parameters	mean	min	max	mean	min	max
Species number	12	7	13	18	12	24
Abundance, [spec./m2]	12076	4460	25380	11018	7238	21371
Biomass, [g/m2]	30.8	12.3	62.9	269.3	553.1	139.8

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Results of Phytoplankton Pigments Studies in the Zmiinyi Island Coastal Waters in the Black Sea, 2004-2012

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Keywords: Black Sea, pigments, phytoplankton, Zmiinyi Island

Abstract

It is known [1] that photosynthetic phytoplankton pigments (PSP) are the specific markers characterizing the processes taking place in marine phytoplankton and enable us to assess not only its structure, but also to estimate its biomass. At that, studies of phytoplankton using assessment of their PSP are more objective and less time-consuming compared with classic microscopy methods. The PSP is most efficient in marine areas where eutrophication happens. In particular, one of such areas is the North-Western Black Sea [2], where eutrophication not only brings down the quality of marine environment causing blooms of phytoplankton, but also causes hypoxia and mass mortalities of marine organisms. The aim of our work was to study the PSP inter-annual and seasonal changes and trends, such as Chl *a,* Chl *b,* Chl *c* and pheophytin *a* in the Zmiinyi Island coastal waters in 2004-2012.

The analysed material included PSP determination in the Zmiinyi Island coastal waters samples which the staff of Marine Research Station (MRS) "Zmiinyi island" of Odessa National I.I.Mechnikov University sampled in the framework of programme "Long-term Integrated Monitoring and Investigations of Zmiinyi Island marine ecosystem". The report shortly describes the methods of PHP concentrations measurements and routine observation of hydrological and hydrochemical parameters. The data on coastal sea waters for 2004-2012 with PSP are analyzed in detail. It is shown that in the surface layer the concentrations of Chl *a,* Chl *b,* Chl *c* were in the average higher than in the bottom layer, 1.7, 1.6 and 1.2 times respectively. The results of studies of each PSP's inter-seasonal and inter-annual changes are presented. It is shown that bimodal picture of average monthly

concentrations distribution of Chl *a,* Chl *b,* Chl *c* has been observed, with maxima in June and November and minimal values in July and in winter period. At that, seasonal changes in the bottom layer have been more pronounced than in the surface water. The long-term and seasonal changes in ratio of three PSPs and pheophytin *a* have been studied. The results of statistical processing of observations outcomes and mutual correlative relationship between the PSPs studied are considered. For the first time we describe and analyze in detail a statistically significant trend in Chl *c* increase, whose concentration has grown almost twice for 9 years, which indicates the structural changes taking place in the Black Sea phytoplankton community during past years. It has been proposed to use Chl *c*/ Chl *a* ratio as the indicator of structural changes taking place in marine phytoplankton.

The study has been carried out in the framework of National research activities and as a contribution to the European FP7 projects ENVIROGRIDS and PERSEUS.

We also would like to thank the staff of the Regional Centre for Integrated Environmental Monitoring and Ecological Studies of the Odessa National I.I. Mechnikov University for field sampling and observations at the MRS "Zmiinyi Island".

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The Use of Scanning Electron Microscopy for the Toxic Dinoflagellata Species Identification

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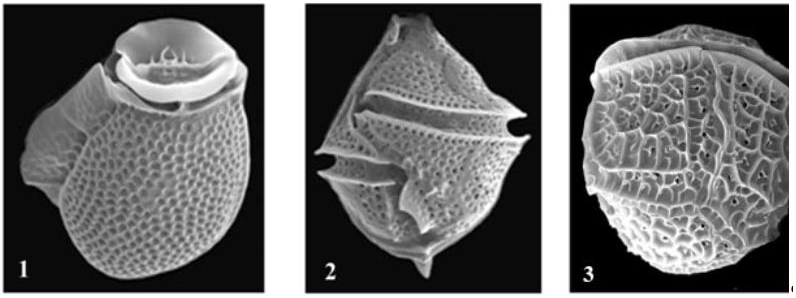
Keywords: Black Sea, SEM, toxic dinoflagellates, micromorphology, species composition

Abstract

The environmental and human health problems arising in connection with Dinoflagellata species proliferation attract the attention of ecologists, toxicologists, physicians and taxonomists in many countries. The toxicity of certain species is so strong that even when they are in low concentrations in water, the wind blowing from the sea and containing droplets with Dinoflagellata species cells may cause irritation of the upper respiratory tract and various allergies [1]. It is well-known that the use of light microscopy for Dinoflagellata species identification is not always enough. In order to improve the accuracy of species identification first scanning electron-microscopic study of Black Sea toxic Dinoflagellata species from the Bay of Sevastopol was conducted in 2010 – 2013. Some of the results achieved are presented in this paper.



Common Black Sea toxic Dinoflagellata species - Scanning Electron Microscope images: 1- Dinophysis fortii Paulsen; 2- Gonyaulax spinifera (Clap. et J. Lachm.) Diesing; 3- Protoceratium reticulatum (Clap. et J. Lachm.) Bütschli. D. fortii produces okadaic acid, dinophysistoxin-2, dinophysistoxin-1 [2], G. spinifera and Protoceratium reticulatum - yessotoxins [2].

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Phytobenthos - Key Biological Element in the Shallow Marine Waters

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Keywords: macroalgae, Black Sea, indicators, water bodies, ecological index, water quality

Abstract

The present paper describes the situation of the macroalgal flora in the period 2009-2012 along the Romanian Black Sea coast, both qualitatively and quantitatively. Key species (*Cystoseira barbata* and *Zostera noltii*) are presented and their role for the communities in the marine shallow waters is highlighted. Also the pressures that negatively affected the development of macroalgal flora over the years, leading to decline (in some cases irreversible) of some species are described. In order to answer to the requirements of the Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD), the biological element macroalgae is used and specific indicators that characterize the ecology of water bodies identified in the Romanian Black Sea were applied.

Plankton Indicators - a Concept for GES Assessment for MSFD Implementation in the Black Sea

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Keywords: phytoplankton, zooplankton, GES indicators, MSFD, Black Sea

Abstract

Among the main challenges in the implementation of WFD and MSFD is the growing demand for robust and reliable methodological approaches to take into account the complexity of multifactor drivers/pressures interactions and plankton responses that are likely non-linear, species and region specific and time dependant.

The study presents a classification system proposed for GES assessment of Black Sea water column habitats. The approach integrates the following steps: 1) water column habitats identification 2) selection of relevant metrics 3) a concept of setting baseline conditions and 4) setting threshold/limits of plankton community traits. The proposed indicators are conceived to capture different aspects of plankton reaction to the marine environment conditions: a) quantitative indicators (abundance and biomass), b) nonparametric biodiversity indices (Menhinick (1964), Sheldon (1969) and Shannon – Weaver (1968)) and c) taxonomic based indicators (C strategy phytoplankton species as a proportion of the total abundance of Dinoflagellates; the sum of the abundance of microflagellates + Euglenophyceae + Cyanophyceae as a % from the total abundance of the phytoplankton community, Diatoms/Dinoflagellates spring biomass ratio; proportion of Copepods and *Noctiluca scintillans* to mesozooplankton biomass, biomass of the invasive ctenophore species *Mnemiopsis leidyi*, non-indigenous/native species ratio, phyto/zooplankton biomass ratio etc). A long-term data set (1954-2010) and different statistical approaches were employed for setting baseline conditions and suggesting thresholds values for the corresponding indicators.

The system was applied for assessment of the Bulgarian Black Sea water habitats recent (2006-2011) ecological state (Galata transect as a test polygon). The results suggest that only some indicators were above GES thresholds, even if the trends were positive. The challenges for the validation of the classification system are also presented and discussed.

Live Agglutinated Foraminifera from Surface Sediments of Sinop Coasts (Southern Black Sea, Turkey)

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Keywords: agglutinated foraminifera, benthos, ecology, taxonomy, Black Sea

Abstract

Agglutinated foraminifera have been generally adapted to brackish water and marine environments from freshwater habitats. The periodic or incidental changes in salinity of these habitats may cause significant alterations in abundance and species diversity of agglutinated foraminiferal assemblages of the area which is of particular interest for the Black Sea. In this study, we investigated live (Rose-Bengal stained) agglutinated foraminifera collected from 3 and 10 m at eight stations from Sinop Bay. Sampling was held monthly between August 2009 and July 2010. Thirty two tube core samples were collected including three replicates via Scuba diving using metal corers with a mouth area of 12.56 cm^2. Agglutinated foraminiferal fauna of Sinop Bay was found to have a low diversity. As a result of the study, a total of 5 agglutinated foraminifera species were identified belonging to 5 genera, 5 families and 4 orders. The dominant agglutinated foraminifera species recorded in the region were *Trochammina inflata* (Montagu, 1808), *Eggerella scabra*

(Williamson, 1858), *Ammoscalaria* sp., *Haplophragmoides* sp. and *Reophax* sp. As to the quantitative analysis in terms of mean abundance values *Eggerella scabra* (36%) was found to be the most dominant species with an abundance value of 3184 indiv./m^2 followed by *Trochammina inflata* (27%) with 2388 indiv./m^2, *Reophax* sp. (18%) with 1592 indiv./m^2, *Ammoscalaria* sp. (9%) with 796 indiv./m^2 and *Haplophragmoides* sp. (9%) with 796 indiv./m^2. BIO-ENV (Primer V.5) analysis revealed that salinity was the influencing factor for the distribution of agglutinated foraminifera species along Sinop coasts. This work has been financially supported by TUBITAK (The Scientific and Technological Research Council of Turkey) and NASU (National Academy of Sciences of Ukraine) (Project number: 108Y340, coordinated by M. Sezgin).

Biodiversity Monitoring in Turkey Using GIS

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Keywords: Biodiversity, protected area, habitat, geographic database, monitoring

Abstract

Turkey is the biodiversity richest country in the Black Sea Basin. However, works on determination and register of flora and fauna species in Turkey is quite new. Because of the importance of this specialty of Turkey, the Noah's Ark Biodiversity Database was developed by the Biodiversity Monitoring Unit. The database is based on internet, open for the public use, accessible by the members with special limited rights and directed to the monitoring of biodiversity. Inquiries can be made in the data base particularly on "species, "habitats" and "areas". Unlimited number of biodiversity data can be entered in the data base. Biodiversity data in the system can be filtered from the area and region, habitat type or protected areas demanded to be examined. Species pin maps can be reached and variations of red list statutes

of species can be monitored in due course. Variations of all the species populations of the country taking place in the data base and variations of protected areas in due time can be monitored. The data base is the largest (500.000 biodiversity data line) and only gov. extended data base where the data regarding the biodiversity of our country have been gathered together, monitored and inquired. Thus, Turkey with quite rich plant and animal species resources will provide sustainability of biodiversity by providing the required decision support mechanism for the environmental protection and area management which is the rising value in globalization process. Single handed implementation and correct realization of the management decisions regarding the natural resources in due time and acceleration of environmental conservation and monitoring activities will be provided with this database.

The Present Status of Phytoplankton in the North Eastern Black Sea

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Abstract

Serious changes have taken place in the present-day phytoplankton in the North East Black Sea since seventies and eighties of the last century. These changed comprise: 1- the change of annual phytoplankton cycle; 2 - the changes in the leading complex of species.

For example, since 2002 till 2012 spring and autumn diatom blooms were registered only in 2007-2009. The centric diatom *Proboscia alata* was the main blooming species (up to 3,0 x 10^5 cells/l, 3,5 g/m^3). At the same time the role of coccolythophore *Emiliania huxleyi* has strengthened, its bloom (more than 1,0 x 10^6 cells/l) is observed now in any season. This alga reaches the maximum growth in the end of May – beginning of June both in the coastal waters and in the deep sea (up to 8-9,0 x 10^6 cells/l, May-June 2012). The role of dinoflagellates remains insignificant, the outbursts of their mass development were fixed in 2008 only (*Scrippsiella trochoidea, Heterocapsa triquetra* – up to 1,0 x 10^5 cells/l, March-April; *P. cordatum* – up to 1, 3 x 10^5 cells /l, July). The summer maximum of diatom *Pseudosolenia calcar-avis* (up to 1,0 x 10^5 cells/l, 3, 0 g/m^3) is observed annually in the open sea.

So, in the North East Black Sea in present-day period the main changes of phytoplankton structure take place in the "diatoms- coccolithophores" system. The main regulation mechanism in this system is a concentration of nutrient – N and P, stoichiometrical rations of these concentrations and the rate of N and P input in the upper production layer. For the first time it was proved experimentally that phosphorus is the main factor, limiting coccolithophores growth in the North East Black Sea. The strengthening of coccolithophores role is connected with a tendency of phosphates concentration increase. The low N/P ratio is a prerequisite for the beginning of bloom in any season. The diatoms bloom takes place not only after cold winters but after warm winters too. The increase of nitrogen and phosphorus at high N/P ratio is stimulating factor for diatom bloom. The primary growth of this or that diatom dominant is determined by its typical stechiometrical N/P ration.

Phytoplankton Winter Bloom in the Black and Caspian Seas

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Abstract

According to the Sverdrup theory open sea phytoplankton bloom begins when the depth of mixing exceeds the critical depth.

However, there are examples when this rule does not hold. Our researches in central parts of the Black and Caspian Seas identified winter phytoplankton bloom at the depth of convective mixing from 40 to 100 m.

For example, in central part of the Black sea in the end of December – beginning of January 2006-2011 at 8-9°C water temperature in the upper mixed layer and the depth of convective mixing reaching 40m, the winter bloom of coccolithophoride *Emiliania huxleyi* was observed in the eastern part of the sea ($1,5\text{-}2.5 \cdot 10^6$ cell/l) and at the same time mass growth of diatom *Proboscia alata* was observed in the western part (up to $3,0 \cdot 10^5$ cell/l, 2,0 g/m^3). The bloom was distributed evenly in the upper 40-meter water layer, the dominant growth of *P.alata* correlated with increased nitrates concentration. In the central part of the Caspian Sea in February 2008 at the temperature in the upper mixed layer of 10-11°C and the depth of convective mixing up to 100 m the bloom of diatom *Cerataulina pelagica* (up to 8,0 g/m3). The main phytoplankton biomass was concentrated in the upper 50-m water layer, at 50-100 m depth the abundance of *C.pelagica* decreased on two occasions.

This evidence can change our views on the phytoplankton bloom formation mechanisms.

Distribution and Abundance of Cetaceans in the Romanian Marine Area

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Keywords: Black Sea, Phocoena phocoena, Tursiops truncatus, Delphinus delphis, distribution, abundance, habitat, etc.

Abstract

This paper is mainly a summary of data on the distribution and abundance of the three species of cetaceans in the 2001 - 2004 periods, particularly in the form of distribution maps.

For each species such data are given:

- Biological characterization of the species;
- Observations on the distribution and abundance;
- Occasional habitats of minor and major importance;
- Critical habitats;
- Disturbing factors;
- Population trends;
- Recommendations for their protection

Pelagic Communities of Seaports and Resort Cities of the Northeastern of the Black Sea (Russian Sector)

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Keywords: phyto-, zoo-, ichthyoplankton, Novorossiysk, Tuapse, Gelendzhik, Anapa, Sochi

Abstract

Positive changes in zooplankton testify to stabilization of the port ecosystem at a higher production level than in the 1990s. The present state of pelagic communities is characterized by a weaker pressure of the predatory comb jelly *Mnemiopsis leidyi* and heterotrophic sea sparkle *Noctiluca scintillans*, and increase in the abundance of net holoplankton, meroplankton and ichthyoplankton. Since 2002, in the Novorossiysk Bay, the abundance of holoplankton have been gradually restored to the level of the 1960s and 1970s, and spawning populations of pelagophilic fish have increased to the level of the 1980s. The autumn maximum of holoplankton biomass, which was not documented in the 1990s, was observed during the peak of *M. leidyi* development (0.4–0.8 g/m^3 in the port aquatic area and 1.8–2.0 g/m^3 in the open part). In summer and autumn, a multifold increase in the density of the rare oligotrophic forms of Copepoda and Cladocera *Paracalanus parvus*, *Centropages ponticus*, *Pseudevadne tergestina, Evadne spinifera* and the common Black sea species *Pleopis polyphemoides*, *Acartia*, sagittae and appendicularia was recorded. In 2010, a previously unknown autumn peak of abundance (30 000 specimens/m^3) of cyclopoid copepods *Oithona davisae* Ferrari et Orsi (syn. *O. brevicornis* f. *minor* Nishida et al.), which were introduced into the bay via ballast waters of commercial ships, was recorded. Similar processes took place in the more polluted port of Tuapse, but the rate of their development was twice as low.

Expressed summer and autumn maxima of the abundance of holoplankton were as well recorded in areas resort cities. In 2010, which was the warmest during the last years, unusual autumn burst of development of *O. davisae*, is revealed in

Gelendzhik and Anapa bays. A multifold increase in the density of the rare oligotrophic forms of Copepoda *P. parvus, C. ponticus,* common Black sea species *Acartia clausi* was noted in the Sochi port in November 2012 at temperature 20°C (54 000 specimens/m^3).

Such deep changes in the pelagial could happen under the effect of climatic features of the past years (positive anomalies of water temperature) and introduction of the comb jelly Beroe ovata into the Black Sea which controls the biomass of the zooplanktophage M. leidyi. Long-term changes in zooplankton biomass were accompanied by the decrease in abundance and biomass of phytoplankton (up to 2–5 times) and its structural reorganization, i.e. reduction of the development of dinophyte algae (to 20% by biomass) and simultaneous increase in the abundance of diatom algae (70% by biomass) and outside the bays the increase in the abundance of coccolithophorids (34% by abundance). Probably, it was caused by their high consumption by zooplankton, long-term changes of climatic conditions and the decrease in water eutrophication. High numerical density of ichthyoplankton and increase of pelagic eggs of rare species of fishes Ctenolabrus rupestris Sciena umbra, Arnoglossus kessleri, Serranus scriba, Liza saliens, suggest the improving condition of coastal waters of northeastern shelf of the Black Sea. At the background of changes of hydrobionts environment, favorable conditions were created for introduction and spreading of alien hydrobionts via ballast waters of commercial ships. A total of 67 introduced species were recorded in coastal waters of the northeastern shelf of the Black Sea (45 Copepoda, 2 Polychaeta, 5 Tintinnida, 6 Bacillariophyceae, 8 Dinophyceae, 1 Prymnesiophyceae). The largest number of alien species was recorded in the Novorossiysk Bay.

Research of the Black Sea Fungi's Fluorescence

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Keywords: Black Sea fungi, light-emission characteristics, mechanical and chemical stimulations

Abstract

Detection methods of micromycetes based on their own luminescence are used in veterinary, medicine, pharmacology, phytopathology and alimentary industries. We have investigated the light-emission characteristics of potentially pathogenic (opportunistic) and saprotroph fungi's complexes of the Black Sea for the first time. Opportunistic fungi have been isolated from soil and water samples taken in August 2011 in the Ukrainian sector of the Black Sea during the 70th cruise of the research vessel "Professor Vodyanitsky", and cellulose-decomposing fungi have been got from fragments of wood collected on the Odessa and Sevastopol region of the Black Sea coast. Monocultures of fungi virtually do not exist in nature, so researches of mycocomplexes (complex of fungi) are justified. In the first series of experiments eight opportunistic mycocomplexes, selected on the analytic nutrient medium (Czapek-Dox Agar), have been studied. Experiments have been carried out in the daytime, but in complete darkness. The Czapek-Dox medium also served as a control during the de-excitation. The fungi's luminescence has been activated by mechanical and chemical stimulation [1]. Mechanical stimulation has been conducted by rapid insertion of marine water into cuvette with the cultures. Fresh water and 96% ethanol have been used as chemicals. Mycocomplex consisting of *Alternaria alternata* (Fr.) Keissl. 1912, *Cyphellophora* sp. and *Hormographiella* sp. has had the most evident characteristics of the luminescence. Stimulation by the fresh water has caused the emission of energy $(2.24 \pm 0.11)\cdot10^8$ quantum·cm^2 and

duration up to 4.94 s, which is in 2 times longer than during the mechanical stimulation ($p<0.05$). Activation of fungi by ethanol has not caused a fluorescence effect.

During the second series of experiments we have studied the culture liquid (marine water with metabolic products of fungi) of 8 saprotroph mycocomplexes. A sterile mixture of salt and fresh water in a ratio of 1:1 has served as control. The rest of the experimental technique has remained unchanged. The complex of micromycetes *Corollospora maritima Werdermann* 1922*, Corollospora* sp*.* and *Cumulospora* sp. has differed by the most powerful light-emission. Stimulation of the culture liquid by fresh water has caused a bright flash $(3.44 \pm 0.17)\cdot10^8$ quantum·cm^{-2}, with duration 4.57 ± 0.22 s. Mechanical stimulation has caused the less intensity of luminescence $(1.77 \pm 0.08)\cdot10^8$ quantum·cm^{-2} with the same duration of emission. Ethanol's exposure has determined light-emission with the four times lower brightness than the mechanical stimulation. Perhaps the fluorescent response of the studied mycocomplexes has been specified by their functional status and trophic specificity.

In the future, these studies will let not only to assess the contribution of the marine fungi into the bioluminescent potential of the oceans' different regions, but also to identify places of the potentially pathogenic fungi's accumulation. Fluorescent rapid method of the opportunistic micromycetes' detection will be demanded in the areas of mass recreation of the population, dolphinariums, aquariums, etc.

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Shallow Water Meiofaunal Dynamics at the Southern Black Sea

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Keywords: Benthos, meiofauna, abundance, biomass, Sinop, Turkey

Abstract

Due to difficult taxonomic identification, lack of taxonomists on meiofaunal taxa and high work load of the process, meiofauna was not a topic preferred to be studied by Turkish scientists up to now. However, the role of meiofauna in marine ecosystem, both in shallow and deep sea, have recently been realized in Turkey. The first detailed meiofaunal study was conducted in Turkey and an annual sampling was carried out at 2 depths (3 and 10 m) along Sinop coasts. The main goal of this study was to provide quantitative data on meiofaunal densities and determine their monthly stocks. Undisturbed samples were collected each month from August 2009 to July 2010 from 8 stations as three replicates. Additional sediment material was also taken for granulometric analyzes. Material was retrieved via Scuba diving with a cylindirical stainless steel coring tube (12.56 cm^2). Samples were fixed onboard with 75% ethanol. In the laboratory, samples were washed through sieves with mesh sizes 1 mm for the upper and 63 micron for the lower size limit. Material was stained with Rose Bengal solution and examined under a dissecting microscope using modified Bogorov chambers, counted, identified at higher taxonomic groups and stored in 2 ml cryo tubes including 75% ethanol. A considerable amount of data was obtained at the end of the laboratory process. Meiofaunal density ranged from $18x10^3$ to $935x10^3$ ind./m^2. Highest values were observed at station A2 in October 2009 and lowest at station D1 in July 2010. Mean meiofaunal density of stations displayed different patterns mostly depending on their grain size structure. In all samples, meiofauna were found to be dominated by Nematoda, Harpacticoida, hard shelled Foraminifera and Polychaeta. Percentage

values of these groups were analyzed on a monthly basis. Regarding the first six sampling months, percentage contribution of Nematoda was highest at stations B1, A1, and C1. Station B1 showed a nematode density of $362x10^3$ ind./m^2 in a total miobenthos density of $737x10^3$ ind./m^2. Harpacticoid copepods revealed significant contributions to stations C1, B1 and B2 with its highest amount ($129x10^3$ ind./m^2) at station C1, following Nematoda. Meiofaunal biomass values ranged between 294.9 to 20368.1 mg/m^2. The highest biomass value was recorded at St. C2 in November 2009 and the lowest at St. D1 in July 2010. As a conclusion, this work provides first comprehensive data about meiofauna of Turkish Black Sea giving a general overview on faunal abundance, biomass and dominance. Meiofaunal abundance displayed changes depending on stations and months. The results demonstrate that meiofaunal density and biomass fluctuates mainly under the influence of seasons, available food and granulometric size structure of the locations.

Ecological Quality Assessment of Coastal Waters Using Zoobenthic Communities: A Case Study from Sinop Bay of the Black Sea, Turkey

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Keywords: Ecological quality, biotic index, zoobenthos, Black Sea, Sinop

Abstract

Environmental parameters can significantly influence the diversity, density and structure of ecosystems and their communities. The significance of the use of

indicators to detect and monitor environmental conditions put forwarded by the Water Framework Directive (WFD, Directive 2000/60/EC). In the present study, an analysis of data on the abundance and diversity of macro-zoobenthic organisms from the Black Sea was used to specify the ecological quality status of Sinop Bay. Zoobenthic communities were studied at different 8 coastal stations (3 and 10 meters) of Sinop Bay during 2009-2010. Samples were collected from soft substrates by SCUBA divers using quadrat. Shannon-*Wiener*, AMBI, M-AMBI and BENTIX indexes were performed for the zoobenthic data. M-AMBI was the most efficient index as it demonstrated conceivable results. When overall ecological quality status of Sinop Bay was discussed the region has generally good and moderate

Conditions for the Establishment of an Invasive Phytoplankton Species: Physiological and Ecological Parameters

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Abstract

In our work the data of ten years' observation over phytoplankton structure in northeast part of the Black Sea were used. A mathematical model of phytoplankton dynamics as function of concentration of nutrient and water exchange rate in the

upper mixed layer was also applied. Kinetic parameters for species were estimated in laboratory experiments using nitrogen and phosphorus additives to natural phytoplankton populations.

It is shown that during different seasons there are certain criteria for the establishment of an invasion species in an ecosystem. During the spring period the species with the maximum rate of nitrogen and phosphorus uptake and the maximum growth rate are selected. During the late spring and early summer, species with low half-saturation constants for nutrient uptake have a chance to become established. In summer and autumn the ratio of the maximum and minimum cell quotas of growth-limiting nutrient becomes a selection criterion.

The nature itself put an experiment on introduction of an invasion species in ecosystem. At the end of spring - the beginning of summer 2005 and 2006 in northeast part of the Black Sea during the coccolythophores *Emiliania huxleyi* bloom new for the Black Sea– small-cellular diatoms *Chaetoceros throndsenii* and *Chaetoceros minimus* were recorded. These species had mass development in these years, however in the next years they were not found. The assessment of kinetic parameters of these species and also of the coccolythophore *E. huxleyi* was carried out in lab. By means of mathematical modeling it is shown that the nitrogen to phosphorus concentration ratio (N/P) is the powerful regulator of phytoplankton structure and of possibility the of invasive species establishment in the ecosystem. The role of *C. throndsenii* amplifies at N/P <4, and *C. minimus* at N/P <1. However, to become a dominating form these conditions are necessary within one hundred days for *C. minimus* . In practice these events are improbable and therefore this species has no opportunity to become dominating in the Black Sea phytoplankton. *C. throndsenii* can coexist with a coccolythophore only in very narrow limits of nitrogen to phosphorus ratio with a water exchange in the upper mixed layer not exceeding 10% per day. *C. minimus* can exist for a long time only in bays or lagoons with rather high continuous loading of phosphorus where it is usually established in the Mediterranean Sea.

The Alien Bivalve Anadara kagoshimensis in the Black Sea Region: Genetic Analysis

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Abstract

Since the XX century, biological invasions became one of the most important components of biosphere evolution. The blood arc *Anadara kagoshimensis* is one of the examples of successful invasive species in the Mediterranean region. This invader was found for the first time in 1969 in the Adriatic sea. Since 1980-th *A. kagoshimensis* is widely spread in the Black sea along the coast of Bulgaria, Romania, Ukraine, Russia, Georgia and Turkey, in some areas completely displacing native species. Specimens have been identified by various authors as *A. inaequivalvis*, *Scapharca inaequivalvis*, *Cunearca cornea*, etc. However experts had doubts about the identity of Mediterranean and Black sea specimens to the taxa listed above. Later, Huber [1] assigned Mediterranean samples of *A. inaequivalvis* and *A.cornea* as representatives of pacific species *A. kagoshimensis*. Yet the question of the species identity of the Black Sea and the Mediterranean alien arc clam and their origin is still not fully resolved. Previous researches were based on morphological data analysis mainly. Molecular genetic approaches and extensive databases could help to resolve this issue. Our aim was to investigate the current information considering the genetics of *A. kagoshimensis* from Mediterranean and Black sea. We analyzed the GeneBank (http://www.ncbi.nlm.nih.gov) database for existing records of nucleotide sequences of Mediterranean and Black sea specimens named *A. inaequivalvis* etc. Moreover we sequenced the the ITS1, H3 (histon 3) and 28S genes of 2 *Anadara* specimens from Black sea and 2 from Yantzy estuary. We compared all sequences with existing GeneBank and BOLD (http://www.boldsystems.org) entries using BLAST and Codon Code Aligner (v.

4.1.1, Codon Code Corporation). Analysis of the GeneBank entries showed that it contains nine records related to *Anadara inaequivalvis* and synonyms from Mediterranean region, including nucleotide sequences of the genes: hemoglobin A (3), B (3), HBI homodimeric hemoglobin (1), metallothionein (1), the 2*nd* internal transcribed spacer (ITS2) of nuclear ribosomal DNA (1). Comparison of the listed above loci showed that the most closely related taxa to the Mediterranean species are *Anadara kagoshimensis* (including synonims: *Anadara sativa*, *Scapharca subcrenata*, *Anadara kagoshimensis*) and *Anadara broughtonii* (=*Scapharca broughtonii*). The first species is slightly more similar to mediterannean *Anadara* (98 % similarity in ITS2, Hem A, B) then the second one (97%) in all loci except HBI homodimeric hemoglobin (98 % sim. *A. broughtonii*, 95% *A. kagoshimens*). However, for many reasons these loci are not suitable for such study. So we analyzed ITS1, H3 and 28S loci of the Black sea specimens of invasive *Anadara*. The ITS1 as ITS 2 showed that the most similar species is *A. kagoshimens* (98%). The 28S loci showed 100% similarity between Black sea and Yantzy estueary specimens and 100% similarity of them to *A. kagoshimensis* from China and South Korea. But this locus is very stable and shows low variation in Arcids. In contrary, H3 showed an average level of variability. Black Sea specimens were slightly different from Yantzy ones (1 substitution) with to variants (C/T and T instead of G in position 105). One of Black sea specimens was 100% similar to *A. kagoshimensis* isolate 2 (JN974603). The other one was different in that position from all entries. Therefore Black sea *Anadara* most closely related to Chinese *A. kagoshimensis.*

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BLUEFISH *Pomatomus Saltatrix* (L., 1766) AND HORSE MACKEREL *Trachurus Mediteraneus Ponticus* Aleev, 1956 DIET IN THE ZMIINYI ISLAND COASTAL WATERS

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Keywords: Zmiinyi Island, ichthyofauna, diet, pelagic fish

Abstract

The Zmiinyi Island coastal waters are among the Black Sea areas of the highest fish capacity. According to the results of our studies of the past decade, the Zmiinyi Island area is one of the main spawning and feeding areas for sprats, anchovy, silverside and gobies that, in their turn, attract a lot of predatory pelagic fish, such as, for example, bluefish and horse mackerel [1, 2]. The aim of this work was to study the peculiarities of bluefish *Pomatomus saltatrix* and horse mackerel *Trachurus mediteraneus ponticus* diet in the Zmiinyi Island coastal waters. Material was collected in 2003 and 2012. Fish were caught using hook and line gear. Complete biological analyses of the fish caught have been carried out using standard ichthyological practices. Digestive tracts of the fish were preserved using 4% formaldehyde for further studies. Altogether, 102 bluefishes and 45 horse mackerels have been analysed.

The diet of bluefish comprised organisms belonging to 7 taxa. The Relative Importance Index of prey items (RII) sizes for horse mackerel shows that its main diet comprised fish (see the Table).

Prey Items	Bluefish		Horse Mackerel	
	2003	2012	2003	2012
Amphipoda	-	-	1.4	1.9
Isopoda	-	-	1.2	2.7
P. elegans	11.1	-	245.4	28.9
En. encrasicholus	260.2	1024.7	450.6	752.4
S. sprattus phalericus	-	120.5	153.3	247.4
M. merlangus euxinus	78.4	189.2	58.1	-
Atherina pontica	-	36.6	79.5	52.3
T. mediteraneus ponticus	-	85.1	-	-
Total number of individuals	15	30	34	78

Table. RII sizes (%) of prey items of bluefish and horse mackerel in the Zmiinyi Island coastal waters in 2003 and 2012

Bluefish diet in the Zmiinyi Island coastal waters included 6 taxa (see the Table).

Fish is the most significant food. Sizes of Food Similarity Index (70.4%) and Species Similarity Index (62,5%) of bluefish and horse mackerel prey items have been quite high, which shows similarity of both studied species' diets.

Acknowledgements

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Microalgae of the Sandy Substrates in the North-Western Part of the Black Sea

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Keywords: microalgae, sand substrate, phytomezopsammon, Black Sea, coast

Abstract

The investigation of microalgae of sand in the Black Sea region has been conducted in the end of 1980-ies, when the concept of *phytomesopsammon*, which means a group of microalgae that dwell between sand particles, was proposed and up to 88 species of diatoms were described from the habitat [1]. Further, these data were added by works on biodiversity of psammon microphytes from the Odessa Bay and Tiligul Liman, influence of environmental factors, as well as the experimental data [2].

The aim of this paper is to show season variation of species composition and abundance of phytomesopsammon in different regions of the North-western part of the Black Sea (NWBS). Samples were collected on the distance of 0, 3, 5 and 15 m from the splash zone in different seasons 2005-2012 in Odessa and Yagorlik Bays, Budakskaya, Karolino-Bugazskaya and Kinburnskaya sand-spits. Microalgae were taken from the surface layer (2 cm). After filtration from sand and mud samples were prepared and cleaned by standard techniques.

Microalgae of phytomesopsammon consisted of 6 groups: Bacillariophyta, Dinophyta, Cyanophyta, Chlorophyta, Cryptophyta, Euglenophyta and Chrysophyta.

Our studies confirm the presence of blooming sands in Kinburnskaya, Karolino-Bugazskaya and Budakskaya sand-spits. Microalgae developed in mass in the 2 cm surface layer of sand. Humidity and sand color varies depending on the distance from the water edge. In the splash zone (hydropsammon) sand is usually colorless with low abundance of algae because of wave action. This zone is characterized by benthic and less plankton species of diatom algae, for example, *Halamphora coffeaeformis* (Agardh) Levkov, *Attheya decora* T. West, *Navicula cancellata* Donkin,

Planotidium delicatulum (Kutzing) Round & Bukhtiyarova, *Nitzschia microcephala* Grunow.

At a distance of 2-3 m above the splash zone (hygropsammon) sand is slightly moistened. The sand is green on the surface because of Cyanophyta and Chlorophyta development. At a depth of 2-3 mm sand is brown, because of Bacillariophyta: *Navicula salinarum* var. *salinarum* Grunow, *Navicula pontica* (Mereschk.) Witkowski, Kulikovskiy, Nevrova & Lange-Bert. comb. & stat. nov., *Opephora marina* (Gregory) Petit, *Navicula cancellata*. In eupsammon (dry sand on the surface) at a distance of 5 m or more, the algal community is formed by representatives of *Rhopalodia, Cymbella, Surirella, Amphora*.

In Odessa Bay no blooming sands were observed. In all seasons Dinophyta and Bacillariophyta were the most abundant group: *Prorocentrum cordatum* (Ostenfeld) Dodge, *Navicula salinarum* var. *salinarum*, *Attheya decora*, *Navicula pontica*, *Nitzschia hybrida.* High number of small representatives of genus *Navicula* and flagellates were also observed in mass.

Abundance of microalgae of psammon depends on humidity of sand, wave activity, sand grains composition, temperature, salinity and ranges from $5{,}0 \cdot 10^3$ (in Odessa Bay) up to $6{,}5 \cdot 10^6$ cells/cm^2 (in Kinburnskaya sand-spit). Thus, phytomesopsammon in north-western part of the Black Sea coast is characterized by a rich species composition and represents a separate ecological group.

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Trophic Role of the Microzooplankton, its Impact on Phytoplankton and the Blooms in the Black Sea

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Keywords: Black Sea, phytoplankton growth rate, microzooplankton grazing, chlorophyll-*a*, primary production

Abstract

For the first time in the Black Sea the seasonal and spatial variability of the microzooplankton grazing impact on phytoplankton was investigated. The experimental results were obtained in recent years in the coastal waters of the Black Sea near the Southern Crimea, and in four scientific expeditions conducted in the western part of the Black Sea on the research vessel "Professor Vodyanitsky" (2010 - 2011) and RV "Vladimir Parshin "(2005). About 200 day experiments were performed. The data allowed us to evaluate the influence of microzooplankton on the formation of phytoplankton blooms in the Black Sea, and to assess its role in the transformation of organic matter and energy from phytoplankton to higher trophic levels. It is shown that the seasonal and spatial variability of the specific microzooplankton grazing rate of phytoplankton is due to the quantity and quality of needed microzooplankton food. The concentration of chlorophyll-*a* and phytoplankton biomass were indicators of the quantity of food, and the average size of phytoplankton cells and their taxonomy were used as the quality of food. The most suitable food for the supply of microzooplankton was small forms of diatoms, causing blooming.

It was found that the development of phytoplankton bloom was observed in cases where the ratio between microzooplankton grazing of algae and phytoplankton growth rate (g/μ) does not exceed 70 – 80%. In the final stages of bloom g/μ was > 100%, which is one of the main mechanisms to limit the process of bloom. In the coastal waters of the Black Sea the average annual removal of primary production

by microzooplankton was estimated as weighty as 65%. Such estimated values are indicated the key role of the microzooplankton in exporting matter and energy from phytoplankton to higher trophic levels.

Factors Influencing the Initiation of Spring Bloom of the Coccolithophorid *Emiliania Huxleyi* in the Black Sea

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Keywords: Black Sea, *Emiliania huxleyi* bloom, phytoplankton growth rate, microzooplankton grazing

Abstract

Studies were conducted in the Black Sea during the expedition R/V "Professor Vodyanitsky" in May 2013. The bloom of *E. huxleyi* was registered in most of the area: in the coastal areas of the western and eastern parts of the sea and in the western cyclonic gyre. Conditions were favorable for *E. huxleyi* bloom during the investigations. The thickness of the upper mixed layer was about 10 m, the surface water temperature was about 20 ºC, salinity reached almost 18 ‰. The intensity of solar radiation (PAR) reached with the average of 44 E· m $^{-2}$· day $^{-1}$. High concentrations of nutrients in the surface waters contributed to the growth of algae. The average nitrates were 0.63 mM, ammonium was 2 times higher. The average phosphates reached 0.28 mM and silica – 1.94 mM. The average ratio of NO3:PO4 was equal to 2.2. Against the background of low concentrations of chlorophyll *a* (0.10 mg/m^3) and low phytoplankton biomass (233mg/m3) share of this coccolithophorid was 78% of the total phytoplankton biomass. The abundance of this alga generally varied from 1.3 to 4.3 million cells/l (94% of the total

phytoplankton abundance). The specific growth rate of the total phytoplankton and coccolithophorid was practically the same and reached the average of 1.13 day^{-1}. This corresponds to the maximum values of the specific growth rate for this coccolithophorid. The specific rate of microzooplankton consumption of phytoplankton was equal to 31% of the specific growth rate of phytoplankton. The high growth rate of coccolithophorid and its weak microzooplankton grazing reflected the initial stage of *Emiliania huxleyi* bloom and the possibility of its further development. Only in the area of low salinity water (15.5 – 16.3 ‰), in the northwestern part of the sea *E. huxleyi* abundance decreased to 0.27 – 0.53 million cells/l, but the diatoms *Cerataulina pelagica* and *Cyclotella caspia* dominated in phytoplankton. In this area, the concentration of chlorophyll *a* increased to 0.33 – 1.10 mg/m^3, and the biomass of phytoplankton - up to 760 - 1300 mg/m^3.

A Preliminary Study on the Mollusc Fauna of İğneada Region (Black Sea, Turkey)

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Keywords: Mollusca, Western Black Sea, Turkey, systematic, ecology

Abstract

The studies on the mollusc fauna of the Turkish Black Sea coasts are scarce, [1, 2, 3, 4]. Igneada, which is located on the western Black Sea coast of Turkey, has a great importance being considered a pilot Marine Protected Area. In the present study, the community composition and spatial distribution of the mollusc fauna of Igneada region are examined. The material was sampled from 9 stations at depths 5, 10 and 20 m in November 2012 and May 2013, using standard van Veen grab. As a result of faunistic analyses, 52 mollusc species belonging to 39 genera and 22

families have been determined. The gastropods are dominant with 36 species within 4 subclasses, bivalves are represented by 16 species within 8 families and 2 subclasses. Among the gastropods, the dominant species are *Bittium reticulatum* (da Costa,1778), *Tricolia pullus pullus* (Linnaeus,1758), *Caecum trachea* (Montagu, 1803) and *Rissoa splendida* (Eichwald,1830), whereas *Chamelea gallina* (Linnaeus,1758)*, Mytilus galloprovincialis* (Lamarck, 1819) and *Mytilaster lineatus* (Gmelin, 1791) are the dominant bivalve species. The highest number of species and individuals occurred in spring.

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Attempt to Use the Nematode Diversity to Evaluate Ecological Quality Status: An Example for the Black Sea

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Keywords: free-living marine nematodes, Ecological Quality Status, maturity index, Sinop

Abstract

The European Water Framework Directive (WFD) proposed the Ecological Quality Status (EQS) to understand the quality of waters which include the biological communities. Several biotic indices were developed based on data of macrobenthic organisms such as Ambi, Benthix, Bopa etc. These indices have been utilized to classify any locality into five groups of ecological quality status. Macrobenthic invertebrate species have been considered as good indicators of pollution due to their sedentary and relatively long lives and their tolerance to stress. However meiofauna, and particularly nematodes, have advantages compared to macrofauna due to their high species richness and high abundances; however, the difficulty of nematode taxonomy limits the use of such group of organisms in ecological studies. On the other hand, the vast number of free-living marine nematodes encountered in small meiobenthic samples from almost all kind of habitats make them a suitable group to be used in environmental studies. Also the fact that they live in close contact with the sediment and spend their whole life as benthic organisms means the changes in environment are reflected in their faunal analysis. In a recent study [1] investigating the role of nematode assemblages in identifying ecological quality status in Mediterranean for the first time, several thresholds have been proposed for nematode indices. The suggestion has also been supported with the presence/absence of specific nematode genera indicating the five ECQ classes. Maturity Index (MI), colonizer-persister class percentage (c-p %) and Shannon Diversity Index (H') were concluded to give better results with genus level

calculations compared to the other widely used indices. The Maturity Index [2], a tool used for years to study the terrestrial and freshwater habitats to indicate the environmental quality based on the nematode community, is also applicable to marine and brackish water ecosystems [3]. Disturbed environments are represented by low MI values, and more stable environments are indicated by higher MI values. MI is calculated as the weighted average of the colonizer-persister (c-p) values which range from 1 to 5. The main purpose of this study is to apply the proposed thresholds on free-living marine nematode community structure of Sinop coasts determined in the scope of a project conducted in August 2009 – July 2010. The nematode index analyses are still in progress. The results will be discussed in an aspect whether they are comparable to those suggested for Mediterranean and this work will provide a baseline for the Black Sea to have an idea on use of nematodes in determination of ecological quality status.

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First Record of *Trefusia* and *Terschellingia distalamphida* (Nematoda) in the Black Sea: Abundant Species at the Oxic/Anoxic Interface

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Keywords: Nematoda, Trefusiidae, Linhomoidae, new record, Black Sea, Turkey

Abstract

Extreme habitats are the focus of several recent surveys in the world oceans and also in the Black Sea [1]. Nematoda is the most abundant taxon among meiobenthic organisms and have a potential to inhabit different environments on earth. They tend to better survive under low-oxgenated, even anoxic conditions compared to other meiobenthic taxa [2]. A survey targeting to better understand the oxic/anoxic interface off Sinop coasts in terms of several aspects [3] included meiofaunal analyses. The material was collected off Sinop Peninsula during the Black Sea Leg of the Expedition of *E/V Nautilus* (Ocean Exploration Trust) in August 2011. Three representative soft bottom locations were selected based on dissolved oxygen readings of the optode equipped on ROV: (1) oxic zone, 69.61 µM; (2) suboxic zone, 1.44 µM; (3) anoxic zone, 0 µM. Quantitative samples were obtained during three dives using plastic tube corers (surface area of 32.15 cm^2) pushed into the sediment by a remote operated vehicle. All sediment samples fixed onboard with 75% ethanol. For wet sieving, 63 µm mesh size was used as the lower limit. Nematodes were mounted in glycerin using slow evaporation method, examined under a Nikon 80i research microscope equipped with Nomarski optics and identified to possible taxon level. Taxonomic analyses revealed characteristic free-living marine nematode species one of which has been reported as a new species to science [4]. *Terschellingia distalamphida* was the most abundant linhomoeid species representing with 52 specimens in the oxic sample whereas only one

specimen found in the suboxic sample. Suboxic site differed in nematode composition and represented mostly by *Trefusia* aff*. longicaudata*. The present study aims to provide new geographical data for these species and to describe their morphological features. To our knowledge, this is the first record of the genus *Trefusia* (*Trefusia* aff. *longicaudata*) and of the species *T. distalamphida* in the Black Sea.

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The Position of an Invasive Crab *Rhithropanopeus harrisii* in the Food Web of the Taman Bay, Sea of Azov

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Keywords: stable isotope analysis (SIA), Invasive species, food web, Rhithropanopeus harrisii

Abstract

Harris mud crab (*Rhithropanopeus harrisii*) has been observed for the first time in the Black Sea in 1937 (the collection of the Zoological Institute of Russian Academy of Sciences) in the Dnieper and Bug estuaries. It is an alien species that has been possibly transported to the Black Sea as a hitchhiker on ships from Europe where it has been found for the first time in Netherlands in 1873-1876 [1]. It is currently found in the Sea of Azov, Taman Bay, in some isolated locations along the coasts and in river estuaries of the Black sea. It is well established and reaches the density of up to 120 specimens per 100 m. sq. in the Taman Bay.

Taman Bay is a partially closed shallow water ecosystem which is influenced by currents from the Black and Azov seas. This study aims to determine the position of *Rhithropanopeus harrissii* in the local food web. To explore food web structure, stable isotope analysis (SIA) of carbon and nitrogen has been applied to several dominating plant and animal species: reed (*Phragmites australis*), seagrass (*Zostera marina*), brown algae, mussel (*Mytilus galloprovincialis*), cockle (*Cerastoderma glaucum*), barnacle (*Balanus improvisus*), common prawn (*Palaemon adspersus*), gammarid amphipods and *Rhithropanapeus harrisii*. According to SIA results, the food web structure is determined by three main carbon sources: seagrass, phytoplankton and reed. *C. glaucum* collected in winter 2013 had $\delta^{13}C$ values very similar to those of reed, suggesting that this species was feeding mainly on reed detritus. On the other hand, the isotopic signature of *C. glaucum* collected in 2012

was more similar to that of mussels (which feed on phytoplankton). Carbon isotopic composition in soft tissues of *Rhithropanopeus harrisii* changes little among years and suggests that this species utilizes carbon produced both by reed and by *Zostera marina*, but not by phytoplankton. Relatively high $\delta^{15}N$ values indicate a high position of this species in the food web, and suggest largely predatory behaviour.

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The Heterocoagulation of Microorganisms and Mineral Colloids as a Model of Concentrating Biogenic Metals in Geochemical Barriers

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Keywords: Heavy metals, colloids, heterocoagulation, microorganisms, microalgae, geochemical barriers

Interaction of microorganisms with metals in soluble and colloidal state may lead to different consequences including selective aggregation of living cells and mineral nanoparticles. Selective aggregation titled as heterocoagulation [1] along with selective bio-absorption of metallic ions can be fatal for microorganisms [2]. At the same time, this phenomenon may play a significant role in the purification of water

media and result in concentration of selected elements in sediments. Therefore, investigation of the pattern of heterocoagulation is important in terms of understanding of metal migration and concentration in natural conditions as well as for development of water purification and metal-enrichment technologies and other practical applications. This paper summarizes key results obtained in this area.

Methods of microorganisms cultivation, preparation of heavy metals colloidal solutions, and registration of interaction of microbial cells and mineral colloids are described in details in [1-3].

Investigation of colloidal interaction processes running in the model systems comprising suspensions of selected species of one-cellular microorganisms (bacteria, cyanobacteria, microalgae and yeasts) and colloids of heavy metals resulted in following finding. Cells of some strains of bacteria and microalgae possess an ability to concentrate on their surface enormous amount of selected mineral particles including colloidal gold [1, 3]. Cells as well stimulate transition of the metals from colloidal to soluble (ionic) state. This process may cause toxic effect on the microorganism and result in the inhibition of the enzyme systems of energy transformation on cell membranes. Ca^{2+} and Mg^{2+} protect cells and neutralize harmful effect of ions Cu, Co, Ni but not Au. It was discovered that aggregation of the cells of some strains of bacteria (*Bacillus sp.*), cyanobacteria (*Spirulina platensis*) and algae (*Chlorella vulgaris*) with gold nanoparticles is energy-dependent and can be regulated by variation of light intensity (for photosynthetic microorganisms), application of specific metabolic inhibitors or content of water media (variation of pH and ionic force). Fragmentation of bacterial cells and testing of fractions obtained proved that plasma membranes are playing key role in the interaction with external media heavy metals in soluble and insoluble state. Proposed theoretical model [4] describes these processes taking into account electrosurface peculiarities of metabolizing cells and inert mineral particles.

Formation of the biomineral aggregates (cells and mineral particles) undermines stability of disperse system. Instability followed by bioaggregates sedimentation is increasing while ionic force of the solution is changing. Such conditions are observed at the geochemical barriers, first of all it is water front where the river meets the sea. Probably, heterocoagulation may contribute to the concentration of the elements at such geochemical barriers.

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Acoustic Facies on Side-Scan Sonar Data; Their Role in Determining the Spatial Distribution of Sediment Types

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Keywords: Black Sea, side-scan sonar, acoustic facies, seafloor sediments

Abstract

Sonar (sound, navigation and ranging) imagery can be used for visualizing seafloor objects and features, being a very useful tool for habitat mapping. The aim of the present paper is to emphasize the possibility of mapping the extent of seafloor sediments by taking in account their particular signature on side-scan sonograms. Previous side-scan surveys for habitat mapping were done recently by [1].

An IXSEA Elics 400-1250 towed side-scan sonar and AUVs equipped with Imagenex YellowFinn side-scan sonars were used for scanning SCI Natura 2000 sites on the Romanian Black Sea Coast. A Van Veen boden greifer was used for sediment sampling for ground-truthing, and grain size laser analyses were performed for determining the particular type of sediment.

The sonar survey of the protected areas offered mosaics depicting the acoustic images. A large number of acoustic facies were identified for various areas, most of them related to each other, belonging to a handful main types. After the scanning of the Natura 2000 sites, grab samples were taken and analyzed on laboratory for assessing the lithology of the seafloor. The QTC SWATHVIEW and QTC CLAMS software packages were used for automatic classifying the seabed according to backscatter intensity. We were able to distinguish between rocks and rocky seafloor, sand, sometimes easily to discern between coarse and fine grained, mud and mussel beds.

Based on the results from the QTC analysis and ground-truthing a clear correlation can be done between the acoustic and sedimentological facies. Taking in account the close relation between living benthic organisms and the lithological type of sediment [2], the acoustic mapping of the seabed is a valuable tool in assessing the extent and distribution of the benthic habitats.

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- **Fisheries and aquaculture, tourism, exploration and exploitation of non-living resources, oil and gas industry, alternative energy**
- **Marine industries and urban development**
- **Policy and management options for recovery of the Black Sea resources**

Global Popularization of E-Repositories in the Marine Informational Environment

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Keywords: marine data management, open access, e-repository, international projects, research institutions, library trends

Current trends in marine information management, implemented within the institution specialized in marine research, are studied. Participation in various international projects, which enable more digital materials from the institution to be

easily accessible and, the other way round, more external data to be fully retrieved, is thoroughly considered.

YugNIRO initiatives as the ASFA National Partner of Ukraine are presented in relation to the possibility of more Black Sea countries to join the ASFIS network (the leading information network coordinated by FAO) with regard to scientific data indexing. The data are provided by FAO Members and verified from other sources wherever possible. The reliability of the analysis based on the data, and the quality of the advice to which it gives rise, depends on the reliability and quality of the data itself. To this end the FAO seeks to continue supporting and strengthening national capacity in the collecting, analysis and use of accurate, reliable and timely data. In this respect the FAO has a unique role in supporting the management and development of the aquaculture and fishery sectors.

The main goals and targets on the e-repositories development and content are discussed. YugNIRO activities within the CEEMaR e-Repository are shown as the initiative for storage, conservation and global access of the institute's born-digital and made-digital collections. CEEMaR clearly meets the international requirements to the open access regulations. The data are uploaded voluntarily; the data acquisition is done for free. One of the further steps in the CEEMaR software development is going to be harvesting by the main marine e-repository, functioning on the DSpace platform – OceanDocs, which will be a step forward in the CEEMaR growing rating.

Creation of a Black Sea Network for Sustainable Tourism Development in Bulgaria, Romania, Ukraine, Moldova and Georgia (BS Tourism Net)

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Keywords: Black Sea; Network; Sustainable Tourism

ABSTRACT

The project will establish and operate a co-operative and self-supporting Black Sea Sustainable Tourism Network of leading municipalities within the Black Sea region, environmental and socio-economic NGO's, environmental associations, tourism organizations and universities involved in tourism development and policy. The network is a cross-border partnership with Ukraine, Bulgaria, Romania, Moldova and Georgia and will apply their combined resources for environmentally sustainable development of tourism within the Black Sea region. To make freely available and accessible tourism data & information, through an interactive internet-based Black Sea Tourism web-portal.

The creation of the Black Sea Sustainable Tourism network contributes to and develops joint tourism initiatives and activities taking into account national traditional products, by realizing:

- Exchange of knowledge, communication, discussions and activities on sustainable tourism within the Black Sea region between tourism information providers and the tourism industry through national information and feedback workshops.
- Tourism industry through national information and feedback workshops.
- Public understanding and public environmental and socio-economic awareness and knowledge regarding tourism activities within the Black Sea region through end-user consultations and the interactive web portal.

- Stimulating and promoting the sustainable tourism potential within Bulgaria, Romania, Ukraine, Moldova and Georgia as well as Europe for national, international and Black Sea regional tourism.

Evolving Characteristics and Potential Evapotranspiration in the Coastal Deltaic Area Sfantu Gheorghe

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Keywords: potential evapotranspiration, interannual variation, statistical estimation

Abstract

The process of evapotranspiration is important for coastal ecosystems. Energy balance and the amount of water evaporated influence regional and global water cycle and biogeochemical cycle and climate variability. Interannual variation in amplitude and dynamics, seasonal and annual potential evapotranspiration is related to climate variability. Under natural conditions, evapotranspiration flows

continuously throughout the year, representing a main link in the water cycle and an important factor affecting heat exchange ecosystems.

Potential evapotranspiration is the maximum amount of water likely to be produced by a soil evaporation and perspiration of plants in a climate. Real balance between the amount of precipitation fallen named *P* and the amount of water taken from the atmosphere as vapour, called potential evapotranspiration *PET* is of particular importance in characterizing climate, representing an expression of power absorption by the atmosphere and expressing quantity water on soil and vegetation that request [1,2]. Study objectives are investigating potential evapotranspiration characteristics of the researched area and determine a model interannual evolution. The area studied is placed in a dry climate where identified an increase in the potential evapotranspiration over 10 years [3]. The method of calculation used in determining potential evapotranspiration is based on monthly average climatic parameters air temperature, and the relationship is that of computing Thornthwaite. In determining a development model will be applied to a number of statistical estimation procedures and statistical hypothesis testing.

Coastal ecosystems are highly sensitive to climate change and vulnerable to increased air temperatures and reduced rainfall weather. It is therefore important to identify ecosystem responses to these changes.

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Identification of the Main Gaps in the Black Sea Monitoring Programmes in Romania, Bulgaria and Turkey

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Keywords: policy and legal framework, integrated monitoring, MSFD

Abstract

MISIS project (www.misisproject.eu) is an integral part of the overall ongoing process of harmonization of policies in the Black Sea region in the field of environment protection, taking into consideration relevant European acquis Major MISIS Project Activities were planned to address the Black Sea monitoring and data/information gaps, initially highlighted in the Diagnostic Report of the Black Sea Commission, taking on board the recommendations given in this Report.

Major MISIS review, the Diagnostic Report II, includes information collected by the MISIS partners on the policy/legal frameworks of monitoring, types of implemented monitoring, status of operational monitoring, parameters measured, monitoring networks available, data management specifics, progress in water/ecological quality/GES (good environmental status) classifications, research infrastructure/

equipment/vessels available, and on trainings and harmonization needs identified through consultation with stakeholders.

The Diagnostic Report II was designed to guide the revision of national monitoring programs and improvements in data reporting and of DPSIRR (drivers/pressures/state/impact, response/recovery) assessments in the MISIS beneficiary countries (Bulgaria (BG), Romania (RO) and Turkey (TR), as required by the EC MSFD, based on the review of information provided by many different stakeholders.

Among the major gaps outlined and recommendations formulated taking into consideration the requirements of the MSFD, the following conclusions were drawn in MISIS:

- Although BG, RO and TR have strong legal/policy and scientific foundations which could provide for the development of integrated monitoring/assessment programmes following the DPSIRR model, important regulations are missing; it is recommended to address the gaps in policy (i.e. monitoring NIS (non-native invasive species) and ship ballast water discharge in risk areas, control on the level of underwater noise, marine litter in the sea, etc.);
- In all beneficiary countries the insufficiency of funding leads to improper geographical coverage and missing mandatory parameters of the monitoring (such as cetacean surveys, marine litter, habitats and biodiversity change, etc.);
- The coordination between the organizations involved in monitoring/data collection in the beneficiary countries is in general poor. Thus, many institutions, weak integration of work and lack of systematic approach characterize the institutional framework of monitoring in BG, RO and TR.
- Drivers (human activities) are relatively well mapped in all beneficiary countries, but the accessibility of data/information, which is dispersed in many different organizations, is an issue. Networking and effective cooperation of institutions controlling pressures with those which deal with state and impacts assessments in the Black Sea is crucial;

- QA/QC in monitoring is well advanced in BG and RO; in TR QA/QC is either not receiving due attention in all institutions or the stakeholders insufficiently reflected their efforts;
- The data of different organizations are reported to various end-users, however, the bulk of them remains for internal use only;
- The lack of well-developed data bases is closely related to the poor provision of data products in the beneficiary countries; much improvement is required in the field of data exchange and integrated products generation;
- Various assessments are produced on a regular or irregular (projects) basis, however, except in Romania the reports stay unpublished and undistributed for wider and public use; the reports prepared by scientists are not qualified the same as the publications in journals with impact factor;
- The inventory of equipment available in the Laboratories of the beneficiary countries shows a high level of capability to manage the various samplings and analyses required by the MSFD, however, sharing of equipment needs to be developed so that to improve the use of capacities, especially in Bulgaria and Turkey;
- Advanced technologies for in situ observations and experiments should be paid more attention in order to fill in the gaps of scientific knowledge and understanding of the processes in the Black Sea in order to assist informed management options;
- Operational monitoring is not an integral part of the national Black Sea monitoring in BG, RO and TR, and this is a major gap which needs to be urgently addressed so that to optimize the MSFD-required monitoring programmes.

Institutional Comparison of the Black Sea and Helsinki Commissions – Impulses to Improve the Performance of the Black Sea Commission?

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Keywords: Black Sea Commission, Helsinki Commission, comparison, institutional structure, Advisory Groups, cross-sector work, policy orientation.

Abstract

Since 1992, the Bucharest Convention (BC) and its implementing body, the Black Sea Commission (BSC) seek to improve the deteriorated environmental situation of the Black Sea. In the Baltic Sea, a comparable regime exists already since 1974, in the form of the Helsinki Commission (HELCOM) and the Helsinki Convention (HC). During the last years, the BSC strengthened its position as a regional actor in the protection of the Black Sea. However, there is still considerable potential for further improvements. The author claims that a) improvements in the performance of the BSC can be achieved, among others, through optimizations in its structure and b) analysis of the historical development and present work of HELCOM can give valuable impulses for such reforms. In the present paper, some possible changes to the structure of the BSC and its Permanent Secretariat (PS) shall be discussed and examined, including:

- Reorganization of Advisory groups (AGs). Here, two options are thinkable. The first option would imply transformation of sectoral AGs into task forces/functional units and change in their focus from predominantly scientific work towards increased delivery of policy oriented results. Under the second option, a structural reform would be promoted, which enables the BSC to concentrate more on its policy-making and coordinating functions and outsource scientific expertise and organizational matters (preparation of trainings, meetings etc.) to AGs and independent bodies. In both cases, the work of AGs should become more output-oriented.

- Decision on the functions and reasonability of existence of Activity Centers (ACs). Most of them either never started functioning or suspended their activities with the termination of international funding. If it is decided to maintain the ACs, their whole concept and place/status within the institutional structure of the BSC should receive a thorough revision.
- Introduction of a central instrument, which enables the BSC to address specific topics under the Bucharest Convention and the Black Sea Strategic Action Plan in a comparable way, similar to the instrument of "Recommendations" at HELCOM.
- Extension of Commission chairmanship term from one year to two years. This could improve continuity and provide incentives for Contracting Parties to plan more long-term actions in course of their Chairmanship.
- An enhanced orientation towards mechanisms of public and stakeholder involvement, to establish the Permanent Secretariat as a central platform for exchange of information, expertise and networking in the field of environmental protection of the Black Sea.
- Moving away from the sectoral character of its work towards a more holistic approach. Such an approach should emphasize interdependencies between various sectors and particularly also the socio-economic impacts of pollution.
- Developing new models of financing to support the work of the BSC.

The paper is part of the wider ongoing PhD project conducted by the author. It is based on a literature review, an evaluation of results from relevant projects and interviews with the BSC, HELCOM and other stakeholders. As for theoretical framework, multilevel governance, global environmental governance and certain forms of institutionalism are considered.

Environmental Security in the Azov Sea Basin

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Keywords: Azov Sea, Don River, Ecosystem goods and services, Watershed, Cossacks, IWRM

Abstract

The Sea of Azov provides a perfect case study to consider environmental security issues from various perspectives. It has strategic importance for both basin countries (Russia and Ukraine) which depend on its ecosystem resources. Once one of the most productive seas in the world, it is now exposed to scarcity in water and aquatic resources. Some ecosystem services and goods are prioritized, while other needs are neglected. It is also increasingly high on the international political agenda, as the gateway to the landlocked and mineral-rich Caspian countries. Existing serious threats to both humans and ecosystems will be amplified by implementation of regional development plans (e.g. construction of new Azov Caspian shipping canal "Eurasia" and increase in transport intensity). Environmental and economic hardships could trigger political instability in the area inhabited by reviving paramilitary Cossack communities. In this context, there is a need for integrated interdisciplinary analysis of the basin's environmental security.

Analysis of these issues was given a major boost by the establishment in 2009 of the Azov Center for Watershed Cooperation (http://azovcenter.ru), which aims at studying the Azov's problems and contributing to environmental security (ES) threat mitigation. Based on the broad ES definition the Center's activities are diverse. One of the important areas is an education and training program targeting water stakeholders and decision makers in the Azov region. The Center works on a number of other national and international projects aimed at assessing and mitigating the regional ES threats. For instance, the project on modeling of the Upper Don River watershed has been successfully completed to assess the possible changes in the Tsimlyansk reservoir water level and to forecast associated changes in ecosystem goods and services provision. The project was carried out in

cooperation with the Central European University within the framework of ENVIROGRIDS project (http://envirogrids.org).

As a result of these activities the serious threats to environmental security in the Sea of Azov and its basin were identified. The unsustainable pattern of resource use has already caused a collapse of the regional fishery, which had been a significant sector within the basin economies and an important component of national food security. The consequent unemployment and other negative effects have contributed to socioeconomic and political instability in the region as well as heightening international tensions. Existing regional development plans aim at giving priority to further utilization of the strategic location of the Azov Sea through development of the transportation network and the construction of new Azov-Caspian shipping canals and dams to support navigation. Additional water abstraction from the Azov basin will undermine ecosystem resilience and stability, diminishing the role of other ecosystem services. Further ecosystem changes coupled with population growth, economic development and likely climate change effects will amplify the present threats to environmental security. Causing unavoidable biodiversity loss and significantly undermining national food security, the existing development plans will trigger other threats to security such as clean water deficit, disease outbreaks, interruptions in agricultural and industrial processes, and higher pollution concentration. Special concern is connected to ageing equipment and the expiring operation time of numerous hydraulic facilities in the region.

The paper aims at reviewing existing ecosystem services provided by the Azov ecosystem, historical paths and future challenges in their sustainable.

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20th Anniversary of the Bucharest Convention: Legal Gaps, Current Trends and Future Challenges

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Keywords: Bucharest Convention and Protocols, legal amendments to the text, procedures, EIA, climate changes, marine litter, marine noise, accession of non-riparian states and organizations, internal rules.

Abstract

In April, 2012 the Convention on the Protection of the Black Sea Against Pollution, also known as Bucharest Convention, celebrated its 20th Anniversary. There is no doubt that after the Bucharest Convention and its Protocols were signed by all the Black Sea riparian countries, these documents became the powerful instruments of International Environmental Law in the Black Sea Basin. Nowadays, the Bucharest Convention is one of the most known Regional Sea Conventions, establishing the legal ground for combating pollution from land-based sources and maritime transport, achieving sustainable management of marine living resources and pursuing sustainable human development in the Black Sea Region. The activities implemented so far by the relevant Convention' bodies allowed to significantly increase the public involvement, address transboundary environmental issues and to introduce the sound environmental decision-making related to the sustainable use of the Black Sea.

At the same time, given that the environmental science is being developed rapidly and after those twenty long years of the implementation of the Bucharest Convention's provisions, it is now obvious that some of the important issues related to the preservation of the precious Black Sea environment and sustainable management of its resources for different reasons had fallen out from the scope of the Bucharest Convention and its Protocols. Meanwhile some of the provisions face the need to be improved or reinforced. These issues relate to both, the subject of the Convention (*inter alia*, introduction of Environmental Impact Assessment (EIA)

procedure, climate changes, marine litter, marine noise etc.) and its procedural structure (accession of non-riparian states and organizations, internal rules of the Black Sea Commission etc).

The aim of this paper is to summarize and examine some gaps and challenges of the Bucharest Convention implementation in the Black Sea basin, to consider and analyze some relevant experience of the European Regional Sea Conventions, as well as relevant organizations and institutions.

Based on the abovementioned analysis, some recommendations on the necessary changes to the text of the Convention and its Protocols will be introduced in this paper.

Eco-Innovative Solutions for Ballast Water Treatment in the Shipping Sector

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Keywords: shipping, marine environmental protection ballast water treatment, eco-innovation

Abstract

The shipping industry is facing major challenges due to recent IMO and EU measures to prevent pollution from shipboard equipment.

In particular, the shipping industry has to fulfil a wide range of constantly increasing requirements in the scope of environmental legislation and regulation. It creates the necessity of introduction of technological changes and innovative, environment protective solutions with reference to particular shipyard processes and products.

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The term environmental innovation, or shortly 'eco-innovation', relates to innovations aiming at a decreased negative influence of innovations on the natural environment.

For assessing the impact of Eco Innovation in ship repair process it is important to evaluate the added value to the ship owner and ship managers. In the current context of societal challenges the environmental impact of the vessel and of all subsequent components, processes and services are realign on the environmental impact and the concern for the continuous reduction of natural resources used and pollutant emissions.

The present value (PV) of a vessel depends on the compliance of the vessel with the environmental regulation. By a ship repair activity targeting the implementation of the international regulation on environment the present value of the vessel increase, but the most important added value for the ship owners is also the reduction of the Worth Depreciation Rate which may be computed as the depreciation of the market price of the vessel over a specific period of time.

This paper summarises a professional approach in implementing eco innovative solution in the ship retrofit process developed within the R&D Project named "Eco innovative refitting technologies and processes for shipbuilding industry promoted by European Repair Shipyards", in short "Eco-REFITEC", which is being funded by the European Union's RTD 7th Framework.

Detailed information is provided based on a case study dedicated to the implementation of Ballast Water Treatment Systems.

Land Use Change Scenarios for the Black Sea Catchment

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Keywords: Land use, land cover, future scenarios, IPCC, downscaling, enviroGRIDS, Metronamica, Black Sea basin

Abstract

The aim of this work was to produce spatially explicit scenarios on land use changes in the Black Sea basin on a 50 year time horizon to support the policy and management options for the safeguard of the Black Sea resources. Land use scenarios are a result of combining several driving forces like demographics and biophysical factors with four different storylines based on interpretation of the global-storylines of the intergovernmental Panel on Climate Changes (IPCC) presented by Special Report for Emission Scenarios (SRES). The defined qualitative storylines were translated into "land use" demands by the application of downscaling techniques, in order to disaggregate the global outputs at regional scale. It has follows a modelling phase, where a spatial allocation model, Metronamica (RIKS) was utilised considering a set of factors, related to the driving forces, to generate the final results. The calibration of the model consists in an iterant process where several inputs were combined until a satisfactory result was reached. Among the inputs, were considered, historical trends based on land use change data (MODIS 2001 and 2008) with role of allocation rules while soil quality, digital elevation model, climate projection (temperature and precipitation) and population trends have influenced the modelling process by way of suitability and constraint maps. The validation of the calibrated model is performed taking into account statistical procedures, visual evaluations oversight by local experts to ensure a plausibility and accuracy of model results. The validated outputs represent, for four different scenarios, the changes in main land use classes: urban, grassland, cropland, forest and consequently shrublands, crops/natural vegetation and barren land, for the years 2025 and 2050. Indicators on forestation, urban sprawl and land abandonment were explored in order to identify significant

potential changes and increase the capacities to assess a sustainable development. Understanding the changes of land use in scenarios strengthens management capacity, envisaging future conditions, helps policy to adapt current strategies to the changing environment. The explorations of land use scenarios are the basis to support the river basin management and marine environment, since are essential data in hydrological models. Under this circumstance, the achieved scenarios will support future assessment for fulfilment of the EU's Water Frame Directive (WFD) and Integrated Coastal Zone Management (ICZM) policies for the Black Sea. This study was financed by European Commission trough the EnviroGRIDS FP7 project.

Demersal Fisheries Dynamics at the Romanian Black Sea Coast During 2000 - 2012

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Keywords: ichthyofauna, Black Sea, species, demersal, catch, fishermen communities, fishing point, boats, fishing gears

Abstract

The Black Sea fish underwent major changes in the last 50 years, both in qualitative and quantitative structure and in the behavior of different species. These changes are consequences of anthropogenic activities, direct and indirect fishing pressures by deteriorating environmental conditions, particularly in the western part of the sea. Demersal fish species inhabiting the continental shelf located in the part of the Romanian Black Sea is the most important segment of regional fishery potential in terms of commercial interests, domestic and international demand. Of all demersal species, only turbot has a particular interest, which, through appropriate management of recovery operations and a good catch, can ensure the

economic recovery of the national marine fisheries, due to the market value of fishery products, whose application is currently poorly met. In Romania, the marine fishing of demersal species enjoys a long tradition, the practice being recorded as an occupation of the fisheries settlements in the eighteenth and nineteenth centuries in Dobrogea and the Romanian marine fisheries. During the twentieth century until the early 2000s, the demersal stocks in the exclusive economic zone of Romania were mostly targeted by illegal fishing practiced by Turkish, Bulgarian or Ukrainian fishermen.

Studies by Russian scientists showed that in the north-eastern Black Sea about 166 species are found, out of which 111 species are of Atlantic origin, 29 species Ponto-Caspian, 6 species autoacclimated, 9 endemic species and 23 local species (Nikolski, Svetovidov). Of these, in the Black Sea are reported a number of 23 families belonging to the group of demersal fish, the most important being: *Squalidae, Acipenseridae, Serranidae, Mullidae, Sparidae, Labridae, Gobiidae, Scophthamidae, Pleuronectidae* and *Soleidae* (Maximov, Zaharia, 2002). Of demersal species, *Psetta maeotica* (turbot) *Platichthys luscus flesus* (European flounder), *Huso huso* (beluga), *Acipenser gueldenstaedti* (Danube sturgeon), *Acipenser stellatus* (starry sturgeon), *Dasyatis pastinaca* (common stingray), *Merlangius merlangus euxinus* (whiting), *Solea vulgaris* (common sole), *Mesogobius batrachocephalus* (knout goby), *Mullus barbatus ponticus* (red mullet), *Neogobius melanostomus* (rount goby) are of commercial interest.

This paper presents the current state of demersal ichthyofauna fisheries at the Romanian Black Sea coast and the time evolution of the main fish species. Romanian research results also reflect the work undertaken in Romania, during 2000- 2012. The demersal ichthyofauna was primarily targeted, as well as the knowledge of the biology of major species that populate the Romanian coast, in the hydroclimatic conditions specific for the period.

Other issues are presented and analyzed as well: demersal fishing methods and techniques; problems demersal fisheries are facing; the evolution of demersal overall catches and by main species of commercial interest; legal and institutional framework; recommendations on the management of demersal resources.

Organizational and Legal Background to Fisheries Management in a Responsible Manner in Ukraine

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Keywords: Responsible Fisheries, Fisheries Management, Black Sea.

Abstract

Over the last years, various international efforts on implementation of principles of responsible fisheries in the Black Sea region are made. Ukraine strives to be fully engaged in them. For the purpose of increased effectiveness of the efforts on implementation of principles of responsible fisheries, the research on organizational and legal framework of fisheries in Ukraine was conducted by YugNIRO with the aim of evaluation of its conformity with principles of responsible fisheries formulated in the Code of Conduct for Responsible Fisheries (hereinafter referred to as the Code) developed by FAO. This research was conducted to order of the state fisheries authority. The legal instruments, adopted in Ukraine and regulating fisheries conduct and fisheries state management, became research material. The research methodology involved comparing the Code provisions to the respective regulations of the legislation of Ukraine.

It is proved that Ukraine has all necessary legal and organizational background for implementation of the main requirements of the Code. Unfortunately, the effectiveness of such implementation still is unsatisfactory.

By some aspects of fisheries management, Ukrainian legislation is even more progressive than the Code. Such are the following:

1) acknowledgement of the necessity of restrictions on the activity not related to fisheries, if it can inflict harm to the stocks of aquatic living resources;

2) obligation on artificial reproduction of the stocks of aquatic living resources, which natural reproduction is deranged.

Analysis of the Code content is useful for detecting weaknesses and flaws in the organization of fisheries management in Ukraine for their subsequent elimination. Such weaknesses and flaws are the following:

- insufficient legal provision of aquaculture development (the Law of Ukraine "On Aquaculture" came into effect since the July of 2013, however the necessary by-laws have not already been adopted);
- insufficient sophistication of legal and institutional basis for fisheries integration in coastal area management;
- insufficient attention to the risks of conflicts among both fishers using various vessels, fishing gears and methods, and fishers engaged in commercial and artisanal fisheries;
- the absence of state support for fishers engaged in artisanal fisheries;
- the absence of legal mechanism for temporary suspension of authorizations to serve as a masters or officers of a fishing vessel in the event of non-compliance with fishing rules;
- the absence of the legal mechanism for recording discards of catches and their parts in documentation with regard to fishing operations.

However, the main barrier for implementation of principles of responsible fisheries in the Black Sea for Ukraine and other states of this region is the absence of international agreement on fisheries management for this water body. The necessity of such agreement for enclosed and semi-enclosed seas and for the Black Sea as one of them is provided both by the United Nations Convention on the Law of the Sea of 1982 (Article 123) and the Code.

The Role of Tourism Geography in the Protection of Marine Environment

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Keywords: Geography, tourism, student, impact

Abstract

In the context of the actual development, the essential protection of the marine environment should be the first priority of the human society. Tourism is an activity with seasonal impact of Black Sea Coast. For identification of marine environment problems determined of tourism activities was realized a questionnaire with questions applied to 80 students from Tourism Geography Study Program from Ovidius University of Constanta. The results have emphasized the students knowledge about tourism activities and impact of tourism from Black Sea Coast. The conclusions showed that in summer vacation, students could participate as volunteers in order to inform tourists on the Black Sea Coast, about the impact of tourism activities to marine environment and them aware the significance of protecting to marine environment.

State of the Fishery Resources in the Romanian Marine Area

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Keywords: Black Sea, sprat, anchovy, horse mackerel, turbot, dogfish, whiting, distribution, abundance, biomass, population structure, growth parameters and mortality rates, parasites, recommendations

Abstract

The material presented in this paper is a brief description of the state of the main fish species of commercial interest in the Romanian littoral in the last five years.

Are presented and analyzed data as well:

- Short biological characterization of the main fish species (sprat, anchovy, horse mackerel, turbot, shark, whiting);
- Distribution and abundance of fishing agglomerations (maps);
- Assessing the biomass of fishing agglomerations;
- Population structure by size classes;
- Growth parameters and mortality rates;
- The degree of parasite;
- Recommendations for their management.

Peculiarities of Driftnet Fisheries in Bulgarian Marine Area

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Keywords: driftnets, Atlantic bonito, Bulgarian marine zone, EU regulations and national legislation

Abstract

A retrospective and prospective evaluation of the driftnets case study in Bulgarian marine zone was in the scope of the present paper. In doing the evaluation process consultations and questionnaires were done with relevant bodies and fishery responsible authorities and research institutes. The first fishery is the Bulgarian fishery for Atlantic Bonito (*Sarda sarda*) which is not under a quota in the Black Sea but is an unauthorized species. The main landing ports and ports of registration for vessels in this fishery are Sozopol, Nessebar, Pomorie, Burgas, Primorsko, Tzarevo, Ahtopol, Kiten and Sinemoretz. This fishery normally operates from September to November and sometimes into December. There are a total of 172 vessels, the majority of which are less than 12m in length, using drifting gillnets and are operating for around 25% of the year (around 90 days). Vessels tend to use driftnets predominantly but will also use drifting longlines to fish. Mesh sizes used by vessels vary from 36-48mm based on the season and the size of the species targeted. Nets tend to be 500m in length but 2-3 nets are often used together, this is referred to as a "fustanela" and vessels regularly carry on board and set multiple nets. The width of these nets range from 150-400 meshes and normal intends to fishing from the surface to the seafloor which (between 20-50m depth) and most fishing vessels operate within 2 miles of shore. Nets are usually soaked for 2-3 hours but are often used overnight in which case they will soak for 8-9 hours. Pingers are not used on nets to deter cetaceans. In this fishery, around 450 fishers are involved with 2-4 fishers per vessel. 48kg of Atlantic Bonito were reported

landed in 2012 with a value of €240; however, these values are not considered to be accurate. No other species have been reported as being caught as by catch or discarded and no interactions with protected species have been reported. Vessels operating in this fishery have total landings using all gear types of more than 500 tones. Vessels will fish all year round with gears other than driftnets. Taking into consideration all the existent EU regulations and national legislation in force regarding the driftnet fishery the final impacts of all measures would be sustainable exploitation of living aquatic resources, taking account of the environmental, economic and social aspects in a balanced manner.

The Black Sea Anchovy (Engraulis encrasicolus ponticus): Its Biology, Fishery and Legislative Control

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Keywords: Anchovy, *Engraulis encrasicolus ponticus,* Fisheries Biology, Fishing legislation, Black Sea, Purse Seining

Abstract

This study investigates the current status and fisheries biology parameters (e.g. length, weight, age), and the fishing yield and season of the Black Sea anchovy (Engraulis encrasicolus ponticus); a species which provides more than half of the fishery production of Turkey. It interrogates data for the fishing quantity,

distribution and density of the anchovy stocks, and the fishing duration of recent years and the 2012-2013 seine vessel fishing season. The past changes in the anchovy stocks were evaluated using the Turkey Statistical Institute annual statistics. The Turkish fishery follows worldwide trends and was approximately 500.000-600.000 t per annum over the past 25 years of which half was from anchovy and 10% from the horse mackerel (Trachurus mediterraneus). As an example, the important fishing area and harbour of Sinop supported a fishing activity of only 12 days in 2011-2012.

The anchovy shoals were found to have migrated to the Georgian coasts thus preventing the Turkish anchovy fishing in recent years. Because of this, most of the Turkish fish meal and fish oil factories which use pelagic fish especially anchovy as a raw material relocated to Georgia. Furthermore, the 9 cm minimum fishing length restriction in Turkey is not applied in Georgia so the smaller anchovies can be caught there. In addition, in recent years there have been changes in breeding, feeding and wintering areas of the anchovy. The anchovy eggs and larvae and zooplankton were highly predated by Mnemiopsis leidyi. Hence the anchovy stocks in the Black Sea have decreased due to overfishing, oceanographic and meteorological changes, predation by an invasive species and pollution. The paper describes the need for the sustainable utilization of these stocks of anchovy and other small pelagic fish, changes in recent fishing technologies and the increasing governance changes during the EU harmonization process.

Valorization of Marine and Onshore Sources of Biomass and Wastes for Biogas Production

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Keywords: Marine biomass, field and domestic wastes, manure, biogas systems, environmental protection

Abstract

The work is focused on the importance of biogas producing as a main pawn of biofuels belonging to renewable energy palette, having in mind the enormous biomass and waste potential of Romanian area, out of each the shore area has a very promising position. The biogas can essentially contribute to growing up of renewable till 20% from total energy demand till 2020. Renewable include wind, solar, hydro-electric and tidal power and geothermal energy and biomass as well.

The paper takes in account the state of the art regarding the existing technologies and highlights the spreading of such kind of plants over the world. Basically, the information on these topics were carefully collected and analyzed, in order to stress both the importance of the subject and the methods to implement on local areas such very advantageous technologies.

For this aim the current applied technologies in Romania (coming from outside) are underlined and, at the same time, the existing Romanian technologies, waiting for turning in account, are described and compared.

One of the most applied concept of biogas plant at EU level is producing, by cogeneration, of electric and thermal energies, out of each, first is supplied to the existing grids and the second is spread into internal (digestor) and external consumers (for heating) [1]

The solution have to be carefully applied, based on local specific conditions, since sometime the thermal energy did not find a feasible utilization due to supplementary cost of distribution or people retaining.

For each specific case an optimal solution can be adopted based on a deep feasibility analysis study.

The Romanian technologies which successfully can compete on the market have big advantages including reduced investment costs, simplicity of operation, easy maintenance and versatility of the materials to be processed into digestor [2], when compared with the outside technologies, entered in the last period time in Romania.

The work comparatively presents the current and future possible situation in Romania, specifically for sea coast area, where the existing raw materials and wastes can contribute, based on a proper management plan and an adequate technology, on a real success for energy saving and for environmental protection as well.

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Pressures and Their Impacts on the Black Sea Ecosystem: Results of PERSEUS Umbrella and Moscow BSEX Workshops

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Keywords: Black Sea, marine ecosystem, pressures and impacts, PERSEUS Umbrella Workshop, Moscow BSEX Workshop

Session 3 Socio-economic Impact on the Marine Environment

Abstract

PERSEUS (Policy-oriented marine Environmental Research in Southern EUropean Seas) is a EC FP7 large-scale Collaborative Project (2012-2015) addressed to the assessment and prediction of combined effects of natural and human-made pressures in the Mediterranean and Black seas in view of their governance. The aim of this report is to present some results of the PERSEUS Umbrella Workshop (January, 22-23, 2013) and Moscow BSEX (Black Sea Experiment) Workshop (June, 14, 2013) concerning analysis of gaps in knowledge on natural and anthropogenic pressures and their impacts at the Black sea ecosystem and plans of future investigations in the frame of the project. In the PERSEUS the pressures on the marine ecosystems and their impacts are studied both at the basin/sub-basin (open sea) and at coastal (selected sites near ports and cities) levels by means of field observations, laboratory and field experiments and modeling studies. Present status of the observing systems and their capabilities are assessed, the needs and mitigation actions to get more synergy between these systems are discussed. The development and application of different level ecosystem models as integrated tools for the environmental assessment consistent with objectives of the Marine Framework Strategy Directive are considered. To promote better governance across the Southern European Seas, the PERSEUS project offers a framework for future implementation of adaptive policies and management schemes. As one of the focuses of this framework, the concept and future plans of the Western Black Sea Pilot Case Study are described. In relation to understanding the complex interactions between anthropogenic and natural pressures and the capacity of the Black Sea to provide goods and services to the surrounding populations, the available data and findings as well as the major problems towards development of appropriate environmental status scenarios are considered. Risks and consequences of not achieving the Good Environmental Status up to 2020 are discussed.

Session 4 Integrated Coastal Zone Management

Topics:

- **Maritime spatial planning**
- **State of the Black Sea coast**
- **Marine and coastal protected areas**
- **Coastal erosion**

Evaluation of the Risks of Floods and Freshets at the Mouths of the Rivers of Kolkhety Lowland, Georgia

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Keywords: Kolkhety lowland, coastal erosion, river mouth

Abstract

The coastal zone of the Black Sea of Georgia covers a 330-km-long section. More than 150 large, average and small rivers flow into the sea. Study of the risks of flooding and its consequences is crucial for the Black Sea region of Georgia, particularly on the background of more frequent water cathastrophic events.

Basing on the combined investigation of the eustatic and geological processes, the coastal zone of Georgia is divided into three major sections, with its central part, located between the rivers Enguri and Natanebi, subsiding most rapidly. Poti-Supsa coastal zone in the central part is characterized by the highest speed of subsidence (within 4,0–5,6 mm/year). The activation of eustatic processes are followed by the erosion and beach degradation processes, intensification of floodings and movement of the coastal line inland.

On the background of the climatic change, increasing of frequency and severity of the natural disasters (storms,floods and freshets) is observed. These processes are strongly revealed in the areas of river mouthes of Kolkheti Lowland, especially when the storms and floods fenomena occur simultaneously.

The article considers the periods of coincidence of the water peak discharge at the river mouths and stormy phenomena and their impact on coastal erosion. The dynamics of floods and freshets was established by evaluating the correlation

coefficients between the water peak discharge and its ordinal number of trends in different months of the observed 40-year-long period. Investigation revealed, that, the coincidence of storms with flood fenomena has a random character. For the rivers studied (Rv. Rioni and Natanebi), the period of coincidence of the maximum of storms and river discharge is observed from February to April, resulting in the intensification of erosional proceses in the area of river mouth.

The North-Western Part of the Black Sea Coasts Changes

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Keywords: North-Western part of the Black Sea, coast, erosion, abrasion

Abstract

Coastal abrasion, as the result of which big volumes of suspended matter enter coastal waters, decrease transparency and cause siltation, which damages a lot coastal algal and seagrass communities and completely destroys natural processes of their reproduction. In line with the EU Marine Strategy Framework Directive coastal abrasion has been chosen one of indicators of impact on coastal ecosystems including the Black Sea.

Aim of the work has been study of abrasion and accumulation processes in the coastal zone of the North-Western Black Sea (NWBS) and coastal zone dynamics under the influence of natural and anthropogenic factors for the past 50 years.

Results of the studies performed in the NWBS in 1945-2013, as well as the authors' own studies using space imagery and air photography together with field surveys and instrumental measurements have been used in the work.

It has been shown that the current geomorphologic state of coastline was formed during neotectonic stage of development and continues its formation. Maps of the NWBS coasts destruction intensity have been presented. Analysis of the maps has shown that abrasion processes intensity is different in different NWBS areas and depends on geological structure and lithological composition of the material exposing on coastal cliffs; sea level, direction and intensity of waves; composition, direction and rate of sediments flow; and human economic activities.

Peculiarities of 14 NWBS coastal areas have been analysed. Special attention has been paid to description of depositional types of coast, such as river deltas (Danube< Dnister, Dnipro), as well as bay-bars of practically all the Black Sea limans. It has been shown that velocity of coastline retreat as the result of abrasion is not uniform. Coastline segments of high speed of changes have been revealed in the NWBS: area between cape Burnas and the Budakskiy Liman – up to 6-7 m per year; between mouth of the Baraboy River and the Sukhoy Liman – up to 3.8 m per year and other areas. It has been shown that during some stormy periods coastal abrasion speed practically on all the NWBS coastline segments grow an order of magnitude, from 0.1-0.5 m to 3-5 m per year. The lowest velocities of natural coastal abrasion have been registered in the areas of port Ilyichevsk, port Odessa, in the coastline segments between the Bolshoy and Maliy Adzhalyksky Limans and from the mouth of the Berezanskiy Liman to cape Ochakovskiy, where average velocities of cliffs retrieval change from 0.1 to 0.3 m per year.

Discussed are peculiarities of coastline changes in the deltaic areas of the Dnipro, the Dnister and the Danube and in the area of the city of Odessa, where natural and anthropogenic displacement of coast towards the sea – formation of new land areas. Programme of complex (coastal and marine) studies of influence of abrasion of different types of coasts on the state of the NWBS coastal waters has been proposed: changes of transparency, flows of nutrients and toxicants into the coastal waters as the result of coastal abrasion.

Research was carried out under the framework of research activities funded by the Ministry of Education and Science for the Ukraine (2003-2013) and as the contributions to the European FP7 project No. 287600 PERSEUS "Policy-oriented marine Environmental Research for the Southern EUropean Seas".

3D Holocene Deposits Map of the Danube Delta; Scenarios

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Keywords: Holocene deposits, 3 D map, geomorphology, soils, morphodynamics, data sharing

Abstract

The Danube Delta has been intensively studied in the recent century with emphasis on geogenesis, morphodynamics, hydro morphology, topography and soils. Most of the studies are descriptive or has result in bi-dimensional thematic maps e.g. geomorhological maps, topo, vegetation, ecosystems map, etc.

The present work refer to the production of a 3 D surface deposit map of the Danube delta showing the succession of peat, fluvial and maritime deposits processed from digital soil map 1:50, 000 scale in ARC/INFO environment. The map revel vertical and horizontal distribution of the Holocene deposits and their thickness. It is thought to be a tool for assessment of CH_4, CO_2, H_2S gas emissions, assessment of peat biomass, extreme flood events during Holocene time and in the selection of sediment cores for further and detailed specific studies on paleoenvironmental reconstruction of the Danube Delta.

The Coastal Variability of Geomorphological Processes at the Romanian Coast in the Last Five Decades (1962-2012)

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Abstract

Research conducted for the last five decades, showed significant shoreline change, between the emerged and submersed beach, and respectively, an aggravation of the coastal geomorphology, from one year to another, with particular socio-economic consequences and a major impact on the Romanian national natural heritage.

Coastal erosion emphasized a great development in winter when storms are frequent and occur at relatively small intervals. At annual level the coastal erosion, in relation with the land benchmark network system arranged by the State Water Board / CSA in 1962, they have been expanding especially in the last half century, with the hydrotechnical development made in the territory.

The negative consequences studied refers to withdrawal of the shoreline, loss of beach surfaces by erosion, and last but not list the effect on coastal ecosystems, including the marine ecosystem of the Danube Delta Biosphere Reserve.

The paper presents some aspects of specific coastline processes that determine the vulnerability of coastal shore sector. These are highlighted through the use of topographic measurements techniques GPS / GIS and applied to historical maps, satellite imagery and photogrammetry data are available, intensity / magnitude of coastal processes is reflected in variability of the shoreline, as well as multi-annual budget of sedimentary deposits on the two geomorphological units of the Romanian shore, and especially the processes afferent to the Danube Delta Coast.

High-Resolution Digital Cartographic Support for Development Plans, Strategies and Management Schemes in the Danube Delta Biosphere Reserve

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Abstract

Danube Delta Biosphere Reserve, the most important Natura 2000 Romania - RoSCI 0065 Danube Delta 4.540km^2, RoSCI 0066 Danube Delta Maritime Area 1.233km^2 and – SPA: RoSPA 0031 Danube Delta and Razim-Sinoie Complex 5.128 km^2, RoSPA 0076 Black Sea 1.401km^2, is the site of SCI with the most numerous species and habitats listed in the Habitats Directive (29 habitat types, 5 plant species, 5 species of mammals, 5 species of amphibians / reptiles, 15 species of fish, 11 species invertebrates
- The site SPA with the most numerous species of birds (89 species out of 105 species in Annex I of the Birds Directive in Romania).
Due to the particular importance of the Natura 2000 Network and area occupied (2.5% of the country) the management plan elaboration is a goal with special importance. This, It could not be done without a cartographic high resolution support, reason, why we developed the project: Development of a high-resolution digital cartographic support needed for development plans, strategies and management schemes in the Danube Delta Biosphere Reserve - CARTODD, founded by the SOP(EU-CSF).
The project has not been limited to the achievement of cartographic support but we realized a number of applications in the field of management of DDBR, like ecological restoration of abandoned agricultural polders and fishery ponds, biodiversity and flood risk management.
The method used to achieve this cartographical support was LIDAR. The accuracy provided by this product satisfies applications, like:
• In terms of climate change, flood risk management for the population and the environment is becoming increasingly important

• classification made for habitats can be significantly enhanced using digital terrain model and digital elevation model.
• Provides data required by hydrological modeling and restoration projects
we developed a software platform for LIDAR data processing in C # language, a module for data converting in proper format and bug fixes, a module for altitudes corrections and a script AVENUE for converting ASCII raster format into ESRI GRID. Also was developed a WEB interface into GIS data visualization - Open Source product:
• MapServer and Geoserver for data server (Map Data Servers)
• Libraries: GeoExt, OpenLayer JavaScript for user interface design.

Pegaso Project Experience and Last Results Regarding Spatial Planning in the Danube Delta

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Abstract

Black Sea, included in the Mediterranean basin, continues to suffer severe environmental degradation. This has led to unsustainable trends which impact the economic activities and people life. Last decades different pressures as urban growth and sprawl, the intensification of activities from the coast to the maritime space, the degradation of the environment and the loss of coastal and marine biodiversity, have been enlarged on the area, stressing the necessity of integrated spatial planning and common management approaches. The PEGASO project has therefore been designed to bring the science and end-user communities relevant to the Mediterranean and Black Sea Basins together: to develop collaboratively relevant actions, to identify common threats and solutions in relation to the long-term sustainable development and environmental protection of coastal zones, in the region of these important seas. This have been done by enhancing existing

coastal, marine and maritime networks, initiating new shared management and policy initiatives, strengthening collaborations between government and non-governmental organizations, between science and ICZM objectives.

The paper presents the project's results obtained during 2010-2013, the stakeholders meeting conclusions, the predicted PEGASO project follow-ups, according the governmental regional and local end-users plans, contributing to: a) PEGASO 'exit strategy' preparing; b) perspectives, opportunities, initiatives, programmes for PEGASO Project's continuity; c) PEGASO contribution and feeding of a 'coastal knowledge centre' and 'information portal' for the Mediterranean and Black Sea basins.

In case of the PEGASO Project expanding beyond the coastal area it is questioned also: a) the enlarging of PEGASO approach beyond the coastal areas to the marine waters and ecosystems; b) the better connection (at regional, national, and local scales) of ICZM approaches and processes, Marine Spatial Planning (MSP) and Integrated Maritime Policies (IMP).

Researches Regarding the Impact of Seawater Corrosion on the Coastal Structures

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Keywords: coastal constructions, seawater aggressiveness, corrosion potential

Abstract

The impact of the marine environment on the coastal structures was reported since the middle of the XIX century. The first report elaborated by L.J. Vicat, concerning concrete corrosion caused by seawater, dates back in 1841. The investigation presents a short history of the researches concerning the aggressiveness of both sea and ocean water on the coastal constructions from different countries.

In order to test the aggressiveness potential of the Black Sea water on the coastal constructions, between the years 2009-2010, a seawater sampling program was carried out in the Năvodari - Vama Veche sector of the Romanian coastline. The water samples were subjected to physical-chemical determinations in order to identify the aggressiveness type that they exercise over coastal structures.

In the present paper, different aggressiveness types of seawater samples are presented, as well as mechanisms by which they affect the sustainability of coastal structures. Another highlighted aspect is the influence of artificial shipping lanes (Danube-Black Sea shipping lanes) on the aggressiveness potential, in the confluence points with Black Sea.

The seawater impact on the coastal structures is exemplified through affected structures analysis (Mamaia Bridge, build in 1935, the hydrotechnics nodes and other coastal structures). The possibilities for diminishing the seawater impact on coastal constructions are also analysed.

A Governance Analysis of the Opportunities for Implementing Marine Spatial Planning in the Black Sea

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Keywords: Marine Spatial Planning, Governance, Black Sea, Natura2000 network, MESMA

What are the main issues, challenges and opportunities for implementing Marine Spatial Planning in the Black Sea area? Within MESMA, a standardized and generic framework for the monitoring and evaluation of spatial marine management areas is developed. The Black Sea is one of nine case studies of the EU-FP7 project MESMA is focused, involving the application of a systematic governance analysis approach. This approach is applied to five cross cutting themes concerning governance issues common to marine spatial planning throughout Europe. Nature conservation is almost by definition a cross border issue. The distribution of species, for instance, is not influenced by the borders of countries. The BSSAP, MSFD and the N2000 are separate initiatives to protect cross boundary species, but their nature conservation goals have a lot in common. Synchronization between these initiatives could improve efficiency of nature conservation and cooperation between the Black Sea region and the European Union. Actively involving stakeholders in the BSC decision making process can help to reach a better supported decision, but might lead to an even more complex and time-consuming process. In the Black Sea region information and data is gathered in most countries, but because of a lack of communication and transparency this knowledge stays fragmented. This paper will present and discuss the outcome of the governance analysis for the above mentioned issues.

Diagnosis and Scenarios for a Better Management Process of Visitors Flows in the Romanian Danube Delta Biosphere Reserve

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Keywords: Public participation, tourism, adaptative management, social-ecological systems, environmental governance

Abstract

The Danube Delta Biosphere Reserve (DDBR) is located on the Romanian Black Sea coast and covers a vast area (580000 hectares) characterized by a low population density and well-preserved ecosystems with considerable potential for tourism. The need for an integrated management for RBDD is not new. Since the 90's was declared as Biosphere Reserve and *the universal value* of the reserve was recognized by the Man and Biosphere (MAB) Program of UNESCO. This study examines the perceptions of stakeholders in DDBR, with the aim of developing key concepts that will be used in future information and communication strategies regarding biodiversity conservation in the area. It is important to assess the implication level of several sectors to increase the efficiencies for sustainability and rehabilitation programs.

A number of 60 stakeholders were interviewed during August-September 2011 and qualitative data were obtained. The discussions were held with different groups of stakeholders: (i) visitors; (ii) local people; (iii) DDBR Authority representatives; (iv) NGO's; (vi) scientists; (v) fishermen; (vii) local authorities; (viii) county authorities; (ix) investors. We used a Fuzzy Cognitive Mapping (FCM) approach and let stakeholders draw cause-effect networks. The identification of different stakeholders' perceptions of the DDBR area allowed us to analyze and to model the cognitive maps, which consist of variables, causal relationships among those variables and of strengths of the connections. Causal mapping contributes to the goal of using peoples' knowledge of ecosystems to improve understanding of socio-ecological systems.

Analysis reveals that DDBR Authority, county authorities and local authorities are substantially worried about the pollution connected with overfishing, while other social groups care more about touristic activities, accessibility degree, health system or financial resources. The lack of coordination and effective policies between the governmental institutions and the different sectors of activities were also identified as a common problem and has accentuated both environmental and socio-economic problems. The result could cause economic and social degradation of the area related to tourism and fishing. Based on stakeholders' perceptions, different management policy options have been simulated in order to explore their potential effects on the biodiversity, nature conservation and the sustainable development of the area.

Aquatic Sensitive Areas at the Ionian Sea (Greece) and Romanian Black Sea Coast; Fishery Situation and Management Procedures

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Keywords: lagoons, fishery, Ionian Sea, Romanian marine protected areas

Abstract

Coastal lagoons are transitional areas between land and sea, formed, in most cases, in river deltas. The present study is an account of the available information on the fishery resources in two Greek lagoonal ecosystems in the Ionian Sea (Amvrakikos and Mesolonghi lagoons) and the marine protected areas (MPAs) of

the Romanian coasts of the Black Sea and to highlight the scientific gaps in their management. The management of all the above lagoonal systems is protected under the Ramsar convention or is part of the Natura 2000 network. On the Romanian coasts eight marine protected areas (MPAs), part of Natura 2000, were designated: Vama Veche - 2 Mai (overlapping with the natural reserve), Underwater sulfur springs from Mangalia, Cape Aurora, Costineşti – 23 August, Marine area from Cape Tuzla, Submerged beach from Eforie Nord - Eforie Sud, Methanogenic underwater structures from Sfantu Gheorghe, Danube Delta - marine zone (overlapping with Danube Delta Biosphere Reserve – marine zone). Recent reports showed that the fisheries production in the Amvrakikos lagoons appears to be stable in basic fish species such as the pilchard, the red mullet, the cuttlefish and the karamote prawn, but the stocks of some benthic species that belong to Sparidae family and the striped red mullet have been reduced or disappeared. The total annual fish catches in the Mesolonghi lagoons decreased from 1500-2000 t (1960s) to 1300-1500 t in recent years. The 92% total annual fish catches in the above area is constituted from eel, Mugilidae species, gilthead seabream and annular seabream. The protected fishes in the Romanian MPAs under the Habitats Directive are: *Alosa immaculata, A. tanaica, A. maeotica, Huso huso, A. gueldenstaedtii, A. stellatus.* There are no time series fishery data for the Romanian MPAs, although in 2012, the stationary fishery in these areas was practised with 83 boats using 4,376 gillnets. The landing time series data can be a very useful tool in order to detect the ecological status of a coastal lagoon. The fishery production in both areas is related to the anthropogenic pressures (agriculture, animal husbandry, industry, small dams, pollution) and the predictable environmental degradation of the coastal areas. This is the most important reason for the overexploitation of the fish stocks. The application of an integrated management plan in both areas presumes the involvement of local and regional administration, in order to control the coastal zone plan.

Session 5 Climate change and its impact on marine ecosystems

Topics:

- **Change in CO_2 fluxes, carbon sequestration, biogeochemical cycles, acidification, hydrology, hydrophysics**

Correspondence of the Maximums of the Black Sea Inter-Annual Level to El Niño

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Keywords: sea level, El Niño phenomenon, fluctuations, repeatability, maximums

Analysis of data of anomalous 2010 demonstrated the global nature of impact of the El Niño phenomenon observed winter 2009-2010 years in the Pacific Ocean. This factor impacts to all processes and must be taken into consideration as for climatic predictions as for solution of practical problems.

The aim of this work is the research of the correspondence as between times of the maximums in the fluctuations for the Black Sea and for the El Niño phenomenon as between periods of variability of the Black Sea's level and the periodicity of El Niño.

The periods of the El Niño appearance fluctuate in range from 4 to 18 years and have the highest repeatability in the 6-8 years. Our results show that maximal sea

level on the Eastern shore of the Pacific Ocean occurs with periods 3-6, 8-14 and 16-23 years.

We have considered the repeatability of years with extreme amplitudes of the level at some Black Sea stations, of the Danube's runoff, of annual precipitation in Odessa for a period of over 100 years in comparison with El Niño years. The synchronous but irregular (in the same year, but with non-periodic time interval) appearance of the maximums in the inter-annual variability of seasonal fluctuations of the considered characteristics during 1900 - 2010 is the key feature of this comparison. The generalized data for the whole period of observations showed that perturbations 2-5, 7, 11, 14-15, 18 and 26 years dominated in the average-annual Black Sea level's heights.

The correspondence between moments of maximums in fluctuations of the Black Sea's level and the El Niño phenomenon, and correspondence between periods of Black Sea level's variability and the periodicity of the El Niño lets us to identify El Niño as a global impacting factor for the level's changes in the World Ocean, and specifically, in the Black Sea, which determines the climatic patterns.

The Use of Renewable Energies at the Romanian Coast of the Black Sea

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Keywords: renewable energy, renewable sources, Romanian coastal zone

Attention to renewable energy is increasing because of the current problems, namely due to climate change induced by increasing the amount of carbon dioxide in the atmosphere. Given this, the EU has established that by 2020, there should be an increase of 20% renewables in total electricity production. Achieving this goal requires that each EU Member State must establish clear objectives for action in this regard. Energy is an important factor in economic development and in view of climate change issues, it is necessary to implement durability and reliable energy sources. Increased use of renewable energy is a key element in energy policy and, in this respect, made a series of research to identify, and to provide estimates of the potential energy from renewable sources such as sun, wind, waves, etc. Applying environmental policies to prevent climate change, limiting the negative effects of climate change, the progressive reduction of emissions of greenhouse gases under the commitments, encourage reducing energy consumption by using energy efficient technologies and supporting the production of cheap and clean energy sources should be a priority for Romania. Environmentally favorable technologies must be developed, distributed, maintained and expanded all over the

world. Hence the need to support local capacity adequate to ensure that these technologies can be used and maintained by local staff. Energy must be harnessed and used in a way that protects the environment at local, global, present and future. Any region is characterized by a particular wind and solar potential by placing the region to wind flows generated by the general circulation of the atmosphere, the local topography and cloud area. From this point of view, coastal areas are, par excellence, regions with a high potential wind and solar [1]. Romanian coastline of the Black Sea has a renewable energy potential due to be taken into account. Thus, while the currents and tidal energy and heat has no immediate interest, solar and waves worth considered. This should be an assessment related to potential theory technically and economically exploitable renewable energy for the Romanian coastal zone [2].

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Occurrence of Extreme Weather Events Over Black Sea from Numerical Simulations and Observation-Based Data

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Keywords: surface wind speed, atmospheric water, threshold values

Abstract

The extreme weather events may have different dominant phenomena (e.g. damaging lightning strokes; heavy rain, snow accumulation etc), but they all involve some common basic ingredients like increased atmospheric humidity and high wind, while additional favorable conditions may be provided by local or regional features like the orography and land-use/ land-type characteristics. A significant contribution to the improvement of short-term forecast of such phenomena may come from an improved knowledge on the regional characteristics of key atmospheric parameters and from synergetic analysis of all available sources of data.

We focus the analysis on two atmospheric variables closely linked with severe weather events, namely precipitation water vapor and surface wind speed. We employ data from numerical regional climate simulations, reanalysis and observation-based datasets in order to asses the seasonal frequency of occurrence of extreme (high) values of these parameters over the Black Sea basin.

The amount of precipitation water in the atmospheric column is important information in weather forecasting applications, like forecast of intense rain episodes [1], lightning warning system in airports [2], tornadic events forecasting [3], NWP assimilation for short-range forecasts etc. Surface wind speed is one of the natural hazard factors affecting human activity both in coastal areas and over open-sea (e.g. maritime transport, extraction and processing natural resources etc). Both these atmospheric parameters play an important role when extreme weather

events occur and improved knowledge on their regional climatic characteristics would contribute to improve the forecast of such events and to mitigate their socio-economical effects.

In the present study the frequency of occurrence (FqO) of extreme values of precipitation water (TPW) and surface wind speed in the Black Sea basin is analyzed, aiming to assess the differences between simulated and observed characteristics. We employ data from an ensemble of high resolution (25 km) regional climate model simulations, realized within the frame of EU project ENSEMBLES (http://ensemblesrt3.dmi.dk/). The analysis is performed for the entire Black Sea basin as well as for several costal sites. The FqO index based on numerical simulations for period 1961-2000 is compared with independent data from ERA-INTERIM reanalysis and high-resolution satellite-derived data, the latest available for shorter but recent periods: IASI (Infrared Atmospheric Sounding Interferometer) derived TPW product (2008-2012) and QuickScat surface wind speed product (2000-2008). The comparison highlights some limitations of the models to reproduce high values of the parameters considered, thus leading to lower seasonal FqO. This information is further used to interpret the results from the climate projections (scenario A1B) realized within ENSEMBLES project, for period 2011-2040.

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40 Years Analysis of the Wave Characteristics and Recent Observations on Currents' Regime Along the Western Black Sea Coast

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Keywords: Romanian Black Sea, waves, currents, long-term analysis, wind

Abstract

The paper presents a detailed analysis of the surface wave regime at Constanta site and of the current regime using the measurements from the seasonal cruises along the Western Black Sea shore, about 30 miles seaward. The measurements of the sea currents performed during 2011 - 2012 in 138 oceanographic stations along the Romanian Black Sea Coast (245 km long) and 55km offshore were analyzed. The water masses circulation along the Romanian shore is north to south, the current speeds ranging from 50 cm/s at the surface to 5 cm/s in the bottom layer, depending on winds and the location of oceanographic station. Different mesoscale features are present in the surface current patterns.

The monthly average values of the wave parameters consist in three daily observations of wave type (sea or swell), direction, height (m), period (s) and length (m) of the waves at 12m water depth, measured by detecting the vertical movement of a surface buoy. The wind speed and direction were measured with automatic weather station, at Constanta meteorological station (44o14' N, 28o38' E) and Gloria Oil Rig (44o31' N, 29o34' E) sites.

Significant changes in the long term evolution (1971 – 2010) of the wave characteristics are mainly due to meteorological factors that have a considerable time variability The annual average of calm sea (wave height less than 0.2m - detection limit of the measurement method), is about 60%, the wave average period is approximately 4.5s and average height of about one meter, resulting in an overall average height of about half a meter for the entire period. In winter season (December to March), the state of the sea, in Beaufort Force scale, is greater than three and the maximum measured wave height in 40 years is 6 m.

Characteristics of Wind-Driven Upwelling in the Black Sea Coastal Zone of Ukraine and Its Long-Term Variability

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Keywords: sea surface temperature, upwelling, empirical mode decomposition.

Abstract

Coastal upwelling has great impact on marine ecosystem as it results in nutrient regeneration in the surface layer. Satellite remote sensing is a good instrument to study spatial structure of upwelling formation. However, its use for studying temporal variability is limited due to short-term period of satellite observations. As an alternative source of data, routine maritime observations on sea surface temperature and wind parameters could be utilized enabling to find the main tendencies of different time scales in upwelling characteristics. But such approach is

not simple to implement due to difficulties of upwelling events extraction which is mainly carried out manually.

The goal of the present study is to investigate long-term variability of characteristics of the coastal upwelling using the routine maritime observations along Ukrainian Black sea coastline for the period of 1936-2012. In order to reach the goal the following tasks have been solved:

1. Development of the objective method to extract upwelling events and to describe its main characteristics such as initial period of upwelling formation, intensity and duration. The method is based on the concept of modulated annual cycle (MAC) and application of adaptive and temporally local time series analysis approach, i.e. empirical mode decomposition (EMD). In order to identify wind-driven upwelling events a special wind index is introduced.

2. Analysis of statistical distributions of each type of the extracted characteristics and their joint probabilities with special treatment of extremes.

3. Analysis of intrinsic modes of long-term variability of upwelling events occurrence, the seasonal-averaged and extreme characteristics by using the empirical mode decomposition (EMD). Interannual to interdecadal modes of variability have been detected encompassing the main time scales of global climate variability in the Northern Hemisphere.

Monitoring and Forecasting Center for the Black Sea

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Keywords: operational monitoring and forecasting, circulation, biogeochemical model, marine environment, climate variability

Abstract

The Marine Hydrophysical Institute-NAS of Ukraine (MHI NASU) operates as an international monitoring and forecasting center for the Black Sea (BS MFC) and an element of unified and integrated European system of marine forecasts developed by "MyOcean" project. Development of the center basic functional elements and extension of the products list carried out over the last 7 years in a number of projects of the framework programs of the European Commission, such as ARENA, ASCABOS, ECOOP, and SESAME. The center was finally designed in 2009 -2012 according to common standards of "MyOcean" project. The "MyOcean2" project started in April 2012 focusing on operational functioning of the centre, improving the quality and term of marine forecast.

The BS MFC consists of operational monitoring and forecasting unit and the dissemination unit which distributes and displays the results of marine forecasts. Specially designed hardware and software supports the internal and external network connections. The service support team operates in the framework of the BS MFC controlling operation of the automatic BS forecasting system and supporting all users.

Nowcasting and forecasting by the system are performed based on the circulation, biooptical and biogeochemical models. Wave model implementation to the operational system is on the way. Temperature, salinity, current velocity, sea level, light diffuse attenuation coefficient, nitrates and phytoplankton concentrations are now produced operationally by the system. The products of the BS MFC are freely

available from the central WEB-portal of the "My Ocean» project (http://www.myocean).

Products of the BS MFC are used by the oceanographic organizations of Bulgaria, Georgia, Romania, Russia and Ukraine to carry out marine forecast with high spatial resolution in their coastal areas. Operational forecast of oil spills drift in the Black Sea is provided also based on BS MFC data.

MyOcean products allow simulating different indicators of the marine environment in order to assess the ecological state and the human impact on the Black Sea; they allow meeting the challenges of navigation safety, maritime rescue operations and assessment of climate variability.

Interannual Variability of Winter-Spring Cyclones Over the Black Sea and its Manifestations in Some Marine Ecosystem Parameters

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Keywords: frequency / area / depth / trajectories of cyclones, transparency, suspended matter, North-Western Black Sea shelf, North Atlantic Oscillation, El Nino-Southern Oscillation.

Abstract

The research is dedicated to the analysis of interannual variability of the main parameters of cyclones in the Black Sea region selected using global NCEP / NCAR reanalyses data sets on the 1000 hPa geopotential height in 1948 – 2006, and associated with global processes in the ocean-atmosphere system: the North Atlantic Oscillation (NAO) and El-Nino-Southern Oscillation (ENSO). Manifestations of NAO and ENSO in transparency and suspended matter distribution observed in

winter-springs of 1978 – 1995 in the surface layer of the North-Western Black Sea shelf via the mechanism involving cyclonic activity are analyzed.

In the first part of the research it is shown that NAO manifests in the Black Sea region mainly in the variability of frequency of cyclones. Joint NAO and ENSO influence is responsible for up to 50 % of cyclones' frequency variance in the Black Sea region. Examples of the manifestations of NAO and classified ENSO events on the trajectories of cyclones are provided too.

In the second part of the research manifestations of NAO and ENSO in transparency and suspended matter distribution in the North-Western Black Sea shelf via the mechanism involving cyclones are shown. The mechanism is the following. Appropriate combinations of anomalies in the ocean-atmosphere system of the North Atlantic (NAO) and Pacific Ocean (ENSO) cause appropriate anomalies in the parameters of cyclones over the catchment areas of European Black Sea rivers. Cyclones in turn affect rivers' discharge, which is responsible for the concentration of biogenes carried by the rivers to the shelf. Biogenes to the large extent determine phytoplankton productivity. As a result suspended matter content and transparency field in the surface water layer of the shelf is altered. Thus, during intensive flood in spring, when content of total and suspended matter become higher (in comparison with winter time), the transparency is lower. Consequently, climatic types of "early" and "late" spring accompanied by the appropriate level of flood intensity are identified.

As a result, it is shown that positive NAO phase is accompanied by less frequent cyclones in the Black Sea region. These conditions negatively affect phytoplankton productivity and suspended organic matter content is lower than mean seasonal values for spring causing higher than normal transparency. Vice versa, negative NAO phase is accompanied by intensification of cyclonic activity in the Black Sea region. As a result, rivers' discharge and sea water temperature are higher than normal for spring. Such conditions cause acceleration of phytoplankton productivity, an increase of suspended matter content and transparency attenuation.

Also in the work there are shown features of the hydrobiological fields in the shelf during different stages of ENSO event development and for different combinations of NAO and ENSO phases. Particularly, when anomalously cold winter associated

with ENSO event is followed by the positive NAO phase in spring, cyclonic activity, rivers' discharge and water temperature are usually lower than a seasonal norm.

Long-Term Changes of Physical & Chemical Characteristics of the Surface Waters in the Zmiinyi Island Area of the Black Sea

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Keywords: Black Sea, salinity, temperature, transparency, pH, oxygen

Abstract

It is known [1,2] that the natural factors like temperature (T), salinity (S), transparency (TI), pH and oxygen (O_2) are the basic parameters for assessments of marine ecosystems' state and marine environment quality. The aim of this work is to analyse the changes and to estimate the trends of main physical and chemical characteristics during 2004-2012 in the Zmiinyi Island area of the Black Sea. As the source material sets of the main principal physical and chemical marine water parameters' observations carried out by the Research Station "Zmiinyi Island" of Odessa National I.I. Mechnikov University in 2004-2012 were used. The main methods of observation and results' analyses are briefly described. Results of 2004-2012 studies of temporal distribution of the sets of physical (T, TI, S) & chemical (O_2 and pH) characteristics of surface waters for 2004-2012 are presented. Very high seasonal changes are shown for the observed T and S values. Minimal and maximal T values of surface water and bottom waters were very different, especially in spring and in summer time. The absolute maximal value of T in surface layer (29.00ºC), was registered on 14-18.08.2010, the minimal (0.64ºC) - on 2.02.2006. The average values for 2004-2012 were 18.32±0.35 for the surface and 17.59±0.27 for the bottom layer. The absolute maximal value of S (19.479

PSU) in the surface layer were registered on 21-22.09.2012, minimal (6.332 PSU) – on 6.05.2012. In the bottom layer, accordingly: 19.549 PSU on 22.09.2012 and 14.799 PSU – on 29.07.2004. The average values of S for 2004-2012 were 15.237±0.235 PSU for the surface and 15.698±0.201 PSU for the bottom layer accordingly. The values of pH in the surface water layer varied within 7.00 (15.11.2016) and 8.88 (10.12.2009) with the average value 8.36±0.08. Changes of pH in the bottom layer were almost similar: from 7.00 (25.11.06) to 8.97 (4.11.2009) with the average value 8.37±0.05. The values of O_2 concentrations in the surface layer varied during the observation period between 4.60 (5.07.2008) and 14.60 mg/l (21-22.12.2007) at the average value 8.03±0.32. At that, practically functional dependence of oxygen concentration on water temperature has been observed. Concentrations of O_2 on bottom layer varied from 4.54 (30.06.2006) to 14.55 (22.12.2007) mg/l, with the average value 7.74±0.27. The values of TI varied within 0.7 (in summer period) and over 8 m – practically all over the winter months. Results of statistical analysis and trends of studied parameters' sets, as well as characteristics of correlation analysis of their interrelations are presented. Vertical profiles of S, T, O_2 and pH in coastal waters of the Zmiinyi Island are analysed. Anomaly high O_2 concentrations on depths 10-15 m in 2010 are described. Significant positive correlation connection between S and transparency is revealed, which will enable us to use salinity and transparency variations for assessment of the stage of marine and river waters' transformation, as well as to assess indirectly the Danube flow influence. The study has been carried out in the framework of research activities funded by the Ministry of Education and Science of Ukraine (2011-2013) and as a contribution to the European FP7 project PERSEUS.

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Long-Term Changes of Nutrients Concentrations in the Surface Waters of Zmiinyi Island Area

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Keywords: Black Sea, nutrients, nitrogen, phosphorus

Abstract

As it is shown in our previous study [1] the quality of marine Black sea marine waters very closed with nutrients levels. The aim of this work is to analyse the changes and to estimate the trends of main nutrients concentrations such as nitrates (NO_3), ammonium (NH_4), nitrites (NO_2), total nitrogen (N_t) , phosphates (PO_4) and total phosphor (P_t) during 2004-2012 in the Zmiinyi Island area of the Black Sea. As the source material sets of the studied characteristics of marine waters sampled and analysed by the Research Station "Zmiinyi Island" of Odessa National I.I. Mechnikov University in 2004-2012 were used. The main methods of observation and results' analyses are briefly described. Results of definition of compounds of nitrogen and of phosphor concentrations in surface waters in Zmiinyi island area in the Black Sea investigations of 2004-2012 are presented. The main values of concentrations of observed nutrients illustrated by table 1.

Table 1. The minimal, maximal and average values of N and P compounds in surface and bottom layers of coastal waters near Zmiinyi island in the Black Sea

Compound	**Surface layer Concentrations [mg/l]**		**Bottom layer Concentrations [mg/l]**	
	Minimal - Maximal	Average	Minimal - Maximal	Average
NH4	0-634	77.5±15.0	1-291	58.5±13.1
NO3	0-617	48.6±6.6	0-460	41.6±5.7
NO2	0-32	3.5±0.4	0-38	3.4±0.4
Nt	7-4900	723±34	11-3530	620±29
PO4	0-154	9.0±1.2	0-205	8.3±1.1
Pt	1-230	21.0±3.4	1-503	22.5±3.1

Results of statistical analysis and trends of studied parameters' sets, as well as characteristics of correlation analysis of their interrelations are presented. It was shown that concentrations of P_t more as 100 mg/l were observed during January and October 2007 and May, August 2011 and August 2012. For the concentration of N_t distribution of high as 1000 mg/l concentrations were in other periods (January – November 2004, March-April and August-November 2006, April – August 2007, May, June and September 2008 and May-June, November and December 2012) and significant correlations with P compounds was not observed. It was described cases and analysed the reasons of high levels of nutrients concentrations in coastal waters. Practically all cases of increasing of concentrations of N compounds can be explain with advection of Danube river waters in area of Zmiinyi island. But the cases of high concentrations of P compounds practically is not connected with river waters inputs and the study of this phenomena is for future. The study has been carried out in the framework of research activities funded by the Ministry of Education and Science of Ukraine (2011-2013) and as a contribution to the European FP7 project PERSEUS.

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Inter-Decadal Variability of the Oxic Water Masses on the Romanian Black Sea Shelf

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Keywords: Black Sea, Cold Intermediate Layer (CIL), upper mixed layer (UML), thermohaline structure.

Abstract

The long-term changes in the water mass thermohaline structure during the last four decades (1971 – 2010) is analyzed using the data collected on the 55 km hydrological section, along the 44^0 10'N (NIMRD data base). For the middle months for each season (February, May, August and November), the changes of the temperature and salinity vertical distribution from one decade to another are relatively small. The upper mixed layer becomes warmer (about 0.1°C/year) while the cold-water mass temperature is practically constant. The air temperature increases with 0.05°C/year for the analyzed period. At the same time the salinity decreases by 0.02 – 0.03 PSU/year in the entire water column. The 8°C isotherm boundary of cold water mass is more appropriate for shallow waters as 70% of the upper limit densities are below 14.2 kg/m^3 and the average cold-water density in the summer period is only 14.24 kg/m^3

Influence of Wind-Driven Circulation on the Biological Productivity along the Western Black Sea

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Keywords: SCW, upwelling, algae bloom, chlorophyll-*a*, Black Sea, wind

Abstract

The paper is focused on the importance of the upwelling phenomena followed by the algae bloom on the Romanian littoral of the Black Sea in 2010-2012 years. The study area is Constanta site ($44^0$14′N and $28^0$38′E) on the Romanian Black Sea Coast, with significant touristic and recreation importance. On the western Black Sea, there are no permanent upwelling and downwelling events due to the high variability of the winds, although the prevailing once determines a north to south general flow. The western Black Sea is a rich nutrient area to which contributes the Danube River. Considerable amount of nutrients are preserved in the Shelf Cold Waters (SCW) during winter convection and the upwelling events result in a high bioproductivity of the seawater during summer. Low temperature and high salinity indicate strong upwelling conditions. The highest correlation is between sea surface temperature and the wind component normal to the coast. Taking into account the considerable special variability, the distribution of temperature and *chll-a* are analyzed. The data used are from the NIMRD (sea surface temperature, salinity,

chll-a), NMA (air temperature, wind) databases and the Modis–Aqua (http://oceancolor.gsfc.nasa.gov - 4km resolution).

Long-Term Variability of Wind Speed in the Coastal Zone of the Ukrainian Azov-Black Sea Region

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Keywords: wind speed, homogeneity, empirical mode decomposition.

Abstract

The aim of the present work is to investigate long-term variability of wind speed in the coastal zone of Azov-Black sea region using the data from routine observations on the network of maritime stations of the Hydrometeorological Service of the Ukraine. The information on wind speeds over 17 coastline maritime stations was used over the whole available period of observations (for several stations the available period starts from the end of the 19 century) of the following time resolutions: wind speeds measured per 4 or 8 hours (intra-day resolution), daily- and monthly-averaged speeds. In order to reach the goal the following tasks have been solved:

Cross-check of the dataset of wind speeds for homogeneity on the level of intra-day, day- and month-resolution. The procedure for homogeneity cross-check was accomplished by using Penalized Maximal *t* and *F* tests [1]. Significant inhomogeneities were found as a consequence of the influence of the following factors: multiple changes of the height of mounting of the windspeed-measuring

device and the type of measuring device, changes in station location, building of the adjacent to the wind-observing place territory. The main difficulty in accounting these factors is incompleteness of the available information (metadata) on all changes in the protocol of observations on each particular station before the 50-ies of the 20 century. It was found that after re-calculation of the wind speed dataset to standard height of mounting of windspeed-measuring device (10 m) and removing of the detected changepoints, the wind-speed dataset may be considered homogeneous starting from 1954. Pre-1954 period can be used with awareness of unexplained inhomogeneities affecting climatic variability conclusions;

By using the empirical mode decomposition (EMD) approach [2] the intrinsic modes of long-term variability of monthly-averaged wind speeds were extracted. The negative trend in the overall structure of the wind-speed variability was found to dominate, being characteristic to the majority of the studied stations and originating from gradual urbanization of the coastal zone and increase in surface roughness during the whole period of observations, as well as due to alterations in atmospheric circulation [3].

Comparative analysis of the EMD modes for the stations with different urbanization rate and/or surface roughness enabled to qualitatively separate the contributions of the above-mentioned factors of wind stilling.

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Space-Time Variability of the Wind Stress Curl and Wind Direction over the Black Sea

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Keywords: the Black Sea, long-term variability, wind stress curl, wind direction

Abstract

A connection between the wind stress curl and wind direction in the Black Sea is examined on annual and interannual scales. The 6 hrs wind and sea level pressure from NCEP-NCAR reanalysis 1948–2012 are used. It is found that the north-easterly winds are the most frequent and south-easterly winds are the less frequent for that period. The high positive values of wind stress curl (cyclonic vorticity) are accompanied by the north-easterly and easterly winds. Cyclonic curl is at a maximum in the eastern part of the Black Sea. The mean negative values of the wind curl (anti-cyclonic vorticity) correspond to the westerly winds and south-westerly winds. In this case the area with the anti-cyclonic vorticity mostly occupies the central and southern parts of the sea. The north-easterly winds are typical for the pattern associated with the high sea level pressure located to the north of the Black Sea and the low sea level pressure situated to the south of the sea. At the multidecadal scale the occurrence of the easterly and north-easterly wind directions tends to be lower, while the occurrence of the westerly and south-westerly wind tends to be higher.

Decadal Variability of Precipitation Inequality Over the Black Sea Coastal Zone

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Keywords: daily precipitation, concentration index, Pacific Decadal Oscillation, North Atlantic Oscillation.

Abstract

Recent results of many authors demonstrate that Pacific Decadal Oscillation (PDO) and Atlantic Oscillation (NAO) are the indicators of global and regional climate change. The *aim* of paper is to study the variability of precipitation inequality over the Black Sea coastal zone associated with PDO.

Data and method. Daily precipitation data observed in 1951 – 2005 at the Black Sea coastal hydrometeorological stations from European Climate Assessment & Dataset (ECA&D) (http://eca.knmi.nl/) and National Climatic Data Center National Oceanic and Atmospheric Administration (NOAA NCDC) (http://www.ncdc.noaa.gov/) were used in the study. Concentration index (CI) method presented by J. Martin-Vide in [1] is applied for analysis of daily precipitation concentration. The CI shows the contribution of the days of greatest rainfall into the total amount. CI was obtained for the year and all the seasons for negative (1950 – 1976) and positive (1977 – 2000) PDO phases.

Results. PDO manifests itself in the regional decadal anomalies mainly through the processes of atmospheric circulation including the cyclones. At the same time precipitation inequality is associated with cyclonic activity. It is true and for the Europe and Black sea region. Mechanism of cyclonic activity over the Europe is known as NAO switch. In positive PDO phase NAO is intensified. The tracks of Mediterranean cyclones shift to the Northern Europe. Negative PDO phase is accompanied by NAO weakening when cyclones trajectories are over Central Europe, including Black Sea and its coastal regions. In this case for most Black sea stations, except Crimean Mountain, the CI values are higher in all seasons and year.

Such example demonstrates Fig. 1. There are presented CI values at the Izmail station in positive and negative PDO phase for the year, winter, spring, summer and winter.

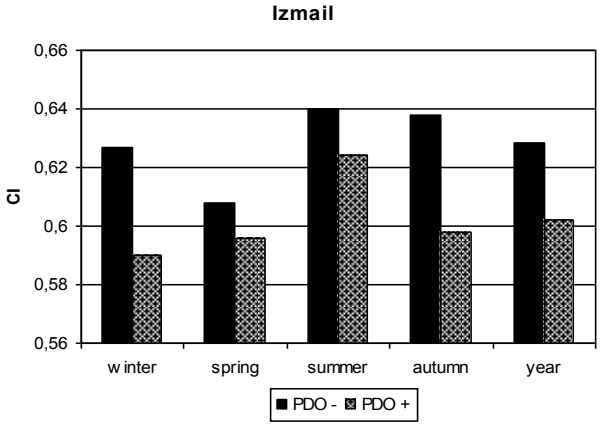

Fig. 1. CI values in negative and positive phases of PDO

Conclusions. The decadal variability of precipitation inequality over the Black Sea coastal zone is associated with joint effects of the processes in the ocean-atmosphere systems in the Atlantic and Pacific Oceans.

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Session 6 Ecosystem Modelling

Topics:

- **Recent ecosystem modelling activities in the Black Sea region**

Modelling the Long-Term Variability of the Black Sea Dynamics

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Keywords: numerical modelling, Black Sea, circulation, ecosystem

Abstract

The aim of the work was to simulate long-term evolution of the Black Sea dynamics and ecosystem (1980 - 2020) by means of numerical modelling. The model of the Black Sea circulation is z-coordinate model with 4.8 km horizontal space resolution and 40 levels in vertical direction. Mixing processes in the upper layer are parameterized with Mellor-Yamada turbulent model. The most important parameter for simulation dynamical processes is atmospheric forcing. In this work we used atmospheric forcing functions for the Black Sea region provided by CMCC using regional climate model COSMO-CLM in the frame of PERSEUS project. These data have a spatial resolution of 14km and a daily temporal resolution. To evaluate quality of the Black Sea circulation dynamics driven by CMCC atmospheric forcing the modelling results are compared with the set of 3D hydrographical fields prepared in MHI as a result of reanalysis of the Black Sea dynamics. This reanalysis was performed by assimilating the temperature and salinity profiles from

hydrographic surveys conducted during 1971-1993 into the regional circulation model. The comparison was carried out for the time interval when these data are available (1980 – 1993). Results of the modelling on the circulation model are used then as input parameters in the lower trophic level model (LTLM) of the Black Sea ecosystem.

Water Security in the Azov Sea Basin: Assessing the Ecosystem Goods and Services of the Tsimlyansk Reservoir

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Keywords: water security, SWAT, Environmental Modelling, Azov Sea, GIS.

Abstract

The assessment of currently available water-related ecosystem goods and services (EGS) and their future availability is required to incorporate ecosystem approach into policy-making process. Good quality and adequate data and the analysis of data using various assessment and modelling methods and tools are required for such estimations.

This research focuses on the Azov Basin representing unique and important watershed in the Black Sea Catchment. The Tsimlyansk reservoir, the largest freshwater body in the Azov Sea basin playing the key role in provision of water related EGS in the region has been chosen as a case study. Located in the middle Don River it controls the entire basin multipurpose water management scheme by redistributing the annual Don River flow. The reservoir plays an important role within national development strategies, e.g. construction of the new Volga-Don shipping canal or industrial water supply. However, according to various evaluations possible changes in climate and regional anthropogenic activities upstream will decrease the water inflow to the reservoir threatening water security in the entire

basin. The main objective of the research is to assess prospective changes in runoff generation in the

Upper Don River catchment, the main water source for the Tsimlyansk reservoir.

Different integrated environmental models are available to analyze data, required for the EGS estimates and the development of future EGS projections. The Soil Water Assessment Tool (SWAT) is one of such integrated modelling frameworks.

The Upper Don River sub-catchment has been chosen for analysis as a vital component of the Azov ecosystem generating water inflow for the Tsimlyansk reservoir, the largest freshwater body in the basin and major EGS provider. The SWAT model was developed for the study area and output data were used for assessing water-related EGS.

Scenarios on land use and climate change developed by EnviroGRIDS project, using data for 2050 have been formulated and analyzed with developed SWAT model. Corresponding change of water inflow has been analyzed; recommendations for decision-makers have need developed.

Four scenarios of potential regional development including land use and climate changes have been formulated and analyzed with SWAT model. Results were used to assess the change of water-related EGS in the Upper Don River by 2050. It was found that according to all scenarios the annual water yield, baseflow and surface runoff in the Upper Don River sub-catchment will decrease, and as a result the streamflow supplying the Tsimlyansk reservoir will be reduced by 28-36%.

Based on the assessment the recommendations for researchers applying SWAT for EGS assessment and the Azov Sea basin decision-makers have been developed. The projected changes in the water supply to the reservoir compromise the EGS provision for the entire Azov basin that should be taken into account while developing strategies on water security in the region. The model and associated datasets can be used for further studies of the Azov ecosystem.

The study contributes to the FP7 Project "EnviroGRIDS: Building Capacity for a Black Sea Catchment Observation and Assessment System supporting Sustainable Development".

Assessment of the Romanian Alpine Habitats Spatial Shifts Based on Climate Change Prediction Scenarios

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Keywords: Climate Change , Maxent, DIVA-GIS, ecosystems distribution, high priority habitats, data sharing

Abstract

Shifts in the ecosystems distribution as results of climate change is of interest for decision-makers in biodiversity conservation at local and European level. This paper presents the use of modeling technique, MAXENT and BIOCLIM (DIVA-GIS), to estimate the impact of climate change on Alpine bioregion of the Continental Europe for improving the management policy in support of stopping the biodiversity lost. The output environmental data and model results are seen at developing a Black Sea Catchment Observation Systems to be further use by scientists, decision-makers and the general public in the Black Sea Catchment.

Priority habitat 6230 occurring in mountain areas and sub-mountain areas of Carpathians was selected for modeling being indicated as sensitive to climate changes (Harald et al. 2008) and of high priority conservation statutes of Natura 2000 list. Input biodiversity layers showing the occurrence of grassland alliances polygons was extracted from Grassland database of the Romania that cover 650,000 ha on four Black Sea basin bioregions, Alpine, Continental, Pontic and

Steppic and include 151149 records. The 6230 habitat is covering in the alpine area 28841 ha and include 123 with high conservation statutes.

The climate database used (1950-2000 for potential distribution and 2000-2050 for potential impact) is Worldclim (Hijmans et al. 2005) which uses 19 derived bioclimatic variables in addition to monthly climate data (maximum and minimum temperature and precipitation) together with the supplementary Romanian digital terrain model, slope and soil layers.

Methological approach in using Entropy Ecological Niche Modeling for deriving actual habitat requirements and assessment of sensitive habitat shifts under climate change prediction is novelty of the paper.

The resulting distribution fits the provided occurrence data very well (AUC of test partition > 0.9) for both models. Scenarios of climate change impact are highlighted by maps showing disappearance and shift of the sensitive habitat 6230 of some Alpine area on the Black Sea catchment basin.

Use of Optimization Method of Hooke-Jeeves in the Calibration of Biogeochemical Model Parameters

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Keywords: biogeochemical modeling, biogenic elements, phytoplankton, optimization methods, method of Hooke-Jeeves.

Abstract

The use of optimization method of Hooke-Jeeves in parameters' calibration of one-dimensional variant of water quality model MECCA for forecasting dynamics of phytoplankton, organic phosphorus and nitrogen, ammonium and phosphates on surface water of the Sevastopol Bay area is described. Method of Hooke-Jeeves is

based on search of a functional minimum by direct method consisting of step sequence of exploring search around the base point which is followed by pattern search in case of success. The model equations include eutrophication block parameters (specific rates of chemical and biological processes) and empirical equations. The coefficients of empirical equations describe the variability of these parameters which depend on the environmental characteristics and external factors. Furthermore, varying the parameters in possible range and minimizing the sum of square deviations of modelling data and data in situ we attempted to achieve the best model results and observational data. Data obtained during computing experiment with (solid line) and without calibration (dotted line) is compared with in situ averaged data received in 2001-2005 (points) (Fig 1). Conclusion about the improvement of a model result is drawn.

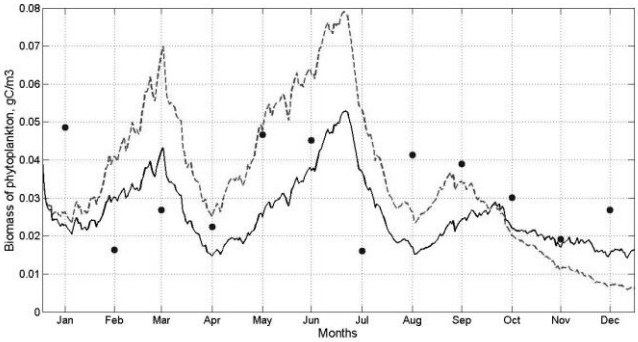

Fig. 1 Annual dynamics of phytoplankton in surface water of the Sevastopol bay

The Algorithm of Potential Abundance (Biomass) Assessment of Fish Benthophage Species in the Danube Lakes (Ukraine) Based on Macrozoobenthos

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Keywords: model, potential abundance, benthophage fishes, macrozoobenthos, Danube Lakes

Abstract

There are a lot of guidelines and methodologies, used in fish-farming, to study fish feeding in water bodies. To assess the fish productivity in artificial reservoirs a feed conversion rate is used. It has a large range of variation of values due to which the peculiarities of a particular species of fish and dynamic of environmental factors in the reservoir might not be taken into account. This approach provides sufficiently objective assessment of fish production in reservoirs that are under human control, which allows people to influence significantly on the state of feed base. But this method could not be applied in natural waters, because it does not take into account the nutritional needs of all species of fish, their trophic relationships in ichthyocenosis and fluctuations of environmental factors.

The Danube Lakes is the largest region of wetlands in Ukraine with great fisheries potential, which nowadays have not been used successfully. The proposed method estimates potential abundance (biomass) of benthophage fishes of the Danube Lakes on the base of macrozoobenthos state. It consists of studying of the feed base of the waterbody and nutrition of fish, analysis of their sexual and size-age composition. Firstly, total production of all feeding macrozoobenthos is estimated for the whole vegetation period per one hectare of the water body. At this stage quantitative parameters, caloricity, temp of reproduction of natural feeds that are in the waterbody and the allowable degree of recycling of organic matter is considered.

On the next stage separately for each age groups (taking into account sex) of all species of fish the value of energy necessary for their vital functions and optimal growth is calculated. Then, on the base of relative age of the population by the average value of the diet for each fish is calculated. Further, taking into account the relative composition of species in the reservoir the weighted average diet for all fish in general is calculated. Using this value and the total production of all feeding macrozoobenthos, the potential total number of fish and the number of individuals for each species separately is found. In addition, on the base of catches the average weight of sample and the total biomass of each species of fish is determined.

This algorithm takes into account the biological and ecological characteristics of the studied species and fluctuations of environmental factors. Therefore, it provides a higher precision compared with methods used in fish-farming and are based on the calculation of the total amount of feed conversion rates.

The calculated value does not show the actual number of fish living in the water body. It points to the possibility of its feed base, that is, determines the maximum number of fish individuals in population at a certain ratio of species in the reservoir, which may feed in this aquatic ecosystem.

Abstracts of the International Symposium

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- Eugen BOLA, Constanta County Prefect
- Decebal FAGADAU, Vice-mayor of Constanța
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Plenary Session

Report on the State of the Marine and Coastal Environment in 2012

DIRECTOR, SCIENTIFIC DIRECTOR,

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KEY WORDS: Black Sea, Romanian coastal area, eutrophication, contamination, biodiversity, endangered species, habitats, protected areas, marine living resources, sustainable development, maritime spatial planning, anthropogenic pressures

Abstract

The state and evolution trends of the Romanian Black Sea coastal environment were monitored in 2012 from the physical, chemical and biological point of view, compared to the reference periods dating back in the early 1960s or in more recent years.

During the winter of 2012, as a follow-up of low temperatures during January-February along with an exceptional storm, specific ice structures - ice pegs,

grouped in ridge steps - developed on the entire area of the beach, continued by ice belts. For the northern sector of the coast, the accumulated areas covered ~74 ha, while the eroded areas covered ~153 ha. The shoreline advancement by >10 m was reported on ~12% of the total length, shoreline retreat by >10 m on ~52%, the rest of the coast being in dynamic balance - the shoreline retreated or advanced by less than +/- 10 m.

Sea level showed in 2012 three distinct fluctuation stages in relation to the monthly multiannual means (1933-2011). Thus, during January - April, the level was below the monthly multiannual means, during May to September the values exceeded slightly the monthly multiannual means for these months. In September and October, the monthly multiannual means were almost equal to the monthly multiannual means for these months, while during November and December the monthly multiannual means were again exceeded.

Marine water temperature in 2012 was 1.57°C higher compared to the reference period (1959-2011). For the western part of the Black Sea, three characteristic water masses were pointed-out: the quasiomogen upper layer (SSQ), the cold intermediate layer (CIL) and the seasonal thermocline. In autumn (October), the cold intermediate layer reaches depths beyond 25 m.

The sea state is due to the frequency of waves higher than 1 m. From this point of view, the maximum height of 6.00 m was reported in February, while the predominantly calm, wind wave and swell periods were reported in March, June and October.

The sea ice phenomenon occurred in the winter of 2012 in the last decade of January and the first decades of February, when littoral zone temperatures dropped below freezing point (-0.8°C).

During summer, three upwelling phenomena were recorded in the coastal area (May and June), caused by the dominant western and south-western winds.

The transparency value distribution points-out the high variability range of marine waters, which, in the northern area, are still under the influence of river input.

The surface salinity varied within the typical variability range of waters in the Romanian Black Sea coast, being influenced mainly by river input, lower in 2012.

During the studied period, the water masses of the Western Black Sea were well oxygenated in all three layers. In the water column, there were some values below the allowed limit (80%) both for the ecological state and the human activity impact area stipulatedin Order 161/2006. No anoxia phenomena were reported in 2012.

The pH of Romanian Black Sea waters ranged within normal limits.

All maximum values of phosphate concentrations were reported at the surface, in stations under the influence of Danube input or of the Constanța urban area. With 93% of the values below 0.60 µM, phosphate concentrations at the Romanian coast showed, during the studied period, values close to the reference period of the 1960s. In 2012, the multiannual mean monthly concentrations of nitrates (April and October) recorded the lowest values measured since 1976. Nitrites also recorded low values, ranging between 0.02 (LOD) - 1.68 µM (mean 0.28 µM). Ammonia concentrations recorded values ranging between 0.31 - 46.47 µM (mean 4.40 µM). The mean annual concentrations of silicates in seawater in Constanța ranged between 6.7 µM (1993) - 66.3 µM (1972) and, in 2012, they recorded the lowest value of the past 20 years, namely 7.7 µM.

In 2012, the mean annual content of chlorophyll *a* in coastal waters recorded a value close to 2011 (3.67 µg/l compared to 4.91 µg/l), but below the annual mean calculated for the period 2001-2010 (6.27 µg/l), thus confirming the recovery trend of the ecological state of the Black Sea costal ecosystem.

Heavy metal contamination of coastal areas may be directly correlated with urban or industrial sources, such as factories, thermo-electric plants, harbors, water treatment plants. River influence on the coastal area is significant, being a major source of metals, mainly as particulates, extreme hydrological events (floods) enhancing such an input. The distribution of metals in waters and sediments from the transitional, coastal and marine areas highlighted the differences between different sectors of the coast, generally being reported slightly elevated concentrations in some coastal areas subject to different anthropogenic pressures (harbors, sewage discharges), but also in the marine area under the influence of the Danube. The concentrations of most heavy metals in water, sediment and biota generally framed within the variation range of mean multiannual values (2007 - 2011).

In 2012, low values (<200 µg/l) of the total petroleum hydrocarbon content - TPH (µg/l) were determined in water samples. The distribution of concentrations on water body types did not point-out any significant differences between the means of the three water bodies, yet the highest values were recorded in marine waters. The petroleum hydrocarbon pollution level of 2012 is significantly lower compared to the period 2006-2009. In 2012, the decreasing trend of hydrocarbon concentrations in investigated environmental components recorded lately (2010-2011) was continued.

In 2012, the analysis of polycyclic aromatic hydrocarbons (PAH) pointed-out high values for the following pollutants: pyrene, fluoranthene, anthracene, phenanthrene and benzo[a]anthracene. The mean values were within similar variation ranges compared to 2006-2011.

Concerning pesticide contamination, in 2012, littoral waters were dominated by lindane, for which the highest values were measured in most stations, both in transitional, coastal and in marine waters. The highest organochlorine pesticide concentrations were measured in transitional waters, mainly in the Portița area. However, high organochlorine concentrations were reported, though, in coastal waters between Constanța South and Vama Veche. In sediments pertaining to transitional and coastal waters, the dominant compounds were lindane, aldrine, p,p' DDT and its metabolites. The highest concentrations were recorded in sediments pertaining to transitional waters in the Sulina area. In biota, the bioaccumulation phenomenon was more intense for the species *Rapana* and *Mya*, for most investigated compounds. In 2012, both in water and in sediments, compared to 2006-2008, the decreasing trend of organochlorine pesticide concentrations of the past years (2009-2011) is maintained, for most investigated compounds.

With reference to the microbiological load, the situation identified during the 2012 summer season pointed-out an evolution of marine water quality depending directly on exceptional hydrological and weather conditions of the past five years (2008-2012), characterized by heat waves in summer, with very high temperatures of shallow marine waters. The maximum values of the analyzed bacterial indicators (>16,000 germs/100 ml) were identified, as in previous years, in areas influenced by waste water discharges, with a potential negative impact on the marine

environment and human health. In 2012, only the faecal streptococci exceeded regulated values.

2012 was characterized by a poor development of the phytoplankton community (the mean of phytoplankton amounts in spring $2.85 \cdot 10^6$ cel·l^{-1} and 1.06 g·m^{-3} and in autumn $96.6 \cdot 10^3$ cel·l^{-1} and 0.38 g·m^{-3}), while algal bloom phenomena were absent throughout the year, except for the developments of the diatom *Skeletonema costatum*, characteristic for the marine ecosystem in spring.

The mean density and biomass values of non-trophic zooplankton recorded lower values compared to previous years, also due to the fact that its maximum development season (summer) was not sampled (the surveys performed only reflect the structure of zooplankton in spring and autumn). The trophic component recorded the maximum development values near the shore, in the southern part of the coast, both in spring and in autumn. 30 taxa belonging to 12 taxonomic groups were identified in the qualitative structure of zooplankton, the highest number since 2004 to the present.

In the summer of 2012, 20 taxa were identified, divided as follows: 9 species belonging to the Chlorophyta phylum, 1 species - Phaeophyta phylum (*Cystoseira barbata*), 8 species of the Rhodophyta phylum (7 species and one variation, namely *Ceramium rubrum* var. *barbatum)* and 2 phanerogames (*Zostera (Zosterella) noltei* and *Stuckenia pectinata*). The dominance of green opportunistic algae was reported in the northern sector of the Romanian coast and the occurrence of the brown alga *Cystoseira barbata* in Mangalia, 2 Mai and Vama Veche, where it is known that marine waters have a better quality, allowing the recovery and development of this key-species for the marine ecosystem. In Mangalia, in summer, well developed *Cystoseira barbata* thickets were reported.

In 2012, 52 macrozoobenthos species were identified, the fauna array maintaining the features of previous years. In 2012, a higher species diversity was reported in transitional waters, where 43 macrozoobenthos species were identified, comparable to 2011. The multiannual trend of the number of species identified in the Romanian Black Sea waters showed a slight, but continuous trend of qualitative balancing. The assessment of benthic community response to anthropogenic pressure on the marine environment quality was made using the biotic indexes (AMBI and M-AMBI) and the mean values obtained for the water bodies investigated during 2011-2012

showed a moderate quality state, with slight trends towards a good state in the south of the coast, less influenced by eutrophication.

The state of biodiversity was defined by the occurrence of 300 species, compared to 200-300 identified during the past 15 years (700 sp. throughout the entire period): 26 endangered species of the 48 in the Red List.

The pressure was expressed by 29 alien species, 8 commercially exploited species (2 molluscs and 6 fish) and 12 anthropogenic activities.

The Red List of marine species was fully updated in 2008 and just for fish in 2009.

It comprises 220 species, listed in 8 IUCN categories: 18 macrophytes and angiosperms, 56 invertebrates, 141 fish and 4 mammals. The IUCN classification of fish species was fully changed in 2009.

Among the 30 species identified in 2012, 3 are rated Vulnerable VU (*Acipenser stellatus, Trachurus mediterraneus ponticus* and *Alosa pontica pontica*), 13 are rated Nearly Threatened NT, and 6 are Data Deficient (DD).

In 2012, the industrial fishery activity in the Romanian Black Sea sector was made in two ways: active gear fishing, with coastal trawler vessels, up to 20 m depths, and fixed gear fishing, practiced along the coast in 18 fishing points, between Sulina - Vama Veche, in shallow waters, 3 - 11 m/trap nets, and also at 20 - 60 m depths/gillnets and longlines. The population structure shows, as in previous years, the occurrence in catches of a great number of species (more than 20), of which the most significant are small-sized species (sprat, anchovy, whiting, horse mackerel, gobies), as well as larger species (turbot and Danube shad). We point-out the low share of dogfish, garfish, mullet and bluefish, and also the occurrence of isolated individuals of blue mackerel and bonito. After a decreasing trend during 2002-2010, when catches dropped from more than 2,000 tons in 2002 to 1,390-1,940 t, during 2003-2006, and below 500 t during 2007-2009, reaching a minimum value in 2010/258 t, in the past 2 years the catches recorded an increasing trend, namely 568 t, in 2011, and 835 t, in 2012.

Since December 2011, NIMRD took again into custody the marine protected area "Vama Veche - 2 Mai Marine Littoral Aquatory" for a period of five years, by Agreement no. 306/13.12.2011, concluded between MEF and the Institute.

Researchers and technicians from the Institute provided permanence during this peak summer season period, carrying-out, besides research and monitoring the parameters and state of the marine protected area activities, ecological education and awareness raising activities, by lecturing and distributing brochures and flyers with information on the marine reserve and the marine environment in general. Communication and awareness raising activities are some of the pillars of the custodian team activity. For such purposes, information flyers with the description of the Reserve were drawn-up and printed, distributed both to tourists in the area and during various events hosted by NIMRD.

In 2012, research aiming at identifying and classifying the marine habitats in the two newly designated marine sites at the Romanian coast were performed, namely *ROSCI0281 Cape Aurora* and *ROSCI0293 Costineşti - 23 August*.

In 2012, the following results were obtained in the field of MSP: setting-up the legal framework in fisheries, adaptable and easy to update; identifying the international legislation harmonized at national level, drawn-up and/or under implementation in Romania; setting-up the integration of marine fisheries in the field of maritime spatial planning; identifying the specific situations concerning conflicts (national and international) and pointing-out support-issues to solve case studies; creating maps, photographs of the main coastal activities in land and marine protected areas, the thematic and integrated marine uses - in the field of fisheries, as well as the distribution of the most important species in the Romanian and Bulgarian maritime area.

Concerning the Integrated Coastal Zone Management activities, at EU level, during 11-12 September 2012, NIMRD was part in the Joint EIONET and Member State Expert groups on Maritime Spatial Planning and Integrated Coastal Zone Management, organized by the European Environment Agency - Copenhagen (EEA). At national level, the National Committee for Coastal Zone Meeting convened in September 2012 and projects in the coastal zone were debated.

The main anthropogenic pressures were dealt with in extenso in the *Initial Assessment of the Marine Environment State*, pursuant to Article 8 of the Marine Strategy Framework Directive. Thus, at the Romanian Black Sea coast, several economic activities and users of the marine environment, acting directly on it, were identified. The local pressures generating organic substances/pollutants are

concentrated in the southern part of the Romanian Black Sea coast, this area being the most developed from the industrial and urban point of view.

* * *

The state and evolution trends of the Romanian marine and coastal environment were monitored in 2012 from the physical, chemical and biological point of view, compared to the reference period of the 1960s and more recent data.

The state of the marine and coastal environment in 2012 confirms the general trend of slight improvement of the monitored parameters.

With the aim of protecting and preserving marine biodiversity, the national and European coherent marine protected area network was developed in 2012, by the designation of 2 new sites: ROSCI0281 Cape Aurora and ROSCI0293 Costineşti - 23 August.

The synthesis of data for 2012, compared to historical data, on the state and evolution trends of the Romanian coastal and marine environment, is part of the "Romanian Environmental Factors State Report".

Active Protection of Coastal Areas Against Erosion Using Multifunctional Mobile Platforms

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KEYWORDS: coastal erosion, wave energy, mobile multipurpose marine platforms

Abstract

The Romanian coastline is extending for over 240 km along the NW side of the Black Sea. The most affected by coastal erosion is the northern part of the coast line. In the last 35 years there are areas on the shoreline that have been retreated inland, between 180 to 300 meters and is estimated that on average 80 ha of beach are lost per year. Similar issues have been noticed also in the southern part of the shoreline, where tourism has important contribution to the economic activities.

The paper is presenting an advanced concept for the active protection of costal shore lines by using on site conversion of the energy of wave and marine currents to power and to use it for generating "damping waves". The study has been developed based on existing patents for the development of a state of the art experimental platform for the protection of coastal areas by means of passive damping, active damping and flow deflection.

The concept of a multipurpose platform integrating also energy accumulation functions shall be presented. There are also studied aspects related to technical feasibility and issues related to the compliance with the existing regulations.

A Data Assimilation Scheme to Improve the Wave Predictions in the Black Sea at the Entrance of the Danube Delta

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KEYWORDS: Danube Delta, data assimilation, buoy, successive correction method, SWAN, wave modeling

Abstract

Numerical wave models based on the spectrum concept have been continuously developed and improved and nowadays quite accurate hindcast and forecast products can be delivered. The use of such models presents the advantage that provides information concerning the sea states on extended geographical areas unlike the in situ measurements that are limited usually only to few locations. Nevertheless, the models may contain also several inaccuracies and in situ and/or remotely sensed wave measurements can be used in combination with the wave model results to derive estimates of the expected values of the sea states by developing data assimilation procedures. A SWAN based modelling system was implemented and focused on the various coastal areas from the Romanian nearshore, including the area at the mouths of the Danube. This sector is very important for the coastal navigation since it represents the main southern entrance in the seventh pan European transportation corridor. In order to assess the effects of the wave current interactions in this area, numerical simulations are performed also in a high resolution computational domain, which is connected to the global wave prediction system implemented for the entire Black Sea basin. For increasing the accuracy of the wave predictions in this high resolution SWAN domain, a data assimilation scheme is currently being implemented and tested. The procedure considers the assimilation of the buoy data in terms of significant wave height. A recursive data processing algorithm based on the successive correction method was developed to improve the model predictions close to the location of the buoy. The assimilation of the buoy data is going to be performed at three levels: time,

geographical space and spectral space. This procedure allows corrections to the boundary conditions considered for the high resolution computational domain implemented in the vicinity of the entrance of Sulina channel. In this way, the results of the wave prediction system based on spectral models become more reliable and this concerns especially the cases when the wave predictions are usually less accurate, as for example the storms. The work is still ongoing and the methodology under development can be extended to other coastal areas with high navigation, as for example the vicinity of the major ports.

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Marine Fish Farm in Recirculating System

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KEYWORDS: market demand, turbot, fish farm, juveniles, recirculating system

Abstract

In May 2008, SC ELCOMEX AQUA SRL started the proceedings for establishing the first fish farm for turbot at the Romanian Black Sea coast. While market demand for this high quality native fish, European funding for this type of projects and the worldwide development of rearing technologies in state of the art recirculating systems were the main drivers in establishing this investment, its completion, marked by the first population with turbot juveniles, in January 2013, showed that the path of this project from idea to fulfillment was neither short, nor easy.

The development stages of this project include:

- Identifying and selecting the providers of technology and turbot juveniles, along with analyzing their compatibility with the conditions at the Black Sea;
- Selecting and purchasing the land which met the conditions required for such an investment;
- The construction proper of the fish farm, in parallel with practical training stages of the staff on the rearing, breeding and maintaining the health of turbot in various institutions in the field in Europe.

The estimated yield of the fish farm is 150 tons/year, in 50 rearing tanks, permanently monitored with a fully automated control system.

Poster Session I - Oceanography and Coastal Engineering

Evolution of the Black Sea Shore in the Danube Delta Biosphere Reserve Area

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KEYWORDS: delta beach, morphodynamics, erosion, accretion

Abstract

The intensification of erosion at the Romanian Black Sea coast has resulted in the implementation of measures for protection since 1962. So, in this sense, in the shore area included in the Danube Delta Biosphere Reserve, 60 topographic concrete landmarks were placed in 1962. In 2012, only 16 landmarks were measured (for two landmarks, their status is unknown). Based on the measurements made on the landmarks, changes from the land - sea interface for 50 years have been estimated. This way, two zones with accretion and erosion were analyzed. The accretion phenomenon is for 25 km of shoreline length with a maximum value of 250 m for CSA 28/1962. Erosion processes occur for about 95 km of shoreline length, with an evaluated value over 600 m for the CSA 50/62 transect. Of the 115 km of shoreline studied during 1962 - 2012, coastal erosion was prevalent and was determined on about four times greater seashore length than the accretion phenomenon.

Sea Level Oscillations and Methodological Implications in the Coastal Dynamics Assessments

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KEYWORDS: sea level, geomorphology, Danube input, sea water temperature, air temperature, flooding, beach erosion

Abstract

This paper aims at establishing the relationship between sea level and changes occurring in the coastal zone as a follow-up of the evolution of this parameter. For the Romanian Black Sea coast, with a specific geomorphological and bathymetric configuration, the influence of sea level manifests differently from one sector to another. As such, these two aspects must be considered when performing coastal dynamics assessments.

On the other hand, although sea level is influenced by the Danube input, it was found that, despite the Danube flow is decreasing, sea level continues to rise. Analyzing the evolution of sea water temperature and air temperature, we found that both parameters show positive growth trends, likely being the cause of the sea level rise and of the flooding of the coastal zone, thus favoring beach erosion.

Contributions to Achievement of a Video and Lighting System for Underwater Remote Controlled Vehicle

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KEYWORDS: Underwater video camera, video transmission, underwater lighting, LED lighting

Abstract

In order to achieve the video system there was chosen a video camera type often fitted to underwater investigation equipments by specialized underwater works companies. The overall dimensions of the sealed chamber are an important requirement for the design. The supply voltage of the underwater video system is 12V. The video signal is transmitted to the surface on a shielded cable and is played on a TFT AV, analog input type. The impedance and section requirements are not critical. The energy consumption of the camera is not exceeding 60 mA at 12 V (stabilized). The objective of the camera is small type "focus free", with good performance between 50 cm and (∞) infinity. Underwater lighting was achieved with LEDs. Camera's waterproof housing allows lighting LEDs mounting, concentric with the camera lens. The development of LED lighting system, placed in the same housing with the video camera, advantages robot size, reducing gauge.
LED lighting meet the needs of underwater higher quality image capture.

Nutrient Levels and Eutrophication of the Romanian Black Sea Waters (2006-2011) - Assessment Related to the Marine Strategy Framework Directive Implementation

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KEYWORDS: nutrients, eutrophication, Danube, Black Sea

Abstract

The assessment of the current nutrient levels and eutrophication of the Romanian Black Sea waters, as part of the Marine Strategy Framework Directive implementation, was based on data acquired during 2006-2011 from the monitoring network stations consisting of 36 stations along the Romanian littoral. Additionally, were collected daily (for chemistry) and bi-weekly (for phytoplankton) data from the Constan'a station. The trends were analyzed based on historical data (1964/1980-2011) from the East Constanța transect. The inorganic phosphorus content is influenced by the Danube's and WWTPs' input. Due to different flows, the fluvial input is more significant. On the long-term, decreased concentrations compared to the values of the 1960s, reference period for the good quality of the Romanian Black Sea waters, were observed. These low values give to phosphorus the feature of a limitative element for the phytoplankton's proliferation. The inorganic nitrogen content is mainly influenced by the Danube's input. Seasonally and on a restricted area, we found in the neighborhood of WWTPs higher ammonia concentrations. On the long-term, we observed the decreasing concentrations up to the level of 1991-1992, when the intensity of the eutrophication started to drop. Therefore, the intensity and number of the monospecific blooms have decreased, the mixed blooms phenomena and the increasing diatoms proportion in the phytoplanktonic populations occurred and, consequently, the eutrophication has been slightly reduced. Dinoflagellates' proportion was reduced, but still, in the

summer, they can reach 40% from the total phytoplankton. Thus, the ecosystem recovery is still fragile and could be easily destabilized by the influence of the anthropogenic pressures and climate changes.

Analysis of Hazardous Substance Contamination of the Marine Ecosystem at the Romanian Black Sea Coast, Part of the Marine Strategy Framework Directive (2008/56/EEC) Implementation

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KEYWORDS: Black Sea, heavy metals, organochlorine pesticides, polycyclic aromatic hydrocarbons

Abstract

The paper presents the contamination of the marine ecosystem with hazardous substances at the Romanian Black Sea coast. The assessment was done by analyzing the data obtained during 2006-2011, based on the indicators recommended by the Water Framework Directive (2000/60/EC), Marine Strategy Framework Directive (2008/56/EEC) and the parameters established by the Advisory Group on Monitoring and Assessment of Pollution of the Black Sea Commission. The distribution of contaminants (heavy metals, organochlorine pesticides, total petroleum hydrocarbons and polycyclic aromatic hydrocarbons) in the Black Sea marine ecosystem components show slightly increased concentrations in the water under the influence of the Danube and in the south, in certain areas subjected to different anthropogenic pressures (harbors, discharges of wastewater). Individual compounds concentrations show a decreasing trend in time, especially for organochlorine pesticides and polycyclic aromatic hydrocarbons.

Identification of the Sources of Polycyclic Aromatic Hydrocarbons in Sediments in the Romanian Black Sea Sector

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KEYWORDS: Polycyclic aromatic hydrocarbon - PAHs, pollution sources, Black Sea, sediments

Abstract

The objective of the study was to determine the concentration of total PAHs and to identify the potential sources of contamination in sediments from the Romanian Black Sea sector. Sixteen priority polycyclic hydrocarbons were identified and determined quantitatively in samples of sediment collected from marine areas (depths over 20 m) from the 12 stations located between Sulina and Mangalia, during 2011-2012. The total concentration of $\sum_{16}$ PAHs ranged from 82 to 6,983 (μg/kg) dry weight in sediments. The ratios of specific PAH compound including low molecular weight/high molecular weight, phenanthrene/anthracene, fluoranthene/(fluoranthene plus pyrene), anthracene/(anthracene plus phenanthrene), indeno(1,2,3-cd)pyrene/(indeno (1,2,3-cd) pyrene plus benzo(g, h, i)perylene) were calculated to evaluate the possible sources of PAHs emission into environment. These ratios reflect pyrolitic inputs in Romanian sediments.

The Wave Field Conditions in the Presence of a Hybrid Wave-Wind Farm Located in the Romanian Nearshore

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Keywords: Black Sea, hybrid energy farm, waves, wind turbines

Abstract

The objective of the current work is to evaluate the influence of a potential wave-wind farm operating in the local wave conditions from the Romanian nearshore, more precisely the sector Mamaia-Chituc. Some relevant case studies were considered in order to identify the evolution of the spatial sheltering effect in the presence of such a hybrid project, taking into account several wave conditions (average and energetic). In order to simplify the numerical simulations carried out with the SWAN model, the corresponding wind turbine tower and NEMOS system were considered as obstacles which modify the incident wave field pattern from the target area. From the analysis of the numerical simulations it was highlighting the fact that the shielding effect occurs mainly due to the NEMOS system, while the wind turbine towers present a local influence only. Beside the influence of the wave energy converter system, the modifications which occur in the target area depend also on the incident wave direction, the scale of the wave height and the characteristics of the local bathymetry. In addition to this, it was noticed that in the shallow water area the dissipative wave processes become more dominant than the influence of the hybrid farm.

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Poster Session II - Marine Ecology and Environmental Protection

Recent Data on the Benthic Populations from the Sandy Bottom Community in the Marine Zone of the Danube Delta Biosphere Reserve (ROSCI0066)

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KEYWORDS: zoobenthos, structural indicators, Danube Delta - marine zone

Abstract

ROSCI0066 Danube Delta - marine zone, a Community importance site, under the Habitats Directive 92/43/EEC requirements adopted by Decision 2009/92/EC, besides the SCI status, also has protected area status in the national network, it is RAMSAR site, UNESCO site and coresponds to the geographical unit of the Danube Delta Biosphere Reserve - Black Sea marine zone, from the Danube mouth - Chilia branch to Cape Midia, to the south and up to the 20 m isobath, to the east.

The marine zone of the Danube Delta is particular due to the major influence of Danube waters and sediments deposited by them, and here are found sedimentary habitats unique at the Romanian littoral. The habitats identified in *ROSCI0066 Danube Delta - marine zone* are: 1110 - *Sandbanks which are slightly covered by*

sea water all the time; 1130 - *Estuaries*; 1140 - *Mudflats and sandflats not covered by seawater at low tide.*

The paper presents the results of research conducted in ROSCI0066 concerning the qualitative and quantitative aspects of the benthic community that characterizes the sedimentary bottoms.

In order to conduct the study, samples were collected from 11 stations (Sulina - Vadu profiles), between 10 m and 17 m depths, during 2011-2012.

The analysis of structural indicators (species composition, frequency, abundance, biomass) allowed to underline some conclusions concerning the ecological status of the macrozoobenthos from the considered biocoenosis.

Compliance Level of the Waters Quality for Molluscs in the Black Sea According to the EU Legislation

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KEYWORDS: EU Directive 2006/113/EC, seawater, marine sediment, molluscs, Black Sea

Abstract

The paper presents the evaluation of the quality of the marine environment and of marine molluscs which was carried-out in year 2011 in the four designated areas by the EU Shellfish Waters Directive 2006/113/EC, for the growth and commercial exploitation at the Romania Black Sea coast.

The main species monitored were the mussel *Mytilus galloprovincialis* (Lamark, 1819) and the rapa whelk *Rapana venosa* (Lamark, 1819).

Water and sediment quality along the Romanian coastline in 2011 was, overall, in conformity with the Shellfish Waters Directive 2006/113/EC.

The level of conformity for salinity was 50% in Areas 1 and 2 from the northern part of the Romanian coastline, which are influenced by the Danube River freshwater input (95% required).

The level of conformity for lead in seawater was 66.70% in Area 1, 60% in Area 3 and 85.7% in Area 4 (100% required). For chrome in sediments, the level of conformity which was achieved was 66.67% in Area 2 and 75% in Area 3 (100% required).

The levels of all parameters analyzed in mussels were in conformity with the EU Directive requirements.

Assessing the Nematode Infestation Degree of Commercial Clupeids at the Romanian Coast

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KEYWORDS: parasites, nematodes, clupeids, commercial species, Romanian coast

Abstract

This paper presents the results of parasitology research on the nematode infestation of the main commercial fish species at the Romanian coast belonging to the family Clupeidae: *Alosa tanaica* Grimm, 1901 (Azov shad), *Alosa immaculata* Bennett, 1835 (Danube shad) *(*synonym *Alosa pontica pontica* Eichwald, 1838) and *Sprattus spratus* Linnaeus, 1758 (sprat).

The investigations were performed during 2012-2013 on fish caught along the Romanian coast from Sulina to Vama Veche, recording the following nematode

worm species *Contracaecum aduncum, Contracaecum sp., Anisakis sp., Porrocaecum sp.*, infesting the abdominal cavity of fish, free or fixed on internal organs, mainly the liver. *Contracaecum aduncum* was also identified as an adult in a low number inside the intestine. The dominant species were *Contracaecum aduncum, Contracaecum sp.* and *Porrocaecum sp.,* along which, sporadically, *Anisakis sp.* was also identified.

The parasite infestation degree, assessed by the values of parasitization intensities (number of parasites/fish) and parasitization extensions (% of fish infested of the total analyzed), was rather high (maximum values up to 20-50 parasites/host in 80-100% of the analyzed fish).

The Danube shad was the most parasitized, actually all analyzed individuals were infested by nematode worms, with intensities ranging between 10 and 50 parasites/host. The Azov shad showed parasitization extensions of 20-50% and sprat 20-60%, with intensities below 30 parasites/host, larger individuals being generally more parasitized than the smaller ones.

Comparison of the Effects of Natural Antioxidants - Vitamin E and Cătinofort (*Hippophae Rhamnoides* Natural Extract) - on the Body of Divers in Saturation

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Keywords: hyperbarism, saturation diving, oxidative stress, natural antioxidants, administration, effects

Abstract

The work presents the results of research performed in the Clinical Laboratory of the Constanţa Diving Center and emphasizes several aspects on the physiology of human adaptation to hyperbaric conditions. The novelty proposed by the paper is the preventive intervention by dosed and analytically controlled intake of adjuvants with antioxidant properties - vitamin E and CĂTINOFORT sea buckthorn extract. The results substantiate and suggest possibilities of applying these treatments to mitigate the effects of the oxidative stress related and inherent to working in hyperbaric conditions.

Spring Season Phytoplankton Communities in Romanian Black Sea Waters

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Abstract

Keywords: phytoplankton, Skeletonema costatum, Black Sea, Danube, spring

The present study analyzed the qualitative and quantitative phytoplankton composition in north-western Black Sea during 2001 - 2010 spring seasons. The results showed changes in the phytoplankton community, especially in the ratio between diatoms and dinoflagellates. The highest development was due to marine diatom Skeletonema costatum and dinoflagellates Heterocapsa triquetra. Following the analysis of samples collected from different locations and at different depths, highest diversity was found in the waters around the Danube mouths (Sulina, Sf. Gheorghe, Portita), both marine and freshwater-brackish water species. The main dominant species describing the phytoplankton communities were the diatoms - Skeletonema costatum, Chaetoceros curvisetus, Chaetoceros similis, Pseudonitzschia delicatissima, the dinoflagellates – Gyrodinium fusiforme, Prorocentrum micans, Peridinium minusculum and among chlorophytes, Scenedesmus quadricauda. These are species that produce frequently algal blooms. Regarding to the quantitative phytoplankton composition, diatoms registered high values of density and biomass, followed by dinoflagellates, chlorophytes, cyanobacteria and species belonging to other groups (Chrysophyta, Cryptophyta and Euglenophyta). These high densities were recorded in superficial waters, especially around the Danube mouths. The abundance of phytoplankton decreased offshore, to the south coast and in the lower water column layer. The diatom that developed massively, about 90% of total density and biomass was Skeletonema costatum. We also followed and correlated biological data with chemical and physical parameters to observe environmental conditions that influenced the phytoplankton community.

Seawater Treatment by Ion Flotation

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KEYWORDS: Seawater treatment, flotation, slidge, oil removal

Abstract

Seawater treatment requires more energy that most other water treatment methods. The flotation separation (Dissolved air flotation-DAF-) has received a considerable interest owing to its simplicity, rapidity, economy, good separation yields (%R > 90), a large possibility of application for species having different nature and structure, flexibility and fiability of equipment and processing for recovery purpose and production of more concentrated sludge, occupying smaller volumes. In this paper will be presented the performances expected with the flotation process (oil removal, dissolved organic carbon reduced, algae removal etc).

A Scientific Network for the Prevention of Environmental Hazards in the Black Sea Basin

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KEYWORDS: scientific network, natural hazards, risk assessment

Natural hazards can lead to Natural Disasters. Disaster Mitigation is a management process to reduce the impact of disasters on people and property. This process includes pre-event measures, actions during and immediately following an event and post-disaster measures. The key elements for natural disaster mitigation are Hazard Identification and Risk Assessment and Applied Research and Technology Transfer. Pre-event measures are the most cost effective, provided that they are based on accurate and Reliable Hazard identification and Risk Assessment, which in turn are based on accurate and reliable data, scientifically proven methodologies.
A Scientific Network for Earthquake, Landslide and Flood Hazard Prevention (SciNetNatHaz) has been established under the coordination of The Technological Education Institute of Serres, Greece, in the frame of Joint Operational Programme "BLACK SEA BASIN 2007-2013". The Partnership gathered 8 partners from Greece, Bulgaria, Romania, Turkey, Moldova and Ukraine. The global objective of the project is to achieve a strong regional partnership and cooperation by the Development of a Scientific Network for the establishment a scientific consensus, in order to setup common strategies and natural hazard prevention methods. The Scientific Network members work together sharing competencies and resources to address earthquake, landslide and flood hazards which does have Trans - boundary consequences both on the economy and on the environment. The project targets are the policy makers, local authorities, scientific community, non-governmental organizations, enterprises, having as final beneficiares: academic community, public authorities and the public. The estimated results are a cross boundary cooperation in preventing ELFH, a cross border know-how and expertise transfer, a WebGIS platform with a geodatabase freely accessed and training.

Poster Session III - Marine Living Resources

Evolution of Romanian Marine Fisheries Following EU Accession

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KEYWORDS: Black Sea, fleet, fishing gears, effort, catch, fishery legislation, recommendations

Abstract

The data presented in this paper are obtained by the National Institute of Research and Development (NIMRD) "Grigore Antipa" as a partner of the National Agency for Fisheries and Aquaculture (NAFA) within the National Fishery Data Collection Programs 2008-2012. The paper contains data regarding:

- Fishing areas;
- Structure of the fishing fleet, fishing gears and fishing effort;
- Number of employees in the marine fisheries;
- Qualitative and quantitative structure of catches;
- Influence of fisheries on the marine environment;
- Legal and institutional framework;
- Recommendations on the management of fishery resources.

State of the Romanian Black Sea Turbot (*Psetta maxima maeotica* L.) Resources

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KEYWORDS: catches, turbot, growth parameters, reproducers biomass, stock, management

Abstract

The paper presents the current state of turbot fishing at the Romanian Black Sea shore, based on the results obtained in the research made during 2000-2010. The investigations on the turbot populations in the Romanian sector focused on: catch evolution, fishing effort and C.P.U.E. (catch per unit effort), population structure, biological parameters and fishable agglomerations' biomasses. At the same time, the main biological characteristics of the turbot are presented, referring to the length class structure, mass and age. Also, the paper refers to the present trends in the evolution of the exploitable turbot stocks. At the end, the legislative frame in which the fishing activity takes place is presented, focusing on territorial waters and economical exclusive zone, the main reglementations being mentioned.

Ecological Methods for Improving the Epibiotic Biofilter in the Rocky Coastal Areas Affected By Anthropogenic Impact

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KEYWORDS: epibiosis, biofilters, bivalves, artificial supports

Abstract

The epibiosis that develops spontaneously in the Black Sea is composed of a cluster of organisms (mono/multicellular algae, protozoa, coelenterates, bryozoans, molluscs, crustaceans etc.), which, during juvenile stages, attach themselves on existing rigid surfaces in the water mass (natural or artificial), where they run their entire life cycle. The qualitative and quantitative structure of this epibiosis varies depending on the existing environmental conditions, but generally bivalve molluscs prevail, with over 80% of the total biomass.

The protection of these mollusc species severely affected can be made solely by applying legislation measures banning mussel harvesting in littoral areas, applying ecological biotechnologies for commercial epibiotic bivalves and using recovery programs well-coordinated and substantiated scientifically.

Knowing the major ecological role of the epibiotic biofilter in cleansing marine water and the fact that during the past decades its natural restoration in major social and economic interest costal areas was insignificant, it is required to find feasible and appropriate measures to ensure a controlled, fast and efficient rehabilitation of the rocky facies clogged as a follow-up of large hydrotechnical works, as well as of the filter-feeding epibiotic organisms, highly affected by anthropogenic impact.

The method elaborated consists in creating artificial supports convenient for the fixation of filtering epibiotic bodies, to be located in rocky facies sectors affected by clogging. The use of appropriate technical means will lead to the extension of the

support area of the above mentioned animals and, implicitly, will enhance significantly the water bio-cleansing capacity of the epibiotic filter formed.

The technical means used/artificial reefs for the rehabilitation of rocky bottom coastal area clogged by human activities are the following: concrete tiles, raw limestone blocks, hydrotechnical protection rigid elements - gabions - and submerged pyramid-shaped structures.

Based on the results obtained in experimental work on the sea water biofiltering capacity by epibiotic organisms, one kg of epibiotic filter-feeding juveniles, of which mussels are 90% of the reference amount, can cleanse, during a 24 hour cycle and up to 85 ÷ 90%, a volume of approx. 73 m^3 of sea water, with a phytoplankton load of approx. 18 mil. cells/liter.

This production technology of marine epibiosis on artificial supports is a purely ecological method, aimed at improving marine water quality in tourist coastal areas by means of local epibiotic biofilters.

Ecologically Efficient Solutions to Reduce the Dolphin By-Catches in Gillnets

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KEYWORDS: Black Sea, dolphins, turbot gillnets, dogfish gillnets, by-catches, pingers

Abstract

At the Romanian coast, as well as in other World Ocean areas, every year, tens and even hundreds of cetaceans die tragically as a follow-up of being accidentally by-caught in commercial fishing gear. The interaction between cetaceans and fisheries is an issue which may affect significantly the conservation state of dolphin

populations, by causing accidental death due to capture or entanglement in gillnet-type fishing gear. For such reasons, with the view to protecting dolphin populations, research has been carried-out to establish technical solutions to reduce accidental by-catches reported in gillnet-type fishing gear. One of these solutions is fitting the fishing gear with special ultrasound devices - pingers.

The Situation of Marine Litter Collected During Demersal Surveys in 2012 in the Romanian Black Sea Area

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KEYWORDS: Black Sea, marine litter, bottom trawl

Abstract

Currently, there are no national or regional programs for the strict monitoring of the existing litter on the seabed. However, adjacently, by carrying-out activities at sea (demersal trawlings,) the collection of wastes from the seabed was favored, which allowed a quantitative and assortment assessment thereof.

In general, the abundance and distribution of the existing marine litter on the seabed shows a considerable spatial variability. Their geographical distribution on the seabed is strongly influenced by hydrodynamics, geomorphology and human factors.

Romania, through the national pelagic and demersal fish species status evaluation program, was favored by trawling operations performed on the seabed to obtain data which allowed the quantitative and qualitative assessment of such wastes in the areas of activity.

Poster Session IV - Ecological Education

Environmental Assessment Training of Researchers from the Mediterranean and the Black Sea

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KEYWORDS: MSFD, GES, environmental indices, training, fishery related indices, AMBI, M-AMBI, TRIX, Ocean Color

Abstract

Leading research Institutes and SMEs from EU Member States, Associated States, Associated Candidate countries, non-EU Mediterranean and Black Sea countries joined forces in a coordinated manner within the PERSEUS Project, in order to address common environmental pressures and, ultimately, take action in the challenge of achieving the Good Environmental State. One of these coordinated actions was the summer school on "The contribution of environmental indices in meeting the objectives and principles of the Marine Strategy Framework Directive", organized in Constanta, Romania, during 3-7 June 2013, within the framework of Work Package 8 (WP8). The main objectives of the PERSEUS Summer School on the contribution of environmental indices in meeting the objectives and principles of the Marine Strategy Framework Directive were to expose participants to aspects of the theoretical and practical background on the assessment of the benthic

ecological status using the index M-AMBI (multivariate AMBI - AZTI's Marine Biotic Index) and MSFD assessment issues; to provide participants with the most important concepts related to the fishery related indices; to get participants acquainted with the main applications of ocean color based index/eutrophication-related core set indicators CSI023 (chlorophyll-a); to present theoretical and practical aspects of characterization of the ecological state of marine and coastal waters using Trophic index (TRIX); to establish links between different researchers involved in the field of environmental indicators related with MSFD. As a result of the conduction of this summer school, 20 Mediterranean and Black Sea young researchers were trained in the basics of MSFD environmental indices, which they can apply in their respective institutes for the better management of marine resources, thus contributing to build experience in the formulation of scientifically based synthetic assessment of the state of the marine environment, aligned with the objectives of the PERSEUS project.

Ecological Education - Management Tool for Vama Veche - 2 Mai Marine Reserve

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KEYWORDS: marine reserve, custody, sustainable management, awareness, ecological education

Abstract

There are 8 marine protected areas along the Romanian Black Sea coast (SCIs - sites of Community importance), from Sfantu Gheorghe down to Vama Veche, each of them sheltering unique flora and fauna and specific habitats. Yet, the Vama Veche - 2 Mai marine protected area is the only underwater reserve on the Romanian coastline. The reserve is currently under the custody of the National

Institute for Marine Reseacrh and Development "Grigore Antipa". The custodians of the protected area have as main task the implementation of the management plan, thus ensuring the integrity of the reserve against any type of threat. As Vama Veche and 2 Mai are well known tourist areas, the environment obviously undergoes strong pressures caused by wild tourism. Yet, tourism and traditional activities (fisheries) in the area are significant issues when dealing with the sustainable management of a protected area. Consequently, a balance between nature preservation and human activities must be sought. Under these circumstances, one of the aims of the custodian team is to develop use ecological education and awareness in exerting the management of the marine reserve and inducing positive changes in the behavior of tourists and stakeholders in the Vama Veche - 2 Mai area. The paper herein is an outline of such tools and activities and the outcomes of using this approach.