

**BLUE GROWTH: CHALLENGES AND
OPPORTUNITIES FOR THE BLACK SEA**

Book of Abstracts

MARBLUE 2024

Session I: Observing the Black Sea

Session II: Biodiversity, Ecology and Conservation of Marine Ecosystems

Session III: Sustainable Use of Marine Resources

Session IV: Oceanography, Marine Geology and GeoEcology

Session V: Maritime Spatial Planning (MSP) and Coastal Management

Session VI: Ocean Literacy and education

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SESSION I - OBSERVING THE BLACK SEA

ORAL PRESENTATIONS

BLACK SEA INTEGRATED OBSERVATORY

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Abstract: The DOORS project is building a System of Systems (SoS) for the Black Sea. The SoS provides a one stop shop for standardised data and model outputs to drive evidence-based knowledge development for the Black Sea region. The SoS brings together heterogeneous data from in-situ measurements and sensor arrays, satellite based observation, external repositories, and model outputs into single interactive visualisation platform for the Black Sea with harmonised data models. By bringing multiple data sets together from across the regions, the SoS is supporting the transfer of knowledge, supporting innovation and enterprise across blue growth sectors to support sustainable and just growth and prosperity in the Black Sea region.

The SoS exploits data xcube technology. The xcube software is fully open source and based on a well-maintained technology stack permitting rapid access to time series data, swiftly created for regions and variables of interest, a feature that facilitates the production of reports. The SoS provides access to a range of near real time data products and model outputs, allowing users to monitor current and unforeseen events in the Black Sea and eventually, explore ‘what if’ type questions. All data streams are accessed, retrieved, processed into a common data model and format, and stored on cloud storage for efficient and secure access. The SoS is properly documented in a so-called recipe to ensure transparency and reproducibility.

A series of Use cases have been co-developed with key stakeholders from the Black Sea, providing intelligence on: (i) the state of the Black Sea, its fragile recovery and reporting on the physical, chemical and biological aspects of the Black Sea; (ii) changes including threats to its status and coastal environment as a result of climate change and early warning of climate extremes; (iii) Blue Growth opportunities; and (iv) environmental stewardship and smarter regulation.

Keywords: *Black Sea, data services, marine observing systems*

Acknowledgements: This research has been supported by the European Union's Horizon 2020 DOORS project (grant no. 101000518).

ECOSYSTEM RESPONSES TO CLIMATE CHANGE

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Abstract: The DOORS project aims to advance sustainable development in the Black Sea by enhancing scientific knowledge, fostering cross-border collaboration, and integrating innovative solutions to address environmental challenges and climate change impacts. Marine Research Infrastructures (RIs) play a key role by providing tools for collecting and analysing data on how climate change affects marine ecosystems.

European RI initiatives, including Euro-Argo, EMSO, LifeWatch, EMBRC, and DANUBIUS-RI, facilitated by EuroGOOS, are collaborating within DOORS to address the Black Sea data needs. This partnership integrates observations, models, and services offering harmonised methods for monitoring, environmental assessments, and policy advice. For example, Euro-Argo ERIC enhances biogeochemical and physical monitoring through long-term deployment of floats feeding into the DOORS System of Systems (SoS). EMBRC ERIC standardises marine biological data acquisition and management for integration into SoS. EMSO ERIC improves data accessibility with a federated management system. DANUBIUS-RI contributes insights from the Danube Deltas and NW Black Sea. LifeWatch ERIC supports data integration and modelling with its open science infrastructure.

DOORS RI partnership promotes best practices, capacity sharing, and integrated services for assessing and managing the Black Sea's ecological responses to climate change, providing training, standardized protocols, and scientific collaboration along the marine data value chain. DOORS standardises data production methods, aligning them with FAIR data principles (Findable, Accessible, Interoperable, and Reusable). This ensures that Black Sea environmental data is fit for regional and national management and policies. The DOORS Harmonization Manual, co-developed through consultations with scientists, policymakers, and stakeholders, further guides this process.

The proposed conference talk will highlight the RIs' contributions to Black Sea science, data harmonization approaches, and the scientific training offered through the DOORS project.

Keywords: *research infrastructures, ocean observing, marine data services, climate change*

Acknowledgements: This abstract is supported by DOORS, an EU Horizon 2020 project funded under Framework Programme for Research and Innovation under grant agreement No 101000518.

REVEALING RESTRATIFICATION PROCESSES AND THEIR BIOGEOCHEMICAL IMPACT IN THE BLACK SEA: INSIGHTS FROM UNDERWATER GLIDER OBSERVATIONS

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Abstract: The Black Sea is a semi-enclosed basin with limited water exchange with the open basins and significant river discharges. These inflows are critical to the Black Sea's hydrology, nutrient availability, and ecosystem biogeochemistry. In the Black Sea, the interaction of atmospheric forcing, river discharges, and mesoscale dynamics contributes to the formation of distinct water masses. The northern part of the Black Sea has a shelf exposed to seasonal hypoxia and eutrophication. In contrast, the southern half is deep and stratified, with anoxic waters below 100 meters. These characteristics made the Black Sea an enormous meromictic sea. In the DOORS project (Developing Optimal and Open Research Support), a glider mission was conducted during the field campaign from May 6 to June 17, 2023, in the Romanian Exclusive Economic Zone. The mission covered 288 nm and collected 863 physical and biogeochemical profiles down to a depth of 1000 meters. During the mission, ten transects were performed in the slope close to the Danube Cone. Each transect lasted around four days to complete, allowing us to better understand the temporal and spatial variability. We detected a coherent cyclonic eddy in the halocline, leading to an increase in chlorophyll in the euphotic layer. During the spring-summer transition period, significant temperature variations of more than 3°C observed in less than two weeks, leading to a significant reduction in the mixed layer depth. We detected anoxic conditions at a depth of 70 meters, indicating poor oxygenation in deeper layers. Evidence of a second subsurface chlorophyll maxima points to complex phytoplankton distributions in the water column. High bbp700nm values below the Deep Chlorophyll Maximum suggest increased suspended particulate matter, likely originating from the Danube cone. The integration of glider observations in the Black Sea observing systems will help us better understand the dynamics and role of ecosystem.

Keywords: *Black Sea, mesoscale activity, restratification, ocean gliders, anoxia*

Acknowledgements: This work is a contribution to Developing Optimal and Open Research Support (DOORS) project.

DOMINANT TIMESCALES OF OPTICAL VARIABILITY IN SURFACE BLACK SEA WATERS

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Abstract: Coastal oceans and transitional waters are heavily impacted by anthropogenic activities and climate change effects. The Black Sea represents a system long under pressure from anthropogenic impacts such as deforestation, pollution from industry and agriculture, overfishing and introduction of exotic species, which have brought enclosed marine ecosystems close to collapse in the recent past. While the Black Sea is on a road towards recovery, current and emerging pressures could jeopardise this trend. In work supported through of the DOORS (Developing Optimal and Open Research Support for the Black Sea) project, we show novel approaches to study marine ecosystems using satellite-derived products applied on the Black Sea. Water color in this system is primarily influenced by colored dissolved organic matter, phytoplankton and suspended sediments. Optical water type (OWT) classification of remote sensing water color products aims to categorize water parcels with differing properties, thus allowing quantification over time of variations in spectral properties associated with water quality metrics. The OWT analysis scheme developed in the EU H2020 CERTO project, building on OC-CCI, uses fuzzy c-means OWT classes designed for characterization of transitional waters. Using the novel MOving Standard deviation Saturation (MOSS) approach on OWT data, we examine dynamics of Black Sea surface water parcels through their persistency, transience and variability over time. Patterns observed from the satellite data are compared with results from Black Sea modelling studies.

Keywords: *water quality indicators, remote sensing, Optical Water Types, dominant timescales of variability*

Acknowledgements: This work was kindly funded by the European Commission through the EU Horizon-2020 project DOORS (Developing Optimal and Open Research Support for the Black Sea), grant number 101000518.

IN-DEPTH CHARACTERIZATION OF THE BLACK SEA WITH A SUSTAINED ARGO FLEET

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Abstract: Through DOORS, Euro-Argo ERIC supports the deployment of biogeochemical profilers, which is a remarkable complement to the regular observation of in-depth physical data by an average of 10 operational Argo floats for already 15 years – 30 as a whole.

Using the Black Sea Argo floats, it has already been demonstrated (Stanev *et al*, 2021) that the temperatures in the Black Sea Cold intermediate layer are currently substantially higher than the values known from historical data. The reconstruction of the geostrophic currents by combining Argo and altimetry data (Poulain *et al*, 2016) shows the vertical extension of the main circulation features and provides evidence of different directions of the intermediate currents with respect to the surface in the eastern basin of the Black Sea. Argo data from already 17 oxygen sensor equipped floats were used to demonstrate the potential of the applied technique to deliver high-quality oxygen data in this oxic/anoxic environment where the oxygen concentration varies from the level of saturation to zero. It was demonstrated that mesoscale processes contribute significantly to the dynamics of the suboxic zone, bringing in anoxic waters up to about 50 m or deepening the pycnocline down to 150-200 m. (Stanev *et al*, 2012).

The additional biogeochemical profiles reveal very specific processes in the Black Sea compared to the open ocean. For instance, the retrieval of chlorophyll-a (chl-a) from fluorescence sensor is not trivial in the Black Sea, due to the very high content of coloured dissolved organic matter (CDOM), which contributes to the fluorescence signal and produces an apparent increase in the chl-a concentration with depth (Ricour *et al*, 2021). In addition, the occurrence of “deep red fluorescence” in the meso- and bathypelagic waters of the Black Sea, is associated with cyanobacteria, namely *Synechococcus* sp. (Calliery *et al*, 2019) which deserves specific treatment for interpretation.

Therefore, the sustained deployment of a fleet of Argo profilers over the Black Sea, to which the DOORS project contributes, is a tremendous asset for new knowledge and monitoring.

Keywords: *ocean observing, marine data services, climate change, biogeochemistry, research infrastructure*

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AQUARIUS - INTEGRATING RESEARCH INFRASTRUCTURES - CONNECTING SCIENTISTS - ENABLING TRANSNATIONAL ACCESS FOR HEALTHY AND SUSTAINABLE MARINE AND FRESHWATER ECOSYSTEMS

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Abstract: AQUARIUS is a four-year Horizon Europe-funded project providing transnational access to a comprehensive and diverse suite of integrated research infrastructures. The project will run from March 2024 - February 2028.

AQUARIUS will target and support research and innovation activities that contribute to the objectives, regional scope and implementation of the EU Mission ‘Restore our Ocean and Waters by 2030.’ The Mission Implementation Plan has informed the thematic (Mission objectives) and geographic (Mission Lighthouse regions) scope of AQUARIUS. Two Super Integration Calls will be launched, the first call being ‘topic-specific’ will target themes and scientific challenges of each of the four lighthouse regions. The second call will be adapted to the outcomes of the first call and focussed on new emerging issues. The impressive catalogue of 57 research infrastructures available include: research vessels, mobile marine observation platforms (autonomous underwater and surface vehicles, gliders, remotely operated vehicles, and ferry boxes), aircraft, drones, satellite services, fixed freshwater and marine observatories, experimental facilities, and data infrastructures.

AQUARIUS will also provide scientific & technical training together with training on data management and stewardship and virtual access and analytics. Floating universities, summer school courses and marine internships for early career marine scientists will be organized as well as webinars, videos and other training materials. All training materials will be shared on the AQUARIUS online training repository.

AQUARIUS will implement best practices in open science & open data making all data FAIR. Scientific teams will be invited to make use of the Blue-Cloud Virtual Research Environment and all metadata & data will become part of the leading European & global data infrastructures such as EMODnet, Copernicus and EOSC.

More information will be presented about the AQUARIUS TA and training opportunities and the research Infrastructures available in the Danube-Black Sea Region during the session.

Keywords: *mission, ocean, waters, training, FAIR Data*

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SIMULATING THE ATMOSPHERE ABOVE THE BLACK SEA WITH THE MAR (V3.14) REGIONAL MODEL: FUTURE PROJECTIONS AND PERSPECTIVES

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Abstract: The MAR model (Modèle Atmosphérique Régional) is a regional climate model used for weather forecasting and climate studies over several continents. As of version 3.14, MAR runs the latest radiative transfer scheme of the ECMWF, ecRad, to compute both shortwave (solar) and longwave (Earth's infrared) radiative fluxes. Through its latest updates, ecRad is also capable of computing spectral shortwave fluxes.

In the context of the BRIDGE-BS project, the updated MAR model has been configured for the Black Sea to simulate its atmospheric conditions over extended periods of time, both to study the past and future Black Sea atmosphere and to produce forcings for the NEMO ocean model. For this purpose, MAR has been forced at its lateral boundaries by the ERA5 reanalyses and by the earth system models MPI and Ec-Earth.

A MAR simulation over 1950-2022 and forced by ERA5 has been run then compared to ERA5 reanalyses and the MSWEPv2 global precipitation dataset to demonstrate the ability of MAR to predict sound atmospheric conditions over the Black Sea. The ability of ecRad to compute spectral shortwave fluxes has also been assessed by comparing its spectral fluxes to PAR observations at Kishinev in Moldova (47 °N, 28.815 °E).

Then, four projections have been run: 1950-2100 under climate scenario SSP585 with MAR forced by MPI and Ec-Earth, respectively, and 1950-2100 under SSP126 forced respectively by MPI or Ec-Earth. The projection under SSP585 forced by MPI result in an increase of the mean temperature above the sea of about 2°C by the end of the 21th century compared to 1950. The mean temperature increase rises to about 3°C under the same scenario when MAR is forced by Ec-Earth. Under SSP126, the mean temperature increases above the sea are reduced respectively to less than 1°C with MPI and around 1.5°C with Ec-Earth.

Keywords: *trend, scenario, climate, spectral, temperature*

Acknowledgements: The authors would like to thank Robin Hogan (Principal Scientist at the European Centre for Medium-Range Weather Forecast) for his help and feedback with respects to the inclusion and tuning of the ecRad radiative transfer scheme within the MAR regional climate model.

SPATIAL-TEMPORAL VARIABILITY OF BASIC HYDROLOGICAL, HYDROCHEMICAL, HYDROBIOLOGICAL AND METEOROLOGICAL PARAMETERS OF THE VARNA LAKES DURING THE PERIOD 2022-2023

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Abstract: The Varna Lake is the deepest Bulgarian coastal lake. Beloslav Lake, located in front of mouth of the Provadiyska River, is of estuary type. Until the beginning of the 20th century both lakes were freshwater, since 1906, with the digging of the navigation channels between them and the sea, the water gradually became salty. In 1954 – 1990 the intensive industry development leads to formation of hypereutrophic conditions, enormous plankton blooms and discharge of wastewater with nutrients, heavy metals, and other pollutants, causing mortality of fish, benthos flora and fauna. After 1990 closing of some chemical plants, reducing of the use of chemical fertilizers, and introducing of legal restrictions the ecological lakes' status improves gradually from bad to moderate. Recently, due to impaired control, dredging and discharge of dredged material were allowed; large long-time emergency spills of fecal wastewater into Varna Lake, unregulated domestic, industrial and agricultural pollutions were registered.

In 2022-2023, under the DOORS Project using autonomous buoys equipped with multi-parameter sonde, continuous long-term measurements were carried out for the surface water layer at two points, studding the intra-annual variability of the temperature, salinity, oxygen (saturation & dissolved), turbidity, fluorescence, and blue-green algae. Information for the vertical structure and its spatial variability of the temperature, salinity, oxygen (saturation & dissolved), pH, turbidity and chlorophyll-a come from the conducted 12 seasonal surveys (total 101 CTD-sonde profiles of the water column). To assess the atmosphere influence, the data from automatic weather station installed on the bank were analyzed. Periods of oxygen deficiency and increased turbidity are outlined. It was established the presence of sharp and strong changes in basic parameters of the living environment (salinity, oxygen, turbidity), as well cases of a drastic increase in intrusion from the Provadiyska River, leading to a sharp decrease of surface salinity in the Beloslav Lake. Apparently, the anthropogenic pressure on the lakes continues to remain strong, definitely masking the natural seasonality of some of the observed fields.

Keywords: *Varna Lake, Beloslav Lake, hydrology, hydrochemistry, hydrobiology, meteorology*

Acknowledgements: This research was funded by the EU H2020 Project 'Developing Optimal and Open Research Support for the Black Sea' (DOORS), Grant Agreement: 101000518.

SESSION I - OBSERVING THE BLACK SEA

POSTER PRESENTATIONS

ASSESSING CUMULATIVE IMPACTS OF EUTROPHICATION AND POLLUTION IN THE BLACK SEA

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Abstract: The Black Sea, a semi-enclosed marine ecosystem, faces escalating environmental challenges due to eutrophication, traditional pollutants, and emerging contaminants. Nutrients, persistent organic pollutants (POPs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals have long been recognized as threats to marine ecosystems. However, recent studies have revealed the presence of emerging contaminants such as pharmaceutical compounds and endocrine-disrupting chemicals, adding complexity to the pollution landscape. These substances enter the Black Sea via various pathways, including wastewater discharge, agricultural runoff, and industrial activities.

The unique hydrodynamics of the Black Sea, characterized by limited water exchange with other seas, contributes to the accumulation of pollutants, intensifying their impacts on marine life and human health. Pharmaceuticals such as antibiotics (e.g., metformin, ciprofloxacin) and endocrine disruptors are detected in coastal waters, particularly in areas like Romania. These contaminants can interfere with hormonal systems and pose significant risks to reproductive health and development in both marine species and humans.

Addressing these issues requires an integrated approach, involving stricter wastewater management, sustainable agricultural practices, and heightened public awareness. Collaborative research and international cooperation are essential to understand the cumulative impacts of eutrophication and pollution, enabling the development of effective mitigation strategies for the long-term sustainability of the Black Sea ecosystem.

Keywords: *Black Sea, eutrophication, pollution, marine waters, pharmaceuticals*

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OPERATIONAL SERVICE FOR SAFE NAVIGATION IN THE ROMANIAN MARITIME PORTS

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Abstract: In the context of geopolitics within the Black Sea basin, maritime traffic through the main Romanian ports reached a record level of over 92 million tons in 2023. An operational service has been designed in accordance with the specific requirements of port authorities, set out in the SafeBless Project, with a primary focus on the provision of support services for the safe navigation and management of port operations. It is anticipated that the decision support functionality will also prove advantageous to other potential users, including fishing companies and a range of other maritime stakeholders such as port administrations, coastguards, rescue services, environmental agencies and others. The modelling system, which forms the basis of the operational service, comprises two nested domains: a first level with a resolution of 500 meters and a second nested level with a resolution of 100 meters. By integrating downscaled numerical models, the service is a dynamic web-based decision support system designed to improve the management, monitoring and forecasting of maritime activities in the areas of the Romanian Black Sea ports. It draws on data from the Copernicus Marine Service, including in-situ data and remote sensing products, and is intended to enhance the efficiency and effectiveness of maritime operations in the region.

Keywords: *safe navigation, Black Sea, waves, hydrodynamics, CMEMS downstream services*

Acknowledgements: This service has been funded by the Copernicus Marine National Collaborative Program 2021-2028.

WARNING SYSTEM FOR LAND-BASED POLLUTION IN THE ROMANIAN COASTAL AREA

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Abstract: Funded by the Copernicus Marine Service, User Engagement Programme, this warning system was developed to monitor land-based pollutant dispersion in Romanian marine and coastal areas. With a special focus on aquaculture sector, the service focuses on simulating the drift of dissolved pollutants in the coastal zone, tracking their path and identifying their potential impact on predefined sites.

This use case developed by seamod.ro and NIMRD is part of SYROCO (SYstem for ROmanian COastal monitoring), a suite of high-resolution modelling and observation tools that allow users to monitor and simulate the path of contaminants in the Romanian coastal area. The combination of these tools will provide reliable estimates of local physical and biogeochemical ocean variables.

In line with EU environmental priorities such as the EU Green Deal and the EU Marine Strategy Framework Directive, the service contributes to the achievement of Good Environmental Status (GES) of marine waters and supports informed decision-making, including Integrated Coastal Zone Management (ICZM) activities.

Keywords: *MSFD, aquaculture, contaminants, water pollution, western Black Sea, CMEMS*

Acknowledgements: This Use Case was funded by the Copernicus Marine Service User Engagement Programme 2022-2028.

**EXTREME STORMS RECORDED ON EMSO-EUXINUS INFRASTRUCTURE,
ROMANIAN CONTRIBUTION TO EMSO-ERIC:
CASE STUDY 17-26 NOVEMBER 2023**

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Abstract: The purpose of this study is to describe the characteristics of extreme storms in the Black Sea in terms of meteorological and oceanographic *in situ* characteristics, based on EMSO-EUXINUS Infrastructure recorded data.

EMSO EUXINUS RESEARCH infrastructure consists of 3 Offshore buoys and one Coastal buoy in front of the Romanian part of the Black Sea. Between 17 and 27 November 2023 EMSO EUXINUS managed to record the meteorological and oceanographic parameters during two major storms, part of the Federico cyclon. Between 17-19 November 2023, during the first storm, the offshore buoy recorded a gust speed of over 115 km/h with N wind direction and a maximum surface current amplitude of 60cm/s with a SW direction. On the coastal buoy the peak of significant wave height was around 7,59m and the maximum gust speed over 115 km/h WSW. The induced storm set up increased the sea level in the coastal area with around 80cm. During the second event the storm set up increased the sea level by the coast with 50 cm, due to the different wind direction (storm began from N and rotated to E). On the second storm (between 25-27 November) the maximum wave height recorded by the Coastal Buoy was around 4,2 m with a peak of maximum gust speed of 126 km/h E.

At a specific moment one of the offshore buoys was in the eye of the storm, whilst a second one being in the middle of the storm. Considering the shape of a cyclone, it was also confirmed by the values in air pressure (differences of 40 mbar) recorded on the offshore buoys which are set at a distance of approximately 50 km.

In what regards the winds, both storms were almost similar, but if we look at the waves, the situation was different due to the storm period and change of wind direction during the second storm. Thus, the second storm recorded lower wave heights and energy.

Based on the information from the wave sensor at the coastal buoy, the computed energy of the waves had a maximum of 5,30 kJ/m².

Keywords: *big storms, wave, Romanian coast, Marine Research Infrastructure, EMSO-ERIC*

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NUMRICAL MODELING AND IN SITU OBSERVATIONS OF FLOATING MARINE LITTER IN THE WESTERN BLACK SEA

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Abstract: The western Black Sea has been identified by various authors as a high-risk area for marine litter pollution due to fluvial inputs from rivers such as the Danube, Dnieper, Don, and Dniester, as well as the intrinsic circulation patterns of the region. LOCATE, a tool developed with the Lagrangian solver OceanParcels for predicting areas of high Floating Marine Litter (FML) accumulation, has been adapted and validated for the Black Sea. This tool utilizes surface current velocity and Stokes drift data from the Copernicus Marine Service (CMEMS) and represents FML as Lagrangian particles (Castro-Rosero et al., 2023; Hernandez et al., 2024). In July 2024, during a 10-day research campaign aboard the R/V Mare Nigrum, eight FML observation transects were conducted. FML density was calculated per km² along these transects. The study's results provide insight into FML transport dynamics in the western Black Sea and emphasize the need for ongoing monitoring and modeling efforts in pollutionvulnerable regions. At the same time, a regional-scale simulation using LOCATE was carried out with hydrodynamic data from the NEMO v4.2 circulation model (resolution of 1/40° x 1/40°) and Stokes drift data from the WAM Cycle 6 spectral wave model (resolution of 1/40° x 1/40°), both provided by CMEMS for the Black Sea domain. The simulation involved releasing 1,000 particles from the mouth of the Danube River, corresponding to the observation period, and comparing the particle trajectories with field observations, particularly at locations of high FML density. In the final contribution we will present detailed analysis of numerically modeled accumulation patterns with comparison with observed marine litter concentrations. The ecological pressure from the political conflict north of the FML measurement area has been observed in several transect by identifying up to 4000 elongated white stripes /km², most probably designed for ammunition and weaponry packaging.

Keywords: Black Sea, Marine Pollution, Lagrangian model, LOCATE, CMEMS.

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**SESSION II - BIODIVERSITY, ECOLOGY
AND CONSERVATION OF MARINE
ECOSYSTEMS**

ORAL PRESENTATIONS

MARINE BIODIVERSITY AND IMPACT OF HUMAN ACTIVITIES ON THE LAND-SEA CONTINUUM IN THE CONTEXT OF CLIMATE CHANGE

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Abstract: Biodiversity in all its evolutionary, functional, organizational, spatial and relative abundance forms is strongly impacted by human activities. Despite their different environmental characteristics, the Mediterranean Sea, hotspot of marine biodiversity, and the Black Seas "uniquum hidrobiologicum" with low biodiversity, are both subject to anthropogenic pressures linked to population growth in coastal areas and to the development of multiple activities on their watersheds.

In a land-sea continuum, terrestrial waters, through the inputs of nutrients, organic matter particles and sediments that they transport to the sea, play a major role in the functioning of marine food web and in structuring of seascapes. Estuarine and coastal systems, among the most productive on the planet, represent key habitats for many species that develop high biomasses and are exploited, sometimes overexploited, by fisheries. However, these areas are also pathways for the introduction of pollutants into the marine environment that can induce eutrophication or impact biodiversity and human health.

The functioning of coastal systems in the oligotrophic Mediterranean Sea is strongly affected not only by global environmental changes but also, unexpectedly, by improvement in wastewater treatment required by the European Water Framework Directive. These changes have reduced nutrients inputs to the sea and primary production and have exerted bottom-up control on the functioning and production of others compartments of marine food web and reduced fisheries production.

Furthermore, in a context of climate change, increasing water demands from agriculture and industries (e.g. dams and nuclear power) is continually reducing terrestrial inputs and increasing the risk of a stronger impact on marine biodiversity.

The anthropocentric and local vision of environment and water resources management often does not take into account their regional particularities and thus lacks an adaptive, End-to-End holistic approach and a large-scale and long-term vision to integrate the human impacts on the land-sea continuum.

Keywords: *Environment, Nutrients, Food web, Fisheries, End-to-end holistic approach, Water management.*

Acknowledgements: ANR CONTAMPUMP « Plancton: pompe biologique de contaminants dans les écosystèmes marins ? ». <https://anr.fr/Projet-ANR-19-CE34-0001>.

SUPPORTING THE FAIRIFICATION PROCESS OF MARINE RESEARCH BIOGEOGRAPHIC DATA FROM DATA-DEFICIENT REGIONS

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Abstract: Ensuring the sustainability and management of marine biodiversity relies heavily on high-quality, standardized data accompanied by detailed metadata. MedOBIS (<http://ipt.medobis.eu/>) is the Mediterranean node of Ocean Biodiversity Information System (OBIS) and it is hosted at the Hellenic Centre for Marine Research. MedOBIS promotes transparency and global collaborations among scientists by committing to the principles of FAIR (Findable, Accessible, Interoperable, Reusable) data by providing an open-access repository for marine research data.

In November 2023, a data training workshop was organised in Lecce, Italy, within the framework of EMODnet Biology V. The workshop had two main goals: i) to educate and train marine scientists from marine data-deficient countries of the Southern Mediterranean on how to standardise and publish their data and ii) to increase the data availability from these countries.

As a result of this workshop, more than 1,000 species occurrence records were shared with the scientific community through the MedOBIS repository, with three additional datasets containing species occurrences pending publication in the coming months. This will significantly increase the number of species occurrences publicly available from a region that currently holds less than 10% of marine species data (155,256 records), compared to the rest of the Mediterranean (1,573,195 records), based on the OBIS database.

This data deficiency in the southern Mediterranean is partly a result of uneven demographic development and geopolitical issues, high unemployment rates among individuals with university-level education, and limited awareness of open science best practices. MedOBIS ultimate goal is to foster greater scientific collaboration and enhance accessibility to valuable research for both the scientific community and the general public.

Keywords: *FAIR data, Mediterranean Sea, marine research data, MedOBIS*

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MAPPING LIFE-HISTORY STRATEGIES OF MACROZOOBENTHIC COMMUNITIES: A CASE STUDY ON THE NORTHWESTERN SHELF OF THE BLACK SEA

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Abstract: In recent decades, biological traits - any morphological, physiological or phenological features defined at the species level- have been widely used to assess how macrozoobenthic life respond to stress and influence ecosystem functioning. In the framework of response and effect traits, response traits - traits that respond in a specific way to environmental factors - can be combined (e.g. age at maturity, longevity, offspring size) to derive specific life-history strategies. These latter inform on species ability to withstand external pressures by sorting vulnerable species (i.e. slow-growing, long-lived) from tolerant to disturbance ones (i.e. fast-growing, short-lived). Despite the growing interest of trait-based approaches in marine ecology, there is still a clear lack of benthic studies considering simultaneously several traits and gathering trait information is time-consuming, unwell documented and scarce for many benthic taxa. Here, we propose to fulfill the gap in macrozoobenthic traits knowledge for the northwestern shelf of the Black Sea. Based on our extensive species and traits datasets, we assess the spatial variability of life-history strategies. In more detail, macrozoobenthic samples were collected during several campaigns, from 2008 to 2017, in a total of 111 sampling sites. Then, we select 15 traits based on those expected to respond to external pressures and we compile a trait matrix for a subset of 96 taxa. From an appropriate clustering of the traits, main life-history strategies are derived and each taxa is defined by a unique functional group (i.e. resistant, resilient and vulnerable groups). For building maps of those functional groups, we use spatial optimal interpolation based on variational analysis. In future research, the confidence in those maps will be improved through the inclusion of neural network tools. Mapping of benthic functional groups may be used as ecological indicators for ecosystem health assessment and may be helpful for conservation policy.

Keywords: *response traits, assembly rule, anthropogenic pressures, spatial interpolation, conservation policy*

Acknowledgements: This work is supported by the F.R.S-FNRS (Fonds de la Recherche Scientifique de Belgique, Communauté Française de Belgique) through funding a FRIA grant. SC and MG acknowledge the support of the EU H2020 BRIDGE-BS project under grant agreement No. 101000240 and EU HE NECCTON project under grant agreement N°101081273.

TRANSPLANTATION OF *NANOZOSTERA NOLTEI* SODS TO ESTABLISH SEAGRASS MEADOWS ON NEWLY NOURISHED SEDIMENTS AS PART OF COASTAL PROTECTION WORKS IN ROMANIA

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Abstract: To increase ecosystem resilience and conserve Natura 2000 habitats, an approach to support recovery of *Nanozostera noltei* in the Romanian Black Sea, is incorporated during coastal development projects by the Romanian government and private sector. Environmental requirements are to generate a suitable site for *N. noltei* establishment over 2.8 ha within coastal infrastructures. A numerical model was developed to include suitable conditions of depth, erosion/sedimentation, and flow/orbital velocities into the design. Seagrass restoration was performed by transplanting 468 *N. noltei* sods (approximately 3.7 m²) from nearby meadows into the constructed beachcell in June 2023. Three different planting patterns were incorporated: single sods, clustered sods and spaced clustered sods, exploring the effectiveness of clustering and spacing for stimulation of self-sustaining feedback mechanisms and optimal use of donor material for future upscaling. In October 2023 observations from drone-imagery show that the seagrass area expanded to approximately 160 m², preliminary indicating suitable siting. To measure the winter hydrodynamical effects on different planting patterns, monitoring results will be presented 1 year post-transplantation. Successful outcomes are that opportunities for large-scale restoration of socio-economic important habitats can be created during coastal development works via the incorporation of requirements and creation of suitable habitat.

Keywords: *Nanozostera noltei*, seagrass restoration, coastal protection, sod transplantation

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A PREMIERE IN THE CONSERVATION OF MARINE BIODIVERSITY - RELOCATION OF *DONACILLA CORNEA* AND *DONAX TRUNCULUS* FROM COASTAL AREAS

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Abstract: In the last 60 years, the Romanian coastline has faced a constant process of reshaping the shoreline. In these conditions, in combination with the harsh eutrophication processes from the 1970s to the 1980s, the populations of some species of bivalves suffered a constant process of diminishing numbers and reducing their distribution areas. Among these species, the most affected were the bivalves *Donacilla cornea* and *Donax trunculus*, both populating habitats of sandy bottoms located in the area of breaking waves and respectively at depths of up to 10-15 m.

The accentuation of the erosion process of the beaches in the last decades imposed as a solution an extensive sanding process between Cap Midia and Vama Veche. The sanding process, however, endangered the populations of *Donax trunculus* and the last population of *Donacilla cornea* that exists in the area of the Romanian coast. In order to avoid the loss of both the habitat and the respective bivalve populations, the Society for Research of Biodiversity and Environmental Engineering AON in collaboration with Romanian and foreign specialists and benefiting from the financial support of Van Oord, the company that carried out the sanding activities, carried out an extensive project in order to relocate the populations of the two species. The project included a series of activities that allowed the final relocation of over 23,000 specimens of *Donacilla cornea* and over 37,000 specimens of *Donax trunculus* from the areas that affected by sanding activities. Representing an absolute novelty at the European level, the relocation of the populations of the two species allowed their maintenance in an area with unique features in terms of the structure of coastal marine habitats on the Romanian coast of the Black Sea.

Keywords: *Donacilla*, *Donax*, relocation, Black Sea

Acknowledgements: The authors thank the Van Oord company (Holland) for the financial support given to the project during the entire implementation period.

FIRST COMPREHENSIVE DENSITY AND ABUNDANCE ESTIMATES OF CETACEANS FOR THE BLACK SEA REGION

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Abstract: An aerial survey was conducted in the Black Sea to assess the abundance, density, and distribution of three endemic odontocete species: the Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*), the Black Sea common dolphin (*Delphinus delphis ponticus*), and the Black Sea harbour porpoise (*Phocoena phocoena relicta*). Systematic line transects covering 52% of the study area (including territorial waters and exclusive economic zones) were surveyed, resulting in 1,744 cetacean sightings along 7,344 kilometers of trackline. Abundance was estimated using both design-based (Multiple Covariate Distance Sampling, MCDS) and model-based (Generalized Additive Models, GAM) approaches. GAMs incorporated environmental covariates (e.g., bathymetry, sea surface temperature, chlorophyll-a concentration) to predict species-habitat relationships and spatial distributions.

Uncorrected model-based estimates indicated summer populations of 108,283 (CV=0.07) *D. delphis ponticus*, 22,720 (CV=0.15) *T. truncatus ponticus*, and 94,808 (CV=0.06) *P. phocoena relicta*. These findings represent the first comprehensive baseline data on the abundance and distribution of these cetaceans in the Black Sea, providing crucial information for effective conservation and management strategies. The resulting spatial distribution models can be used to identify critical habitats, assess potential threats, and inform marine spatial planning efforts, thereby contributing to the fulfillment of national and international conservation obligations.

Keywords: Black Sea, aerial survey, line transect method, large scale survey, dolphins, porpoises.

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**SESSION II - BIODIVERSITY, ECOLOGY
AND CONSERVATION OF MARINE
ECOSYSTEMS**

POSTER PRESENTATIONS

THE POTENTIAL TOXIC EFFECTS OF CERTAIN PHARMACEUTICAL SUBSTANCES ON THE EARLY STAGES OF ZEBRAFISH

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Abstract: The prevalence of pharmaceutical contamination has increased in recent years, mostly due to apprehensions over its potential impact on aquatic fauna and human health. This issue has gained worldwide attention because high levels of pharmaceutical compounds have been detected in rivers, oceans, groundwater, and even drinking water. However, wastewater treatment plants are unable to fully eradicate pharmaceutical contaminants from wastewater. The point of this study was to look at what effects three different medicines might have on zebrafish embryos and larvae, based on how much of each is known to be in the environment. (*Danio rerio*).

The zebrafish is a highly valuable animal model in such research because of its sensitivity to pollution exposure, dynamic development, transparency, and ability to suggest a wide range of physiological and behavioral variables.

Hence, by the straightforward exposure and combination of these chemicals, mortality was noticed, also modifications in heartbeats, variations in the hatching rate of the larvae, and even behavioral changes. The zebrafish, a valuable study tool, facilitates the establishment of new and existing boundaries and enhances knowledge of potential impacts on aquatic fauna. Investigating these impacts on aquatic organisms may lead to a greater focus on the development of new methods for the elimination of such chemicals.

Keywords: *toxicity, pollutants, zebrafish, behavior.*

BIOACCUMULATION OF METALS IN SOME FISH SPECIES FROM THE ROMANIAN DANUBE RIVER: A REVIEW

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Abstract: The Danube is the second-largest river in Europe and has been subject to pollution in the past. Additionally, in the last few years, the rapid pace of industrialization and urbanization has led to the inevitable pollution of this aquatic ecosystem by certain metals (essential and non-essential elements). This issue is considered the central problem of pollution in the Danube and is gaining increasing attention. Fish is a good source of proteins, polyunsaturated fatty acids (especially omega-3 fatty acids), essential vitamins, and minerals. Fish are often exposed to metals present in their aquatic environment through direct contact with contaminated water or by consuming organisms that have accumulated metals in their tissues; therefore, the elevated concentrations of metals in water and sediments are reflected in the fish flesh. In this context, the safety of fish and fishery products for human consumption is a public health concern. In the last two decades, more and more reports have shown that Danube River fish are contaminated with metals, causing great concern among consumers. The negative perception continues, although recent scientific studies show that metal levels in the edible parts of the fish are below acceptable limits. The objective of this study was to put together a multitude of scientific research studies that investigate the levels of some metals in various tissues of some fish species with high economic value in the Romanian market, as well as the levels of metals in the water and sediments. The collected data were then utilized to assess the potential health risks posed to humans.

Keywords: metals, tissue bioaccumulation, commercial fish species, Danube River

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PRELIMINARY ASSESSMENT OF ANTHROPOGENIC MICROPLASTICS INGESTION BY THE EUROPEAN ANCHOVY (*ENGRAULIS ENCRASICOLUS*) FROM THE ROMANIAN BLACK SEA COAST

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Abstract: Microplastics (particles <5 mm) has become nowadays a serious threat to both the marine environment and biota, including fish. In recent years the Black Sea has been described as one of the most polluted with plastic litter compared to other European seas. Although recent studies have shown ingestion of microplastics in different fish species from the Black Sea, such data are missing for the Romanian sector.

In this study the abundance, color, shape and size of microplastics from the gastrointestinal tract (GIT) of *Engraulis encrasicolus* (European anchovy, Linnaeus, 1758) collected from different locations of the Romanian coast (NW Black Sea) were determined for the first time. Microplastics were determined by 10% potassium hydroxide (KOH) digestion method, based on MSFD TG-ML recommendations (Galgani et al., 2023).

Preliminary results show a high incidence of ingested MPs, meaning up to 90% frequency of occurrence (FO), with transparent fibers and sizes of 330 µm-1 mm being the most predominant characteristics encountered. The abundance of the total microplastics in the GITs of all anchovies was on average 3.36 items ind⁻¹ and represents the highest level reported in the Black Sea.

This is the first research showing that commercial European anchovies of the Romanian coast are contaminated by microplastics and can serve as a starting point for other more advanced studies. Given the high level of microplastics ingestion by anchovy we found, more research is needed to adequately assess the status of microplastics pollution in this fish species of the Black Sea and its impact both on human and the ecosystem health.

Keywords: *pelagic marine fish, plastic accumulation, gastrointestinal tract, microfibers, NW Black Sea*

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BEST PRACTICES IN THE GOVERNANCE OF RIVER, COASTAL AND MARINE RESTORATION INITIATIVES AND OPPORTUNITIES FOR SCALABILITY

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Abstract: Restored ecosystem areas complement, buffer, and enhance areas subject to intense conservation action. However, restoration must be managed, and as a rapidly expanding and developing field of research and practice, implementation can take a wide variety of forms and activities. While physical, chemical and biological aspects and processes are key components of any restoration journey, so too are the people and communities within the ecosystem, which further adds to the complexity.

The BlueMissionAA project is building an Atlantic and Arctic coordination hub to support Mission Ocean implementation. It is one of four coordination and support action (CSA) projects creating a support system for marine biodiversity restoration initiatives across all European waters and sea basins, including the Danube and Black Sea. Under BlueMissionAA, research examined approaches taken by teams in the governance of catchment-based, coastal, and marine ecosystem restoration projects. Identified best practice approaches were found to be widely applicable across all Mission areas, including the Black Sea.

Managers and coordinators of 6 case studies were interviewed, giving insights into the achievements and pitfalls they have encountered so far on their team's restoration journeys. We used the internationally recognised Society for Ecological Restoration's *Standards of Practice to Guide Ecosystem Restoration* framework to evaluate each case study, identifying best practice approaches, while also uncovering opportunities for scalability (in areas such as 3D printed reefs, public-private partnership, citizen science, and nature-based solutions). Our findings highlight the importance of stakeholder engagement, sustainable financing, ecosystem-based approaches, adaptive management, and partnership with local communities.

This poster provides an opportunity to share best practices in the management of biodiversity and marine ecosystem restoration projects. It seeks to connect the learnings harnessed from the Atlantic Area, and make them available to actors, stakeholders and our colleagues seeking to restore Black Sea river, coastal and marine areas.

Keywords: *best practice, biodiversity, restoration, Mission Ocean, scalability*

Acknowledgements: BlueMissionAA is funded under the EU Horizon Europe Research and Innovation Programme under Grant Agreement No 101093962.

ANTHROPOGENIC INFLUENCES AND THEIR IMPACT ON THE BENTHIC COMMUNITIES OF THE SULINA ARM AND ITS MEANDERS

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Abstract: The Danube Delta, one of the most important and valuable wetlands in Europe, is home to remarkable biodiversity, including diverse and complex benthic communities. In recent years, anthropogenic influences such as increased shipping, overfishing, and tourism activities have placed considerable pressure on these fragile ecosystems. This study aims to analyze the impact of human activities on the benthic communities of the Sulina Arm and its associated meanders, using data collected in 2023 and comparing it to data from 2019. Pollution, climate change, and human interventions such as dyking, dredging, intense boat traffic on the Sulina Arm, and overfishing have had significant effects on benthic ecosystems. A total of 61 samples were collected for macrobenthic faunal analysis during two distinct periods, May and October 2023, to assess seasonal variations and the impact of anthropogenic factors on benthic biodiversity and population density. Data from 2023 were compared with similar results from 2019 to evaluate long-term trends. The study reveals that human pressures have caused a significant decline in the diversity and density of benthic populations. In 2023, benthic density was reduced by half compared to 2019, both in May and October. The observed decrease in density and taxonomic diversity between 2019 and 2023 underscores the urgent need for protective measures to safeguard these aquatic habitats.

Keywords: *benthic communities, anthropogenic influences, impact, Sulina arm*

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THE EFFECT OF CLIMATICAL CHANGES ON PEACH CULTURE IN DOBROGEA

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Abstract: The peach is one of the most valuable fruit trees, which stands out for its early fruiting, high production potential and superior fruit quality. In our country, the consumption of fresh fruit takes for two and a half months. In the last 20 years, the climate changes consisting in the tendency of the air temperature to increase in the winter months, the appearance of some late frosts in the spring, thermal amplitude during the spring had a differentiated effect in terms of the development of flowering buds depending on the cultivar, trees age, plot position, etc. The flowering of fruit trees is an indication of the intensity of the physiological processes that determine plant growth, showing particular interest, especially in the context in which it influences the fruiting process and the yield of fruits on the plant. The paper presents the results recorded for new peach cultivars, created at Research Station for Fruit Growing Constanța (RSFG Constanta) and how they reacted to climate changes from 2022-2024. The fruit trees were studied in competition crops experiments, each cultivar was represented by 20 trees planted in 2011. Observations were made using BBCH scale, climatic data were taken with the support of the IMT300 weather station.

Consequently, in the relationship between peach trees and environmental conditions we need to intervene with some means of protection like: specific chemical sprinkling before blooming, protecting cover net.

Key words: *Prunus persica*, cultivars, biology, temperatures.

Acknowledgements: This work has been partially conceived in the framework of the project ADER 6.1.1/18.07.2023.

CULTIVABLE BACTERIAL DIVERSITY AND DISTRIBUTION IN A PACIFIC OCEAN SURFACE WATER TRANSECT

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Abstract: Bacterial resistance to existing antibiotics has led to the pursuit for new therapeutic agents. With this purpose, we have collected surface marine water samples following a Pacific Ocean transect from Costa Rica to Galapagos Islands.

The samples were cultivated and isolated on different growth media followed by the identification of the isolated strains through 16S rRNA gene sequencing. One hundred and twelve selected bacterial strains, belonging to different phyla, were tested further for antibiotic susceptibility and antimicrobial activity. The results revealed that twenty-eight bacterial isolates registered antimicrobial activity against six pathogenic strains although, two unidentified isolates inhibited all the tested strains with twenty-seven isolates inhibiting the clinical pathogen *Pseudomonas* CN11 while three *Acinetobacter* species had activity against the G+ and G- pathogens tested.

The isolate *Bacillus* sp. (6GEL.13B-3B) registered activity only against the pathogen *Enterobacter asburiae* 19069 ONE1 while the isolate *Pantoea* sp. (1GEL.8A) had activity only against the pathogen *Pseudomonas* CN11.

The vast antimicrobial resistance spectrum and the widespread multidrug-resistant phenotypes detected in bacterial strains offer new understandings into the evolution of environmental resistomes presenting at the same time promising opportunities for discovering new bioactive molecules and valuable biocatalysts.

Keywords: *antimicrobial resistance, antimicrobial activity, marine bacterial isolates, 16S rRNA*

Acknowledgements: This research is funded by project RO1567-IBB05/2024 (The Romanian Academy).

THE VARIATION OF NON-INDIGENOUS TINTINNIDS (CILIOPHORA) STRUCTURE IN THE LAST YEARS ALONG THE ROMANIAN BLACK SEA

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Abstract: Recent years have been characterized, among others, by an increased penetration of non-indigenous marine species in the Black Sea basin. This has led to the acclimatization of some of these species to the Romanian coast, including several species of tintinnids.

Tintinnids are microzooplanktonic loricate ciliates with a special role in the marine ecosystem since they are involved in both the phytoplanktonic and microbial food webs.

To a better understanding of the status of these species, data from 2018-2023 period in the four marine reporting units (transitional, coastal, marine, and offshore waters) were analyzed. Eight non-indigenous tintinnid species were identified with a distribution and abundance that varied broadly. The species *Rhizodamus tagatzi* dominated 41% of transitional waters, *Eutintinnus lusus-undae* was the quantitatively dominant species (mean density) in coastal (33%) and marine (40%) waters. Offshore waters were characterized by the lowest diversity of non-indigenous tintinnids (5) being quantitatively dominated by *Amphorellopsis acuta* (81% of the mean density of non-indigenous tintinnids).

Ongoing monitoring of the occurrence, abundance, and distribution of these species provides information on the state of the marine ecosystem and, is also intended to respond to the Marine Strategy Framework Directive (MSFD) and more specifically to the descriptor D2-Non-indigenous Species.

Keywords: tintinnids, non-indigenous species, mean density, diversity, marine reporting units

Acknowledgements: This research has been carried out with financial support from the SIPOCA-608 Project "Improving the capacity of central public authorities in the field of marine environment protection in terms of monitoring, evaluation, planning, implementation, and reporting of the stability requirements in the Marine Strategy Framework Directive and for managing the integration of the coastal zone", and "Study on the comprehensive monitoring program of the Black Sea marine ecosystem according to the requirements of the Strategy Framework Directive for the marine environment (2008/56/EC) (2023-2024)".

MACROPHYTOBENTHOS-ECOLOGICAL VALUE AND IMPORTANT SOURCE OF NATURAL BIOLOGICAL COMPOUNDS

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Abstract: Rocky shores of many coastal areas, are dominated by macrovegetation, that is almost exclusively represented by seaweeds. Macroalgae play a very important ecological role in marine ecosystems, but besides that, they have the capacity of natural and culture regeneration, so they develop large biomasses, which encourage studies regarding exploitation solutions for the benefit of the entire world population.

At the Romanian littoral, even if is not very long, and the rocky substrate is not very wide, we can find some macroalgal species, from Chlorophyta and Rhodophyta phyla, that can develop in large biomasses, this making them suitable for harvesting and utilization in different ways.

The algae contain plenty minerals: iodine, magnesium, potassium, calcium, iron, manganese; vitamins, amino acids, carbohydrates, fatty matters, plenty chlorophyll, and antibiotic substances. They have applicability in agriculture as fertilizers, contributing to the introduction in the biological circuit of indispensable elements and also favor the maintenance of an optimal granular structure of the soil, retaining thus humidity for a longer period of time.

In our country, there have been a number of research in order to introduce macroalgae in agriculture, as soil fertilizers and in zootechny as food for domestic animals, but unfortunately, macroalgal industry is not developed and there is little interest in harvesting as well as in cultivating seaweeds. But analysis of various bibliographical sources and present investigations showed that green and red algae contain some valuable compounds. Red algae (especially *Porphyra*) contain significant values of vitamin C and carotenoids, and green algae *Enteromorpha* and *Cladophora* contain appreciably larger quantities of carbohydrates nitrogen and phosphorous compared to most algae.

Unfortunately, the Romanian littoral, strongly affected by the anthropic pressure, does not have a divers macrophytic flora. However, given certain conditions, it develops appreciable biomasses of certain species as mentioned, that could become sources of raw materials for different compounds.

Keywords: *macrophytobenthos, Chlorophyta, Rhodophyta, natural compounds*

REINFORSEA- ADVANCING RESPONSIBLE MARINE RESEARCH AND INNOVATION INTERPRETED FOR STAKEHOLDERS

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Abstract: The REINFORSEA project is focused on advancing the widespread adoption of Open Research and Responsible Innovation (ORRI) practices within the Black Sea marine research community. By acknowledging and addressing the region's unique environmental, social, and economic challenges, the project seeks to adapt ORRI principles to meet these specific needs. This tailored approach aims to enhance marine research's effectiveness, sustainability, and long-term impact in the Black Sea. REINFORSEA brings together a wide range of stakeholders including academia, industry, government, and the public to promote collaboration, knowledge sharing, and a strong commitment to ORRI values across the Blue Economy. A key objective is to strengthen the capacity of marine researchers in the region by providing comprehensive training, resources, and support on ORRI methodologies. This ensures that research practices uphold the highest standards of responsibility and ethics while addressing the unique challenges of the Black Sea. Through these efforts, REINFORSEA aims to create a more inclusive, transparent, and socially responsible research environment, promoting innovation and sustainability in the Black Sea region for the long term.

Keywords: *ORRI methodologies, Black Sea marine research, collaboration, sustainability, knowledge sharing*

Acknowledgements: This research has been carried out with financial support from the REINFORCING Project -Responsible tErritories and Institutions eNable and Foster Open Research and inClusive Innovation for traNsitions Governance, Funded by the European Union, REINFORSEA Project.

COMPARATIVE CYTOLOGICAL ASPECTS OF MACROPHYTE ALGAE FROM THE BLACK SEA

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Abstract: Our research aimed to analyse the ultrastructure of the algal cell in *Bryopsis plumosa*, *Cladophora vagabunda*, *Enteromorpha intestinalis*, *Ulva rigida*, *Ceramium rubrum*, *Callithamnion corymbosum*, *Polysiphonia denudata*, *Porphyra leucosticta*, *Ectocarpus siliculosus*, *Punctaria latifolia*, *Cystoseira barbata*, to complete the already existing data on the ultrastructure of the algal cell and allow a comparative cytological analysis.

The studies carried out showed the importance of cytological characteristics in the systematics of green algae, which are characterized by: parenchymal differentiation of the thallus; chloroplasts enveloped by a double plastidial envelope, which do not present additional envelopes of the endoplasmic reticulum; the thylakoids form overlapping lamellae in a varied number, being arranged parallel to the plastidial envelope, without continuity with it, or between them; the presence of bilenticular pyrenoids; absence of grana formations; the presence of starch as a reserve substance with intraplastidial placement.

The ultrastructural characteristics encountered in all analysed red algae species are: cellular differentiation depending on the area of origin in the thallus; the presence as a reserve product of floridee starch, arranged extraplastidially, especially in the middle and basal area of the thallus; chloroplasts with a double plastidial envelope, without an additional envelope originating from diverticula of the endoplasmic reticulum; thylakoids arranged parallel, one per lamella.

The ultrastructural characteristics found in the researched brown algae species are: chloroplasts covered by membranes of the endoplasmic reticulum on the outside; four membranes that surround each chloroplast, two of their own and two of the endoplasmic reticulum; the presence of a lamellar thylakoid belt; thylakoid lamellae formed by three grouped stromal thylakoids; absence of starch as a reserve substance; intracytoplasmic of mannitol and laminarin reserves; numerous punctuations with plasmodesmata between neighbouring cells, grouped in specific areas.

Keywords: ultrastructural characteristics, algal cell, chloroplasts, thylakoids, starch.

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MICROPLASTICS IN COASTAL AND DEEP SEDIMENTS OF THE ROMANIAN BLACK SEA

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Abstract: Microplastics (MPs) or plastic particles smaller than 5 mm are widely recognized as one of emerging concern contaminants in the marine environment with sediments as their final destination. In this study, microplastic contamination in both beach and deep-sea sediments of the NW Black Sea (Romanian sector) was evaluated. Coastal sediment samples were collected from 3 different sandy beaches along the Romanian littoral of the Black Sea. The seafloor sediments (up to 120 m depth) were taken during the DOORS-1 Black Sea Survey 2023 from six locations of the north-western Black Sea. The assessment of abundance and composition of microplastics followed the recommendations described in the EU MSFD TG10 guidance (Galgani et al., 2023). We recovered 199 items (25% fibres and 42% fragments) in total by evaluating the number and shape of microplastics in each surface and deep-sea sediments, and the main colours were black and blue. Microplastics were more abundant in the beach sediments (6-58 items/m²) than in the seafloor samples. Our study showed different degrees of microplastic contamination of both surface and seafloor sediments of Romanian Black Sea. However further research, as well as standard methods is required to adequately assess the status of microplastics pollution in coastal and seafloor sediments of this particular European marine basin.

Keywords: *plastic contamination, beach sediments, seafloor sediments, NW Black Sea*

Acknowledgements: This research has been carried out with financial support from the European Union's Horizon 2020 Framework program under the DOORS project (grant no. 101036071) and the Romanian NUCLEU Programme (SMART-BLUE PN-23230104).

STUDY OF THE ZOOBENTHIC COMMUNITIES FROM SHALLOW INFRA-LITTORAL HABITATS OF THE EFORIE SOUTH – CAPE TUZLA BLACK SEA AREA

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Abstract: The interest area of this study is in the southern sector of the Romanian coast of the Black Sea, in its shallow area; that area has registered a lot of restructurings mainly due to coastal erosion processes generated by coastal currents. The aim of this study is to make an inventory of the invertebrate's community associated with macroalgal benthal substratum in this area; the trophic structure within the benthic biocenoses: the substrate and trophic relationships between the macroalgal substratum and the invertebrate associations, the relationships between the zooplankton communities and the zoobenthos.

The study was carried out based on a qualitative and quantitative sample collected from the interest area, in two stages: in the prevernal and vernal seasons of 2023; 26 integral samples were collected (macroalgae and fauna, sometimes even fragments of the hard substrate on which the algae were attached), directly, by diving on two depth horizons of 0.5m - 1m and 1m - 2m.

The macroalgal community was dominated by the green macroalgae (species of the genus *Ulva* sometimes associated with *Cladophora* and *Bryopsis*) in a proportion of 82% accompanied by species of red macroalgae especially of the genus *Ceramium* (in prevernal season associated with *Polysiphonia* and *Porphyra*).

The faunal list of the benthic community studied included 87 specific and supra-specific taxa from 8 phylum's, including species characteristic of the phytall substratum but also opportunistic species that mainly populate the adjacent psammic substratum or species that can move easily (especially decapod crustaceans). The benthic communities include all trophic categories of organisms: detritivores, herbivores, omnivores (specific or nonspecific filter feeders, sedimentivores) and carnivores, the dominant group being the omnivores-detritivores.

The trophic structure of the communities includes on average 4 trophic levels (there are cases of 6, even 7 levels if we consider the zooplankton fauna used as a trophic resource).

Keywords: trophic, macroalgal, phytal substratum, zoobenthos

THE INFLUENCE OF LIGHT ON THE SPECIES *ACARTIA (ACARTIURA) CLAUSII* GIESBRECHT, 1889

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Abstract: The light interval has a significant and measurable impact on the *Acartia (Acartiura) clausi* species, influencing not only the circadian rhythm but also productivity, hatching rate and survival rate. A laboratory experiment investigated how light photoperiods affect the metabolism of individuals of the species *A. clausi*.

Individuals of *A. clausi* were reared for several generations (6) under controlled laboratory conditions, after which they were acclimatized for 48 hours to three distinct photoperiods: 16 hours of light and 8 hours of darkness (16L:8D), 12 hours of light and 12 hours of darkness (12L:12D), and 24 hours of continuous light (24L:0D). The influence of these photoperiods on the productivity of *A. clausi* females was evaluated, monitoring the number of eggs produced at 24 hours and the hatching rate at 48 hours. The results obtained showed that, for photoperiods 16L:8D, 12L:12D, and 24L:0D, hatching rates were 93%, 89%, and 88%, respectively. It was also observed that the highest average number of eggs produced was recorded at photoperiod 24L:0D, with a number of 101 eggs produced in 48 hours. The experiment continued until the organisms reached the adult stage and the survival rate was also evaluated. Thus, for the 16L:8D photoperiod, the survival rate was 46%, which was the highest of all conditions tested.

This study was conducted to determine the most favorable growth conditions for *A. clausi* individuals, given the importance of this species in the live fish food trade as well as in toxicity research.

Keywords: *Acartia clausii*, marine species, experimental, light, hatching rates.

Acknowledgements: The study has been supported by NUCLEU Program, funded by the Ministry of Research, Innovation and Digitization.

SYNERGISTIC CHEMICAL INTERACTIONS OF CONTAMINANT MIXTURES IN OCEANIC WATERS

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Abstract: The synergistic effect becomes noticeable when the combined impact of multiple contaminants exceeds the sum of their individual effects, leading to more severe biological consequences. For example, aquatic organisms are exposed to a complex mixture of pollutants, where the presence of various organic and metallic contaminants in sediments can significantly amplify the toxic effects of each substance. This suggests that synergistic toxicity may occur at concentrations relevant to real-world environments. When the combined toxicity of a mixture surpasses predictions based on concentration-addition models, it indicates that synergistic effects may pose serious risks to aquatic life.

This paper seeks to identify the common features shared by all synergistic chemical processes. Often, this shared element is not immediately apparent, resulting in diverse interpretations of synergism based on specific chemical processes. These interpretations can vary according to the chemical structures of the reagents, their mechanisms, kinetics, and energy considerations.

Our research has determined that a unifying aspect of synergistic phenomena is the formation of mixed compounds or complexes. Recognizing this common characteristic enhances our understanding of synergism and supports more targeted exploration or prediction of such effects. When a synergistic effect is observed, it is crucial to acknowledge that it involves the formation of a mixed complex with varied properties.

These insights are valuable for developing novel synergistic processes with specific properties. The applicability of these systems extends across multiple fields, including oceanography, geochemistry, analytical chemistry etc. Future research should focus on isolating and characterizing mixed compounds before further reactions and improving our understanding of thermodynamics and kinetics through theoretical calculations, as current knowledge is primarily empirical.

Keywords: *chemical processes, chemical thermodynamics, metallic contaminant, mixed compound, sediment*

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CONSIDERING OPTIONS TO RECONNECT THE RAZELM-SINOE LAGOON SYSTEM TO THE BLACK SEA

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Abstract: Various studies emphasize the need to improve the water circulation in the Razelm-Sinoe lagoon system. A preliminary analysis on the possible effects of reopening the connection between the lagoon system and the Black Sea has been performed in the present study. In this way, the breeding habitats for many freshwater and marine fish species are expected to be restored. Numerical modelling has been used to test several options to reconnect the lagoon system to the Black Sea. The analysis of the options is based on the calculated water renewal time. Our results show that reopening the connection to the sea is expected to lead to an improved water circulation in the lagoon system. At the same time, monitoring of discharge and salinity in the lagoon system is highly needed.

Keywords: *lagoon system, connection, numerical modelling, options, water renewal time*

Acknowledgements: This work has been performed within the Horizon Europe project DANUBE4all.

**AGE AND GROWTH CHARACTERISTICS OF THE STARGAZER
(*URANOSCOPUS SCABER*, LINNAEUS, 1758) POPULATION
ALONG THE BULGARIAN BLACK SEA COAST**

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Abstract: The stargazer (*Uranoscopus scaber*) is the sole representative of the Uranoscopidae family in the Black Sea basin. This non-commercial benthic species inhabits the sandy coastal seabeds. However, there is a dearth of information regarding its biological characteristics in Bulgarian waters. This study aimed to examine the size, length-weight relationship, and age distribution of the stargazer population along Bulgaria's Black Sea coast. Specimens were obtained during scientific observations aboard fishing vessels using beam trawls to catch *Rapana venosa* in the spring and summer of 2024, involving 104 trawls. The research primarily concentrated on the northern and central Black Sea regions at depths ranging from 16 to 28 m. A total of 353 stargazers were collected and analysed, comprising 288 females and 65 males. The fish average total length (TL) was determined to be 15.7 cm, with a mean weight of 77.55 g. Females were found to be larger (16.3 cm; 85.06 g) compared to males (13.2 cm; 44.25 g). Length-weight relationships were calculated for the entire population ($W = 0.0177 \times TL^{3.023}$), females ($W = 0.0236 \times TL^{2.9224}$), and males ($W = 0.0155 \times TL^{3.0668}$). These findings suggest minor differences in growth between sexes during the observed period. The age of the sampled individuals ranged from 2 to 6 years, as determined through otolith analysis using a binocular microscope. An R script was employed to assess the growth parameters of the stargazers according to the von Bertalanffy equation ($L_{\infty} = 33.93$ cm, $k = 0.1218$, $t_0 = -1.3192$, derived from the data of all examined specimens).

Keywords: *Uranoscopus scaber*, age structure, sex structure, length-weight relationship, Western Black Sea

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UTILIZING CITIZEN SCIENCE DATA: AN EFFICIENT APPROACH FOR IDENTIFYING NON-INDIGENOUS FISH SPECIES - CASE STUDY FROM THE BULGARIAN BLACK SEA

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Abstract: Over the past few decades, citizen science, which involves volunteers participating in scientific research by monitoring sites and gathering data, has gained significant attention. The growing popularity of citizen science can be attributed to its capacity to generate extensive datasets across broad temporal and spatial scales, which would otherwise be challenging to obtain. This study utilized citizen science data from both small-scale fisheries and pelagic trawlers to gather information on rare non-indigenous fish species along the Bulgarian Black Sea coastline. Although studies in other parts of the Black Sea have documented the invasion and establishment of thermophilic fish from the Mediterranean Sea, a phenomenon known as mediterraneanization, research on the Bulgarian coast has been limited. To address this knowledge gap, citizen science was employed between 2022 and 2023 to collect information on non-indigenous fish species near the Bulgarian shore. This approach enabled the documenting of four sparid species: *Lithognathus mormyrus* (Linnaeus 1758), *Spicara smaris* (Linnaeus 1758), *Diplodus puntazzo* (Walbaum 1792), and *Diplodus annularis* (Linnaeus 1758). The results and accumulated data highlight the potential of citizen science as a valuable research tool for monitoring non-indigenous fish species.

Keywords: *citizen science, Black Sea, Sparidae, Mediterraneanization*

Acknowledgements: This research was supported by MASRI: Infrastructure for Sustainable Development of Marine Research and Participation in the European Infrastructure EURO - ARGO - MASRI is a project of the National Roadmap for Scientific Infrastructure (2020 – 2027) of The Republic of Bulgaria, gratefully acknowledged by the authors.

THE ROLE OF AGRICULTURE IN THE PROTECTION OF MARINE ECOSYSTEMS

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Abstract: Agriculture today is different from agriculture in the past. The new technologies adopted by farmers are increasingly less polluting and less consuming of inputs (fuels, pesticides, etc.). Nowadays minimal or no till technologies are used more and more by farmers. The amounts of pesticides used in agricultural technologies are getting smaller and smaller, this is also due to the introduction of the latest discoveries regarding their effectiveness, the use of new, more effective formulas (localized, fazial application, the use of slow-release molecules) of the active substance or with the release of the active substance only in the case of certain conditions in the soil, related to humidity, the use of precision equipment in the forecast and even in the application of treatments, etc.). The legislation adopted by Romania, which provides for measures to protect ecosystems, not only marine ones, is strictly applied in agriculture. The paper presents the measures taken in agriculture to reduce groundwater and surface water pollution, in accordance with the 2020 Resolution of the European Environment Agency, as well as the European Commission from 2022 objective of reducing pollution to zero, included in the European Green Deal.

Keywords: *agriculture, pollution, technologies, measures, reduction*

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Thank you for the opportunity to participate in various research activities in the last 20 years, outside of research projects.

ZOOPLANKTON FROM ROMANIAN COASTAL WATERS – COMPOSITION AND EVOLUTIONARY STRUCTURAL TRENDS

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Abstract: The research of the planktonic communities - zooplankton and phytoplankton from the Romanian waters of the Black Sea already sums up more than a half of a century, through the contribution of those who laid the foundations of Romanian marine research, as well as the researchers who took over and continued these studies, either in the research institutes on the seashore or in the universities.

These historical studies highlighted the qualitative composition and biological diversity of the zooplankton, as well as the way in which this association underwent various quantitative changes or was influenced by non-native species, which arrived in the Black Sea waters in recent decades.

Zooplankton - through its representatives, for the most part, primary consumers - has a very important role in the transmission of matter and energy along the trophic chains, influencing the structural and functional dynamics, both phytoplankton it feeds on, and of the fish pelagic, zooplanktonophagous, which consume it.

Due to a series of research studies which have been carried out in recent years - some coordinated by S.C. Blumenfield S.R.L., in collaboration with FSNSA, UOC - who also monitored the zooplankton situation, this paper aims to present a synthesis of the resulting observations.

The qualitative structure and the proportion of different zooplanktonic species will be done and quantitative data of holoplankton and meroplankton in the samples studied from Romanian waters will be analysed.

In the studied samples, the main adult forms belonged to *Noctiluca scintilans* (Cystoflagellata), *Acartia clausi* (Calanoida) and some Cyclopoida and from meroplankton larvae of Bivalvia, Copepoda and *Aurelia aurita*.

Synthetic comparisons with data from the literature will be attempted.

Keywords: *Black Sea, zooplankton, Romanian waters*

Acknowledgements: Thanks SC Blumenfield for the collaboration and the possibility of participating in various evaluation and research studies in the last 10 years.

ENVIRONMENTAL POLLUTION: THE CONSEQUENCES OF THE WAR ON THE ROMANIAN BLACK SEA COAST

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Abstract: Nowadays, the crisis between Russia and Ukraine has sensibilized the Black Sea region and the effects are being felt by the aquatic environment. The military operations conducted on land, air and sea in this conflict, as well as the regular operational (training) activities, raise concerns for the economic, environmental and human health security of the surrounding states, and the environmental impacts will persist for a long time.

The objective of our study is to identify, based on literature research, potential pollutants caused by current military operations with negative impact on the marine environment. Explosives used in military operations are a potential source of chemical pollution of the environment, as they are known to be energy materials that produce toxic and greenhouse gas emissions as well as heavy metal pollutants, which can be released into the environment with harmful effects and environmental risks.

Military training exercises carried out in the Romanian coastal training area include live firing with a variety of weapons and weapon systems, from small arms and long-range rifles to artillery and rockets. Besides these, a real environmental hazard is the presence of naval mines, which are carried by currents, in the Western coastal areas of the Pontic Basin. As a result, in addition to the noise pollution produced by munitions explosions, the contaminants due to military operations that pose a real threat to the environment are heavy metals (from bullet casings, tracer materials, mine bodies, mine fuses, fuel, explosive primers, etc.), explosives based on RDX, TNT and ammonium perchlorate, or ammunition containing per- and poly-fluoroalkyl substances (PFAS). Apart from weapons, chemical pollution during armed conflict results from chemical spills resulting from damage to civilian industrial facilities and waste sites as well as oil and lubricant spills resulting from different elements engaged in the battle.

Keywords: *contaminants, explosives, toxic emissions, military operations*

Acknowledgements: This research was supported by European project –EMFAF-2023-PIA-FLAGSHIP-Black Sea SIERRA-Harnessing complementary curricular preparedness via sustainable management in response to civil and military pollution on the coastline, tributaries and lagoons in Black Sea’s North, West, South zone.

THE ADAPTATION OF THE PROGRESS ACTIONS IN ACCORDANCE WITH STAKEHOLDER REQUIREMENTS IN CO-CREATION STAGE OF THE RESPONSE PROJECT'S DEVELOPMENT

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Abstract: In support of the good operational practices' context established across Black Sea countries in relation with various types and impacts of the marine pollution, RESPONSE Project - *Building Response Frameworks under existing and new Marine Pollution Challenges in the Black Sea*, funded by European Climate, Infrastructure and Environment Executive Agency (CINEA), through EMFAF Projects Grants Scheme, was design to empower marine pollution training, monitoring and mitigation. RESPONSE takes a hierarchical approach to combine the required layers of information needed to produce an integrated, interoperable, and harmonized set of training tools and curriculum for identifying, observing, mapping and mitigating marine pollution at the coastal and marine ecosystems of the Black Sea region. RESPONSE aims to involve, inspire and influence stakeholders through the co-design, co-creation, co-establishment, co-implementation and co-assessment of training programs. The active engagement and participation of key stakeholders will ensure the effectiveness of the training programs in the long-term, by their integration in the operation system of key institutions. Strategic plans will be co-designed and applied to support sustainable and adaptive operation beyond the lifespan of RESPONSE further opening of science to the social, economic, environmental and cultural realm. The present work emphasized specific actions at the early stages of the project, focused on identification of the various target groups and regional stakeholders' requirements and specifications for professional training on marine pollution and share background data, tools and information support systems for related marine risks. The communication and dissemination of the RESPONSE trainings outputs to regional key/BS stakeholder groups are based on several scientific and technological grounding research activities to provide specialized training and policy with potential transferability to the regional networks of participants in the domain of the marine pollution monitoring and mitigation.

Keywords: *marine pollution, type of pollutants, training curricula, training tools, environmental protection*

Acknowledgements: The encompassed works were carried out in the framework of the EMFAF funding scheme for the Black Sea, RESPONSE Project - 101124661/2023, Building Response Frameworks under existing new Marine Pollution Challenges in the Black Sea.

MONITORING COASTAL ENVIRONMENTAL POLLUTION USING UAVs AND AI

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Abstract: Coastal ecosystems are increasingly affected by pollution, with significant consequences for biodiversity and water quality. Traditional methods for monitoring these environments often prove insufficient due to their limited precision and inability to deliver real-time data. This research explores the integration of Unmanned Aerial Vehicles (UAVs) equipped with multispectral sensors and Artificial Intelligence (AI) for efficient, high-resolution coastal pollution monitoring.

Using multispectral imaging, UAVs capture detailed data on waterborne and airborne pollutants, which are then processed by AI algorithms to generate real-time pollution maps. This approach allows for the identification of pollution hotspots, sources, and distribution patterns with enhanced accuracy. The use of AI facilitates automated data interpretation, helping to assess the extent and potential impact of pollutants on marine biodiversity.

The research emphasizes the importance of timely detection and intervention, particularly in regions where pollution directly threatens marine species and habitats. The findings contribute to conservation efforts and offer a scalable, cost-effective solution for environmental monitoring. Additionally, the project aims to support decision-makers by providing actionable data that can inform environmental policies and coastal management practices.

Keywords: *UAV, AI, coastal pollution, multispectral sensors, marine ecosystems*

Acknowledgements: I would like to express my deepest gratitude to my PhD coordinator, Ing. Dr. Panaitescu Liliana, for her continuous guidance, support, and encouragement throughout the development of this research. Her expertise and constructive feedback were invaluable in shaping the direction and quality of this work. I would also like to extend my appreciation to my colleagues and peers who offered insights and advice during the research and preparation phases.

HABITAT PREFERENCES AND TROPHIC INTERACTIONS OF THE BENTHIC INVERTEBRATE COMMUNITIES INHABITING DEPOSITIONAL AND EROSIONAL BANKS OF A MEANDER FROM DANUBE DELTA (ROMANIA)

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Abstract: The present study assessed the ecological preferences and the trophic interactions of the benthic invertebrate communities inhabiting erosional and depositional banks developed within a meander of the River Danube flowing through its delta (Danube Delta, Romania). The invertebrates from two mesohabitats, the concave (i.e. erosional) and convex (i.e. depositional) banks developed in the apex region of the meander were sampled quantitatively and qualitatively, along with sediment samples for assessing the grain-size characteristics and hydrodynamic parameters (i.e., critical shear stress, the Reynolds number, the critical velocity and Shields parameter). The results showed that increased siltation with fine sediments in the depositional bank led to a community dominated by chironomids, oligochaetes and bivalves, whereas the opposite bank comprised crayfish, caddis fly larvae and amphipods with a preference for coarser sediments. The $\delta^{13}\text{C}$ of most consumers revealed that the dominant forms of carbon entries in the analyzed food webs were photosynthetic based, whereas certain snails, chironomids and basal resources from the depositional bank were ^{13}C depleted ($\delta^{13}\text{C}$: -35 to -39 ‰). Such low ratios for $\delta^{13}\text{C}$ (mean < -35 ‰) reflected the potential of carbon entry through the base of depositional food web as a result of methane oxidation at sediment-water interface (i.e. chemosynthesis), induced by the fine sediments deposition that could have favored the methane production. Grazing methane-oxidizing bacteria in the depositional meander bank could have provided the primary consumers with up to 50 % and the omnivores and predatory invertebrates with up to 30 % of their carbon, which could represent an important subsidy from an additional, chemosynthetic source. The impact of a supplementary carbon input was further reflected in increasing depositional food web basal niche diversity, which led to distinct trophic niches and lower interspecific competition of consumers compared to the erosional bank of the meander.

Keywords: *River meanders, Stable isotopes of $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$, Depositional and erosional banks*

Acknowledgments: This work was supported by MRID through the Core Program within the National Research, Development and Innovation Plan 2022–2027 project no. 23020101(SIA-PRO), contract no 7N/2023 and project PNRR-III-C9-2022 – I5 cod 18/16.11.2022 (Response).

IPBES ASSESSMENT ON INVASIVE ALIEN SPECIES AND THEIR CONTROL

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Abstract: The recent Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report highlights the serious and growing threat invasive alien species (IAS) pose to biodiversity and ecosystems. Globally, over 37000 alien species have been established, including more than 3,500 classified as invasive. Alien species, which include plants, animals, fungi, and microorganisms, are introduced at unprecedented rates, with about 200 new species recorded annually. Invasive species, a subset of alien species, negatively impact ecosystems and, in some cases, human activities. Most reported impacts are from the Americas (34%), Europe and Central Asia (31%), and the Asia-Pacific region (25%), with fewer in Africa (7%). Terrestrial ecosystems face the greatest impact, accounting for 75% of documented effects, particularly in forests, woodlands, and agricultural lands. In contrast, aquatic environments, including both freshwater and marine ecosystems, account for about 24% of the recorded impacts.

Marine ecosystems are particularly vulnerable due to the difficulty of implementing effective control measures, especially in open water systems. Approximately 70% of marine IAS are introduced via biofouling, and once established, they are notoriously difficult to eradicate. Prevention is therefore key, with strategies focused on stopping introductions and the early detection of invasive species being the most effective approaches in marine systems. The risks posed by IAS are closely linked to global environmental challenges, including climate change and resource exploitation. Effective management requires integrated governance, involving policy alignment across sectors, international cooperation, and raising awareness of IAS impacts.

Keywords: *marine ecosystems, coastal ecosystems, impact, management, integrated governance*

Acknowledgements: We are grateful to the hundreds of experts, policymakers, and practitioners, including members of Indigenous Peoples and local communities, who generously contributed their time and knowledge as authors, fellows, review editors and contributing authors of the Assessment of Invasive Alien Species and their Control, as well as to the IPBES management committee (www.ipbes.net/ias).

UNDERSTANDING THE EFFECTS OF PLASTIC POLLUTION IN OCEANS USING ZEBRAFISH

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Abstract: Despite the public's growing awareness, plastic pollution is a major environmental issue because it impacts marine fauna, causing physical, chemical, and biological harm to organisms. It is estimated that the oceans contain 75-199 million tons of plastic waste, with 33 billion pounds entering the marine environment annually.

Model organisms have been crucial in biological and clinical research. Scientific research uses *Danio rerio* (zebrafish) as a model organism because of its advantages, including its size, husbandry, early morphology, mammalian-like physiological responses, and behavioral abnormalities due to environmental pollutants, which make them useful for assessing toxicity.

The aim of this study is to provide an overview of literature about the effects of plastics on zebrafish. Exposure to microplastics (5.0 mm in size or less) and nanoplastics (between 1 and 1,000 nanometers across) can induce oxidative stress, behavioral disturbances such as anxiety-like behaviors, affect the nervous system's function, alter behavior and cognitive function, cause neuroinflammation, and affect locomotor activity, learning and memory, social behavior, and predator avoidance responses. Ingesting pollutants through their diet can accumulate them in zebrafish tissues. Globally, researchers are conducting studies on the impact of plastic on the environment and human health.

Keywords: *plastic pollution, microplastics, nanoplastics, zebrafish*

BENTHO-PELAGIC COUPLING ON THE NORTH-WESTERN SHELF OF THE BLACK SEA

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Abstract: The marine ecosystems, especially coastal, are under intensive anthropogenic influences and Black Sea ecosystem structure and function are strongly affected by these pressures. This leads to the complexity of the basic nutrient input and energy transfer of the food web and the trend of coupling between various energy channels. Anthropogenic pressures regulate benthopelagic coupling directly and indirectly through their effects on the physical and biological components of ecosystems. However, there are large gaps in our understanding of the responses of inorganic nutrient and organic matter fluxes between benthic habitats and the water column. Here, we propose to fulfill the gap in benthic turnover rates of organic matter (CO₂ release, O₂ consumption, nutrient release from sediments) and to estimate the contribution of fluxes sustained by benthos to the overall benthopelagic exchange knowledge for the northwestern shelf of the Black Sea. Based on extensive datasets obtained within the DOORS-2 Open Sea Survey in Western Black Sea, Cruise 2 / Leg1 - R/V Mare Nigrum (2023) and MN148 - RECORDED Cruise (2016), we assessed sediment nutrient cycling capacity, and we estimated the contribution of fluxes sustained by benthos to the overall benthopelagic exchange. Our results highlight that deeper sediment is less active and consumes less oxygen. The same trend is present in the silicate, phosphate and ammonium fluxes, which reveals a maximum of nutrients release at water depths around 30 m. A great part of the oxygen consumption and nitrogen release happens in the water column, which is the result of intensive cycling within the water and only weak coupling to the sediment. This result highlights the severity of the nutrient discharge by Danube, which cannot be compensated by benthic processes. Benthic macrofauna play a central role in organic matter retention, remineralization and benthic-pelagic exchange, both directly through ingestion, biomass production, respiration and excretion and indirectly through bioturbation. More bioturbation means more energy consumption and results in higher oxygen demand. Our results show how indeed the benthic oxygen fluxes are decreasing along with decreasing bioturbation intensity.

Keywords: *benthopelagic coupling, anthropogenic pressures, Black Sea.*

Acknowledgements: This study is supported by the European Union H2020 project DOORS, grant agreement no. 101000518 and the Romanian Ministry of Research CORE Programme projects PN 23300202 and PN23300103.

CELLULAR METHODS USED TO ASSESS BENTHAL ORGANISMS' HEALTH RISKS DUE TO ENVIRONMENTAL CONTAMINANTS EXPOSURE

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Abstract: The sustainable use of oceans and seas is greatly impacted by marine pollution and habitat degradation, which can also have an adverse effect on human health through consumption of contaminated marine nutrient sources and direct contact with polluted waters. Therefore, the monitoring of pollution in the western part of the Pontic Basin has long been a priority concern for researchers.

Currently, researchers in the field of marine ecosystem conservation and protection give high priority in their monitoring studies to the use of aquatic organisms as bioindicators of pollution. Assessing the health status of aquatic ecosystems through these bioindicators is becoming a modern approach in line with European requirements.

Organisms exhibit a high degree of responsiveness to environmental conditions by generating signals at different levels, such as population, individual, and molecular, in response to changes in the environment. In the Black Sea, there are several studies on the organisms used as bioindicators (*Mytilus galloprovincialis* (Lamarck, 1819), and *Rapana venosa* (Valenciennes, 1846)) for the identification of heavy metals, PAHs, and PCBs, based on their responses to the stress induced by the presence of contaminants in the environment. Nevertheless, there are not many detailed studies in the currently available literature on the use of the amphipoda crustaceans *Pontogammarus (Euxinia) maeoticus*, *Gammarus sp.* as a bioindicator. These species exhibit a detritivorous eating behaviour, favouring the consumption of organic plant or animal waste. Additionally, representatives of these species provide benthic fish from the surrounding habitat with a plentiful and easily accessible food source. Our paper aims to highlight the importance of using cellular and cytogenetic methods in monitoring programs to detect and understand the pollutants that could threaten this fragile ecosystem in the Romanian coastal area.

Keywords: cytogenetic, contaminant, biotester, monitoring studies

SESSION III - SUSTAINABLE USE OF MARINE RESOURCES

ORAL PRESENTATIONS

EFFECTS AND RESPONSES OF FISHES AND AQUACULTURE RESOURCES TO THE CLIMATIC CHANGES – VIEW TO THE BULGARIAN COAST OF THE BLACK SEA

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Abstract: Main climate drivers of change and its expected impacts.

Extensive modifications the Black Sea ecosystem for the last 50 years (overfishing, excess nutrient loading, presence of invasive species, climate changes) have been indicated as major drivers for community reorganization. Studying the sensitivity of fishes to temperature and oxygen availability can support the study of their response to climate change and provide more unbiased knowledge on the expected patterns in their spatial dispersal. Furthermore, given the findings of the effects of fishing pressure on fish's genetic diversity and stock spatial integrity, stock management strategies must focus on the development of an integrated ecosystem-based management approach to benthic fisheries, considering the impact of other benthic-species fisheries on turbot stock spatial dispersal, population dynamics, and species habitat integrity.

Keywords: *Black Sea, fishing, ecosystem, aquaculture*

INTERNATIONAL TRADE AS A DRIVER IN BLACK SEA CLAMS HARVESTING

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Abstract: The study examines the recent developments in the harvesting and processing of bivalve molluscs in the Black Sea. It focuses specifically on marine bivalves that live buried in the sand of the seabed, popularly known as clams. Clams have not been traditionally exploited and consumed in the Black Sea coastal countries. The demand for these marine organisms for culinary purposes is driven by markets outside the region, mainly in the northern Mediterranean. Therefore, the analysis of the trade flows generated by this fishery provides a good picture of the evolution of the sector and the driving forces behind it. The survey is based on statistics from FAO and national authorities, as well as trade sources. It attempts to shed a light on the species composition of this fishery, which is frequently merged into one generic category. The relatively short period of growth of the sector has been accompanied by a delay in the adoption of governance measures by some national authorities. The impact of growing commercial interest on the management of local clam stocks is thus briefly outlined. The review attempts to contribute to the sustainable exploitation of this less studied Black Sea fishery through the prism of economic analysis.

Keywords: *international trade, clams, Black Sea, sustainability*

TAILORING WESTERN BLACK SEA AQUACULTURE TO IMPENDING CLIMATE CHANGE: LABORATORY TESTING OF GILTHEAD SEABREAM *Sparus aurata* (LINNAEUS, 1758) AS A POTENTIAL CANDIDATE

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Abstract: Romanian marine aquaculture has recently attracted the focus of experts aiming to stimulate its development. However, climate change calls for the diversification of species, seeking alternatives tolerating warmer summer temperatures. In this context, the research on the adaptability of gilthead seabream (*Sparus aurata* Linnaeus, 1758) for the use in marine aquaculture was performed. The experiment demonstrated the possibility of transferring three months old juveniles from a 36‰ salinity into Black Sea water (mean salinity 15‰), without any mortality. The evolution of the stress induced by the difference in salinity was carefully monitored. Glycemic levels between 68-82 mg/dl before, 157-171 mg/dl one hour after the sudden change in salinity and 115-124 mg/dl at 24 hours were documented, respectively. Corroborated with the color changes and the resumption of active feeding and schooling behavior in less than 12 hours, it can be inferred that the use of the species is feasible in Romania. An average biomass increase comparable to relevant literature was documented: from seven grams initially to 300 grams after seven months of laboratory rearing. The biochemical analysis of the meat also revealed a balanced composition. After reaching the 500 g threshold, some of the individuals from the batch adapted to growing in captivity were transferred to the Constanta Aquarium and are part of the exhibition for showcasing the secrets of the marine environment, for the wider benefit of society. Overall, *S. aurata* proved a viable candidate for Western Black Sea cage aquaculture in a rotational system, complementary to colder water species.

Keywords: *aquaculture, adaptability, Black Sea, rotation, seabream*

Acknowledgements: This study has been carried out with financial support from the NUCLEU SMART-BLUE Programme, funded by the Romanian Ministry of Research, Innovation and Digitization, project no. PN 23230301.

SIMULATING ANCHOVY'S FULL LIFE CYCLE IN THE BLACK SEA: A COUPLED BIOGEOCHEMICAL-DEB-MOVEMENT-IBM MODEL

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Abstract: European anchovy (*Engraulis encrasicolus*) is an abundant small pelagic fish in the Black Sea and supports a significant commercial fishery. Anchovy is highly sensitive to climate fluctuations that affect environmental and biological conditions. Presently, reconstructed biomass and population data from stock assessments lack detailed spatial resolution. We are developing a 3D full-life-cycle individual-based population model for Black Sea anchovy. The model is one-way coupled to a Black Sea hydrodynamics-biogeochemical model (BAMHBI) that provides temperature, circulation (transport), and prey for the anchovy. The IBM uses the same grid as the hydrodynamics-BAMHBI model. Individual anchovy progress daily through five life stages (egg, early larvae, late larvae, juvenile, and adult) and we follow individuals until age-4. A dynamic energy budget (DEB) submodel is used to simulate growth across all life stages and generate egg production. The model incorporates phototrophic small and large flagellates as food sources for larvae, and micro- and meso-zooplankton for juveniles and adults. Movement is based on a kinesis algorithm with temperature and food as cues; eggs are physically transported. A super-individual approach is utilized for computational efficiency. Calibration proceeded by separately tuning the DEB, movement, and density-dependent mortality, and then comparing predictions to data when all were combined into the full 3D population model. We presently are evaluating the full model using a baseline simulation of 1990 to 2022. We will then use simulation experiments to explore, under present-day and plausible future climates, the mechanisms that cause high and low recruitment years, population responses to changes in harvest, and the effects of invasive species that compete for common prey. We plan to use the modeling to provide insights into the sustainability and resilience of Black Sea anchovy population to climate, harvest, and stressors. Better understanding of the spatiotemporal variation in population dynamics can inform fishery management and conservation strategies.

Keywords: Black Sea, European Anchovy, DEB-IBM, population dynamics, biogeochemical model.

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CONTRIBUTIONS TOWARDS AN INTEROPERABLE, DATA-INTENSIVE, AND COST-EFFECTIVE DIGITAL TWINS OF THE OCEAN (DTO) FOR FISHERIES IN THE BLACK SEA

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Abstract: The present work presents several Earth Observation (EO) services extended with the intention to act in the direction of meeting users' requirements, thus enhancing certain relevant tools that improve the access to data and information and allow certain BS fisheries' stakeholders to perform different analyses and run scenarios for specific activities, to increase the efficiency of their conservation measures.

The development purposes of a Digital Twin of the Ocean pilot (DTO) in the BS, were followed in the implementation of a dynamic IT platform expansion, a web-based mobile-friendly decision support system to enhance the management, monitoring and forecasting data and information on the Romanian marine and coastal zone, in order to support the identification of the oceanographic characteristics as a base of documentation of the potential highly productive fishing zones.

In this specific application, Earth Observation data provide the important hydro-biological parameters of the marine ecosystem and specific sustainable fishing indexes in assembly with primary productivity and marine living resources distributions on the western Black Sea areas. The system was developed for fisheries purposes in an ongoing project - Iliad, financed by EC/H20202 Green Deal funding scheme, which will deliver the information through a pilot DTO providing the favourable fishing areas on the Romanian Black Sea Shelf.

Keywords: *marine fisheries, Black Sea EO services, sustainability indexes*

Acknowledgements: The work was supported by ILIAD Project - Integrated Digital Framework for Comprehensive Maritime Data and Information Services, contract no. 101037643/2021.

ASSESSING THE POTENTIAL BEAM-TRAWLING IMPACT ON BLACK SEA HABITATS AIMING AT SUSTAINABLE FISHERIES MANAGEMENT

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Abstract: The North-Western shelf of the Black Sea is highly vulnerable to disturbances of its habitats and ecosystems. In the past 10 years, this area has become targeted by beam trawl fisheries for the invasive gastropod *Rapana venosa* (Valenciennes, 1846), with a potential destructive impact of soft bottoms. Few studies have been carried out in the Black Sea, and most investigations focused on gear selectivity and by-catch rates. In this context, our novel research aimed, on the one hand, to assess and quantify the actual impact of beam trawling and propose effective spatial/temporal management measures for a sustainable zonation of the North-Western Black Sea shelf (marine zone of the Danube Delta Biosphere Reserve), on the other hand. The methodology used integrated beam trawl catch dynamics information, VMS data, geophysical investigations and macrozoobenthos sampling. Our findings show that beam trawling activities can cause changes in the benthic habitat structure (lower number of taxa, lower values of ecological indicators and an overall non-GES status). Further in-depth investigations are needed to underpin the ecosystem-based management of this marine protected area (MPA), aiming to allow the recovery of the affected benthic habitats by proposing potential spatio-temporal management measures (such as Fisheries Restricted Areas - FRAs).

Keywords: *beam trawling; benthic macrofauna; ecosystem-based management; Fisheries Restricted Areas (FRAs)*

Acknowledgements: This research was funded by the Romanian Ministry of Research, Innovation, and Digitization in the framework of the national NUCLEU Programs, projects: PN23300202 and PN23230301, POIM project “Revision of the Danube Delta Biosphere Reserve Management Plan and Regulation“, SMIS Code 123322, contract number 253/18.06.2019, the Program Development of the National R&D system - AMBI AQUA - no. 23PFE, and the European Union’s Horizon 2020 BRIDGE-BS project under grant agreement no. 101000240, and the DOORS project under grant agreement no. 101000518.

RESULTS OF THE UNDERWATER SURVEY OF THE SUBMERGED ISLAND AND ADJACENT AQUATORIUM IN THE SOUTH-EAST BLACK SEA COAST OF GEORGIA

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Abstract: The maritime history of Georgia, deeply rooted in antiquity, is reflected in ancient Greek mythology, particularly the myth of Jason, Medea, and the Argonauts. Seafaring activities, especially cabotage navigation, were facilitated by the presence of islands near the mainland.

The existence of islands in the Georgian waters of the Black Sea was documented in historical sources such as Procopius of Caesarea and Strabo, as well as on Late Medieval and 19th-century maps by cartographers like Andreas Cellarius and Jean-Denis Barbié du Bocage. Notably, one of these maps labels an island as the "Tomb of Absyrtus," now apparently submerged due to fluctuations in Black Sea levels, which have varied between +2 to +3 meters and -10 to -13 meters over the last 4,000 years.

Despite local fishermen occasionally discovering cultural heritage artifacts on the seabed, the existence of these submerged islands was not scientifically verified until 2019. Earlier attempts to establish underwater archaeology—a field requiring extensive multidisciplinary research—had not yet been adequately addressed in Georgia.

This work presents the 2019 discovery of one of the islands potentially mentioned in ancient Greek manuscripts and depicted on historical maps. It also reflects the results of the research cruise by the R/V *Mare Nigrum* (MN 256), conducted in 2024 as part of the EU Horizon 2020 project DOORS (Developing Optimal and Open Research Support for the Black Sea).

The expedition focused on the area near Gonio, where 13 km of bathymetric lines and backscatter data covering 0.74 km² were surveyed. Structures with geometric features, including walls 3 to 8 meters in length and up to 0.5 meters high, were discovered at depths of 12-13 meters. Given the absence of such formations elsewhere on the adjacent seafloor areas, these findings suggest the presence of potential man-made structures, marking a significant step forward in underwater archaeological exploration in the Black Sea waters of Georgia and warranting further investigation.

Keywords: *Underwater archaeology, submerged island, paleogeomorphology, Black Sea cruise*

Acknowledgements: This work is supported by DOORS, an EU Horizon 2020 project funded under grant agreement No. 101000518. The support of the DOORS Cruise-3 Black Sea Survey 2024 (MN 246) core scientific team and the crew of the R/V *Mare Nigrum* is deeply appreciated.

SESSION III - SUSTAINABLE USE OF MARINE RESOURCES

POSTER PRESENTATIONS

REPRODUCTIVE BIOLOGY OF TURBOT (*Scophthalmus maximus*) THROUGH THE SPRING-SUMMER SEASON ON THE BULGARIAN BLACK SEA COAST

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Abstract: In recent years, climate and environmental changes also had an immense effect on the spawning dynamics of fish. Therefore, the present study aimed to clarify the reproductive biology aspects, including age, absolute and relative fecundity, oocyte diameter and gonad maturity stage of turbot (*Scophthalmus maximus*) along the western Black Sea coast in the spring-summer season of 2023. The absolute fecundity estimated for the 37 ovaries out-of-spawning season was 269921 eggs and the average relative fecundity was 87156. The histological analysis of female individuals revealed that all were in the vitellogenic stage II and oocytes (mean diameter 300 µm) located at the ovarian lamellae's periphery. The results of this study unequivocally show that despite changes in food and environmental conditions the spawning season of turbot has not changed.

Keywords: *Black sea, fecundity, reproductive biology, turbot*

Acknowledgements: This research was made possible by the support of MASRI: Infrastructure for Sustainable Development of Marine Research and Participation in the European Infrastructure. EURO-ARGO-MASRI is a project of the National Roadmap for Scientific Infrastructure (2020–2027) of the Republic of Bulgaria, for which the authors are grateful. This work was funded by the Agriculture Academy, Bulgaria, project number: Ж180/2022.

HEALTH BENEFITS OF ULVA LACTUCA EXTRACT OBTAINED VIA SUPERCRITICAL FLUIDS ON CYPRINUS CARPIO REARED UNDER VARYING WATER EXCHANGE RATES

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Abstract: The study investigates the health benefits of *Ulva lactuca* extract, obtained through supercritical fluid extraction, on the species *Cyprinus carpio* (common carp) reared at different water exchange rates in recirculating aquaculture systems (RAS). An inadequate water exchange rate can lead to the accumulation of toxic compounds, which act as stress factors for aquatic organisms. The inclusion of *Ulva lactuca* extract in fish feed was evaluated for its potential to enhance immunity, reduce stress, and improve the overall health status of the fish. Three groups with different water exchange rates were established for the experiment: ER1 - 7.5 l/kg/day, ER2 - 3.75 l/kg/day, and ER3 - 2.5 l/kg/day. Each group was tested with three types of diets: C, a control diet, E5, an experimental diet supplemented with 5% extract, and E10, an experimental diet supplemented with 10% extract.

At the end of the experiment, supplementation with *Ulva lactuca* extract significantly improved fish growth performance and helped mitigate the negative impact of inadequate water exchange, thereby enhancing their welfare.

Keywords: *Cyprinus carpio*, *Ulva lactuca*, health status, water exchange

Acknowledgements: This research work was carried out with the support of the Romania Centre for Modelling Recirculating Aquaculture Systems, Galați.

ACTIVE MOLECULES WITH ANTIMICROBIAL AND ANTIOXIDANT ACTIVITY FROM HYDROALCOHOLIC MACERATES OF *Cladophora vagabunda* (Linnaeus) DEVELOPED IN NEW TOPICAL PHARMACEUTICAL FORMULATIONS IN THE FIELD OF REGENERATIVE MEDICINE

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Abstract: A new trend in regenerative medicine is the use of bioactive compounds from natural vegetal products in the preparation of topical pharmaceutical formulations, due to their easy administration, proven healing action, the protection of skin lesions and the assurance of oxygen permeability. Recent literature highlights the growing interest in marine algae research, as a food source due to their broad range of functional benefits beyond basic nutritional value. Algae possess intrinsic characteristics that make them an appealing and sustainable dietary option, being rich in easily digestible proteins, fats, carbohydrates, vitamins, and minerals, vital bioactive compounds such as phycocyanin, astaxanthin, lutein, zeaxanthin, β -carotene and oleic acid, which significantly contribute to immune support and overall nutritional well-being. These components are also associated with potential therapeutic effects in the prevention and treatment of various degenerative diseases. This study refers to a process for obtaining pharmaceutical preparations of a type of mucoadhesive trochists with applications in oropharyngeal diseases. The process consists in the preparation of a mixture of usual excipients in powder form in which it disperses 0.5...1% hydroalcoholic extract from green algae *Cladophora vagabunda*, 0.25...1% hydroalcoholic extract from grape pomace and 0.05...0.15% volatile oils from aromatic plants such as cinnamon, thyme and turmeric, followed by the dispersion of a mixture of 0.15...0.5% gelatin acid extracted from marine mollusk *Rapana venosa* or gelatin for pharmaceutical use of animal origin, sorbitol, glycerin and distilled water, with kneading until a dense elastic mass having the necessary consistency to form discoidal trochists, having organoleptic characteristics and behavioral properties suitable for use as disinfectant adjuvants in the therapy of some staphylococcal infectious diseases of the oropharyngeal mucous membranes. This study also refers to a process for obtaining cream type dermato-cosmetic preparations based on bioactive components from marine and viticultural sources. The process consists in incorporation of 0.5...1.5% hydroalcoholic extracts from *Cladophora vagabunda* marine algae in 90.4...98% mass semi-solid carbopol-based ointment bases, respectively in 0.25...1.75% liquid extracts of pomace from grapes of the Mamaia and Fetească regală variety, with a concentration of 10% in ethyl alcohol, as well as 0.3...3% peptides and collagen extracted from marine mollusk *Rapana venosa*, under continuous stirring, until complete homogenization. The result is a translucent cream-type preparation, pale yellow in color, having physical-chemical and behavioral characteristics suitable for effective protection against the harmful effects of UV radiation.

Keywords: biocomposites, marine green algae, grape pomace, aromatic plants, mucoadhesive trochists, dermato-cosmetic cream

Acknowledgements: This work was carried out in the framework of the research project PN-III-P1-1.2-PCCDI-2017-0701 "Complex Valorisation Of Black Sea Region Bioresources By Developing And Applying Innovative And Emerging Biotechnologies" acronym INOBIOMAR.

BLACKNETS – EXORCISING THE BLACK SEA’S SILENT KILLERS

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Abstract: The increasing threat posed by abandoned, lost, and discarded fishing gear (ALDFG), also known as derelict fishing gear, has led to growing international efforts to address its devastating impacts on marine environments. ALDFG is recognized as the most dangerous form of marine litter, causing severe damage to marine ecosystems and endangering numerous species, many of which are already threatened with extinction. The BlackNETs project, funded by Interreg Next Black Sea Basin, is a critical initiative aimed at tackling this issue in the Black Sea region. With a budget of €456,660.26 and an 18-month timeline, the project seeks to improve coastal management and develop governance plans to preserve biodiversity and coastal ecosystems. The project’s objectives include quantifying and minimizing the impact of ALDFG, identifying polluting factors, and promoting sustainable alternatives. Through actions such as mapping derelict gear accumulation areas, retrieving lost fishing gear, and raising awareness among stakeholders, the project aims to remove at least 8,000 kg of ALDFG from Black Sea waters. Key partners include Mare Nostrum NGO (Romania), Karadeniz Technical University (Türkiye), the Institute of Oceanology (Bulgaria), and LEPL Ilia State University (Georgia). The BlackNETs project represents a significant step toward reducing ALDFG and protecting the Black Sea’s marine and coastal habitats, ultimately contributing to a cleaner and healthier environment.

Keywords: *ALDFG, environment, Black Sea, marine ecosystem, biodiversity conservation, ghost nets*

Acknowledgements: Project funded by the Interreg Next Black Sea Basin Programme, co-financed by European Union.

COMMUNITIES OF METAZOAN PARASITES OF *ALOSA IMMACULATA* (BENNETT, 1835) FROM THE DANUBE WATERS IN THE ROMANIAN AREA. RECENT FINDINGS

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Abstract: *Alosa immaculata*, also known as the Danube shad, is a pelagic fish with a high economic value for all Black Sea countries. Parasitic metazoan comprises a polyphyletic group of six taxa: flatworms (Platyhelminthes), tapeworms (Cestodes), flukes (Trematodes - microscopic parasites that can infect the skin and gills), roundworms (Nematodes), acanthocephalans, and crustaceans. The biological material used to identify the parasite was collected from the Danube River, in the areas of Brăila, Galați, and Sfântu Gheorghe, between March and April 2024. The analysis of 53 specimens of *A. immaculata* evaluated identified one ectoparasite species (*Mazocraes alosae*) and three endoparasite species (*Lecithaster sp.*, *Hysterothylacium aduncum*, *Contracaecum sp.*). The research revealed that the Danube shad infected with *M. alosae* had an average parasite intensity value ranging from 2.6 - 4 parasites/host, a prevalence between 56 - 68%, and an average abundance of 1.8 - 2.8 parasites/fish. *Lecithaster sp.* recorded prevalence values ranging from 52 - 66%, and the highest mean parasitization intensity was reported in Brăila (2.8 parasites/host). *Contracaecum sp.* was reported in all three study areas, with the highest level of infestation being determined in the Danube shad sampled from the Galati area. *H. aduncum* was reported in the intestine of most of the specimens investigated, at relatively high average intensities of 15.3 parasites/host in Brăila and with a prevalence of 89% in Galați. The average parasite abundance ranged between 7.5 - 12.4 parasites/fish, with the most parasitized specimens being identified in Galati. Some of the different specific parasite products were highlighted, where the parasitism intensities were higher than 24 parasites/host, bleeding lesions in the digestive tract. However, these changes were reported in a small number of fish specimens.

Keywords: Danube shad, parasites metazoan, intensity, prevalence, host

Acknowledgements: ADER 14.1.2. Research on the influence of hydroclimatic changes on the stocks and migration of the Danube shad - *Alosa immaculata* from the Danube mouths to the Iron Gates II dam.

ADDITIONAL FISHERIES DATA ON PONTIC SHAD (*ALOSA IMMACULATA*) ONE OF THE MAIN FISH RESOURCES OF THE DANUBE-BLACK SEA SYSTEM

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Abstract: The latest information data on the Pontic shad fishery of the Danube-Black Sea system came from the year 2024, based on a sequence of steps including field studies, analyses, simulations that the INCDDD uses in a standardised way to estimate fish stocks by length-frequency length-weight relationships when measured (TL-total length, SL-standard length, W-weight) for over 1100 adult migratory individuals from commercial catches, scales taken from significant numbers of individuals for age structure and observations of sex structure, gonad maturity and IAL (index of larval abundance) as reproductive success. Comparisons with the past were made between official catches and also IAL and Index of Fattening (Fulton). The most important fish stock parameters are growth, recruitment, natural mortality and fishing mortality parameters for the deltaic fisheries including the Pontic shad fishery. Spatially, the population of Pontic shad is interpreted as a system with two main compartments: the stock in the western and south-western Black Sea and the cycling compartment, represented on the one hand by sexually mature individuals migrating to the Danube to spawn and on the other hand by juveniles, the result of reproduction, entering the stock. As this is a migratory stock, for practical reasons and due to the uncertainties caused by the different results of the assessment models, it is not recommended to intensify the fishery or to reduce the mesh size, but only to fish in a way that avoids catches below the minimum allowable catch, even if the results of 2024 are much better than those of the last three years. Another indication of the uncertainty of the intensification of the Pontic shad fishery is the low number of Pontic shad larvae, which shows that the spawning success in 2024 has not increased significantly, but is close to the historical low, requiring further legislative corrections for future.

Keywords: *Pontic shad, fisheries stock parameters*

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UPDATED STATE OF SMALL-SCALE FISHERIES ON THE ROMANIAN BLACK SEA AREA

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Abstract: Romanian small-scale fisheries are practiced along the Black Sea coast in five fishing ports (Sulina, Cape Midia, Tomis, Constanta and Mangalia) and other 18 small fishing stations, located between Sulina - Vama Veche, at depths ranging between 2 - 20 m and sometimes up to 50 m, when practicing specialized turbot fisheries. Of significant importance is fishing with divers for the *Rapana venosa*, the species with the greatest impact on the landed catches. In the coastal area, between Vama Veche and Sulina, which also represents an important area for the reproduction, feeding and rearing of some important fish species, the small-scale fishing is practiced with fixed and active gear, throughout the year, mainly using the following types of fishing gears: pound nets, gillnets, longlines, beach seines, cages/traps, handlines and from 2013 with beam trawl. Catch and fishery productivity vary from year to year, depending on environmental conditions, fishing effort, status of main commercial species and human factors. During the analyzed period (2019 - 2023), catches in shallow waters were between 7149 and 3127 tons, which has an increasing trend compared to the previous period (2012 – 2017).

Keywords: *small scale fisheries, landed catches, Romanian Black Sea area*

Acknowledgements: This research was carried-out in the frame of the Project “Services for the realization and implementation of the National Program for Data Collection of the Romanian fishing sector, 2023”.

USING AQUACULTURE WASTEWATER AS A GROWTH MEDIUM FOR CULTIVATION OF THE DIATOM *SKELETONEMA COSTATUM*

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Abstract: Aquaculture wastewater (AWW) is rich in substances that have the potential to cause environmental pollution. However, microalgae can absorb these compounds and convert them into biomass. This study aimed to evaluate the potential use of aquaculture wastewater as a growth medium for the diatom *Skeletonema costatum* to promote a sustainable economy. *Skeletonema costatum* was batch cultured in pretreated aquaculture wastewater from *Chelon auratus*, taken from the primary decanter of the recirculating system. The cell density, growth rates and nutrient removal efficiency of microalgae grown in batch cultures with different proportions of aquaculture wastewater (25%, 50%, 75% and 100%) and enriched growth medium were investigated. During wastewater treatment, the cell density at the peak of the exponential growth phase increased almost 278 times in the AWW 25% batch, 169 times in the AWW 50% batch, 232 times in the AWW 75% batch and 26 times in the AWW 100% batch compared to the initial level at the start of the assay. The growth rates ranged from 1.25 (in AWW 100% batch) to 1.78 (in AWW 25% batch). The results showed a high "efficiency" of phosphorus uptake (the limiting factor) and a very low "efficiency" of silicate uptake (in excess). Inorganic nitrogen dynamics showed significant increases over the experiment in all media, suggesting unassessed initial sources of organic nitrogen in the enriched culture medium and wastewater. Therefore, since no lag phases were observed in the growth curve of the cultures, this indicates that *Skeletonema costatum* can adapt to and utilise nutrients in the aquaculture wastewater for its growth.

Keywords: *microalgae, Skeletonema costatum, growth rate, aquaculture wastewater, nutrient removal*

Acknowledgements: The study has been supported by the NUCLEU Program (SMART-BLUE 2023-2026), funded by the Ministry of Research, Innovation and Digitization, financing contract no. 33N/2023, project PN23230201.

EFFECTS OF DIETARY SUPPLEMENTATION WITH PROBIOTICS AND PREBIOTICS ON GROWTH, PHYSIOLOGICAL CONDITION, AND RESISTANCE TO PATHOGENS CHALLENGE IN NILE TILAPIA

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Abstract: This study aimed to investigate the effects of the probiotic *Betaplus*[®] and prebiotic *Technomos*[®] as feed additives for Nile tilapia in terms of growth performance, health profiles, and resistance to infection with *Aeromonas hydrophila* and *Pseudomonas fluorescens*. A total of 960 healthy juvenile Nile tilapia (1.5 ± 0.01 g) were randomly divided into four experimental variants with three replicates for each variant. Fish were fed a commercial diet (control group, V₀), supplemented with *BetaPlus*[®] probiotics $-1\% \times \text{BW}$ (V₁), *TechnoMos*[®] prebiotics $-1\% \times \text{BW}$ (V₂), and with *BetaPlus*[®] probiotics and *TechnoMos*[®] prebiotics in a ratio of $1:1\% \times \text{BW}$ (V₃). Results on growth performance showed the best values in the probiotic variant, correlated with the health profile and the relative survival percentage after the challenge test with *A. hydrophila* and *P. fluorescens*. Similarly, the effects of dietary supplementation with probiotics and prebiotics on physiological conditions also recorded beneficial results in the synbiotic variant, where a high survival percentage was obtained after infection with the two pathogenic bacteria. In conclusion, the results of this study indicate that dietary supplementation with feed additives consisting of mentioned probiotics, prebiotics, and their combination as synbiotics has the potential to promote growth performance, improving tilapia immunity and increasing survival after the challenge test.

Keywords: growth; hematology; infection; prebiotic; probiotic

OCCURRENCE OF THE NEW INVASIVE BLUE CRAB IN BLACK SEA WATERS NEAR CAPE SHABLA, BULGARIA

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Abstract: The Black Sea is a closed brackish-water intercontinental sea, part of the Mediterranean basin, with which it is connected through the Bosphorus Strait, the Sea of Marmara, and the Dardanelles Strait. Due to this connection, many organisms from the Mediterranean Sea migrated to the Black Sea. One of these migratory organisms is the invasive blue crab. In the present study, we report the occurrence of one male *Callinectes sapidus* (carapace length: 209 mm, width: 102 cm, weight: 530.9 g) caught during commercial fishing on Black Sea waters near Cape Shabla, Bulgaria. Additional monitoring activities should be undertaken in the Black Sea to clarify the possibility of reproduction and determine the reproductive season of blue crab.

Keywords: *Black sea, Blue crab, invasive specimen*

Acknowledgements: This research was made possible by the support of MASRI: Infrastructure for Sustainable Development of Marine Research and Participation in the European Infrastructure. EURO-ARGO-MASRI is a project of the National Roadmap for Scientific Infrastructure (2020–2027) of the Republic of Bulgaria, for which the authors express their gratitude.

ASSESSING CHALLENGES AND OPPORTUNITIES IN THE BLACK SEA: INSIGHTS FROM THE 2ND MULTI-ACTOR FORUM

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Abstract: The Black Sea’s intricate dynamics and opportunities, although receiving increasing attention from stakeholders, remain largely unexplored, underscoring the need to bring together various sector representatives to better understand their perspectives and needs. Consequently, to identify the needs of the Black Sea, a series of Multi-Actor Forums (MAFs) have been organized, with the most recent, the 2nd MAF, convening in Trabzon, Türkiye, in February 2024. The local stakeholders from various sectors discussed topics such as multi-modal transportation, port infrastructure improvements, and the sustainable development of fisheries, aquaculture, renewable energy, and marine tourism. In sum, key topics included regulatory reforms, technology, sustainability, and community engagement for responsible maritime practices. The MAF served as a platform for collaborative dialogue and strategic planning to address the dynamic challenges and opportunities within the Black Sea region

Keywords: *Blue Economy development, coastal management, fisheries, Türkiye*

Acknowledgements: his research was supported by the European Union Research (EU HORIZON 2020) Project called “DOORS, no:101000518” (Developing Optimal and Research Support for the Black Sea).

MODERN TRENDS OF THE BLUE ECONOMY IN UKRAINE

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Abstract: The priority sectors of the blue economy of Ukraine include: maritime transport, port activity, shipbuilding and repair, capture fisheries and coastal tourism, the development of which is one of the main tasks. The crises of the last decade have had a serious impact on the maritime economic activities of Ukraine in the Black Sea and other parts of the World Ocean. This led to its displacement from the international markets of maritime transport, fishing, coastal tourism, etc. The return of positions in the sphere of the blue economy is of priority importance for Ukraine.

From 2011 to 2021, the amount of cargo transported by maritime transport of Ukraine decreased more than twice, from 4.1 million tons in 2011 to 1.9 million tons in 2021. It should be noted that the number of merchant fleet registered in Ukraine decreased from 499 vessels in 2011 to 407 vessels in 2023, which is accompanied by a decrease in the total dead-weight of merchant vessels from 679.2 thousand tons in 2011 to 370.3 thousand tons in 2018. At the same time, the average age of vessels increases annually and in 2023 it was 41.24 years.

The highest cargo handling rates in Ukrainian seaports in the period 2017-2023 were recorded in 2019 and 2020 (160 and 159 million tons, respectively), the lowest - in 2022 and 2023 (59 and 62 million tons, respectively).

It should be noted that the annexation of Crimea caused significant damage to the marine living resources sector of Ukraine. Thus, in the period 2010-2013, marine living resources capture production by Ukraine in the Black Sea was 41.13-44.77 thousand tons of live weight, in 2014 this indicator dropped to 4.63 thousand tons and subsequently its value did not exceed 14 thousand tons (in 2019).

Keywords: *maritime transport, seaports, capture fisheries, merchant fleet, Black Sea.*

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NUTRACEUTICALS FROM THE BLACK SEA: A ONE HEALTH APPROACH TO SUSTAINABLE DEVELOPMENT

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Abstract: Nutraceuticals have the potential to be integrated into One Health approaches, so offering a prospective solution to worldwide interdisciplinary challenges such as antibiotic resistance, malnutrition, and the rising incidence of chronic diseases. The One Health concept underscores the interdependence of animal, human, and environmental health and advocates for a comprehensive and multidisciplinary strategy to achieve optimal health results. Nutraceuticals, a diverse array of bioactive compounds derived from food sources, have a significant impact on the domains of nutrition and pharmaceutical sciences, offering notable benefits for individualized treatments. Marine sources have recently garnered significant attention. Studies on molecules originating from marine sources have identified novel bioactive compounds with important characteristics that enhance their suitability as nutraceuticals in the food and food supplement sectors. Harnessing Black Sea resources and discovering new environmentally friendly methods to incorporate them into pharmaceutical forms is an important research perspective, particularly in the One Health concept.

Keywords: *nutraceuticals, One Health, Black Sea resources, eco-friendly, marine molecules*

Acknowledgment: This research was supported by the project “Research on the development of a food quality scheme along the food chain according to the One Health concept,” code project ADER 16.1.2.

TURNING INVASIVE RAPANA INTO AN ECONOMIC OPPORTUNITY IN THE BLACK SEA

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Abstract: The invasive species *Rapana venosa* presents significant ecological challenges to the biodiversity of the Black Sea, while also offering economic opportunities for coastal communities through its sustainable harvesting. This project focuses on creating a model that balances ecological preservation with economic growth by addressing the overpopulation of *Rapana venosa*, which threatens local ecosystems by preying on native species and disrupting the food chain. Selective and sustainable harvesting techniques will be employed to mitigate its impact while generating income for local communities.

A key component is integrating local fishers, marine biologists, and stakeholders to develop best practices through training and capacity-building initiatives. These efforts aim to equip communities with the skills needed to manage rapana populations effectively while adhering to sustainability principles. The project will also focus on optimizing the full rapana value chain, from harvesting to processing, reducing waste, and increasing efficiency in local processing facilities to maximize economic returns.

Additionally, environmental impact assessments (EIAs) will be conducted in collaboration with academic institutions to ensure that the harvesting practices meet both national and international marine conservation standards. Technological innovations, such as improved fishing gear and processing methods, will be introduced to enhance sustainability, reduce bycatch, and ensure long-term resource availability.

This comprehensive approach aims to ensure that the exploitation of *Rapana venosa* is ecologically responsible and economically beneficial, contributing to the resilience of both coastal communities and marine ecosystems in the Black Sea region. Furthermore, by promoting the use of advanced processing technologies and exploring international markets for rapana-based products, this project aims to position the Black Sea region as a leader in sustainable marine resource utilization. Through continuous monitoring and data collection, the project's impact on both the environment and the local economy will be thoroughly assessed and adjusted as needed.

Keywords: *Rapana venosa, circular economy, sustainable harvesting, Black Sea, economic development*

Acknowledgements: We acknowledge the contributions of the BlackSea4Fish project for their valuable insights, data, and support in managing the *Rapana venosa* population in the Black Sea. Their contributions, particularly in providing critical information and research, have been crucial to aligning the project with environmental sustainability goals and informed decision-making.

CARBON SEQUESTRATION IN THE DEEP-ANOXIC BLACK SEA

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Abstract: With growing concerns about the escalating levels of atmospheric CO₂ and their adverse effects on global climate, the imperative for sustainable carbon sequestration solutions has never been more critical. Rewind is mitigating global warming by accelerating the natural process of organic matter burial and preservation at the bottom of the sea. This is accomplished by collecting agricultural and forestry surpluses and transporting this biomass for storage in the deep Black Sea, thereby sequestering the carbon. The slow degradation of wood and other organic materials within the Black Sea, coupled with the persistent stratification of the Black Sea that hinders the ascent of inorganic decomposition byproducts, engenders a protracted process of carbon sequestration spanning hundreds to thousands of years. The deposition of biomass to the deep Black Sea is expected to be environmentally safe. The addition of a relatively minor amount of sulfide to the already-high concentration of sulfide in the water is not expected to affect the current biodiversity, due to the lack of higher organisms, other than microorganisms, in the deep Black Sea. Additionally, no organic or inorganic pollutants will be introduced into the water column, as the wood will be analyzed prior to its deposition to ensure environmental safety.

Keywords: *Carbon-sequestration, biomass, global warming.*

PILOT STUDY FOR CULTIVATING *ULVA* GREEN ALGAE TO FOSTER MARINE MACROALGAE AQUACULTURE ALONG THE ROMANIAN BLACK SEA COAST

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Abstract: Marine macroalgae aquaculture provides an algal biomass that can subsequently be used as a source of bioactive compounds with applications in various fields, prioritizing human well-being and promoting a circular economy. *Ulva*’s special properties have increased the interest for their large-scale cultivation and valorification across Europe. *Ulva* species cultivation, although not a traditional practice on the Romanian shore, could bring major benefits to society through the subsequent exploitation of an algal biomass superior in terms of composition compared to the natural environment. This study presents the results of a two-month experimental culture of *Ulva* spp. carried out to test controlled reproduction and growth techniques under laboratory controlled-conditions. The experimental part provided a complete knowledge of species’ life cycle, crucial for a large-scale cultivation. The culture was performed using two different nutrient media, Von Stosch Enrichment (VSE) and Provasoli Enriched Seawater (PES), to establish the most efficient one for cultivating *Ulva* species along the Romanian coast. The results are presented comparatively. Daily visual and microscopic observations of specimen’s development and weekly length measurements were ensured to observe the growth rate. After 2 months, an algal biomass consisting exclusively of green algae of commercial interest *Ulva* spp. was obtained, with potential for further valorisation. This study can be considered as the first step towards a large-scale cultivation along the Romanian Black Sea coast. Scaling up (e.g. cultivation in large ponds) will ensure a much more abundant algal biomass with potential for exploitation in various fields and industries (e.g. food, feed, pharmaceuticals, cosmetics).

Keywords: *macroalgae, green algae, Ulva spp., laboratory culture, biomass*

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BROWN SEAWEED WITH VALORIZATION POTENTIAL FROM ROMANIAN BLACK SEA COAST

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Abstract: In the last decades, interest has grown in seaweeds exploitation as a natural resource and from aquaculture being a living marine resource with a huge potential for economy.

The use and valorization of brown seaweeds from the Romanian Black Sea coast, it has not been fully investigated, studies indicate a biochemical composition and nutritional qualities that make them suitable for use in different branches of economy.

Gongolaria barbata (Stackhouse) Kuntze 1891 (formerly known as *Cystroseira barbata* (Stackhouse) C. Agardh, 1820) is one of the largest algae in the Black Sea basin. The study of these seaweed associations is used for biomonitoring, the ecological status and the level of eutrophication of a habitat, is an indicator of water purity

On the Romanian coast, *Gongolaria barbata* has not been intensively studied in terms of its valorization potential, but it has recently attracted attention due to its biochemical properties presented in this paper that lead to some possibilities of use for economic purposes. The existence of valuable biochemical compounds in the composition of this brown macroalga qualifies it in the marine resources category of interest with biotechnological applications.

Keywords: *brown seaweed, Gongolaria barbata, biochemical composition, valorization potential, Black Sea coast*

Acknowledgements: This study has been supported by NUCLEU Program, contract 33N/2023, project PN23230201 “Research on marine ecosystem vulnerabilities and identify practical protection and restoration solutions for sustainable and smart use”, funded by the Ministry of Research, Innovation and Digitization.

EXPLORING MARINE LIFE THROUGH UPCYCLED ART UNDER BRIDGE-BS & DOORS PROJECTS

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Abstract: As part of Task 9.4 "Hands-on Marine Science," GeoEcoMar organized a series of interactive beach activities from February to May 2024 with students from various schools and high schools. These activities were designed to introduce students to marine science and promote environmental awareness through upcycled art as part of the "Exploring Marine Life through Upcycled Art" competition, set to take place on June 14. Invitations were sent to schools through multiple channels, encouraging participation in this hands-on initiative. The program included multiple stages: students first took part in beach research, where they identified marine organisms using informative brochures, guided by teachers and GeoEcoMar experts. Following the research, the students engaged in a beach cleanup campaign, collecting waste for proper disposal. Clean, collected materials were later repurposed for artistic creations. Students, under the supervision of their teachers, used these recycled items to build imaginative representations of marine life, blending science with creativity. An exhibition of the students' work was held at GeoEcoMar's institute in Constanța. This event showcased over 35 creative exhibits, produced by 84 children aged 6-14. The exhibition will not only display the artistic talents of the participants but also emphasize the importance of recycling and ocean conservation. The competition's final stage, scheduled for June 14, was evaluated as the most impressive works, with special prizes awarded for outstanding creativity and environmental awareness. Teachers have expressed a strong interest in disseminating the campaign video to other classes to further raise awareness. Through these activities, GeoEcoMar aims to foster student engagement in marine conservation, encourage ecological education, and inspire creative reuse of materials, while promoting interdisciplinary learning and community involvement.

Keywords: *marine science, upcycled art, environmental awareness, recycled materials*

Acknowledgements: European Union's Horizon 2020 BRIDGE-BS project under grant agreement no. 101000240 and DOORS project under grant agreement no. 101000518.

THE EFFECT OF PROBIOTICS ON GROWTH PERFORMANCE, HAEMATOLOGICAL AND BIOCHEMICAL PROFILES IN SIBERIAN STURGEON (*ACIPENSER BAERII* BRANDT, 1869)

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Abstract: The use of probiotics in aquaculture has become a necessity to increase disease resistance. Probiotics are also capable of increasing feed digestion and conversion, decreasing sensitivity to stress, and improving the health of the fish. The aim of this study was to analyse the effect of probiotics on survival, welfare, growth indices and blood composition in Siberian sturgeon (*Acipenser baerii*), reared in a recirculating system. Diets were supplemented with *Lactobacillus acidophilus* (FLa) and *Saccharomyces boulardii* (FSb), separately and combined (FLa + Sb). The effect of probiotics was investigated on 2000 fish with a mean weight of 8.82 ± 0.29 g/specimen. Fish were fed for eight weeks with four different diets: a control without probiotics, one with the addition of lactic acid bacteria (La), one with the addition of yeast (Sb), and one with a mixture of bacteria and yeast in equal proportions (50% La + 50% Sb). FLa + Sb showed a better condition factor (Fulton coefficient, $K = 0.39\%$) and significantly higher growth performance in terms of individual growth ($WGi = 35.56$ g), total growth gain ($WGt = 15.30$ g), specific growth rate (SGR, $2.70\%/day$), and feed conversion ratio ($FCR = 1.58$), compared to the control. The concentration of lymphocytes, monocytes, and neutrophils was higher in the tanks fed with probiotics compared to the control. The presence of probiotics caused a decrease in cholesterol and glucose. There were significant differences between the Immunoglobulin M values identified in the tank fed with FLa + Sb and the control tank. The results showed that the addition of lactic acid bacteria and yeasts, introduced as probiotics in the diets of *Acipenser baerii*, reared in a recirculating system, improved the growth indicators, survival, and welfare of the fish.

Keywords: *probiotics, aquaculture, acipenser baerii, siberian sturgeon*

SESSION IV - OCEANOGRAPHY, MARINE GEOLOGY AND GEOECOLOGY

ORAL PRESENTATIONS

UNDERSTANDING THE BLACK SEA: EVOLUTION AND MECHANISMS THAT CONTROLS ITS EVOLUTION DURING THE HOLOCENE. READING THE PAST TO BETTER PREDICT THE FUTURE

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Abstract: A synthesis of a research project conducted for more than ten years, started within the framework of a bilateral agreement between Romania and France, and then extended by a European project is presented. Since the preliminary mapping of the northern Bosphorus outlet of the Black Sea continental shelf by the 90's NATO project, an important data set acquired within this framework of collaboration is now available, bringing morphological, seismic and sedimentological information. A large part of the results obtained on the recognition of the sedimentary systems of the Black Sea come from knowledge acquired on the external factors controlling variations in sea level and climates. The anoxic basin of the Black Sea is an excellent laboratory for understanding the role of climate on the natural modifications of a closed to semi-closed basin, whose behaviour (very particular due to this situation) makes it an important paleoclimatic archive.

The Black Sea has been subjected to various depositional and erosional events due to the changing global sea level, during glacial and interglacial stages of Pleistocene. These sea level changes of the Black Sea are complicated and do not fully track the global sea level, due to its regional climatic conditions, confined geographical conditions and limited connection to the world ocean. Its brackish-fresh conditions have changed to marine condition, since Holocene with the northward flowing under current of Mediterranean waters from the Bosphorus. The last re-entrance of the Mediterranean waters into the Black Sea has been controversial and a matter of debate in terms of its mode and timing in the published studies carried out on the North-western and South-western shelf of the Black Sea, and in the Marmara Sea, from 1997 to 2011. Since 2011, the date of the last reconnection seems to have been widely agreed and would have occurred with the Initial Marine Inflow (IMI) dated around 8.9 - 8.5ky BP or 9.3-9ky BP. The confluence of the Bosphorus and Black Sea at the inner shelf area is the critical site for understanding the processes that occurred in the recent past. Together with this understanding, recent studies carried out on gas hydrates analyses show that evidenced multiple BSR are confirming the changing of salinity of the Black Sea, over the last 9000 years. This further confirms the interest in deepening sedimentological and paleoclimatic studies in the Black Sea.

Keywords: *Stratigraphy, paleoclimate, Mediterranean/Black Sea connexion, Holocene*

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SWOT MONITORING OF HYDROLOGICAL PROCESSES IN THE DANUBE DELTA

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Abstract: Among the most dynamic ecosystems are deltas, which are sculpted by intricate hydrological processes triggered by river discharges that periodically flood the delta plain and introduce pollutants, nutrients, and sediments. Understanding the operation of these systems and how they have adapted to climate change depends on monitoring these processes. Studying river deltas and coastal habitats is made easier by the Surface Water and Ocean Topography (SWOT) satellite project, which provides a unique method of high spatial and temporal resolution water surface observation. By offering precise 2D maps of altimetric data on surface water bodies at a resolution of 100 meters. SWOT data are crucial for river delta monitoring, as they can detect water levels even beneath vegetation. This feature makes it possible to monitor floods in areas that were previously inaccessible due to the water's obscuration by extensive vegetation. While SWOT tools enable the investigation of water elevation globally, conventional methods of determining water levels typically rely on in-situ measurements, which have spatial limits. This work demonstrates the potential of SWOT data to transform our understanding of hydrological processes. We report on a preliminary investigation carried out in the Danube Delta, where daily water level measurements obtained at strategic places like Sfântu Gheorghe, Tulcea, Isaccea, and Sulina were used to validate 1-year satellite data. The initial validation of SWOT data against in-situ measurements revealed a high level of accuracy, demonstrating its potential for monitoring water levels and floods in the Danube Delta. However, it is necessary to correct and filter potential errors, which are often prevalent in flat, highly reflective water bodies. Preliminary analyses revealed that SWOT data can help to inform models to evaluate river-sea interactions along the Black Sea coast. This study presents the preliminary results of the first application of SWOT data in the Danube Delta.

Keywords: *Danube Delta, SWOT satellite, hydrology, floods, remote sensing*

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IMPACTS OF KAKHOVKA DAM BREACH ON MARINE ENVIRONMENT OF NORTH-WESTERN BLACK SEA

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Abstract: We used Earth observation and modelling approaches, to observe the dynamics of water area and biogeochemical parameters, and movements of pollutants in the north-western Black Sea (NWBS) after the Kakhovka dam breach in June 2023.

After the destruction of the Kakhovka dam, the plume of desalinated (salinity < 10 ‰) and polluted (high concentrations of suspended and biogenic substances) waters initially spread westward along the northern coast of the Dniro-Buh estuarine region in the direction of the Odesa coast reaching it on June 9–10, and then southward along the west coast of the NWBS reaching the Tuzla Limans group on June 14. The transformed polluted waters covered the water area up to the Chilia branch of the Danube River. From the middle of June, the plume expanded toward the open sea like ‘tongues’ that emerged at the Dniester and Danube-Dniester (Tuzla) seabed uplifts and southward from the Odesa Bank to Tendra seabed uplift.

The large amount of biogenic and organic substances led to the algae bloom visible from the satellite images as high concentrations of Chlorophyll *a*. Over time, the area of the bloom spread from the coast south-eastward to the open sea. Gravitational sedimentation of organic matter produced by phytoplankton and its accumulation in the bottom sediments in water areas affected by the bloom can increase in summer the risk of hypoxia and anoxia phenomena in the bottom layer at depths below the seasonal thermocline, deeper 15 m.

The modelled concentration of mineral suspension reveals a high-level pollution of bottom sediments along the northern and western coasts of the NWBS, on the Odesa Bank and Dniester seabed uplift, in the Gulf of Odesa. In these areas, we can expect secondary seawater pollution with toxic substances adsorbed on the suspension due to wind-wave dispersing of bottom sediments during storms.

Keywords: *Kakhovka dam breach, north-western Black Sea, chlorophyll *a*, Earth observation, modelling*

Acknowledgements: This study was granted by Research England on behalf of UK Research and Innovation (Project #11147).

METHANE DYNAMICS ACROSS THE BLACK SEA FROM SEDIMENTS TO ATMOSPHERE: DATA UPDATE FROM GHASS2 AND DOORS CRUISES

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Abstract: Methane, a powerful greenhouse gas, plays a key role in atmospheric chemistry and climate change. Although the marine's contribution to atmospheric methane is relatively small, there is a need to better constrain its budget. Therefore, understanding the methane dynamics of marine methane, in particular the transfer at the interfaces: sediments-water column and water column-atmosphere is essential. Methane emissions from oceans and seas are widespread and heterogeneously distributed. The Black Sea is an anoxic basin and is the largest aquatic reservoir of methane, larger in size than the global ocean. At the Black Sea, a hotspot for methane emissions, discharges from the seafloor are distributed from shallow coastal shelves to deep basins. Methane originates from microbial processes and thermal cracking of organic matter and exists as dissolved gas, free gas, and gas hydrates. Gas hydrate-bearing sediments, vulnerable to dissociation, are also widespread. Methane discharges at the seafloor can cause local acidification, endangering ecosystems, potentially making the Black Sea a significant carbon source.

Recent scientific expeditions in the Black Sea (Ghass2, Doors2 and Doors3) investigated methane emissions using advanced sensors, collected hydrate-bearing sediment cores, and performed high-resolution sampling to both understand geological influences on methane formation and characterize the microbial communities involved the methane cycle. Moreover, methane concentrations were measured at the sediment-water interface, along the water column and in surface water-air exchanges. This work intends to be an update of the current dynamics of the methane distribution on the different sectors of the Black Sea.

Keywords: Gas monitoring, gas hydrates, geochemistry, microbial communities.

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METHANE SPATIAL VARIABILITY AND DISTRIBUTION PATTERN IN THE NORTHWEST PART OF BLACK SEA

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Abstract: As the Methane is considered to be the third most important greenhouse gas after water vapor and carbon dioxide, and the Black Sea as the largest methane reservoir in the world, our goal is to study the spatial variability and distribution pattern of methane at the seawater-atmosphere interface from the Northwestern part of the Black Sea.

Here, we present the results of two cruises carried out on board of R/V Mare Nigrum in the mid summer and early autumn of 2023 year in which we tried to cover a large part of Northwest Black Sea area.

The underway methane measurements were performed using a cavity ring-down spectroscopy (CRDS)-Picarro G2301- gas analyzer coupled to a custom made air-water equilibrator system (AWES - Amiston Ltd. Air Water Equilibration System) based on a 3M™ Liqui-Cel™ membrane contractor and a water system feed. Also, in support for dissolved CH₄ calculations we used a system for sea surface temperature and salinity monitoring.

The first cruise (12th - 16th July 2023) has been conducted under the Romanian National monitoring programme covering the Romanian sector of Black Sea. Here we found a large variability of methane concentrations ranged between 3.708 and 45.623 nmol L⁻¹ with highest values in front of Danube discharge area and the lowest in the open sea.

The second cruise covered part of the south Romanian sector and part of north Bulgarian sector were the variability on the methane concentrations ranged between 3.461 and 10.687 nmol L⁻¹ and was done in the framework of Doors project (10th - 20th September, 2023).

Measurements from both cruises strengthen the fact that shallow well mixed waters and coastal area act like a net source of methane to the atmosphere compared to the shelf and open sea.

Keywords: *methane, Black Sea, coastal area.*

Acknowledgements: This study is supported by the European Union H2020 project DOORS, grant agreement no. 101000518 and the Romanian Ministry of Research CORE Programme projects PN 23300103.

TURBIDITE DEPOSITS AND RESEDIMENTATION IN THE BLACK SEA AS AN INDICATOR OF SEABED INSTABILITY UNDER CLIMATE CHANGE (IN THE RESULTS OF RESEARCH CRUISES OF THE DOORS PROJECT)

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Abstract: The presence of redeposited seafloor sediments and turbidite deposits can be caused by various geological, geomorphological, hydrodynamic, seismic and other factors. Also, one of the probable causes of the activation of turbidite flows in the Black Sea is the presence of gas hydrates, the instability of which intensifies during periods of climate change, in particular, during periods of global warming. Degassing of gas hydrates leads to a physical impact on non-lithified sediments, bringing them into a mobile state; turbidite flows arise as a result of this under conditions of sufficient bottom slopes. Turbidite deposits in the Black Sea were sampled during the research cruises of the DOORS project on the R/V “Mare Nigrum” (MN 249, MN 256). Proximal turbidites were discovered at a depth of 1116 m in the waters of the Bulgaria EEZ in a zone of the seabed presumably favourable for hydrate formation. The deposits consist of uneven alternation of layers of fine sand and pelite (layers from 0.5 cm to 4 cm). The length of the core of discovered turbidites is 90 cm, in the lower part the sand layer contains parts of *Dreissena* shells. Above the turbidite layer is a sand mass whose texture and shape indicate an underwater landslide. The turbidite deposits are covered by a layer of sapropel, above which are modern deep-sea coccolithic silts.

The presence of the Neoeuxinian fauna and the overlying sapropel layer indicates that the turbidite layer was formed at the end of the Late Pleistocene – beginning of the Holocene, i.e. during the period of a sharp rise in the Black Sea level associated with the last strong warming. The location of these turbidites and signs of underwater landslides in the area of potential gas hydrate accumulation and the absence of similar deposits within the adjacent areas of the seabed may indicate that their formation was caused by the transition of gas hydrates to an unstable form under the conditions of the Holocene warming.

Distal turbidite deposits and signs of sediment resedimentation based on disturbed textures of layered coccolithophoridine oozes in Holocene sediments are described in the waters of the Georgian EEZ.

Keywords: *Black Sea, seafloor sediments, turbidites deposits, climate change*

Acknowledgments: This abstract is supported by DOORS, an EU Horizon 2020 project funded under Framework Programme for Research and Innovation under grant agreement No 101000518.

GEOLOGICAL AND GEOMORPHOLOGICAL FACTORS OF GAS HYDRATE FORMATION AND DISTRIBUTION IN THE BLACK SEA

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Abstract: Numerous studies have been carried out to examine the geological, morphological, structural, sedimentary, and physical characteristics of gas hydrates in the Black Sea. It has been demonstrated that understanding the distribution of gas hydrates is essential not only for assessing their potential as a future energy resource but also for evaluating their influence on climate change, slope stability, and geosystem dynamics.

As a result of geological and geomorphological studies and analysis of gas hydrate distribution, a complex relationship between existing geological and geomorphological data and seabed features/indicators has been identified for the Black Sea. To determine the impact of the structural-tectonic factor on the formation of gas hydrates, a detailed analysis of the fault system in the Black Sea was carried out and the priority influence of the tectonic factor on the gas hydrate phenomena was determined.

A comprehensive analysis of the geological, morphological, and physical factors influencing gas hydrate formation was carried out using cartographic modelling. Priority was given to factors such as lithology, stratigraphy, and bathymetry, along with temperature and heat flow characteristics. Each factor was ranked based on its correlation with the density of gas hydrate occurrence. The integrated gas hydrate susceptibility map was created using overlay analysis, which provides new spatial information and a comprehensive gas hydrates distribution model for the Black Sea. The gas hydrate susceptibility map depicts areas with potential for gas hydrate formation, determined by correlating key contributing factors with existing gas hydrate distribution.

The presence of gas hydrates and their dissociation could trigger slope failure, turbidites, and submarine landslides. An integrated analysis based on the cruise data (R/V Mare Nigrum, cruise MN 249) is performed to examine the instability in gas hydrate zones in the Black Sea. This study provides valuable insights for improving marine geohazard preparedness, reducing risks, and promoting sustainable practices in the Black Sea region.

Keywords: *Black Sea, gas hydrates, susceptibility modelling, marine geohazards*

Acknowledgments: This abstract is supported by DOORS, an EU Horizon 2020 project funded under the Framework Programme for Research and Innovation under grant agreement No 101000518.

**SESSION IV - OCEANOGRAPHY, MARINE
GEOLOGY AND GEOECOLOGY**

POSTER PRESENTATIONS

ASSESSING VULNERABILITY OF BLACK SEA COASTAL AREAS TO FLOODING FROM SEA LEVEL RISE DURING EXTREME WEATHER EVENTS

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Abstract: This study aims to evaluate the vulnerability of the Romanian Black Sea coastal area to flooding caused by exceptional sea level rises across various scenarios. The research focuses on identifying hot spots, or regions with extreme vulnerability, using digital terrain models, spatial analysis techniques and integrating geospatial data identifying the at risk due to the climate change who will have impact on coastal area. This analysis is important for guiding future coastal management strategies and developing effective mitigation measures to protect at-risk communities and ecosystems along the Romanian Black Sea coast.

These areas will face challenging times if appropriate measures to reduce the impact of storms on beaches are not implemented and optimal management plans are not adopted, considering all variables and factors involved. The findings will offer valuable insights into the spatial distribution of flood risk, helping prioritize areas that require immediate attention and resources and serving as a guideline for policy-makers in the Black Sea area.

Keywords: *coastal flood, storm, hotspots, spatial analysis*

Acknowledgement: This work was supported by PN 23230101 “Integrated model for spatial assessment for the marine and coastal environment vulnerabilities and adaptation for the socio-economic system to the cumulative impact of pressures – support in the implementation of maritime policies and the Blue Economy”.

ROMANIAN NATIONAL OCEANOGRAPHIC AND ENVIRONMENTAL DATA CENTER IN THE EUROPEAN CONTEXT

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Abstract: Large amounts of marine data are continuously being collected around the world. Access to marine data and a good management of these data is of vital importance for marine research, for international cooperation and data exchange.

In Romania, NIMRD (National Institute for Marine Research and Development “Grigore Antipa”) is the leading marine research institution, as well as national coordinator and focal point with respect to international research tasks and responsibilities in the field of marine science. Being the technical operator of the marine monitoring network (physical, chemical and biological) and for coastal erosion survey, NIMRD hold a comprehensive volume of marine data and information.

In 2007, following the IOC/IODE and objectives and recommendations as well as the poor managing system of national marine data and information, NIMRD established the “Romanian National Oceanographic and Environmental Data Center” (<https://www.nodc.ro/>), which replaced the existing Designated National Agency. The center is officially recognized by the IOC/IODE (<http://www.iode.org>) as the national facility for international data and information exchange.

Its mission is to collect, acquire, process, store and disseminate marine data and metadata hold by Romanian institutes and agencies, as well as to provide graduate level of education in marine sciences. Its main objectives are to facilitate the access to marine information, promote development of indicators on marine science and technology, environment and socioeconomics and to encourage cooperation between the National and European Institutions.

This paper presents the certain national actions underpinned in order to adopt and adapt the best practices developed within the Pan-European Initiatives SeaDataCloud and EMODnet on the use of marine data and metadata standardization, data quality assurance (QA) and data quality control (QC) and data management.

Keywords: *marine data management, data quality control, SeaDataCloud, EMODnet*

Acknowledgements: The activity of Romanian National Oceanographic and Environmental Data Center is supported by different national and international projects, amongst other by: SMART-BLUE (PN2323) funded by Romanian Ministry of Research, Innovation and Digitization; EMODnet Chemistry funded by the European Union under the service contract no. EASME/EMFF/2020/3.1.11/Lot5/SI2.846161; H2020 SeaDataCloud funded by the European Union under the Grant Agreement no. 730960. Authors acknowledge the contribution of the NIMRD staff involved in the technical infra-structure development, in oceanographic data gathering, harmonisation, standardisation and quality control, and in data products preparation.

IMPACT OF THE COASTAL EROSION ON THE ROMANIAN BLACK SEA COAST: CHALLENGES AND SOLUTIONS FACING THE CLIMATE CHANGE

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Abstract: This study details the impact of coastal erosion on the Romanian Black Sea coast, an issue exacerbated by the increasingly frequent and severe storms encountered in recent years. The analysis focuses on two extreme weather events: the storm in November 2023 and the one in August 2024, both of which caused extreme hydrodynamic conditions with large waves that accelerated the erosion process.

The storms have led to the destabilization of the sediment balance in this sensitive area, causing an alarming loss of essential natural building materials for maintaining coastal stability. Rising sea levels, accompanied by heavy rainfall, increase the vulnerability of the coasts and contribute to soil migration, affecting not only the surrounding environment but also local infrastructure, including roads, buildings, and tourist facilities. This has a direct impact on the local economy, influencing tourism and coastal communities. The results of this study underscore an urgent need for immediate and well-planned interventions, such as: implementing coastal protection projects, restoring natural habitats through the planting of endemic vegetation, and developing sustainable resource management strategies. These measures are essential not only for protecting existing infrastructure but also for conserving the biodiversity of the Black Sea area, which is threatened by these adverse phenomena.

Keywords: *erosion, storms, Romanian coast, vulnerability, protection*

Acknowledgements: This research was conducted as part of the PN23230102 project titled “Prevention and Management of Risks Associated with Hazardous Physical and Hydrological Marine Phenomena through the Development of Innovative, Energy-Independent, Environmentally Friendly Solutions.” It was funded by a grant from the Ministry of Research, Innovation, and Digitization.

THERMODYNAMIC THEORY OF OCEAN BUFFERING CAPACITIES AGAINST MULTIPLE EXTERNAL PERTURBATIONS

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Abstract: The paper aims to advance the understanding of how coastal oceans respond to multiple external perturbations such as increased atmospheric CO₂, global warming, and pollutants as heavy metals, nitrates, and phosphates. Ocean acidification, driven by the rising atmospheric CO₂ levels, has already raised concerns about its long-term impact on marine ecosystems. Current predictive models focus mainly on homogeneous ocean systems, leaving a gap in addressing the complexities of heterogeneous systems, which include interactions between solid, liquid, and gaseous phases.

The paper introduces an innovative theoretical framework based on buffer theory and chemical thermodynamics for ocean systems. By developing new equations for buffer capacities that account for the heterogeneous nature of oceans, our research provides a more accurate method for predicting the ocean resistance to acidification and contamination. These equations take into consideration a variety of chemical species, including carbonates, phosphates, and heavy metals, and how they interact with ocean sediments and minerals.

The paper focuses on predicting the long-term effects of anthropogenic pollutants on the ocean buffering capabilities, examining the potential impacts of artificial ocean alkalization, and assessing how chemical equilibria shift under future climate conditions. The developed approach offers new insights into the mechanisms controlling ocean chemistry and provides valuable tools for environmental policy aimed at mitigating ocean acidification and pollution.

Through the integration of experimental data and theoretical models, the developed approach enhances our ability to predict and manage the future health of coastal ocean systems, supporting sustainable marine ecosystem management.

Keywords: *buffer theory, chemical thermodynamics, pollutants, ocean acidification, ocean alkalization*

Acknowledgements. This work has been carried out within the Institutional Research Program of the State University of Moldova for the period 2024-2027, subprogram “*Advanced Research in Computational and Environmental Chemistry, Identification of Technological Treatment Processes, Formation of Water Quality and Quantity*”, code 010603.

IMPACTS OF CLIMATE CHANGE ON CRITICAL MARITIME INFRASTRUCTURE: A CASE STUDY OF THE ROMANIAN BLACK SEA COAST

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Abstract: The rising impacts of climate change pose a significant threat to global security, affecting various sectors and intensifying existing vulnerabilities. This study focuses on the critical maritime infrastructure along the Romanian Black Sea coast, examining the implications of sea-level rise, coastal erosion, and extreme weather events.

The climate-induced changes have the potential to disrupt port operations, compromise energy security, and impact military installations, with cascading effects on economic stability and national defense. The research investigates the specific vulnerabilities of the Romanian Black Sea coastal region, highlighting the critical need for adaptation and mitigation strategies to protect critical infrastructure and ensure the long-term sustainability of this vital maritime area.

By analyzing the complex relationship between climate change and maritime security, this study contributes to a deeper understanding of the challenges faced by coastal nations. It provides valuable insights for policymakers and stakeholders involved in protecting critical infrastructure in a changing climate.

Keywords: *critical maritime infrastructure, climate change, maritime security, climate change impact, climate change and national security*

Acknowledgements: This study has been carried out with financial support from the Sectorial Research-Development Plan of the Romanian Ministry of National Defence, PSCD 2024 – 2027 Project 096 “Adaptation of the Romanian Navy to climate change: exploring the implications of climate change for Romania's defence and security and opportunities for green defence”. and PSCD 2021 – 2025 Project „Development of an integrated monitoring system to increase the quality of hydro-oceanographic data in the area of responsibility of the Romanian Naval Forces”.

DANUBE INFLUENCE ON THE RADIONUCLIDES CONCENTRATION ON THE NORTHERN SECTOR OF THE BLACK SEA ROMANIAN COAST

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Abstract: The current paper represents a study that shows the values of radionuclide concentrations and their activity in sediments from the Romanian coastal area, sediments that are strongly influenced by the circulation of water masses from tributaries. Due to the characteristics of the marine currents in the Black Sea, the sediment load transported by rivers and streams flowing into the northern and northwestern parts of the sea is deposited in the Romanian coastal area.

Due to the presence of nuclear power plants over time within the Black Sea basin, radioactive pollution is a factor that must be considered in assessing the marine ecosystem. The Black Sea hydrological network also includes the Chernobyl Nuclear Power Plant, which, in 1986, through the accident that destroyed Unit 4, generated the largest contamination with artificial radioactive products in the surrounding environment. A significant portion of the released radionuclides reached the Black Sea along with sediments transported by rivers.

Keywords: *radioactivity, coastal area, Black Sea, sediment*

Acknowledgements: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, project number PN23230102.

RESEARCH ON MICROPLASTICS IN BOTTOM SEDIMENTS: GAINING PRACTICAL EXPERIENCE

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Abstract: In recent decades, the global community has increasingly focused on the issue of environmental pollution caused by plastic waste, particularly microplastics (MP), which are derivatives of the polymer industry. The management of MP and its impact on living systems is an active area of research, with one key focus being the study of MP accumulation processes in the geological environment, especially in the bottom sediments of aquatic basins.

As part of the DOORS project, recently initiated by the SSI 'MariGeoEcoCenter NAS of Ukraine,' systematic sampling is being conducted within the wave-surf zone along the Ukrainian Black Sea coast to study the distribution of plastic and microplastics in the geological environment of the Black Sea. To obtain representative samples from areas with varying geological conditions for microplastic accumulation, specialized marine expeditions have been carried out in selected areas of the Romanian and Georgian shelf zones.

In addition to gaining valuable practical experience in identifying artificial polymers in the geological environment and developing information databases, the project is advancing a new arsenal of research methods. One significant outcome is the innovative approach to collecting microplastic (MP) samples from coastal areas within the wave-surf zone—passive sampling using filter cloth traps. This method leverages the natural process of separating particles of different densities in water flows, enabling a substantial increase in MP collection from beach surfaces, particularly from materials carried by backwash and reverse wave flows.

New sampler was developed for collecting microplastics (MP) from the surface layer of bottom sediments in various water basins. The device's operational principle is unique, with no current analogs. Experimental tests indicate that the new sampler could become an effective and affordable tool for obtaining sediment samples, including comprehensive studies of MP characteristics at the sediment-water interface. Additionally, the sampler can perform primary separation of the upper sediment layer, concentrating the least dense components within the sample.

Keywords: *microplastics, Black Sea, bottom sediments, innovative sampling*

Acknowledgments: This abstract is supported by DOORS, an EU Horizon 2020 project funded under Framework Programme for Research and Innovation under grant agreement No 101000518.

NUTRIENTS' VARIABILITY IN THE SOUTHERN BLACK SEA ROMANIAN EXCLUSIVE ECONOMIC ZONE

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Abstract: Nutrients are crucial to marine ecosystems, especially as they drive the production of organic matter through photosynthesis. However, anthropogenic activities like industrial discharge, agriculture runoff, and fossil fuel burning have disrupted natural nutrient cycles, leading to significant environmental challenges (Grasshoff et al., 1999).

Two multidisciplinary cruises were carried out on board *R/V Mare Nigrum* in the winter (February) and early summer (June) of 2023, along a transect Mangalia - East, in the southern Romanian Zone. Water sampling was performed using a SBE 25 CTD and a SBE 32 model rosette system equipped with 12 Niskin 5-liter bottles, after visualization of the vertical profiles of the main CTD parameters (temperature, salinity, dissolved oxygen, pH, fluorescence and turbidity) with the help of sensors on the equipment. The collected samples were preserved by freezing (-55°C) and analysed in the Geochemistry laboratory of NIRD GeoEcoMar according to Grasshoff et al., 1999 methods.

Surface phosphate, nitrate, and nitrite showed significantly higher concentrations in winter, contrary to surface silicate, which was higher in early summer. Vertical profiles of phosphate showed two maxima; an upper one at SigT=15.6-15.7 (stronger in summer) and a lower one, more pronounced at SigT=16.2. The nitrate vertical profile exhibited a maximum at Sig T=15.4–15.7, followed by a clear decrease up to concentrations below the detection limits at SigT >16.2 due to the organic matter degradation. Silicate and ammonia showed a sharp increase from SigT=16.2 and accumulated in the bottom anoxic waters.

These data fields play an important role in understanding the region's marine ecosystem health and its resilience in the face of environmental and anthropogenic pressures.

Keywords: *nutrients, Black Sea, hydro-chemical measurements, seasonal variation*

Acknowledgements: This research was funded within the H2020 Advancing Black Sea Research and Innovation to Co-Develop Blue Growth within Resilient Ecosystems - BRIDGE-BS project.

DEVELOPMENT OF AN IN-SITU SENSOR FOR SULPHIDE MEASUREMENTS IN THE BLACK SEA

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Abstract: The Black Sea is the largest anoxic basin in the world. Measurements of dissolved sulphide are of importance to understanding biogeochemical cycling in the region and for monitoring environmental change. Existing sensors for sulphide are limited by signal drift, high power consumption and poor long-term performance. As part of the DOORS project, NOC are developing an in-situ sulphide sensor based on lab-on-chip technology that uses a colorimetric reagent-based assay. It is capable of measurements at 6 000 m depth and has a wide dynamic range of < 1 to 700 $\mu\text{mol} / \text{L}$. We describe the development and main characteristics of the sensor together with data from a first deployment aboard the RV Mare Nigrum in the Black Sea in September 2023 together with the plans for continued development of the sensor.

Keywords: *Black Sea, sulphide, biogeochemistry, in-situ sensor, lab-on-chip*

Acknowledgements: This work was funded by the DOORS project. “Developing Optimal and Open Research Support for the Black Sea Project (DOORS) funded by the European Union’s Horizon 2020 Framework Programme for Research and Innovation under grant agreement No 101000518”

THE HYDROLOGICAL AND GEOMORPHOLOGICAL EFFECTS INDUCED DURING THE WINTER STORMS PRODUCED IN THE NORTHWESTERN BLACK SEA BASIN, IN THE CONTEXT OF THE CLIMATE CHANGES

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Abstract: The present work investigates the possibility of producing events related to meteotsunamis. Wave and sea level recorders in the coastal area were used to analyze the last major storms that occurred in the western Black Sea basin between 19 and 27 November 2023, with significant impacts on the Romanian coast.

The specific synoptic conditions favoring the occurrence of the meteotsunami phenomenon are related to atmospheric pressure disturbances, as well as rapid movements of the air masses, respectively, wind speeds of over 100 km/h, which produce very large amplitudes of the sea surface, violent waves with heights of over 4 meters. Recorded sea level data suggest the presence of the long waves that caused coastal flooding similar to severe cold season storms.

Certain analyses of the wave data recorded by the Spotter buoys, as well as the sea level oscillations recorded along the coast in the Constanta and Mangalia areas, have led to the classification of the event that occurred in the winter of 2023 as a meteotsunami. In addition, the areas of the Romanian coast most affected by this violent phenomenon have been identified, considering the characteristics of the Black Sea, as a semi-enclosed and micro-tidal basin with rapid sea level fluctuations, affecting both beaches and coastal infrastructure.

Keywords: *Black Sea, meteotsunami, winter storm, sea level oscillations*

Acknowledgements: This work was supported by the CMEMS founded user-engagement program: SafeBLESS and Siroco Projects (CMEMS Projects Lot1 for BS/2023-2024) and PN23230102 (2022-2026) and CLIMEWAR (CLimate change IMPact Evaluation on future Wave conditions at regional scale for the Black and Mediterranean seas marine system), supported by a grant of the Romanian Ministry of Research, Innovation and Digitization, CNCS - UEFISCDI, project number PN-III-P4-PCE-2021-0015, within PNCDI III.

SESSION V - MARINE SPATIAL PLANNING (MSP), COASTAL MANAGEMENT

ORAL PRESENTATIONS

DOUGHNUT THEORY FOR COASTAL COMMUNITIES: A SUSTAINABLE DEVELOPMENT FRAMEWORK

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Abstract: The doughnut theory will be applied to analyze and assess the sustainable development of coastal communities. The methodology of determination and definition of the doughnut, which is formed by social foundation (inner ring) and ecological ceiling (outer ring), should be focused on the following pillars:

(a) Social foundation represents basic human needs framed by the optimal threshold for each need to secure an appropriate standard of living as well as cultural aspects related to everyday routine and practices, which determine the possible set of development measures. Among such needs one can mention, at least, the following: education, access to safe drinking water and healthy food, affordable housing and healthcare etc. Cultural considerations are important since they are based on traditional practices, formed over the centuries. Because of their long history, these practices represent a solid base for developing sustainable economic activities, such as sustainable fishing or rational management of coastal resources.

(b) Ecological ceiling represents the maximum level of environmental pressure the coastal community can withstand without being irreversibly damaged. It is crucial to show that over-passing the threshold barriers will cause depletion of the resources available to coastal communities, which, in turn, will ultimately destroy the traditional way of life, cultural identity of the communities, as well as will decrease their standard of living. Determination of ecological ceiling implies identification of environmental pressure on the coastline, such as, pollution overfishing or habitat destruction), setting the threshold values for each parameter, as well as considering such environmental factors such as sea level rise, ocean acidification etc. Establishing critical values is particularly challenging, since the threshold can vary from region to region due to local factors. Among such threshold, we can mention establishing water quality standards and upper limits of fresh water use per capita, establishing adequate quotas for fishing, introducing restrictions for new project development in coastal areas, as well as implementation of the appropriate climate change adaptation strategies.

Overall, doughnut theory is a valuable tool useful for coastal communities to monitor their state of sustainability.

Keywords: *Sustainability, Coastal communities, social sustainability, Ecological ceiling, Doughnut theory*

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THE EO-BASED OPERATIONAL SERVICES FOR THE MONITORING AND MANAGEMENT OF THE MARINE AND COASTAL AREAS OF THE BLACK SEA

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Abstract: The western Black Sea basin is a region of particular interest in terms of its past and present level of ecological degradation by anthropogenic influences among the European Seas. Its coastal areas are the subject of continuous remote monitoring and operational observing system, towards human activities harmonization. Integrated Coastal Zone Management (ICZM), as a long-term management tool integrated within Maritime Spatial Planning (MSP), was established to protect the population, sustain exploitation of coastal resources and mitigate the effects of climate change and marine hazards. In the same direction the Earth Observation (EO) data can significantly contribute to the advance of oceanographic knowledge, but also to support ICZM measures' implementation in the area.

The Earth Observations data provided by European Space Agency (ESA) through Copernicus Marine Environment Monitoring Service (CMEMS), including the model data provided by several forecast systems, constitutes the source for several user-orientated, operational services for specific activities in the western Black Sea basin.

In the present work, will be described, two European Space Agency's funded projects, develop based on a holistic approach that covers different elements with potential environmental impact. Its were developed to deliver specific support services at regional and national level, being supportive for the strategy concerning the Blue Growth in the region, by facilitating the access to key environmental variables related to aquaculture, coastal tourism, pollution and habitat management. Several EO-based results of EO4CZM and EO4BSP projects, will be presented together with associated lessons learned, for future implementations in various areas and activities domains within the Black Sea.

Keywords: *EO services, coastal monitoring, Decision Support Systems, environmental protection*

Acknowledgements: The encompassed works were carried out in the framework of the ESA funding scheme: Black Sea and Danube Regional Initiative – Black Sea Environmental Protection, but also PN 23230102 project.

A CONCEPTUAL MODEL FOR ENABLING SUSTAINABLE MANAGEMENT OF BLACK SEA'S SOIL-SEDIMENT-WATER ECOSYSTEMS IN SUPPORT OF EUROPEAN POLICY

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Abstract: The health of Black Sea's soil-sediment-water ecosystems is under pressure from economic activities and a changing climate. This decreases health and hampers the service provision capacity of these ecosystems and thus impacts human well-being. Protecting and where feasible restoring of ecosystem health has currently become the key European environmental policy objective and for this it is needed to take an entire system approach and engage stakeholders. 'Entire' means that soil, sediment and water are regarded as closely interlinked environmental matrices that need to be managed by taking a 'river (or mountain) to sea' perspective, crossing spatial, discipline, political and cultural boundaries. This paper presents a conceptual model to support that purpose. Essentially, the conceptual model presents an approach for ecosystem-based management aimed to achieve healthy ecosystems, i.e. soil-sediment-water ecosystems that have the continued capacity to support ecosystem services to the benefit of their users. The model proposes a cyclic (iterative, learning-by-doing) approach and integrates soil-sediment-water, ecosystems, ecosystem services, users (stakeholders), pressures, information, management strategy and program of measures as building blocks. To successfully apply the model, it is above all needed to take an entrepreneurial approach, i.e. leave comfort zones, take an adventurous road, learn together to manage together, be adaptive and consider other than only command-and-control solutions. Furthermore, authorities should become facilitative leaders to engage users in co-creation of an ecosystem-based management strategy. Real live and place-based experimenting with multiple stakeholders, such as in Living Labs and Lighthouses, may provide an ideal instrument for such application, i.e. where the conceptual model can be used and support the achievement of European environmental policy objectives.

Keywords: *ecosystems, management, soil, sediment, water, conceptual model*

Acknowledgements: Writing of this publication was facilitated by the 'Developing Optimal and Open Research Support for the Black Sea' (DOORS) project, which has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement No 101000518.

DATA MANAGEMENT AND OPEN SCIENCE PRACTICES IN HE-AQUARIUS PROJECT

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Abstract: AQUARIUS is a recent HE funded project. An impressive range of 57 research infrastructure services will be made available by Transnational Access (TA) Calls to include research vessels, mobile marine observation platforms, fixed marine facilities, experimental research facilities, river & basin supersites, aircraft, drones, satellite services, and sophisticated data infrastructures. By collecting new data and generating new information and knowledge, AQUARIUS will support the EU Mission to Restore our Ocean and waters by 2030, the Sustainable Blue Economy Partnership, the European Green Deal, and international climate initiatives, as well contribute to the DTO and Decade of the Oceans.

Two AQUARIUS TA Funding Calls will be targeted at themes for each of the four lighthouse regions, consisting of Mediterranean Sea, Atlantic Ocean and Arctic Coasts, Baltic and North Sea basins, and Black Sea, along with their associated rivers. In the TA projects many new data sets in a large variety of data types will be collected by TA scientific teams, making use and combining multiple and different observation installations as provided. There will be a strong effort in AQUARIUS to get the maximum return of investment from the TA activities towards serving the EU Mission and Partnership targets and associated initiatives with the generation of new data, data products, and scientific knowledge. Therefore, AQUARIUS has adopted an open data policy, which will be implemented with a dedicated Data Management approach, to ensure that all gathered and generated metadata and data will be managed in line with the FAIR principles (Findable, Accessible, Interoperable, Reusable). In addition, TA researchers will be introduced into Open Science practices through synergy with the HE Blue-Cloud 2026 project and its Virtual Research Environment.

At the session more information will be presented about the AQUARIUS TA opportunities for researchers, and its Data Management and Open Science practices.

Keywords: *Data Management, FAIR, Open Science, Transnational Access, AQUARIUS*

Acknowledgements: AQUARIUS has received funding from the European Union's Horizon Europe Framework Programme for Research and Innovation under grant agreement No 101130915.

SATELLITE BASED MAPPING OF SEAGRASS MEADOWS AROUND SİNOP (BLACK SEA, TÜRKİYE)

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Abstract: Seagrasses play a vital role in marine ecosystems by improving water quality, providing essential habitats, and acting as a natural barrier against waves and tides. They also contribute to carbon sequestration and contribute to blue carbon storage. Advanced technologies like machine learning and satellite imagery are aiding conservation efforts worldwide. Understanding the factors influencing the seagrass-sea cucumber association is essential for preserving these delicate ecosystems and their biodiversity. In this study, ESA's Sentinel 2 satellite was used to map the seagrass meadows distributed around Sinop in the Black Sea. The images between July 1-31, in which seagrass meadows provide the best view, were classified by Supervised Classification (smileRandomForest) using java Script code in the Google Earth Engine (GEE) interface, and seagrass areas were identified and analyzed and mapped. Confirmation was made as a result of the experiences of fishermen and researchers who have worked in the region in the areas determined as seagrass and the observations made in the field in this study. According to the results obtained, it was determined that an area of 3551 pixels = 35508 square meters in the study area was covered with seagrass, which is close to the size of approximately 8 football fields. It has been observed that seagrass meadows are distributed up to a compound depth (about 20 m) where sunlight is effective and are more abundant in coastal areas and sheltered areas. It has been determined that seagrass meadows are heavily distributed especially in Sinop inland region, Akliman region, Ayancık-İstefan regions. These conclusions were also supported by information from fishermen and drone shots.

Keywords: *climate change, artificial reefs, protected area, fisheries, satellite, Black Sea*

Acknowledgements: This study is co-financed by Republic of Türkiye and EU with the scope of the Climate Change Adaptation Grant Program (CCAGP) - IPA II (MS-MPAs – Project No: TR2017 ESOP MI A3 04/CCAGP /041).

STRENGTHENING THE CLIMATE CHANGE ADAPTATION THROUGH THE MAPPING OF SEAGRASS MEADOWS FOR MARINE PROTECTION AREAS IN THE BLACK SEA (MS-MPAs)

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Abstract: This study includes research and field studies within the scope of MS-MPAs project jointly funded by the Republic of Türkiye and the EU. The aim of the MS-MPAs to avoid, reduce exposure and increase resilience to climate change-related risks in the fisheries, biodiversity and environment sectors in the Black Sea (around Sinop); Mapping of seagrass habitat and designation of marine protected areas (MPAs) supported by artificial reefs (ARs) and expansion of the knowledge base on climate change adaptation in Türkiye.

In this study, a visual compilation of scientific field studies consisting of artificial reefs, diving observations, fishing activities and tourism purposes within the scope of the MS-MPAs project was presented and discussed.

Keywords: *climate change, artificial reefs, diving observation, fishing, Black Sea*

Acknowledgements: This study is co-financed by Republic of Türkiye and EU with the scope of the Climate Change Adaptation Grant Program (CCAGP) - IPA II (MS-MPAs – Project No: TR2017 ESOP MI A3 04/CCAGP /041).

MULTI-ACTOR FORUMS TO ADVANCE A SUSTAINABLE BLUE ECONOMY: BLUE TRANSITIONS IN THE BLACK SEA

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Abstract: The sustainable development of regions worldwide is contingent upon the Blue Economy, which encompasses all economic activities associated with coastal regions, oceans, and waters. The Black Sea, which is located at the intersection of Asia and Europe, has the potential to expand a thriving Blue Economy. Conversely, this potential is accompanied by a unique set of challenges that must be addressed in order to ensure the long-term growth of maritime sectors in the regional area. DOORS Black Sea, an EU-funded initiative, is designed to address these concerns by providing Black Sea research support that is both optimal and accessible. In an effort to revitalise the Black Sea and cultivate "blue economy" opportunities, DOORS facilitates collaboration among industry, academia, and local communities by implementing a system of systems (SoS) that addresses the effects of climate change and human activities on the marine ecosystem. The success, value, and impact of DOORS are contingent upon the involvement of stakeholders. Project work is imbued with increased significance as a result of collaboration with researchers, which advances science and technology. In order to aid scientists in the prioritisation of Black Sea issues, Multi-Actor Forums (MAFs) facilitate the collaboration of a variety of national stakeholders from Georgia, Romania, Bulgaria, and Turkey. The focus is on innovations that address inequalities and blue economy policies. This method also contributes to the co-design of the region's System of Systems, which provides the requisite datasets for researchers to resolve environmental challenges and advance the blue economy. An online survey was developed and distributed to all BS countries from March to May 2023 to validate the results of the first round of MAFs. The survey's objective was to identify the most significant Blue Economy sectors to be incorporated into the BS agendas and to evaluate entrepreneur assistance, impediments, and objectives. The sectors that should be prioritised in the Black Sea and the most significant challenges per country that need to be brought to the forefront of the public dialogue are revealed by the results of the first round of MAFs and the online survey.

Keywords: *multi-actor forums, living labs, co-creation, blue economy, Black Sea, systems approaches*

Acknowledgements: This paper is an output of the science project DOORS. DOORS has received funding from the from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement No 101000518.

SESSION V - MARINE SPATIAL PLANNING (MSP), COASTAL MANAGEMENT

POSTER PRESENTATIONS

THE ROLE OF HUMAN IMPACT IN UPDATING THE MARINE CONNECTIVITY MODEL IN THE BULGARIAN BLACK SEA COAST

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Abstract: Since ancient times people's lives have always been associated with water ponds. The first civilizations have developed in coastal areas taking advantage of natural resources. Over the years, people have begun to have an adverse impact on the environment they inhabit, forming the second group of factors - those that are the result of human activity.

Using the historical approach in their research the authors offer utilization coefficient of natural resources in the coastal area of Bulgaria. This ratio is in direct subordination to the duration of use of a given region and also duration and intensity of the impact of human factor and could help to create a map of areas with more or less exhausted natural resources along the Bulgarian Black Sea coast. This coefficient will contribute to a better understanding of the integrated management of coastal zones in Mediterranean and Black Sea countries.

The report briefly discusses in chronological order the civilization periods in the history of the Bulgarian Black Sea coast. A review of climate changes affected the living conditions in the coastal marine area was made. A rating of anthropogenic effects lead to changes in natural resources in different historical periods was made as well. The attention of authors is focused on the development of civilization processes driven by natural resources of the area.

In conclusion the authors try to summarize the sensitivity of human development from nature factors and integrated coastal zone management indicators and the important role of Blue Economy for sustainable development. It is recommended to use interdisciplinary and complex approach to understand better the past and to create a successful scenario for the future development of the coastal zones and human society.

Keywords: *Blue Economy, coastal zone management indicators, climate changes, MSP, sustainable development*

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METOCEAN ANALYSIS TO SUPPORT SPATIAL PLANNING ACTIVITIES IN THE ROMANIAN MARITIME AREA

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Abstract: In the context of the SafeBless project, a service oriented towards the Romanian maritime and coastal zone has been developed by the National Institute for Marine Research and Development “Grigore Antipa” and HIDROMOD, a company with a proven track record in data analysis and the implementation and maintenance of operational services. This service has the potential to serve as a valuable tool for public authorities and other maritime users interested in mapping areas suitable for a range of maritime activities, including aquaculture, offshore energy, oil and gas, fisheries, and tourism. The service enables users to identify areas where a set of hydrodynamic and water quality parameters (e.g. waves, currents, temperature, oxygen, etc.) satisfy a set of specific criteria (remaining within, above or below a set of limits over a defined period of time). A quick overview of the state of the different sea areas in relation to the different required uses can be easily obtained based on a statistical analysis of the Copernicus Marine Service data available for a period of 20-30 years, filtered by a set of criteria that each of the parameters must meet.

Keywords: *maritime spatial planning, Black Sea, metocean parameters, CMEMS downstream services*

Acknowledgements: This service has been funded by the Copernicus Marine National Collaborative Program 2021-2028.

ASSESSING THE QUALITY OF ROMANIAN BLACK SEA BATHING WATERS USING GIS SPATIAL ANALYSIS FOR SUSTAINABLE TOURISM DEVELOPMENT

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Abstract: The quality of bathing waters along the Romanian Black Sea coast is critical to environmental conservation and sustainable tourism development. This study utilizes GIS spatial analysis to assess water quality at several key beaches, including Mamaia, Constanta, Eforie, Olimp, and Vama Veche. The analysis identifies spatial patterns of water quality variation by using data on water temperature, pH levels, bacterial contamination (such as *Escherichia coli* and enterococci), and turbidity. Results show that while most beaches meet European Union water quality standards, certain areas - particularly in the southern sector near Mangalia - display elevated levels of bacterial contamination, likely linked to local wastewater discharge. GIS mapping has been instrumental in pinpointing high-risk zones and areas that require targeted environmental intervention. The findings underscore the need for enhanced wastewater treatment and stricter monitoring to support the region's eco-friendly tourism objectives. This spatial approach provides policymakers with valuable insights, enlightening them on the areas that need attention for sustainable tourism development.

Keywords: *environmental monitoring, geodatabase development, GIS, development tourist*

Acknowledgements: The authors thank Ms. Marieta Iorga and Ms. Cristina Vanghele (Ichim) from the *Dobrogea Litoral Water Basin Administration, Constanta, Romania*, for facilitating access to the company's database.

ROMANIAN MARINE PROTECTED AREAS IN THE CONTEXT OF BLUE JUSTICE

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Abstract: Seas and oceans guarantee our food, climate regulation, and well-being, but they are largely threatened by heatwaves, overfishing, and ecosystem destruction caused by ever-expanding human activities. The European Union and its member states have designated marine protected areas (MPAs) as areas where the protection of marine biodiversity is a priority. Latest papers reveal that in 2022, 86% of the 11.4% of EU waters covered by MPAs showed light, minimal, or no protection from the most harmful human activities, such as dredging, mining, or the most damaging fishing gears. From this perspective, it is urgent to reduce pressures on coastal and marine ecosystems by regulating activities more broadly, thus increasing their level of protection and addressing equitable access for all stakeholders. Using the Romanian Natura 2000 network as a benchmark, this paper will investigate the effects of the coastal and marine governance on conservation targets and blue justice. Most MPA coverage showed minimal protection across Black Sea providing limited social-ecological outcomes. Reaching the EU's 10% strict protection target will require radical changes to the regulation of activities in Romania assuring equity for all levels.

Keywords: *MPA, Black Sea, equity, regulations, economic activities*

Acknowledgements: This study was supported by the Romanian Ministry of Research, Innovation, and Digitalization 760054 JUST4MPA, within the PNRR-III-C9-2022 - I8 call and 760010 – ResPonSe, within the PNRR-III-C9-2022 – I5 call.

MARITIME HYDROGRAPHIC DIRECTORATE'S ROLE IN ENHANCING MARITIME RESILIENCE THROUGH SPATIAL PLANNING AND REGULATORY FRAMEWORKS

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Abstract: This paper examines the Maritime Hydrographic Directorate's active involvement in shaping regulations that support the resilience of Romania's maritime domain. It focuses on the Romanian Maritime Spatial Plan and associated legislation, underlining the MHD's significant contributions. Leveraging its vast experience and diverse activities in the Black Sea, the Directorate offers invaluable expertise to the maritime spatial planning process.

The paper underscores its recognized role as a pivotal authority in maritime environmental knowledge and implementing international navigation safety standards. Furthermore, it details the MHD's specific inputs to the MSP, encompassing port data, shipping lanes, navigational hazards, and restricted zones. The paper also explores the MHD's responsibilities in coastline monitoring, addressing unexploded ordnance, ensuring maritime traffic safety, and managing the official maritime hydrographic database. Additionally, it delves into the draft law concerning offshore wind energy exploitation, highlighting its interrelation with the Plan and emphasizing the Directorate's perspectives on national security and navigation safety considerations. The paper advocates for the MHD's continued involvement in legislative processes to safeguard navigation safety and national security within Romania's maritime domain.

Keywords: *Maritime Spatial Plan, navigation safety standards, hydrographic database*

Acknowledgements: This study has been carried out with financial support from the Sectorial Research-Development Plan of the Romanian Ministry of National Defence, PSCD 2021 – 2025 Project 094: “Analysis of the effects of marine environmental factors on marine objects/mines located on the seabed, within the area of responsibility of the Romanian Naval Forces”, PSCD 2021 – 2025 Project (097 / 2021, 092 / 2022, 093/2023): „Development of an integrated monitoring system to increase the quality of hydro-oceanographic data in the area of responsibility of the Romanian Naval Forces”.

GAPS AND OPPORTUNITIES WITHIN MARINE PROTECTED AREAS AND MARITIME SPATIAL PLANNING INTEGRATION

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Abstract: MSP4BIO project aims to develop and demonstrate the ways in which knowledge-based MSP becomes a vehicle and a tool for the protection and restoration of biodiversity through an Integrated and modular Ecological-Socio-Economic (ESE) management framework for the protection and restoration of marine ecosystems.

The Romanian part of Western Black Sea Pilot Site, from Cape Tuzla in Romania to Vama Veche, includes diverse coastal, onshore and offshore domains and Marine Protected Areas (MPAs) supporting huge biodiversity and ecosystem services. The sector supports both environmental and socio-economic uses, experiencing increasing both land-based and marine pressures mainly due to population increase, urbanization, agriculture growth, tourism and leisure activities, industry, transportation, and fishing. The need to deal in the future with the impacts of climate change in combination with finding adaptive responses is an important issue.

Current gaps and opportunities in relation to the biodiversity in marine management were investigated at Western Black Sea pilot site through a combination of desktop analysis and interactions with the stakeholders (Communities of Practice). The study focused on four themes: the current status of the MPA network, the (transboundary) coherence between area designations, MSP and other environmental legislation, the integration of social and economic aspects in MPAs and stakeholder confidence in MPA and MSP processes.

Keywords: *Maritime Spatial Planning, marine protected areas, human pressures, ecological values*

Acknowledgements: This work was supported by 101060707 — MSP4BIO — HORIZON-CL6-2021-BIODIV-01 “*Improved Science-Based Maritime Spatial Planning to Safeguard and Restore Biodiversity in a coherent European MPA network*” project.

SESSION VI - OCEAN LITERACY AND EDUCATION

ORAL PRESENTATIONS

ADVANCING WATER LITERACY: INTEGRATING KNOWLEDGE, ATTITUDES, AND BEHAVIORS FOR SUSTAINABLE MANAGEMENT IN THE FACE OF CLIMATE CHANGE

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Abstract: Water literacy, encompassing the integration of water-related knowledge, attitudes, and behaviors, has become vital in addressing global water challenges exacerbated by climate change. As traditional water management practices face scrutiny, there is an increasing need for comprehensive educational frameworks that encompass both natural and socio-economic dimensions of water systems. Historically focused on the biological and physical aspects, water education is now evolving to include socio-cultural and economic factors, reflecting a broader understanding of water's role in sustainability and social equity. The effects of climate change, such as altered precipitation patterns and increased frequency of extreme weather events, highlight the urgent need for robust water literacy education. Effective water literacy can prepare communities to handle these challenges by integrating scientific, local, and hydrosocial knowledge with practical skills for sustainable management. However, implementing water literacy programs faces challenges such as educational limitations, resource constraints, and the need for context-specific approaches. Future efforts should focus on policy recommendations, enhanced interdisciplinary curricula, and continuous evaluation to adapt educational strategies to evolving water crises. By incorporating diverse perspectives and addressing ethical considerations, water literacy can foster informed and responsible management of water resources, essential for achieving sustainability and resilience in a changing climate.

Keywords: *Water Literacy, Climate Change, Sustainable Management, Socio-Hydrologic Systems, Interdisciplinary Education, Water Scarcity, Environmental Education*

Acknowledgements: This study has received funding from the European Union's Horizon Europe, research and innovation programme under grant agreement no. 101112815.

NON-FORMAL APPROACH OF OCEAN LITERACY AT THE BLACK SEA

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Abstract: Ocean Literacy is a fresh and too little-known concept among the educational community of the Black Sea. There is still a lot of work to be done, in order not only to promote this concept, but to efficiently implement it. Mare Nostrum has an extensive know-how and experience in Ocean Literacy, approaching it through non-formal and creative educational methods.

Moreover, working with very diverse groups of stakeholders and beneficiaries, from high-level representatives to 3-year-old kindergarteners, gives Mare Nostrum a very good grasp on how Ocean Literacy and education can go hand in hand, for a better and bluer Black Sea.

Change always comes with an effort, this is a fact. Efforts have been made in Mare Nostrum towards sustainability and quality education at the Black Sea, since its beginning. The journey through environmental education, education for sustainable development and now Ocean Literacy, always brought the challenge of creating strong mechanisms and tools for their implementation. This helped the educational experts in Mare Nostrum to develop their originality, learning & teaching strategy and to 'collect' a large number of educational instruments.

Sharing the expertise is important for building new connections, working together and creating a synergy of common efforts, which all lead to the wellbeing of the Black Sea.

Keywords: *ocean literacy, education, Black Sea*

Acknowledgements: N/A

FROM ENVIRONMENTAL EDUCATION TO OCEAN LITERACY

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Abstract: This study examines the evolution of ocean related education among young people in Romania, over 20 years. The research aims to evaluate the impact of educational initiatives on environmental awareness and the understanding of marine ecosystems. At the beginning of 2000, environmental education in Romania was still emerging, with limited resources and awareness of ocean literacy being minimal. Nowadays, substantial efforts in formal and informal education, alongside global environmental movements, have significantly influenced the way young people perceive and engage with environmental issues, particularly regarding ocean health.

The comparison highlights shifts in knowledge, attitudes, and behaviors related to environmental conservation and marine ecosystems. The 2024 results show a marked improvement in understanding ocean-related issues, with more young people expressing concern for marine pollution, climate change, and sustainable practices. However, gaps remain, particularly in the integration of ocean literacy into the national curriculum.

The role of global platforms and initiatives (such as the United Nations Decade of Ocean Science) is also explored, in shaping youth perspectives. The findings underline the importance of continuous education, public awareness campaigns, and policy support to enhance ocean literacy. While progress has been made, more targeted initiatives are required to fully embed ocean literacy into formal education systems, preparing future generations to tackle critical environmental challenges effectively.

Keywords: *ocean literacy, education, youth, United Nations Decade of Ocean Science, public awareness*

Acknowledgements: N/A

CO-CREATING EDUCATIONAL RESOURCES WITH CHILDREN: BIODIVERSITY LITERACY AND YOUTH EMPOWERMENT

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Abstract: Teaching Resources for Youth-informed Biodiversity Education (TRYBE) was a co-creation project which ran in 2023 which aimed to equip children and young people with the skills they need to address the critical issue of biodiversity loss and biodiversity literacy through education and empowerment. TRYBE co-created a set of educational resources with children aged 8-16 years old and two Irish education networks (Irish Schools Sustainability Network and Biodiversity in Schools). This set of resources included an activity book, an activity calendar, and a set of online e-resources, intended for use both in classrooms and informal education environments. The resources co-created with the young people have been received very positively by schools, education networks, and other stakeholders with hundreds of copies ordered and downloaded from our website, indicating a gap in the educational market in Ireland for alike resources.

Following on from this project, we are researching the experiences of the young people involved in this intergenerational co-creation process, and the perspectives of their parents/guardians, with a view to sharing learnings for other educational and climate literacy initiatives planning on co-creating with young people. Our findings point to a strong desire from children and parents for more projects like this one which aim to increase children's climate and biodiversity literacy and practical skills such as creative writing, critical analysis, and public speaking. This oral presentation will give an overview of the TRYBE project, focusing on its methods (intergenerational co-creation in an online space), its outcomes (increased agency and efficacy in young people, increased climate and biodiversity literacy), and an insight into our main research findings.

Keywords: *co-creation, intergenerational, biodiversity, education, youth*

Acknowledgements: The TRYBE project was a legacy project from the Children and Young People's Assembly on Biodiversity Loss (CYPABL), led by Dublin City University in 2022 and funded by the Government of Ireland. TRYBE was funded by Science Foundation Ireland under the *Discover* funding programme and led by University College Cork.

INTEGRATING OCEAN LITERACY INTO THE HIGH SCHOOL CURRICULUM: CHALLENGES AND OPPORTUNITIES

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Abstract: Ocean literacy is essential for understanding the complexity of marine ecosystems and their influence on the global environment, economy, and society. Oceans cover over 70% of the Earth's surface and play a crucial role in regulating the climate, providing oxygen, absorbing carbon dioxide, and influencing weather patterns. Additionally, oceans are home to extraordinary biodiversity, supporting numerous species, many of which have yet to be discovered or studied. In a world facing challenges such as climate change, pollution, and overfishing, education in the field of ocean literacy becomes imperative for developing generations of environmentally conscious citizens.

Integrating ocean literacy into high school curricula is a valuable opportunity to educate young people about the importance of oceans and the marine environment. Proposals for this integration include the development of specific modules that address the fundamentals of oceanography, marine ecosystems, the impact of human activities on the oceans, and conservation measures. These modules would not only provide students with theoretical knowledge, but also cultivate practical skills through interactive activities, such as study trips, research projects, and brainstorming on ecological topics.

The impact of this integration on students can be considerable. Knowledge and awareness of ocean and environmental issues will encourage them to adopt responsible attitudes and behaviors, motivating them to become ambassadors for environmental conservation in their communities. By fostering a sense of responsibility towards nature, it will contribute to the formation of active citizens, capable of addressing the ecological challenges of tomorrow with innovation and determination.

Keywords: *environment, marine ecosystems, oceanography, knowledge, research*

OCEAN LITERACY IN THE BLACK SEA: A PATH TO SUSTAINABILITY

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Abstract: Ocean literacy, defined as understanding the reciprocal relationship between the ocean and society, is critical for fostering informed decision-making and sustainable interactions with marine ecosystems. In the Black Sea, a region marked by unique environmental challenges and rich cultural heritage, addressing ocean literacy is particularly crucial. Engaging citizens and stakeholders in this endeavour enhances their awareness of the ocean's pivotal role in societal well-being and equips them to contribute to its preservation.

The DOORS Ocean Literacy Network focuses on fostering this awareness through a variety of activities aligned with the UN Decade of Ocean Science for Sustainable Development 2021-2030 and other international efforts. By promoting the intersection of science, policy, and public engagement, the network contributes to educational events and initiatives in Black Sea countries such as Romania, Georgia, Turkiye, Ukraine, and Bulgaria. These efforts are aimed at increasing public understanding of ocean sustainability and blue economy principles, utilising resources like marine litter collection, smartphone technologies, and interactive workshops.

In our talk, we will present the activities of the network, including the integration of ocean literacy into research institutions and public organisations. We will also highlight key initiatives which underscore the DOORS efforts in connecting marine science and society, such as the EuroGOOS Scientists for Ocean Literacy survey for European oceanographic agencies.

Through these efforts, the Black Sea region can benefit from international ocean literacy initiatives, developing its own tailored pathway to enhance public engagement and contribute to the sustainable management of its unique marine environment.

Keywords: *ocean literacy, marine service, sustainability, Ocean Decade*

Acknowledgements: This abstract is supported by DOORS, an EU Horizon 2020 project funded under Framework Programme for Research and Innovation under grant agreement No 101000518.

PROMOTING OCEAN LITERACY VIA BLUE SCHOOLS IN EUROPE

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Abstract. Blue growth concept is something that many people are not aware of, however there are some attempts to improve this awareness. This study aims to represent the outputs of SHORE project which is funded under European Union's Horizon research and innovation program. Project stands for "Student and school activities for the promotion of education on 'blue' sustainability and the protection of marine and freshwater ecosystems". Ocean Literacy implies for understanding the public's awareness and knowledge about the ocean's influence on them and their influence on the ocean. Sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems defined as blue economy. Sustainable Development Goals (SDGs) of United Nations focus on the goals related to marine environments and how they intersect with ocean literacy and the blue economy. Blue schools are one of the main components of this project which contains developing a blue school curriculum and integrate to the national education systems in the partner countries. In this study those 4 main aspects were examined in depth through collaborative partnerships and educational activities. Partners of the project are from different countries in Europe which are Austria, Czechia, Hungary, Italy, Poland, Romania and Türkiye. In the first part of the study the Ocean Literacy has been examined via questionnaires in each partner country. More than 400 questionnaires were held to see the literacy levels and perception of oceans, climate change and Sustainable Development Goals (SDG). Every partner also reviewed their education systems and developed recommendations to adopt ocean literacy components in education, starting with national curriculum at various education levels. This study also highlights the blue economy's potential as a root for sustainable development. Blue school potential and development as well as challenges and opportunities is discussed in this paper.

Keywords: *Blue economy, water sustainability, public perception, education, Europe, climate change*

Acknowledgements: This study has received funding from the European Union's Horizon Europe, research and innovation programme under grant agreement no. 101112815.

MULTI-ACTOR FORUMS TO ADVANCE A SUSTAINABLE BLUE ECONOMY: BLUE TRANSITIONS IN THE BLACK SEA

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Abstract: The sustainable development of regions worldwide is contingent upon the Blue Economy, which encompasses all economic activities associated with coastal regions, oceans, and waters. The Black Sea, which is located at the intersection of Asia and Europe, has the potential to expand a thriving Blue Economy. Conversely, this potential is accompanied by a unique set of challenges that must be addressed in order to ensure the long-term growth of maritime sectors in the regional area. DOORS Black Sea, an EU-funded initiative, is designed to address these concerns by providing Black Sea research support that is both optimal and accessible. In an effort to revitalise the Black Sea and cultivate "blue economy" opportunities, DOORS facilitates collaboration among industry, academia, and local communities by implementing a system of systems (SoS) that addresses the effects of climate change and human activities on the marine ecosystem. The success, value, and impact of DOORS are contingent upon the involvement of stakeholders. Project work is imbued with increased significance as a result of collaboration with researchers, which advances science and technology. In order to aid scientists in the prioritisation of Black Sea issues, Multi-Actor Forums (MAFs) facilitate the collaboration of a variety of national stakeholders from Georgia, Romania, Bulgaria, and Turkey. The focus is on innovations that address inequalities and blue economy policies. This method also contributes to the co-design of the region's System of Systems, which provides the requisite datasets for researchers to resolve environmental challenges and advance the blue economy. An online survey was developed and distributed to all BS countries from March to May 2023 to validate the results of the first round of MAFs. The survey's objective was to identify the most significant Blue Economy sectors to be incorporated into the BS agendas and to evaluate entrepreneur assistance, impediments, and objectives. The sectors that should be prioritised in the Black Sea and the most significant challenges per country that need to be brought to the forefront of the public dialogue are revealed by the results of the first round of MAFs and the online survey.

Keywords: *multi-actor forums, living labs, co-creation, Blue Economy, Black Sea, systems approaches*

Acknowledgements: This paper is an output of the science project DOORS. DOORS has received funding from the from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement No 101000518.

SESSION VI - OCEAN LITERACY AND EDUCATION

POSTER PRESENTATIONS

ARTIFICIAL REEFS (ARs) IN THE BLACK SEA: MODEL AR APPLICATION AND TRAINING AROUND THE SINOP PENINSULA (TÜRKİYE) WITHIN THE SCOPE OF CCAGP

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Abstract: The Black Sea ecosystem is under increasing pressure from climate change, overfishing, and habitat degradation. Artificial Reefs (ARs) provide a promising strategy to combat these issues by fostering marine biodiversity, supporting fish stocks, and promoting sustainable fisheries. This study focuses on the deployment of a model AR system around the Sinop Peninsula, a region critically affected by climate-induced environmental changes, and raising awareness among target groups, especially fishermen. As part of the project (MS-MPAs), a total of 40 concrete artificial reefs (C35) were constructed and placed over a 1-decare (40X25m) in the around Sinop peninsula (Karakum region). In determining the area where ARs will be placed; features such as depth, wind, current, habitat, as well as the opinions of fishermen were taken into account. Through direct communication, information dissemination, and targeted training meetings, the mitigation of negative reactions from fishermen toward the AR area and its implementation has become attainable. Subsequently, the establishment of the AR area found particular acceptance among fishermen involved in small-scale fishing activities. Early monitoring results indicate an increase in local biodiversity, with key species such as brown meagre, annular sea bream, black scorpionfish, various crabs, shrimps and pipefish species being observed within the artificial reef zone. By supporting marine biodiversity and creating climate-resilient habitats, the MS-MPAs project has contributed to the sustainability of local fisheries and provides a replicable model for other regions of the Black Sea. Moreover, the collected data offers valuable insights for expanding AR applications, fostering collaboration in marine conservation efforts across Türkiye and neighboring countries.

Keywords: *climate change, artificial reefs, protected area, fisheries, Black Sea*

Acknowledgements: This study is co-financed by Republic of Türkiye and EU with the scope of the Climate Change Adaptation Grant Program (CCAGP) - IPA II (MS-MPAs – Project No: TR2017 ESOP MI A3 04/CCAGP /041).

SEASONAL MONITORING OF FAUNAL BIODIVERSITY AROUND ARTIFICIAL REEFS (ARs) PLACED ON THE SİNOP COAST OF THE BLACK SEA

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Abstract: The world's marine and ocean environments are deteriorating and deteriorating daily. Natural reefs and biodiversity in global oceans and seas are under significant threat. Despite numerous precautions and legal regulations, it takes a long time for aquatic ecosystems to rehabilitate and regain their health. At this juncture, ecosystems need to be supported by scientific studies. For this purpose, classical and modern artificial reef (AR) models have been among the most widely used methods since ancient times.

This study aimed to conduct seasonal monitoring of faunal biodiversity in an area consisting of concrete artificial reefs (ARs) placed along the Sinop coast of the Black Sea, a region of considerable importance for fisheries and aquatic biodiversity in the Black Sea. In this context, the status of biodiversity was monitored through diving observations, as well as pot and gillnet fishing activities during the spring and summer seasons in the ARs (with seagrass, 6-8 m depth), Control 1 area (with seagrass, 6-8 m depth), and Control 2 area (without seagrass, 30-45 m depth).

According to the initial data obtained, a significant difference was observed in the biodiversity and abundance of fish and arthropods between the monitored sites during the spring and summer seasons ($P < 0.05$). Notable fish species at the ARs site included the brown meagre (*Sciaena umbra*), annular sea bream (*Diplodus annularis*), and scorpion fish (*Scorpaena porcus*). Among arthropods, the yellow round crab (*Eriphia verrucosa*) was recorded as the most frequently observed and captured species. Once trials for all seasons are completed, the effects on biodiversity, species abundance, and size composition around the artificial reefs will become clearer.

Keywords: *marine ecosystem, fish, arthropod, crustacean, seagrasses*

Acknowledgements: This study is co-financed by Republic of Türkiye and EU with the scope of the Climate Change Adaptation Grant Program (CCAGP) - IPA II (MS-MPAs – Project No: TR2017 ESOP MI A3 04/CCAGP /041).

SEASONAL CHANGES IN SEAGRASS ON THE SİNOP COAST OF THE BLACK SEA

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Abstract: Seagrasses are important primary producers that contribute to coastal ecosystem productivity in oceans and seas. They are valuable resources providing nature-based solutions to combat the effects of climate change. Globally, seagrasses sequester carbon 35 times faster than tropical rainforests. Seagrass beds serve as critical spawning grounds for a diverse range of species, including those that are endangered and commercially important. As is the case in many seas and oceans today, seagrass habitats in the Black Sea are increasingly threatened by various factors, including physical pollution, chemical pollution, commercial fishing activities, and coastal habitat degradation. There are six species of seagrass in the Black Sea, of these; *Zostera marina* and *Zostera noltii* are commonly found along the Sinop coast.

In this study aimed to determine the change abundance of seagrass along the Sinop Coast of the Black Sea. Additionally, it sought to observe changes in this area by placing artificial reefs within the sampling region to enhance biodiversity in the sea meadow habitat. Seasonal sampling has been planned at three stations within the sampling area. Sampling was conducted using quadrats of 100 cm and 25 cm sizes. Observations and sampling of seagrass were conducted through diving. Sampling for summer and spring has been completed. It was determined that, compared to the spring season, seagrass cover and density increased during the summer season.

Keywords: *sea meadow, Zostera marina, Zostera noltii, density, biodiversity*

Acknowledgements: This study is co-financed by Republic of Türkiye and EU with the scope of the Climate Change Adaptation Grant Program (CCAGP) - IPA II (MS-MPAs – Project No: TR2017 ESOP MI A3 04/CCAGP /041).

EARTHgames4EyoUth

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Abstract: The EARTHgames4EyoUth project is focused on the development of Earth competences among young Europeans, and it tackles knowledge, skills, and attitudes towards reducing global and climate change impacts with special focus on SDGs and provides a pathway of a smooth transition from policies to the grassroots level, making them more consumable for youngsters.

This project provides youth work sector with a new framework of competences, a set of interactive games and a communication and an educational program, which will address a wide array of environmental issues from various perspectives and using various approaches.

The EARTHgames4EyoUth project brings unique combination of methods (competence framework, gamification of policies and non-formal education program with a scientific emphasis) and learners (youth workers and young people themselves).

The project coordinator is Mare Nostrum NGO, from Romania. The expertise on environmental education, non-formal methods and project management is what the team brings on board. Slovak Eco Quality is the partner from Slovakia that will innovate the world of competences, by proposing a new framework, which will change the way we see competences. Taking care of quality trainings and making sure that the project idea will be paid forward is the responsibility of UniGrowth Development Center, from Armenia. In Poland, Today We Have is the team that coordinates gamification activities and contributes with expertise on working with young people in international contexts.

The team knows and understands the current needs for increasing awareness of citizens across the world and thus we propose universal tools for effective communication and education which can be used and adapted to individual/local needs across Europe.

Keywords: *Earth competences, games, educational program, young*

Acknowledgements: This project is financed by the European Union, under the Erasmus+ programme.

MUSEUMS OF NATURAL SCIENCES WITH LIVING HERITAGE - AWARENESS FACTOR, EDUCATION AND TRAINING OF THE YOUNG GENERATION FOR A CAREER IN A BLUE ECONOMY

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Abstract: Modern approaches to the definition of museums support the need to use museum heritage for educational, recreational, entertainment and even economic development of a region (Neamu, 2010; Hume & Mills, 2011; Grenier, 2010; Friman, 2006).

Due to its specificity, the Complex Museum of Natural Sciences Constanta represents the connection between research, education and the public, being a design point of information easily accessible by citizens.

In the current context, the objectives of CMSN Constanta, through the educational activities carried out by its specialists, are: to contribute to the formation of the next "blue" generation, to help to understand the term "blue skills" but also to develop blue careers to support sustainable development and conservation of coastal marine environments, to promote the sustainable blue economy.

Keywords: *marine environmental education, blue skills, blue economy, museum of natural sciences, ocean literacy*

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CONNECTING PROFESSIONALS AND FOSTERING CROSS-BORDER RELATIONSHIPS: DOORS ESRE

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Abstract: Connecting communities, especially those of a diverse range of cultures and attitudes towards environmental conservation and monitoring activities, is an important part of creating cohesive and mutually beneficial partnerships. Doing so forms the essential foundations of working together to better address growing climate related issues and enable better management of delicate ecosystems. Building this connectivity is an important aspect for Black Sea communities to realize Black Sea economic and environmental ambitions.

Cross-boundary collaborations are known to be effective ways to drive scientific community exchanges and synergies efforts to advocate for and implement environmental challenge solutions. This could be of particular benefit to the Black Sea basin, with a diverse and wide-ranging community of talent that can be harnessed.

The DOORS Early-Stage Researcher Exchange (ESRE) was developed and implemented to promote and enable such connectivity. Early-career researchers were brought through a programme of connecting with scientific experts in a field of interest, developing a collaboration proposal with them, and implementing this proposal through a hosting exchange. Having either the host or the participant based in the Black Sea was an essential element of this programme. Collaborative activities were supported in the areas of water quality monitoring, spatial analysis of marine litter, cross boundary fisheries management, river hydrodynamics, and the study of algae. Overall, the exchanges were positively viewed. Through the exchange, participants consistently made more than 1 connection, expanding their network of local contacts beyond their nominated mentor.

In conclusion, the DOORS ESRE is an initiative that has had a clearly positive outcome on connecting communities and fostering cross-boundary relationships.

Keywords: *Black Sea, research, collaboration, communities, exchanges*

Acknowledgements: This work has been conducted under the Horizon 2020 DOORS Project, funded by the Framework Programme for Research and Innovation under grant agreement No 101000518.

EXPLORING PUBLIC PERCEPTIONS: OCEAN LITERACY AND CLIMATE CHANGE IN EUROPE

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Abstract: Ocean literacy has become increasingly important in addressing the growing challenges facing marine ecosystems, particularly those exacerbated by climate change. In an effort to better understand public perceptions and attitudes toward ocean-related issues, a comprehensive survey was conducted across seven countries: Austria, Czechia, Italy, Hungary, Poland, Romania, and Türkiye. This survey, which involved 409 participants, was carried out as part of the SHORE project. The aim of the study was to collect robust data on key themes, including public understanding of ocean health, the "sea blindness" phenomenon, the blue economy, and the effects of climate change on marine ecosystems. The results of this survey provide valuable insights into the public's awareness of the interconnectedness between ocean health and sustainable practices. While many respondents demonstrated a strong understanding of the significant impact climate change has on marine ecosystems, there remains a clear need for further educational efforts, particularly regarding the blue economy and the concept of "sea blindness. The data gathered will be instrumental in shaping the development of innovative educational programs and resources within the SHORE project, aimed at fostering ocean literacy, promoting sustainable behaviors, and empowering students to act as agents of change in their communities. These findings emphasize the need for targeted educational efforts that address these gaps in knowledge. By integrating ocean literacy into broader educational frameworks, particularly with a focus on sustainability and climate change, communities can be better equipped to engage with and contribute to the preservation of marine ecosystems. This survey provides crucial data that will inform the design of educational programs aimed at raising awareness and fostering sustainable behaviors among diverse populations.

Keywords: *ocean literacy, Blue Economy, sea blindness, climate change, marine conservation, sustainable development, environmental education*

Acknowledgements: This study has received funding from the European Union's Horizon Europe, research and innovation programme under grant agreement no. 101112815.

EOL - ENVIRONMENTAL AND OCEAN LITERACY IN THE BLACK SEA BASIN

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Abstract: United Nations Strategic Development Goal (SDG) 4.7 points to the transformative power of education when it supports sustainable development agendas and calls on decision-makers to ensure that all learners acquire the knowledge and skills necessary to support sustainable lifestyles. However, formal and non-formal education systems in Türkiye, Bulgaria and Greece have been inadequate in delivering such education, and adults are particularly left behind although they have a greater impact on the environment. The overall objective of the EOL project is to increase environmental and ocean literacy and green competences among young adults in communities in Türkiye, Bulgaria and Greece in order to contribute to the conservation of nature and biodiversity in the Black Sea Basin. The project will empower young adults via 30 dissemination trainings, and an awareness raising video. An education programme and a trainers' manual will be designed and two training of trainers will be organized for civil society organizations (CSOs) and local government representatives to strengthen their education capacity. Nine dissemination trainings will be organized as a pilot action for local governments. An international workshop will be organized and a white paper will be written for local CSOs and local governments to strengthen their environmental education policy-making capacities. The scope of environmental issues necessitates transnational cooperation and harmonization in the field of environmental education as acknowledged by international and regional instruments such as SDGs and the GreenComp. Environmental education should also foster an understanding of the interconnection among communities and be shaped by a global citizenship approach, which makes regional collaboration necessary. Transnational approach is needed to develop common solutions in line with international/regional standards, build capacity and foster implementation of effective and aligned policies and practices in all three countries.

Keywords: *ocean literacy, Black Sea, environmental education, GreenComp*

Acknowledgements: Project EOL - Environmental and Ocean Literacy in The Black Sea Basin is co-funded by the European Union's Interreg NEXT Black Sea Basin Programme.

AQUATIC PLASTIC DANUBE REGION: TACKLING PLASTIC POLLUTION IN THE WORLD'S MOST INTERNATIONAL RIVER BASIN

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Abstract: The Aquatic Plastic Danube Region project is a transnational initiative under the Interreg Danube Transnational Programme, aimed at reducing plastic pollution in the Danube River and its tributaries and promoting efficient pollution management strategies. Through comprehensive research, cross-sector cooperation, and public engagement, the project addresses the sources, pathways, and impacts of plastic pollution. Key activities include advanced microplastic research, collaboration with hydropower plants to mitigate operational challenges, and citizen science programs involving schools and local communities. By uniting stakeholders across the Danube region, the project fosters sustainable solutions to safeguard aquatic ecosystems and reduce plastic waste. The project also raises awareness through initiatives like the Transnational River Cleanup Challenge, encouraging local communities to take action.

Keywords: *Danube River, riverine litter, collaboration, pollution, Tid(y)Up*

Acknowledgements: The work is performed within the project “Initiating bottom-up management solutions to reduce plastic waste in the Danube Basin” (AQUATIC PLASTIC), financed under Interreg Danube Region Program, co-financed by the European Union, with a value of € 2.166.493,50.

I LIVE BY THE SEA. AN EXAMPLE OF OCEAN LITERACY INTERNATIONAL ACTION

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Abstract: The philosophy behind the I live by the Sea Contest is to create a platform which enables exchange of information for all people interested in the ocean. We strive to create an international society, whose members believe in the need to achieve the UN Sustainable Development Goals, with special emphasis on marine issues. We think that the opportunity to contact people from various parts of the world is a great value in itself. Therefore, taking part in the contest with a chance that his/her work will be presented in various world places, during important events dedicated to the oceans, we help to promote their own perception of reality and their regions. We want the participants to share this vision with us.

Through their participation we hope to involve youth of different natural and cultural heritage to share their views on marine issues in a creative way. This involves a great number of contributions from the Black Sea region, mainly from Romania, which is due to a very fruitful cooperation with Mare Nostrum. The Romanian contributions have been awarded in many editions and showed worldwide.

All works submitted are reviewed by a panel of International Judges. Due to a variety of options for contestants the panel involves experts from several art and science areas.

The contest is an official partner of the United Nations Decade of Ocean Science for Sustainable Development and in 2022 and during the European Maritime Day in Ravenna 2022, the Director General of DG MARE of the European Commission has awarded the I live by the Sea contest with a: Main EU4Ocean coalition award Sky Blue; for significant achievement in bringing forward ocean literacy in Europe, its efforts and initiatives in translating the spirit and principles of the EU4Ocean coalition, while mobilizing diverse community.

Keywords: *ocean literacy, nonformal education, photos and films, contest, UN Ocean Decade*

Acknowledgements: UN Ocean Decade.

COMPUTED TOMOGRAPHIC REPRESENTATION OF ANATOMICAL STRUCTURES USING PLASTINATED SECTIONS OF BLACK SEA TURBOT

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Abstract: Anatomical structures visualised by computed tomography (CT) have been studied and described on plastinated sections (scans, scanograms) of the turbot *Scophthalmus maximus* (syn. *Psetta maximus*) var. *maeotica* (Pallas, 1814) (Pleuronectiformes, Scophthalmidae) (turbot or Black Sea turbot) collected from natural populations in the Black Sea with the assistance of the Institute of Fisheries Resources - Varna. The results of the digital data processing show that the combination of plastination and CT is an effective approach as it allows, for the first time, a very clear visualisation of the anatomical structures included. This has allowed a detailed description of these structures and the creation of a schematic representation of the turbot skeleton. The structures presented in this way would be useful for the comparative anatomy of this species, for which data are still insufficient. On the other hand, such plastinated specimens are convenient for use by specialists due to their harmlessness and indefinite shelf life.

Keywords: *anatomical preparation, CT scan, fish morphology, epoxy resin, fish specimen*

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AWARENESS-RAISING AND INCREASING PUBLIC KNOWLEDGE ON THE ECOLOGICAL AND ECONOMIC IMPORTANCE OF SUSTAINABLE BLACK SEA FISHERIES

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Abstract: In the context of awareness-raising, data collection, and testing of mitigation measures in selected Black Sea fisheries, our study contributed to the cetaceans' bycatch assessment in turbot gillnet fisheries. An important fact that has been observed for the first time during the trials is the high mortality of turbot specimens in the gillnets. In order to catch around 100 individuals alive depending on soak time and the gear type, the dead specimens were between 20-50. The gear with highest mortality rates is the multifilament one. We identified also that rays and stingrays have huge impact on the turbot gillnets, mainly the stingrays destroyed the nets completely. Also, is crucial to point out is that no cetaceans have been caught in pinger gillnets until present.

Fishermen interviewed generally avoided providing information on bycatch species for fear of reducing their quotas or closing fisheries for those species. In this sense, we recommend the involvement of fishermen in training courses and improving their knowledge with the aim of optimizing their activity with economic benefits but also with a contribution to blue growth.

Keywords: *awareness, sustainable fisheries, blue growth, positives socioeconomic outcomes*

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BLACK SEA PAPERS – SCOPUS BIBLIOMETRIC ANALYSIS

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Abstract: Black Sea region has a geostrategic of increasing importance. In order to identify key stakeholders and research themes based on scientific production we carried a bibliometric analysis based on data extracted from SCOPUS database, which covers a variety of research fields connected or centered on the Black Sea region. The dataset contains 20000 observations comprising fields containing names for authors, affiliations, abstracts and journal/conferences. We identified that scientific production has steadily increased by 10% over the past 27 years, with authors affiliated to academic institutions from Republic of Türkiye leading the pack, followed by authors from countries bordering the Black Sea.

Keywords: *Black Sea, SCOPUS, bibliometric analysis*

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