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Abstract Book

International Conference

"Environmental Toxicants in Freshwater and Marine Ecosystems in the Black Sea Basin"

September 8th-11th, 2020
Kavala, Greece

BSB27-MONITOX

Black Sea Basin interdisciplinary cooperation network for sustainable joint monitoring of environmental toxicants migration, improved evaluation of ecological state and human health impact of harmful substances, and public exposure prevention

Editors

Thomas Spanos
Antoaneta Ene
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Εκτύπωση: Organotiki OE
2020

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Editors Preface

The **International Conference "Environmental Toxicants in Freshwater and Marine Ecosystems in the Black Sea Basin"** is organized by the International Hellenic University (IHU), Greece and Dunarea de Jos University of Galati, (UDJG), Romania, in the frame of the project with code BSB27, *"Black Sea Basin interdisciplinary cooperation network for sustainable joint monitoring of environmental toxicants migration, improved evaluation of ecological state and human health impact of harmful substances, and public exposure prevention" (acronym "MONITOX"),* funded under the EU CBC Joint Operational Programme "Black Sea Basin 2014-2020" framework, in collaboration with the partner institutions - Institute of Zoology, Republic of Moldova (IZ), Institute of Geology and Seismology, Republic of Moldova (IGS) and "Danube Delta" National Institute for Research and Development, Tulcea, Romania.

The Conference is focused on the current developments on environmental monitoring and management of deltaic and wetland areas with an emphasis on the results obtained so far in the frame of research activities of the Project BSB27. It provides an opportunity for members of the target groups, scientists, decision-makers and stakeholders to meet each other and to establish new relations and partnerships. This fact will promote the cooperation in environmental research and management among countries from the connected regions - Black Sea Basin and the Mediterranean Basin.

Participation is very encouraging, from researchers and specialists members of the project BSB27, to scientists and young researchers representing other institutions from Greece, Romania, Republic of Moldova, Ukraine, Turkey, Jordan, Cyprus, the Netherlands, Spain, Republic of Armenia, Palestine and Russian Federation, as well as volunteers – undergraduate students, magisters, doctoral students, alumni. More than 65 abstracts were selected for plenary and poster presentations, covering a wide range of topics grouped in three interrelated sections.

The **sections** of the conference are:

1. *Monitoring of toxicants in Rivers – Deltas – Seas ecosystems in the Black and Aegean Seas Basins*
2. *Water quality, human health and biodiversity*
3. *Environmental technologies, oil fingerprinting, restoration and management of aquatic ecosystems*

The editors would like to thank: the authors of the papers, the international scientific committee for their assistance in reviewing, EU CBC Joint Operational Programme "Black Sea Basin 2014-2020" for their funding.

We hope that the International Conference of MONITOX network will provide a suitable background for the exchange of information and ideas in virtually all areas of environmental research specific to deltas and wetlands ecosystems, leading us towards a better scientific and academic interdisciplinary networking in the Black Sea Basin.

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Section 2 - Water Quality, Human Health and Biodiversity

Section 3 - Environmental technologies, oil fingerprinting, restoration and management of aquatic ecosystems

SECTION 1. Monitoring of toxicants in Rivers – Deltas – Seas ecosystems in the Black and Aegean Seas Basins

S1.01. MONITOX international network for monitoring of toxicants in the Black Sea Basin

Antoaneta Ene[1*,2], Elena Zubcov[2,3], Thomas Spanos[2,4], Oleg Bogdevich[2,5], Liliana Teodorof[2,6]

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Preliminary results jointly obtained in the period 2018-2020 in the frame of MONITOX international network created and developed through the BSB27-MONITOX project are presented, regarding the monitoring of various classes of toxic substances in targeted environmental matrices (surface water, groundwater, sediments, soils and biota) in the Black Sea and Northern Aegean Sea Basins – toxicants levels and distribution mapping, employed investigation techniques, intercomparison exercises between partner institutions.

A conceptual model and innovative tools for the assessment of toxicants' impact upon human health and ecological state of aquatic ecosystems using a risk calculator are described.

Acknowledgement: We acknowledge the funding from ENI project with eMS code BSB27 MONITOX (2018-2021), Joint Operational Programme Black Sea Basin 2014-2020.

S1.02. The content of metals in fresh and frozen fish imported in Moldova

Elena Zubcov[1,2*], Nina Bagrin[1], Victor Ciornea[1], Natalia Zubcov[1], Lucia Biletchi[1], Nadejda Andreev[1], Antoaneta Ene [2,3], Despina Selina Spanou[4], Thomas Spanos[5]

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The improvement of the methodology of assessment of the quality of fish products and ecological state of aquatic ecosystems, used in fish culture, became a priority, according to the standards and directives of EU, UNESCO and FAO, which foresee the adaptation of ISO methods. The elaboration of national schemes of indicators of the quality of fish products, appreciation of the safety of fish products and of their risks for human health is a task of major importance. The quantity of imported fish in Moldova exceeds greatly the quantity of autochthonous, captured and cultured, fish. This fact determined us to perform a screening of the content of metals in fresh and frozen fish products. Samples of fish imported from France, Norway, Greece, Italy, Spain, China, etc. were investigated.

In most of cases, the content of metals in imported fish, including of those listed in the Moldovan Sanitary Regulation on the contaminants in food products (Governmental Decision no.520/2010), was higher than that recorded in local, grown in pond, fish. Some concentrations, for example, of arsenic (As – 5.2-7.4 mg/kg) in the European pilchard *(Sardina pilchardus)*, as well in gilt-head (sea) bream *(Sparus aurata)* and sablefish *(Anoplopoma fimbria)* (As – 2.8-4.2 mg/kg) were quite high and exceeded the maximum allowable concentrations (MAC) for fish products by 3-7 times. Also, the content of lead in sablefish and yellowfin tuna *(Thunnus albacares)* exceeded the MAC almost by two times. Of a high concern are the concentrations of bismuth (Bi) found in the Atlantic salmon *(Salmo salar)* from Norway and gilt-head (sea) bream. The pharmaceutical compounds, which penetrate into waters,

may be one of the sources of this metal in fish products. The content of zinc (Zn - 103-134 mg/kg) and chromium (Cr – 6.6 mg/kg) in fish from a range of countries exceed the MAC for fish products.

Acknowledgements: The research was carried out within BSB 27 Monitox project of JOP Black Sea Basin 2014-2020 and the national project 18.51.07.08A/PS.

S1.03. Study of drinking water radioactivity in the Republic of Moldova

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Sustainable development depends to a large extent on water resources management. These resources are formed and managed in river basins. Drinking water quality in the Republic of Moldova is monitored in accordance with the provisions of the Drinking Water Quality Law 272/1999 with subsequent amendments [1] and the Fundamental Norms of Radiation Protection [2] which established the requirements for protecting the health of the population regarding radioactive substances from drinking water. By adopting the above-mentioned normative acts, the country has complied with the provisions of European Directive 98/83 [3] on the quality of water intended for human consumption and of Council Directive 2013/59/EURATOM laying down requirements for the protection of public health with regard to radioactive substances in water intended for human consumption [4].All waters contain at least naturally occurring radionuclides and are thus naturally radioactive. Mineral spring waters may even contain radioactivity concentrations exceeding the recommended levels of total *alpha* or total *beta* radioactivity and might be considered inappropriate for regular human consumption. This has been documented in many countries and it is known that some thermal spring waters may contain, in particular, exceedingly high radium or radon concentrations, reaching for example up to 1,000 Bq/L of ^{226}Ra and 5,000 Bq/L of ^{222}Rn or even more [5]. Other than mineral and thermal spring waters, the water from public supplies can sometimes be a surprise also and display relatively high values of total *alpha* or total *beta* activity. Therein, the limit value of 0.1 Bq/L previously recommended and on occasion the current limit

of 0.5 Bq/L adopted in the EU for total *alpha* activity exceeded in public water supplies. This occurs with groundwater in some regions with uranium bearing rocks and in aquitards with long water residence time and redox conditions that allow for dissolution of radionuclides from the rock into pore water. In general, following nuclear releases, besides tritium, the most common radionuclides usually are iodine (^{133}I, ^{132}I, ^{131}I), strontium (^{89}Sr, ^{90}Sr), and caesium (^{137}Cs, ^{136}Cs,^{134}Cs) radioisotopes, as observed in Europe following the atmospheric transport of radionuclides from the Fukushima nuclear accident in 2011 [6]. Pollution and contamination of drinking water potentially cause severe problems to health so the water quality management addresses both national and international action to assess and prevent associated hazards. A survey to study natural radioactivity in drinking water was carried out in the Republic of Moldova. Approximately 3111 samples of drinking water were analysed. The samples were categorized according to their origin: bottled or public supply. The samples were analysed for gross beta, ^{220}Rn, ^{222}Rn, ^{137}Cs and ^{90}Sr activity. The activity concentration for gross *beta* was found to range from 0.41 to 1.53 Bq/L. The gross *beta* activity content in the majority of the samples is due to ^{40}K. Average concentrations of ^{137}Cs and ^{90}Sr activity in the studied waters ranged respectively from 0.02 to 3.2 Bq/L and 0.012 to 2.2 Bq/L. Regarding radon detection, the results showed that the average concentration of radon in artesian wells was 1.93 Bq/m^3; in the aqueduct water – 3.12 Bq/m^3; in the spring waters – 6.17 Bq/m^3; in wells – 3.87 Bq/m^3, in bottled water – 0.1 Bq/l, in mine water – 0.93 Bq/l and in the surface water — about 1 Bq/m^3. It was stated that ^{222}Rn concentrations in the surveyed waters did not exceed the permissible values according to national rules and Directive 2013/59/EURATOM.

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S1.04. The analysis of spatial distribution of POPs contaminated sites in Low Danube Region of Republic of Moldova

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The inventory of contaminated sites (CS), which was made in Republic of Moldova, showed a significant number of POPs contaminated sites. The database with the ranking and risk assessment of CS for the environment and public health was created after this inventory. This first step in the management of CS needs in the further development of legislative framework and scientific support for the remediation of CS. The presentation will provide an analysis of the actual situation with the study and management of POPs CS in Republic of Moldova. Several case studies are presented for the risk assessment on the regional and local levels as well as the projects by the remediation of contaminated soil realized in conditions of Republic of Moldova.

The analysis of the actual status with CS is provided by the examples of the case studies of CS with high risk for the environment and public health. The toxic substance determination was made using GC/MS technique. The obtained results showed that a situation with CS was not changed essential from the past studies (2009 - 2011). The contamination level remains on the same level and risks for the environment are high. The usual practice of the local authorities is to cover CS sites by the relative clean soil without a project design and remediation of the contaminated soil. The principal conclusion is that the further progress for the remediation of CS and the reduction of risks depends of the legislative improvement for the regulation of this activity and development of the cooperation with all stakeholders for CS management: local and central authorities, private sector and scientific community.

Acknowledgement: We acknowledge the funding from ENI project with eMS code BSB27 MONITOX (2018-2021), Joint Operational Programme Black Sea Basin 2014-2020.

S1.05. The study of modern and obsolete pesticides in groundwater of Republic of Moldova

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Water Management Plan of Danube-Prut-Black Sea basin in Republic of Moldova included a groundwater component according to Water Framework Directive (WFD). Seven principal aquifers were delineated into eleven groundwater bodies (GWB). Every GWB were characterized for their quantity and quality parameters. The new monitoring sites were proposed for GWBs, which have no monitoring points. The groundwater quality analysis included major ions, heavy metals, modern and obsolete (POPs) pesticides. GC/MS technology was used for the pesticide determination. The used method for the pesticide determination was validated and proposed for the implementation in the national monitoring programs. The obtained results showed an absence of POPs substances in groundwater samples. Several modern pesticides and trifluraline were determined in GWBs for shallow aquifers in springs and shallow wells. The conclusion is that deep GWBs have no a contamination affect from point and diffuse pollution sources. The shallow GWBs affected slightly from diffuse pollution as a result of the agriculture production in the vegetation season. The local shallow groundwater contamination is indicated also near contaminated sites.

Acknowledgement: We acknowledge the funding from ENI project with eMS code BSB27 MONITOX (2018-2021), Joint Operational Programme Black Sea Basin 2014-2020.

S1.06. Ecological risk assessment of heavy metal pollution in sediments from Romanian MONITOX network

Liliana Teodorof[1], Adrian Burada[1], Cristina Despina[1], Daniela Seceleanu-Odor[1], Cosmin Spiridon[1], Antoaneta Ene[2*], Elena Zubcov[3], Thomas Spanos[4], Oleg Bogdevich[5]

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The Ecological Status of sediments in MONITOX network area was established using different indices. In spring 2019, during national trip, it was collected 32 sediment samples in the system of Danube river - Black Sea, as follows: Lower Danube RO-BG (1), Lower Danube RO (10), Lower Prut RO-MD border (2), Danube Delta RO-UA border (7), Danube Delta –RO (2), Black-Sea area-RO (10). The heavy metals (Cd, Cr, Cu, Pb, Zn, Mn) were extracted using the microwave oven Anton Paar and analysed using ICP-MS Elan DRCe Perkin Elmer. In order to comprehensively understand the contamination of heavy metals in the sediments, there were calculated the Single Ecological Risk Index (E_r^{Me}), Contamination Factor (CF^{Me}), Enrichment Factor (EF^{Me}), Geoaccumulation Index (I_{geo}^{Me}). The selected heavy metals concentrations were integrated together with the standard quality levels, background concentrations in 3 indices: Ecological Risk Index (RI), Global Pollution Index (PLI) and Nemerow Pollution Index (PI_N). All indices were reported to the corresponding quality classes. Ecological risk factor of heavy metals, (Er^{Me}), quantitatively calculated to express the potential ecological risk, have values corresponding to low ecological risk for sediments ($Er^{Me}<40$).

All the sediments are deficiency to minimal enrichment with Cd, Cu, Pb, Zn ($EF^{Me}<2$). The sediments from Black-Sea area, have the $EF^{Me}<1.5$, suggest that the trace metal concentration may come entirely from natural weathering processes. The sediment from Lower Danube RO-BG presents moderate enrichment with chromium and significant enrichment from Lower Danube RO, due to anthropogenic activities.

The contamination factor (CF^{Me}), considered to be a simple and effective tool in monitoring the heavy metal contamination, has values corresponding to low pollution level with Cd, Cu, Pb, Zn ($CF^{Me}<1$). For Cr, the sediments from Lower Danube RO-BG and Black Sea area-RO have low pollution level and the others have moderate pollution level ($1 \leq CF^{Me}<3$). According with Geoaccumulation Index for Cd, Cr, Cu, Pb, Zn, all the sediments are unpolluted ($I_{geo}{}^{Me}<0$). At the integrated levels, taking into accounts the Risk Index, the heavy metals have low ecological risk for sediments (RI<150). The values of Global Pollution Index indicate that the sediments are unpolluted with heavy metals (PLI<1) and from Nemerow Pollution Index values, it results that the sediments are not contaminated with heavy metals ($PI_N<1$).

At individual level, but also at integrative level, the sediments from the Black Sea area have the minimum contamination with heavy metals and the sediments from Lower Danube RO area have the maximum contamination, fact possible attributed to the historical pollution resulting from anthropogenic activities.

Acknowledgement: We acknowledge the funding from ENI project eMS code BSB27 MONITOX (2018-2021), Joint Operational Programme Black Sea Basin 2014-2020.

S1.07. Variations of heavy metals contamination in bottom sediments in the maritime sector of Danube River

Cristina Despina[1*], Teodorof Liliana[1], Daniela Seceleanu-Odor[1], Adrian Burada[1], Mihaela Tiganus[1], Cosmin Spiridon[1], Marian Tudor[1], Antoaneta Ene[2], Christina Chatzichristou[3]

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Bottom sediments of the Danube River provide large information on the history of riparian human interactions with surrounding environments. This study investigated heavy metals (Cd, Cr, Cu, Mn, Ni, Pb, Zn) variations in bottom sediments samples collected in 2019 from the maritime sector of the Danube River, over a length of 175 km. The survey covered 25 sampling points and included the river bed of the

Danube, upstream and downstream the main urban agglomerations, such as Fetesti, Cernavoda, Braila, Galati, Tulcea and also the river beds of the Danube three arms, Chilia, Sulina and Sf. Gheorghe, up to its discharge into the Black Sea.

Due to the geographical location, in the catchment area, the investigated sector of the Danube is one of the most vulnerable area along this river. In addition, apart from the multiple pressure sources coming from increased urbanization and industrialization along the 10 countries that Danube River is passing though, navigation poses a significant pressure on this large river, as the main transport route to the Black Sea.

Inductively coupled plasma mass spectrometry technique combined with microwave digestion system was used to assess the variations in heavy metals content of the sediment. The results of the study highlighted the negative effect of the urban agglomerations on bottom sediment with higher level of contamination downstream the urban sections of the river.

Acknowledgement: We acknowledge the funding from ENI project eMS code BSB27 MONITOX (2018-2021), Joint Operational Programme Black Sea Basin 2014-2020.

S1.08. Spatial distribution of heavy metal concentrations in the coastal sediments of Romania

Adrian Burada[1*], Cristina Despina[1], Daniela Seceleanu-Odor[1], Mihaela Ţigănuş[1], Cosmin Spiridon[1], Liliana Teodorof [1], Antoaneta Ene[2]

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In the context of major concern on the heavy metals role in affecting marine coastal ecosystems, this study was undertaken to evaluate the contamination degree with cadmium, chromium, copper, manganese, nickel, lead and zinc in order to assess the environment quality in the coastal area of Romania.

Sediments samples were collected in 2019 from 6 stations starting from Gura Portitei area in the north until Mangalia in the south.

Analytical method used for trace elements determination and quantification was inductively coupled plasma mass spectrometry (ICPMS).

The obtained results showed differences in spatial distribution of the heavy metal concentrations depending on the element, the characteristics of the sediment and the influence of anthropogenic sources. Thereby, higher metals content was determined, in general, in the coastal area around seaports, shipyards (Mamaia, Mangalia) and can be attribute to anthropogenic waste, caused either by cities and coastal industries, seaport activities or inputs of untreated sewage in the target area. Also, there were noted some accumulation trends in the Portita sampling point, in the case of some elements.

The information resulting in this study can lead to the observation of the key pattern of metals accumulation in the investigated ecosystems.

Acknowledgement: We acknowledge the funding from ENI project eMS code BSB27 MONITOX (2018-2021), Joint Operational Programme Black Sea Basin 2014-2020.

S1.09. Assessment of longitudinal variation in nutrients load in lower sector of the Danube River to its flow into the Black Sea

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This paper considers the assessment of surface water quality, from nutrients point of view, in the line with the provision of the Water Framework Directive, in the Romanian sector of the Danube River between Calarași-Silistra area up to its 3 flowing mouths into the Black Sea.

A monitoring campaign, conducted in 2019 over 25 sampling points along the Danube River, established the longitudinal variation in nutrient loads, including inputs coming from a large urban agglomeration along the studied area. Analytical determinations of

ammonium nitrogen, nitrite nitrogen, nitrate nitrogen, total nitrogen, orthophosphates phosphorus and total phosphorus were performed in a certified laboratory using molecular absorption spectrometric methods. These indicators provide relevant information on the degree of water contamination and the presence of untreated or improperly treated wastewaters.

Results showed differences between total nitrogen concentration and the sum of nitrogen inorganic forms, indicating an increased load of organic matter. However, the values determined for nutrients, both nitrogen and phosphorus compounds, in the studied period, generally framed into the target limit of good ecological status according to current legislation. Data collecting in this study also reflect the regional pattern of nutrients conditions in surface water of the lower sector of the Danube River.

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S1.10. Organochlorine pesticides in water and bottom sediments of the Dniester River ecosystem

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Assessment of the dynamics of polluting and toxic substances in surface waters and bottom sediments of river ecosystems is one of the indicators of an integrated load of the Dniester river basin, Dniester estuary and the Black Sea. In the current work, joint data from the section of the Middle and Lower Dniester are presented. On the territory of Moldova, samples were collected downstream of Dniester hydroelectric station 2- at villages Naslancea, Valcinet, Soroca, Camenca, Erjova, Goieni, Cocieri, Vadu-lui-Voda, Varnița, Sucleia,

Palanca, in Ukraine - at village Mayaki, from a distance of 15.4 km away, from the flowing of Dniester river in Dnestrovsk estuary, during the period December 2018 to August 2019. Chemical analysis was carried out by methods adapted to ISO standards using modern equipment (Agilent 7890B and others), certified in Ukraine and Moldova, part of material was analyzed in Sweden as part of the Visby Project Scholarship for PhD exchange studies, 2018-2019 year at University of Agricultural Sciences (SLU), Uppsala, Sweden (1).

The studied organochlorine pesticides (OCPs) (α, ß, and γ isomers of HCH, DDT and its metabolites DDE, DDD, aldrin, dieldrin, heptachlor, hexachlorobenzene, etc.) belong to a particularly dangerous group of compounds of persistent organic pollutants (POPs). The most toxic of this group are dichlorodiphenyltrichloroethane DDT and HCH (Lindane), which ranked on top list in terms of production and use in agriculture even until the 1980s [2]. The widespread use of OCP in the last century has led to the accumulation of these compounds in water bodies and in the streams, soils, animals, and plants. One of the fundamental physicochemical processes in aquatic ecosystems that reduce the migration of pesticides is the adsorption of pesticides by suspended solids, their deposition and accumulation in bottom sediments.

Over the past 2 years, the γ-HCH isomer (Lindane) has not been detected in the middle section of the Dniester, but was found in all samples in the lower Dniester - near Mayaki in the range of 0.17 to 2.12 ng /l, and during February its concentration was 10 times higher and exceeded the environmental quality standard (EQS = 0.20 ng / l). The concentrations of the ß - HCH isomer varied from analytical zero <0.05 ng / l to 1.55 ng/l, the average value was 0.55 ng/l. No content of the α - HCH isomer was detected in all water samples. The total content of DDT and its metabolites in the lower Dniester was in the range of 3.28-19.42 ng/l and did not exceed EQS.

In the silts of the Middle Dniester, the highest concentration of HCB was found at Soroca (0.98 ng g-1 dw). DDT and its transformation products were found in all samples of silts. The concentrations of ∑6DDT ranged from 1.1 to 52 ng g-1dw with maximum values at Goieni p, p'-DDE and p, p'-DDD were the predominant compounds and constituted 56% and 26% of ∑6DDTs in the Middle and Lower Dniester River within the Moldova [1]. In the bottom sediments in the lower Dniester, the concentration of the γ -HCH isomer was 0.25-1.02 μg/kg, which exceeded the environmental quality standard by 5 and 20 times (EQS = 0.05 μg /kg), ß- isomer HCH (was detected only in March -0.24 μg/kg of the α-HCH isomer, not detected. DDT content in the silts varied in the range of 1.52-10.90 μg/kg), which exceeds 4 times the EQS (EQS = 2.5

µg/kg),DDD (9.68 µg /kg) was almost 4 times higher than EQS. The concentrations of dieldrin and heptachlor of 5.4 and 6.13 µg/kg, exceeded EQS by 10, 8 and 2.5 times respectively.

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S1.11. The dynamics of the Prut river flow (in the limits of the Republic of Moldova)

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The Prut river is one of main tributaries of the Danube. Being a transboundary river (length - 967 km, basin - 27540 km^2), it begins from the Ukrainian Carpathians and flows through Romania and the Republic of Moldova forming a natural border between these two countries. Present research is dedicated to assessment of general dynamics of the Prut river flow in the Moldova limits. The Prut river flow is regulated by the Costesti-Stanca reservoir, built in the beginning of '80 of the last century (length – 70 km, total volume 1,400 mil. m^3), its hydropower plant is jointly operated by Romania and Moldova. The Prut river flow measurements are performed at Sirauti (1990-present, basin area - 9230 km^2) situated upstream reservoir and at Ungheni (1956-present, basin area -15200 km^2) positioned in the downstream. At Sirauti station the following hydrological characteristics are calculated: average flow - 72.2 m^3/s, runoff - 247 mm, volume 2.26 km^3. Seasonal flow distribution is: winter - 13%, spring -35%, summer - 35%, autumn -17%. At Costesti-Stanca station (measuring the outflow from reservoir) the hydrological

characteristics are: average flow - 76 m^3/s, runoff - 203 mm, volume 2.4 km^3. Seasonal flow distribution is: winter - 15%, spring -30%, summer - 36%, autumn -20%. At Ungheni station, before the Costesti-Stanca reservoir construction, the hydrological characteristics were: average flow - 86.6 m^3/s, runoff - 180 mm, volume 2.73 km^3. Seasonal flow distribution is: winter - 12%, spring -38%, summer - 33%, autumn -17%. After hydrotechnical structure construction the flow is as follows: average flow - 80.4 m^3/s, runoff - 167 mm, volume 2.54 km^3. Seasonal flow distribution is: winter - 17%, spring -29%, summer - 35%, autumn - 19%. Thus, the average flow and volume increase with the basin area, main water resources are formed during spring and summer (70%), however, the reservoir contributes to a distribution of flow from spring months to summer - winter months.

S1.12. Characteristics of the main aquifer complexes and horizons. Case study – the Republic of Moldova

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Main hydrogeological subdivisions are the aquifers complexes and horizons differentiated according to different criteria. The purpose of present research is assessment of characteristics of the main aquifer complexes and horizons in the limits of the Republic of Moldova. The data sources used for present research are the State Fund on Subsoil Information, laboratory investigations, cartographic and bibliographic sources on the groundwater monitoring data. Short description of aquifers complexes and horizons is provided below. The Holocenic Aquifer (aA_3) is characterized by the presence of sands, often with gravel inclusions. The thicknesses of the rocks is 20-30 m. The flow of the wells is equal to 1-2 l/sec. The aquifer rocks of the Pontian horizon (N_2p) are granular sands. Their depth varies from 2-40 m to 5-120 m to the southwest, and the groundwater depth - from 1-5 m to 50-90 m. The Upper Sarmatian-Meotian aquifer (N_1S_3-m) is formed from fine-grained sands, siltstone with intercalation of clays. The thickness of the aquifer rocks varies from 20.0 m to 300 m (in the south part). The Middle Sarmatian aquifer (Congerian) (N_1S_2) comprises the congerian sands of the Middle Sarmatian. Rocks are fine-grained sands with intercalation of clay, sandstone and limestone. The aquifer horizon thickness ranges from 5-15 m to 20-30 m. The Badenian-Sarmatian aquifer (N_1b-s) is

developed everywhere. The aquifer rocks are the reef limestone, with intercalation of marls and sands. The thickness is 30-50 m, in some areas increasing up to 100-500 m. The hydrogeological conditions of the country are determined by the geological structure of the territory, the tectonic conditions, the anthropogenic, climatological, geomorphological factors, through which aquifer structures with a high degree of complexity have been generated.

S1.13. Approaches to creating the information system for the analysis of monitoring results in the framework of the MONITOX program

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The study of spatial information includes interaction with data sets and maps related to solving a specific issue, which is best implemented in geographic information systems (GIS). A some set of digital spatial information constitutes spatial data. They consist of two interconnected parts that form a description of the spatial position and thematic content of the data; positional (topological-geometric), and non-positional (attributive). One of the basic (elementary) types of spatial objects that modern GIS operates with is usually considered a point (point object) - a 0-dimensional object characterized by plan coordinates. Depending on the type of object, its location is determined by a pair (triplet) of coordinates organized in a certain way within the framework of some data model. The list of properties corresponds to the attributes of an object, its qualitative and quantitative characteristics. The conditions under which an entity is displayed as a point object can be expressed by the following provisions:

- spatial arrangement of the entity (*is important*);
- metric dimensions of the entity (*are not important*);
- the size of the object is not expressed in the scale of the model.

An important property of turned objects is that they are independent of each other. Attribute data in a GIS provides a link between the location of a symbol and its meaning. Most often, this is a *Character*, *Number* and *Date*. All the described properties are possessed by the objects that are used in the implementation of the MONITOX project, and in particular the creation of a system for monitoring environmental pollution.

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S1.14. The characteristic of stable isotope composition of the precipitation for the evaluation of water cycle in transboundary region of Romania, Ukraine and Republic of Moldova

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The stable isotope technique is a perspective method for the evaluation of the water cycle in the water resource formation. It is important for regions with the treat of the water scarcity. The evaluation of the recharge mechanism of the transboundary groundwater aquifers is a very important in this region. The stable isotope composition of H^2 and O^{18} in the precipitation was analyzed from five meteorological stations from the Republic of Moldova in the period 2007 – 2015 years, which are in GNIP network. The analysis was made in Isotope Hydrology Laboratory of IAEA by stable isotope analyzer Pikarro2140i. The obtained results were compared with neighbouring countries GNIP stations. The importance of stable isotope analysis of all water objects as precipitation, river and groundwater was demonstrated. Spatial and temporal variations of stabe isotopes in hydrological systems are the result of isotope fractionation that accompanies physical, chemical and biological processes taking place in nature. Season variation of stable isotope ration was analysed. The local meteoric water lilines (LMWL) for every stations were compared with global meteoric water line (GMWL). The spatial trend was determined in the stable isotope ration from north to south part of the country. The study of the stable isotope relation between precipitation, rivers and groundwater is important for the water balance evaluation and water management purposes.

S1.15. Prediction of heavy metals in fish from the Black Sea Basin, using machine learning technique

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The presence of toxic metals such as Zn, Fe, Cu, As, Pb and Cd in water systems pose a threat to the aquatic fish fauna, due to their persistance, bioacumulation and biomagnification potential. The constant monitoring of the aquatic environment is important in order to avoid any risks associated to human health related to consumption of contaminated fish. Elevated levels of heavy metals have been reported around industrial centres, large cities and ports in the Black Sea Basin. Fish are suitable bioindicators of metal pollution due to their capacity to accumulate higher metals concentrations in their tissues. Therefore, the aim of the pressent study was to develop a prediction model that can accurately estimate the concentrations of heavy metals in different fish species from the Black Sea (*Alosa immaculata*) and from Danube River (*Silurus glanis*, *Cyprinus carpio*, *Carassius gibelio*, *Esox lucius*, *Leuciscus aspius*, *Abramis brama*), using the machine learning tehnique. The data base used for the model developement consisted of numerical values of metal concentrations in fish meat and liver. The independend variables were values recorded for Ca, Mg, Na and K concentrations and the dependend variables were Zn, Fe, Cu, As, Pb and Cd. The algorithms were selected from sklearn.ensemble, sklearn.tree and seaborn library. In this study, 4 algorithms were used: decision tree, random forest, boosting regressor and bagging regressor. The algorithms bagging and boosting regressor scored the lowest values of the RMSE, when

predicting the dependent variables in fish muscle and liver. The machine learning algorithms are suitable to predict heavy metals in both fish muscle and liver, and thus, represents a cost efficient, alternative, sustainable technique for the determination of heavy metals in the aquatic environments.

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S1.16. Natural radioactivity and risk to population in selected recreational and beach sites from Black and Aegean Seas in Romania and Greece

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This work presents selected results obtained for nuclear dose rates measured in the period 2019-2020 in outdoor spaces in various target areas of the project BSB27 MONITOX in Romania and Greece, Black Sea and Aegean Sea coasts (recreational sites and beaches): Constanta, Mamaia, Navodari, Vama Veche, Corbu, Vadu, Sulina, Sfantu Gheorghe (RO), and Kavala, Nea Iraklitsa, Nea Peramos (Kavala Prefecture) and Sotiras, Chrissi Amoudia - Thassos island (GR).

The average outdoor gamma radiation dose rates at Black Sea, Romania, range between 71 nGy/h (Vama veche beach) and 195 nGy/h (Corbu) and at Aegean Sea, Greece, between 120 nGy/h (Chrissi Amoudia beach) and 394 nGy/h (Nea Peramos beach).

The calculated average for each site was compared with limit stipulated by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

Activity concentrations of the natural radioactive isotopes from uranium (^{238}U,^{235}U) and thorium (^{232}Th) series and ^{40}K in samples of sands and sediments were determined by high resolution gamma-ray spectrometry technique at Laboratory of Experimental Nuclear Physics and Dosimetry, INPOLDE research center, Dunarea de Jos University of Galati, Romania, using an ORTEC-AMETEK spectrometer with HPGe detector. Based on the activity values, the hazard risk was calculated using the total outdoor absorbed dose rates at 1m above the ground surface due to γ-rays emission in air from ^{226}Ra, ^{232}Th, and ^{40}K and compared with the equivalent dose obtained from the direct outdoor measurements.

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S1.17. Active measurement methods of indoor radon and thoron in selected spaces in Galati town

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The paper presents a review of results obtained in the period 2019-2020 during complex studies performed in the frame of international projects by team of Dunarea de Jos University of Galati, regarding the investigation of indoor radon (222-Rn) and thoron (220-Th) concentrations and their temporal variations in selected dwellings and public spaces in Galati town, SE Romania.

For the measurements a Thoron Scout calibrated instrument of SARAD type has been used. The data were processed with the aid of SARAD Radon Vision 6.3.4 software. The variability of radon/thoron levels in a house or public space greatly depend on several the factors,

such as: construction material, location, ventilation of the space, existence of basement, floor level, measuring time, geological features, etc.

The obtained values are compared with the world average value reported by UNSCEAR and published values for dwellings in Romania and other countries. It is known the fact that the exposure of human beings to ionizing radiation from external and internal natural sources, is 2.4 mSv y^{-1} and from this 1.2 mSv y^{-1} is due to indoor radon. The obtained results show that the radon concentration in several houses, built from slag bricks or adobe, exceeds the legislated limit for the average annual reference level (300 Bq m^{-3} set by Romanian legislation, Law no. 63/2018).

Utilization of the active detectors is very advantageous by offering a graphic with the hourly variations of radon/thoron concentration in air over a long period, based on which there could be identified the intervals in which the supplementary aeration of spaces would be necessary.

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S1.18. Monitoring outdoor radiation doses in areas of the Black Sea and Aegean Sea Basins

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This work presents a synthesis of results obtained through modelling of real time monitoring data provided by EC for nuclear dose rates measured in April-May 2020 in outdoor environments, in various

sites in Black Sea and Northern Aegean Sea basins (Romania, Bulgaria, Turkey, Greece), including some target areas of the project BSB27 MONITOX. Results highlighted for each targeted spot an hourly and daily variation of the outdoor gamma dose rate.

The calculated average values obtained for each location of outdoor gamma radiation dose rate are the following: 77 nGy/h (Sf. Gheorghe), 95 nGy/h (M.Kogalniceanu, Constanta), 106 nGy/h (Mangalia) at Black Sea, Romania; 89 nGy/h (Kaliakra), 104 nGy/h (Varna) at Black Sea, Bulgaria; 50 nGy/h (Sinop), 98 nGy/h (Izmir) at Black Sea, Turkey; and 56 nGy/h (Thessaloniki), 83 nGy/h (Komotini), 91 nGy/h (Keramoti), Aegean Sea basin, Greece.

The results of modelling the temporal variations will be used for the target regions as a base in further investigations and preparation of maps of terrestrial gamma dose rates and calculation of the health risk for population in the frame of MONITOX project.

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S1.19. Radioactivity measurement of Danube River sediments in Romania by gamma-ray spectrometry

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This paper presents the radioactivity measurement of Danube River sediment samples collected during 2018 by the National Institute of Hydrology and Water Management from the Giurgiu-Isaccea sector and Danube Delta branches (22 samples). Activity concentration of natural radionuclides from ^{238}U-^{226}Ra and ^{232}Th radioactive series, ^{235}U, and ^{40}K, as well as ^{137}Cs man made radionuclide were determined by gamma-ray spectrometry at the Horia Hulubei National Institute of Physics and Nuclear Engineering. Mass fractions of U, Th, and K were

also assessed. The results are compared with previously obtained data on Danube sediments collected in expedition campaigns between 1991 and 1997, as well as literature data.

S1.20. Monitoring of oligoelements in water ecosystems

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Currently, the research of the migration of trace elements is of particular interest for hydrobiology, ecology and hydrochemistry. This growing interest is due both to deciphering biochemical processes, determining the role of trace elements in the functioning of living organisms, their importance in the functioning of ecosystems, and through the technical progress made in determining these elements. Particularly, the development of adsorption and atomic emission spectrometry greatly increased the knowledge of trace elements in the living environment and organisms. Thus, the need to determine trace elements is motivated by a large number of theoretical and practical problems.

To understand the functioning processes of aquatic ecosystems, it is necessary to investigate the migration of trace elements in the multilateral systems "water-suspensions-bottoms sediments-hydrobionts", "water-phytoplankton-zooplankton-fish" and to decipher the ecotoxicological processes and the role of these elements in the life of aquatic organisms. The study of processes and level of accumulation of metals in fish, molluscs, both as aquatic organisms and food products, which can affect human health, is also of a high value.

It is extremely important to study, together with the trace elements with toxic effects (Hg, Cd, Pb, As), the level, migration, accumulation processes, positive and negative effects of other elements, which role in the functioning of aquatic ecosystems is less known, such as are Bi, Se, Sr, Ba, Cr, Ni and others.

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S1.21. HCH and DDT residues in sediments from rivers in Moldova

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Organochlorine pesticides (OCPs), such as dichlorodiphenyltrichloroethane (DDT), and hexachlorocyclohexane (HCH) are categorised as persistent organic pollutants (POPs). They have been of great concern because of their bioaccumulation and toxicity to non-target organisms, persistence and long-range transport into environment.

These chemicals can enter aquatic environments through agricultural runoff, effluent release and atmospheric deposition and other ways. Due to lower water solubility, POPs tend to sorb on the suspended particles and, through the sedimentation process, accumulate on the bottom of water body. POPs can be uptaken by bottom organisms and biomagnified over the food web. Therefore, the investigation of POPs in sediments can provide a valuable information about pollution in the region and possible toxic effect on aquatic organisms.

Surface sediment samples (0-5 cm depth) from the Prut and Dniester rivers were analysed for *o,p'*- and *p,p'*-DDT and their transformation products (DDE and DDD), and four isomers of HCH (α-, ß-, γ-, δ-HCH). The total DDTs average concentrations for 2016-2018 (summer period) in the sediments ranged between 5.1 and 46 ng g^{-1} dry weight along the Dniester River, with highest values found along the Dubossari reservoir. The average values for the Prut River were several orders of magnitude smaller than those found in the Dniester and varied between 3.0 and 28 ng g^{-1} dry weight, the highest values being found at Leuseni and Sculeni sampling sites. In both rivers *p,p'*-DDE was the predominant compound comprising on average 40% from all analytes, followed by *p,p'*-DDD (28%), which reflects the degradation of historical DDT input in other environmental matrices.

Among all four HCH isomers analysed in this study, only α- and ß-HCH were present in sediment samples, with the predominance of ß-compound, indicating on HCHs degradation over long-term aging. Although HCHs were applied in the agricultural purpose in the past with the same intensity as DDT, the residues of HCHs were less abundant comparing with those of DDTs. In the Dniester and Prut Rivers the

average HCHs concentrations ranged from 0.067 to 1.7 and from 0.11 to 1.1 ng g^{-1} dry weight, respectively. Low values can be explained by that fact that HCHs, compared to DDTs, have higher water solubility, higher vapour pressure, greater biodegradability and lower lipophilicity.

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S1.22. Modeling the spatiotemporal distribution of microplastics in Kavala Gulf

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Microplastics, their sources, loads and distribution in the marine environment are important topics in current marine research. In this work, a three-dimensional hydrodynamic numerical model was implemented to assess the dispersion and distribution of microplastics in Kavala Gulf. The two wastewater treatment plants (WWTP) of Kavala and Palio were considered as the main sources and inflow data in terms of wastewater discharge and microplastics concentration were provided by DEAYAK. The simulation had a duration of a year, taking into account the seasonal variability in the circulation pattern, the meteorological forcing and the operational parameters of both WWTPs. Results showed that the contribution of Kavala's WWTP is at least one order of magnitude higher than that of Palio, for the entire year, with the exception of touristic months (June and July). In winter, the higher microplastic concentrations are simulated in Kavala main port and in the nearby coastal zone, due to the influence of eastern and northeastern winds keeping the plume attached to the coastline of the western Kavala Gulf. From early spring to early summer, north and northeastern winds transport the plumes as far as Keramoti. In the same time period the plumes from both WWTPs contribute to increase significantly the microplastics concentration in the small gulf of Palio where the most popular beaches are situated. In autumn, as a result of the impact of southern and western winds and the established anticyclonic circulation, the microplastics in the upper layers of the water column tend to disperse periodically towards the central part of the gulf. As a conclusion, it seems that the dispersion of the

microplastics inside the study area appears effected by the surface hydrodynamic circulation and presents a distinct seasonality that follows the wind climate pattern in the area.

S1.23. Identifying anthropogenic pressures exerting Contaminants of Emerging Concern (CECs) in the Nestos Delta lagoons catchment: link to ecosystem services

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Emerging pollutants or contaminants of emerging concern (CECs) are detected in the aquatic environment at low concentrations. They derive from anthropogenic sources and end up in our water ecosystems. These CECs and their transformation products are persistent, widely distributed and have been qualified as a risk to human health and environmental ecosystems which urgently needs to be addressed. To undertake such actions, an holistic catchment approach is necessary starting from the identification of point and non-point pollution sources related to CECs and linking them to Ecosystem Services (ES) provided by the system. Nestos Delta (ND) coastal lagoons are located in the northern Aegean Sea, at the western bank of Nestos River Delta (Greece). ND lagoons are important due to the recorded high biodiversity and significant economic value. They are part of Eastern Macedonia and Thrace National Park, Natura 2000 network (GR1150010), a Ramsar area and 4 of them (Vassova, Eratino, Agiasma, Keramoti) have been exploited (extensive aquaculture) since 1947.According to the River Basin Management Plan of Thrace the exerted pressures have impact both on the distribution of CECs and the ES provided by the study site, since they are also responsible for N, P and BOD that end-up in ND lagoons. Comparing these results to land uses provided by CORINE Land Cover (2018 reference year), we conclude that even though the area coverage is mainly agricultural (>65%), livestock, urban activities and tourism are the ones having high impact on CECs' distribution. Selection and quantification of the proper indicators of ES is required to develop policies related to water systems

management in order to maintain services' sustainability. Since the main pressures have been identified, the development of a DPSER model could provide a useful management tool to address practical measures to reduce anthropogenic impacts on the water system.

S1.24. Review of assessment methodology used for soil and sediments pollution by heavy metals based on single and multiple complex indexes

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The paper presents a review of methodology used for the assessment of soil and sediments pollution by heavy metals based on various single and multiple complex indexes, applied for selected sites in Romania. The study was focused on the contamination of agricultural soils located in industrialized areas, waste soils from industrial factories decommissioning and synthesis of the information for Danube river sediment data (database of Project MIS ETC 1676 - INPOLDE).

The *single pollution indices* were the following: Geoaccumulation Index (Igeo), Enrichment Factor (EF), Pollution Index (PI), Threshold Pollution Index (PIT), and Contamination Factor (CF), being calculated from the contents of each individual heavy metal in soils and used for the classification of soils into several classes according to the degree of pollution.

Total complex indices of pollution were calculated as multielement indices based on *single pollution indices*. Each type of total complex indices of pollution can be composed of the mentioned single indices separately. We present the calculation method of *integrated indices of pollution* and classes of pollution/contamination: Sum of Pollution Index (PI_{sum}), Average Pollution Index (PI_{Avg}), Integrated Pollution Index (IPI), Integrated Threshold Pollution Index (IPIT), Pollution Load Index (PLI), New Pollution Index (PIN), Nemerow Pollution Index (PINemerow), Degree of Contamination (C_{deg}), Modified

Contamination Factor (mC_{deg}), as well as *indices of ecological risk*: Potential Ecological Risk Index (PERI), Mean ERM Quotient (MERMQ), and Contamination Severity Index (CSI). Further work is scheduled for the assessment of health risk indices - Hazard Index (HI) (non-carcinogenic) and Risk Index (RI) (carcinogenic).

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SECTION 2. Water quality, human health and biodiversity

S2.01. Evaluation of groundwater quality through environmetrics. The case of Nestos and Strymon River regions, Northern Greece

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In the present study potable water samples were regularly collected from two geographical regions in Northern Greece. The two regions are close to the Nestos and Strymon Rivers. Throughout 2015, samples from 13 sites were collected and analyzed with a frequency of three times per each quarter for the following parameters: chloride, calcium, nitrate, potassium, electric conductivity and total hardness. The main objective of this study was to investigate the effects of the geographical region and seasonal influence on the above parameters regarding the limits given by the 98/83/EC Directive. The findings of the Linear Mixed Effects modeling revealed statistically significant main effects of both factors on the examined parameters.

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S2.02. Assessment of physical-chemical characteristics of surface water in Nestos River: a review

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Nestos River, whose springs are located in Rila Mountains in Southern Bulgaria, flows through Bulgaria and Greece and discharges into the North Aegean Sea creating its Delta. The Nestos Delta is one of the most important wetlands in Greece as well as in Europe due to its extent and diverse habitats. It is included in the Wetlands List of International Importance under the Ramsar Convention, belongs to the Natura 2000 Network as well as to the Special Protection Areas of the Birds of the European Union. It is also part of the Eastern Macedonia and Thrace National Park. Because of its importance during the last years, River Nestos has been monitored for several physical-chemical parameters and a large amount of work concerning water quality has been published. In the frame of this study, we present a review of academic / journal articles, conference papers, project reports, about physical-chemical characteristics of surface water from sites of the Nestos River in the Greek territory.

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S2.03. Indicator fish species and associations from the river ecosystems of different types

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The intensification of anthropic pressure and rapid climate change led to substantial changes in the structure of ichthyocenoses. The analysis of status of the populations of 'nucleus' species from a certain biogeographic region allows reconstructing the history of environmental conditions and highlighting the current limiting factors.

Thus, within the boundaries of the Republic of Moldova, the representatives of such families as *Petromyzontidae*, *Acipenseridae*, *Thymallidae*, *Salmonidae, Lotidae*, *Cottidae,* etc., have practically disappeared or are sporadically met. In addition to the typical reophilic and cryophilic taxa, the populations of species characteristic for the natural marshes (e.g. *Carassius gibelio*, *Tinca tinca*, *Umbra krameri*, *Misgurnus fossilis*), which were drained and supported a massive chemicalization in the 1950s - 1980s, have been affected.

The multiannual analysis of ichthyocenoses of small rivers from different areas of the Republic of Moldova demonstrated a greater diversity of species indicators of clean waters *(Barbatula barbatula*, species of the genera *Gobio* and R*omanogobio*, *Gymnocephalus cernuus*, *Rhodeus amarus*, *Neogobius fluviatilis*, *Squalis cephalus*, *Leuciscus leuciscus*, *Alburnoides bipunctatus*, *Cottus gobio*, *Phoxinus phoxinus,* etc.) in the north and central areas of the country. From our point of view, the higher degree of bank afforestation and the greater number of underground springs, which actively contribute to maintaining of a more favorable thermal and hydrological regime, is more important in the creation of this ichthyological picture than the lower level of pollution in these areas. The most representative species of small rivers, heavily affected by the human activity, are *Carassius gibelio*, *Rutilus rutilus*, *Perccottus glenii*, species of genus *Cobitis*, and even *Perca fluviatilis*,

which is able to form strong and long lasting associations under these conditions.

Also, there have been highlighted significant changes in the fish populations of medium and large rivers, such as Dniester and Prut, under the increasing anthropogenic threats, such as fragmentation and intense clogging of rivers, excessive development of aquatic vegetation, water pollution, illicit fishing, etc.

Previously, in the structure of ichthyocenoses of these rivers, the 'nucleus' species were members of migratory (*Huso huso*, *Acipenser stellatus*, *Acipenser gueldenstaedtii*, *Alosa immaculata*), semimigratory (*Rutilus frisii*, *Pelecus cultratus*, *Rutilus heckelii*) and potamodrommous (*Acipenser ruthenus*, *Vimba vimba, Ballerus sapa, Chondrostoma nasus, Barbus barbus, Squalius cephalus*) ecological guilds, most of them being litho-psammophilous and oxyphilous.

Nowadays, the dominance of ecological guilds of small and medium-sized, euryoxybiontic, eurythermic, omnivore and polyphilous species, with partial spawning and increased offspring care, occur. As a rule, the invasive (*Carassius gibelio, Pseudorasbora parva, Lepomis gibbosus, Perccottus glenii*), intervening (Neogobius *melanostomus, Neogobius fluviatilis, Neogobius gymnotrachus, Neogobius gymnotrachororus Synotrachus, Pungitius platygaster, Gasterosteus aculeatus, Atherina boyeri, Clupeonella cultriventris*), as well small and medium-sized opportunistic native species (*Rhodeus amarus, Alburnus alburnus, Perca fluviatilis, Rutilus rutilus, Blicca bjoerkna, Cobitis* complex) form the eudominant (D5) and dominant (D4) groups in captures from the natural aquatic ecosystems.

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S2.04. Microbiological quality and contamination level of water of Black Sea and Northern Aegean Sea

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The microbiological contamination of the water in the Black Sea basin is a direct effect of both natural and anthropogenic causes. The increase in nutrient and pollutant loads comes from rivers, such as the Danube, from industrial and municipal wastewater sources along the coast and from discharges into the sea. Thus, the Danube provides majority of the river inflow to the Black Sea and changes within the river basin are having effect on the presence and evolution of nutrients and pollutants in the sea. Due to the fact that a crucial issue throughout the rivers and especially in the Danube and Black Sea basin is the microbiological contamination with faecal bacteria resulted from anthropogenic activity, the assessment of the presence of pathogenic bacteria in water is a major concern for the protection of human and animal health. Coliform bacteria are indicators for the assessment of faecal pollution and a potential presence of pathogens, which is caused mainly of untreated wastewater.

In this study the rate of the microbiological contamination of the Black Sea and Northern Aegean Sea water collected in the BSB27 MONITOX project target sites, from SE part of Romania and NE part of Greece, was evaluated by counting of the bacteria indicators of the organic pollution (heterotrophic bacteria and the total coliforms). Total mesophilic aerobic bacteria from the analyzed water for Black Sea area (Romania), ranged from 1.11 x 10^2 to 1.70 x 10^4 CFU/mL and MPN of coliforms between 250 CFU/mL to 7000 CFU/mL. For area of Aegean Sea (Kavala, Greece) the MPN of coliforms were absent and the number of mesophillic aerobic bacteria was 1.50 x 10 CFU/mL.

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S2.05. Promoting sustainable water management in Palestine and Jordan through innovative education and cooperation between companies and universities

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Water is a rare commodity in the Middle East that requires sustainable management for the welfare of the region. Climate change in the region because of the higher temperatures and more intense rainfall events is expected to further compound the pressure on the current water resources. These new conditions will require a new generation of water managers to learn and utilize new and innovative methods and techniques to achieve water sustainability. This is why the WaSec project is developing science-based water management teaching and training material through the establishment of educational courses. The WaSec project is funded by the European Commission through the ERASMUS + Program. It involves 13 partners that include universities, a public organization and private companies from six countries (Cyprus, Greece, Jordan, Netherlands, Palestine and Spain). Five of the six countries are from the Mediterranean region and have extensive experience in water scarcity conditions. Specifically, ten courses are being developed: a) Water Quality, b) Integrated Water Resources

Management, c) Hydrology and Hydrogeology, d) Water and Wastewater Treatment and Reuse, e) Climate Change & Water Sustainability, f) Water Policy and Governance - Transboundary Basins, g) Water Energy Food Nexus, h) Entrepreneurship and Innovation in Water, i) Special Topics in Water Resources and j) Master Thesis. The courses developed will incorporate the latest and newest technologies on water management. In addition, the courses will utilize new pedagogical approaches with interactive exercises, use of videos, social networks, flexible learning path, blended courses etc., to enhance learning capacities. Another innovation of the project is the involvement of water professionals of the region. These professionals will provide feedback on the educational material developed since in many cases there is a gap between what is being taught in universities and what is needed by the graduates to be attractive in the job market. To get professionals involved, a Network with water professionals (universities, public organizations, companies and enterprises) for the Middle East has been established. This network will provide feedback on the new state of the art courses that will be developed and taught in Jordan and Palestine to enhance the knowledge, tools and skills of the graduates and increase their attractiveness to enterprises. Finally, another key goal is the active involvement of enterprises in the courses by providing real-life water case studies, presenting seminars on their projects or providing practical placement opportunities to further promote entrepreneurship. Overall, the graduates will have the scientific background but also the practical knowledge to implement sustainable water management under climate change conditions.

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S2.06. Chemometric analysis on arsenic contamination of surface water in Kavala Prefecture

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The presence of arsenic in water causes most of the problems in the environment, as it exhibits high mobility over a wide range of pH values and redox conditions. Several factors have been identified that affect the fate and transport processes of arsenic in groundwater and surface water, such as the presence of competing - synergistic ions. Manganese (Mn2+) and iron (Fe2+) ions are natural indicators of the presence of As ions. On the contrary, nitrate ions at normal concentrations in groundwater certifies the existence of oxidative conditions, which are not conducive to increase the concentration of arsenic in water. In the current research work, the correlation of arsenic concentration with the chemical parameters monitored in the surface water systems under the Water Framework Directive 2000/60/EC was investigated. Data and measurements of this study were obtained from the monitoring program of surface water systems of the Kavala Prefecture, an area with high concentrations of arsenic in groundwater. In order to investigate and model the relationship between the set of chemical parameters and As measurements, the Mixed Effects Models (MEM) were used, whereas we made use of ordination methods to graphically explore patterns in the multivariate set of the examined parameters.

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S2.07. Sampling and analysis of the stock of the *Sparus aurata* population in the wintering trenches of the Mesolonghi Lagoon, Greece

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This study describes the sampling of the species *Sparus aurata* from three selected wintering trenches in the lagoon of Messolonghi, Greece. *Sparus aurata* is an important commercial species, which lives and matures in the lagoon. In order to capture the fish, a net was placed in the trenches and the fish population was estimated using the Petersen and Schnabel methods. The index known as Catch Per Unit Effort (CPUE) was also calculated. The Petersen marks necessary for the population estimation using the capture-recapture methods (the Petersen and Schnabel methods), were placed on the operculum of the fish while they were anesthetized for safe handling. In the third trench the total length and total weight of the fish was also measured and the collected data was used to design the total length and weight scatter plot, the trend line, the equation and the equations coefficient. The frequency histogram of the total length and weight of the fish was also designed and the descriptive measures of the species total length and weight (mean, median, standard deviation, minimum, maximum and variance) were calculated. The results of the collected data give us an assessment and understanding of the fish stock of *Sparus aurata* in Messolonghi lagoon.

S2.08. Occurrence of heavy metals and quality assessment in drinking waters

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In drinking water, heavy metals can reach through domestic installations, and their presence in high concentrations can seriously damage human health. The heavy metals are naturally present in soil and water, some are considered indispensable for life, but, in high concentrations, those may become toxic; copper, zinc, manganese, iron, etc. are just a few examples. However, in low concentrations, some elements like cadmium, mercury, lead, nickel, and chromium are considered also toxic and are included in another category of heavy metals.

In present, the existing information about the occurrence of heavy metals in the water designed to be used by the urban population from Targoviste city, Romania is insufficient. In this respect, the present inquiry aims to provide a water-quality data set by using consistent sampling methods and analysis, correlated with health index risk data and potential influence on human health. In this study 360 samples from capture groundwater stations, which deserved the Targoviste city area were collected.

The measurements of water temperatures, pH, electrical conductivity, total dissolved solids, and salinity were performed using multiparameter equipment (Consort 3030). Alkalinity was determined by titration methods in order to quantify the carbonate species in the drinking water samples. The metals (Cd, Cr, Ni, Pb, Cu, Mn, and Zn) were measured in the drinking water samples using inductively coupled plasma-mass spectrometry (iCAP™ Q ICP-MS). The average concentrations of heavy metals were correlated with physicochemical indicators. The results indicate that for only one groundwater station the metals may pose a detrimental health risk to the exposed population.

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S2.09. Spatial analysis of shallow groundwater quality from rural areas

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In Romania, in rural areas, water from shallow groundwater is used for both drinking and irrigating the field crops. In this respect, irrigated agriculture depends on a good quality water supply. Currently, at the national level, there is no unitary approach to the quantitative and qualitative indicators of irrigation water. In order to assess the quality of the water, it is compulsory to carry out periodically complex physicochemical analyses, because the quality of the water is changed over time, under the influence of both environmental and anthropogenic factors. Romania has adopted a series of normative acts regarding the use of irrigation, such as the Convention for climate change and biological diversity ratified in 1994 at the Paris Convention (i.e., Law no. 111/1998).

In this study, 80 samples of shallow groundwater from rural areas were collected following the EPA Groundwater Sampling – Operating Procedure. The measurements of water temperatures, pH, electrical conductivity, total dissolved solids, and salinity were performed using multiparameter equipment (Consort 3030). Alkalinity was determined by titration methods in order to quantify the carbonate species in the drinking water samples. The metals (Fe, Mn, Cr, Pb, Ni, Zn, Al, Cu, and Cd) were measured in the drinking water samples using inductively coupled plasma-mass spectrometry (iCAP™ Q ICP-MS). The ions concentration (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, HCO_3^{-}, SO_4^{2-} , NO_3^{-}) were determined by ion chromatography (Thermo Scientific Dionex IonPac system with AS15/AG15 and CG16 /CS16 columns). The Water Quality Index (WQI) and National Sanitation Foundation Water Quality Index (NSDWQI) were calculated. On the other hand, the spatial maps of the

groundwater quality based on the suitability of water for ecology were achieved.

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S2.10. A study on drinking water quality in SE Romania

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The aim of this work is the study of drinking water quality indicators in selected localities in SE Romania (Galati, Braila, Faurei, Buzau, Focsani). Water samples were taken from sources of drinking water *(*tap water, well water, spring water, filtered tap water with biological filter), frequently used by the population (15 places). They were subjected to chemical and physico-chemical analysis in order to determine the physical, chemical parameters of quality that can affect the health of residents.

In five water sources (Independenta (tap), Independenta (spring), Lunca/Buzau, Liesti fountain at 40 m depth, Galati (biologically filtered tap) the pH is below 6.5, a value that does not fit into STAS acquis in force - SR ISO 10523-2009. Regarding the conductivity there are some values that exceed the limit 2.5 mS / cm SR EN 27888 ISO 7888-1997, such as: 6.99 mS / cm - Lunca / Buzau, 4.82 mS / cm - Independenta (spring), 3.95 mS / cm samples from Faurei – spring.

Total hardness expressed in German degrees varies from source to source and it is in strict correlation with TDS and its calcium and magnesium content. In the sample Galati - biological filtered tap water DT value (^{0}G) is very small: 3.36 and TDS is 125 mg/L. Tap water from Galati, Focsani, Faurei, Braila have DT in the 26.8 to 28 ^{0}G, common values and accepted by consumers and specialists in water analysis. SR ISO 6059-2008 indicates a minimum allowed value of 5 ^{0}G. Oxidability

index values in the major cases are below that the maximum allowed, 5 mg O_2 / L water according to SR EN ISO 8467-2001. But in some cases the values exceed the limits as: Independenta: 8 mg O_2/L; Lunca/Buzau: 10 mg O_2/L; Focsani/spring: 9 mg O_2 /L; Focsani/tap: 8 mg O_2 /L; Galati/tap: 6 mg O_2 /L.

Water is a fundamental and indispensable constituent of the human body. Small changes produce serious disorders and insufficient water intake is much less tolerated than in other deficiency.

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S2.11. Pharmaceutical residues monitoring in surface water in Romania. Status and concerns

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Although pharmaceuticals have been recognized as a potentially hazardous group of substances with respect to the environment, few monitoring studies have been performed targeting only certain classes of pharmaceuticals. Among this, nine samples from important rivers of Romania among which Danube, Siret, Prut, Prahova, Jijia river were investigated for pharmaceutical and antifungal residues in 2012. In a post target approach analysis, high resolution mass spectrometry (HRMS) was successfully applied for screening of 43 pharmaceuticals and fungicides in water. The study confirmed the presence of pharmaceuticals such as: diclofenac, sulfamethoxazole, carbamazepine, trimethoprim. Regarding the group of antibiotics, erythromycin was detected in three samples at a concentration of up to 15 ng L^{-1}. The antifungal compounds detected in the water samples were: fluconazole, thiabendazole, tebuconazole, enylconazole and carbendazim. It is also worth mentioning the concentration of diclofenac in drinking water of 50 ng L^{-1}, a concentration that exceeds the maximum allowable level for medicinal products for human use provided by EMEA/CHMP/SWP/ 4447/00(2006).

Analysis of samples collected from Danube river basin in Romania in 2014, were analysed for 67 compounds, pharmaceuticals and antifungals using HRMS technique. Concentrations of carbamazepine ranging from 20 to 49 ng L^{-1} and diclofenac lower than 20 ng L^{-1} in the Danube and a maximum of 252 ng L^{-1} in the Argeș River were measured. Five samples were collected form the Danube Delta. The analysis releaved concentrations of sulfamethoxazole between 4 and 6.5 ng L^{-1} and carbamazepine ranging from 7.5 to 21 ng L^{-1} in all samples. Tylosine was detected in one sample, the antifungals enylconazole and flutriafol in two samples. A concentration of 57 ng L^{-1} for griseofulvin was measured in Lake Gorgova in the Danube Delta.

In 2016 a monitoring study in the 8 fishing areas in Moldova region (eastern Romania). Diclofenac, sulfamethoxazol, trimetoprim, carbamazepine, cafeine, imazalil, thiabendazol were founded in concentrations ranging from 5 to 40 ng L^{-1}.

Given the increased interest for the micropollutants' fate in the aquatic environment and the lack of the data, contaminants of emerging concern including pharmaceuticals have to be monitored in Romania in surface water through future projects and programs, as otherwise recommended the European Union Directive 2013/39/EU and the Watch List of Decision 2015/495/EU, respectively.

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S2.12. Protect-Streams-4-Sea – A new Black Sea programme project

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To sustainably manage the Black Sea, the sources of pollutants and litter to the streams and rivers that contribute to Sea pollution need be identified and quantified. These sources are major contributors to the degradation of the Black Sea. The two main sources are surface erosion and stream bank erosion and their measurements will take place at different scales. For surface erosion initially gerlach traps and runoff plots will be installed and measured. The traps and plots will be placed under different land-use/vegetation covers and/or burnt areas or frequently flooded areas. Afterwards calibrated hydrologic models, will be applied to determine the potential pollutants sources at the watershed scale. These models will utilize the plot data. The models will estimate the potential that different land-uses (agricultural, grassland, forests, urban etc.) and natural disaster (e.g. wildfires and floods) have as contributors. Future contributions and pollutant levels will also be estimated by the models, by utilizing climate change forecasts (IPCC predictions). The focus will be on nonpoint source pollutants that cause eutrophication in closed seas. The most vulnerable areas to erosion will be located with the use of indices developed in a GIS environment with the use of satellite images. Finally based on the areas identified by the indices, drone mapping will be applied at a smaller scale for the different land use/vegetation covers to more accurately identify the areas that are most likely to have high surface erosion risk and collect litter. In regard to pollutants and litter from stream bank erosion, traditional (e.g. erosion pins, cross-section surveys) and innovative methods (e.g. laser scanning) will be used at

the plot scale along with the GIS Stream Bank Erosion Index that utilizes satellite images. Furthermore, drone mapping will be applied to capture more accurately the locations of litter gathering, sediment erosion or deposition. The use of drones for stream bank monitoring have not been utilized to its full extent. Overall, the surface and stream bank erosion methods applied at different scales will provide estimates of their potential contributions to the Black Sea. Riparian and watershed land-use/vegetation covers and natural disasters (floods and wildfires) impacts that are major factors on their potential contributions will be assessed.

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S2.13. UNESCO Chair Con-E-Ect: Mapping sustainability for riparian areas and deltas

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Riparian areas and deltas are ecosystems essential for the human welfare, since they provide many unique ecosystems services. In addition, the majority of the people are congregate in or adjacent to riparian areas and deltas. Finally, climate change is expected to severely impact these two ecosystems. Consequently, the conservation of these ecosystems is a main priority worldwide. Con-E-Ect is meeting its main objective through innovative research, dissemination activities, training and awareness events for various target groups. Through these activities, Con-E-Ect wants integrated water resources and ecohydrological principles, ecosystem based and ecotourism approaches, and nature-based solutions to be adopted by policy makers, water managers and stakeholders for the sustainable management of these ecosystems. Specifically, it is running a new MSc program titled Man & Water that aims to address water challenges by an integrated

perspective and under the prism of human interventions. This MSc will provide the new generation of researchers that will manage these ecosystems sustainably. The UNESCO Chair has or is establishing collaboration with other relevant UNESCO Chairs such as the: a) UNESCO Chair on World Heritage and Biosphere Reserve Observation and Education, Heidelberg University of Education, Germany, b) UNESCO Chair on Ecohydrology and Applied Ecology, University of Lodz, Poland and c) UNESCO Chair in Sustainable Mountain Development, University of the Highlands and Islands Perth College, UK. It has also built partnerships with municipalities of the region that have led to research projects such as the: a) Urban Riparian Areas, with the Municipality of Drama, b) Sustainable Ecotourism Development, with the Municipality of Avdira, and c) the Eski Kapou Restoration Plan, with the Municipality of Kavala. The chair finally is also participating in EU funded project such as a) WaSec, on sustainable water management in the Eastern Mediterranean region, funded by ERASMUS, b) Monitox, to improve joint monitoring of environmental toxic pollution in deltas, funded by the Black Sea Programme and c) Protect-Streams-4-Sea, to mitigate nonpoint sources pollutants from reaching streams to maintain a clean Black Sea, also funded by the Black Sea Programme. The awareness on the importance and best practices to conserve and maintain riparian areas and deltas in Greece and in the region has steadily increased.

S2.14. Sustainable urban riparian areas – The case study of Drama city

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The increase in human population and the congregation of people in large cities has made urbanization one of the major problems form natural ecosystems. This is particularly true for riparian ecosystems since many cities and towns are built along rivers and streams. Typically, riparian areas are degraded or eliminated in urban settings that also leads to their fragmentation. Connectivity is a key feature for the proper functioning of riparian areas. In contrast, if urban riparian areas are restored and manage sustainably, they can provide many ecosystem services, such as decreased water pollution, recreation and relaxation areas and opportunities to escape from their daily routine and even climate change impact mitigation. The objective of this project was to assess the current condition of the riparian areas and stream reaches than run through the city of Drama, Greece. To accomplish this, visual assessment protocols were utilized; the Stream Visual Assessment Protocol (SVAP) and the Riparian Forest Quality (QBR). These protocols are complementary to each other since one focus on streams (SVAP) and the other on riparian vegetation (QBR). Overall, the urban riparian areas that were visually assessed with both protocols, indicate strong alterations and poor quality. The urban riparian areas of Drama appear to be fragmented, face urban encroachment with many human infrastructures that have modified the stream channel and degraded the riparian vegetation and the frequent presence of garbage is very frequent found. The use of ecosystem-based approaches, ecohydrological methods and nature-based solution needs to be utilized for the more effective management of these urban riparian areas in order to maintain and/or improve the quality. Finally, the awareness best management practices for riparian areas needs to be reinforced and promoted to municipality officials.

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S2.15. Pontic shad (*Alosa immaculata* Bennett, 1835) from the Dniester River in the current ecological conditions

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In the last two decades, the most important spawning grounds for the reproduction of Pontic shad in the Dniester River are attested in Dubasari-Speia river sector, with a length of about 100 km. Reproductive migrations begin in March, at a water temperature of about 5 ºC, are the most intense at the temperature of 10–17 ºC (end of April - first half of May) and end at 22–24 ºC (end of June – beginning of July). Pontic shad eggs are bathypelagic, being spawned in several portions (up to three), usually during the night and in the morning. The mean absolute prolificacy is of 98.9 thousand eggs, ranging from 55.3 thousand eggs to 184.0 thousand eggs. After the construction of Dubasari dam, cases of spawning of all egg portions are rarely attested, and usually only a portion is spawned.

The determining factor for the laying down of all three portions of eggs is considered to be the favorable water flow over a long period of time (as in May-July of 2018 and 2019). Thus, in some females, captured in the first decade of July 2018, the ovaries were at stage IV3 of development, while the successful completion of the reproductive season, with oocytes at the stages VI-II of maturation, was found in others. In females of Pontic shad that managed to lay down the third portion of eggs, the ovaries contained both oocytes in the protoplasmic growth phase and oocytes in the early phase of trophoplasmic growth (D1). The gonadosomatic index reaches the value of 1.92.

The age structure of the breeding group of Pontic shad from the Dniester River demonstrates the presence of three age groups: 3, 4 and 5 years, with a numerical share of 2.3%, 32.7% and 65.0%, respectively. Comparative analysis of the sex structure of the Pontic shad from the Dniester River indicates that, with the age increase, the sex ratio shifts in favor of females (at 3 years – 49% ♀ / 51% ♂; 4 years - 81% ♀ / 19% ♂; at 5 years - 77% ♀ / 23% ♂).

The study of the growth rate revealed the 3 year old individuals reach a length of 17.0–18.0 cm and a weight of 64.0–101.0 g, those of 4 years - a length of 23.5–25.0 cm and the weight of 163.0–260.0 g, while

in 5 year old females there are two distinct pregnancy groups: with a length of 25.5–26.5 cm and with a weight of 190.0–220.0 g, and respectively the length of 29.7–32.0 cm and the weight of 270.0–410.0 g. In this way, currently two ecological forms of Pontic shad, which reach the sexual maturity in different periods, can be distinguished - with low growth rate and fast growth rate.

Scientific control fisheries, which were performed in May of three consecutive years (2017-2019) near the Olanesti village (Lower Dniester) with the floating net (mesh side dimensions of 30x30 mm, h – 3 m, l = 50 m, distance of trailing – 500 m), put in evidence the very weak reproductive migration of Pontic shad in 2018, in comparison with those from 2017 and 2019. For example, the fishing effort in 2017 was of 16.9 ind./trailing, in 2018 - only 6.05 ind./trailing, and in 2019 - 30.7 ind./trailing.

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S2.16. Water quality of the mouth of the Prut and Danube rivers according to microbiological indices in the spring of 2019

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Planktonic microorganisms are an integral component of all aquatic ecosystems and their role in the transformation of autochthonous and allochthonous organics is difficult to overestimate. Their quantitative development is a reliable indicator of both the trophic status, and the sanitary and biological state of the water body.

A quantitative analysis of the state of bacterioplankton at the mouth of the Prut River (Giurgiulesti) and in two branches of the Danube (Sulina and Sfântu Gheorghe) was done in the spring of 2019 (Table 1). The water quality of the lower part of the Prut River (Moldova) and the Romanian sector of the Danube delta was assessed based on the Moldovan *Regulation on environment quality requirements for the surface waters* (Government Decision no. 890/2013).

Table 1. Microbiological indices and sanitary-microbiological state of the lower sectors of the Prut and Danube rivers, spring 2019

Sampling point	Ntot (million cells/ml)	Nsapr (thousand cells/ml)	Bacterial index (Nsapr/Ntot), %	Water quality class*
Giurgiulesti	1.2	5.8	0.48	II-IV
Sulina	0.8	0.92	0.12	II-III
Sfantu Gheorghe	0.9	0.78	0.087	II-III
Sacalin island	2.7	0.69	0.027	II-III

* Water quality classes: II – good, III – moderately polluted, IV – polluted.

According to obtained data, the water quality in the studied sections of both rivers, at least during the observation period, was relatively good and varied, in most of cases, within II-III (good - moderately polluted) classes, and only sometimes – within II-IV (good - polluted) classes.

For comparison, in spring of 2014 and 2015 at Giurgiulesti, the total number of bacterioplankton (Ntot) ranged 0.7-1.40 million cells/ml (water classes I-II), and the number of saprophytes (Nsapr) – 0.26-4.24 thousand cells/ml (classes II-III). In the same period, at Vilkova sampling points (Danube, lower part of the Chilia branch), Ntot was of 3.0-8.0 million cells/ml (classes III-IV) and Nsapr – of 2.18-35.42 thousand cells/ml (classes III-IV). The bacterial index varied at Giurgiulesti from 0.04% to 0.30% (classes I-III) and at Vilkova -from 0.027 to 1.1%, that means the water quality oscillated between the very good and very polluted (classes I-V).

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S2.17. The response of zooplankton communities to the influence of pollutants

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Structural and functional indicators of zooplankton can be used in the system of environmental and toxicological monitoring, which still awaits due attention from environmental toxicology, designed to conduct research in natural ecosystems exposed to toxicological pollutants. The entry into the water body of toxic substances almost always has a negative, stressful effect on the ecosystem, leading to a deterioration of its condition or a transition from optimal to extreme ecological state. As many studies have noted (Pashkova, 2012; Vandysh, 2006; Braginskii et al. 1987), the reaction of zooplankton communities to toxic substances is fundamentally different in comparison with the action of an excess of nutrients or organic matter leading to eutrophication, during which, along with structural changes, intensification of the functioning of communities, increasing the biological productivity of the reservoir as a whole is observed.

As a result of the action of toxic pollutants, when structural parameters change, profound disturbances in the functioning of communities are observed, including their gradual degradation, loss of ecosystem functions, and community death under extreme toxic conditions. With the introduction of toxic substances in water, the total number of zooplankton species and its quantitative development decrease, as a result of which the quantitative structure of the community and the decrease in the species diversity index are simplified (Shurganova, 2014; Albanese et al, 2013). The decrease in species richness occurs mainly due to a decrease in the specialized stenobiont endemic and relict species, as well as species with large individuals and a long life cycle. At the same time, an increase in the number of euribiotic, cosmopolitan species and of small species and those with short life cycle is observed (Xiong et al. 2017, Yang et al., 2018).

As a result of toxicity, certain changes also occur in structural quantity of the communities: from the main taxonomic groups of zooplankton, the dominance passes from cladocerans to rotifers and copepods, which are more resistant to the presence of toxic substances. The resistance of rotifers to the toxicity of the aquatic environment is due to the high reproduction rate and the ability to lay dormant eggs protected by the thick capsule from adverse factors. From the copepod group, cyclopids have a special resistance to the action of toxic substances due to the chitinuous layer of the body,

pradotorism and sexual reproduction. Cladocerans and Calanoids are vulnerable to toxic substances due to their type of nutrition by filtering, thus quickly absorbing and accumulating dissolved and toxic organic substances. As a result, omnivorous and predatory consumers (Andronikova, 1996) begin to dominate among trophic groups instead of peaceful, non-predatory ones. In the process of toxicification, the rate of reproduction of zooplankton is significantly reduced due to a decrease in fertility and the speed of production processes - the daily P /B coefficients decrease on average from 0.22 to 0.14 (Pashkova, 2012).

In addition to the composition and quality of pollutants entering water bodies, it is important to consider the degree of intensity and duration of exposure to pollutants. One should bear in mind that during a prolonged supply of pollutants, some harmful substances accumulate in the bottom sediments, which over time pass in the the water. Therefore, the effect on planktonic organisms can occur without visible sources of pollution (Litvinchuk, 2019).

Representatives of zooplankton filtrators play a leading role in the transformation of matter and energy transfer along the trophic chain from phytoplankton to fish, which affects the functioning of the aquatic ecosystem. Vorozhun (2009) studied the rate of water filtration and the feeding of *Daphnia* with green algae, where it was found that the consumption of green algae by the species *Daphnia magna* decreased when exposed to an anionic surfactant. The suppression of the filtration activity of zooplankton by some water polluting substances is a certain danger, since as a result, the regulatory function of zooplankton in the aquatic ecosystems may decrease by a range of parameters. Assessment of the indicative capabilities of zooplankton in the diagnosis of the ecological and toxicological state of aquatic ecosystems is one of the promising areas of hydrobiological research.

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S2.18. Comparative analysis of acid-neutralizing capacity of rivers in the Republic of Moldova

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Anthropogenic acidification of the environment became a spread phenomenon in the twentieth century and continues today, affecting not only the hydrosphere, but also the lithosphere and biota. Surface water ecosystems are most exposed, as acidification affects all their components, including water, bottom sediments and hydrobionts. Acid precipitations alter the geochemical cycles of chemicals elements both in the catchment area and in water body. An increase in acidity has negative consequences for the aquatic ecosystem, such as a modification in the ionic composition of water, the transition of metals from a bound form to a free and, ultimately, a reduction of the buffer capacity of a water body.

The full buffering capacity is ensured by all components of water ecosystem: dissolved ions and suspended substances, bottom sediments and aquatic organisms. The accepted criterion for water acidification is acid-neutralizing capacity (ANC, mmol/L) proposed by Henriksen et al. (1992), which is calculated by the ratio of ions in the water, such as Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, SO_4^{2-}, NO_3^{-}, HCO_3^{-}, H^{+} and Al^{3+}. The disadvantage of Henriksen' method is that it does not take into account the acid-neutralizing capacity of suspended solids, organic acids (humic, fulvic), polypeptides, polyphenols etc. There is another approach: to give the

preference in the study of complex and multifactorial processes to modelling rather than to calculation method. Given this, for evaluation and comparison of the acid-neutralizing capacity of water bodies to anthropogenic acidification, the direct method of potentiometric titration with graphic processing of the obtained results was chosen. For a comparative analysis, water samples from the Prut and Dniester rivers were selected.

The Dniester and Prut rivers are the main waterways of the Republic of Moldova. Each of these river ecosystems has its own critical points and reference sectors, which were taken into account when sampling. On the Dniester River, the stations of Naslavcea, Soroca and Vadul lui Voda were selected; on the Prut River - stations Costesti (dam) and Cahul. Sampling was carried out in the winter season, which in the hydrological conditions of Moldova (very low water level) often becomes critical for the ecological state of the aquatic ecosystems.

The main components of a water body, which determine the values of such interrelated parameters as pH, alkalinity and ANC, are carbonates (CO_3^{-2}), bicarbonates (HCO_3^-) and hydroxide ions (OH^-). The titration curve for each of the processed samples has its own characteristics both in form and in the value of ANC (acid-neutralizing capacity), determined by the "pH inflection point". Biological effects of water acidification begin at the pH value < 6.5 (admissible *Lower limit* for fresh water ecosystems). The critical value of pH, below which the irreversible biological effects may occur, is considered that of 5.6. From the titration curves, the following values were obtained for the ANC parameter: 1.6 - 1.5 (mmol/L) at the acceptable pH value and 3.3 - 3.4 (mmol/L) at the critical pH value - for the Prut River; for the Dniester River - in a similar sequence: 1.4 - 1.9 - 1.1 (mmol/L) and 2.6 - 2.7 - 2.8 (mmol/L). In the worldwide hydrochemical practice, such ANC values are considered to reveal a high risk of water acidification.

The titration curves also allow estimating the total alkalinity (A_T): titration point at pH = 4.5±0.5. The total alkalinity in the Prut River samples was of 3.9 mmol/L (195 mg/L $CaCO_3$), and in the Dniester River samples varied within 2.8 and 3.0 mmol/L (140 - 150 mg/L $CaCO_3$). An alkalinity of less than 45 mg/L $CaCO_3$ is associated with a low buffer capacity. Thus, the hydro-chemical buffer system at the studied river sites, estimated by the parameter A_T, has a rather high capacity.

In conclusion, the acid-neutralizing capacity of the Prut River is higher than that of the Dniester River. The Costesti – Braniste section of the Prut River has a good capacity to withstand anthropogenic acidification. Downstream, this ability is slightly lower at the

acceptable pH level (6.5), but it is quite high at the critical level (pH < 5.6).

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S2.19. Chemical oxygen demand in the Prut river waters at Giurgiulesti port

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The investigations have been carried in the area of Giurgiulesti International Free Port (GIFP), located on the Moldovan maritime section of Danube. The researches have been done during vegetation seasons of 2015-2019 period. For determination of chemical oxygen demand by potassium permanganate (COD_{Mn}) the Moldovan standard SM SR EN ISO 8467:2006 was used, of chemical oxygen demand by potassium dichromate (COD_{Cr}) - SM SR ISO 6060:2006.

In given period the values of COD_{Mn} varied between 5 and 10 mgO_2/L in 81.8% of cases and were higher, up to 13.0 mgO_2/L, in all other cases. The annual mean values of COD_{Mn} oscillated slightly – from 7.3 to 9.2 mgO_2/L. In 31.8% of analysed water samples, the values of COD_{Cr} were of 15-30 mgO_2/L, but in 68.2% of cases, they were higher, up to 72.8 mgO_2/L. The annual mean values of COD_{Cr} differed more significantly – from 28.4 to 40.2 mgO_2/L, being the highest in 2017. No classic river seasonal trends of COD_{Mn} and COD_{Cr} were observed, because of strong anthropogenic impact.

The COD_{Mn}/COD_{Cr} ratio varied between 0.17 and 0.41, with the average of 0.26. In summer of 2016, high values of COD_{Mn} and relatively low values of COD_{Cr} were registered, resulting in a COD_{Mn}/COD_{Cr} ratio higher than 0.40, which indicates the prevalence of easily degradable organic compounds. Based on the Moldovan *Regulation on environment quality requirements for the surface waters* (2013), in most of cases, the Prut waters at the Giurgiulesti sampling point, according to the values of COD_{Mn} were characterised as moderately polluted (3rd water quality class), but to those of COD_{Cr} – as polluted (4th class).

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S2.20. Dams' impact in hydrology and freshwater ichthyofauna of River Nestos

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Anthropogenic interventions in the natural environment, from antiquity to the present day, have many forms. The construction of dams on river ecosystems is one of the oldest interventions. Regardless of their size, the impact of dams on river ecosystem are conspicuous on the hydrology and the ecology of rivers and on the fish populations that inhabit them. River Nestos is one of the biggest rivers in North Greece and originates from Mountain Rila in Bulgaria, covering an area of 5,749 km^2. Three dams were constructed along the drainage basin of the Greek part of Nestos, Thisavros Dam, the Platanovrysi Dam and the irrigation dam of Toxotes. The first two dams are located upstream, forming Thisavros and Platanovrissi dam-lakes. To evaluate the effects of the dams on hydrology, ecology and the ichthyofauna of River Nestos, samplings were carried out at different stations along the basin of the river, both upstream and downstream of the dams. At each station, water and fish samples were collected for further analysis. In total, 20 different fish species were identified in River Nestos, both in the main riverbed and its dam-lakes. The most abundant of those were *Squalius orpheus* (40.2% of total catches) and *Barbus strumicae* (35.1%). Regarding the water temperature, during summer a strong thermal stratification was observed in the dam-lakes, while in autumn the water column appeared to be relatively homogenous. During summer, downstream of the dams the water temperature was found to be 9 ºC lower than the temperature upstream of them. As for the chemical condition of the water, nutrient salts, such as nitrate, phosphate, ammonium and silicate, concentrations were found to be reduced in the surface layer of the dam-lakes, in contrast to the concentration of their

in the bottom layer. This has as result the alteration of their concentrations downstream of the dams. The reduction in biodiversity, which was observed in Platanovrisi dam-lake (8 species, in contrast to 12 species in Thisavros dam-lake and 17 in the riverine part of Nestos), could be caused by the isolation of the fish populations due to the dams' construction, in combination with the existence of small flood-gates, weirs, etc. These obstacles, especially Toxotes Dam, prevent the downstream and upstream spawning migration of *Anguilla anguilla* (European eel) and *Alosa fallax* (Twait Shad), respectively. In addition, the three dams prohibit the gene flow between the population of all species. The different temperatures that observed on both sides of the dams during summer, play an important role in the qualitative composition of the Nestos River fishfauna.

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S2.21. The presence of invasive fish species black bullhead (*Ameiurus melas*, Rafinesque 1820) in low Danube River, in ROSCI0012 Măcin branch

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In America, from Southern Canada to Guatemala, is found the native area of the black bullhead (*Ameiurus melas* Rafinesque, 1820), that is a member of the family Ictaluridae which contains four native species. The other three species are *A. nebulosus* (brown bullhead), *A. natalis* (yellow bullhead) and *Ictalurus punctatus* (Copp et al., 2016). Between *A. nebulosus* (brown bullhead) and *A. melas* (black bullhead), there are many confusions of identification due to similar taxonomic characteristics. This has led in several countries to doubts about which of the two species is present in natural waters. The black bullhead can be easily mistaken with the brown bullhead (Zogaris, 2017). In Europe, the species was brought for the first time in France in 1861, then in Germany in 1880 and 1885. The present European range comprises Albania, Belgium, France, Germany, Hungary, Italy, Ireland, Holland, Poland, Romania, Russia, Spain, Switzerland, Great Britain and

former Yugoslavia (Popa et al., 2006). In Romanian waters the first sighting of the black bullhead was in 1997, in Ier and Barcău rivers (Wilhelm 1998). After that, in 2018 in Someș river, six specimens of *A.melas* were captured and identified based on the pectoral spine morphology and other biological traits. This was the first report of *A. melas* in Someș river. (Păpuc et al., 2018). In the Danube river, in 2005, at km 929 were fished by a sport fisherman one specimen of *A. melas*. This event was the first record of this species in the Romanian sector of the Danube River (Popa et al., 2006). These report represents the first finding of the black bullhead in the Romanian sector of the Danube River. It is supposed that the black bullhead have reached the romanian basin from Hungary where it was brought from Italy for growth in aquaculture systems. That subsequently escaped and reached the Criș basin, then naturally spreading in the Romanian waters (Wilhelm, 1998).

During the inventory activity of community interest fish species from ROSCI0012 Măcin Branch, on September 20, 2019, in a temporary shallow water with an area of approx. 100 sqm, with a depth of approx. 0.5 m and with a layer of thick mud were caught with a net 10 specimens of black bullhead (*A. melas*). The shallow water from which the black bullhead (*A. melas*) was captured is located in the area between the bank of Măcin Branch and the defense dam, near Ciobanu locality, with GPS coordinates 44 ° 45'21.01 "N, 28 ° 0'45.53" E. The species that remained captive in this shallow water resisted to the unfavorable environmental conditions that appeared as a result of the withdrawal of the Danube waters from the flood zone. The 10 captured specimens were measured, the largest having a length of 18.5 cm and the smallest specimen having a length of 13.4 cm. The fish can be grouped into two age categories, 1+ and 2+. This paper bringing new information regarding the presence of black bullhead (*A. melas*) in the most eastern part of Danube river. Further studies are necessary to monitor and assess the impact of this invasive non-native fish on local fish populations.

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S2.22. Phytoplankton state and water quality in the Lower Prut River

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Research on phytoplankton was carried out during 2019, samples were collected from lower sector of Prut River. Sampling and analysis of phytoplankton was carried out by conventional hydrobiological methods [1,2]. During 2019 year the diversity of quantitative parameters of phytoplankton, as well as the water quality, using algae species as indicators of saprobity were assessed.

In phytoplankton compositions of the lower sector of Prut River were identified 42 species. It was found that the phytoplankton species of the following groups predominated: *Cyanophyta, Bacillariophyta* and *Chlorophyta*. The basis of the floristic diversity of Prut River consists of species: *Aphanizomenon flos-aquae*, *Oscillatoria lacustris* from green

algae, *Cyclotella kuetzingiana, Navicula cryptocephala, Synedra acus, Synedra ulna* from diatoms algae, *Monoraphidium Komarkovae, Monoraphidium contortum* and *Scenedesmus quadricauda* from green algae.

The number of phytoplankton species in Prut River was in limits 1.06-15.9 mln. cell/l. In lower sector of Prut River was attested the preponderance of *Cyanophyta* in the forming of the number of algae species. The biomass of planktonic algae was in limits 1.4-9.6 g/m^3. The main part in the formation of phytoplankton biomass was *Bacillariophyta* algae: *Cymatopleura solea, Gyrosigma acuminatum, Nitzschia sigmoidea, Surirella robusta, Stauroneis anceps*.

The saprobic index values were established within 1.93-2.32 at Prut river lower sector. The values of saprobic indices were estimated on the basis of species-indicators (29 species) from phytoplankton composition, which were in proportion of 62 % typically□□-mezosaprobic. According to these indices, the water quality of Prut River lower sector was satisfactory for the development of phytoplankton and was attributed mainly to II-III (good-moderately polluted) quality classes.

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SECTION 3. Environmental technologies, oil fingerprinting, restoration and management of aquatic ecosystems

S3.01. Treatment of wastewater and nutrients recovery by microalgae

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Wastewater management constitutes a concern of strategic importance, as population growth and rapid industrialization have eventually resulted in water resources facing severe quantitative and qualitative threats. Nowadays, wastewater reuse has been more and more considered of vital necessity for worldwide sustainable development, as the discharge of huge amounts of effluents, usually loaded with nutrients (mainly nitrogen and phosphorus), heavy metals and other contaminants, are directly responsible of serious environmental problems. Advanced biological and physicochemical processes have been tested for nutrients removal from different wastewater effluents, such as chemical precipitation, ammonia stripping, aerobic biological processes and denitrification. Nevertheless, these processes besides being complex, presenting high operating costs and energy demand and resulting in by-products that restrict their application, focusing rather on nutrients removal than recovery from the effluents. Utilization of microalgae for bioremediation of wastewaters with the concomitant production of biomass, on the other hand, has received growing attention in recent years owing to its outstanding advantages, including (1) simultaneous efficient N and P recovery via microalgal photosynthetic assimilation; (2) cost effectiveness and environment friendliness, as no additional chemicals are required, while oxygen generation, carbon dioxide biofixation, and metal ion reduction can be realized at the same time; and (3) potential utilization of the harvested microalgal biomass for production of food, animal feed, biofuels, biofertilizers, and other sustainable bio-products. Microalgae consist of a wide range of photosynthetic organisms, presenting comparable photosynthetic efficiency to higher plants, rapid

growth rate, and notable adaptability. Carbon, nitrogen, and phosphorus are essential elements for their growth and can be effectively used via different metabolic pathways. They have demonstrated the ability to bio-remediate different wastewater streams nutrients efficiently, with methods to further enhance performance through species selection and biomass concentration. All these features make them an attractive wastewater treatment technology, in a complete alignment with the concept of circular and bio-based economy and the development of biorefinery concept. Microalgae have been used for the treatment of high strength and high nitrogen content wastewater through various reactor configurations. In an early work, mixed cultures of activated sludge biota and microalgae were examined for the treatment of wastewater from a baker yeast production plan, with N-concentration of about 0,5 g/L. Experimental studies took place in a lab-scale sequencing batch reactor (SBR) and the results revealed the beneficial role of microalgae for the advanced treatment of the certain wastewaters. In a recent work, a 25 L tubular lab-scale photobioreactor (PBR) was used for the treatment of the effluent from an anaerobic digester producing biogas from animal manure. The experimental system included a membrane unit for biomass harvesting and was equipped with all the appropriate sensors for monitoring and control of its operation. Digestate sample was initially used for the growth of prevailing microalgae species under certain conditions of lighting, aiming to the isolation of inherent species that were acclimatized to the specific effluent. *Chlorella Sorikiniana* was identified by this procedure, following its cultivation using digestate as substrate, and the culture was then used for the start up of the PBR. Reduction of the ammonium nitrogen content by more than 80% of the influent was observed, demonstrating the efficient of the particular microalgae species for the treatment of the certain digestate effluent.

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S3.02. Evaluation of chromatographic techniques for the determination of pesticide residues in various products

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Pesticides are well-known for their side effects on plants, humans and abiotic environment. They contribute in the deterioration not only of soils but also of surface water and groundwater. The purpose of this study was to examine the effectiveness of applied chromatographic techniques in the detection of pesticide residues. Thus, a meta-analysis was carried out on the results of the sampling tests implemented at national level in accordance with Greek and European legislation. The data came from the pesticide residue sampling tests, carried out during 2014-2015 by the national pesticide residue testing laboratories employing different types of chromatographic and spectroscopic equipment. In total, 4480 samples were examined, which related to 80 different products. The research question of whether or not the use of LC-MS/MS equipment affects the detection capacity of laboratories, and hence the reliability control of pesticide residues in various matrices, was thoroughly investigated. The analysis of the results revealed that the laboratories used LC-MS/MS equipment had about three times as many findings as the laboratories that did not use the corresponding equipment for most of the examined products. The results are in line with those of the relevant literature, which elucidates that the non-use of LC-MS/MS significantly limits the reliability control. The implemented meta-analysis contributed significantly in the comparison of the chromatographic techniques used under real conditions in the regulatory framework for controlling pesticide residues.

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S3.03. Removal of chromium (VI) from galvanic effluents by chemical coagulation and electrocoagulation

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Chromium contamination of the environment originates from various industrial activities, such as metallurgical, anodizing, dyeing, tanning and dyeing plants. The toxicity of the metal depends on its oxidation state. Hexavalent chromium is 100 times more toxic than trivalent. The permitted levels of Cr (VI) are 0.5 mg/L for effluent and 0.05 mg/L for drinking water respectively. In the present work, the removal of hexavalent chromium from real electroplating wastewaters is studied by the chemical coagulation and the electrocoagulation processes. All parameters that influence the effectiveness of the two methods, such as pH, coagulant dose, initial chromium concentration, applied current density and time of processing, are investigated and optimized. Finally, the two processes are compared and evaluated. The chemical coagulation occurs by adding the calculated volume of the coagulant solution $FeCl_3 \cdot 6H_2O$ to 200mL of treated wastewater sample containing 300 mg/L Cr(VI), under rapid stirring at 200 rpm for 5 minutes followed by slow stirring at 60 rpm for 25 minutes. As can be seen in Figure 1, the percent removal efficiency of chromium is 34.97, 72.8 and 89.6% for coagulant doses of 100, 200 and 400 mg/L respectively. Maximum removal of chromium by 99.9% was achieved at doses of 500 mg/L or more. The electrocoagulation experiments were performed in a 500 mL cylindrical electrochemical reactor containing the same wastewater sample under stirring at 200 rpm. Three iron electrodes were used as electrodes in parallel (5 x 5 x 0.3 cm), each of them with an effective surface area of 25 cm^2 and a distance of 1 cm. The electrochemical treatment achieved a rapid and effective 99.9% reduction of chromium. For current densities of 5, 10 and 15 mA/cm^2, the initial concentration of 300 mg/L Cr (VI) was reduced below the permissible limits (0.5 mg/L) in only 35, 20, and 10 minutes, respectively. The efficiency of the two coagulation methods studied was compared on the basis of: a) the consumption of coagulant, electrode mass and electricity, b) the amount of sludge produced and c) the required processing time. The total costs for chemical and

electrochemical coagulation were estimated at 1.03 €/m^3 and 0.69 €/m^3 of treated wastewater respectively. Both methods are effective in removing chromium from electroplating wastewater with the latter process being advantageous in terms of total cost and processing time.

S3.04. An innovative model for sustainable reuse of effluent and sludge of septic tanks via vermifiltration and lactic acid-fermentation

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Septic systems are wastewaters treatment units for onsite storage or partial treatment of domestic wastewaters. A typical septic tank contains scum (the substances floating on the top, *e.g.* fats, oil, grease or any other floating matter), sludge (*i.e.* solids sedimented on the bottom of the septic tank) and effluent (semi-treated wastewater which fills the most part of the septic tank). Most of the pathogens contained in the effluent and sludge die within 2-3 months, a substantial concentration remains due to the continuous inflow of the blackwater fraction from the toilet facilities. Furthermore, the effluent and septic sludge may potentially contain pharmaceuticals, endocrine disruptors or surfactant substances from house cleaning or personal care products as well as high concentration of organic compounds and nutrients (N and P). Those contaminants can pollute both surface water and groundwater resources once the effluent and the septic sludge are finally disposed of in the environment.

The application of appropriate treatment and reuse approaches may prevent or reduce pollution of the water resources. Based on a technology review study by Singh et al. (2017) and Krysnasamy et al. (2013), and a recent research on lactic acid fermentation of fecal sludge from EcoSan systems (Andreev, 2017), a demonstration model was designed and developed in this study, which applies the concept of lactic acid fermentation and vermifiltration for treatment of effluent and sludge from septic tanks.

The model, which runs on a batch mode, consists of various components including:

1) a 1000 L capacity septic tank with a buffle wall to allow settling of solids, and prevent plugging of the inlet pipe by the scum layer;

2) a one-compartment vermifilter a vermibed and matrix of biochar, pebble and gravel. The biochar layer traps the solids and nutrients as well as reduces the odour, the pebble and gravel has an additional treatment role for removing of remaining organic matter, N and P and preventing of clogging of the system;

3) collector for the treated effluent and

4) an irrigation system that is fed by the vermifilter effluent.

In order to have the system functioning all year around, the elements 2-4 are placed in a greenhouse. The water from the septic tank flows into an equaliser, then pumped to the second reservoir (located above the vermifilter), from where via gravitation flows into the vermifilter. For the primary treatment of the effluent and sludge, a multi-strains lactic acid bacteria culture (LAB) (*Lactobacillus, Leuconostoc, Pediococcus, Bacillus* sp.) obtained from sauerkraut fermentation, at a ratio of 1 L per 50 L of wastewater (Andreev, 2017) will be added to the septic tank. LAB culture addition will contribute as antimicrobial against to the pathogens (Alepu Odey, 2018), reduction of COD and odour as well as sludge solubilization (Lee et al., 2008).

The density of earthworms added to the vermibed will be 15,000 specimens per m^2. The performance of this innovative biotreatment model (*e.g.* the quality of treated effluent and sludge as well as the LAB inoculum metabolic performance) will be tested under household conditions in the Republic of Moldova. If successful, the system may serve as a reliable technology for the bio-treatment of the house's effluents and sludge from the septic tanks that are commonly applied in rural and peri-urban areas of Moldova Country.

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S3.05. The use of *Daphnia magna* species in bio-remediation of freshwater ecosystems

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The pollution effect of wastewaters, leading to a reduction of bio-productivity and biodiversity of freshwater ecosystems is well known. In the Republic of Moldova, a large portion of wastewater is insufficiently treated due to mal-functionality of treatment plants, thus often untreated or poorly treated wastewaters are discharged into the water bodies. In rural localities as well as in district centres (rayons), treatment plants are completely missing or almost non-functional, most often wastewater being treated insufficiently, with only mechanical stage, but without biological treatment. As a result, there is an intensive pollution of water basins with nutrients, suspended substances, pathogenic microorganisms, pharmaceuticals and other pollutants, contributing to their eutrophication and continuous degradation. Bio-remediation by the use of aquatic organisms is of particular interest, because it is not expensive and can be based on organisms already existing in aquatic basins.

The application of inferior crustaceans in wastewater treatment is based upon the self-purification mechanism linked to trophic connections of organisms and the fact that in the natural aquatic ecosystems zooplankton organisms act as a natural biological filter. The filtration capacity of filtering zooplankton organisms is so intensive they can pass during a period of 24 hour an entire water volume of an eutrophic ecosystem through their filtering apparatus. *Daphnia magna* Straus, 1826 attracted the attention of researchers (Kampf et al. 2006 Shiny et al., 2005), owing to their biological filtration capacity and the reduction of the toxic effects of wastewater. Most

of the representatives of Cladocera are predominant in eutrophic water bodies in comparison to the copepods, due to their ability to feed under the conditions of dense suspensions. Owing to their ability to filter and feed on cleavage solids, nutrients, algae and micro-organisms, *D. magna* can serve as cost-effective and user-friendly biological filters, contributing to the bio-remediation of aquatic ecosystems and the restoration of bio-production, especially fish bio-production. *Daphnia* grown in wastewater ponds of Luxemburg, reached a consumption of phytoplankton of 66-92 % and that of bacterioplankton - 0,1 to 18 % of biomass during a period of 24 hours (Michucova 2007).

Experimental studies performed by Kampf et al. (2004), under mesocosms and semi-technical conditions have shown that *D. magna* can be effective in reducing coliform bacteria as well as in preventing the excessive development of algae. At a hydraulic wastewater retention time of over 12 hours, using a *D. magna* concentration of over 50 individuals, a reduction of the solid particles was achieved - 30% due to *Daphnia* filtration and 18% due to sedimentation (Serra & Colomer, 2016). At a density of 2000 specimens per litre, a reduction of 80% of suspended particles can be attained (Frook, 1974). *D. magna* also contributes to the inactivation of *E.coli* by 1.2 log units, which was 6 times more efficient than conventional macro-filtration (Serra et al., 2014). Another study (Michukova, 2008) indicated that *D. magna* contributes to a complete reduction of the number of coliforms in wastewater by predating on these bacteria. The culture of *D. magna* can be used in the treatment of wastewater from livestock farms (Alexandrov n.d. cited by Michucova, 2007). The given research demonstrated a high potential of use of polyculture of *D. magna*, microalgae and other crustacean in the treatment of wastewater from zootechnical farms. It is important to conduct research under laboratory and field conditions for assessment of the performance of treatment using such biological methods.

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S3.06. Investigation of major and trace elements in marine algae and filter paper with algae mass additions using SEM-EDX and PIXE

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The article presents the research carried out for the exploitation of macrophyte seaweed from Black Sea, Romania, as addition in the form of dried and grinded biomass within the pulp slurry in order to improve the quality of the filter paper. The algae *Ulva rigida* C. Agardh was added in a percentage of 0.5%, 1%, 2%, 4% and 8% (comparatively with the dry material) in the composition of a filter paper with a grammage of 80 g/m^2.

Concentrations and distribution maps of major and trace elements in marine algae and filter paper with algae mass additions

were determined and modeled using: a) Scanning Electron Microscopy (SEM) with Energy Dispersive X-ray Analysis (SEM-EDX) at INPOLDE Research Center, ReForm-UDJG Platform, Faculty of Sciences and Environment, and Electron Microscopy Laboratory at "Dunarea de Jos" University of Galati (UDJG) and b) Particle induced X-ray emission (PIXE) at Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH).

Concentration values were corelated with results obtained for selected physical-mechanical characteristics considered important for defining the quality of the filter paper with and without the addition of dry algal biomass.

S3.07. ATR-FTIR method applied to identification of plastics

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The worldwide production of plastics has increased considerably since the development of synthetic polymers in the middle of the 20th century. When discarded in the marine environment, plastics can become an environmental hazard. Plastic debris enters the marine environment in a wide range of sizes, in the micrometer to meter range. Microplastic particles comprise either manufactured plastics of microscopic size, such as scrubbers and industrial pellets that serve as precursors for manufactured plastic products (primary sources), or fragments or fibers of plastics derived from the breakdown of larger plastic products (secondary sources). Degradation processes of plastics are extremely slow, and thus microplastics potentially persist for very long time periods in the marine environment.

Fourier transform infrared (FTIR) spectroscopy is a non-destructive and rapid method of analysis. FTIR spectrometry is widely used for polymer identification, and, more recently, ATR–FTIR (Attenuated Total Reflection) has been shown to give excellent results. Plastic polymers possess highly specific IR spectra with distinct band patterns making IR spectroscopy an optimal technique for the identification of microplastics. Six types of plastics were characterized in this paper from vibrational point of view.

Biodegradable plastics are desirable alternatives to synthetic plastics which have led to serious problems of solid waste pollution. Four kinds of biodegradable plastics, such as poly (lactic acid), poly (butylenes adipate-co-terephthalate)-PBAT, poly (butylenes succinate) and poly (hydroxybutyrate-cohydroxyvalerate), are used more and more in everyday life. Using ATR–FTIR method we identified that the sample of biodegradable bag has mostly the same composition with PBAT biodegradable plastic.

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S3.08. Climate change and riparian areas – a review

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Global warming around is having major impacts to human welfare and ecosystems services. For the Mediterranean region, an increase in average annual temperature and a decrease in average annual rainfall has been forecast. In addition, precipitation events are expected to be more intense and shorter in duration. This should increase the pressure on the limited water resources of this region. This should also exacerbate the pressures and impacts on semi-aquatic ecosystems such as riparian areas. Riparian areas, are transitional zones that connect aquatic and terrestrial ecosystem (ecotones). They offer great values to humans because of the many ecosystem services due to their unique and different characteristics. At the same time, they are also susceptible to anthropogenic pressures. This study investigated and identified potential climate change impacts on riparian areas and best adaptation practices by reviewing the existing literature. Emphasis was given to the Mediterranean region. The specific analysis recorded that changes in the hydrologic regimes of the streams and rivers will impact riparian areas functionality. In addition, the increased flood magnitude and frequencies also need to be considered. The above are expected to

disrupt the ecological succession of riparian ecosystems. Worst case scenarios predict their complete disappearance or their shift to different types of vegetation and hydrologic conditions. The most frequently proposed adaptation measure included the use of the innovative technologies to better predict stream flows, soil moistures, aquifer water levels and in general the water budget.

The enhanced awareness of society and responsible authorities on climate change impacts and best mitigation measures for riparian areas in also essential. Finally, the key is sustainable water management though the implementation of integrated water resources management, ecosystem-based and eco-hydrological approaches and nature-based solutions.

S3.09. Identifying high flood risk areas in Attica Prefect, Greece, with the use of Geographical Information Systems (GIS) and historical records

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Floods are natural phenomena that occur after major rainfall events or fast snowmelt. Anthropogenic activities (e.g. urbanization) and climate change have accelerated their frequency, magnitude and impacts. This is particularly true for Greece that due its topography and climate conditions have many torrents that experience frequent flash flood events. In this study, Geographic Information Systems (GIS) and historical records were used to identify the areas that have experienced frequent floods in the past. The Prefecture of Attica of Greece that includes Athens was the study area. The reason for selecting this Prefect was the increase in population that has led frequent to the unorganized development of roads, housing etc., even in and adjacent to torrents. In the last 5 years, many flooding events have occurred with the most significant the deadly event in Mandra in 2017 that is right

outside of Athens. Firstly, all the data from the Fire Brigade were collect on water pumping events from 2012-2018 due to flooding in houses and stores for all 61 municipalities of Attica. These data were entered in GIS and maps were developed. Each municipality of Attica was categorized based on the number of pumping events as: a) High Flooding Risk, b) Medium Flooding Risk and c) Low Flooding Risk. Based on this categorization, 16 municipalities were in the high flooding risk, 18 in the medium flooding risk and the 27 in low flooding risk. The maps clearly highlighted that some municipalities were more prone to flooding and should be the focal area flood prevention and protection measures. Overall, this is a simple way of presenting the historical data in the form of maps that should be utilized as a tool for the Fire Brigade and Civil Protection, during rainfall events to forecast potential areas that could be flooded.

S3.10. Using a 7-year timeseries of erosion pin data to evaluate the important factors for stream bank erosion and deposition

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Stream bank erosion is a major contributor of sediments to water bodies. These sediments can significantly degrade their quality and impact the aquatic habitat and the fish populations. The main reason for the increase is agriculture. Row-cropped field leave the watersheds bare for long part of the year thus increase surface runoff and stream discharge. Grazing can leave the stream bank bare of vegetation while also reducing their stability due to cattle trampling.

The aim of this study was to analyse a seven-year dataset concerning changes of stream banks. The dataset was from 30 stream reaches that flow through 3 regions of Iowa, USA. The reaches were adjacent to seven different land uses: row-cropped fields, continuous pastures, rotational pastures, intensive rotational pastures, cattle

fenced out of the streams, grass filters, riparian forest buffers. Erosion pins were placed on eroded banks. The pins were measured three times a year (summer, autumn and spring) for the first five years and once for the last two years. Pins were not measure in the winter in the first five years because their access was difficult. Different statistical methods were used to examine the relationship between stream bank change and influential external factors. These factors were bank position, neighbouring land use, rainfall, the time period the measurements were taken and the frequency of the measurements. The analysis showed that overall, the lower parts of the stream banks have less erosion than the higher parts of the banks. Based on the seasonal data, spring had the largest stream bank changes while autumn had the smallest. The most frequent measurement of the pins (three times a year) better captured the stream bank changes compared to annual measurements. Finally, conservation management practices had the least stream bank changes compared to the grazing and row-crop agriculture practices. This study results clearly showcases that conservation practices need to be promoted and implemented if we want to reduce stream bank erosion sustainably. In addition, ecosystem-based and ecohydrological approaches need to also be implemented at the watershed scale. Finally, a more systematic monitoring of stream bank changes is needed if we want to understand the process of stream bank changes.

S3.11. Comparing a lowland, semi-mountainous and mountainous stream of Greece with the use of a Visual Protocol

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Riparian areas are unique ecosystems that act as natural biofilters. Specifically, they can improve water quality by acting as a microbiological and chemical natural filter. These areas retain the nutrients that are eroded from the agricultural fields. They also store water and materials during flood thus mitigating them. The tree cover can reduce sunlight intensity, creating a "microclimate". This cover can

also regulate the temperature of the adjacent aquatic ecosystem and thus control the growth of aquatic vegetation. Because of these services that they offer their conservation is a necessity. This study assessed three streams in different landscape environment specifically in a lowland, semi-mountainous and mountainous areas. The three streams that were assessed were Olynthios River (lowland), Edessaios River (semi-mountainous) and Xerolaki Stream (mountainous), in Centra Macedonia of Greece. The assessed was conducted with the Stream Visual Assessment Protocol (SVAP) that has been used worldwide successfully. The SVAP assess a number of different variables that are summed to provide the final grade of the area that can be characterized as: Excellent, Good, Fair and Poor. In addition, with the use of GIS the adjacent vegetation covers/land-uses were evaluated. Based on the GIS analysis for Olynthios River in the riparian areas there are agricultural fields, forests and semi-natural areas and artificial infrastructures. For the Edessaios River there are also agricultural fields, forests and semi-natural areas and artificial infrastructures. Finally, for Xerolaki Stream the riparian areas consisted mainly of forest vegetation and the rest of agricultural areas. In regard to stream substrate, Edessaios River and Xerolaki Stream had primarily gravel and boulders due to the adjacent landscape and the fact the stream slope was steeper. In contract sand was found in high percentages only in the Olynthios River that is in the lowlands and has substantially lower stream slopes. Finally based on the SVAP the Edessaios River is in the best condition, followed by the Olynthios River and finally Xerolaki Stream is in the worst condition. In general, all three rivers/steams have anthropogenic effects that degrade them and measures must be taken for their sustainable management and conservation.

S3.12. Keyword analysis of image-based velocimetry methods applied on water resources

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Integrated water resources management and ecosystem-based restoration plans require accurate and reliable measurements and appropriate easy-to-use instrumentational tools for both velocity and discharge of water bodies. In addition, the ecological status of these aquatic systems (coastal, lake and fluvial ecosystem) can be assessed as water velocity and discharge play a very important role on water quality. Image-based velocimetry methods can be considered as an environmental technology because of their non-contact character. The image-based velocimetry methods are low cost and innovative techniques used to estimate the surface velocity of water resources. The main concept is very simple by using algorithms to track the movement of surface particles that are flowing on the surface of the water based on continuous frames capturing the water surface. This study reviewed scientific publications published online that studied specific image-based methods that calculate the velocity and discharge of water bodies. The specific analysis concentrated on publications until the end of 2018. The keywords "water", "PIV river", "PTV river", "LSPIV", "STIV", "LSPTV" were used in several search engines. More than 400 publication were reviewed in order to conduct an analysis based on their keywords. The keywords were grouped in three major categories based on similarity/relativity of the keywords: a) methods, b) LSPIV system and c) scientific field. These major categories were also divided in sub-categories. The first category "methods" had two sub-categories: i) imaged-based and ii) traditional. The second category "LSPIV system" was separated into four sub-categories, specifically into: i) tools, ii) orthorectification, iii) tracers and iv) procedures. Finally, the keywords of the "scientific field" had six sub-categories: i) water resources, ii) geomorphology, iii) ecohydrology and hydrobiology, iv)

engineering and human constructions, v) remote sensing and vi) modelling. Scientific gaps regarding image-based methods on measuring parameters of water bodies are identified based on this analysis. This allowed to present suggestions on future research direction based on these methodologies and future possibilities to enhance integrated water resources management.

S3.13. Public perception of rural people on riparian areas in Greece

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Riparian areas, are complex and sensitive transitional zones that connect aquatic and terrestrial ecosystem. The higher soil moisture and frequent floods of then riparian areas lead to different type of vegetation (hydrophilic) compared to adjacent uplands that is also denser and more biodiverse. The unique and different characteristics of the riparian areas lead to the many ecosystem services they offer to humans. This is particularly true in riparian areas of urban or semi-urban environments. In this study the perception of the inhabitants of small urban areas were mined. Specifically, a photographic questionnaire was used to mined the preference of the citizens of the Municipal Unit of Kalampaki, which belongs to the Municipality of Doxatos in the Prefecture of Drama in Greece. The questionnaire targeted to different groups, the general public and the professionals dealing the management of natural resources. The questionnaires for the two target groups were slightly different. Both questionnaires consisted of three sections that were: a) personal information, b) four sets of different photos for their ranking based on their personal preference, and finally c) some general questions about the riparian areas. The differences between the two questionnaires (general public and professionals) were in the first section were the professionals had three additional questions in regard to their studies and field of work. One hundred (100) questionnaires were completed by the general public and 30 by the professionals for a total of 130. The analysis based on the participant answers indicated that a large percentage preferred streams

with meanders and rich and dense natural riparian vegetation. In addition, many people also prefer their home to be located near streams and riparian areas that should showcase the importance of taking protection measures to keep the steam and riparian ecosystems clean and healthy. Surprisingly a large percentage of people preferred streams with anthropogenic infrastructure and sparse vegetation. This indicates that need to increase the general public awareness of the ecosystem services that stream and riparian areas offer. Information days, workshops and conference should be organized the Forest Service, the Municipalities and the Universities on the uniqueness and importance the riparian areas. Finally, most participant believe that local government should be responsible for the maintenance of high-quality stream and riparian areas and mitigating problems such as high insect populations (e.g. mosquitos) and insects and garbage accumulation.

S3.14. Stream discharge measurements to assess the water resources of Agia Barbara Stream of Drama, Greece

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Water is essential for the health and welfare of people and its societies. Although our planet is covered with water, the actual freshwater supplies are limited. With the exponential increase in population sustainable and innovative ways of water management need to be implemented. The aim of this study was to record the hydrologic regime of the Agia Varvara stream that run though the city of Drama in Greece. Having knowledge of the hydrologic regime of the stream will also help in the science-based management of extreme hydrological phenomena such as floods, severe droughts and water pollution. To measure stream discharge measurements were taken three times a

week from May 2019 until June 2019. Discharge was measured with the use of a current meter along two different cross-sections that were relatively close to each other. The width of the first cross-section was 7.2 m with higher stream flows while the second cross-section had a width of 8.5 m lower stream flows. The analysis of the results showed that stream was the lowest during the summer months, specifically from June 2018 until August 2018, as expected. The highest stream flows were during the end of the winter months but mainly with the spring months, specifically from February 2019 until the April 2019. The high flows are because of the melting snow in the surrounding mountain peaks, the greater rainfall and the rich aquifer of the area. The measurements were for relatively short time (only one year), but because they were taken quite frequently, they provide a good first perspective of the hydrologic regimes of Agia Barbara stream. Ideally, such measurements in the stream should be continued for multiple year in order to better assess the hydrologic regime. Finally using new technologies (UAVs and remote sensing) in combination with the classic methods (current meter), should help improve the accuracy but also increase the scale of the measurements and predictions in regard to future water supplies.

S3.15. Evaluating the condition of riparian areas of Xanthi Prefecture, Greece, along streams of different orders

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Riparian areas because of their unique hydrologic conditions offer important ecosystem services. They can improve water quality, provide functions for river ecosystem maintenance and productivity, increase the diversity of flora and fauna, provide transport corridors for the wild fauna, and even mitigate peak floods. Economic incentives have

increased anthropogenic effects in the riparian areas, that include the replacement of the riparian vegetation with agricultural fields, overgrazing, illegal logging, waste dumping, resulting in their significant degradation. This is the reason why it is essential to know the quality of the riparian areas and streams in order to take the best management measures to improve or maintain them. Best management practices can promote ecotourism and increase biodiversity in the riparian areas that could help the economic development of the neighbouring communities. The purpose of this study was to evaluate the condition of some riparian areas and their streams in the Prefecture of Xanthi. Two visual assessment protocols were used for this study, specifically the Stream Visual Assessment Protocol (SVAP) and the Riparian Forest Quality (QBR). These protocols are complementary to each other, as SVAP focuses on the systematic and rapid evaluation of the condition of a stream while QBR focuses on evaluating the condition of riparian vegetation. In addition, visual protocols are ideal as a first evaluation tool of riparian areas and rivers conditions, because they are fast and easy use. A total of three streams of different order (1st, 2nd and 3rd) were evaluate. The results show that they have major anthropogenic impacts with the presence of human infrastructures, degraded riparian vegetation and abundant presence of garbage. This is the reason why both protocols evaluated the quality of the riparian areas and streams as poor to moderate but mostly poor. The results clearly indicate that ecosystem approaches, ecohydrological methods and nature-based solutions need to be implemented to improve them sustainably and for the long-term. Finally, local government officials but also the general public need to be informed about best management practices that need to be implemented in riparian areas.

S3.16. Climate change impacts on the genesis and impacts of flash flood

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The increase in extreme events and disasters worldwide due to climate change is one of the greatest concerns. The increase of extreme meteorological events, especially precipitation, has led to subsequent increased risk of flooding events. The aim of this study was to examine the potential correlation between climate change and the development of extreme hydro-meteorological phenomena, with an emphasis of flash flood event and their impact on the socio-economic environment. To assess the correlation between natural disasters and climate change and their effects and impacts, natural disaster databases have been developed and are updated constantly worldwide. The databases that were used in this study were: a) EM-DAT, The Emergency Events Database - Université catholique de Louvain (UCLouvain) – CRED, b) ETC-ICM, European Topic Centre on Inland, Coastal and Marine waters and EEC, c) DesInventar, Disaster Inventory System (United Nations Office for Disaster Risk Reduction – UNISDR) and d) Dartmouth Flood Observatory, University of Colorado. From these databases, the cases of natural disasters that are caused by floods, especially flash floods, were highlighted. The data on floods mined from them, were annual floods, annual number of victims, the number of people affected and the annual economic damages, for the period 1900-2019. After analysing the data, they showed significant increases in annual floods and flash floods, especially in the last 5 years. The positive fact was that there is no increase in the number of victims, although there is an increasing trend in the number of people affected by the floods, as well as the financial losses that have been caused, especially in the last 50 years. The changes in these parameters, directly related to climate change, and their correlation to the variation of the frequency of flash floods and the time-varying parameters that determine the effects of these natural phenomena for the period 1990-2018, were also studied. The

steady upward trend in the average global temperature (that characterizes climate change) was found to correspond to an increase in the number of floods and flash floods. Overall, the incidence of extreme weather events, such as very intense rainfall events, have increased, and this is linked to climate change. These extreme events lead to more frequent floods and disasters that often exceed the design specifications of the infrastructure that increase the risk and susceptibility, especially in urban settings.

S3.17. Assessing mountainous riparian areas – The case of Kato Nevrokopi, Greece

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Riparian areas offer many ecosystem services and this is the main reason for their conservation, protection and restoration. These ecosystems have been used extensively by human throughout history and is the main reason why many scientists consider them as the most degraded. Agriculture, urbanization and changes in the streams and rivers (e.g. dams) are the main culprits for their degradation. Methods that quickly assess the current conditions of riparian areas are needed, as a first assessment. Based on this assessment the next steps will be determined. Such methods are the visual protocols. The purpose of this study was to assess the condition of the stream and the riparian areas of Kato Nevrokopi, Drama, Greece. The Stream Visual Assessment Protocol (SVAP), was selected to be used in the study. The SVAP focuses on the mainly on the condition that stream reach by assessing different factors. The results of the protocol indicate that the stream and its riparian areas that were assessed have extensive anthropogenic interventions and rates overall as poor quality. The riparian areas near and in Kato Nevrokopi have been fragmented due to the presence of human infrastructure while the stream channel has been modified.

Implementing ecosystem-based approaches and nature-based solution are imperative if the goal is to improve and conserve the stream and its riparian areas. Another important action is enhancing the awareness of the local officials and general public on best practices for managing stream and riparian areas.

Keywords: Riparian ecosystems, anthropogenic disturbances, visual protocols, Ecosystems-based approaches

S3.18. Using HEC-RAS to evaluate flooding risk of the urban stream of Katerini, Greece

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Flooding events are becoming more frequent with greater magnitudes leading to major efforts are done worldwide to mitigate its potential negative impacts on humans. Floods are typically, the results of heavy rainfall and quick snowmelt. A simple definition is the overflow of water in an area that is usually dry. The reason for the increase of floods are primarily anthropogenic. The concentration of people in major cities and the high percentage of impermeable surfaces in these settings has increased surface runoff and leads to more flooding events in urban areas. These areas are highly vulnerable to floods because of the many people that live there and the infrastructure that are in danger. In addition, climate change also plays a key role in the frequency and magnitude of floods today. It has altered the characteristics of rainfall (e.g. intensity, duration) resulting in increased flooding events. Urban floods are on the rise in Greece and one the flood in Mandra near Athens in November 2017 had many casualties. The aim of this study is to assess the flood risk of the Pelekas stream that passes through the city of Katerini. Katerini is the capital of Pieria Prefect in Northern Greece. The study area has had serious flood events in past and such events would impact both agricultural crops but also many urban infrastructures. To assess flood risk, the Hydrological

Engineering Center - River Analysis System (HEC-RAS) was utilized. Geographic Information Systems (GIS) were used to estimate the morphometric and hydrographic characteristics of the Peleka watershed. Twenty stream cross sections near and in the urban area of Katerini were taken as the input data for HEC-RAS. The results of the HEC-RAS, indicate that several urban areas of Katerini have a high flood risk. A more detailed study on the flooding risk of Pelekas stream needs to be conducted that will be the guide for a new flood management plan to prevent future flooding and protect urban infrastructure and avoid human casualties.

S3.19. Application of a meso-scale approach to estimate ecological flows in Nestos River (N. Greece)

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Flow regulation for power production and irrigation set challenges to the integrity of freshwater ecosystems. Ecological flows support a sustainable ecological status in rivers as requested by the EU Directives. This study aims to assess the impact of anthropogenic flow fluctuations on instream habitats in Nestos River (N. Greece) at a mesohabitat scale and depict a reference ecohydrological regime. Fieldwork involved mobile GPS/GIS mapping, hydromorphological measurements and fish fauna samplings by electrofishing under multiple flow conditions. In total, 81 Hydro-Morphological Units (HMUs) were surveyed and 7,532 fish individuals were recorded. Next, historical flow data (2006–2008) were introduced for upstream and downstream of Toxotes Dam. Finally, environmental and biological data were combined by implementing a MesoHABitat SIMulation model (MesoHABSIM). This software computed a habitat/flow rating curve that indicated a marginal ecohydrological status occurring at a flow range from 10 to 15 m^3/s downstream Toxotes Dam. Given this, habitat suitability (optimal /suitable/unsuitable) and availability (% of Maximum Wetted Area) were mapped for all species

and age classes. Moreover, Uniform Continuous Under-Threshold (UCUT) curves analysis revealed that stressful events (AQ<AQ97) occurred during summer due to water abstraction and hydropeaking. Finally, habitat Stress Days Alteration index (iSDA) indicated an increase of stressful days from 44 to 160% depending on species and age class. The findings suggest that water management policies currently applied in Nestos basin need to be revised.

S3.20. Implementation of the water monitoring system at the level of the Prut-Bârlad River Basin, Romania

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The activity of water quantitative monitoring within the Prut-Bârlad Water Basin Administration (A.B.A. Prut-Bârlad) aims to ensure the concordance between the water needs and water resources. Thus, for well determined periods (quarterly, half-yearly, annually) the full use of the potential of water resources is ensured correlated with the water requirements of the socio-economic systems and with the regulatory acts from the point of view of water management. The monitoring of the evolution of the hydrometric parameters of the Prut River is carried out according to the program of observations and measurements within 80 hydrometric stations on rivers, of which 60 automatic stations. Hydrometric stations are equipped with classical and automatic equipment for observing, measuring and determining the various hydrometeorological, hydrological and hydromorphological parameters. The most important data from hydrometric stations are the data on the evolution of surface water levels and flows that are transmitted daily to the National Administration "Romanian Waters" and the National Institute of Hydrology and Water Management. The automatic stations serve two major components: increasing the safety of hydrotechnical constructions and increasing the intervention capacity in case of natural disasters. For the hydrotechnical constructions within the A.B.A. Prut-Bârlad, and especially for the Stanca-Costesti Dam,

were highlighted a number of parameters which are necessary to be measured and transmitted with the help of specific equipment and sensors.

In the Romanian Register of Large Dams, which has a total of 247 dams, the Stanca-Costesti Dam is on the 49th place in order of height and on the 2nd place according to the total volume of the accumulation lake (1.4 km^3, after the Iron Gates).The Stanca-Costesti hydrotechnical construction was built in order to regulate the flows on the Prut River, supply water to populated centers and industry, mitigate floods, produce electricity, ensure the necessary levels for navigation and for transboundary transit of vehicles. Data provided by hydrometric stations on Prut river in Romania and Stanca-Costesti dam lake will serve as a basis for the study of the water flow fluctuations for improving the decision-making process at national and cross-border level.

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S3.21. A theoretical study of the percolation phenomenon in the ecological framework

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In the present paper the fractional calculus is involved as an effective tool, aiming to study the water percolation into the porous soil. This is a more accurate treatment of the diffusion in the aquifers. The described phenomenon is seen as a natural water filtration system whose features are better depicted by the fractional derivative, occurring into the Fick law of diffusion. The actual analysis is one dimensional, making the task as easy as possible in order to emphasize the great utility of the fractional frame of work. In the final section, the paper is trying to reach the highly important problem of the groundwater contamination.