



5th INTERNATIONAL CONFERENCE **Water resources and wetlands**

Programme and Book of Abstracts

8-12 September, 2021 Tulcea (Romania)



Editors: Petre Gâstescu, Petre Bretcan



INTERNATIONAL CONFERENCE

5th Water resources and wetlands

2021
Tulcea
Romania

8-12 September

5th International Conference
Water resources and wetlands

8-12 September, 2021 Tulcea (Romania)

Programme
and
Book of Abstracts

Editors: Petre Gâstescu and Petre Bretcan

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Programme and Book of Abstracts to the 5th International Conference Water resources and wetlands, Tulcea, Romania, 8-12 September 2021

Editors: Petre GĂȘTESCU and Petre BREȚCAN



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WRW2021 Program at a Glance

8 September 2021	Arrivals of participants, transfer Bucharest airport – Tulcea		
	Bucharest time		
9 September 2021	18:00-20:00	Registration - Hotel Delta 4*, 1 st floor	
	8:00-10:00	Registration - Hotel Delta 4*, 1 st floor	
	10:00-11:30	Opening ceremony / Official Addressing – Room A (Hotel Delta 4*, 1 st floor)	
	11:30-11:45	Coffee break	
	11:45-13:30	Plenary session - Room A (Hotel Delta 4*, 1 st floor)	
	13:00-15:00	Lunch, Hotel Delta	
	15:00-16:40	Oral presentation Hotel Delta 4* - Room A (1st floor) Impact of Anthropogenic activity in Mediterranean watersheds, Aquatic toxicology & Aquatic microbiology	Oral presentation Hotel Delta 4* - Room B (1st floor) Remote sensing and GIS - support for monitoring of inland waters
	16:40-17:00	Coffee break	
	17:00-19:00	Oral presentation Hotel Delta 4* - Room A (1 st floor) Water policies	Oral presentation Hotel Delta 4* - Room B (1 st floor) Climate changing and water resources
	20:00	Gala Dinner, Hotel Delta	
10 September 2021	9:00-10:40	Oral presentation Hotel Delta 4* - Room A (1 st floor) Rivers and lakes ecosystem ecology	Oral presentation Hotel Delta 4* Room B (1 st floor) Deltas and wetlands
	10:40-11:00	Coffee break	
	11:00-13:00	Oral presentation Hotel Delta 4* - Room A (1 st floor) Connectivity of Inland Waters	Oral presentation Hotel Delta 4* Room B (1 st floor) Climate changing and water resources & Coastal environment
	13:00-14:30	Lunch, Hotel Delta	
	14:30-16:00	Posters viewing Hotel Delta 4*	
	16:00-16:30	Workshop AQUACOSM-plus: Offering Access to European Network of Leading Ecosystem Scale Experimental Aquatic Mesocosm Facilities Jens C NEJSTGAARD, Stella A BERGER, Katharina MAKOWER, Consortium AQUACOSMplus	
	16:30-18:00	Plenary session - Hotel Delta 4*, Room A (1 st floor)	
	18:00-18:30	Coffee break	
11 September 2021	18:30-19:00	Conference closing	
	8:30-9:00	Boarding the ship	
	9:00-18:00	Field trip in the Danube Delta Monitoring water quality - demonstration using autonomous robotic boat	
12 September 2021	13:00	Lunch on board	
	7:00-11:00	Departures Tulcea-Bucharest airport	

Program

Wednesday, 8 September 2021

Arrivals of participants, transfer Bucharest airport - Tulcea

18:00-20:00 Registration, Hotel Delta 4*, 1st floor

Thursday, 9 September 2021

8:00-10:00 Registration, **Hotel Delta 4*, 1st floor**

10:00-11:30 Opening ceremony – Official addressing

Opening of the Conference by Mr. **Petre GÂȘTESCU**, President of Romanian Limnogeographical Association

Welcoming address by Mr. **Markus WEITERE**, President of German Limnological Society

Welcoming address by Mr. **Piotr KLIMASZYK**, President of Polish Limnological Society

Welcoming address by Mr. **Marian TUDOR**, General Director of Danube Delta National Institute, Tulcea

Welcoming address by

Welcoming address by Ms. **Atena-Adriana GROZA**, Governor, Danube Delta Biosphere Reserve Authority

Welcoming address by Mr. **Stefan ILIE**, Mayor, Tulcea City

Welcoming Address by Ms. **Núria BONADA**, President of the Iberian Limnological Society (AIL)

Welcoming Address by Mr. **Martin J. KAINZ**, President of the Austrian Society of Limnology and Vice-President of the International Society of Limnology (SIL)

Welcoming Address by Mr. **Thomas SCHNEIDER**, Technical University Munich (TUM), Chair for Aquatic System Biology, Limnological Station

Welcoming Address by Mr. **Gheorghe SERBAN**, „Babeș-Bolyai” University of Cluj-Napoca (Romania)

Welcoming Address by Mr. **Ionut MINEA**, „Al.I. Cuza” University of Iași (Romania)

Welcoming Address by Ms. **Gabriela TOROIMAC**, University of Bucharest (Romania)

Welcoming Address by Ms. **Danut TANISLAV**, Valahia University of Targoviste (Romania)

Welcoming Address by Mr. **Grigore BABOIANU**, Ecological and Social Consultancy Center - ACCES21 Tulcea (Romania)

Welcoming Address by Mr. **Catalin TIBULEAC**, Association of Danube Delta Tourist Destination Management

Welcoming Address by Mr. **George SUCIU jr.**, Beia Consult International, Romania

11:30-11:45 Coffee break

11:45-13:30 Plenary session

Moderators: Włodzimierz MARSZELEWSKI, Gheorghe SERBAN

11:45-12:45 FRESHWATER BIODIVERSITY IN MEDITERRANEAN CLIMATE REGIONS: CURRENT STATUS AND FUTURE TRENDS

Núria BONADA

12:45-13:30 THE MANY SECRETS OF AQUATIC FOOD WEBS - ESSENTIAL NUTRIENTS AND POTENTIAL CONTAMINANTS IN A CHANGING WORLD

Martin J. KAINZ, Matthias Pilecky, Libor Zavorka, Margaux Mathieu-Resuge, Fen Guo, Nadine Ebm, Sami Taipale, Michael T. Brett, Stuart E. Bunn, Brian Fry

13:30-15:00 Lunch, Hotel Delta

15:00-16:40 Oral presentations (Hotel Delta 4*, 1st floor)

Session 1: Impact of Anthropogenic activity in Mediterranean watersheds, Aquatic toxicology & Aquatic microbiology Room A (Hotel Delta 4*, 1st floor)

Chairpersons: Angela BOGGERO, Piotr KLIMASZYK

15:00-15:20 LAKES PAIONE (NW ITALY): TRENDS IN WATER CHEMISTRY, MACROINVERTEBRATES AND ACIDIFICATION INDICES OVER THE LAST 30 YEARS

Angela BOGGERO, Riccardo FORNAROLI, Daniele PAGANELLI, Silvia ZAUPA, Elzbieta DUMNICKA, Michela ROGORA (Italy)

15:20-15:40 ANTHROPOGENIC POLLUTION OF WATER RESOURCES AND ECOHYDROLOGICAL SOLUTIONS FOR QUALITY IMPROVEMENT

Edyta KIEDRZYŃSKA, Marcin KIEDRZYŃSKI, Joanna MANKIEWICZ-BOCZEK, Maciej ZALEWSKI (Poland)

15:40-16:00 IMPACTS ANALYSIS OF MACROINVERTEBRATE ALIEN SPECIES IN THE HYDROGRAPHIC SYSTEM OF A SUBALPINE LAKE ON THE ITALIAN-SWISS BORDER

Daniele PAGANELLI, Lyudmila KAMBURSKA, Silvia ZAUPA, Laura GARZOLI, Angela BOGGERO (Italy)

16:00-16:20 EFFECTS OF THERMAL STRATIFICATION ON BACTERIAL COMMUNITY COMPOSITION THROUGHOUT WATER COLUMN IN A DEEP LAKE

E.Gozde ÖZBAYRAM, Latife KOKER, Reyhan AKÇAALAN, Fatih AYDIN, Meriç ALBAY (Turkey)

16:20-16:40 ADAPTATION ENHANCES THE POSITIVE EFFECT OF TEMPERATURE ON THE COMPETITIVE ABILITIES OF CYANOBACTERIA

Bogdan DRUGĂ, Elisabeth RAMM, Edina SZEKERES, Cecilia CHIRIAC, Adriana HEGEDUS, Maria STOCKENREITER (Romania/Germany)

Session 2 Remote sensing and GIS - support for monitoring of inland waters, Room B (Hotel Delta 4*, 1st floor)

Chairpersons: Thomas SCHNEIDER, Danut TANISLAV

15:00-15:20 SENTINEL-2 TIME SERIES FOR MAPPING THE SPATIO-TEMPORAL DEVELOPMENT OF SUBMERGED AQUATIC VEGETATION AT LAKE STARNBERG (GERMANY)

Christine FRITZ, Katja KUHWALD, Natascha OPPELT, Thomas SCHNEIDER (Germany)

15:20-15:40 SATELLITE SURVEY OF RESTORED RIVER SITES. CASE STUDIES IN ROMANIA

Gabriela IOANA-TOROIMAC, Liliana ZAHARIA, Gabriela Adina MOROȘANU, Alexandra CHELU (Romania)

15:40-16:00 REMOTE SENSING AND IN-SITU MONITORING OF RIVER-CONNECTED GERMAN LOWLAND LAKES

Andreas JECHOW, Igor OGASHAWARA, Christine KIEL, Katrin KOHNERT, Jens C NEJSTGAARD, Hans-Peter GROSSART, Gabriel SINGER, Franz HÖLKER, Jürgen FISCHER, Thomas RUHTZ, Peter GEGER, Maximilian BRELL, Thomas SCHNEIDER, Bert PALM, Paul REMMLER, Jan BUMBERGER, Sabine WOLLRAB, Stella A. BERGER and the CONNECT Lake-Team (Germany/Austria)

16:00-16:20 SURVEY AND STATUS DESCRIPTION OF AQUATIC REED BEDS AT LAKE CHIEMSEE, GERMANY, USING LOW-COST UAV AND HIGH-END PASSIVE AND ACTIVE AIRCRAFT SYSTEMS

Simon BEIER, Nicolas CORTI, Thomas SCHNEIDER (Germany)

16:20-16:40 INTEGRATED ECOSYSTEM ECOLOGY (CHLOROPHYLL-A) OF EYDAP'S RESERVOIRS PROFILES BY USING ROBOTIC BOATS

Georgios KATSOURAS, Michalis CHALARIS, Nikos TSALAS, Alekos DOSIS, Stylianos SAMIOS, Efthymios LYTRAS, Kostas PAPADOPOULOS, Antigoni SYNODINO (Greece)

16:40-17:00 Coffee break

17:00 - 19:00 Oral presentations (Hotel Delta 4*, 1st floor)

Session 1: Water policies, Room A (Hotel Delta 4*, 1st floor)

Chairpersons: Jens C NEJSTGAARD, Mădălina-Teodora ANDREI

17:00-17:20 WATER MANAGEMENT WITH GREEN INFRASTRUCTURES IN ENSURING SUSTAINABILITY OF TURKISH CITIES

Mehmet Emin BİRPINAR, Çiğdem TUĞAÇ (Turkey)

17:20-17:40 ASSESSING OF WATER-RELATED RULES IN LOCAL MASTER PLANS AROUND PORTUGUESE VOUGA RIVER BASIN

Carla RODRIGUES, Teresa FIDÉLIS (Portugal)

17:40-18:00 ASSESSMENT OF SUSTAINABLE DEVELOPMENT CHALLENGES WITHIN A SUBURBAN LACUSTRINE COMPLEX (CRAIOVA, ROMANIA)

Oana MITITELU-IONUŞ, Cristina ŞOŞEA (Romania)

18:00-18:20 BALANCING NONPOINT SOURCE WATER QUALITY MANAGEMENT WITH WETLAND AND STREAM PRESERVATION: LESSONS LEARNED

Andrew DER (USA)

18:20-18:40 SPATIAL PLANNING IN SERBIA: TOURISM DEVELOPMENT BASED ON WATER BODIES IN PROTECTED AREAS

Marijana PANTIĆ, Saša MILIJIĆ (Serbia)

18:40-19:00 THE WATER QUALITY ASSESSMENT OF SITNICA RIVER AND ITS PROTECTION MEASURES

Besime Kajtazi (Kosovo)

Session 2: Climate changing and water resources, Room B (Hotel Delta 4*, 1st floor)

Chairpersons: Dariusz BOROWIAK, Dana Maria (OPREA) CONSTANTIN

17:00-17:20 INTELLIGENT WATER MANAGEMENT SOLUTION FOR SMART CITIES AND SMART AGRICULTURE

Cristina Mihaela BALACEANU, George SUCIU, Filip CONSTANTIN, Oana ORZA, Sabina BOSOC, Alexandru NEGOITA (Romania)

17:20-17:40 VARIABILITY OF RUNOFF OF THE UPPER NOTEĆ RIVER (CENTRAL POLAND)
IN 1981-2016

Katarzyna KUBIAK-WÓJCICKA (Poland)

17:40-18:00 MULTIDISCIPLINARITY AND INNOVATIONS IN AGRO-HYDRO-
METEOROLOGICAL MONITORING (AgHMM) ON IRRIGATION/ DRAINAGE OBJECTS.
CONCLUSIONS FROM THE POLISH RESEARCH INOMEL PROGRAM

Bogdan BAŁK (Poland)

18:00-18:20 MINIMUM FLOW CHARACTERISTICS IN CRIȘUL NEGRU CATCHMENT

Dan-Mircea MIHALEA, Gheorghe ȘERBAN, Ruth PERJU, Ovidiu GACEU (Romania)

18:20-18:40 DEVELOPMENT, ECONOMIC GROWTH, AND SPECIES ENDANGERMENT

Joeri SOL (Netherlands)

18:40-19:00 SMART CONTROL OF THE CLIMATE RESILIENCE OF EUROPEAN COASTAL
CITY (SCORE) HORIZON 2020 - COASTAL CITY LIVING LAB - CASE OF GDAŃSK

Katarzyna BARAŃCZUK, Jacek BARAŃCZUK (Poland)

20:00 Gala Dinner, Hotel Delta

Friday, 10 September 2021

9:00-10:40 Oral presentations (Hotel Delta 4*, 1st floor)

Session 1: Rivers and lakes ecosystem ecology, Room A (Hotel Delta 4*, 1st floor)

Chairpersons: Ionut MINEA, Stylianos SAMIOS

09:00-09:20 AQUACOSM-PLUS: OFFERING ACCESS TO EUROPEAN NETWORK OF LEADING ECOSYSTEM SCALE EXPERIMENTAL AQUATIC MESOCOSM FACILITIES

Jens C NEJSTGAARD, Stella A BERGER, Katharina MAKOWER, Consortium AQUACOSMplus (Germany)

09:20-09:40 APPLICATION OF STATISTICAL MODELING IN RISK ANALYSIS OF SHALLOW LAKES

Zeljka RUDIC, Bojana VUJOVIC, Goran NIKOLIC, Mile BOZIC, Vera RAICEVIC (Serbia)

09:40-10:00 MODELING OF RESHAPING THE BOTTOM OF LARGE RESERVOIRS

Marina SHMAKOVA, Aleksandr RAKHUBA (Russia)

10:00-10:20 INFLUENCE OF FLOODING AND URBANIZED TERRITORIES ON HYDROLOGICAL REGIME AND WATER QUALITY IN THE AMUR RIVER

Aleksei MAKHINOV, Vladimir KIM, Liu SHUGUANG, Aleksandra MAKHINOVA (Russia)

10:20-10:40 HYDROGEN PEROXIDE CONCENTRATION AS AN INDICATOR OF ABIOTIC ENVIRONMENTAL STRESS OF MACROPHYTES FOR MANAGEMENT

Takashi ASAEDA, Mahendra BANIYA, Gulgina MUHTAR, Hiranya JAYASANKA, Fumiko IMAMURA, Akio NOHARA, Hiroki WATANABE, Maoko IGUCHI (Japan)

Session 2: Deltas and wetlands, Room B (Hotel Delta 4*, 1st floor)

Chairpersons: Gabriela TOROIMAC, Renata DONDAJEWSKA-PIELKA

09:00-09:20 *ALDROVANDA VESICULOSA* – POPULATION STATUS AND SPECIES PROTECTION IN EASTERN POLAND

Barbara BANACH-ALBIŃSKA, Marzena PARZYMIES, Magdalena POGORZELEC (Poland)

09:20-09:40 ROLE OF WETLAND ECOSYSTEMS IN WATER QUALITY FORMATION IN TRANSBOUNDARY TERRITORIES OF THE AMUR REGION

Victoria KUPTSOVA, Vladimir CHAKOV, Elena Zakharchenko (Russia)

09:40-10:00 HYSTERETIC BEHAVIOR OF LIQUID DISCHARGE AND SUSPENDED SEDIMENTS CONCENTRATION DURING FLOODS IN THE JIU RIVER BASIN (ROMANIA)

Gabriela Adina MOROȘANU, Jérémy BONNEFOUS, Liliana ZAHARIA, Gabriel MINEA, Gabriela IOANA – TOROIMAC (Romania/France)

10:00-10:20 POSSIBILITIES OF WETLAND RESTORATION IN ORDER TO SUPPORT BIODIVERSITY IN THE POIPIE REGION IN THE SOUTH OF SLOVAKIA

Adam REPEL, Martina ZELENÁKOVÁ (Slovakia)

10:20-10:40 A SIMPLE APPROACH TO ESTIMATE RAINFALL AT DIFFERENT RETURN PERIOD

Nurbaiah MOHAMMAD NOH, Ismail ATAN, Jurina JAAFAR, Yasmin ASHAARI, Mohd BAKRI SAMSUDIN, Mohd Riza KHATIB, Aminuddin BAKI (Malaysia)

10:40-11:00 Coffee break

11:00-13:00 Oral presentations (Hotel Delta 4*, 1st floor)

Session 1: Connectivity of Inland Waters, Room A (Hotel Delta 4*, 1st floor)

Chairpersons: Takashi ASAEDA, Stella A. BERGER

11:00-11:20 NEW METHOD TO IDENTIFY THE COLONIZATION LEVEL OF RIPARIAN VEGETATION SPECIES

Takashi ASAEDA, Md Harun RASHID, Mizanur RAHMAN, Fumiko IMAMURA (Japan)

11:20-11:40 TESTING EFFECTS OF WATER RETENTION TIME ON PHYTOPLANKTON DYNAMICS IN CONNECTED LAKE ECOSYSTEMS IN A LARGE-SCALE ENCLOSURE EXPERIMENT

Stella A BERGER, Sabine WOLLRAB, Jens C. NEJSTGAARD, Christine KIEL, Igor OGASHAWARA, Andreas JECHOW, Katrin KOHNERT, Isimemen OSEMWEGIE, Lena MELLIN, Hans-Peter GROSSART, Gabriel SINGER, Franz HÖLKER, Thomas RUHTZ, Jürgen FISCHER, Gunnar LISCHIED, and the CONNECT LakeLab-Team (Germany)

11:40-12:00 GO WITH THE FLOW - PHYTOPLANKTON DYNAMICS IN RIVER-CONNECTED GERMAN LOWLAND LAKES

Christine KIEL, Igor OGASHAWARA, Andreas JECHOW, Katrin KOHNERT, Jens C NEJSTGAARD, Hans-Peter GROSSART, Gabriel SINGER, Franz HÖLKER, Jürgen FISCHER, Thomas RUHTZ, Peter GEGER, Torsten SACHS, Gunnar LISCHIED, Thomas SCHNEIDER, Sabine WOLLRAB, Stella A. BERGER and the CONNECT Lake-Team (Germany/Austria)

12:00-12:20 FEATURES OF THE IMPACT OF WASTEWATER FROM WASTEWATER TREATMENT PLANTS DISCHARGE ON HYDROECOSYSTEMS OF MOUNTAIN AND LOWLAND RIVERS

Roman BABKO, Tatiana KUZMINA, Volodymyr PLIASHECHNYK, Yaroslav DANKO, Jacek ZABURKO, Joanna SZLUŻYK-CIEPLAK, Grzegorz ŁAGÓD (Ukraine/Poland)

12:20-12:40 HYDROGEN PEROXIDE CAN BE A PLAUSIBLE BIOMARKER IN CYANOBACTERIAL RESPONSES TO PHOTOINHIBITION

Mizanur RAHMAN, Takashi ASAEDA, Helayaye Damitha Lakmali ABEYNAYAKA (Japan)

Session 2: Climate changing and water resources & Coastal environment, Room B (Hotel Delta 4*, 1st floor)

Chairpersons: Alben ALEXANDROVA, Alin MIHU-PINTILIE

11:00-11:20 WILL GLOBAL WARMING ENHANCE GREENHOUSE GAS EMISSIONS FROM LAKES? INSIGHTS FROM ARTIFICIALLY HEATED LAKE IN POLAND

Michał WOSZCZYK, Sławomir CERBIN (Poland)

11:20-11:40 EFFECTS OF TEMPERATURE ON FRESHWATER MACROINVERTEBRATES

Luca BONACINA, Angela BOGGERO, Valeria MEZZANOTTE, Riccardo FORNAROLI (Italy)

11:40-12:00 BASEFLOW IN HORNÁD RIVER BASIN

Patrik NAGY, Martina ZELEŇÁKOVÁ (Slovakia)

12:00-12:20 BIODIVERSITY OF RECENT DIATOM TAPHOCOENOSSES IN THE PUCK LAGOON (SOUTHERN BALTIC SEA)

Dominika HETKO, Małgorzata WITAK (Poland)

12:20-12:40 LINKING TRAWL SELECTIVITY AND WHITING OXIDATIVE STRESS RESPONSE INTO SUSTAINABLE FISHERY MANAGEMENT

Jordan RAEV, Violin RAYKOV, Konstantin PETROV, Nesho CHIPEV, Elina TSVETANOVA, Almira GEORGIEVA, Alben ALEXANDROVA (Bulgaria)

13:00 -14:30 Lunch, Hotel Delta

14:30-16:00 Posters viewing Hotel Delta, Room A (Hotel Delta 4*, 1st floor)

16:00-16:30 Hotel Delta, Room A (Hotel Delta 4*, 1st floor)

Workshop: AQUACOSM-plus: Offering Access to European Network of Leading Ecosystem Scale Experimental Aquatic Mesocosm Facilities

Jens C NEJSTGAARD¹, Stella A BERGER¹, Katharina MAKOWER¹, Consortium AQUACOSMplus²

¹ Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Stechlin, Germany,

² www.aquacosm.eu

Corresponding author e-mail: nejstgaard@igb-berlin.de

<http://www.limnology.ro/wrw2020/workshop.html>

16:30-18:00 Plenary session Hotel Delta - Room A (Hotel Delta, 1st floor)

Moderators: Petre GÂȘTESCU, Martin KAINZ

16:30-17:15 ALL RIVERS FLOW INTO THE OCEAN – ALL THEIR PLASTIC TOO? (TEMPORAL) SINKS OF MICROPLASTICS IN FRESHWATERS

Friederike GABEL

17:15-18:00 DARK SIDE OF CHEMICAL RESTORATION OF LAKES

Piotr KLIMASZYK, Michał RYBAK, Tomasz JONIAK, Agnieszka DREWEK

18:00-18:30 Coffee break

18:30-19:00 Conference closing

Saturday, 11 September 2021

8:30-9:00 Boarding the ship

9:00-18:00 Field trip in the Danube Delta

13:00 Lunch on board

Monitoring water quality - demonstration using autonomous robotic boat

Sunday, 12 September 2021

7:00 Departures Tulcea-Bucharest airport

Friday, 10 September 2021

14:30-16:00 Posters viewing - Room A, Hotel Delta 4*, 1st floor

Moderators: Gabriela MOROSANU, Petre BRETCAN

P1 STUDY OF ATTITUDES AND PERCEPTIONS OF LOCAL COMMUNITY ACCORDING TO THE MANAGEMENT OF LAKE KERKINI (GR1260008), N. GREECE

Anna LATSIOU, Vassilis DETSIS, Georgios EFTHIMIOU and Despina SDRALI (Greece)

P2 CLADOCERA TRAINING SET FROM CENTRAL EUROPE: TOWARDS A QUANTITATIVE RECONSTRUCTION.

Izabela ZAWISKA, Monika RZODKIEWICZ, Michał WOSZCZYK, Jarosław JASIEWICZ (Poland)

P3 INFLUENCE OF BIOLOGICAL REMAINS ON GRAIN-SIZE DISTRIBUTION OF MONTCORTÈS LAKE SEDIMENTS: DEEPENING ON PALEOLIMNOLOGICAL INTERPRETATION.

Pilar LOPEZ-LASERAS, Xènia RODRÍGUEZ, Pelayo NISTAL, Mari Carmen TRAPOTE, Joan GOMÀ, Teresa VEGAS-VILARUBIA (Spain)

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Dāvis GRUBERTS, Jana PAIDERE, Ivars DRUVIETIS (Latvia)

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Keynote speaker

Núria BONADA

University of Barcelona (Spain)



I am a Serra Húnter Associate Professor at the University of Barcelona where I lead the FEHM research group (Freshwater Ecology, Hydrology and Management), that includes more than 20 members. My research career has mainly focused on different aspects of stream ecology. In particular, on the study of large-scale spatial patterns of aquatic macroinvertebrates and their responses to natural and non-natural disturbances, by combining basic and applied research. My research has resulted in more than 150 publications that include more than 90 SCI papers, and I have an H-index of 37. I have contributed to more than 150

presentations in meetings and have given 10 plenary talks in national and international conferences. I have been Associate Editor of *Hydrobiologia*, *Aquatic Sciences* and *Biology Letters*, and I am in the editorial board of *Freshwater Science*, *PCI Ecology* and *PCI Entomology*. I am also in the Advisory Board of some international projects and of the Collserola Natural Park. I have participated in 24 funded national and international projects and 23 contracts with the public administration. Of these, I have been the principal investigator of 8 projects and 7 contracts. In total, I have brought to the University of Granada and Barcelona more than 1M€. My CV also stands out for the collaboration with 10+ national and 30+ international researchers, which is reflected in the number of stays abroad, projects' collaborators, and published papers. I am also the President of the Iberian Limnological Society (AIL) (www.limnetica.net).

FRESHWATER BIODIVERSITY IN MEDITERRANEAN CLIMATE REGIONS: CURRENT STATUS AND FUTURE TRENDS

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Abstract. Freshwater ecosystems account for 0.3% of the planet's freshwater but they are the habitat for 9% of all described species and 35% of vertebrate species. The levels of freshwater biodiversity loss are alarming, doubling those found in terrestrial or

marine ecosystems. Mediterranean climate regions are considered global hotspots of biodiversity, also for freshwater organisms. Rivers in these regions (med-rivers) are unique ecosystems because of their predictable winter flooding and summer drought regimes. They support many species adapted to both floods and droughts, and their high levels of freshwater biodiversity are explained by past historical events and current environmental heterogeneity. At the same time, Med-rivers have been affected for centuries, in some cases millennia, by multiple human activities that increasingly threaten their biodiversity. These threats include changes in land use, nutrient loads, heavy metal concentrations, salinity, water withdrawals, invasive species and, more recently, xenobiotics or emerging organic pollutants. In addition, future climate change scenarios predict increases in drought conditions and in the occurrence of extreme events, such as floods, heat waves, and wildfires. The diversity of aquatic organisms is declining more rapidly in med-rivers than in rivers anywhere else in the world and, for some taxonomic groups, Mediterranean regions have more introduced than native species. Freshwater biodiversity conservation in med-rivers requires innovative approaches to account for both natural and human disturbances. Current protection figures, including the Natura2000 network, do not appear to be very efficient in protecting freshwater biodiversity in med-rivers, so it is necessary to establish conservation criteria adapted to the characteristics of these ecosystems.

Keywords: rivers and streams, floods, droughts, flow intermittence, conservation, management

Martin J. KAINZ

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The research of Martin Kainz focuses on the importance of energy linkages among habitats in freshwater ecosystems. He is especially interested in the function of dietary energy from terrestrial and aquatic sources to consumers in aquatic food webs. He is currently interested in understanding how climate change affects functions, such as vision, cognition, and reproduction in aquatic consumers. His research team explores food web functioning using experimental and field studies and applies biochemical tracers, such as fatty acids and stable isotopes, and recently compound-specific stable isotopes. Martin's passion for exploring aquatic food webs has taken him to Canada, USA, China, Australia, and many countries in Europe. After his MSc at the University of

Vienna, Martin Kainz pursued his doctoral research on trophic transfer of mercury in lakes and reservoirs of Québec, Canada, at the Université du Québec à Montréal, Canada. During this post-doctoral research at the University of Victoria, BC, and the Canadian Water Research Institute, Burlington, ON, Canada, he investigated how to use fatty acids as dietary biomarkers from various sources to aquatic consumers. He currently heads the research group LIPTOX at the Inter-university Centre for Aquatic Ecosystem Research 'WasserCluster Lunz' in Austria. Martin Kainz is currently also president of the Austrian Society of Limnology and a vice-president of the International Society of Limnology (SIL). My lab page: www.kainzlab.com

THE MANY SECRETS OF AQUATIC FOOD WEBS - ESSENTIAL NUTRIENTS AND POTENTIAL CONTAMINANTS IN A CHANGING WORLD

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Abstract. Dietary energy is essential for all consumers, whereas potential contaminants, such as microplastics (MP), may have detrimental physiological effects. In this talk, I will present current and upcoming research about dietary energy and contaminant sources and their physiological implications for aquatic consumers, and will focus on dietary

carbon, lipids, and microplastics in organisms of various ecosystems. Among dietary energy sources, lipids and some polyunsaturated fatty acids (PUFA) are considered essential for consumers, yet in certain aquatic ecosystems their dietary provision may be too low to meet the consumers' physiological demand. I will present how consumers within various trophic networks utilize and rework lipids of allochthonous and autochthonous sources to meet their physiological requirements and how MP can become integral parts of cell membranes. In our current research program, we investigate fatty acids and compound-specific stable isotopes in leaf litter, algae, invertebrates, as well as in fish muscle tissues and organs (liver, gonads, brain, eyes) and show that consumers retain dietary energy preferably from autochthonous sources (algae), whereas long-chain saturated fatty acids, used as indicators of allochthonous dietary diet sources, decrease in concentrations with increasing trophic levels and remain isotopically unchanged. The combined use of fatty acids and their stable isotopes revealed that fishes can convert dietary PUFA to the highly unsaturated docosahexaenoic acid (DHA) in their liver cells and, based on lighter $\delta^{13}C$ values of DHA in fish brain and eyes than in fish liver, it is suggested that neural tissues can further synthesize essential DHA from precursor PUFA. In general, the supply of dietary energy appears to get steadily reworked within consumers of aquatic food webs and even in fish organs to satisfy the consumers' physiological demands. This presentation will round up with some perspectives for nutritional aquatic ecology in a world that faces unprecedented challenges during ongoing climate change.



Friederike GABEL

Institute of Landscape Ecology
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Dr. Friederike Gabel is a post doc at the Institute of Landscape Ecology at the University of Münster, Germany. She completed her PhD on effects of ship-induced waves on benthic invertebrates at the Humboldt University Berlin and the Leibniz-Institute of Freshwater Ecology and Inland Fisheries Berlin. Her research interests are aquatic ecosystem – human interactions, with a focus on benthic invertebrates and biofilms. The investigations are ranging from restoration ecology to effects of biological invasions, habitat degradation and

modifications by global change. During a research stay at the Radboud University Nijmegen, The Netherlands, she studied physiological effects of global warming on crustacea. Since 2014 she focuses on the impacts of microplastic pollution on freshwater ecosystems. She has received grants from several funding organizations such as the German Federal Environmental Foundation and the Federal Ministry of Education and Research and several awards such as the Schwoerbel-Benndorf Young Scientist Award of the German Limnological Society. Her teaching covers zoological classes, physical geography and human-environmental interactions on the Bachelor and Master level.

ALL RIVERS FLOW INTO THE OCEAN – ALL THEIR PLASTIC TOO? (TEMPORAL) SINKS OF MICROPLASTICS IN FRESHWATERS

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Abstract. It is assumed that 80% of the marine plastic originates from land and major parts may be transported via rivers. In all rivers studied so far, plastic was found. However, the longitudinal distribution of plastic in rivers is largely unknown. First studies indicate that the amount of suspended plastic does not correlate with the kilometers flew. Some sampling points downstream other contain less plastic than sites located more upstream. Furthermore, microplastics induce adverse effects on aquatic biota such as reduced growth, and reproduction and higher mortality. In this presentation we investigate possible sinks of microplastics in rivers. The decrease of flow velocities can lead to higher sedimentation rates and the uptake of plastic by organisms (temporally) excludes plastic from the water column. This may result in unexpected patterns of plastic distribution in freshwaters and diverse impacts on freshwater fauna.

Piotr KLIMASZYK

Adam Mickiewicz University in Poznań (Poland)

Piotr Klimaszyk is an associated professor at Adam Mickiewicz University in Poznań. He is a Head of the Department of Water Protection at Faculty of Biology AMU. Since the beginning of his scientific career he has been interested in the interactions between aquatic and terrestrial ecosystems. Initially he studied the functioning of ponds and small bodies of water in different types of landscape, the role of surface runoff in shaping the trophic state of lakes and the influence of waterbirds on the translocation of nutrients between aquatic and terrestrial ecosystems. During his scientific internship in Kazakhstan, he participated in research on the changes in the biotope and biocenoses of the Aral Sea. His current interests include aquatic ecotoxicology and lake restoration ecology. He is a member of the Drawa National Park Advisory Board and, since 2021, President of the Polish Limnological Society.



DARK SIDE OF CHEMICAL RESTORATION OF LAKES

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Abstract. In Europe more than 50% of the water bodies are in a bad ecological and chemical state, and in Central Europe estimates show that even over 80% are seriously polluted. The problem of deteriorating aquatic ecosystems quality has raised worldwide concerns and has resulted in national and international law regulations to protect and restore water resources. According to Water Framework Directive, all water ecosystems in European Union countries should achieve good ecological status by 2027. To improve freshwater ecosystems' quality and ecological status, it is necessary to apply effective restoration methods. These methods are very diverse, ranging from biological that alter ecosystem food chains, through technical methods - supplying oxygen to deep layers of lakes or removing bottom sediments, to chemical methods that alter biogeochemical processes. Often a combination of several methods is used simultaneously, however their primary goal is to stimulate re-oligotrophization processes. Among the chemical methods the introduction of acidic solutions of iron (Fe) or aluminum (Al) salts, which bind phosphates into complex compounds is very common. Chemical inactivation of phosphorus results in almost immediate improvements in water quality at relatively low

cost. However, the effects of coagulants are not always predictable, and the magnitude of ecosystem hazards is not fully understood. The use of the coagulants results in physical and chemical transformations, which lead to short-term acidification, deterioration of optical water properties and sedimentation of aggregates-flocks. We found the changes in functional traits of charophytes and macrophytes (relative growth rate inhibition, stem, leaves and roots mass reduction or photosynthetic surface area augmentation through the development of branchlets and side-branches) treated with coagulants. The response is species-depend. High coagulant concentration create the possibility of plant death. Acidification also contributes to the dissolution of the carbonate encrustation covering the charophytes and imbalance the calcium budget in the ecosystem (in sulphate compounds). Elimination of bioavailable phosphates and excess of Fe or Al ions has consequences in the disruption of ecological homeostasis resulting in the C: N: P ratio change and metal ions accumulation. In the case of consumers, experimental studies show that Fe and Al-based coagulants may disrupt embryonic development and reduce the reproductive success of pike – species of particular interest for biomanipulation – top-down regulation. In the mussels, filter feeders essential for the ecosystem health, disturbances in filtration rate, with closing time extension, starting immediately after coagulant application were observed. Acidification and the environmental elemental composition changes lead to the metal ions accumulation and reduction of phosphorus and calcium content in the mussels bodies.

Keywords: eutrophication, phosphorus, lakes restoration, aluminum coagulant, iron coagulant, adverse effects

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THE BIODIVERSITY OF THE DANUBE DELTA BIOSPHERE RESERVE REFLECTED IN THE STRUCTURE OF THE ECOSYSTEMS

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Abstract

Taking into account the morphologic-hydrographic configuration of natural ecosystems or ecosystems partly modified by man the area, its flora and fauna communities and the long-term human impact, the two main categories of Danube Delta ecosystems associated Biosphere Reserve, have been delimited: natural ecosystems or ecosystems partly modified by man; anthropic ecosystems. To identify and characterize ecosystems, have been analysed the data on hydrography, morphology, biodiversity, human settlements, types of land use, spatial changes through the construction of agricultural, fisheries, forestry polders, modification of the network of channels and canals with consequences on the water circulation system inside the delta. The first category natural and partly modified by man ecosystems comprises 23 types (water bodies: running waters-Danube and its main branches, channels and canals; standing freshwater-lakes; standing brackish and salt waters-coastal lagoons, coastal, marine zones; wetlands: water fringe vegetation-flooded reed beds, floating reed beds <plaur>, riparian willow formations, frequently flooded river levees; forests, shrubs and herbaceous vegetation: temperate riverine forests-mixed oak woods, shrubs and herbaceous vegetation, steppe meadows, meadows on low marine levees; dunes, beaches). The second category anthropic ecosystems includes 7 types (agricultural lands, forest areas-plantation on the river banks, fish farms, settlements-villages, towns). With the establishment of the Danube Delta Biosphere Reserve in 1990, with the statutory provisions on the protection and conservation of biodiversity, the deltaic landscape, some of the previous pressures were reduced, but the pollution of the Danube waters less consolidated beaches (Sulina, Sfântu Gheorghe, Chituc) and related with touristic activities, on ecosystems as a whole. The tourism activitie, also must represent not only a positive and dynamic development factor but also a practical solution to keeping the environment unaltered. These aspects were mentioned in the characterization of the ecosystems presented in this article.

Keywords: Danube Delta, morphology, hydrology, biodiversity, natural and modified ecosystems.

HYDROGEN PEROXIDE CONCENTRATION AS AN INDICATOR OF ABIOTIC ENVIRONMENTAL STRESS OF MACROPHYTES FOR MANAGEMENT

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Abstract

Submerged macrophytes are often-found in Japan rivers, which have spread widely in the past two decades in gravel rivers, where no submerged macrophytes found before. As a result, Japanese gravel bed ecosystems have now been dominated by macrophytes. In rivers and streams, water flow velocity is considered as a major abiotic stressor on submerged macrophytes. At the same time, the solar radiation and temperature also have some effects. However, as they are different types of physical quantities, it is difficult to compare the magnitude of their effects. Plant cellular level hydrogen peroxide (H_2O_2) is one of the major reactive oxygen species (ROS) generated as a byproduct of normal cell metabolism and functions as a signaling molecule. However, under stressful conditions, ROS are extensively generated and have adverse effects on the normal functioning of cells. The interactive effects of water flow velocity, temperature and light regimes on the accumulation of H_2O_2 in plant tissues were evaluated using H_2O_2 as an indicator of environmental stress. Field studies were conducted at several locations in natural streams and were complemented with laboratory experiments to determine the stress responses of the several macrophyte species to these abiotic stressors. The variations in H_2O_2 , antioxidant activities and photosynthetic pigments as responses to and indicators of environmental stress were analyzed. The results showed that H_2O_2 concentrations in macrophyte tissues uniquely increased with flow velocity or solar radiation for all species, while increased or decreased with water temperature, depending on species. When the H_2O_2 concentration exceeds some particular values, plant tissue starts to deteriorate, and the chlorophyll concentration decline, indicating the critical values required for survival of particular macrophyte species. The antioxidant activities increased proportionally with the H_2O_2 concentration; however, there was a delay in the antioxidant activity response. The total H_2O_2 concentration is given by the sum of concentrations estimated from the relation with each stress intensity. It was indicated that H_2O_2 concentration becomes a useful indicator of environmental stress intensity on macrophytes, and is widely available in the management.

Keywords: hydrogen peroxide, abiotic environmental stress, oxidative stress, monitoring method, macrophyte management, photo-inhibition

SPACE-TIME AND NICTEMERAL VARIATION OF NITRATE (NO₃) ON THE SURFACE AND BOTTOM OF THE WATER COLUMN, AT TWO POINTS WITH DIFFERENT FRAMEWORKS, IN THE JACUÍ DELTA, LAKE GUAÍBA, RS, BRAZIL

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Abstract

In the present work, nitrate in surface and bottom water was evaluated at two specific points, with direct influence on its water quality, in addition to the proximity of the points to the capture of raw water by the Municipal Department of Water and Sewers (DMAE) in this spring, in the Jacuí Delta, upper course of Lake Guaíba, a group of sixteen islands, canals, swamps and ponds formed by the meeting of the Jacuí, Gravataí, Sinos and Caí rivers, in Porto Alegre, RS. Surface and bottom water samples were obtained with the aid of portable equipment for 24 hours totaling 12 samples from each horizon, in two collection points, located on the left side of the stream with greater urban influence and another point on the right side with greater rural influence, after the collections, the NO₃ values were verified in the laboratory, totaling four sample campaigns (september, november 2019 and in january and february 2020), contemplating the spring and summer seasons. Through the analysis of variance, significant differences were detected between the sampling points and between the sampling campaigns. The left side of the Jacuí Delta receives the greatest contribution from the Gravataí River. Regarding the temporal variation, the average was lower in september, increasing significantly in november. For the point on the right bank of the flow with the greatest influence of the Jacuí River, the average value was significantly higher in the 1st sampling campaign (september), the points analyzed showed opposite behaviors for each campaign. This temporal oscillation was probably influenced by temperature variation, rainfall events, wind and wave performance, production and decomposition processes, among others. It is expected with this work, to collaborate with subsidies for the understanding of processes occurring in the Jacuí Delta as a control of nutrient entry.

Keywords: Nitrate; APA Delta do Jacuí; Guaíba Lake; water quality; nictemeral; limnology

FORESTS LOCATED ON BANATULUI MOUNTAINS RIVER SLOPES THAT SUPPLY ACCUMULATION LAKES

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Abstract

The forests from river slopes located in Banatului Mountains that supply accumulation lakes from these mountains have an extremely important ecologic purpose. Even though they occupy a small surface (8%) in comparison with other forest types from this area, they ensure a regularization of water fluxes, reducing erosion and landslides. In addition, they contribute to soil water infiltration and to the reduction of accumulation lake clogging. All these effects are also translated in the specific management measures destined for them (prohibiting cuttings, with the exception of hygiene ones, ensuring natural regeneration, etc.). The present paper analyses all state forests that belong to this category and to this area, which comprises 24 forest districts. The data was centralized and interpreted from management forest plans. The analysis of an extremely wide set of data (9774 stand elements) ensures a good representation of the obtained results. These results relate to stand conditions (location, age, structure, consistency, production class, and species) as well as site conditions (exposition, field inclination and altitude, flora, soil and station type). These forests are mainly comprised of common beech, followed by Norway spruce, oak and other species. Furthermore, they have a relatively uniform distribution on ages (with a preponderance of forests aged 20-40), have mainly relative even-aged and relative uneven-aged structures, high consistencies and average production classes. From the point of view of site conditions, these forests are mainly distributed on North-West and South-West expositions, on high and very high slopes, at average altitudes specific to Banatului Mountains, on dystic cambisoils and eutric cambisoils, on stations from the common beech mountain-premontane level on superior and average quality, on common beech or mixtures forest types with an *Asperula-Asarum* flora. In conclusion, it can be seen that forests from river slopes that supply accumulation lakes from Banatului Mountains are forests of a high quality (superior production classes, high consistencies, diversified structures) that use in a superior way local site conditions (soils of average and superior quality).

Keywords: stands, accumulation lakes, site, soil, altitude, exposition.

POSSIBILITIES OF WETLAND RESTORATION IN ORDER TO SUPPORT BIODIVERSITY IN THE POIPIE REGION IN THE SOUTH OF SLOVAKIA

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Abstract

The diverse activities of man in nature significantly affect the structure and functioning of ecosystems, endangering their integrity. Many native ecosystems have been destroyed (destruction), divided into smaller parts (fragmentation) or damaged in other ways (disturbance). In places of indigenous ecosystems, man deliberately created new ones (anthropogenic), or eventually altered the original ecosystems to provide him with the necessary food, raw materials and other benefits to meet his well-being needs. Long-term efforts to protect nature and the landscape, nor the protection of biodiversity in the last two decades have yielded the desired result - halting the process of species extinction, reducing biodiversity and maintaining functioning ecosystems in the country. Recovery of disturbed ecosystems now appears to be a necessity leading to the restoration of the structure and functions of ecosystems in the country. The concerned area is located in the Ipeľ river basin in the south of central Slovakia in Central Europe. The article deals with the possibilities of revitalization of small-scale protected nature reserves located in this basin in order to restore biodiversity and eliminate adverse effects of anthropogenic activity. This region is characterized by the hills, where the dominant feature is the third longest Slovak river, Ipeľ. Ipeľ is the left side inflow of the Danube with the total length of 232.5 km. The share of the total Ipeľ river basin in whole area of Slovakia is 7.4%. The highest flows in the Ipeľ watercourse occur in March and April, the minimum flows in September and October. The average annual temperature in this area is 9.8 ° C and the annual total rainfall is around 600mm. The concerned area is characterized as an area of European importance called Poiplie, and is part of the network of protected areas of EU NATURA 2000 countries. In the 1970s, the significant adjustments to the flow of rivers has been conducted in the whole territory of Slovakia, including the Poiplie region. On the upper part of the river Ipeľ there is a water reservoir Málinec. This article deals with the section of Ipeľ between the towns Lučenec and Šahy. In almost all of this part, Ipeľ maintains the original, unchanged route and forms the border between Slovakia and Hungary. The number of dry seasons is currently increasing and the natural wetland environment is gradually drying out and disappearing in this area too. There are several small-scale nature reserves in this area, which are gradually losing their natural biodiversity due to anthropological interventions in the Ipeľ river basin. The subject of the protection of these small-scale protected areas is to ensure the protection of the hydrophilic, marsh and water communities of Poiplie with the occurrence of several rare, endangered and protected species of fauna and flora. This paper shows a proposal for concrete technical actions that can enhance the landscape's water retention capacity and create suitable conditions for maintaining and restoring biodiversity. The article deals with the proposal of technical actions to increase biodiversity in the nature reserve Dálovský Močiar, NNR Kiarovský Močiar, NNR Tešmácka mokrad' and NNR Ryžovisko. All

of these reserves are protected areas located in Poiplic and are currently experiencing a decline in biodiversity and a loss of naturally occurring fauna and flora.

Keywords: wetland restoration, revitalization, Ipeř river, biodiversity restoring

AQUACOSM-PLUS: OFFERING ACCESS TO EUROPEAN NETWORK OF LEADING ECOSYSTEM SCALE EXPERIMENTAL AQUATIC MESOCOSM FACILITIES

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Abstract

Human impact on the environment manifests in rapidly changing status of lakes and rivers around the globe. A wide range of effects have already been documented. We argue that for better understanding the mechanisms behind the observed development of any ecosystem, a combination of long-term data, coupled with ecosystem-scale experiments, have a greater potential to yield data that helps to understand the responses observed in each ecosystem by providing more comprehensive data for successful model testing and development of predictive concepts. However, the knowledge about the ongoing processes on ecosystem levels, is still limited for most systems. One reason is the great need for substantial technical investments and know-how to experimentally study ecosystems on adequate scales. Advanced large-scale facilities allowing such studies are not readily available to scientists throughout Europe, and even less so throughout the world. To overcome this regional lack of access to aquatic experimental (mesocosm) facilities, the EU-funded Research Infrastructure (RI)-projects AQUACOSM (2017-2020) and the newly expanded AQUACOSM-plus (www.aquacosm.eu, 2020-2024) offers access to >50 leading research facilities across the EU. The AQUACOSM-plus project network is further linked to a world-wide cooperation through the MESOCOSM.EU portal, a virtual network of >100 research facilities. Both networks comprise mesocosm facilities in all aquatic systems, including rivers, ponds, lakes, estuaries and marine systems – offering unique opportunities to conduct ecosystem-scale experimental studies of relevance to aquatic-terrestrial coupling. In this talk we want to inspire you use these opportunities and apply for support (travels, subsistence and housing) from our network to participate in, or even design future experiments together! These experimental research facilities can be used for large-scale process-based studies to test models based on trend or response observations, in order to understand underlying mechanisms of ecosystem functioning relating to the present global Grand Challenges (climate change, biodiversity loss, eutrophication, emerging pollutants, and much more). Interested persons are also welcome to suggest other uses of these research facilities, such as conducting ecosystem solution-based experiments to enable effective management in aquatic ecosystems. The AQUACOSM-plus network will fund access to >10.000 days for a wide range of external

users, including scientists, students, industry and developers, from the whole world. Hope to see you at the talk!

Keywords: ecosystem-scale, mesocosm, aquatic enclosure, funding opportunity, networking, collaborative science

CLADOCERA TRAINING SET FROM CENTRAL EUROPE: TOWARDS A QUANTITATIVE RECONSTRUCTION.

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Abstract

The reconstruction of the past environment changes is possible through the use of lake sediments considered to be excellent archives of the past. The sources of information preserved in the sediments are various: the physical and chemical properties of the sediments as well as remaining animal species composition analysis. Cladocera is one of the main components of lake zooplankton, many species remains can be found in lake sediment samples and recognized to species level. The traditional way to interpret results of the paleolimnological analysis is based on the use of indicative species as well as a full assessment of the subfossil communities species composition. Nowadays quantitative methods are developing. In paleolimnology, there is a tendency to apply quantitative reconstruction such as transfer functions. In order to obtain quantitative information on past environmental changes, a training set was built based on the subfossil Cladocera from the sediments of lakes located in Central Europe. Cladocera species composition depends mainly on the trophic state of the lake. Therefore, in summer 2018, 2019 and 2020 sediment samples from the deepest part of 64 lakes characterized by different trophic status were collected. Both, sediment and water samples, were prepared in the laboratory according to adequate methodology and analyzed. The water quality parameters were measured during field campaign: Secchi depth (m), chlorophyll-a ($\mu\text{g/l}$), cyanobacteria (phycocyanin BGA, $\mu\text{g/l}$), dissolved oxygen (mg/l), total dissolved solids TDS (mg/l), pH, temperature. Moreover, water samples were taken and analyzed in the laboratory to determine HCO_3^- , SO_4^{2-} , NO_3^- , NH_4^+ , P_{tot} and PO_4^{3-} . The water properties measured in situ demonstrate that studied lakes represent a wide gradient of values, particularly: Secchi depth (5.96-0.53 m), conductivity (103.3-481.4 μS), chlorophyll-a (0.45-40.53 $\mu\text{g/l}$) and phycocyanin BGA (0-5.88 $\mu\text{g/l}$). The results of Cladocera found as subfossils in sediments and from zooplankton revealed changes in species distribution and can be related to variable water parameters. Bosminidae family species predominate.

Interestingly, the rare *Bosmina* species such as *Bosmina (E.) longicornis*, *Bosmina (E.) reflexa*, *Bosmina (E.) thersites* were found in a large numbers in the sediment samples. *Bosmina (E.) thersites* seems to prefer more eutrophic conditions while *Bosmina (E.) reflexa* was found in less productive lakes.

Keywords: subfossil Cladocera analysis, transfer function approach, trophic state reconstruction, Central Europe

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THE ROLE OF PLANNING LEGISLATION IN THE PROTECTION OF "PRVONEK" ACCUMULATION

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Abstract

Planning documents serve as the basis for planning the areas and sustainable use of land, water and other resources, through integral approach to the development and protection of space. Spatial plans for special-purpose areas (SPSPA) for accumulation basins provide the ground for sanitary protection of basins, protection and development of the catchment area, improvement of infrastructural and public services and utilities equipment and other. The "Prvonek" accumulation, belonging to the territory of the City of Vranje, is a multi-purpose facility for water supply and/or regulation of high and low water regimes. In its planning, construction and utilisation, all the possible implications on the catchment area and accumulation were taken into consideration. In that context it is required to examine the impact of population on the utilisation and management of land and water resources in the accumulation and/or exploitation of forests and forest and agricultural land. Pollution of surface water and groundwater that drain into the accumulation and the infill of accumulation with erosion deposits present the limits in terms of protection and preservation of accumulation and other natural potentials of the area. This paper analysis the catchment area of the "Prvonek" accumulation and presents the planning solutions and/or their effect on the utilisation and management of the accumulation, as well as the protection and preservation of land in the catchment area.

Keywords: accumulation, land, protection, population, catchment basin, forests

INFLUENCE OF BIOLOGICAL REMAINS ON GRAIN-SIZE DISTRIBUTION OF MONTCORTÈS LAKE SEDIMENTS: DEEPENING ON PALEOLIMNOLOGICAL INTERPRETATION

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Abstract

The varved lake sediments (also known as annually laminated sediments) are natural paleoenvironmental archives at seasonal to annual scale that offer a continuous and homogeneous series of environmental and climatic records. The grain size data have been widely used for paleoenvironmental reconstructions as an indicator of climatic changes, since it is affected by hydrodynamic conditions, fluvial transport, runoff and eolian activity. Previous studies on grain-size distributions of lake sediments have focused mainly on the lithogenic phase and in its relationship with transport mechanisms, but relatively little attention has been paid to the biological component of sediment, in terms of grain size. Diatoms frustules and pollen grains are usual biological components of sediments, and they are frequently used as proxies for paleoecological interpretations. Since biological remains also contribute to determine the distribution of grain-size, an accurate knowledge of the relationship between grain-size and the abundance of sedimentary biological particles may be useful for paleoecological reconstructions avoiding the misinterpretation of measured bulk sediment grain-size distributions. Lake Montcortès is located in the southern flank of the Central Pyrenees (Catalonia, Spain). It is a karstic lake with a surface area of 0.14 km² and 32 m depth. The lake's sedimentary record shows thin well preserved biogenic varves formed during the Late Holocene. The varve structure alternates between sublayers of endogenic calcite and organic detritus, with additional detrital layers and turbidites embedded in the varve succession. Previous studies on the distribution of biological remains along a varved core (1413-2012 CE) revealed the importance of Cannabis pollen (25-30 microns) related to hemp retting (mid 17th to late 19th). Also, large amounts of very small frustules of *Cyclotella ocellata* (6 -19 microns) and *C. cyclopuncta* (5.5 - 12 microns) spike the same sedimentary record, except for the period between 1850 and 1886 CE. Finally, a study of modern analogues showed the seasonal sedimentation of calcite crystals with variable size. In order to relate these variables with the grain-size distribution of bulk sediment, a stratigraphically correlated core was subsampled at the same resolution (80 samples). Samples were first treated with H₂O₂ (10% volume) and latter disaggregated and dispersed ultrasonically with pyrophosphate. Granulometric determination was performed with a Beckman-Coulter LS230 laser equipment. Grain size distribution shows alternance of unimodal and polimodal distributions, with conspicuous modes around 110-140, 25-30, and 10-15 and microns.

Keywords: varved sediments, grain-size, pollen, diatoms, calcite crystals

DOWNSTREAM CHANGES IN PHYTOPLANKTON AND ZOOPLANKTON COMMUNITIES OF THE MIDDLE DAUGAVA RIVER DURING THE SUMMER LOW-WATER PERIOD: A LAGRANGIAN DRIFT STUDY

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Abstract

On July 9–10, 2014, the first real-time diurnal Lagrangian drift experiment was conducted on the Middle Daugava at Daugavpils (SE Latvia) to reveal downstream changes in its phytoplankton and zooplankton communities during the summer low-water period. The drift experiment was conducted *in situ* by applying a manned drifting research platform made from a maritime life-raft. During the drift, the platform tracked selected water masses in the river for 23 hours, and instrumental measurements of their physical and chemical properties were performed along the route each hour. Simultaneously, phytoplankton and zooplankton samples were collected and analyzed later by applying standard methods. In total, measurements were performed and samples of water were collected at 23 sites along the drift route ~ 33 km in length. During this study, 93 phytoplankton taxa were identified. The most abundant were green algae (40 taxa), diatoms (25 taxa) and blue-green algae (16 taxa). The number of taxa per sample varied significantly along the route (between 28 and 45, respectively). However, there was no significant downstream trend stated. The most abundant algae were *Cryptomonas* sp., which were found in almost all sampling sites. Other 18 green algae and diatom taxa were found in more than 70% of the sites (i.e. *Ankistrodesmus* sp., *Coelastrum microporum*, *Cosmarium* sp., *Crucigienia rectangularis*, *Dyctiosphaerium pulchellum*, *Koliella* sp., *Oocystis lacustris*, *Pediastrum boreanum*, *Scenedesmus apiculatus*, etc.). In total, 56 zooplankton taxa were also identified during this study, mostly rotifers, both by their abundance and number of taxa. Overall abundance gradually decreased towards the end of the drift. Macrophagous and microphagous organisms were dominant groups of the rotifers. The abundances of loricate planktonic microphagous *Keratella cochlearis* and loricate, soft-loricate or illoricate littoral microphagous *Brachionus quadridentatus*, *Lecane closterocerca*, *Euchlanis dilatata*, Bdelloidea, as well as the macrophagous *Cephalodella* sp. changed differently along the route. Thus, *Keratella cochlearis* dominated the zooplankton at the beginning of the drift, and its abundance decreased downstream. In contrast, the abundance of other taxa mentioned above increased in the middle and end sections of the drift route. Results of this Lagrangian study illustrate that river channel's morphology and current velocity are among main physical factors that determine the zooplankton communities' structure during its downstream transport. Statistical analysis of the results of instrumental measurements revealed also the diurnal

cycles of several parameters (temperature, dissolved oxygen, etc.), probably related to the energy and gas exchange between the drifting water masses and the atmosphere.

Keywords: phytoplankton, zooplankton, downstream changes, Lagrangian method

THE NEW DATA ON THE DISTRIBUTION OF DIATOMS IN THE CENTRAL EUROPEAN LAKES AS A BASIS TO RECONSTRUCT PAST ENVIRONMENTAL CHANGES

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Abstract

The transfer function method has been developed as a useful tool for reconstruction of the past environmental changes. It is based on the assumption that the modern species, which ecological requirements are known, can be used to quantitative reconstructions of the past changes. We present preliminary results from an ongoing research project aiming at quantifying the relationships between modern diatom assemblages and present-day environmental conditions. These relationships will be used to develop a diatom-based training set that will be applied to future studies of environmental change in Polish lakes. Surface sediments for diatom and chemical analyses were collected from 44 lakes located in north-eastern Poland from the deepest part of the lake in summer 2018, 2019 and 2020. At each site, a suite of important water quality parameters was collected: Secchi depth (m), Chlorophyll ($\mu\text{g/l}$), cyanobacteria (phycocyanin BGA, $\mu\text{g/l}$), dissolved oxygen (mg/l), total dissolved solids TDS (mg/l), pH, temperature. Moreover, water samples were taken and analyzed in the laboratory to determine HCO_3^- , SO_4^{2-} , NO_3^- , NH_4^+ , P_{tot} and PO_4^{3-} . Diatom assemblages from each site were counted and identified to the most specific taxonomic level possible. Diatom data were compiled for comparison with corresponding environmental data and development of indicator models. The first results of the analysis show changes in diatom distribution as well as the chemical and physical water properties. We found 157 taxa of diatoms and 40 species with minimum 2% abundance. The most abundant species from the north-eastern training set were: *Aulacoseira ambigua*, *Pantocsekiella comensis*, *Staurosira construens*, *Staurosirella lapponica*, and *Stephanodiscus parvus*.

This study is a contribution to project funded by National Science Centre 2016/23/D/ST10/03071.

Keywords: diatom, transfer function, training set, environmental gradients, NE Polish lakes

STUDY OF ATTITUDES AND PERCEPTIONS OF LOCAL COMMUNITY ACCORDING TO THE MANAGEMENT OF LAKE KERKINI (GR1260008), N. GREECE

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Abstract

Lake Kerkini is one of the most important lakes in Northern Greece hosting rich biodiversity. It is an artificial lake protected by international conventions and the EU and national legislation. It belongs to the European ecological network NATURA 2000 under code GR1260008. Aim of this study was to investigate the attitudes and perceptions of the inhabitants of the settlements near Lake Kerkini, with respect to the management of the lake's ecosystems, with special focus on its integration into the Natura 2000 Network and its Management Body's (M.B.) actions. An anonymous questionnaire that was used as a survey tool was filled by inhabitants of the settlements located around the lake. The survey took place in the summer of 2019. The results of the survey showed that half of the residents knew about the NATURA 2000 network, while 1/3 of the respondents did not know what the NATURA 2000 network was. 13.22% of them did not know that Kerkini belongs to Natura 2000 network. 31.61% of respondents believed that the integration of the lake into the network has stimulated ecotourism and the local economy, while ¼ of them (24.14%) believed that the area did not benefit from the protection status. Regarding the M.B. only 32.18% of the respondents are aware of its existence and actions, while there is a small percentage (7.47%) who believe that the operation of the Management Body impedes the daily life of residents due to imposed bans and restrictions. The majority of respondents, who were positive about: a) the NATURA 2000 network (89.1%) and b) the existence and operation of the MB (87.9%), were people active in the secondary and tertiary sectors.

Keywords: Kerkini Lake, protected area, management, attitudes, perceptions

MODELING OF RESHAPING THE BOTTOM OF LARGE RESERVOIRS

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Abstract

The Kuibyshev reservoir was formed on the Volga river and is the largest in Eurasia. The length of the reservoir along the Volga is 510 km with its maximum depth of 41 m and average depth of 8 m; the area of water mirror is 6,450 km². Conditions of runoff formation in catchment area, as well as seasonal and daily pondage are the reasons for unsteady pattern of the reservoir. Specificity of flow control in the Kuibyshev reservoir

pre-determines water masses motion, flow speed pattern, as well as degree of water saturation with suspended sediments and, therefore, reservoir bed siltation intensity. The lowest flow velocity in the reservoir is observed in summer-autumn period of year; at this time, the reservoir bottom is reshaped least actively. During spring filling, flow velocity in the reservoir is at maximum, hence, favorable conditions to transfer small and large fractions of suspended sediments are created. Most of them enter the reservoir during its spring time filling, although sometimes, sediments maximum was observed earlier, before reaching the peak of flood wave in the reservoir. Flow pattern unsteadiness leads to increase or decrease in flow transfer capacity and, hence, changes in bottom levels. Complex configuration of banks, large depth gradients and basin morphology's particulars pre-determine instability of sedimentation processes in water area. 3D hydrodynamic model of the reservoir (A. Rakhuba) forms the basis for calculating bottom level motions of the Kuibyshev reservoir. This model is supplemented with analytical formula for sediment consumption (M. Shmakova) and hydraulic ratios to calculate erosion and sediments accumulation (M. Shmakova). Four ice-free months runoff simulation of the Kuibyshev reservoir includes the following main water content phases: low water period and periods of snow flood and rain floods. The study of spatial and temporal patterns of bottom reshaping has shown that greatest intensity of such reshaping occurs during the period of large level gradients, i.e. high water. Flood swelling is featured by intensive bottom erosion. When flood recesses, transfer capacity decreases that leads to sedimentation. The greatest motions in bottom reshaping occurs in the places of channel contraction, which is explained by sharp changes in channel capacity.

Keywords: modeling, reservoir, bottom, sediment, erosion, accumulation

PHYTOPLANKTON COMPOSITION AND WATER QUALITY IN FISH FARMING PONDS

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Abstract

The Czech Republic is a country with a very long tradition in fish farming. Since there is a lack of natural lakes, fishponds are the most common type of stagnant water bodies in this country. Although the deterioration of water quality – especially eutrophication – has been observed, research on planktonic communities of fishponds, especially small ones, has been neglected and not sufficiently studied in the last years. Monitoring of the plankton and basic water parameters takes an important place for successful aquaculture management. Therefore, we conducted phytoplankton and water analyses in fish farming ponds Bohuslavice 1 (1 ha), Bohuslavice 2 (0.8 ha) and Bohuslavice 3 (0.6 ha), which are located in the District Prostějov, within the Olomouc Region in the Czech Republic. Water samples were collected monthly or bi-weekly during the April-September period in 2016 and 2017 using plankton net and sampling containers. Basic parameters of water were measured immediately in the field using mobile instrument. Dissolved oxygen

concentration was the highest in the spring and decreased over the following months, reaching a minimum during the summer months in each pond in both years. All monitored ponds showed similar nutrient concentrations (mean \pm SD: TN = 1.74 \pm 0.64 mg/l, TP = 0.27 \pm 0.18 mg/l). Altogether, 130 taxa of phytoplankton from eight divisions: Cyanobacteria (11), Dinophyta (4), Cryptophyta (3), Chrysophyta (9), Xantophyta (4), Bacillariophyta (22), Euglenophyta (19) and Chlorophyta (58), were identified in ponds. Green algae were the most diverse group in each pond. Green algae were also the most abundant group in most samples during the monitoring. The main representatives were from genera *Monoraphidium*, *Desmodesmus*, *Scenedesmus*, *Pediastrum*, *Crucigenia* and *Tetrastrum*. In addition to these taxa, genera *Trachelomonas* (euglenophytes) and colonial *Fragilaria* (diatoms) were also numerous. Surprisingly, *Peridinium* sp. (dinophytes) was the most dominant species (70% of the total amount of cells) in July 2016 in Bohuslavice 1 fishpond. The greatest phytoplankton abundance in Bohuslavice 1 pond was documented in September 2017, in Bohuslavice 2 pond was in July 2017, while in Bohuslavice 3 pond the greatest phytoplankton abundance was observed in September 2016. The dissolved oxygen concentration, composition and abundance of phytoplankton were probably affected by excessive growth of free-floating plants *Lemna minor* and *Spirodela polyrhiza*, which covered a significant part of the surface of all three ponds in both years, and submerged macrophyte *Ceratophyllum* inhabiting Bohuslavice 1 and 3 fishponds.

Keywords: phytoplankton, green algae, nutrients, oxygen, macrophytes, pond

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WATER QUALITY – WEATHER CONDITIONS – SUBMERGED VEGETATION RELATIONS IN SHALLOW RESTORED RESERVOIR

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Abstract

Small (37 ha) and shallow (max depth 9 m, mean depth 2 m) man-made Rusalka reservoir situated in Poznan (Western Poland) is under restoration by means of phosphorus inactivation since 2006. Massive cyanobacterial blooms were replaced partially by submerged macrophytes vegetation. The aim of the studies conducted in 2016-2019 was to determine spatial and temporal variability in water quality (nutrients and chlorophyll-a concentrations) in relation to submerged vegetation (mainly *Potamogeton crispus*). Until its full development, there was no intensive phytoplankton proliferation due to (i) the competition for nutrients and (ii) allelopathic influence of *P. crispus* metabolites on phytoplankton, especially cyanobacteria. It was only in August that the cyanobacterial bloom appeared as a result of release of phosphorus in the process of the mineralization of plant tissue. This phenomenon was more significant in 2018-2019 in comparison to

2016-2017 due to variation in weather conditions. Last two years were characterized by higher temperatures and long periods with very low precipitation, causing drought in Poland. It affected both submerged vegetation (shorter life span) and phytoplankton (higher biomass, expressed as chlorophyll-a), as well as water quality (increased internal loading from sediments, typical for shallow lakes). However, the concentrations of phosphorus remained on similar level due to (i) lower external loading (lower precipitation) and (ii) frequent phosphorus inactivation in the course of restoration process (so called 'sustainable restoration'). The studies of water quality in Rusałka reservoir in last years underlined the urgent need of regular monitoring during the process of restoration in the light of weather condition changes (most probably related to climate changes), allowing to adjust the frequency of phosphorus precipitation as well as indicate the timing of macrophytes harvesting.

Keywords: drought, nitrogen, phosphorus, restoration, submerged macrophytes.

PRELIMINARY DATA REGARDING NESTING SITE SELECTION OF THE EURASIAN COOT (*FULICA ATRA*) IN THE LOCAL CONDITIONS OF CÂMPENEȘTI, ROMANIA

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Abstract

In this paper, we analyze the coot's preferability in choosing the nest site, regarding a series of environmental parameters such as water depth, vegetation density and type of vegetation. We aim to determine the limits of those parameters in order to establish which conditions are optimal. These results can improve the measures that can be implemented through wetland management plans in favour of coots and other waterfowl well-being. The measurements were conducted on two ponds included in a fishing complex, located in Câmpenești, Cluj County. The ponds surface and peripheric vegetation were investigated, comprising a surface of a total of 423320 square meters. Ten nests (5 nests on each pond) were identified and on those sites, measurements were taken. Even if the number of nests is low, given the large surface investigated that comprises of numerous possible spots for nest positioning which were not utilised, we can evaluate the preference of coots in this matter. The results of this analyse show a mean value of 55,3 cm ($ds = 16.0627$) in case of water depth and a mean value of 33 stems/50 square meters ($ds = 14.9295$) where the nest is located. Regarding the vegetation type, the most preferred were the pure common reedbeds and the mixed reedbeds (cattail and common reedbed), summing a percentage of 60% in favour of other types identified. For common reed, the average percentage at the nesting site is 44% whereas for the cattail is 36%. This result is unusual in relation with the fact that the mean estimative percentage of the nest material is 42% cattail which is used even when at the nest site this plant is absent, being

brought from various distances. The correlation between the clutch size and these parameters was analysed, and the results show that there is no strong correlation in any of the cases. In conclusion, we can determine, in terms of preferability the limits for water depth and vegetations density as well in case of vegetation type. This research was funded by Babeş-Bolyai University through the research scholarship "*Special scholarship for research activity*".

Keywords: wetlands, fishponds, waterfowl, reedbed, cattail

APPLICATION OF STATISTICAL MODELING IN RISK ANALYSIS OF SHALLOW LAKES

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Abstract

Shallow lakes have an important role for the humanity and maintenance of environmental quality. However, shallow aquatic ecosystems are affected by numerous stressors as eutrophication, pollution, invasion of different species, drought, uncontrolled fishery, climate changes. Mentioned stressors often have a synergistic impact that enlarges the consequences and contributes to accelerated degradation of the shallow lake ecosystem. To assess the (ecological or environmental) risk, researchers use different kind of models that can be grouped into two main categories: statistical and dynamic models. By applying statistical modelling methods, it is possible to determine the statistical relationship between variables (physico-chemical and/or microbiological parameters), and reveal relations that are not obvious but may be relevant for the research problem. Statistical models could be used for reducing the number of variables in the analysis, but also for understanding the structure of the investigated phenomenon or the relative importance of the analyzed factors. In this paper, the main idea was to choose easily measurable parameters that could be used in future prediction of the risk of biomass hyperproduction and microbial risk. Factor analysis (principal components method) was used for reducing the number of variables. Data collected from two very shallow Pannonian lakes, Palic and Ludas, located at the north of the Republic of Serbia were used for the analysis. Two parameters were chosen as good descriptors of the lake state and good candidates for future detection of the risk of biomass hyperproduction and microbial risk: chlorophyll *a* (eutrophication) and enterococci (faecal pollution). The candidates for explanatory variables (predictors) were dissolved oxygen, saturation percentage, pH, electrochemical conductivity, temperature, and total suspended solids. The independent variables were analysed separately with the enterococci and chlorophyll *a* in order to improve the understanding of the connection. In the analysis of a set of variables with enterococci, the first component explains 38% of the variance of the original data set, while the second component explains another 22%. In the analysis of a set of variables with chlorophyll *a*, the first component explains 45% of variance of data, while the second component explains another 20%. In the formation of the main components, in addition to

enterococci, and the chlorophyll *a*, a significant part in both models, temperature, pH and suspended solids. In this way, the determined three potential predictors among easily measurable parameters, which could be further used in risk modelling.

Keywords: shallow lakes, pollution, eutrophication, risk, factor analysis

INFLUENCE OF FLOODING AND URBANIZED TERRITORIES ON HYDROLOGICAL REGIME AND WATER QUALITY IN THE AMUR RIVER

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Abstract

The flow of the Amur River is formed over a vast area (1855 thousand km²), where the natural conditions are diverse. A great influence on the formation of water quality in the Amur River is exerted by floods and economic activity of large cities located in its basin. The uneven flow of water by season and during the period of catastrophic floods determines the dynamics of the main indicators of water quality in the Amur River. Catastrophic Amur floods are dangerous natural phenomena, they lead to significant changes in the river bed and its floodplain. The water level rises by 8–15 m, the flow velocity is 3–4 m/s. The greatest floods are observed in the channel of the Middle and Lower reaches of the Amur River. The width of floods in the floodplain reaches 30 km. Flood waters in the Amur River in 2013 and 2019 were formed in the middle reaches of the river basin. High water discharges and the largest sediment transport during the flood period of 2013 were observed in the lower reaches of the Amur River. The flood lasted 3 months. We examined sediment transport and deposition in the lower Amur River in 2013–2014 to investigate the geography of floodwater sources. Four causes of flooding at Amur-2013 were identified: 1. rapid melting of snow in mountain rivers; 2. prolonged downpours in the basin of the tributaries of the Amur; 3. discharge of water from reservoirs; 4. Flood waves on the rivers Zeya, Ussuri and Sungari reached Amur when the water level in the Amur River was at its maximum. As a result, the water level in the Amur River in 2013 near the city of Khabarovsk rose to a record level of 808 cm over the past 120 years. The average suspension content in the Amur River channel was 850–950 g/m³. The runoff of contaminated watercourses from the territory of Khabarovsk (371 km²) was 300 m³/s). The water quality in the Amur River corresponded to class IV and was characterized by the category of “polluted”. The wastewater from industrial enterprises and city streams had a great influence on the pollution of the Amur River. The content of heavy metals (Fe, Mn, Cu, Al, Pb, Zn, Ag) exceeded their background concentrations by 2–3 times. The oil content was 0.3–0.35 mg/dm³. The conditions of transport and sedimentation in the channel and in the floodplain during the period of high floods on the Amur River in 2013, 2019 are studied. High flow rates and a large volume of sediment

runoff determine the patterns of sedimentation of alluvial deposits in the Amur floodplain and their pollution. There are formed four sediment accumulation zones in the floodplain: 1. Lowering of the central floodplain, filled with clay deposits and contaminated with heavy metals; 2. Lightly polluted sand plumes of a high floodplain; 3. Sandy river banks; 4. Alluvial braids in the riverbed, connected to the floodplain.

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Keywords: floods, urban areas, heavy metals

WATER QUALITY IN IRON GATE / DJERDAP NATURAL PARKS. FIRST FINDINGS OF “AEPS”, AN INTERREG – IPA CBC ROMANIA – SERBIA PROJECT.

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Abstract

The paper presents the objectives and expected results of a new started research project that involves two relevant education and research Balkan institutions, University Politehnica Timisoara and University of Belgrade, Technical Faculty in Bor. Thru the “AEPS” project, specific water quality analysis will be performed on Danube and its main tributaries in target area (Nera, Cerna, Berzasca, Porecka and Pek): COD, CBO₅, ammonia, nitrates, nitrites, phosphates, conductivity and for the first time in the area heavy metals contaminants will be analyzed (mercury, lead, nickel, zinc, copper, arsenic, cadmium, uranium). The paper presents first findings on surface water quality analysis, current status of project development and implemented activities, expected results and environmental issues in Iron Gate / Djerdap natural parks.

Keywords: Danube, heavy metal, water quality, cross-border pollution

PROMOTING INTEGRATED INVESTIGATION OF THE IMPACTS OF DAM OPERATION ON RESERVOIRS AND DOWNSTREAM RIVERS TO DEVELOP ECOSYSTEM-BASED MANAGEMENT-CRITERIA

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Abstract

Reservoirs have become common systems within the river networks at the global scale, fundamental to sustain human needs such as hydropower, water supply, flood control, navigation or multiple uses. Their presence however has induced marked environmental alterations and the increasing environmental consciousness is leading to develop new management strategies aimed at reducing reservoirs impact on downstream river ecosystems. To date, the implementation of environmental conservation measures is underdeveloped, limited in many cases to the release of minimum flows without accounting for other alterations of the hydrological regime, thermal alterations and the disruption of the sediment cycle. Robust research outputs are essential to provide sound ecosystem-based management-criteria which may help water resource managers, environmental protection authorities as well as the governments to make reservoirs management more eco-sustainable. To this purpose, integrated studies on the biological responses, both at downstream and impounded reaches, focusing on the main environmental pressures induced by reservoirs, should be carried out extensively. Large monitoring datasets on benthic macroinvertebrates can be analysed to detect the long-term consequences of reservoirs by using a control/impact approach. Moreover, data collected in previous research should be joined to data from new case studies to investigate the impact of dams on the lake biological assemblages (diatoms, macroinvertebrates and fish) under water level fluctuations induced by dam operation, and of flow and thermal alterations on river assemblages. A multiple case-study approach can be used to extensively test the correlation among controlled sediment flushing operations and both physical and biological responses. These operations have been increasingly carried out to recover the storage capacity of reservoirs, often representing an additional source of stress for lake and river habitats and assemblages. In this case, a before/after-control/impact approach should be adopted, and great emphasis should be given on the implementation and validation of a specific biomonitoring index. Accounting

for the results from the analysis of the specific pressures induced by reservoirs on the lake itself and on the downstream river, the most sensitive species can be identified and selected as targets for in-depth molecular investigations aimed at detecting the overall impact of dam operation on their population genetics. We will present some results about this topic with the aim to stimulate the discussion and interaction among research groups focusing on the relevant research area. Collaborations are essential to provide the scientific knowledge necessary to make further steps towards a more eco-sustainable management of reservoirs, whose urgency is dictated not only by the need of preserving biodiversity and ecosystem integrity, but also by the increasing number of both aged and new small reservoirs in a context of climate change.

Keywords: Reservoirs, Diatoms, Macroinvertebrates, Fish, Temperature Regime, Sediment, Water Management

ADAPTATION ENHANCES THE POSITIVE EFFECT OF TEMPERATURE ON THE COMPETITIVE ABILITIES OF CYANOBACTERIA

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Abstract

The positive effect of global warming on the growth of cyanobacteria has been widely predicted, but long-term studies targeting their adaptive potential to higher temperature are missing. Predicting the magnitude and impact of cyanobacterial blooms in the future as a response to global warming requires an understanding of how cyanobacteria might change in future scenarios. Here we examined the effect of heat adaptation on *Microcystis aeruginosa*, and its impact on plankton community composition. The evolutionary potential of three freshly isolated *M. aeruginosa* strains has been evaluated. One of the three strains displayed significantly higher growth rates after six months of cultivation at higher temperatures. Following inoculation into a natural plankton community, the overall cyanobacterial abundance increased in the cultures inoculated with heat-adapted strains of *M. aeruginosa* as compared to ambient-adapted ones. The structure of both prokaryotic and eukaryotic communities was impacted by inoculated cyanobacteria and temperature during the experiments. We found evidence that, similar to some marine algae, metabolic plasticity of cyanobacteria might be an indicator of their

evolutionary potential. The results of this study emphasize the remarkable adaptive potential / plasticity of cyanobacteria to stressors, and strongly advocate for including adaptive evolution in future research programs concerning cyanobacterial blooms in a changing climate.

Acknowledgements

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Keywords: *Microcystis*, cyanobacterial blooms, adaptive evolution, climate change, warming

WATER DEFICIT IN NORTH-EASTERN PART OF ROMANIA

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Abstract

Lack of rainfall in short time scales mainly affects soil moisture, whereas long-term rainfall deficit often affects streamflow and groundwater. The evolution of drought phenomena at all natural levels are analyzed selectively using different standardized parameters. Atmospheric drought was evaluated using Standardized Precipitation Index (SPI) and standardized precipitation-evaporation index (SPEI), hydrological drought was evaluated using Streamflow Drought INDEX (SDI) and hydrogeological drought can be evaluate using Standardized Groundwater Index (SGI). The evaluation of water deficit based on these indexes was made for 4 meteorological stations, 7 hydrometric statins and 15 hydrogeological wells from north-eastern part of Romania in the period from 1983 to 2018. The results show that there is a common evolution and good correlation (for more than 80% of meteorological stations, hydrometrical stations and hydrogeological wells analyzed) between atmospheric drought, hydrological and groundwater deficit for cumulated periods of 6 and 12 months. The water deficit evolution in the period analyzed increase in last year with impact on reducing of precipitation input on cumulated period of 6 and 12 months with 10% and decreasing the streams flow (with 15 %) and groundwater level (with 12%).

Keywords: water deficit, SPI, SPEI, SDI, SGI, North-Eastern Romania

INTELLIGENT WATER MANAGEMENT SOLUTION FOR SMART AGRICULTURE

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Abstract

The use of technologies offers a way of providing the total amount of water needed for plant irrigation. Within this scope, the Internet of Things (IoT) is one of the best options for smart water applications, although the development needs to be integrated with the technologies required. The basis of the article is the SWAM project, from which the results of the research carried out were extracted. For Smart Agriculture (drinking water, respectively irrigation), the project aims to provide a trustworthy, intelligent, integrated water management solution based on the IoT. It was demonstrated that this solution is useful for cost-efficiency management, smart environmental management, monitoring, security considerations and environmental pollution detection. The SWAM project provides an end-to-end solution, including probes (hardware) and services (software). SWAM's primary concern is smart irrigation, which is required to mitigate the impacts of drought and boost agricultural productivity by providing a controlled supply of additional water quantities to the soil compared to those received under natural conditions, ensuring high and consistent agriculture production. The aim of this article is to present a Smart Platform that operates and manages water quality and enhances the functioning of the surface water network. The data is collected from a sensor network that is connected to a Cloud database in order to monitor climatic conditions, water and air quality, which are required for irrigation in Smart Agriculture. Furthermore, Blockchain is a security solution for the system presented, as each transaction carried out by the system will be monitored throughout the process. This capability will provide not only security but also privacy aspects.

Keywords: water, IoT, architecture, smart agriculture, irrigation

DEVELOPMENT, ECONOMIC GROWTH, AND SPECIES ENDANGERMENT

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Abstract

The heightened rate of global biodiversity loss is both alarming and well documented. Some of its drivers are clear (e.g., habitat loss, harvesting, climate change), however there remains debate about how income growth contributes to biodiversity loss. While most theories have environmental damage increase with income at early stage of

development, the Environmental Kuznets Curve posits that economic growth may reduce environmental damage once a certain threshold level of wealth is reached. Some early empirical explorations that related biodiversity loss to income have been encouraging of such beneficial income effects for biodiversity loss, but more recent studies cast doubt over these earlier findings. This paper explores how socioeconomic variables relate to regional variation in the endangerment and population trends of small-ranged species using the IUNC Red List of Threatened Species assessments of 3,508 species. Here we show that there is no indication of an Environmental Kuznets Curve for biodiversity loss, rather GDP per capita is negatively associated with both species endangerment and decreasing population trends. The focus on small ranged species gives a subset of species that is relatively more endangered than the IUCN population. Arguably, this focus minimizes regional spillover effects and studies a subset of species for which regional policy may be particularly important. The findings suggest that poverty is more harmful than affluence for biodiversity of small ranged species. Consequently, policies aimed at poverty alleviation may have the potential to halt biodiversity loss simultaneously.

Keywords: Biodiversity, Conservation, Economic growth, IUCN Red List, Poverty (maximum 6)

CLIMATE CHANGES AND EXTREME WEATHER PHENOMENA

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Abstract

The paper presents a definition of the main terms regarding climate changes and extreme weather phenomena, followed by statistics of extreme weather and climate phenomena from the Middle Ages to the present day extracted from the journals and chronicles of foreign travellers who have passed through the Romanian countries and, respectively, of Romanian and foreign chroniclers. Information related to the field of historical climatology have been correlated with the values of the climate elements measured in the last hundred years. Finally, presentation of some aspects concerning the research methodology that do not confirm a causal connection between climate changes and extreme climate phenomena.

Keywords: Historical climatology, extreme climatic phenomena, climate change

A SIMPLE APPROACH TO ESTIMATE RAINFALL AT DIFFERENT RETURN PERIOD

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Abstract

The estimation of rainfall of different return period is very important in designing hydraulic structures of the area. Most of the available methods require the application of trial and error procedure to determine the suitability of distribution function for any particular section. The method suggested in the present paper can be easily applied without testing the suitability of different distribution functions. The Johnson transformation was known to be able to reduce the coefficient of skewness to near zero for rainfall data. The transformed rainfall data are fitted to the normal distribution and used in the design of hydraulic structures. The study indicates that the transformed normal distribution can be used as the determine approach towards estimating rainfall at different return period. Rainfall estimation is an important tool in water resources planning and management.

Keywords: coefficient of skewness, Johnson transformation, normal distribution, rainfall data

VARIABILITY OF RUNOFF OF THE UPPER NOTEĆ RIVER (CENTRAL POLAND) IN 1981-2016

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Abstract

The aim of this paper is to determine the long-term variability of runoff of the upper Noteć River in the period 1981-2016. The study area includes the upper Noteć River catchment located in the central part of Poland. Water resources of the upper Noteć River are among the lowest in Poland. Annual precipitation recorded at 5 meteorological stations was used for analysis. Annual precipitation totals in 1981-2016 ranged from 491.5 mm (station Kołuda Wielka) to 534.9 mm (Strzelno). Average specific runoff of the Noteć River ranged from 2.05 to 3.33 $\text{dm}^3\text{s}^{-1}\text{km}^{-2}$. Increasing trends in annual precipitation totals were recorded over the period under study, but this did not translate into increasing trends in flows. A slight upward trend in flows was recorded only at the Noć Kalina station and included mean and minimum annual flows. The analysis of flow variability index C_v ,

coefficient k and number of days with low flows below flow Q70% and Q95% showed that the flow of the upper Noteč River at the Łysek, Noć Kalina and Pakość stations is disturbed.

Keywords: variability indices, precipitation, flow, upper Noteč River, Poland

BASEFLOW IN HORNÁD RIVER BASIN

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Abstract

Drought is a worldwide phenomenon that arises from lack of precipitation. Drought can be divided into hydrological drought, climatological drought and soil moisture. In this paper I deal with hydrological drought. Although the lack of rainfall is the main cause of drought, it manifests itself later than in meteorological drought. It takes longer for the lack of precipitation to manifest itself in the hydrological system. Long-term lack of rainfall can cause the development of hydrological drought and thus cause below-average water flows in the basins, drying up of lakes and reservoirs, reducing soil moisture, to run out of groundwater supplies. Water scarcity has a negative impact on various sectors of industry, agriculture, water supply, energy production and many other socio-economic aspects. Drought increases the risk of fires in the country. Another such phenomenon is extreme tidal floods, which arise from above-average precipitation. Recently, we have witnessed alternating dry periods with wet periods. The majority of the Hornád River Basin is located in eastern Slovakia. The Hornád River Basin consists of the Hornád River and Hnilec River and other smaller tributaries. The Hornád River in the upper part of the river flows through the Slovak Paradise where it cuts through a canyon valley called the Hornád Gorge. At the confluence of the Hornád and Hnilec rivers there is a water reservoir Ružín, which is used for electricity production and water supply for industry. At Kysak the river turns sharply to the south where it flows through Košice. Near the village Nižná Hutka flows into Hornád. Torysa is a significant left tributary of the Hornád, then continues south and continues to Hungary. The Hornád River flows into Slaná. The Hornád River Basin is a sub-basin of the Danube River. The water reservoir Palcmanšká Maša is created on the Upper course of the Hnilec river, this water reservoir is used mainly for electricity production and tourism. The knowledge of the baseflow regime is important for water resource management, protection of aquatic ecosystems, hydropower production, socio-economic aspects and low flow forecasting. The base flow index (BFI) can be defined as the ratio of the long-term average base flow to the total flow. A number of methods have been developed for baseflow separation. We know three basic baseflow separation methods: fixed interval method, sliding interval method and local minimum method. A high BFI value means that the catchment area has a stable flow regime and therefore has the ability to maintain a sufficient flow rate during the dry season. Baseflow analysis and separation was done using BFI + 3.0 software. The module development methodology is

based on Tallaksen and Van Lannen. The software allows you to choose from eleven baseflow separation methods and then analyze the results in graphical or tabular form. I analyzed the baseflow in the Hornád basin at selected water stations. The output of the thesis is the analysis and separation of baseflow in the Hornád basin. For baseflow analysis, I used historical daily average flows over a period of forty years. Data provided by Slovak hydrometeorological Institute.

Keywords: basin Hornád, baseflow, drought, hydrology drought, rainfall, water resource management

THE CLIMATE VARIABILITY OF THE YEAR 2019 IN THE SOUTHERN-WESTERN ROMANIA

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Abstract

The climate variability results from the different interaction of the climate system components. The main purpose of this study is to analyze the climate variability with a view on the average state variation of the main climatic variables, such as the air temperature and atmospheric precipitation, for the year 2019 in the Southern-Western Romania. The year 2019, according to the World Meteorological Organization (WMO) is the second warmest year in the world, with a positive deviation of 1.1°C from the average air temperature, for the period 1850-1900. At the level of Romania, also including the study area, the year 2019 has been the warmest year since 1900. The Southern-Western part of Romania, also called Oltenia represents 12% of the country's surface and it is an important agricultural region. In this study, there have been used the climate data from 16 weather stations belonging to the National Meteorological Administration. In the analysis of the main climatic variables of the year 2019, there were used the following meteorological parameters: the average, the minimum and maximum monthly air temperature, the average seasonal air temperature and the average monthly quantities of precipitation. Also, the monthly average data of the maximum temperature at the soil surface, the Spring Arrival index and the Hellmann Classification were used for establishing the types of thermic and pluviometric time of the year 2019, for the Southern-Western Romania. The methods used are the classical statistics and the GIS techniques. The results have indicated that 2019 was a warm year with average annual air temperature values in Oltenia ranging from 8.9°C at Voineasa to 14.0°C at Dr. Tr. Severin, while the deviations from the period 1901-1990 were between 1.4°C at Tg.

Logrești and 2.7°C at Drăgășani. According to the Hellmann Classification, the year 2019 was warm throughout the study area. All the deviations of the monthly average air temperature from 1901-1990 were positive. The biggest deviations of the monthly average for the whole region were, in decreasing order, in the months: November with 4.1°C, March with 4.0°C, February with 3.2°C and December with 2.9°C. From the precipitation point of view, it was a normal year, on average, but with biggest differences in the types of the pluviometric time, within the study area, according to the Hellmann Classification. The annual amount of precipitation for the study area was 647.8 l/m², and its percentage deviation from the period 1901-1990 was -4.1%, which confirms the characteristic of a normal pluviometric year, on average. The analysis of the short-term climate variability, continuing with the long-term variability represents the tools for identifying the impact of the current global warming on the environment and society.

Keywords: air temperature, precipitation, weather types, climate variability, year 2019, Southern-Western Romania.

ASSESSING OF WATER-RELATED RULES IN LOCAL MASTER PLANS AROUND PORTUGUESE VOUGA RIVER BASIN

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Abstract

Estuaries, coastal lagoons and wetlands are territories of high environmental sensitivity, and are also among the most threatened by the conflicting human activities which damage their ecological functions. Moreover the potential risks of water-related climate change, such as floods and droughts, are claimed to be aggravated by anthropogenic pressures related to land use options. Spatial planning at the local level, especially around sensitive areas, assumes an important role for the protection of water and the associated values and services. Municipal master plans determine the spatial development model, identify key development trends of the municipalities, sets directions for land uses and promote the enhancement and protection of water resources, among other environmental values. The adoption of land use rules able to incorporate cross-sectoral perspectives, such as land use and water protection, established in a concerted and collaborative governance between the municipalities located upstream and downstream of the hydrographic basin, may help preventing future water-related risks and to promote sustainability and resilience of water sensitive areas. Supported by a set of rule-related analytical factors, this article analyses the land use regulations adopted by a set of local master plans on the surrounding territories of Ria de Aveiro and located upstream of the Vouga River, a hydrographic basin of the center of Portugal, and assesses how their regulatory approaches cover the protection, use and valorization of water resources. The results reveal a fragile incorporation of water issues into the land use regulations of

municipal master plans on the surrounding territories of Ria de Aveiro, and a reduced differentiation between the upstream and downstream municipalities of the Vouga River basin. They also reveal a limited scope of the predominant approaches, which are essentially prohibitive, offering limited space for innovative land use practices. It also reveals a limited scope of the ruling approaches, being essentially prohibitive and, consequently, offering limited room for innovation and new land use practices. The developed analysis showed that the regulations of the municipal master plans, along a hydrographic basin and in the presence of areas of high environmental sensitivity, should strengthen the incorporation of guidelines that minimize the vulnerabilities and the risks of climate changes related to water, promoting the resilience of the territory at the local level.

Keywords: water, permitting, land use regulations, local master plans, Portugal

CLIMATE-INDUCED CHANGES IN A MEDITERRANEAN LAKE SINCE THE PRE-INDUSTRIAL PERIOD, ACCORDING TO THE STUDY OF DIATOM COMMUNITIES

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Abstract

From 1880 to 2012 of the common era (CE), the superficial temperature of Earth has increased approximately 0,85 °C because of the anthropogenic emission of greenhouse gases resulting from the Second Industrial Revolution (1873-1914 CE). Our research team is running a high-resolution (sub-decadal) paleoclimatic and paleoecological reconstruction of the last 500 years through the varved sediments of Montcortès lake in order to separate natural and anthropogenic signals during global warming. This time period includes the Little Ice Age and the Industrial era. Montcortès lake is a karstic, meromictic lake located in the Central Pyrenees. In this study, it is investigated to what extent diatom species can be used as climatic proxies. Diatom samples from MONT-0713-G05 sediment core were used (1717 -2013 CE). Altogether, 52 sediment samples were treated through standard methods, mounted in Naphrax and inventoried under the microscope. Taxa abundances were related to the Northern Hemisphere temperature, to the regional temperature and precipitation of the last 80 years, and also to local environmental variables including hemp abundance and biological indicators of eutrophy, by using multivariate statistical methods. The diatom community was dominated by the planktonic *Cyclotella cyclopuncta* from 1717 to 1971 CE. From 1978 to 2013 CE, warming and moderate eutrophic conditions apparently favoured the planktonic *Cyclotella ocellata*, which became the dominant species in the diatom community alternately with *C. cyclopuncta*. Interestingly, this alternation in the dominant species occurred in relatively short-term periods—7, or exceptionally 14, years at most, which is the highest temporal resolution reached for this period—, leading to a great instability in the

planktonic community of the lake. Other planktonic species such as *Puncticulata radiosa* or *Stephanodiscus alpinus* also gained relevance in the community, although far less than *C. ocellata*. Hemp crops and retting inside the lake until 1896 CE caused the rise of eutrophic, mesosaprobic, and/or acidophile populations, particularly *Fragilaria tenera* and *Amphora pediculus*. During periods of predominance of water mixing—i.e. second half of 18th and first half of 19th century, and later during the first half of the 20th century—the water column was more oxygenated and fertilized, favouring the planktonic community. On the other hand, heavy rainfalls and low temperatures in the mid-late 19th century probably caused a rise in the water level and turbidity, and the consequent fall of both planktonic and benthic communities. All in all, we conclude that some diatom species found in the Montcortès lake could serve as proxies of warming or eutrophication, although correlations with the environmental variables were generally not remarkably strong. A key point of this study is the high resolution and the temporal precision of the data thanks to the varved sediments of the lake. Moreover, the analysed period encompasses the industrialisation and the global warming, which are two major factors that have and will presumably continue to notably affect the ecosystems. This study should be used for further research that will go in depth in the relationships between taxa and environment in a climate change context.

Keywords: paleoecology, paleoclimatology, global warming, diatoms, meromixis, varves

MULTIDISCIPLINARITY AND INNOVATIONS IN AGRO-HYDRO-METEOROLOGICAL MONITORING (AgHMM) ON IRRIGATION/ DRAINAGE OBJECTS. CONCLUSIONS FROM THE POLISH RESEARCH INOMEL PROGRAM

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Abstract

One of the goals of monitoring the environment in rural areas is controlling water management processes to reduce the negative effects of drought or excess water, as well as its saving. In Poland in changeable climate conditions, where about 60% area of permanent grasslands and arable lands is significantly dependent on rainfall it is necessary to have the different monitoring systems for proper water management for crop production. Climate change, observed since the early 80 has increased the number of periods of drought, some of which last for several months. Rainfall deficiency is increasingly limiting the water available to plants and drying up potentially other water sources, e.g. drainage ditches, streams, ponds, storage reservoirs, etc. For the purposes of the Polish research INOMEL program^{*)}, at the turn of 2018/2019 in central part of Poland at six different localizations of drainage and irrigation objects were created agro-hydro-meteorological monitoring systems (AgHMM). Multidisciplinary measurements involve monitoring of meteorological, agrometeorological, hydrological and hydraulic parameters as well as remote sensing. This monitoring is not limited only to measurements for operational purposes, as it also covers other activities such collection

data, their transmission with assessments and forecasts of agro-hydro-meteorological characteristics of drainage and irrigation objects to other project participants. Some data and assessments are also provided, relaying to interested entities, to farmers, water users' associations and agricultural consultants. Joint research is conducted by a consortium whose participants are: Institute of Technology and Life Sciences (leader), Warsaw University of Life Sciences, Wrocław University of Environmental and Life Sciences, Poznań University of Life Sciences, Geofabryka Ltd, Agrocom Polska Jerzy Koronczok. Interdisciplinarity of monitoring means simultaneous measuring and observing in three environments: atmosphere, soil and water. Innovative elements in the AHMM give opportunity to:

- using various, technologically advanced measurement techniques of monitoring of drainage/ irrigations objects, and modern techniques of transmission data, which are available on-line
- ability to quickly data acquisition and exchange information between consortium members and interested persons and institutions,
- enriching knowledge of the environment conditions by assessment state of plants using observations made by drones and satellite images,
- applying 7-day weather forecasts dedicated to each drainage/ irrigation object for the purposes to modelling changes of agro-hydro-meteorological conditions.

After the end of the growing season in 2020, the obtained monitoring results and experiences regarding the usage of the monitoring system were undertaken works to create a prototype of a monitoring and forecasting system for commercial purposes. It is assumed that the measuring equipment proposed for use in the prototype of the AgHMM monitoring system should provide an accurate and reliable assessment of agro-hydro-meteorological conditions in the drainage/ irrigation object. Also, the meteorological forecasts obtained from the forecasting model should apply strictly to this object. As a result, these activities will make it possible to obtain the necessary data used later in computer programs and mathematical models for the purpose of operational irrigation and drainage planning in rural areas. Due to the COVID-19 pandemic, work on this prototype is still ongoing and should be completed by the end of 2021.

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Keywords: drainage and irrigation objects, climate change, monitoring, innovation

MINIMUM FLOW CHARACTERISTICS IN CRIȘUL NEGRU CATCHMENT

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Abstract

The study of water resources is important for river basin management at national and local/regional scales, especially in decision making and strategies developed for the mitigation of extreme phenomena effects (high flow and floods, low flow and droughts/water scarcity). The low flow represents one of the phases of rivers hydrological regime which can occur as prolonged periods with below-average streamflow, hydrological droughts with extremely low discharges and, in some cases, river drying. Naturally, the factors that generate these phenomena are, on the one hand, the climatic conditions, and, on the other, the lithological and morphological characteristics. But natural phenomena are frequently intensified by pressures on water resources such as water consumption. The present paper aims to emphasize the characteristics of low flow in Crișul Negru Catchment, located in the western part of Romania, with a surface of 4237 km² (on the territory of Romania) and draining both, high mountainous and low depressionary and plain areas. To achieve the proposed objective, hydrological data, namely mean daily discharges and minimum monthly and annual discharges, were statistically processed and analyzed. The data were obtained between 1980 and 2019 at gauging stations (g.st.) situated on the main collector (3 g.st.) and its tributaries (5 g.st.). The gauging stations were selected considering the length of the historical data series and the representativeness of the hydrological regime of the (sub-)basins. To highlight the characteristics of low flow (variability, duration, frequency, and magnitude) and identify the periods with low flow, threshold values were applied: the average of minimum annual discharges, the discharge with 80%, 95% and 97% probability of exceedance (based on flow-duration curves), the 7Q10 discharge (annual minimum 7-day average discharge with a 10-year recurrence interval). In terms of interannual variability of low flows and minimum annual discharges, a descending trend was identified, which means an increase in the intensity of droughts. The specific periods of low flow are, in general, in late summer and autumn. The river drying occurs in plane subbasins or catchments with small drainage surfaces, every year or in extremely dry years (with precipitation deficit). The management of water resources in drought periods should be done considering the water demand for human activities, but maintaining the ecological function of the rivers; therefore, the results of such analysis can contribute to a better understanding of the present hydrological regime and its trends, for improving and adopting the adequate measures for the mitigation of drought and water scarcity effects.

Keywords: low flow, drought, variability, frequency, probability of exceedance, Crișul Negru Catchment

HYBRID SYSTEM COMBINING CHEMICAL, PHOTOCHEMICAL AND ULTRASOUND REACTORS FOR WASTEWATER TREATMENT

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Abstract

The global agro-industrial progress triggered by the exponential growth of the world population was accompanied by various air, water and soil pollutants. The issue of water pollution is reaching nowadays a planetary scale and there is a continuously increasing pressure on the environmental engineers to develop, design and optimize new and effective methods and equipment for waste water treatment. Consequently, over the years, an impressive number of physical, chemical, biological methods and combination therein have been proposed for the wastewater treatment, each having its own advantages and drawbacks. These methods are required to evolve with the technical progress and with the continuous tightening of the environmental standards and regulations. In this context, strategies that allow the achievement of the new performance criterions regarding the waste water treatment include: i) finding new, more effective technologies and equipment; ii) combining and grouping the current methods; iii) optimizing the existing technologies. Considering the large number of methods proposed so far, the first option seems rather difficult, and requires advanced and expensive equipment. The next two options are by far more feasible and currently trendy as revealed by literature, where many studies focused on hybrid equipment and technologies that combines various physical, chemical and biochemical methods (e.g. adsorption, photocatalytic degradation and membrane filtration, sono-electro-chemical, sono-photo-catalytic, microwave-assisted oxidation, hybrid membrane-biofilm and so on) and possibly even more studies regarding the use of artificial intelligence (AI) instruments (e.g. machine learning – ML, fuzzy logic – FL, artificial neural networks – ANNs, genetic algorithms – GA, bio inspired metaheuristics – BIAs and more) for modelling and optimization of wastewater treatment technologies. Therefore, this work focuses on a hybrid system that combines a series of three reactors: chemical, sono-chemical and photo-chemical. The equipment aims to provide an economically viable efficient system for pollutants removal that combines classic and less conventional wastewater treatment methods in a singular treatment unit functionally and economically optimized using artificial intelligence instruments (ANNs and BIAs). The lab-scale pilot system encloses a series of three modules (reactors): chemical (CH), ultrasound (US), and ultraviolet (UV), a tampon vessel and a recirculation pump. A system of pipes allows the recirculation and/or the by-passing for each reactor and ensure a considerable functional flexibility, the

modules being able to operate separately or in various combinations – depending on the pollutant or pollutants category. The functional purpose of the system is not to bring together three different reactors and consequently three different treatment methods, but to combine them in such manner to achieve the so called “synergistic effect”. In order to accomplish this a series of parameters directly affecting the removal efficiency were identified and at this time are under study: flow rate, flow regime, stirring intensity, UV intensity, US frequency, inlet/outlet position). The preliminary results obtained indicated that the performance of the system is improved compared with the individual modules. In case of the UV module, the residence time distribution method (RTD) pointed out two classic flow defects: short-circuits and dead zones, a more in-depth analysis of the characteristics causing these effects being required.

Keywords: hybrid equipment, sono-photo-chemical, waste water, hydrodynamic studies, short-circuits, dead zones

Acknowledgements

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EFFECTS OF TEMPERATURE ON FRESHWATER MACROINVERTEBRATES

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Abstract

Water temperature is one of the primary factors affecting the life history of macroinvertebrates. Thus, knowing how benthic invertebrates respond to changes in water temperature is crucial to understand the effect of climate change on freshwater ecosystems. In the last decade, the total number of papers concerning the topic increased, also thanks to theoretical studies. Indeed, the availability of big databases, together with the development of analytical skills, allowed the elaboration of long trends of biological data to make interpretations and predictions about the changes in macroinvertebrate communities facing climate change. There is a wide range of responses put in place by macroinvertebrates subjected to temperature changes. Notwithstanding the substantial progresses done in the last decades to better understand the relationship between temperature and life-history traits there are many open questions regarding the physiological mechanism adopted by the different taxa towards thermal variation. Thermal heating induces the upregulation of several genes that control the activity of heat-shock proteins such as several biochemical processes, not yet completely studied. Moreover, the upregulation has been observed also in the organisms considered “stenothermal”, highlighting that the belonging to some thermal categories should be reconsidered in relation with other more limiting factors. Different life stages show

different thermal adaptiveness highlighting that laboratory experiments using only one life stage are not always adequate to define the thermal sensitivity of the considered taxa. The ecological studies at the community level must necessarily generalize the trait studied in some key species at higher taxonomic units. A more specific trait-based approach that aimed to extend the current knowledge about the thermal and ecological preferences of each taxon may represent the preferred way to understand how the whole community responds in a changing world. Most of the studies that predict changes in freshwater communities at a macro-regional scale take into account climatic drivers without considering the specific thermal conditions of each freshwater ecosystem. Deeper knowledge about the current status of the thermal alterations on a wide range of aquatic ecosystems may be the first step to better predict alterations on communities and disentangle the thermal stress from others. The intraspecific genetic loss due to climate warming greatly exceeds the extinction of the different species so that in the assessment of the whole biodiversity loss driven by climate change (and other stressors) also the intraspecific component has to be taken into account.

Keywords: Temperature, Macroinvertebrates, Inland waters, Biological response

SMART CONTROL OF THE CLIMATE RESILIENCE OF EUROPEAN COASTAL CITY (SCORE) HORIZON 2020 - COASTAL CITY LIVING LAB - CASE OF GDAŃSK

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Abstract

The four year project, SCORE (Smart Control of the Climate Resilience in European Coastal Cities), outlines a comprehensive strategy, developed via a network of 10 Coastal City Living Labs (CCLs), to rapidly, equitably and sustainably enhance coastal city climate resilience through an Ecosystem-Based Approach (EBA) supported by sophisticated digital technologies. The intensification of extreme weather events, coastal erosion and sea-level rise are major challenges to be urgently addressed by European coastal cities. CCLs are located in: Sligo (Ireland), Lisbon (Portugal), Barcelona (Spain), Dublin (Ireland), Benidorm (Spain), Basque Country – Guipuzcoa coastline (Spain), Massa (Italy), Koper (Slovenia), Samsun (Turkey) and Gdańsk (Poland). Although all CCLs have different environmental and geographical conditions, they face similar challenges as shown by the hazards they experience: coastal and inland flooding, coastal erosion and coastal storm surge. The potential sectoral impacts of these risks are also similar, these being: risk to tourism, loss of cultural heritage, damage to commercial and residential buildings, damage to energy networks, agricultural stress, loss of wetlands, loss of animal habitat, damage to civil infrastructure, and risk to the local economy. The first CCL in Poland has been launched since the beginning of July and will be located at the University of Gdańsk. Gdańsk is a city on the Baltic coast of northern Poland. With a population of almost 470 ths Gdańsk is the capital and largest city of the Pomeranian Voivodeship and the most important city in the

geographical region of Pomerania. Gdańsk lies at the mouth of the Motława River, connected to the Leniwka, a branch in the delta of the nearby Vistula River, which drains 60 % of Poland and connects Gdańsk with the Polish capital, Warsaw. Gdańsk has a climate with both oceanic and continental influence. The city has moderately cold and cloudy winters and mild summers with frequent rains and thunderstorms. The city is located at an altitude of 0 m above sea level up to 180 m above sea level. The topography, the surrounding sea and the prevailing climate influence the 2 main types of hazards in Gdansk namely coastal flooding and land flooding. The aim of Gdańsk CCLL will be an attempt to implement the Living Lab concept in Gdańsk in terms of resilience to climate change and its effective management at the local and regional level. One of the main challenges of CCLL will be to establish a user-based platform for real-time monitoring and forecasting of various climatic factors affecting the environment in the Gdańsk area. By creating Gdańsk CCLL, we would like to teach its participants - citizens, scientists and decision-makers, how to care for the natural environment together by implementing urban innovations that will allow for more conscious participation and co-decision about the city's development.

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003534.

Keywords: climate change, climate resilience, smart city, Coastal City Living Lab

ASSESSMENT OF THE SOLAR RADIATION AVAILABILITY FOR AQUATIC MACROPHYTES ASSOCIATIONS FROM POENI WETLAND ON GLAVACIOC RIVER, ROMANIA

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Abstract

Climate change has a variety of impacts on health, ecosystems, and the economy, often interacting with other factors, such as changes in land use. These impacts are expected to become more severe in the coming decades. If not addressed properly, these effects will be very costly, affecting the health of the population and ecosystems, damaging goods and infrastructure, and some impacts may be irreversible. As mitigation measures cannot prevent all the effects of climate change, complementary actions are also needed to adapt to the dynamic evolution of the climate and through the use of intelligent telemetry

systems and smart sensors. Important indicators for vegetation growth and development, including aquatic macrophytes, are the solar radiation parameters. Thus, the monitoring of these parameters is required to estimate the ecophysiological processes for riparian and aquatic vegetation in the context of climate variability. In this work, the solar radiation parameters with a focus on Photosynthetically Active Radiation (PAR), were measured between April and September 2019 in Poeni wetland on Glavacioc River, Romania. The Glavacioc River is a tributary of the Câlniștea River having a length of 120 km, a sinuosity coefficient of 1.69 and an average altitude of 118 m. It has a basin of 682 km², oriented from northeast to southeast, more developed in the upper part. Poeni wetland has an aquatic habitat represented by heavily eutrophic ponds with shallow depths that are supersaturated in nutrients in some periods of time with an active decomposition of organic waste, turbid water and often with an unpleasant odor. The most abundant aquatic species were identified as *Lemna* spp., *Ceratophyllum demersum*, *Trapa natans*, *Salvinia* spp., etc. The solar radiation parameters were measured with Kipp & Zonen albedometer and pyranometer and with a Delta-T Devices PAR sensor at a close distance from the association of aquatic plants avoiding shading by the surrounding leaf canopy. It was found that the average diurnal available radiation was approximately 130 W m⁻² during the monitoring sessions, while the PAR average levels ranged between 345 and 975 μmols m⁻² s⁻¹ depending on the day and cloud cover. Light availability is a key factor that regulates the depth distribution, abundance and productivity of submerged aquatic macrophytes and the growth rate of the floating species. The results can provide support in modeling the growth and photosynthesis efficiency of the aquatic species and the spatial distribution of submerged aquatic vegetation in the context of future climate change.

Keywords: macrophyte, *Lemna* spp., *Trapa natans*, PAR, monitoring, small river

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OXIDATIVE STRESS INDEX AS BIOMARKER OF THE STATE OF BULGARIAN BLACK SEA COASTAL ECOSYSTEMS: A PILOT STUDY ON BIVALVES

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Abstract

Marine coastal and estuarine ecosystems suffer increasing anthropogenic pressures. The risk assessment of pollution and changes in Black Sea coastal ecosystems was mainly based on toxicological analyses of the environment and sentinel organisms, or shifts in species communities. However, individual biological effects and responses of indicator organisms themselves, remain underestimated. Benthic bivalve communities are an important part of Black Sea coastal ecosystems, where psamophilic clam species (i.e. *Chamelea*, *Donax*, *Mya* etc.) play an important role providing also valuable ecosystem services. In benthic bivalves different xenobiotics are bioaccumulated and transmitted through food chains. It is well known that xenobiotics, as well as variations in environmental factors can provoke excess generation of reactive oxygen species (ROS) in bivalves and induce oxidative stress (OS). The present study reports on a preliminary investigation of the pro/antioxidant status in soft tissues of *Donax trunculus* L. from 4 different sites of the Bulgarian Black Sea coast (Varna Bay, coastal zones of Kranevo, Shkorpilovtsi and Ahtopol). The lipid peroxidation, glutathione levels and the activities of the antioxidant enzymes catalase, superoxide dismutase, glutathione peroxidase, and glutathione reductase, as well as the glutathione-S-transferase and glucose-6-phosphate dehydrogenase were assessed spectrophotometrically. Based on the data of the OS biomarkers in the clams a pro-oxidative (PrO) score and an antioxidant enzyme (AOE) score were estimated. These scores were used to calculate a Specific Oxidative Stress (SOS) index, which was applied for the first time to assess the ecological state of the marine environment of the studied coastal sites. In *D. trunculus* from Varna Bay high levels of OS were found and the value of the SOS index was highest (+2,652). In the clams from this site the pro-oxidant processes were strongly activated, together with an inhibition/depletion of the antioxidant protection system. The SOS index for the coastal habitat of Kranevo was also relatively high (+1,091). In the clams from this habitat the antioxidant enzyme system was activated in response to the pro-oxidative process activation, attempting to compensate the OS. Lowest value of the SOS index (-0,893) was calculated for the coastal habitats of Ahtopol. The obtained results clearly indicated the presence of differences in the ecological state of the environment of the studied habitats, Varna Bay being the most stressful environment. In conclusion, the redox status of bivalves and the proposed SOS index seemed to be reliable biomarkers of the stressfulness of coastal marine environments in the Black Sea.

Keywords: psamophilic clams, Black Sea, oxidative stress, coastal marine environment

THE INTERANNUAL VARIABILITY OF THE STRUCTURAL CHARACTERISTICS OF PHYTOPLANKTON, ITS SPECIFIC GROWTH RATE AND MICROZOOPLANKTON GRAZING IN THE SURFACE LAYER OF THE SEVASTOPOL BAY (BLACK SEA)

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Abstract

The phytoplankton biomass interannual variability, its taxonomic and species composition in the surface layer of the Sevastopol Bay waters during the period of 2000-2014 were analysed. A gradual decrease in the total algae biomass and relative share of diatoms, as well as an increase in the share of dinoflagellates and coccolithophores, was detected. During the research period relative biomass of diatoms decreased in average from 83 % to 44 %, and relative biomass of dinoflagellates increased in average from 14 % to 38 %. The remaining phytoplankton biomass was generated mainly by coccolithophores, where dominated the coccolithophorid *Emiliania huxleyi* (Lohmann) W.W.Hay & H.P.Mohler. According to our calculations, their relative share was increasing in average from 2 % to 15 %. The restructuring of the phytoplankton taxonomic composition was occurring mainly resulting water temperature increase and, to a lesser extent, due to the nutrients concentration decrease. For the entire 15-year observation period the positive trend in changing of average annual temperatures values with a sufficiently high determination coefficient was detected ($R^2 = 0,66$). The water temperature increase, especially in a summer, adversely impacts functioning of the most diatoms species. This is, probably, the main reason for the restructuring of their species composition, which is largely pronounced in the summer. In the Sevastopol Bay in the summer of 2010-2014, representatives of the *Chaetoceros* genus were not observed among the dominated species, although they caused algae blooms in previous years. However, other species had appeared: *Nitzschia tenuirostris* Mer., *Striatella interrupta* (Ehrenberg) Heiberg, *Cyclotella caspia* Grunow и *Pseudosolenia calcar-avis* (Schultze) B.G.Sundström. The composition of the dinoflagellates dominant species was not varied over the entire observation period. Among them, the representatives of *Prorocentrum*, *Gymnodinium* and *Ceratium* genus were dominating. Variation of the phytoplankton taxonomic and species composition caused a decrease in average annual growth rate of phytoplankton, and also microzooplankton grazing rate. For instance, in 2006 - 2007, when the main phytoplankton biomass consisted of diatoms (in average 60% annually), the specific growth rate of phytoplankton was equal to of $0,94 \text{ day}^{-1}$ in average annually. In 2010 and 2014 the diatoms share was below 45 %. This led to the decrease of the phytoplankton specific growth rate values to $0,61\text{--}0,70 \text{ day}^{-1}$ in average annually. The average annual specific rate of phytoplankton consumption by microzooplankton was also decreased. In 2006 - 2007 it was $0,68 \text{ day}^{-1}$, in 2010 – $0,43 \text{ day}^{-1}$, and in 2014 – $0,35 \text{ day}^{-1}$. It indicates

that the matter and energy flow from phytoplankton to microzooplankton, as well as to the upper trophic levels, is decreasing.

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Keywords: phytoplankton biomass, growth rate, microzooplankton grazing, Black Sea.

LINKING TRAWL SELECTIVITY AND WHITING OXIDATIVE STRESS RESPONSE INTO SUSTAINABLE FISHERY MANAGEMENT

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Abstract

Whiting formed the main bycatch of the mid-water otter trawl in NW Black Sea, as almost 100% of species is discarded due to lack of market interest. In the present study mid-water trawl selectivity experiments were conducted on board of F/V Sv. Nikola in Nessebar and Sozopol Bays in the period of June 2019 and July 2020, using the cover codend technique with meshes 14, 16 and 18mm, and analysed using the logistic equation with the maximum likelihood method. $L_{50\%}$ varied from 9, 88 (s.e.0.59) to 12,6cm (s.e.0,62), and selectivity factor (SF \approx 0.7). The mean size of the first maturity was estimated at 12,5 cm. Despite the species is not targeted one, minimum landing size in Bulgaria was set to 9 cm. Codend with mesh 18mm is the most selective and would decrease the discards of the immature individuals in higher proportion. Additionally, the pro/antioxidant status of whiting individuals was assessed by measuring oxidative stress (OS) markers in gills and liver. Impairment of the pro/antioxidant balance in both organs was clearly demonstrated. However, there were differences in the oxidative processes in both organs. The pro/antioxidant balance in liver seemed to be more strongly influenced by background factors of the water environment (i.e. presence of pollutants, pH) and no correlation with body size was found. Here, fish caught in deeper waters had an almost threefold increase in lipid peroxidation (LPO), suppression of antioxidant enzymes and reduction in acetylcholine esterase activity. In gills OS markers showed correlation with body size and here the pro/antioxidant processes seemed to respond to pressure by additional factors, i.e. temperature and oxygen content. Gills demonstrated higher degree of OS (increased LPO), but here compensatory mechanisms were triggered (i.e. increased superoxide dismutase activity) which supported the physiological processes in the body and probably determined the correlation with body size (age). These results, although preliminary, indicated that OS was induced in gills and liver of whiting in response to

various environmental factors including fisheries impact. The pro/antioxidant balance defines the metabolic status of whiting and determines to what extent their phenotype as well as their marine environment along the Bulgarian coast provide conditions to fulfill their metabolic requirements and support healthy populations. This can be used in marine environmental monitoring and also in determining the state of whiting populations.

Keywords: whiting, trawl selectivity, minimum landing size, oxidative stress, Black Sea

Acknowledgements: This work was supported by grant № КП-06-H41/7 of National Science Fund, Bulgaria

BIODIVERSITY OF RECENT DIATOM TAPHOCOENOSSES IN THE PUCK LAGOON (SOUTHERN BALTIC SEA)

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Abstract

The aim of this study was to analyze diatom flora preserved in sandy and muddy surface sediments of the Puck Lagoon, the shallowest part of the Gulf of Gdańsk, southern Baltic Sea. The material studied consists of 129 sediment samples collected from the bottom of the whole lagoon by means of Van Veen Grab sampler in August and September 2019. The diatom samples were prepared according to standard Battarbee (1986) procedure. The analysis was performed with a NIKON microscope under a 100× oil immersion objective. The counting method of Schrader and Gersonde (1978) was used, and in each sample from 300 to 600 valves were counted in order to estimate percentage abundance of particular taxa. The concentration of diatom valves per unit weight of dry sediment was estimated according Bodén (1991) method. The diatoms were divided into groups according to their habitat, salinity, trophy and saprobity preferences. The percentage content of all ecological groups was estimated in each sample. A total of 57 genera represented by 160 species were identified in the bottom of Puck Lagoon. In most samples eutraphentic α - or/and β -mesosaprobic taxa predominated. However, based on species composition, three main areas with distinct diatom flora can be distinguished. In northern part of lagoon including the coastal zone along the Hel Peninsula, the high frequency of marine and brackish diatoms, represented by *Opephora guenter-grassii*, *O. horstiana*, *O. mutabilis* and *Nanofrustulum krumbeinii* was noted. The second region covers the central part of the study area. In its western part the abundance of *Achnanthes lemmermannii* belonging to oligohalobous halophilous clearly indicates the influence of riverine waters of Reda, Gizdepka and Płutnica. However, in its eastern part located near the Outer Puck Bay, the higher frequency of marine species *Catenula adhaerens* was recorded. In the third region, located in southern part of Puck Lagoon, the higher frequency of the anthropogenic planktic species *Cyclotella choctawhatcheeana* was noted. Worth noting is the abundance of two eutraphentic species *Amphora pediculus* and *Planothidium delicatulum* that occur in large numbers in all regions of the Puck Lagoon.

Keywords: diatoms, biodiversity, sediments, Puck Lagoon, Baltic Sea

WILL GLOBAL WARMING ENHANCE GREENHOUSE GAS EMISSIONS FROM LAKES? INSIGHTS FROM ARTIFICIALLY HEATED LAKE IN POLAND

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Abstract

Since the late 1950s Lake Licheńskie (middle Poland) has been involved in a cooling system of the adjacent electric power plants. Owing to constant inflow of coolant waters the lake became 3-4°C warmer than non-heated lakes nearby and consequently changed its mixing regime, red-ox conditions as well as underwent floristic and faunistic transformations which made it more comparable to sub-tropical rather than temperate lakes. Therefore the lake can act as touchstone of what mid-European lakes are going to be within the next decades due to global warming. In 2014/15 we performed one year-long monitoring of CH₄, CO₂ and N₂O in Lake Licheńskie to assess if the long-term heating influenced diffusive emissions of greenhouse gases. Our estimations consistently show that the lake acts as a net source of the gases to the atmosphere. The CH₄, CO₂ and N₂O fluxes were positive throughout the period of study and ranged from 0.03 to 12.36 mg·m⁻²·d⁻¹ (0.002 – 0.77 mmol·m⁻²·d⁻¹), from 0.1 to 17.5 g·m⁻²·d⁻¹ (1 – 398 mmol·m⁻²·d⁻¹) and from 0.01 to 0.32 mg·m⁻²·d⁻¹ (0.15 – 7.23 μmol·m⁻²·d⁻¹), respectively. The CO₂ emission fluxes obtained seemed relatively high, and N₂O fluxes were rather low. In general however, the emissions were not considerably different than the values in other boreal and temperate lakes. The maximum emissions of CO₂ occurred during winter, N₂O was primarily released during spring and the largest CH₄ diffusion was during the summer. During the summer months, both N₂O and CO₂ fluxes were at their minimum values. From this study it appears that the temperature increase alone is insufficient to increase the greenhouse gas emissions greatly.

Keywords: greenhouse gases, global warming, heated lake, Poland

ALDROVANDA VESICULOSA – POPULATION STATUS AND SPECIES PROTECTION IN EASTERN POLAND

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Abstract

Aldrovanda vesiculosa L. is an aquatic carnivorous plant species, threatened with extinction. It is listed in the Appendix I of the Convention on the conservation of European Wildlife and Natural Habitats 1993 (Berne Convention) and in Appendix II and IV of the Habitats Directive 92/43/EWG. It was common in prehistoric times, but nowadays it is present at few stands around the World. In the area of today's Poland, *aldrovanda* was recorded in 92 sites through the ages. In the 50s of the 20th century there were about 70 locations of the species recorded, in the beginning of 70s – only 14, and now it occurs very rarely, in dispersed sites. In 2008 there were 7 locations of natural populations, 5 restored sites and 8 replacement sites where *aldrovanda* was introduced in the years 1992-1998. In Poland *Aldrovanda vesiculosa* is under strict law protection since 2001. The presented data here concerns the activities undertaken in a project 'An active protection of *Aldrovanda vesiculosa* on the territory of Lubelszczyzna region', no. POIS.02.04.00-00-0034/18, cofinanced by the Operational Programme 'Infrastructure and Environment'. The aim of the project is protection of the rare and threatened with extinction plant species - *Aldrovanda vesiculosa* in Eastern Poland, what is implemented through preservation, supplementation and reconstruction of *aldrovanda* populations. The tasks include protection of genetic resources through cultivation and propagation of plants in tissue cultures, and then restoration through reintroduction of new populations or strengthening the existing ones. A multidirectional monitoring, both of populations and habitats is also conducted, so it is possible to quickly react in case of any problems that might occur due to changing environmental conditions or in the functioning of populations.

Keywords: waterwheel plant, aquatic plant, carnivorous species, endangered species, reintroduction

DIVERSITY OF LITTORAL ARTHROPODS OF ESTUARIES

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Abstract

It is well known that most of the human settlements for thousands of years have been oriented to the shores of water bodies, which greatly facilitated the problem of survival for them. Over the past century, ties with water bodies and their productive floodplains has been lost. Today, floodplains and shores of water bodies are mainly used as recreation zones. Previously preserved superproductive ecosystems – the wetlands – are mercilessly destroyed by construction in the immediate vicinity of recreational places – water bodies. The response to these processes was the “Wetland International” program. It is well known that specific communities form at the water-land boundary. Aquatic invertebrates are an important food source for insectivorous terrestrial predators: they are mainly representatives of arthropods, especially spiders (Aranea), ground beetles (Carabidae) and staphylins (Staphylinidae) (Palm, Lindroth, 1936; Palmén, Platonoff, 1943; Lindroth, 1963; Andersen, 1982, 1983; Koch, 1989, 1992; Andersen, Hanssen, 1994; Hammond, 1998; Hering, 1998; Framenau et al., 2002; Lott 2003). Ground beetles, a group of highly specialized arthropods, trophically oriented to the production of hydroecosystems. The close connection of these arthropods with hydroecosystems determines their spatial preferences. Most species limit their distribution to coastal or floodplain habitats. This applies to imago and larval stages. The paper presents the results of studies for the period 2008-2012. We studied estuaries whose hydrological characteristics were changed as a result of massive regulation of river flow and the rivers flowing into them (southern Ukraine). Diversity and distribution of halobiont and halophilic species in a gradient from freshwater to saline conditions were studied. We analyzed the distribution of populations of more than 100 species of ground beetles identified along the banks of the estuary and rivers flowing into it. The paper presents a comparative analysis of the structure of assemblages of ground beetles of the littoral coast of the Black Sea (Ukraine, Bulgaria) with the Mediterranean and North Seas. Own and literature data are generalized: (1) studies on the coasts of the seas, salt estuaries and lagoons, (2) studies of salt marshes or salt lakes within the continent, i.e. remote from the sea coasts.

Keywords: riparian, halobiont, Carabidae, riverbank, shore of sea

THE PROCEDURE OF HABITAT SELECTION FOR THE REINTRODUCTION OF THE ENDANGERED *SALIX LAPPONUM* IN POLAND

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Abstract

The reintroduction, translocation and population restocking of endangered plant species are carried out all over the world in order to sustain the biodiversity of natural plant communities. Particular interest is focused on endemic or native plant species that are threatened with extinction, whose conservation is both important and difficult due to changing conditions and the degradation or fragmentation of their natural habitats. The choice of a suitable habitat to establish new populations through reintroduction is a key question, which becomes especially difficult when the habitat requirements of the species are not precisely known and when both current and predicted climate change must be considered. We present a procedure for selecting and verifying the optimal location for establishing a new population of the relict species *Salix lapponum* on the peat bogs in eastern Poland. Fragmentary data from the 1950s regarding its population resources in this part of Poland, which suggested that the species faced increasing risk of extinction, became the basis for undertaking multifaceted research. We aimed to demonstrate the importance of an approach combining the results of multifaceted analyses with the subjective experience and judgment of a practitioner. We began by selecting 30 historically known sites of the species and chose the optimal for the reintroduction process. The reintroduction of *S. lapponum* in the site ultimately chosen proved satisfactory with respect to plant survival. Suitable statistical analyses should be applied, but their value will increase with the amount and variety of available data on the habitat in the initial stage of site selection. The experience and intuition of a practitioner making the final choice of reintroduction site could prove to be crucial, so its importance should be emphasized.

Keywords: downy willow, peatland, habitat condition, reintroduction

PRELIMINARY DATA ON THE REINTRODUCTION METHOD EFFICIENCY OF ENDANGERED RELICT PLANT SPECIES OF PEAT BOGS IN THE CENTRAL PART OF EASTERN POLAND

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Abstract

As a part of the active protection of endangered relict species populations occurring in the peat bogs of the Łeczna-Włodawa Lakeland in the central part of Eastern Poland, the activities included two species belonging to the Salicaceae family - *Salix lapponum* and *S. myrtilloides*. They are the most endangered species of the genus *Salix* in Poland. Long-term field studies, threats identification and experimental attempts to increase existing populations have allowed the development of an active protection method for these two endangered species. The method of active protection of endangered species included four stages: 1. the collection of propagating material from a natural site, 2. the multiplication of plants by using tissue cultures, 3. the acclimatization of plants in conditions as close as possible to natural conditions, 4. plants planting to target site. Previous attempts to translocation plants into natural sites without the acclimatization and in worse condition (small plants without woody shoots) failed. It was assumed that the acclimatization stage has a significant impact on the final effect of reintroduction (number of adopted and translocated plants). Researches included two full reintroduction cycles has been conducted since 2018. The acclimatization was carried out for 30 days. During the process the plants were kept in similar to natural climatic and habitat conditions. At the beginning and the end of the acclimatization process, chosen morphological features were assessed. Preliminary results of reintroduced plants monitoring indicated that the acclimatization is very important element of the process. However, it is necessary to continue observation in next years.

Keywords: wetlands, reintroduction, acclimatization, *Salix lapponum*, *Salix myrtilloides*

ROLE OF WETLAND ECOSYSTEMS IN WATER QUALITY FORMATION IN TRANSBOUNDARY TERRITORIES OF THE AMUR REGION

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Abstract

There is increasing interest in the study of the biogeospheric role of wetland ecosystems in modern global climate change. They are known to perform a variety of environmental functions, such as regulating runoff and water supplies; improving the quality of surface and groundwater; increasing water infiltration. The filtering properties of wetlands are in most cases determined by the effect of their vegetation cover, which serves as a biogeochemical barrier on the migration of many chemical elements. Therefore, the vegetation affects the chemical composition of water passing through the wetlands, contributing to its purification. Current consequences of anthropogenic influence (fires, reclamation, laying of linear structures, etc.) on wetland ecosystems pose a serious threat to their functioning. Within the boundaries of Khanka and Sanjiang lowlands, about 80 % of wetland area is converted to agricultural fields that led on the one side to increased flood intensities and soil pollution by nitrates and herbicides in this region. Fires are determining factor contributing in degradation of vegetation cover and reduction of the area of natural wetlands in the south of Russian Far East. The medium number of wetland fire is 4–10 for 1975–2019. Preserved wetlands become fragmented and have been an ongoing transformation. To restore wetland ecosystems in order to reduce the effects of pollution of natural waters, it is necessary to develop new approaches to reduce the anthropogenic load on them and technologies for the restoration of natural wetland vegetation that plays an important role in the accumulation of pollutants during floods. Scientists of the Institute of Water and Ecology Problems of FEB RAS was proposed to use *Sphagnum fallax* H. Klinggr. and *S. squarrosum* Crome for the purification of natural waters. These two eutrophic species of *Sphagnum* mosses occur in floodplain phytocenoses in the basins of Lake Khanka and the River Ussuri. There are many factors that determine the competitive advantage of sphagnum mosses in binding pollutants, including their morphology and features of the cellular structure, thus ensuring *Sphagnum*'s ability to absorb by their entire surface. The moss tissues, as well as synthetic ion-exchange resins, are capable to be easily saturated with high concentrations of hydrogen ions and light metals which are also easily replaced by heavier metals with higher values of ion-exchange potential. In addition, the cover of sphagnum mosses significantly slows down the flow of water, reducing the risks of floods downstream in comparison with vascular plants. Our experimental studies *in situ* have shown that the floating beds of *Sphagnum fallax* and *S. squarrosum* successfully adapted to extreme water quality fluctuations in degraded riverine wetland ecosystems in northeastern China during flooding. They also acted as effective absorbents of toxic chemicals. So, for example, *S. fallax* can be used to eliminate the consequences of water pollution by heavy metals Fe, Mn, and Cr, and *S. squarrosum* is very promising for treating water from Mn,

N, and P. The restoration of lost plant communities in floodplain phytocenoses, including Sphagnum mosses, would promote the resumption of the natural functions of wetland ecosystems and reduce flood risks.

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Keywords: Sphagnum, wetland, pollution, fluctuations, floating beds

BALANCING NONPOINT SOURCE WATER QUALITY MANAGEMENT WITH WETLAND AND STREAM PRESERVATION: LESSONS LEARNED

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Abstract

Current and contemporary regulation of development-related activities in pre-regulation pre-existing lands that affect receiving waters, can require complex approaches to nonpoint source pollution - or stormwater management (SWM) - along with wetland resource avoidance including an on-the-ground historical basis for practicable regulatory decision-making. Such experience indicates growth can be accommodated in a manner that not only decreases pre-existing nutrient loads but also avoids and minimizes stream and wetland impacts while remaining compatible with effective SWM strategies to the degree of even improving post-construction conditions. In response to increasing regulatory authority over its water resources, the state regulatory agency, the Maryland Department of the Environment (MDE), USA, in cooperation with other local and federal agencies as well as the regional civil engineering industry, has over the years combined various regulatory programs and processes into a "one stop shop" where various issues can be addressed in a consistent manner. This is effective when large-scale multi-phased complex projects are submitted for applicable water resource permits. Experience has shown that successful outcomes can be achieved with a balance of various approaches within this process. Specifically, avoidance and minimization requirements of wetland/stream protection programs may not necessarily be compatible with more traditional SWM strategies that were shown to have room for improvement. Further, MDE's process may necessitate the consideration of SWM and wetland avoidance requirements and practices that can exceed those not historically required by the local municipality. This innovative example project is the first (late 1990s) of several (the last one completed around 2015) development projects in a 405-hectare (1000 acre) watershed of the Potomac River in the greater Washington, DC area and is actually one of the nation's first "Environmental Site Design (ESD)" or "Green Infrastructure" approaches to nonpoint source water quality management before the strategy was formalized in the industry. Regulated water and wetland resource impacts were reduced and mitigated by innovative design revisions along with creative and contemporary

approaches to wetland mitigation and SWM strategies. These practices were subsequently utilized and refined for further future development projects in this agricultural watershed – and generated State-wide criteria. The positive outcome of this process is attributable to an effective partnering of engineering and ecology, a water quality/stream biomonitoring plan, and a pro-active "win-win" public involvement process.

Keywords: wetlands, nonpoint, stormwater, stream, watershed, regulation

BIODIVERSITY AND ITS REVALUATION TROUGH NATURE TOURISM, INCLUDING WETLANDS. STUDY CASE: ROMANIA

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Abstract

For more than half a century, there have been constant losses of biodiversity with profound consequences for the natural world and for human well-being. They take place through intensive agricultural production systems, constructions' expansion, quarrying exploitation, overexploitation of the forest fund, oceans and seas, rivers and streams, lakes and soils, invasions by alien species, pollution. But these more active biodiversity losses are due to climate changes. The biodiversity, including wetlands, can be exploited sustainably through certain types of tourism. The capitalization started through ecological tourism or rural tourism,. But their expansion beyond certain limits has led to the unsustainable exploitation of natural resources, despite statements of minor impact on nature. In this context, it can be stated that, in the near future, the most recommended will be nature tourism. This type of tourism excludes the construction of tourist structures near or inside all protected areas so as not to damage the integrity of the natural environment and not to degrade the natural capital resources on which economic and social development is based.

Keywords: biodiversity, protected areas, nature tourism

ASSESSING THE LITHOLOGICAL COMPOSITION OF CORE SEDIMENT SAMPLES TO INVESTIGATE THE INFLUENCE OF NATURAL AND ANTHROPOGENIC STRESSORS

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Abstract

Naturally occurring processes, as well as anthropogenic activities, leave their marks on terrestrial and aquatic ecosystems which are undergoing extensive material and energy exchanges. Both natural and anthropogenic factors have played a significant role in creating the past and present hydro-morpho-dynamic conditions at the Danube Delta Biosphere Reserve edifice. This study was aimed to assess the anthropogenic and natural factors influencing spatial changes in the lithological composition of core sediment gathered from specific transitional environments. In this sense, six sediment cores were retrieved from Tătaru Lake (located in the fluvial delta plain), Puiu Lake (located in the marine delta plain), and Musura Bay (located in the coastal environment). To understand how lacustrine ecosystems *versus* coastal ecosystems respond to the natural and anthropogenic factors we assess between-core variation of the main lithological components (total organic matter - TOM%, total carbonates - CAR%, siliciclastic fraction - SIL%) and their spatial accumulation and layer distribution. Core sediments were analyzed for their lithological composition by means of LOI Method, attempting to figure the degree of natural and or/anthropogenic influence to the investigated transitional ecosystems. Results indicated a considerable vertical (in-depth) variation of the investigated parameters in function of the natural location of the sampling sites, and particularly, showed notable differences between the layers. The spatial variability, as well as in-depth fluctuations of the investigated parameters in core-sediments retrieved from different environs, indicated that the sediments have different susceptibilities to local environmental changes, which is important to improve understanding of deltaic/coastal processes and dynamics using sediment cores. The results obtained in this paper are based on a preliminary approach to better understand the hydro-sedimentary processes that occurred within these depositional settings. Further detailed new information and complex investigations are necessary to decipher the active deltaic sedimentation mechanisms in a fluvial-delta-sea environment.

Keywords: Danube Delta, natural factors, sediment cores, total organic matter, transitional environment

ASSESSMENT OF SUSTAINABLE DEVELOPMENT CHALLENGES WITHIN A SUBURBAN LACUSTRINE COMPLEX (CRAIOVA, ROMANIA)

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Abstract

The process of urbanization takes up a lot of wetlands, profoundly changing the natural connection of surrounding river–lake systems, all the while causing serious damage to the environment of connected catchments. Given the rapid advancement of urbanization, the sustainable development of suburban areas including water conservancy projects has received more and more attention. The nature reserve "Preajba-Făcăi Lacustrine Complex" (Code site 2,394) is situated in the South-Est of Craiova, Romania. Most species of community interest in this aquatic protected area of national interest have lake banks, dikes and the aquatic surface as preferred biotope. The Preajba river basin lies under constant anthropogenic pressures, which include the quest for socio-economic development within the lacustrine ecosystem. More than an original blend between urban (Craiova) and rural (Malu Mare), this catchment represents a distinct, opportune territory in terms of development, but also a depositary of land use and environmental conflicts. The present paper reviews these adverse activities that exert pressure on the lakes and the Preajba stream, presented in four subsystems: environment, infrastructural facilities, social and economic. The paper also highlights the case of the railway accident that took place during the summer of 2018, when a considerable amount of biodiesel was discharged and affected the Preajba stream. In this sense, the results reveal the fact that Craiova urban system and the Preajba river–lake systems are far from being isolated and static, there is actually a constantly changing relation and influence between them. Thus, the study raises awareness of the local authorities and stakeholders concerning the fundamental and practical aspects of the aquatic protected area in the logic of a global approach for sustainable policies.

Keywords: urbanization, sustainability, lake, protected area, Preajba Valley

SPATIAL PLANNING IN SERBIA: TOURISM DEVELOPMENT BASED ON WATER BODIES IN PROTECTED AREAS

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Abstract

Water resources such as rivers, lakes and even wetlands have always been elements that enrich an area and, in addition to undeniable ecological functions, they represent

powerful attractions for tourists. Strategically valuable and ecologically significant water bodies are often simultaneously aesthetic jams in landscape. For their multiply values becomes clear that planning of their use and protection require careful and formalized actions if a form of public policies. Spatial purpose area spatial plans in Serbia represent one of the mechanisms for the protection of water resources, but also a tool for bringing added value through their use in purpose of tourism development by targeting balanced approach. This article will focus precisely on the review of spatial plans, which regulate the use and protection of water resources under constitutional state protection in Serbia. Therefore, the water bodies that are central element of the spatial plans will be case studies. Given that rivers and lakes, river gorges and biodiversity elements are of particular attractiveness to visitors, which raises the question whether the spatial plans manage to equalize environmental and economic development in sites under protection. Through measures of development, protection and balancing between these aspects, this paper will present the strengths and weaknesses from three perspectives: environmental, economic and social. Elements of water resources that are recognized by the spatial plans will be detected by analyzing descriptive parts of the documents. Application of this method is expected to reveal connections between water protection and tourism development. In the other segment, this research will address tourism development measures and nature/water protection measures and comment on their synchronization or contradiction. Embedding these facts and estimations in a broader context – governance, population density and tourism indicators, the paper will give a complete overview on the tourism development based on water bodies in analyzed protected areas. The article will present all the important multifunctional development strengths and obstacles in case of protected natural resources based on water bodies as central elements. The results are expected to be applicable in much broader context than the local and national, in which analyzed case studies pursue legal protection.

Keywords: water bodies, tourism, spatial planning, protected areas, case study, Serbia

WATER MANAGEMENT WITH GREEN INFRASTRUCTURES IN ENSURING SUSTAINABILITY OF TURKISH CITIES

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Abstract

In addition to the rapid growth and spread of cities, the pressure created by the increasing population on Natural Resources is now taking place at a rate above the carrying capacity of the environment. The problems caused by urban activities such as waste, pollution, greenhouse gas emissions and environmental degradation are

incomparable to the past and cause global warming. Cities are highly dependent on ecosystem services, that is, the resources that nature provides to sustain our existence. Water has a privileged place within these sources. Water is a basic resource for life and for all human activities. It is also irreplaceable in terms of the ecosystem and the services it provides. Access to healthy water is primarily defined by the United Nations as a fundamental human right. Water, on the other hand, is a resource where the negative effects of climate change are already beginning to be seen and could directly threaten the security of states. The vulnerability of water to changes in the climate system is paramount because climate change directly affects the water cycle. Extreme weather events due to climate change can cause sudden, unexpected events unlike conventional climate regimes. This also changes the rainfall regime. This situation causes urban floods in cities where rainfall becomes more frequent, resulting in loss of property and lives. In urban areas where the rainfall regime is decreasing, conversely, it causes water scarcity. In the cities, especially the large number of impermeable surfaces affects the natural flow system of water. Changes in the water cycle prevent the feeding of underground and above-ground water sources. Rainwater, which cannot pass underground at the appropriate time, is contaminated during its stay on the surface. This is the reason why water resources are damaged when polluted water reaches the water reserves. It is observed that urban infrastructure systems are increasingly handled with an integrated approach to create sustainable cities that are resilient to the negative effects of climate change and green infrastructure solutions are developed in order to ensure the sustainability of water. One of the most important features of a city resilient to climate change is providing effective water management and providing quality water to its citizens. The aim of the study is to address the strategies and green infrastructure solutions that need to be implemented by taking into consideration the issue of sustainable management of water resources in cities, especially in the context of climate change. In today's conditions, reaching climate change- resilient cities depends on sustainable management of natural resources directly affected by global warming, the determination of green infrastructure strategies and appropriate adaptation considering local characteristics.

Keywords: Water, climate change, green infrastructure, urban resiliency.

METHODOLOGICAL ELEMENTS OF BENEFIT COST ANALYSIS FOR HYDROGRAPHIC BASIN

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Abstract

The implementation of the Water Framework Directive (DCA / WFD) at the level of the Member States, implies the use of analytical methods (Cost-efficiency analysis, Cost-benefit analysis, etc.) and application of general and specific principles (polluter / user-pays principle, principle prevention, the principle of minimizing pollution at source, etc.),

in order to obtain a "good state" for all bodies of water, both for surface and underground bodies. The paper refers to the presentation of a methodological framework regarding the cost benefit analysis, at the level of a river basin.

Keywords: Cost-Benefit Analysis, Economic evaluation, Efficiency

Water project

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Abstract

The paper presents the project of the Technical University in Košice: Raising the awareness of residents, especially Košice and Prešov self-governing region in the field of sustainability of water resources with emphasis on the involvement of students. The aim of the submitted project is to raising awareness about water management and water resources in the Slovak republic. The activities in the project are divided into four groups – informational, includes thematic brochures, audio record, video record and pamphlets; media, includes advertisement; online activities include web site, social networks and online competitions and the last activity – presentation, includes professional lectures. The targets groups of the project are kindergarten children, primary school students, citizens of affected area and government. The project activities are designed for certain target group, especially the members of the government were invited to the professional lectures. But, on the other hand, information activities mainly the thematic brochures are designed for all four targets group. There are 3 types of the thematic brochures for all four target groups, and every brochure is divided into 2 thematic topics. The topics are: Water of Eastern Slovakia, Household water, Flood, Flood protection, Water structures of Eastern Slovakia, Water in the landscape. Online activities, mainly online competitions are designed for kindergarten children and primary school children. The competitions are designed for kindergarten children and primary school children, and the topics are: Water unites us, Future of the water, As you can see the water is not just from the tap, Water through the lens.

Keywords: water project, household water, flood, flood protection

THE QUALITY ASSESMENT OF RIVER SITNICA AND ITS PROTECTION MEASURES

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Abstract

Kosovo's waters are unevenly distributed in time and space. Kosovo is water scarce, and it also has the low level of water resources development and storage. In particular Iber basin is water stressed, but in the next 20 years it is expected that all four Kosovo's basins will be water stressed. This is due to population and general economic growth, and resource variability. The anticipated revitalization of the irrigation and mining sector and additional demands from the energy sector will increase pressure on new water demands. For these reasons, the water quality of existing resources will become an ever-growing problem if not addressed now. River Sitnica is main river stretching in Kosovo valley, where main urban areas including capital Prishtina, and main industries are located. To study and evaluate the quality of the river Sitnica, water samples were taken at five characteristic points of the river for which physic-chemical analyzes were made, the results of which were then compared with reference values for different types of surface water quality according to local legislation (Administrative Instruction 16/2017) that transposes the requirements of Water Framework Directive. Sampling and analysis were done in two series: dry and post-rainfall period. The results show that the river Sitnica upstream has a good quality but, as soon as it starts to pass in urban areas we have a degradation of its parameters, drop in oxygen level, high values of biological oxygen demand and chemical oxygen demand which means that the river loses its purification capabilities as it hosts numerous discharges from urban and industrial wastewaters which in themselves contain different pollutants. According to this study the quality of river Sitnica is not even meeting the criteria for "moderate type" of surface water quality. This water cannot be used safely for any purpose without prior adequate treatment. Kosovo is lacking behind in terms of achieving certain goals and implementing European Environmental Directives in water sector, namely the Water Framework Directive and Urban Wastewater Treatment Directive. As a country with a European perspective, we must take necessary actions for protection of rivers by developing a management plans to slow down their further degradation and progressively improve quality and sustainable use.

Keywords: Clean rivers; protection of water resources; water managemnet

MICROPLASTICS IN SHALLOW COASTAL AREAS OF BRAZIL: A REVIEW OF SOURCES, EFFECTS AND MAIN SOLUTIONS

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Abstract

The oceans are important sources of food and resources, bearers of great biological diversity and play a fundamental role in regulating the temperature of the planet and in the cycling of nutrients. However, over the past few decades, marine ecosystems have been receiving high amounts of waste, the largest proportion of which is decomposed into smaller particles (<5 mm) called microplastics, which are present from the sand strip of the beaches to deep marine locations. Thus, this study reviews the sources, effects and main solutions to reduce microplastic contamination in coastal marine ecosystems on the Brazilian coast. Brazil has a coastal zone of 8,698 km in length (388 thousand km²), where thirteen of the seventeen capital cities of the coastal states are located on the seashore, concentrating greater demographic density. Along the Brazilian coast, in addition to intense urbanization in estuarine areas and bays, port, industrial and tourist exploration activities are developed, which ends up generating numerous problems of pollution and contamination of marine ecosystems by various sources and different types of materials. Among the sources of microplastics in Brazilian marine ecosystems, we can highlight mainly the discharge of untreated sewage in affluents and coastal areas, one of the major environmental problems faced by the country, considering that more than half of the generated sewage is not treated, containing synthetic fibers, microplastics from personal care, hygiene, cleaning and cosmetics products; the inappropriate disposal of plastic waste on the beaches resulting from tourism, recreational and fishing activities, which end up suffering fragmentation due to UV photodegradation, mechanical action, hydrolysis and microbial activity; and, industrial and port activities. The main effects caused by microplastics on the Brazilian coast, until now, are related to accidental ingestion by several marine species, causing toxicological effects, due to the adsorption or leaching of contaminants present in the microplastic particles, in addition to other adverse effects, such as hormonal dysfunctions, neurotoxic effects, behavioral and dietary changes, reproductive dysfunction, reduced viability, mobility and even death; the possibility of concentration and transport of different pollutants such as persistent organics; and, with biological risks, in which microorganisms are carried to places where they would not arrive naturally, contributing to the introduction and transport of pathogenic microorganisms or invasive species. Among the main solutions to stop the growth of microplastic contamination in Brazilian coastal ecosystems are environmental education activities to contain the inappropriate disposal of solid waste and the development of research to create bioplastics from renewable sources. So far, there is no effective and economically viable remedy for the removal of microplastics from the oceans and the future consequences of this contamination for marine ecosystems cannot be estimated with precision. Research and studies are still needed to estimate long- and

short-term effects and consequences. Governmental actions are the most urgent, but the awareness and consequently the participation of the whole society in the prevention and combat of marine pollution by microplastics, is fundamental, mainly when we consider the dismantling of the environmental policies of the current Brazilian government.

Keywords: Coastal ecosystems; Environment; Marine waste; Ocean; Plastic; Pollution.

LAKES PAIONE (NW ITALY): TRENDS IN WATER CHEMISTRY, MACROINVERTEBRATES AND ACIDIFICATION INDICES OVER THE LAST 30 YEARS

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Abstract

Mountain lakes are common features of Alpine landscapes, and researchers' attention to them has increased recently in response to the growing awareness of their pivotal role as indicators of atmospheric pollution and climate change effects. Lakes Paione, (Paione Superiore and Paione Inferiore) are situated above the tree line at altitudes >2,000 m a.s.l., are characterized by small sizes and low nutrient levels. Since the '90s, these lakes were monitored by the CNR – Water Research Institute for chemical and biological characteristics in the context of national and European projects, to assess their vulnerability to the deposition of atmospheric pollutants. The lakes proved to be sensitive towards acidification: they underwent acidification in the 1980s and then recovered from the chemical point of view starting from the 1990s due to decreasing deposition of acidity. During 2020, following the provision of the EU National Emissions Ceilings Directive (NECD), all the available data regarding Lakes Paione were organized in a dedicated database, giving particular importance to updating and unifying macroinvertebrate and diatoms taxonomy to facilitate the interpretation of data collected over such a long period of time and to allow comparisons with data collected in other geographical areas. According to the Fauna Europaea classification, the macroinvertebrate database reports the abundances of taxa (mainly identified to species level) in 95 samples for a total of 1,969 records. Commonly-used indices of richness, diversity and abundances were applied to the most representative macroinvertebrate taxa groups, on the contrary several indices based on the occurrence or on the relative abundance of acid-sensitive taxa were applied to macroinvertebrates as a whole. Lake Paione Inferiore shows a higher biodiversity than Lake Paione Superiore, probably because it experiences higher water temperatures and a lower impact of acidification phenomena, as suggested by the higher values of some the applied acidification indices. In general, only a few acidification

indices proved to be consistent with the physical-chemical information available. In most cases, the overestimation of the effects of acidification are related with the taxonomic lists of species produced by each index: these lists do not include many of the taxa present south of the Alps because of their biogeographic distribution, and are mainly focused on Ephemeroptera, Plecoptera and Trichoptera (EPT taxa), which are poorly represented in Lakes Paione and in their watercourses, where chironomids and oligochaetes dominate. In the past, the development of the LAMM and Braukmann indices which considered several macroinvertebrates taxa other than EPT, favored the assessment of the acidification status of lentic environments. The next efforts should focus on including a larger number of chironomid and oligochaetes taxa at an identification resolution useful for evaluating their degree of sensitivity to acidification. While we were able to highlight a distinct recovery in the chemical status of these lakes, the responses of macroinvertebrates did not show a clear correlation with pH and alkalinity increases, suggesting that pressures other than acidification could limit the change in biodiversity and the biological recovery in these sites.

Keywords: Acidification, Macroinvertebrate, Biomonitoring, Long-term, Recovery

ANTHROPOGENIC POLLUTION OF WATER RESOURCES AND ECOHYDROLOGICAL SOLUTIONS FOR QUALITY IMPROVEMENT

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Abstract

The world is faced with problems related to quality and quantity of surface water resources due to extensive industrialization, increasing population density and a highly urbanized society. Water pollution and input of nutrient especially phosphorus (P) and nitrogen (N) load to rivers and coastal zones driven by human activities is a major problem in many river catchments and coastal marine ecosystems in Europe and the world. This intensified anthropogenic input of nutrients leads during summer periods to strong eutrophication and toxic algal blooms in many lakes, water dam reservoirs, and coastal zones in Poland and Europe. Ecohydrology provides scientific understanding of the hydrology/biota interplay in the catchment, and develops of systemic solutions on how to use nature-based processes to water quality improvement and Sustainable Water Resources Management. The main objectives of the ecohydrological research led in Poland were: (i) evaluation of the most significant anthropogenic factors determining eutrophication of the Baltic Sea - transboundary level, (ii) quantification of nutrients

transfer along the Pilica River continuum from the source to the estuary - national level , (iii) evaluation of the role played by WWTPs in contamination of the Pilica River and the Baltic Sea - regional level, and (iv) elaboration of the innovation hybrid sequential biofiltration system (HSBS) for wastewater purification (in Rozprza and Szadek Town) as an example of nature-based solution - local level. Research conducted in the Pilica River catchment has a much broader scope and focused on the analysis of hydrological processes and the following contaminations: chemical (nutrients, dioxins, heavy metals, surfactants), and microbiological pollution, and drug resistance (antibiotic-resistant bacteria - ARB, antibiotic-resistant genes - ARG), which affect ecotoxicity state of waters. These interdisciplinary and innovative studies connected with the use of multidimensional statistical analysis of water and wastewater quality in particular catchment scales, including artificial neural networks and methods in the field of pattern recognition, bring new and utilitarian knowledge about the spread and transformation of pollutants in the catchments of rivers to promote a better understanding of ecosystem health and the scale of pollution and also to encourage sustainable social practices, especially in the Baltic Sea region. Innovative studies in the Pilica River catchment can act as a basis for the management of other river catchments, both in Poland and abroad. This, in turn, will contribute to the reduction of eutrophication and degradation of water resources prescribed by the Water Framework Directive, Wastewater Directive, and the Baltic Sea Action Plan.

The research were conducted within the framework of the following projects:

- Project of the National Science Centre, Poland - Project No. 2015/19/B/ST10/02167
- Project of the Polish Ministry of Science and Higher Education - Project No. NN305 365738
- Project of the National Centre for Research and Development, Poland - Project No. TANGO2/339929/NCBR/201

Keywords: river, wastewater, microbiological pollution, antibiotic-resistance, Pilica River catchment, ecohydrological solutions.

TESTING THE EFFECTS OF WATER LEVEL MANAGEMENT ON THE LITTORAL FAUNA OF A LARGE DEEP TEMPERATE LAKE (LAKE MAGGIORE, NW ITALY) USED AS A CASE STUDY

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Abstract

The Interreg ParchiVerbanoTicino project (ID481668) was launched in 2019 to respond to the increased water demand by stakeholders to the managers of the water resource of Lake Maggiore (NW Italy). The main goal of the project is the development of common strategies for the shared and sustainable management of the water resources, with particular concern for the protected natural areas in the territory. The entire area, constituted by the watershed of Lake Maggiore and the River Ticino outlet, acts as an important ecological corridor among pristine natural sites in the high human-impacted area of the River Po Plain. The main goal of the project is to assess the effects of the water-level management along the shores of this large deep lake regulated through the Miorina Dam placed at the lake's outlet on both macro- and meio-fauna, used as indicators of stress considering their pivotal role in the food-web. Quantifying the stress impacts on the macroinvertebrate and meiofaunal assemblages is challenging, also considering the importance that freshwater has for human wellbeing and socio-economic services. In order to find suitable sampling stations for both macro and meio-fauna we selected three areas along the lake shores with a mix sediment texture. Following the North-South axis of the lake, the three stations were distributed within the Emerald (Switzerland) and Natura 2000 networks (Italy) and placed in the northern, central and southern part of the lake, as they are subject to different water level amplitudes during the water management period (from mid-March to mid-September). At each station, the monitoring was conducted both in habitats subject to (partial or total) drought during the period of minimum water level, and in permanently wet habitats all year around. These stations could be considered as model ecosystems to describe the possible impacts of Miorina Dam water management on the naturalness of littoral habitats and harbored biological assemblages. An overview of the activities planned by the project is provided, with a focus on the effects of water level management on the coastal fauna of the lake using chironomids as a proxy for macroinvertebrates assemblages and copepods as a proxy for the meiofaunal ones. In particular, the effects were investigated, analyzing changes in body size, biomass, biodiversity, and restructuring the trophic web of both assemblages in the lake.

Keywords: water level fluctuations, macroinvertebrates, meiofauna, body size, biomass, trophic guilds

IMPACTS ANALYSIS OF MACROINVERTEBRATE ALIEN SPECIES IN THE HYDROGRAPHIC SYSTEM OF A SUBALPINE LAKE ON THE ITALIAN-SWISS BORDER

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Abstract

Invasive alien species (IAS) affect all ecosystems at global scale, and they are recognised worldwide as a serious threat to biodiversity. Moreover, the increasing number of IAS is strongly linked to the increase in international trade and their invasion is driven by human activities. The management of invasive alien species and their pathways of introduction are the main core of EU regulation 1143/2014 and the species included in the list of Union concern are subject to measures that include restrictions on keeping, importing, selling, breeding and growing. Member States are required to act on pathways of unintentional introduction, to take measures for prevention, early detection and rapid eradication of these species, and to manage species that are already widespread in their territories. To address the problem of biological invasions, it is important to analyse different factors that favour the introduction, establishment and spread of invasive species but it is also important to understand which bio-ecological traits of alien species favour the colonisation of a new environment. The combination of these analyses identifies potential risks at an early stage and suggests appropriate measures to mitigate their impacts. In this study, we analysed the potential invasiveness of the macroinvertebrate alien species in the hydrographic system of Lake Maggiore, one of the large and deep lakes on the Italian-Swiss border. The investigated area is characterised by various pressures such as high-density population, intensive agriculture, industries, and tourism. These anthropogenic pressures are some of the most relevant activities that favour biological invasions. The identified macroinvertebrate alien species were assessed by means of the Aquatic Species Invasiveness Screening Kit (AS-ISK), a specific risk assessment tool developed for quantifying the impacts of alien species on commercial, environmental and species traits sectors. In total, in the catchment of Lake Maggiore, 17 aquatic IAS are reported: 10 molluscs, 4 decapods and 3 amphipods. The assessment results indicate 7 species with a high level of invasiveness: the decapods *Procambarus clarkii*, *Orconectes limosus* and *Pacifastacus lenisculus*, the bivalves *Dreissena polymorpha*, *Corbicula fluminea* and *Sinanodonta woodiana*, and the gastropod *Pseudosuccinea columella*. Despite most of the IAS assessed in this study are not included in the list of Union concern, this does not mean that they do not have any impacts. Nevertheless, it is also true that for most of these IAS, it is very difficult to perform any actions to eradicate them because they are already well-established in the assessment area. However, it is still important to monitor their spread and be aware of the impacts that they can cause. When the opportunity of eradication is not feasible, the only option is to attempt to control them. In conclusion, this study represents a first step in the assessment of the macrobenthic community in the

catchment area of Lake Maggiore and it could contribute to refine potential management strategies aimed at reducing the impacts of IAS in the future, taking also into account the effects of climate change.

Keywords: potential invasiveness, AS-ISK, Lake Maggiore, non-native macrobenthic fauna

NEW METHOD TO IDENTIFY THE COLONIZATION LEVEL OF RIPARIAN VEGETATION SPECIES

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Abstract

Riparian vegetation is constantly exposed to abiotic stress, such as hydrological and edaphic stresses. Reactive oxidative species (ROS) are generated in the plant cell organelles based on the intensity of these stresses. The current study examined the colonization of riparian vegetation communities across the elevation gradient by the quantification of environmental stress using foliar hydrogen peroxide concentration. Observation was conducted in the riparian zones of Japanese rivers for common woody and herbaceous species: *Salix* spp., *Robinia pseudoacacia*, *Ailanthus altissima*, and *Juglans mandshurica* as representative tree species, and *Phragmites australis*, *Phragmites japonica*, *Miscanthus sacchariflorus*, as representative herb species. Leaf tissue was sampled, both from light exposed and shaded conditions, at different elevation along transects perpendicular to the river, and H₂O₂ concentrations in the leaf tissues were analyzed. Soil from each sampling location was also sampled and analyzed for nitrogen and moisture content. The comparison between light exposed and dark-adapted samples indicated that solar radiation cannot be considered as a stressor for the plants, and nor did H₂O₂ concentration change systematically with prevailing nutrient conditions. Thus, soil moisture content was the most important significant stress factor for plants in the riparian zone. Soil moisture content decreased with elevation. Unique relationships were observed between plant leaf H₂O₂ concentration and soil moisture content for different vegetation types (trees vs. herbs). The H₂O₂ concentration of tree species, except for *Salix* spp., decreased with decreasing moisture content regardless of species, while that of *Salix* spp. increased with increasing soil moisture. H₂O₂ concentration of herb spp. increased with soil moisture. All studied species were found to colonize where H₂O₂ concentration was below than a threshold value for respective species. Thus, the study suggests that foliar H₂O₂ concentration can be used as an indicator of distribution of riparian vegetation.

Keywords: riparian vegetation, hydrogen peroxide, environmental stress, soil moisture, habitat indicator, river management

TESTING EFFECTS OF WATER RETENTION TIME ON PHYTOPLANKTON DYNAMICS IN CONNECTED LAKE ECOSYSTEMS IN A LARGE-SCALE ENCLOSURE EXPERIMENT

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Abstract

Lake ecosystems face severe anthropogenic forcing through land use alterations and climate change, which compromise water quality and the provision of ecosystem services. Effective management to preserve ecosystem functioning relies on mechanistic understanding of the response of lake ecosystems to environmental stressors. These responses are influenced by features of the lakes themselves, but also by the close connectivity to their surrounding landscape through the catchment, and to neighboring lakes by rivers. To improve our mechanistic understanding of biological coherence in river-connected lake ecosystems, we tested following hypotheses: Lake-to-lake connectivity drives biological coherence in lake chains and facilitates widespread impact of eutrophication events. Differences in water residence time, i.e. strength of lake connectivity, may stimulate or discourage seasonal coherence with respect to water constituents, phytoplankton communities, primary production and hence ecosystem functions. Increasing lake connectivity allows faster and spatially more extensive impact propagation through a lake chain, which may increase eutrophication impacts at the regional scale of the lake chain, i.e. a higher risk of cyanobacterial blooms. To test how lake connectivity drives biological coherence and eutrophication impacts in *deep* lake chains we conducted a controlled experiment in the unique IGB Lake-Lab, a large-scale mesocosm facility in Lake Stechlin. In August 2019 we set up six experimental circular lake-chains of four mesocosms each to establish two levels of connectivity based on epilimnetic water residence times typical for lakes in the region. To ensure identical initial conditions, all mesocosm water was simultaneously exchanged with water from the surrounding Lake Stechlin. At the start of the experiment, a storm and nutrient-runoff event was simulated by adding P and N (Redfield ratio) and mixing the epilimnion from 4 to 14 m into the deep cyanobacteria layer of the head-mesocosm of each circular chain. Thereafter high and low retention times, respectively, was simulated by pumping unfiltered epilimnetic water from each mesocosm into the adjacent one in each circular lake-chains. During the experiment we monitored temporal coherence of phytoplankton dynamics, cyanobacteria bloom formation and several processes relating to grazing, production and ecosystem functioning. High-resolution *in-situ* multi-sensor profiler measuring light, temperature, pH, conductivity, oxygen, turbidity, and total Chl-*a* were combined with high-throughput pictured based Flowcytometry (FlowCam, Fluid Imaging) and hyperspectral remote sensing, e.g. airborne Hypspx-cameras and field spectrometers. Additional parameters of lake physics, pelagic processes and near remote sensing were measured through participants of the AQUACOSM TA-program (aquacosm.eu), not presented here. Our results indicate that short retention time synchronizes the epilimnion

plankton community after four weeks, while long retention time lead to differences in phytoplankton community structure. Surprisingly low phytoplankton biomass developed in the epilimnion, while the deep chlorophyll maximum, dominated by *Planktothrix rubescence*, was strongly pronounced at 10-14 m depth. Although low epilimnetic Chl-a values were challenging to measure with remote sensing tools the combination of *in-situ* multi-sensors with high throughput plankton analyses and remote sensing improves our understanding of biological dynamics and coherence in river-connected lake ecosystems and will be useful to support future lake monitoring and management.

KEYWORDS: mesocosm experiment, lake connectivity, phytoplankton dynamics, primary production, water retention time

GO WITH THE FLOW - PHYTOPLANKTON DYNAMICS IN RIVER-CONNECTED GERMAN LOWLAND LAKES

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Abstract

As predicted by recent climate models extreme weather events will further increase in the future and specifically affect freshwater ecosystems. For example, heavy rainfall that causes nutrient run-off from the catchment as well as intense storms that can change mixing patterns of freshwater bodies, increase the likelihood of eutrophication and thus the frequency, intensity and composition of algal blooms. Such events have been suggested to particularly increase the risk of harmful algal blooms and result in elevated greenhouse gas emissions. In river-connected lakes this is of special concern, since extreme weather events can not only influence the local environment, but also change the environment downstream and thus affect regional lake systems. Currently, the water quality of river-connected German lowland lakes shows a poor or bad ecological status according to the European Water Frame Directive. However, phytoplankton dynamics in these systems are poorly understood and yet, monitoring is often limited in space and

time. Therefore, the interdisciplinary CONNECT project aims for comprehensive insights in plankton ecology of connected river-lake systems and related processes by using a unique combination of high frequency *in-situ* measurements, high-throughput lab approaches and various remote sensing tools. We hypothesize that lake connectivity is of major importance for spreading nutrient loading events and subsequent algal blooms, thus increasing the coherence between lake ecosystems along a river-lake chain. To test this, we studied 19 lakes of different trophic state and grade of connectivity in the upper Havel-river system in NE Germany. Continuous *in-situ* measurements by multiparameter probes were combined with monthly water samplings and high-throughput plankton analyses in the lab as well as different remote sensing tools. Results from image-based flow cytometry (using FlowCam 8000series instruments, FluidImaging) and HPLC analysis of phytoplankton pigments suggested that strongly connected lakes along a river system were more coherent showing similar phytoplankton biomasses and composition while the phytoplankton community structure was different among weakly connected lakes. In combination with satellite remote sensing data spatial gradients of phytoplankton distribution were found. The CONNECT project helps to better understand spatial and temporal phytoplankton dynamics in river-connected lakes and could support new ways of future freshwater monitoring and management.

KEYWORDS: river-lake chains, phytoplankton dynamics, image-based flow cytometry, phytoplankton pigments

FEATURES OF THE IMPACT OF WASTEWATER TREATMENT PLANTS DISCHARGE ON HYDROECOSYSTEMS OF MOUNTAIN AND LOWLAND RIVERS

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Abstract

Among the sources of surface water pollution, effluents from wastewater treatment systems is of particular importance. Modern cleaning technologies are constantly being improved; drain less technologies already exist, but the transition to such technologies will obviously not happen so soon. Today, almost all cities in the world dump treated wastewater and it is unlikely that the situation will change drastically in the coming

decades. The diversity of wastewater treatment systems that exists today indicates that humanity is only at the stage of finding the best solution. In addition to the variety of technological solutions in the field of water purification, it should be noted the variety of reservoirs-receivers. In fact, natural water bodies are considered as systems for the post-treatment of residual contaminants coming from sewage. In addition, in many respects, both the level of the negative effect and the distance over which this influence can spread, depend on the state of the receiver and on its self-cleaning potential. Today we have extensive literature on the functioning of communities of activated sludge organisms, while there are a very limited number of works aimed at studying the effects of effluents and the reaction of water bodies to them. The available works, as a rule, rely on generally accepted standard methods and approaches, including hydrochemical indicators, which are practically not applicable to assess biological diversity and the impact of various allochthonous incomes on it. In general, if the thesis that effluents have a negative effect does not require additional evidences, then information about how far this effect can spread in water bodies of various types is rather small. We studied the effect of treatment facilities similar in technology and volume, discharging wastewater into a mountain and flatland river, and estimated the distance and intensity of their impact. The assessment is based on biological indicators and rate of oxygen consumption. It is shown that standard hydrobiological methods for assessing destruction and production do not work in conditions of high-energy subsidies. Original methods are proposed for assessing the level of destruction and approaches to assessing the effect of effluents on hydroecosystems based on an analysis of the distribution of populations of the protozoa coming with effluents.

Keywords: treatment plant, biological indicators, saprobity, ciliata

SURVEY AND STATUS DESCRIPTION OF AQUATIC REED BEDS AT LAKE CHIEMSEE, GERMANY, USING LOW-COST UAV AND HIGH-END PASSIVE AND ACTIVE AIRCRAFT SYSTEMS

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Abstract

Common reed (*Phragmites australis*) beds in the shore zones of lakes are characterized by high biodiversity, provide habitats for a large number of organisms and contribute significantly to water quality. Traditionally, terrestrial mapping and visual interpretation of aerial photography is employed to assess permanent in water growing aquatic reed beds. Climate change effects like frequent storm and flood events alter the growth conditions of aquatic reed beds. A more frequent monitoring of these sensitive ecosystems seems necessary. The rapid development of technology in remote sensing rise expectations toward a more objective assessment of changes at increased cost efficiency,

the latter a precondition for a more frequent monitoring. The aim of our studies was to figure out which data types and methods are suitable for an automated derivation of parameters for the characterization of water reed status. Cost-effective multicopter and fixed wing unmanned autonomous vehicles (UAV) systems were investigated in comparison to technical high-end systems, e.g. the combination of hyperspectral HySpex and photogrammetric 3K sensors as well as a GreenLiDAR system. UAV systems cover the requirements of small independent offices specialized in environmental monitoring and assessment. The high-end systems show the current technical possibilities for detailed reed monitoring. Transect mapping on 14 test and verification areas (TTFs) served as a basis for comparison. Our conclusion is that aquatic reeds can be evaluated by the data of each of the compared systems. An important result is that especially the structural characteristics 'height', 'area', 'density' and 'front line design' of the reed stands are suitable for monitoring by remote sensing data. These can be derived via 3-D capable systems (UAV, 3K, GreenLiDAR). The accuracies are in comparable orders of magnitude and always significantly higher than those achieved in transect mapping. A unique advantage of the GreenLiDAR system is its ability to map the shore line at the time of acquisition. The variables 'vitality' and 'degree of stress' cannot be determined unambiguously by spectral information alone. However, the investigations indicated that spectral information in combination with structural information via 3D data allow well-founded, objective assessments of extension and status of aquatic reed populations. This results in a hitherto unattainable quality of the description of the condition of aquatic reed beds.

Keywords: aquatic reed, remote sensing, UAV, 3K, HySpex, GreenLidar

SENTINEL-2 TIME SERIES FOR MAPPING THE SPATIO-TEMPORAL DEVELOPMENT OF SUBMERGED AQUATIC VEGETATION AT LAKE STARNBERG (GERMANY)

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Abstract

Submerged aquatic vegetation (SAV) are sensitive to environmental changes and serve as bio-indicators for the trophic state of freshwater lakes. Variations in water temperature, light availability and nutrient concentration affect SAV growth and species composition. The European Water Framework Directive (WFD) recommends a regular monitoring of SAV. Climate change affects the growth of SAV. The aim of the presented research was to figure out to which level of detail it is possible to assess species composition, biomass production and growing patch dynamics by Sentinel-2 (S-2) multi-seasonal observations at Lake Starnberg, south of Munich, Germany. The four very first Sentinel 2 (S2) data sets

recorded on 3rd, 13th, 23rd August, 12th September 2015 from Lake Starnberg, South-Germany, were analysed. S2 data were processed to remote sensing reflectance by EoMAP GmbH & Co. KG using their MIP bio-optical model correcting for atmosphere, water surface and water column effects. For mapping the macrophyte populations we compared two methods: the semi-empirical method of depth-invariant indices after Lyzenga (1978, 1981) and the physically based, bio-optical model WASI-2D (Gege, 2014). For parameterisation of the two models we used spectral endmembers (sediment, meadow-growing and tall-growing species) provided by growth-models after (Fritz et al., 2018). Both methods, i.e. the depth-invariant index and WASI-2D, were able to retrieve bottom substrate maps, differentiating between SAV and sediment, which indicates the potential suitability of S-2A for monitoring littoral bottom coverage. In both cases, reflectance/growth models developed on in-situ measurements provided species-, time- and site- specific endmember spectra. Both approaches detected similar spatial patterns and distributions of SAV and sediment, but they were hardly able to clearly differentiate between meadow- and tall-growing SAV. The reduced penetration depth (smaller shallow water area) with lower sun zenith angle at imaging dates later in the season indicates that there are other, non biological factors influencing the detection and assessment of SAV patches as well.

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Keywords: submerged macrophytes, Sentinel 2, time series, water contents, mapping, phenological model

SATELLITE SURVEY OF RESTORED RIVER SITES. CASE STUDIES IN ROMANIA

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Abstract

A large number of river restoration projects report rapidly the achievement of their objectives. Are the river restoration actions effective on long-term? The aim of our study was to contribute at understanding the effects of river restoration based on a diachronic analysis of satellite images. We investigated 4 river restoration projects in the southern lowlands of Romania aiming to extend the wetland surface, implemented in 1994-1996 (2), 2011 (1), and 2014-2015 (1). These river restoration projects were completed on small areas ranging from 490 ha to 2100 ha. To conduct the diachronic analysis, we used Landsat images and we surveyed land cover changes post-restoration until 2019. Most images are from late winter and early spring (February-April), period corresponding to high waters in the southern lowlands of Romania. The analysis relies mostly on NDWI (Normalized Difference Water Index) – to detect the water content and NDVI (Normalized Difference Vegetation Index) – to detect the vegetation state. In the case of the Comana marsh (in the Romanian Plain), which corresponds to an anabranching sector of a second order tributary of the Danube River, the restoration project was conducted mainly in 2011, aiming to extend the wetland upstream of a small dam built within the project, and was accomplished in November 2011. When compared to the marsh state pre-restoration (considered in March 2011), the maximum extent of the water surface and wetland was in April 2014, with an over +300% increase. Then, until spring 2019, the area of the water surface and wetland oscillated between -15% and +226% compared to the pre-restoration state. On the contrary, for the oldest projects (Babina and Cernovca islets in the Danube Delta), the area of the water surface and wetland increased compared to the pre-restoration state, it was maintained for several years, and then it progressively decreased until spring 2019. For the newest project (Carasuhat polder in the Danube Delta), the area of the water surface and wetland also increased until spring 2019. These preliminary findings suggest that the hydrological regime has a major role in the success of river restoration projects. Additionally, these results raise the question of the maintenance of river restoration projects – natural evolution of the river site versus further human restorative actions.

Keywords: river restoration, wetland, Landsat, NDWI, NDVI

REMOTE SENSING AND IN-SITU MONITORING OF RIVER-CONNECTED GERMAN LOWLAND LAKES

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Abstract

Optical remote sensing is a promising tool for inland water monitoring and modern satellite technology provides medium to high spatial resolution, coverage of a large area and relatively fast revisiting times. For example, the Multi-Spectral Imager (MSI) on board of Sentinel-2 provides several bands in the visible spectrum useful for water constituent retrieval at a spatial resolution of 20 m, while the revisiting time is 2-3 days in some regions. However, higher temporal resolution is necessary to track for example phytoplankton dynamics to gain a deeper understanding of processes like eutrophication or harmful algal blooms. Unfortunately, high frequency monitoring has until now mainly been performed at single spatial points in lakes. Thus, a more holistic approach that combines high-frequency in-situ measurements at single (or limited number of) points with remote sensing for large area coverage is needed. The interdisciplinary CONNECT project aims to acquire comprehensive understanding of ecological connectivity and coherence of river-connected lakes. Since spring 2019, we study 19 lakes of different trophic state and grade of connectivity in the upper Havel-river system in north-eastern Germany. We deployed a buoy system with multi-parameter probes, perform monthly water samplings from spring to fall in 2019 and 2020 and utilize data from several spaceborne sensors (e.g. Sentinel-2 MSI, Landsat 8). Furthermore, we performed remote sensing campaigns with airborne hyperspectral sensors, ground based reference measurements and built a low-cost optical hyperspectral measurement sensor for the buoy system. Here we present technical details of the CONNECT measurement systems and first campaign results with a focus on remote sensing and the low-cost near surface hyperspectral sensors. With this combined approach we could unravel temporal and spatial gradients of phytoplankton distribution.

Keywords: river-connected lakes, lake coherence, lake connectivity, inland water remote sensing, near surface sensing, new sensor systems

MACHINE LEARNING FOR MISSING VALUE OF WATER DATA IN A MOROCCAN SOUTH-EASTERN BASIN

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Abstract

In 2009, Morocco launched the National Water Strategy and National Water Plan (PNE), which focus on the role of complementary water management actions to address water problems, but without a completeness of measurement data and metadata, it is difficult to achieve this vision. Ziz-R hris river basin is a Moroccan South-Eastern basin with an arid and semi-arid climate, all water resources being impacted by climate change. In this context, water data services constitute a key instrument for the better water resources management. However, with missing value we cannot carry out efficient models for stockholders and decision makers. The available hydrological dataset on Ziz-R hris basin was analyzed for hydrological data quality, by identifying missing values and any possible errors. The infilling of missing values was done by analytic techniques including Regression analysis and Machine learning. Finally, the estimated values were validated by using historical data. In this research, we will present a statistical study aiming at missing values from data collected at hydrological stations in Ziz-R hris river basin, particularly by using machine learning techniques, integrating Python and R programs. Also, we will present the reasons of this issue, based on a series of interviews with actors from local administration in charge of water management.

Keywords: Data management, data quality, Metadata, R and Python, Machine learning, Water management

HYSTERETIC BEHAVIOR OF LIQUID DISCHARGE AND SUSPENDED SEDIMENTS CONCENTRATION DURING FLOODS IN THE JIU RIVER BASIN (ROMANIA)

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Abstract

Understanding the mechanisms controlling the sediment dynamics is crucial during floods, given the high variability of hydro-sedimentary processes (flow velocity, erosion, sediment transport and deposition) specific to these extreme events. The analysis of the hysteretic behavior of liquid flow and suspended sediment load opens a new research path, emphasizing the relationship between the two fluxes. Different contributions (remote or closer to the riverbed) of alluvial sources from the river channel, or from the slopes can be recognized through the hysteresis effect between liquid and solid fluxes. In this context, the paper explores the relationship between the liquid discharge (Q , $m^3 \cdot s^{-1}$) and suspended sediments concentration (SSC, $g \cdot m^{-3}$) during the highest-magnitude floods between 2001 – 2010, by using data from 22 hydrometric stations from Jiu River basin (the main tributary of Danube River in the SW Romania). During the studied period, 10 floods were analyzed, with a specific focus on identifying and classifying the hysteretic behavior of liquid and solid fluxes. In order to find the dominant fine sediment sources, a hysteresis index (HI) was computed, for the median discharge (defined as the Q at 50% of the flow value range), according to the standard method proposed by Lawler *et al.* (2006). The resulting HI values for the 10 floods were analyzed by the shape of the hysteresis loops, in order to classify the hysteresis effect in one of the 5 categories in terms of the relation between the liquid and solid fluxes: linear, direct, indirect, 8-shaped and complex. In most cases, a linear (positive or clockwise hysteresis) or complex relationship between Q and SSC was found. There are fewer situations with a negative hysteresis (indirect relationship or counterclockwise hysteresis). For most of the events, the small sub-catchments appear to be largely controlled by the sediment storages available on the slopes (as sediment supply by geomorphic processes and alluvial fans), whereas in the largest sub-basins, the accumulation forms (islets and sand beaches) in the riverbeds increase, through resuspension, the suspended sediment concentration recorded at the downstream gauging stations.

Keywords: hysteresis index, Jiu River Basin, liquid discharge, suspended sediments concentration

FLOOD DYNAMICS AND RISK MANAGEMENT AT THE ESTUARY OF GIANH RIVER: ARE MEASURES ABLE TO REDUCE RISKS SATISFACTORILY?

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Abstract

Flood risk has always been one of the most significant challenges for sustainable territory planning, particularly in the context of climate change and urban growth. The Gianh River's estuary, located in central Vietnam, is regularly exposed to floods, causes significant damage to human and material. The scientific background is crucial to improve flood risk management and propose measures to mitigate these risks. This article aims to analyze the causes of the worsening risk of flooding with two steps principal: 1) application of hydrodynamic models to simulate flooding in 2013; 2) socioeconomic field surveys conducted in 2020. The results underline the economic transition policy since 1986 has led to rapid urbanization. The coastal plains in Vietnam in general and in the study area are significantly affected by urbanization. In the case study, all agricultural regions will be replaced by urban areas in 2030. This transition will have severe consequences on people and assets and the effects on hydrological characteristics. The speed of flow between the urbanized and agricultural zones in two communes: Quang Phuc and Quang Thuan ($>0.5\text{m/s}$ and from $0.2\text{-}0.5\text{ m/s}$). In final, the results presents also a flood hazard assessment under the climate change scenarios, used to assist decision-makers in urban planning and agriculture, and reduce vulnerability. These studies can serve as a theoretical framework for flood risk management in other metropolitan regions around the world.

Keywords: flood, Gianh river, urban, land use

INTEGRATED ECOSYSTEM ECOLOGY (CHLOROPHYLL-A) OF EYDAP'S RESERVOIRS PROFILES BY USING ROBOTIC BOATS

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Abstract

The Research and Development Department of EYDAP (R&D) is responsible for the operation of two autonomous robotic boats as a result of participation in the EU funded INTCATCH project. The autonomous boats operated in 2020 in all four Reservoirs of EYDAP (Yliki, Marathon, Mornos and Evinos) and with their integrated sensors (chl-a, dissolved oxygen, conductivity, pH, temperature, total nitrogen and phosphorus) collected more than 290,000 data along the perimeter of the Reservoirs, covering more than 90 kilometers. The data appeared in real time in the field and in the headquarters office via tablet, mobile and PC through appropriate applications, providing at the same time a safer working environment against COVID-19. The aim of the present study is to investigate the trophic state of EYDAP's reservoirs assessing chlorophyll-a concentrations. The robotic boats scanned a far greater area of all catchments and the results proved the oligotrophic state of Mornos and Evinos reservoirs while the state of Yliki and Marathon ranges between oligotrophic to mesotrophic. By using the continuous monitoring system, potential sources and pathways of nutrients inputs could be identified and the results provided EYDAP the opportunity to have a more comprehensive picture of the trophic state and the water quality of the catchments in real time and take immediate countermeasures if necessary.

Keywords: Robotic boats, Greek Catchments, Monitoring Strategy, Real-time, Trophic State, Chlorophyll-a.

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GIS-BASED HYDRO-GEOMORPHOLOGICAL HAZARDS AND ANTHROPOGENIC IMPACT ASSESSMENT INSIDE HALMYRIS FORTRESS ON THE EASTERN FLANK OF THE DANUBE LIMES

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Abstract

The last Roman fort on the Eastern side of the Danube Limes is Halmyris (Danube Delta). It was a city-port which play a primordial military role, situated at the link between the fluvial and the marine environment. The fortress was famous for its location at the foot of the legendary Peuce Island. During the period of maximum expansion of the Roman Empire, the Halmyris fort benefits from important natural resources from two environments with distinct characteristics: marine (Halmyris Bay) and freshwater (Danube Delta). When the city was founded, the St. George arm was the most important navigation route at the mouth of the Danube. Therefore, the penetration upstream was monitored strictly by the guards of the city-port of Halmyris (customs). Today, the ruins of the fortress still preserve the memory of those ancient times. In this context, the conservation of the archaeological site is a complex scientific approach and must involve more advanced risk assessment methods. From this point of view, the evaluation of anthropogenic impact and the hydro-geomorphological processes (e.g., erosion, floods) that affect the topographic surface and causes irreversible damage inside the archaeological site must be a priority. In this study, for evaluations of the present conservation stage inside of Halmyris archeological site and surrounding area a GIS method was developed. The assessment of natural and anthropogenic hazards was carried out within several buffer zones with 50 m equidistance, having as a central element the Roman fortress because the degradation severity decreases from the inside to the outside of site. Three risk maps based on LiDAR derived-DEM (1 m resolution) were generated: flood hazard vulnerability map, degradation severity (erosion) map, and anthropogenic pressure map. The descriptive statistics of affected areas corresponds to the inside perimeter of the site and buffer zones of 50 m, 100 m, 150 m, and 200 m. Therefore, the assessment of environment evolution and present conservation stage has been achieved to improve the risk management plan of the Halmyris archeological site.

Keywords: GIS, Halmyris archaeological site, hydro-geomorphological hazards, anthropogenic impact, conservation stage, Danube Delta.

PLANKTONIC CILIATE ASSEMBLAGES IN DIFFERENT TYPES OF POOLS IN TEMPERATE, TROPICAL, AND POLAR CLIMATE ZONES—IMPLICATIONS FOR CLIMATE CHANGE

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Abstract

Small water bodies are typically characterized by high diversity of various groups of microorganisms. Moreover, these ecosystems react very quickly to even the slightest climate changes (e.g., temperature increase or water level fluctuations). Thus far, studies of planktonic ciliates in small water bodies having different origins and located in various climate zones have been scarce. Our study aimed at verifying the following hypotheses: planktonic ciliates demonstrate clear species diversity in the pools of different trophic status; basins in the warmer climates are characterized by higher biodiversity of planktonic ciliate than those in the polar climate zone; individual functional groups of ciliates demonstrate considerable diversity, both between individual basin types as well as climate zones. The study was conducted in temperate, tropical, and polar climate zones in 21 small water bodies. It has been show that while the basin type clearly influences the makeup of microbial communities, the influence of climate is stronger. Factors influencing the occurrence of these microorganisms to the greatest degree were temperature, total organic carbon, and nutrients. Our results show that in warmer climates, the abundance of bacterivores ciliates is higher and that of mixotrophs lower. This has consequences on climate change modeling and assessment of their influence on the carbon cycle in the ecosystems of small water bodies.

Keywords: climate changes, small reservoirs, protozoa

EFFECT OF CYANOBACTERIAL BLOOMS IN FRESHWATER ECOSYSTEMS ON THE TOTAL NUMBER OF HETEROTROPHIC BACTERIA

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Abstract

In recent decades algal blooms, and cyanobacterial blooms in particular, have become increasingly common in aquatic ecosystems worldwide. This rapid increase in the population of cyanobacteria is a major global problem, and the one that is primarily connected to climate change and eutrophication of water bodies. Due to toxin

production, cyanobacteria pose a serious threat to public health. More importantly, cyanobacterial blooms can lead to ecological degradation of aquatic ecosystems. The presence, activity, and toxicity of these microorganisms cause the disappearance of other microbial groups and disturb the functioning of water bodies. Bacteria play a key role in the transformation and mineralization of organic matter. Changes in the functional structure of reducers affect the ecological balance of entire ecosystems, reducing their natural and recreational values. Detailed phycological and microbiological studies were carried out in 2019. The research was conducted in five lakes located in northern Poland. My study was aimed at assessing the impact of cyanobacterial blooms and physicochemical and biological parameters in freshwater ecosystems on the total number of heterotrophic bacteria. The abundance of heterotrophic bacteria was determined by culture method. Phycological analysis was carried out based on microscopic features according to available keys. The results indicate that the total number of heterotrophic bacteria was significantly correlated with the temperature and oxygen concentration in water. The highest number of heterotrophic bacteria (1×10^4 CFU m^{-3}) was recorded in hypertrophic Ostrowąs Lake in July. Whereas the lowest number of heterotrophic bacteria was recorded in eutrophic Charzykowskie Lake in August (4×10^1 CFU m^{-3}). Analysis of variance shows that total number of heterotrophic bacteria depended on the research month, where the most differences were observed between August and September. In the examined lakes a few types of water blooms were distinguished, including potentially toxic species of blue-green algae: *Dolichospermum planctonicum*, *Microcystis aeruginosa*, and *Planktothrix agardhii*. The current conditions of the lakes require further monitoring of changes in the ecosystem.

Keywords: bacterioplankton, cyanobacterial blooms, lakes, chlorophyll *a*

ECOLOGY OF FAECAL BACTERIA: OCCURRENCE AND ANTIBIOTIC RESISTANCE IN THE URBANIZED SECTION OF THE BRDA RIVER

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Abstract

Bacteria play a key role in aquatic ecosystems. Their ecology depends on a number of environmental parameters. The additional influence of anthropogenic factors is connected with sanitary risk, particularly in urban areas. In recent years the widespread use of antibiotics in medicine and agriculture has led to the increased occurrence of antibiotic-resistant bacteria in aquatic environments. This phenomenon may have serious consequences for public health. In addition, an increased concentration of antibiotic substances in aquatic ecosystems may affect not only the quantitative and qualitative structure of bacteriocenoses but also their ecological role. The study was aimed at assessing the impact of environmental parameters on the abundance of bacterioplankton under different spatio-temporal conditions in the urbanized section of the Brda River.

Distribution of faecal bacteria were detected using the guidelines of the European standard ISO 9308-1:2014 for *Escherichia coli* and ISO 7899-2:2000 for enterococci. Antimicrobial resistance of faecal bacteria *Escherichia coli* isolated from ChromoCult® Coliform Agar (CCA) selective medium and of enterococci isolated from Slanetz and Bartley (SB) medium was determined using the disk diffusion method according the guidelines of The European Committee on Antimicrobial Susceptibility Testing (EUCAST). The results indicate that the location of sampling sites significantly affected by the distribution of faecal *Escherichia coli* and enterococci in the studied part of the river. On the other hand, there were no significant seasonal changes in abundance of planktonic bacteria. In addition, the abundance of bacterioplankton was not correlated with all measured physico-chemical parameters. Majority of faecal strains were sensitive to the applied antibiotics and antibiograms showed the absence of multi-drug resistant strains. Enterococci exhibited the highest resistance to imipenem (45%), while *Escherichia coli*, to cefoxitin (31%). Because of the presence of potentially pathogenic bacteria a real threat, regular monitoring of water quality is highly recommended, especially in recreation and urbanized areas.

Keywords: bacterioplankton; faecal bacteria; antibacterial resistance; river pollution; urbanization

TOXIGENIC CYANOBACTERIA IN BYSTRZYCA RIVER (E. POLAND) BEYOND THE ZEMBORZYCKI DAM RESERVOIR

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Abstract

In the shallow, hypertrophic dam reservoir on Bystrzyca river in Lublin (E. Poland) multi-species water blooms formed by cyanobacteria which develop from May to the beginning of October are a real nuisance. In 2017, 14 potentially toxigenic species with dominant *Aphanizomenon* spp and *Dolichospermum* spp (Nostocales) at the temperature > 23 °C (mid - summer) and *Planktothrix agardhii* at < 20 °C (September) were found. Cyanobacterial biomass transferred from the reservoir to the river decreased along the distance (10 km) from the reservoir and with the decrease in water temperature from 24.8 to 19.3 °C, despite the considerable increase in the concentration of dissolved biogenic compounds. The biomass of some Nostocales (e.g. *Dolichospermum* spp, *Aphanizomenon* spp) decreased from 10 to 15 – times, while the biomasses of *Cylindrospermopsis raciborskii* and *P. agardhii* were not affected. High positive correlation between total cyanobacterial biomass and water temperature in the river was found. In September, at 15 °C *Cuspidothrix issatschenkoi*, *C. raciborskii* and *P. agardhii* reached higher contribution (13.8-29.9 %) to the total cyanobacterial biomass than other species. *Dolichospermum* spp and *P. agardhii* were the main producers of hepatotoxic

microcystins (MCs) with the mean cell quota $3.3 \pm 0.9 \mu\text{g}/\text{mg}$ F.W. In the cyanobacteria which survived in the river water four MC iso-forms (MC-LF, -LY, -dmRR, -[DAsp3] RR) were found, while in the reservoir seven and neurotoxic anatoxin-a. Due to survival of microcystins' producers a recreational use of the river is not recommended, especially in mid-summer.

Keywords: cyanobacteria, microcystin iso-forms, river, water temperature

MICROBIOLOGICAL CONTAMINATION OF WATER IN URBAN FOUNTAINS

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Abstract

Fountains, whose primary function is to decorate parks, squares and gardens, are frequently used by animals as a source of drinking water and by people as bathing facilities. Sharing water with animals promotes transmission of microbial pathogens and leads to an increase in water-related diseases. This study was aimed at evaluating microbial contamination of water in Bydgoszcz fountains. Microbiological analysis (based on Polish standards) were conducted to determine the number of psychrophilic and mesophilic bacteria as well as the number of bacteria used as indicators of sanitary conditions. Water samples contained bacteria from all tested groups. The highest numbers were recorded in the fountain in the Old Market Square ("Dzieci bawiące się z gęsią" fountain). The lowest numbers of psychrophilic, mesophilic, and coliform bacteria were found in the fountain near the Pomeranian Philharmonic. The lowest numbers of *Escherichia coli* and faecal enterococci were recorded in the "Potop" fountain in Kazimierz Wielki Park. The results indicate that the number of bacteria depended mainly on the sampling date; the highest bacterial contamination was noted in summer.

Keywords: indicator bacteria, urban fountains, epidemiologic risk, water

HYDROGEN PEROXIDE CAN BE A PLAUSIBLE BIOMARKER IN CYANOBACTERIAL RESPONSES TO PHOTOINHIBITION

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Abstract

The effect of combined stresses, photoinhibition and nutrient depletion, on the oxidative stress of cyanobacteria was measured in laboratory experiments and the prediction model for the growth rate was developed. *Phormidium ambiguum* was exposed to various PAR intensities and phosphorous concentrations with fixed nitrogen concentration. The

samples were subjected to stress assays by detecting hydrogen peroxide (H₂O₂) concentration and antioxidant enzyme activities of catalase (CAT), and superoxide dismutase (SOD). Besides these biomarkers, protein contents were also analyzed. H₂O₂ concentration decreased until 30 μmol/m²/s of photosynthetically active radiation (PAR), then, increased with further higher PAR intensity. Regarding with phosphorous concentration, generally decreased with increasing phosphorous concentration. SOD activity is proportionate to the H₂O₂ per protein content, and CAT activity linearly increased with H₂O₂ concentration. Almost no H₂O₂ concentration was detected outside cells. These results indicated that H₂O₂ concentration was majorly biologically produced, and thus the accumulated H₂O₂ concentration inside cells is parameterized with H₂O₂ concentration per protein content. Over 30 μmol/m²/s of photosynthetically active radiation (PAR), H₂O₂ concentration per protein had a similar increasing trend with PAR intensity, independently of phosphorous concentration. While, with increasing phosphorous concentration, H₂O₂ per protein decreased in the similar pattern regardless of PAR intensity. Protein content decreased with increasing H₂O₂ per protein, gradually until 4nmol/mg of H₂O₂ concentration, which provides the threshold to restrict the growth of cyanobacteria. With these results, an empirical formula to obtain the protein content was developed as a function of PAR intensity and phosphorous concentration.

Key words: cyanobacteria, hydrogen peroxide, production rate, combined stress, antioxidant activity

EFFECTS OF THERMAL STRATIFICATION ON BACTERIAL COMMUNITY COMPOSITION THROUGHOUT WATER COLUMN IN A DEEP LAKE

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Abstract

In temperate regions, reservoirs are generally stratified during a year, affecting water quality, nutrient concentrations, and ecosystem functions. While the stratified aquatic systems provide diverse habitats for microorganisms, the stratification regime also has impacts on the community dynamics and contributes to community alterations. Lake Iznik is a mesotrophic deep lake (65 m max. depth) that stratify between June-September each year. This study aimed to assess the effects of stratification on bacterial community structures throughout a water column in the alkaline Lake Iznik. For this purpose, the samples were collected from the deepest point of the lake from the three thermal layers namely, epilimnion (0.1 m), metalimnion (20 m), and hypolimnion (40 m) in August 2020. The water samples were filtered from a 0.22 μm filter and the total DNAs were isolated from the filter papers using the NucleoSpin® Soil Kit (Macherey-Nagel, Germany) according to the manufacturer's protocol. 16S rRNA gene-targeted amplicon sequencing

approach was used to assess the bacterial community compositions and sequencing was carried out in Illumina® MiSeq™ platform. Water temperature, pH, dissolved oxygen (DO), and conductivity (EC) was measured in situ by a portable multiparameter (650 MDS, YSI, USA) and chemical parameters were determined according to standard methods (1989). The temperature (from 25.76 to 9.37°C), EC (from 1035 to 398 µS/cm), and pH (from 9.1 to 7.7) were gradually decreased throughout the water column. While a remarked increase was observed in phosphorous (from 25.75 to 119.72 µg/L) and nitrate (from 94.68 to 167.71 µg/L) levels along with the water column, DO level significantly decreased to 1.04 mg/L in the hypolimnion. The bacterial community in the epilimnion was predominated by Actinobacteria which represented 52% of the total reads and the abundance went down through the water column and the minimum level was recorded in the hypolimnion (28%). Proteobacteria (18%) was the second abundant phylum in the epilimnion followed by Bacteroidetes (12%) and Verrucomicrobia (9%). Proteobacteria became dominant in the hypolimnion and 46% of the bacterial community was represented by Proteobacteria species. Among the classified bacterial families, the majority of the total reads were assigned to Sporichthyaceae, Illumatobacteraceae, Burkholderiaceae, and Microbacteriaceae in all three samples. The Shannon and Pielou's evenness indices showed that the diversity and evenness of the bacterial communities were increased through the water column and the highest values were calculated for the sample collected from the hypolimnion. The results of this study are in line with similar studies which also showed significant community shifts between the different layers during the stratification period. This work contributes to existing knowledge of bacterial diversity of stratified lakes by providing high throughput data from a unique alkaline environment.

Keywords: alkaline lake, high throughput sequencing, water quality

DANUBE DELTA, TOURIST POTENTIAL AND IMPACT OF TOURIST ACTIVITY ON THE ENVIRONMENT

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Abstract

The originality of Romania's tourist potential is a representative feature of the tourist product that Romania can supply, as promoted on the internal and external tourist market respectively, however not at the level of its true potential. The new statute of the Danube Delta, as a biosphere reserve, following the year 1990, meant a change of direction and reorganizing of the tourist activity, in the context of protecting biodiversity and the landscape and of a sustainable turning to good account of the renewable natural resources. The assets of the natural tourist potential are completed by the anthropic potential, there resulting an indivisible, unique complex, specific to the Danube Delta Biosphere Reserve. The peculiarities of the geographic conditions of the Danube Delta have triggered practicing tourism forms and programs specific to this area. The natural

and cultural assets of the Danube Delta are natural and anthropic resources of the Danube Delta Biosphere Reserve than can be turned to good account through practicing tourism. Overall, tourism is one of the major components of the social and economic life, having become nowadays an economic sector with tangible development resources. Due to the fact that the Danube Delta is a geographic environment under permanent formation, fragile and vulnerable, the impact of tourism in general can be felt at the level of the natural and anthropic habitats, with major consequences on the whole ecological balance. Since tourism is a main development vector, it is necessary to pay the utmost attention to the consequences of this activity on all the other sectors of activity. Tourism must represent not only a positive and dynamic development factor but also a practical solution to keeping the environment unaltered. The tourism-environment relationship is vital, since the protection and preservation of the environment is the key condition for tourism to exist and develop. This connection is a complex, bidirectional one. The natural environment, through its components is one of the basic resources of tourism and on the other hand the tourist activity has both a positive and a negative influence on the ecological balance, however dangerously fragile in the Danube Delta, modifying its structure and ecosystemic functions. Ecotourism stands apart from the other forms of tourism through a tighter and more direct connection with the natural and cultural-historic environment. When integrated within the sustainable development, ecotourism implies activities destined to directly contribute to the protection of nature and the unaltered preservation of the ancient human creation.

Keywords: Danube Delta, tourist potential, tourism forms, tourism-environment, ecotourism, sustainable development

GRAZING IMPACT ON LAND DEGRADATION IN THE CURVATURE SUBCARPATHIANS (ROMANIA) – PRELIMINARY RESULTS

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Abstract

In various environments, unsustainable grazing is a pressure factor on land and water resources quality. We deal with grazing impact on land degradation based on machine learning algorithms (e.g., random forest) using 18 explanatory variables (e.g., grazing density, tree-cover density, slope, grassland probability, etc.) in the Curvature Subcarpathians (Romania). The data for model training, validation, and testing consisted

of over 4300 sampling points taken by Google Earth imagery, within the study area (6792 sq km), on binary form, erosion or not erosion. The model has been implemented in R environment, with *randomforest* package, which offered good results in terms of accuracy (92%) and ROC curve, indicating a class A performance model on testing data. Here, we report preliminary results and found that the main explanatory variables to land degradation are tree cover density, slope factor, land use land cover type, profile curvature, and aspect of the hills while grazing density and grassland probability playing a lesser role in the land degradation process. Also, we discovered that the Curvature Subcarpathians geomorphologic region is highly exposed to the erosion process, affecting the hillslopes, grazing fields, and agricultural land as well. The less exposed areas to erosion are the forested areas and the large river valleys (e.g., Buzău river alluvial fan). Overall, based on our approach we concluded that land degradation in the Curvature Subcarpathians region is unlikely affected by grazing.

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Keywords: grazing, land use, machine learning, Curvature Subcarpathians

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