

**3rd CENTRAL EUROPEAN SYMPOSIUM
FOR AQUATIC MACROINVERTEBRATE RESEARCH**

8-13 JULY 2018
ŁÓDŹ, POLAND

BOOK OF ABSTRACTS

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ORGANIZING COMMITTEE
at the Department of Invertebrate Zoology & Hydrobiology
University of Łódź:

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Agnieszka Mroczkowska

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Angelika Radwańska

Robert Sobczyk

Sylwia Woźniak

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WOLFRAM GRAF (University of Natural Resources and Life Sciences, Austria)

LYUBOMIR KENDEROV (Sofia University "St. Kliment Ohridski", Bulgaria)

PLENARY SPEAKERS

Filipe Costa is a marine ecologist and Assistant Professor at the University of Minho, Portugal, since 2008, where he leads the research group on Molecular Ecology and Biodiversity of the Centre for Molecular and Environmental Biology (CBMA). Earlier he was a Post-doctoral fellow at the University of Guelph, Canada, and between 2006-2007 a Marie Curie Fellow at Bangor University, UK. Filipe's main research interests dwell around the themes of molecular biodiversity and evolution, with a strong focus on the application of DNA barcodes to investigate marine life. He was the lead author of the proof-of-concept study on the application of DNA barcodes to crustaceans, and has worked extensively in the development of reference libraries of DNA barcodes for marine invertebrates from Europe, contributing to expose considerable hidden and cryptic diversity in diverse taxonomic groups, and to reveal unforeseen evolutionary paths. Recent research interests and activities concentrate on the development high-throughput monitoring tools through (e)DNA metabarcoding, with particular focus on estuarine and marine ecosystems, macro and meiobenthos, and zooplanktonic communities. Filipe Costa serves as Portugal delegate in the International Barcode of Life (iBOL), and in the management committee of the European Cost Action DNAqua-Net.



Jaroslaw Kobak is an associate professor in the Department of Invertebrate Zoology, Faculty of Biology and Environmental Protection at Nicolaus Copernicus University in Toruń, Poland, where he has worked since receiving his PhD in aquatic ecology in 2001. His early scientific interests concerned the behaviour and ecology of the zebra mussel, an invasive bivalve of worldwide importance, which was the topic of his habilitation thesis completed in 2010. His current research focuses on the behavioural ecology of aquatic invertebrates and biology of aquatic invasive species, especially those of Ponto-Caspian origin: dreissenid mussels, amphipod crustaceans and goby fishes. He conducts experimental studies on relationships between these organisms, their predator-prey interactions, habitat preferences, responses to biotic and abiotic environmental factors, behaviour and impact on native communities. He has been a leader or investigator in 13 research projects funded by national granting agencies in Poland and published over 60 scientific papers in international journals, mainly in the aforementioned areas, as well as two chapters in books on zebra mussel biology. Also, he has been a member of the executive board of the Association of Polish Malacologists since 2016.



Dr. Calum MacNeil is an independent consultant in aquatic ecology and the Deputy Editor-In-Chief (inland waters) of the journal 'Management of Biological Invasions', as well as associate editor on several other journals and an international referee for the research bodies of several different governments. He gained a BSc in biology from the University of Stirling, Scotland and a PhD on the ecosystem impacts of freshwater invasive amphipod 'shrimps' from The Queen's University of Belfast, N. Ireland. He has over 20 year experience as a freshwater ecologist and published 70+ peer reviewed papers and 25+ government/consultant reports. He has worked on glacial salmon stream ecology in Alaska, on the water quality of New Zealand lakes (NIWA), macroinvertebrate community structure and trophic ecology in Scottish highland streams, the impacts of 'killer shrimp' amphipods in the Netherlands (as the winner of a



LINKECOL award), the impacts of sewage on lake ecology of the largest expanse of freshwater in Western Europe – Lough Neagh, N. Ireland (INTERREG award) and the role of invasive macroinvertebrates and parasites on community ecology including fish diets and water quality monitoring in Irish and English rivers. He has also worked as a freshwater ecologist for the Environment Agency in the UK and recently as the Freshwater Biologist and Environmental Protection Officer for the Isle of Man Government, where he was in charge of river biological and chemical monitoring, sea bathing water quality monitoring, pollution investigations, government press releases (to BBC and others) and policy development (including post-BREXIT).

Rachel Stubbington is a Senior Lecturer in Ecology and Environmental Sciences in the School of Science and Technology at Nottingham Trent University (NTU) in the United Kingdom. She obtained a BSc (H) in Environmental Biology from NTU in 2006 before moving to Loughborough University, UK, to study for a PhD in river ecology under the supervision of Prof Paul J. Wood, graduating in 2011. Her research explores the ecohydrological dynamics temporary river ecosystems in temperate climates and focuses on macroinvertebrate community responses to flow variability including streambed drying. She leads the Community Ecology and Biomonitoring Working Group within the EU COST Action



Science and Management of Intermittent Rivers and Ephemeral Streams and recently led a UK Research Council-funded project to produce a Natural Capital Synthesis Report characterizing the natural assets and ecosystem services of temporary rivers. Beyond academia, Rachel previously worked for the Environment Agency of England as a freshwater ecologist. She remains committed to ensuring the applied relevance of her research and is working closely with industry collaborators to develop novel biomonitoring approaches that use terrestrial biota to characterize the ecological quality of temporary rivers during dry phases. She has published 25 journal articles and 2 book chapters since 2008, including lead authorship of the Aquatic Invertebrates chapter in the 2017 book Intermittent Rivers and Ephemeral Streams: Ecology and Management.

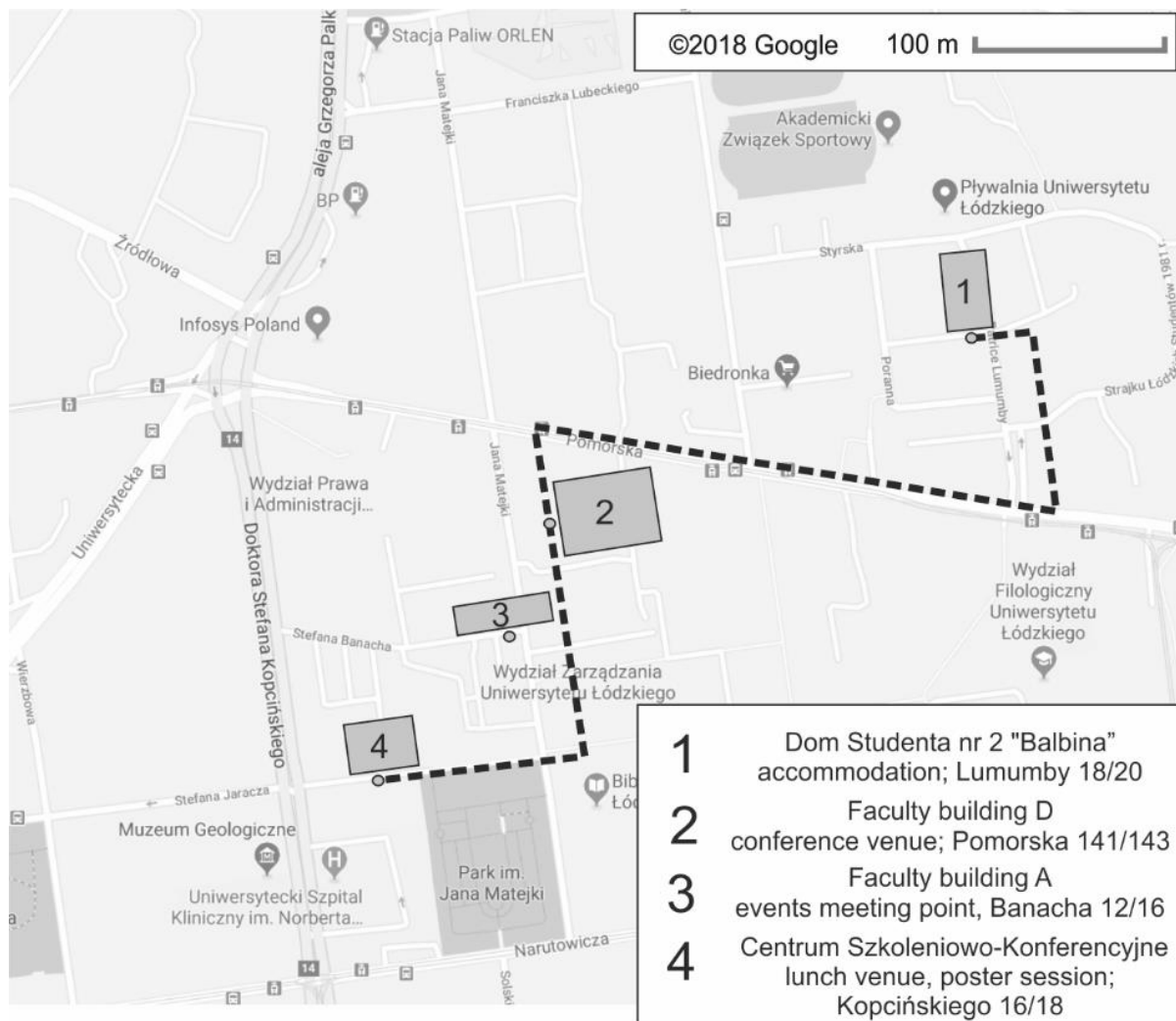
GENERAL INFORMATION

VENUE

Our 3rd CESAMIR is hosted by the Faculty of Biology and Environmental Protection, University of Łódź.

Registration, all oral presentations as well as the Opening/Closing Ceremonies (Monday/Friday) will be held in the Faculty of Biology and Environmental Protection building D (#2 on the Map 1) (address: Pomorska 141/143, 90-236 Łódź).

Welcome Reception, lunches and poster session will take place in the University of Łódź Training and Conference Centre (Centrum Szkoleniowo-Konferencyjne - CSK, #4 on the Map 1) (address: Kopcińskiego 16/18, 90-232 Łódź).



Map 1

DURING THE SYMPOSIUM

Registration & information

All participants, including speakers, must register at the information desk and will receive an official conference package, the invoice, a “Certificate of attendance” and a name badge. At the desk there will be also an opportunity to upload their presentation file.

Opening hours of the registration and information desk:

Sunday, 8 July: 15:00 – 20:00

Monday, 9 July: 08:30 – 19:00

Tuesday, Thursday & Friday, 10,12,13 July: during coffee breaks

Name badges

Every attendee is asked to wear her/his official name badge visibly all time to enter the sessions, meals and social events.

Lunches and coffee breaks

The conference fee covers lunches at CSK and coffee breaks on all days with presentations (not on Wednesday). Having the lunch, please use the tickets provided during the registration.

Accompanying persons

Accompanying persons are also welcome on this meeting. Their registration package includes welcome reception (Sunday), Barbecue & Bonfire evening (Monday), Mid-Conference trip (with recreational kayaking on the Pilica River, lunch package included) (Wednesday), guided tour through Łódź Old Quarter (Thursday afternoon) and conference dinner (Thursday evening).

SOCIAL EVENTS

Welcome reception

ALL participants are invited to attend on the Welcome Reception from 18:00 to 20:00 on Sunday, 8 July, at the University of Łódź Training and Conference Centre (Centrum Szkoleniowo-Konferencyjne, **#4 on the map**).

Barbecue & Bonfire evening

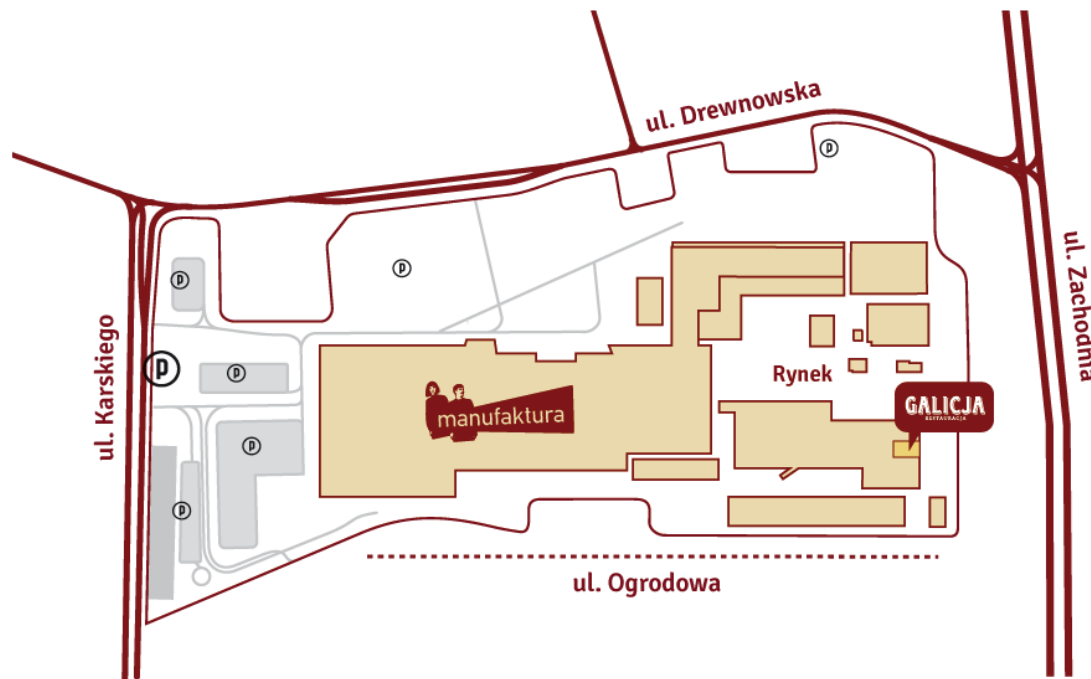
ALL participants are invited to attend on the Barbecue & Bonfire evening from 20:00 to 24:00 on Monday, 9 July, in the one of the nicest area outside the city (Łagiewniki Forest). We will be hosted by the University of Łódź Training and Conference Centre (Centrum Szkoleniowo-Konferencyjne, address: Rogowska 26, 91-529 Łódź). We will go there by buses and the meeting point will be at the front of the main building of our Faculty (building A, **#3 on the map**), departure at 19:00. The first returning bus will leave at 22:00.

Mid-conference trip

On Wednesday, 11 July, participants with FULL, STANDARD and ACCOMPANYING PERSON Packages will attend in an all-day-long mid-conference trip (lunch package included). We will go by buses to Spała (ca 70 km) and have opportunity for the recreational and easy canoeing on the Pilica River to Inowłódz (ca 2 hours). During that time we will enjoy flora and fauna of the Pilica River and its floodplains. We will also have small tour in Spała showing its interesting history as a former hunting lodge owned by Emperor Nicholas II of Russia. The day will finish with bonfire on the Gać River bank (in front of the restaurant: Karczma Spalska). We will departure to Łódź around 18:00.

Guided tour through the Łódź historical quarter & Conference Dinner

Participants with FULL and ACCOMPANYING PERSON Packages are invited to attend on a guided tour through the Łódź historical quarter at 16:30-19:30 on Thursday, 12 July. The guides will tell us about the history of this fascinating city and of the most famous fabricant families, which influenced its development. The tour will end at the “Manufaktura” shopping-cultural centre where, at 19:30, in the Restaurant “Galicja” (**indicated on the Map 2**), our Conference Dinner will start.



Map 2

INSTRUCTIONS

For oral presenters

- ✓ Talks except plenaries will be scheduled in 20-minute slots. We strongly encourage all presenters finish their talks in 15 minutes to allow 5 minutes for discussion and questions from the audience. Please note that the time limit will be strictly enforced by the session chairs to facilitate keeping the time schedule of the symposium.
- ✓ Speakers should provide their presentation file on a USB memory stick / Flash drive during the registration or coffee breaks at the information desk, but no later than 1 hour before their session. Speakers of the morning session, please hand the presentations over the day before.
- ✓ Presentation file must be compatible with Power-Point (*.ppt, *.pptx) or Adobe (*.pdf) formats. If you have other special needs (video, other file formats, etc.), please let us know during the registration process and/or contact the organizing committee via e-mail before the Symposium.
- ✓ The name of the file should be as follows: “name-session-slot”, for example JohnDoe-RS1-1.ppt
- ✓ The presentation files will be uploaded to the hard drive of the computer in the lecture room before the session and removed afterwards by the Symposium staff. A laser pointer will be provided for presentation. Please note that it is not possible to use your own computer.

For poster presenters

The maximum poster size is 110 cm (height) by 80 cm (width). The recommended size is the B1 portrait (100 cm x 70.7 cm).

Audiovisual equipment and additional presentation file is not allowed for poster presentations. The posters will be mounted on movable walls provided by the organizers and presented during the whole symposium. Materials for mounting will be provided on the movable walls, please do not use your own.

Posters should be mounted no later than 1 hour before the beginning of the poster session according to the numbers provided by the organisers (see LIST OF POSTERS).

AWARDS

“Best student poster prize”

All posters presented by undergraduate students and PhD students will be judged by the members of the Scientific Committee. Main criteria: presentation of the scientific content, clarity, structure, design. Based on the proposal of the jury one poster will be awarded.

“Best student speaker prize”

Oral presentations are held by undergraduate students and PhD students will be judged by the members of the Scientific Committee. Main criteria: preparedness of the presenter, clarity, design. Based on the proposal of the jury one speaker will be awarded.

SCIENTIFIC PROGRAMME

Sunday, 8 July

- 15.00-20.00 registration (D)
D – Faculty of Biology and Environmental Protection building D (Pomorska 141/143, 90-236 Łódź)
Welcome Reception (CSK)
- 18.00-20.00 *CSK – University of Łódź Training and Conference Centre (Centrum Szkoleniowo-Konferencyjne)*
(Kopcińskiego 16/18, 90-232 Łódź)

Monday, 9 July

9:00-9:15 opening ceremony (D)

- 09:15-10:15 **plenary lecture I:**
Jarosław Kobak et al.: The art of choice: Experimental evaluation of microhabitat selection by aquatic macroinvertebrates. A case of Ponto-Caspian gammarids

10:15-10:45 COFFEE BREAK

Ecology & Behaviour

- 10:45 CSABAI Z, BODA P, BOUKAL D.S. Parsing the effects of weather conditions and species phenology on the flight activity of water beetles and bugs
- 11:05 ŠUMANOVIĆ M, BERACKO P, MILIŠA M. Comparing spring and stream section in tufa depositing system
- 11:25 PERNECKER B, MAUCHART P, SÁLY P, SZIVÁK I, MÓRA A, BODA R, CSABAI Z. Can the food availability determine the reach-scale distribution of the Balkan Goldenring (*Cordulegaster heros*) larvae?
- 11:45 POZOJEVIĆ J, JURŠIĆ L, VUČKOVIĆ N, DORIĆ V, MIHALJEVIĆ Z. The influence of predatory behavior on spatial distribution of lentic water mite (Acari: Hydrachnidia) assemblages
- 12:05 POZNAŃSKA-KAKAREKO M, KAKAREKO T, ŻBIKOWSKI J, CZARNECKA M, JERMACZ Ł, KOBAK J. Effect of substratum drying on the survival and migrations of macroinvertebrates – laboratory and field experiments
- 12:25 PETRUŽELOVÁ J, BOJKOVÁ J, SYCHRA J, SIVÝ Š, ŠORFOVÁ V, VRBA J, SOLDÁN T. Macroinvertebrate communities of montane standing waters in the Czech Republic and Bavaria: effects of past acidification and littoral zone properties
- 12:45-14:30 lunch and poster mounting (CSK)

Ecology & Behaviour

- 14:30 ŻBIKOWSKI J. Comparison of macrozoobenthos structure of shallow water environments of different types
- 14:50 LUDÁNYI M, MIHALICZKU E, MÜLLER Z, KISS B. The distribution area of thick shelled river mussel (*Unio crassus* PHILIPPSON, 1788) in Hungary and its relationship with the habitat composition
- 15:10 SYROVÁTKA V, BOJKOVÁ J, GEORGIEVOVÁ B, KAPRALOVÁ A, POLÁŠKOVÁ V, ŠORFOVÁ V, ŠUPINA J, ZHAI M, HORSÁK M. The predation of *Gammarus fossarum* on non-biting midge (Diptera: Chironomidae) larvae
- 15:30-16:00 COFFEE BREAK

Ecology & Behaviour

- 16:00 SZIVÁK I, MÓRA A, ORTMANN-AJKAI A, MÉHES N, DEÁK Cs, CSABAI Z. The effect of habitat heterogeneity and spatial extent on occupancy frequency distribution of freshwater insect species
- 16:20 CZARNECKA M, KAKAREKO T, JERMACZ Ł, PAWLAK R, KOBAK J. Effects of nocturnal exposure to artificial light and habitat complexity on the fish foraging on amphipods
- 16:40 MENCZELESZ N, SZIVÁK I, SCHMERA D. A quantitative review on experimental stream system

- 19:00-23:00 *Barbecue & Bonfire evening (meeting point: building A, first return bus 22.00)*
building A - the Faculty of Biology and Environmental Protection building A
(Banacha 12/16, 90-237 Łódź)

Tuesday, 10 July

plenary lecture II

9:00-10:00 Filipe Costa et al.: Aquatic macroinvertebrates diversity and evolution: some novel perspectives after 15 years of DNA barcoding

10:00-10:30 COFFEE BREAK

Parallel Session 1

Diversity & Biogeography/Phylogeography

10:30 COPILAS-CIOCIANU D, ZIMȚA A.A, GRABOWSKI M, PETRUSEK A. Contrasting patterns of cryptic diversity in a disjunctly distributed Carpathian endemic amphipod indicate long-term persistence in northern refugia

10:50 WEBER D, STOCH F, FLOT J.F. A new insight into the phylogeny and biogeography of the subterranean *Niphargus virei* clade (Amphipoda: Niphargidae) in Western Europe

11:10 ČIAMPOR F.JR, ŠÍPOŠOVÁ D, ČIAMPOROVÁ-ZAŤOVIČOVÁ Z. Population genetics of diving beetles populations in Tatra Mountains alpine lakes

11:30 ZIZKA V.M.A, LEESE F, PEINERT B, GEIGER M.F. DNA metabarcoding from sample fixative as a quick and voucher preserving biodiversity assessment method

11:50 CSAPO H, WATTIER R, MAMOS T, REWICZ T, BAČELA-SPYCHALSKA K, KRZYWOŹNIAK P, GRABOWSKI M. Up the Danube and beyond with *Gammarus roeselii*. A two-marker story of successful postglacial colonisation

12:10 BOZÁŇOVÁ J, ČIAMPOR F. JR, MAMOS T, GRABOWSKI M, ČIAMPOROVÁ-ZAŤOVIČOVÁ Z. Genetic diversity of aquatic invertebrates in the Western Carpathians

12:30-14:00 lunch (CSK)

Parallel Session 1

Diversity & Biogeography/Phylogeography

14:00 SWOROBOWICZ L, GRABOWSKI M, MAMOS T, WYSOCKA A. Thriving through the Ice Age: the surprising story of a freshwater isopod crustacean

14:20 EVTIMOVA V. How well do we know caddis fauna? A review on morpho-taxonomic and genetic diversity of Trichoptera from Bulgaria

14:40 GÖZLER A.M, BAYTAŞOĞLU H, BAŞÇINAR S.N, ERBAY M. Soft-Bottom Molluscs Diversity of the Southwestern Black Sea (Istanbul-Iğneada) in autumn

15:00 UTEVSKY S, VLADYMYRSKA M, KHOMENKO A. Geographical ranges and species concepts in leeches (Annelida: Hirudinida)

15:20 FAIS M, DUARTE S, VIEIRA P.E, SOUSA R, HAJIBABAEI M, CANCHAYA C.A, COSTA F.O. Surveying estuarine meiobenthos through DNA metabarcoding: a pilot study in the Lima estuary (NW Portugal)

15:40-20:00 COFFEE BREAK + Poster Session (CSK)

Parallel Session 2

Anthropogenic Impact/Bioindicators

BEERMANN A.J, ZIZKA V.M.A, ELBRECHT V, BARANOV V, LEESE F. Quantitative metabarcoding reveals the complex and hidden responses of chironomids to multiple stressors

DORIĆ V, VUČKOVIĆ N, POZOJEVIĆ I, MIHALJEVIĆ Z. Chironomid community responses to environmental drivers in man-made lakes of the Dinaric karst

RIMCHESKA B, VIDINOVA Y. How different anthropological impacts affect benthic macroinvertebrate assemblages in the same water body type – preliminary results of a case study on cross-border territory (NW Bulgaria/NE R. Macedonia)

VUČKOVIĆ N, POZOJEVIĆ I, VILENICA M, ČERBA D, KEROVEC M, PREVIŠIĆ A, TERNJEJ I, MIHALJEVIĆ Z. The influence of anthropogenic stressors on littoral benthic macroinvertebrate communities in man-made lakes

GULIN V, FILIPOVIĆ MARIJUĆ V, DRAGUN Z, SERTIĆ PERIĆ M, MATONIČKIN KEPČIJA R, VELKI M, EČIMOVIĆ S, HACKENBERGER B.K, ERK M. Assessment of metal exposure in industrially/agriculturally impacted freshwater ecosystem using amphipod *Gammarus fossarum* Koch as a bioindicator

FLĄKOWSKI W, AWRAHMAN Z.A, RAINBOW P.S. *Gammarus fossarum* and *Hydropsyche angustipennis* as trace metal biomonitors in the lateral risk assessment – a comparative study

Parallel Session 2

Conservation & Management

ORLIĆ K, BURIĆ L, HUDINA S, MAGUIRE I, MAKKONEN J, VLADUŠIĆ T, ŠVER L, HRAŠČAN R, BIELEN A. Predicting the effects of climate change on pathogen-host balance in freshwater ecosystems: a case study of indigenous European crayfish and crayfish plague

SVITOK M, MATUŠOVÁ Z, GODUNKO R.J, HAMERLÍK L, HRIVNÁK R, NOVIKMEC M. The surrogacy potential of pond-dwelling dragonflies in Central Europe

SYCHRA J, MERTA L, ZHAI M. The enigmatic copepod *Hemidiaptomus amblyodon* and its endangered temporal habitats

MÉSZÁROS A, CSABAI Z. Aquatic beetles versus restoration dredging: A case study from a Hungarian peat bog

KISS B, LUDÁNYI M, SZABÓ T, MAGURA T, MÜLLER Z. Effects of non-indigenous macroinvertebrates on the composition of watercourses' macrozoobenthos communities in Hungary according to time and spatial analysis

Wednesday, 11 July - Spała Fieldtrip (canoeing/bonfire)

08:00 *departure to Spała (meeting point: building A)*

10:30-18:00 *canoeing, guided tour in Spała, bonfire (Karczma Spalska Restaurant)*

18:00 *departure to Łódź*

Thursday, 12 July

plenary lecture III

9:00-10:00 Calum MacNeil: Freshwater macroinvertebrates as bioindicators of water quality; problems and perspectives, including the increasingly relevant issue of biocontamination by invasive species

10:00-10:30 COFFEE BREAK

Parallel Session 1**Invasive Species**

10:30 WINKELMANN C, HELLMANN C, WORISCHKA S. The vegetarian side of the killer shrimp

10:50 DZIERŻYŃSKA-BIAŁOŃCZYK A, JERMACZ Ł, ŁABĘCKA A.M, KOBAK J. Behavioural responses of the zebra mussel *Dreissena polymorpha* to conspecifics

11:10 ŠIDAGYTĖ E, LESUTIENĖ J, ARBAČIAUSKAS K. Trophic behavior of native and invasive populations of Ponto-Caspian mysids

Parallel Session 1**Invasive Species**

11:30 SCHMIDT-DREWELLO A, HOUBEN S, RISS, H.W, MEYER E.I. Inter- and intraspecific chemical communication between native and alien gammaridean species (Amphipoda: Crustacea)

11:50 BALOGH C, SERFŐZŐ Z, KOBAK J Do physical traits of dreissenid bivalves determine the competitive success of the quagga mussel over zebra mussel?

12:10 MACIASZEK R, SOSNOWSKI W. First European record of *Cladogonium* sp. parasitic algae common in Taiwanese ornamental shrimp breeding farms and its invasive potential on European crustaceans

12:30-14:00 lunch (CSK)

Parallel Session 1**Invasive Species**

14:00 JERMACZ Ł, NOWAKOWSKA A, KLETKIEWICZ H, KOBAK J. The ecology of fear – Impact of short and chronic predation risk on the physiology of native and invasive gammarids

14:20 MAUCHART P, PERNECKER B, CZIROK A, BODA P, MÓRA A, CSABAI Z. No experimental evidence on the active long-range dispersal of the Asian clam [*Corbicula fluminea* (O. F. Müller, 1774)]

14:40 REMMERS W, GERGS R, KOESTER M, WINKELMANN C. Environmental gradients and competitive interactions between indigenous and invasive amphipods can lead to stable invasion barriers

16:30-19:30 *guided tour through Łódź downtown (meeting point: building A)*

19:30- 2 am *Conference Dinner (Galicja Restaurant at Manufaktura)*

Parallel Session 2**Diversity & Biogeography/Phylogeography**

TARKOWSKI A, BUCZYŃSKI P. Dragonfly fauna of calcareous fens in middle-eastern Poland

KENDEROV L, IHTIMANSKA M, PAVLOVA M, KAZAKOV S, TRICHKOVA T. New data on the mysid species (Mysida, Crustacea) from the Bulgarian section of the Danube River

HUPAŁO K, STOCH F, MAMOS T, REWICZ T, BOULAABA S, FLOT J.F, GRABOWSKI M. The more the merrier – the extraordinary cryptic diversity in freshwater *Echinogammarus* (Gammaridae, Amphipoda) from Sicily

Parallel Session 2**Anthropogenic Impact/Bioindicators**

POPOVIĆ N, TUBIĆ B, RAKOVIĆ M, MARINKOVIĆ N, CSÁNYI B, SZEKERES J, BORZA P, SLOBODNIK J, LIŠKA I, MILOŠEVIĆ Đ, KOLAREVIĆ S, ILIĆ M, MITROVIĆ M, PAUNOVIĆ M. Aquatic macroinvertebrate community patterns as a tool prioritization of River Basin Specific Pollutants

VAN HAAREN T. Oligochaetes are not only indicators of trophic level

TÜRKMEN G, KAZANCI N. The first comprehensive application of TR-BMWP to evaluate the habitat quality of some streams in ecologically different areas of Turkey

Parallel Session 2**Paleolimnology**

CHAMUTIOVÁ T, HAMERLÍK L, SZARLOWICZ K, PÍPÍK R, THOMKOVÁ K, PŘÍDALOVÁ M, BITUŠÍK P. Comparison of historical development of three man-made reservoirs in a mining region using subfossil chironomids

ANTCZAK-ORLEWSKA O, PŁÓCIENNIK M, KOTRYS B, OKUPNY D, KITTEL P. Chironomidae-inferred climatic and palaeoenvironmental reconstructions based on palaeochannel fill from Central Poland

HAMERLIK L, WOJEWÓDKA M, ZAWISZA E. The recent environmental history of two Central American lakes: a subfossil chironomid record from lakes Apastepeque and Yojoa

Friday, 13 July

plenary lecture IV

9:00-10:00 Rachel Stubbington: Diversity in the face of adversity: the macroinvertebrate communities of dynamic, aquatic-terrestrial 'temporary' streams

Intermittent Streams

10:00 LOSKOTOVÁ B, HAVELKA J, POLÁŠEK M, PAŘIL P. Streambed sediment as an invertebrate refuge during the long-term drying

10:20 MARUNA M, MATONIČKIN KEPČIJA R, MILIŠA M. Macroinvertebrate pioneers in rewetted, historically dry channels

10:40 MILIŠA M, MATONIČKIN KEPČIJA R. Water scarcity – the macroinvertebrate perspective

11:00-11:30 COFFEE BREAK

11:30 PAŘIL P, POLÁŠEK M, STRAKA M, POLÁŠKOVÁ V, LOSKOTOVÁ B, DOSTÁLOVÁ A, ZAHŘÁDKOVÁ S. No country for old perennial streams alias Czech drying through the looking glass

11:50 POLÁŠEK M, POLÁŠKOVÁ V, STRAKA M, PAŘIL P. Different ways how to survive dry episode: a role of species traits in resistance and/or resilience to stream intermittence

12:10 STRAKA M, POLÁŠEK M, SYROVÁTKA V, PAŘIL P. Benthic macroinvertebrates as indicators of stream intermittency

12:30-13:00 closing ceremony

13:00-14:30 lunch (CSK)

LIST OF POSTERS

1. Andjus S, Nikolic N, Čanak Atlagić J, Đuknić J, Kračun-Kolarević M, Tubić B. What Causes Malformations in Freshwater Sponge Spicules? - Preliminary Research in Serbian Rivers.
2. Antczak-Orlewska O, Tończyk G. Plecoptera distribution and diversity in the selected streams of the Tatra National Park.
3. Berlajolli V, Płóciennik M, Mroczkowska A, Antczak-Orlewska O, Pešić V. Macroinvertebrates in small rheocene springs – sampling and diversity indexing.
4. Boda P, Bozóki T, Mauchart P, Pernecker B, Móra A, Csabai Z. Lessons learned in lab experiments on habitat selection and intraspecific competition of *Aphelocheirus aestivalis* (Fabr.) (Heteroptera: Nepomorpha).
5. Boóz B, Csabai Z, Móra A. Composition and diversity of chironomid assemblages in a heavily human-impacted stream in South Hungary.
6. Borza P. Differences in the mesh size of the filtering apparatus among invasive Ponto-Caspian *Chelicorophium* species (Crustacea, Amphipoda, Corophiidae) indicate niche differentiation by food particle size.
7. Bozóki T, Krasznai-Kun E.Á, Csercsa A, Várbíró G, Boda P. Temporal and spatial dynamics in aquatic macroinvertebrate communities along a small urban stream.
8. Buczyńska E, Buczyński P. Survival under anthropogenic impact: the response of dragonflies (Odonata), beetles (Coleoptera) and caddisflies (Trichoptera) to environmental disturbances in a two-way industrial canal system.
9. Čanak Atlagić J, Andjus S, Đuknić J, Milivojević A, Kulić K, Pokrajac J, Tubić B, Marković V. Do mining activities influence macroinvertebrate communities? – the Pek River preliminary research.
10. Cebulska K, Krodkiewska M. The impact of coal mine water discharge on the diversity of benthic macroinvertebrates in the Kłodnica River (Southern Poland).
11. Čerba D, Koh M, Mitrović M, Mihaljević Z. Chironomid assemblages in artificial and heavily modified freshwater ecosystems.
12. Čiamporová-Zaťovičová Z, Božáňová J, Macko P, Čiampor F.Jr. Slovak aquatic macroinvertebrate fauna DNA barcoding – status quo.
13. Cieplok A, Spyra A, Krodkiewska M, Lewin I, Strzelec M. The influence of various forms of aquatic habitats protection on the diversity of benthos fauna in industrial areas.
14. Copilaș-Ciocianu D, Borza P, Petrusek A. Morphological variability in the antipredator defence mechanism of *Gammarus roeselii* (Crustacea, Amphipoda): phenotypic plasticity or local adaptation?
15. Czachorowski S. Naturalness indicators as a new bioindication method in biocenosis monitoring, using caddisflies (Trichoptera) as an example.
16. Djikanović V, Čanak Atlagić J, Zorić K, Ilić M, Skorić S. The diet of 22 fish species in the Belgrade sector of the Danube River.
17. Dostálová A, Pařil P. Impact of drying up of streams on population structure and fecundity of freshwater gammarid *Gammarus fossarum*.
18. Đuknić J, Čanak Atlagić J, Andjus S, Tomović J, Atanacković A, Vasiljević B, Paunović M. Analysis of macroinvertebrate community and eutrophication assessment of Zelengora karstic lakes.
19. Ergović V, Čerba D, Mihaljević Z. The use of pupal exuviae in the research of chironomid (Chironomidae, Diptera) biodiversity in freshwater reservoirs.
20. Fekete J, Buchner D, Mizsei E, Leese F, Csabai Z, Várbíró G. Modelling the distribution of *Cordulegaster heros* and *C. bidentata* (Odonata) and their potential eDNA detection.

21. Fleituch T, Beermann A, Buczyńska E, Leese F. An attempt to explain caddisfly diversity patterns using classical taxonomy and DNA barcoding along a latitudinal stream gradient (southern Poland).
22. Florkowska M, Tończyk G, Čiamporová-Zaťovičová Z, Čiampor F.Jr, Grabowski M, Mamos T. In search for refugia in Western Carpathians through DNA barcoding. The case of stoneflies (Plecoptera).
23. Galir Balkić A, Špoljarić Maronić D, Žuna Pfeiffer T, Stević F, Kezerle A. Spatial and seasonal oscillation in zooplankton taxonomical and functional groups under distinct environmental scenarios.
24. Khaitov V, Makarycheva A, Gantsevich M, Lentsman N, Skazina M, Gagarina A, Katolikova M, Strelkov P. Discriminating eaters: sea stars *Asterias rubens* L. feed preferably on *Mytilus trossulus* Gould in mixed stocks of *Mytilus trossulus* and *Mytilus edulis* L.
25. Gellert M, Kwiatkowska K, Majecki J. Feeding strategies of larvae *Chaetopteryx villosa* (Trichoptera: Limnephilidae).
26. Georgieva G, Kenderov L, Dashinov D, Uzunov Y. Distribution and species composition of aquatic oligochaetes (Annelida: Oligochaeta Limicola) from Central Balkan National Park, Bulgaria.
27. Gregušová K, Vlková V, Beracko P. Diversity and spatio-temporal variations in chironomid larvae assemblages in the longitudinal gradient of two headwater streams.
28. Grgić I, Previšić A, Vilenica M, Brigić A, Dorić V, Mihaljević Z. Macroinvertebrate community of a sub-Mediterranean temporary karst river in the Western Balkans.
29. Halabowski D, Lewin I, Sowa A. Macroinvertebrate communities of a salinised river with coal mine water discharge (the Bolina River, Upper Silesia, Poland).
30. Hanjalić J, Čučuković A, Dorić S, Lasić L, Šubara J, Kalamujić Stroil B. Morphometric and DNA barcoding assessment of macrozoobenthos community structure as indicator of water quality in Natural Monument “Skakavac”.
31. Idiado E, Płóciennik M, Włodarczyk P, Bilecka J, Gligorović B, Pavicević A, Pesić V. Chironomidae of springs in the Zeta Valley and the adjacent regions.
32. Ihtimanska M, Ilkova J. Distribution of Chironomid larvae in Srebarna Lake and Danube River (North-East Bulgaria) in relation to some environmental variables.
33. Ivicheva K. Aquatic macroinvertebrates and other groups of aquatic organisms in the ecological assessment of a river (Vologda, Russia).
34. Jabłońska A, Wrzesińska W, Zawal A, Grabowski M. Integrative taxonomy reveals the new species of *Palaemon* from the Lake Skadar basin.
35. Jabłońska-Barna I, Rychter A. Alien species in the macrozoobentos in the western part of the Vistula Lagoon (Southeastern Baltic Sea, Poland).
36. Maguire I, Pavić V, Majnarić S, Abramović L, Jelić M. Morphological diversity of the stone crayfish (*Austropotamobius torrentium*) in Croatia.
37. Karaouzas I, Smeti E, Kalogianni E, Skoulikidis N.Th. Do macroinvertebrate and diatom indices indicate same responses to anthropogenic pressures?
38. Karimzadeh K, Zahmatkesh Koumleh A. The investigation of heat shock protein changes (Hsp70) in Caspian Sea gammarus (*Pontogammarus maeoticus*) under heat stress.
39. Khomenko A, Utevsky S, Palatov D, Huseynov M, Farzali Sh, Shrestha M, Son M, Utevsky A. Geographical distribution and taxonomic status of *Dina stschegolewi* (Lukin & Epshtein, 1960) (Hirudinida: Erpobdellidae).
40. Koh M, Čerba D, Žganec K. The structure and dynamics of the non-biting midge assemblages (Chironomidae, Diptera) in a dinaric karst river, River Dobra, Croatia.

41. Kolicka M, Stefaniak A, Mamos T. Gastrotricha in the Arctic: first assessment of diversity using integrative approach.
42. Kolicka M, Dabert M, Olszanowski Z. Phylogenetic position of *Bifidochaetus arcticus* (Gastrotricha, Chaetonotida) - Chaetonotidae origin in brackish habitats?
43. Kozlov O, Balakhonova V, Arshevsky S, Pavlenko A, Arshevskaya O. Biodiversity and ecology of semiaquatic insect larvae in the lakes of the Western Siberia southwest part.
44. Kralj T, Ćuk R, Valić D, Žganec K. Patterns of distribution and abundance of alien and native peracarid crustaceans in Croatian large rivers.
45. Krasznai-Kun E.A, Boda P, Borics G, Lukács B.A, Várbíró G. Dynamics in the effects of the species-area relationship vs. local environmental factors in bomb crater ponds.
46. Kruijt D. The underwater vacuum cleaner. A new sampling technique developed by Bureau Waardenburg.
47. Łabęcka A.M, Domagała J. Reproduction of *Sinanodonta woodiana* (Bivalvia: Unionidae) – an invasive mussel species in a female-based population.
48. Leite B.R, Troncoso J.S, Costa F.O. Bioassessment of marine macrobenthic colonization of artificial substrates using morphological and DNA-based methodologies.
49. Lewin I, Halabowski D. A North American invader extends its range in European rivers – the first records of the occurrence of *Gammarus tigrinus* Sexton, 1939 in the tributaries of the upper Vistula River (Poland).
50. Mioduchowska M, Czyż J.M, Gołdyn B, Kilikowska A, Namiotko T, Pinceel T, Łaciak M, Wysocka A, Sell J. Detection of bacterial endosymbionts in new freshwater crustacean hosts species: experimental application of non-degenerate primers designed to amplify bacterial 16S rRNA gene.
51. Mocq J, Boukal D.S. Thermal and ontogenetic dependence of trophic interactions in *Sympetrum* sp.
52. Móra A, Calleja E, Mauchart P, Pernecker B, Rewicz T, Sant Q, Csabai Z. Larval data on the occurrence of Odonata species in the Maltase Islands with notes on their breeding sites.
53. Morhun H, Khomenko A, Palatov D, Prokin A, Son M, Utevsky S. *Theodoxus* in the South Caucasus: species diversity or morphological plasticity?
54. Mroczkowska A, Kittel P, Dolbunova E, Gauthier E, Mazurkevich A, Okupny D, Płóciennik M, Pawłowski D, Rządziejewicz M, Wieckowska-Lüth M. Hydrological regime and ecological character of the Great Serteya Post-lake Basin based on the multi-proxy research conducted at the Serteya II site (Western Russia).
55. Novikmec M, Kozák D, Matúšová Z, Svitok M. Searching for effective sampling scheme for estimation of pond dwelling Odonata diversity.
56. Boulaaba S, Płóciennik M, Zrelli S, Antczak-Orlewska O, Boumaiza M. Chironomidae of North Tunisian wadis – ecology, distribution and diversity.
57. Płóciennik M, Pawłowski D, Antczak-Orlewska O, Milecka K, Vilizzi L. From an oxbow to a mire – the response of Chironomidae and Cladocera to the long-term changes in Pawłowa palaeolake.
58. Polášková V, Zhai M, Bojková J, Syrovátka V, Šorfová V, Schenková J, Polášek M, Horsák M. The influence of air and water temperature on spring fen macroinvertebrates: are they threatened by climate changes?
59. Previšić A, Petrović M, Vučković N, Vilenica M, Malević M, Rožman M. Emerging contaminants in freshwaters: deciphering impact on aquatic macroinvertebrate metabolic response and ecosystem transfer.

60. Rimcheska B, Vidinova Y, Tyufekchieva V, Evtimova V. EPT taxa from mountainous and semi-mountainous sites (European river type R5): diversity, threats and conservation status.
61. Rybakovas A, Arbačiauskas K, Jokšas K, Markovskienė V. Assessment of contaminant concentrations and genotoxicity biomarker responses in bivalve mussels (Unionidae) from Lithuanian rivers.
62. Pabis K, Siciński J, Serigstad B, Sobczyk R. Distribution and diversity of polychaetes on continental margin in Gulf of Guinea (Ghana's coast).
63. Soroka M, Burzyński A. Hermaphroditic freshwater mussel *Anodonta cygnea* does not have supranumerary open reading frames in the mitogenome.
64. Soroka M, Sayenko E.M, Kholin S.K. A molecular and conchological comparison of *Sinanodonta amurensis* Moskvicheva, 1973 and *Sinanodonta primorjensis* Bogatov and Zatravkin, 1988 (Bivalvia: Unionidae).
65. Maciaszek R, Sosnowski W, Łapa P. Diseases and health issues of ornamental shrimps in exhibitions.
66. Sowa A, Krodkiewska M, Halabowski D, Tończyk G. The biodiversity of macroinvertebrate communities in hyposaline settling ponds in a coal mine area (Upper Silesian Coal Basin, southern Poland).
67. Spacek J. Non-native species of aquatic invertebrates in the Czech part of the Elbe River basin.
68. Spyra A. Habitat requirements and distribution patterns of freshwater snails with special emphasis to Planorbidae: analysis in neighbouring to forest and forest ponds.
69. Svitok M, Dekanová V, Novikmec M, Veselská M. Leaf litter breakdown in ponds: a role of taxonomic and functional diversity of shredders.
70. Szeles J, Tamás M, Bozóki T, Boda P, Kraszna E, Gyulai I, Kókai Z, Nagy-Sándor A, Várbiro G. Artificial ponds in the floodplain – More than refugia for amphibians.
71. Türkmen G, Kazanci N. New record of *Ecdyonurus adjaricus* (Ephemeroptera, Heptageniidae) for Turkey and its habitat characteristics.
72. Müller Z, Kiss B, Ambrus A, Juhász P, Kovács T, Ködöböcz V, Ludányi M, Málnás K, Szabó T, Varga I. Methodology and results of aquatic macroinvertebrate communities monitoring in the frame of Hungarian Biodiversity Monitoring System (2001-2017).
73. Vlaičević B, Čerba D, Turković Čakalić I, Koh M, Ergović V, Peršić V. Macroinvertebrate diversity of a drainage ditch exposed to different anthropogenic pressures.
74. Woźniak S, Antczak-Orlewska O, Płóciennik M, Tończyk G. Chironomidae assemblages of running and stagnant waters in the Tatra National Park.
75. Xërxa B, Sartori M, Gattolliat J.L, Gashi A. Preliminary checklist of Mayflies (Insecta: Ephemeroptera) of Kosovo.
76. Zahmatkesh Koumleh A, Karimzadeh K. Age and Sex-related changes in body composition in different parts of body in fresh water crayfish (*Astacus leptodactylus*).
77. Zawal A, Budniak M, Stępień E, Michoński G, Kłosowska M, Bańkowska A, Szlauer-Łukaszewska A, Poleszczuk G, Krepski T, Deptuła W, Czernicki T, Janusz K, Śmietana P. Short term research of ecological conditions of lake „Jeziorko Wdzydzkie” after biological bioremediation.
78. Zhivoglyadova L.A, Frolenko L.N, Kovalev E.A. Invasion of benthic invertebrates into the Sea of Azov and the lower reaches of the Don River.
79. Zhivoglyadova L.A, Labay V.S, Dairova D.S. Trophic organization of benthic macroinvertebrate communities of the Lyutoga River and its tributaries (South Sakhalin).

80. Jażdżewska A.M, Ziemkiewicz A. New wood-boring deep-sea amphipod studied using morphological and molecular methods.
81. Zuyev Y, Kolosovskaia E. The biodiversity and the abundance of zoobenthos on the rocky littoral and below of oligotrophic lake.

ABSTRACTS

PLENARY LECTURES

Aquatic macroinvertebrates diversity and evolution: some novel perspectives after 15 years of DNA barcoding

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Over the past 15 years, the use of short DNA sequences from a standardized region of the genome for the purpose of species identification (i.e. DNA barcodes) has been gradually and extensively applied to all major groups of eukaryotic life. The massive screening of sequence variation on a short fragment of the mitochondrial DNA across multiple and diverse animal taxa, provided insights that are challenging our perception of species diversity, ecology, biogeography and evolution in various taxonomic groups. For numerous aquatic macroinvertebrate (AMI) species, DNA barcodes are the only genetic information ever recorded. Hence, DNA barcodes can be very useful as a primary screening tool to probe the diversity, taxonomic status, biogeography and evolutionary patterns in this group. Large numbers of partial DNA sequences of the mitochondrial gene coding for cytochrome oxidase I (COI) are now available for numerous species of AMI, enabling broad, large-scale assessments. Here, we showcase some novel DNA barcode-driven perspectives on biodiversity and evolution of AMI, focusing on members of the superorder Peracarida, a diverse and ecologically relevant group of crustaceans both in marine and fresh waters. The examination of a comprehensive dataset of marine peracarids from Europe, comprised of 202 morphospecies and over 1300 DNA sequences, revealed the existence of significant levels of intraspecific genetic divergence, exposing circa 70 putative new marine peracarid species. Although the majority of species in this dataset did not display relevant divergence, some other species contributed disproportionately to the total number of potential new species, surpassing 10 hidden taxa in some cases of cryptic species complexes. Allopatry is usually the case among these marine cryptic species. Notably, when marine and fresh water AMI are compared, the incidence of hidden diversity is notoriously superior in the former, where exceptional extreme cases of cryptic diversity can be found (e.g. >100 molecular operation taxonomic units (MOTUs) within a morphospecies). We illustrate this biome comparison with members of the amphipod genus *Gammarus*, for which we have comprehensive multi-loci data from marine and fresh water species, including mitochondrial and nuclear markers. Finally, using an example with an isopod from the Macaronesian archipelagos, in the northeast Atlantic, we illustrate how DNA barcodes are contributing to expose unnoticed mechanisms of diversification and evolution in marine peracarids that may override other common interpretations based on geographic isolation and geological events. All together, these novel barcode-driven perspectives on biological diversity and evolution of AMI have profound implications for environmental monitoring, biogeography and conservation, and therefore deserve broad consideration and discussion in future research.

Freshwater macroinvertebrates as bioindicators of water quality; problems and perspectives, including the increasingly relevant issue of biocontamination by invasive species

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The assessment of biological water quality using biotic indices and macroinvertebrate assemblages is a common feature of many government ecological assessment programmes used to monitor and protect freshwaters. I provide examples of how abiotic and biotic factors may undermine the robustness of macroinvertebrate derived indices to accurately reflect changing organic water quality. I show how ongoing metal pollution from mines can greatly influence the composition of macroinvertebrate assemblages and confound the use of water quality biotic indices. Freshwater macroinvertebrate invaders can often be more competitive or predatory than natives or more tolerant of poor organic water quality. They can also be ‘keystone’ species influencing the structure of the rest of the macroinvertebrate assemblage and impacting on other trophic levels. I provide examples from both the Isle of Man Government’s routine water quality monitoring programme and from the aftermath of major pollution incidents relying on biotic indices to reflect pollution impacts, to highlight the increasing problems invaders pose to ecological managers. Relatively simple ways to account for ‘biocontamination’ and the presence and impacts of such invaders in macroinvertebrate samples used in ecological assessment / enforcement cases are discussed. I speculate on how biological monitoring of freshwaters may change in the future.

The art of choice: Experimental evaluation of microhabitat selection by aquatic macroinvertebrates. A case of Ponto-Caspian gammarids

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Field data can show us the distribution of organisms in relation to environmental conditions, but, due to the high number of interacting variables, it is difficult to draw clear conclusions on causal impacts of particular factors. This can be particularly true for alien species, whose distribution may depend not only on preferences, but also on casual places of initial introduction. This points to the need of experimental evaluation of animal preferences and responses to key environmental factors.

In recent years, our team has used experimental approach to determine habitat preferences of invasive Ponto-Caspian gammarids with regard to substratum (substratum choice tests), flow (flow-through chamber with stagnant water refuges), temperature (thermal gradient), salinity (Y-maze), depth (vertical gradient), predators, intra- and interspecific interactions. We will use this example to show advantages and caveats of laboratory experiments in studies on relationships between organisms and their environment.

Various gammarid species had quite similar habitat preferences: they selected rocky habitats over small-grained ones and macrophytes and never preferred flowing water over stagnant areas, though were capable of withstanding moderate flows. They generally selected warmer water than acclimation temperature, though this also depended on sex and parasite infection. They did not avoid or even preferred water of low ionic content, despite their previously postulated affinity for saline waters, considered as the reason for their absence from small European streams. Various gammarid species differed in their preferred depth.

Biotic factors affected gammarid behaviour and modified their responses to abiotic variables. The strongest competitor, *Dikerogammarus villosus* displaced other species to suboptimal microhabitats and stimulated their migrations to new areas. However, the presence of a top predator (fish) decreased interspecific tensions and enabled coexistence of species. In the predator presence, *D. villosus* moved to shallower water, formed clusters, but also approached predator scent, probably responding to food cues in fish faeces. In contrast, another species, *P. robustoides* avoided predation cues and increased activity in their presence.

Experimental approach allowed to determine key abiotic factors driving alien gammarid distribution: they will select warm, slowly flowing waters with low ionic content and rocky substrata. Their separation in the field may result from different depth preferences, anti-predator responses or competitive displacement. Their avoidance of small streams seems to be unrelated to ionic content, rather being caused by temperature or flow cues. Our results emphasize the role of biotic factors: non-consumptive predator effects and competitors in understanding the behaviour and distribution of aquatic invertebrates.

Our work was supported by NCN grants 2011/03/D/NZ8/03012, 2012/05/B/NZ8/00479 and 2013/09/N/NZ8/03191.

Diversity in the face of adversity: the macroinvertebrate communities of dynamic, aquatic-terrestrial ‘temporary’ streams

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Temporary streams, which sometimes stop flowing and may lose all surface water, can dominate lotic networks in arid and mediterranean regions, and are also common in temperate areas with cooler, wetter climates. Across regions, the dynamic ecohydrology of these aquatic-terrestrial ecosystems is receiving unprecedented research attention. Focusing on oceanic regions, I will explore the aquatic macroinvertebrate communities present in temporary streams across flowing, pool, and dry phases. Inhabitation of a heterogeneous, shifting habitat mosaic by assemblages including lotic, lentic, and terrestrial taxa can lead to high beta-diversity in temporary stream networks. I will outline two conceptual models: one illustrates that biodiversity can be higher in temporary than perennial systems, particularly when beta- and gamma-diversity are considered; the second relates this diversity to transitions between lotic, lentic, and terrestrial conditions. I will then examine the fate of aquatic macroinvertebrates during dry phases, with a surprisingly diverse “seedbank” of dormant and active eggs, juveniles and adults persisting within “dry” sediments. Finally, I will highlight the threats to temporary stream communities posed by human impacts, including water-resource and land-use stressors, which interact within our changing climate to alter flow permanence regimes. Research is needed to inform development of innovative approaches that underpin effective temporary stream monitoring and management. Collaboration with the stakeholders responsible for ecological quality is crucial from the outset, to promote uptake of new approaches that enhance protection of temporary streams and their macroinvertebrate communities.

ABSTRACTS

ORAL PRESENTATIONS

Chironomidae-inferred climatic and palaeoenvironmental reconstructions based on palaeochannel fill from Central Poland

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Chironomidae (Diptera) subfossil remains are used as a reliable proxy for climatic reconstructions. They respond rapidly to climate changes and larval head capsules preserve well in sediment deposits. Thanks to the diverse ecological preferences and ubiquity of Chironomidae, they also play an important role in reconstructions of past ecological conditions. Important signals can be derived also from subfossil remains of other insects, mainly beetles (Coleoptera). Such analyses have been done on the basis of insect remains collected from the sediments of the palaeochannel of the Luciąża River (the 3rd-order river in the Vistula River Basin), located in Rozprza (51°18'07" N; 19°40'04" E), Central Poland.

The radiocarbon chronology shows that the 214 cm long sediment core covers the Late Glacial and Holocene history starting from the Allerød interstadial (ca. 13,300 cal. BP). The palaeontomological analyses conducted show that the insect assemblages have transformed over time, delineating the periods of local and regional environmental changes. There is also a hiatus in the profile, which clearly overlaps with the early Holocene phase of the palaeochannel basin evolution, where hardly any subfossils have been found.

A thick layer of sediments dated to the late Allerød probably corresponds to the cold inter-allerød oscillation. Such fast sediment accumulation has contributed to very good preservation of many insect remains. The Chironomidae-inferred quantitative reconstruction of the mean July air temperature is based on the Swiss-Norwegian-Polish Training Set with the application of WA-PLS and Artificial Neural Networks (ANN) methods. Cool mean summer temperatures in the late Allerød could confirm the record of the 'Gerzensee oscillation' (ca. 13,200-12,900 BP) in Central Poland.

The project has been financed by grant from the Polish National Science Centre based on the decision No. DEC-2013/11/B/HS3/03785.

Do physical traits of dreissenid bivalves determine the competitive success of the quagga mussel over zebra mussel?

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Invasive dreissenid species, the zebra mussel (*D. polymorpha*) and the quagga mussel (*D. r. bugensis*) are commonly known from European and North American freshwaters. Their co-appearance usually leads to the reduction or even total displacement of the zebra mussel within years. The cause of the competitive success of the quagga mussel over zebra mussel is still unknown, but one might be different physical properties leading to the selective advantage against fish and bird predation.

In the present study, shell crush resistance, attachment strength (the strength of byssus threads), and amount of energetic storage product (body glycogen reserve) were measured in mussels collected from Lake Balaton, Hungary using mussels of different size and different exposure times. Mussels were collected from the western part of the lake. Experiments were carried out in aerated 200-L tanks connected to Lake Balaton with a flow-through system. Mussels were placed onto plates and sampled after two days, one week and one month of exposure. Attachment and shell strength of mussels were measured with a digital force gauge with forceps. The mussels were pulled gently perpendicularly to the plate until it was detached, then measured the length, opened its shell and broke both valves.

Zebra mussel shells were harder than those of quagga mussels, though the difference between the species decreased with size. Mussel attachment was affected by species, exposure time and mussel length. Initial (after two days of settlement) attachment strength of zebra mussels was stronger than that of quagga mussels irrespective of their length. After 1 week, the attachment of both species did not differ from each other. After a long term exposure (one month) significant difference appeared between the byssal strength of the two species. The increment of attachment strength per unit length was greater in quagga than in zebra mussels. Thus, small zebra mussels were more strongly attached than small quagga mussels, whereas the opposite was true for the largest individuals. Large zebra mussels contained less glycogen than large quagga mussels and small zebra mussels.

Results suggest that small zebra mussels start to re-attach earlier and/or invest more energy into adhesion at the beginning of this process, which gains higher protection against predators and hydrodynamics as well. In contrast, large quagga mussels seem to accumulate storage material instead of using plus energy for attachment and shell hardening, which probably provides effective survival during winter, and yields extensive larvae propagation in suitable conditions. Our findings do not support the hypothesis that higher resistance to predation determines the dominance of quagga over zebra mussel. Notwithstanding, energy allocation to other traits, such as faster growth and/or tolerance to low temperature, which allows extended period of larval propagation, may be a more useful strategy increasing quagga mussel success.

Quantitative metabarcoding reveals the complex and hidden responses of chironomids to multiple stressors

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Stream ecosystems are impacted by multiple stressors worldwide, yet combined effects of multiple stressors on macrozoobenthic communities are still poorly understood. The dipteran insect family Chironomidae ('non-biting midges') is a highly diverse taxon with more than 10,000 described species globally and the most abundant insect group in many streams. However, chironomids often only play a minor or undifferentiated role in ecological studies and stream ecosystem assessments due to the difficulties associated with their identification, in particular when based on larval morphology. DNA metabarcoding offers a promising approach to more accurately capture this species diversity. Here, we used DNA metabarcoding to obtain and evaluate chironomid diversity in a multiple stressor experiment conducted at a German low-mountain range site.

In an outdoor experiment manipulating salinity, fine sediment and flow velocity 59,325 chironomids have been sampled from two microhabitats, i.e. streambed and leaf litter, from 64 mesocosms each (8 replicates per treatment). On family level, chironomids of the streambed responded positively to added fine sediment and flow velocity alteration and chironomids of the leaf litter negatively to altered flow velocity. Using operational taxonomic units (OTUs) obtained through DNA metabarcoding the individual response patterns could further be disentangled and revealed 15 different response patterns among the most common 35 OTUs. Morphological identification can be insufficient when dealing with morphological difficult groups such as chironomids. When pooled to a higher taxonomic level, response patterns of individual taxa to stressors are masked, potentially leading to false conclusions. On the opposite side, high taxonomic resolution obtained by metabarcoding promises to aid with investigating multiple stressor effects and with assigning ecological traits to operational taxonomic units, which then in return also hold the potential to be used for water quality assessments.

Genetic diversity of aquatic invertebrates in the Western Carpathians

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The extensive mountain systems of the Carpathian Arch extend *across* the Central and Eastern Europe and is recognised among the most valuable biodiversity hotspots in Europe. Particularly interesting part of the Carpathian Arch are the Western Carpathians, where the existence of glacial microrefugia for cold-adapted species are supported by recent molecular data. These refugia were localised in relatively high altitudes and proximity to Pleistocene glaciers. Possibly, their presence was enabled by the vast systems of karst springs, characterized by relatively stable thermal and chemical stability throughout seasons. Due to their specific environmental characteristics, karst springs are considered as refugia for many rare species of fauna and flora. Nevertheless, the molecular diversity and phylogeography of biota of the karst springs in the Western Carpathians have not been examined so far. The main aim of our study is to reveal and compare the population genetic diversity patterns in benthic invertebrates of different life strategies in the spring ecosystems of the Western Carpathians based on the barcoding fragment of mtDNA (COI). All the generated barcodes will be uploaded to BOLD (Barcode of Life Data Systems) in order to create a reference library. So far, we have focused on the reophilic beetles, *Elmis aenea* and *Limnius perrisi* (Elmidae), and the amphipod *Gammarus fossarum*-complex (Gammaridae), inhabits majority of small streams and springs in the Western Carpathians. The material was collected from more than 100 localities from Slovakia, Czech Republic and Poland. The populations of *Elmis aenea* and *Limnius perrisi* are genetically homogeneous with one dominant haplotype. Additionally, the Mismatch Distribution and Bayesian Skyline Plot show a recent demographic and spatial population expansion in both species, suggesting post-glacial colonisation, although of different dynamics. A completely different pattern of genetic variability was revealed in the *Gammarus fossarum*-complex, with at least 146 haplotypes recorded in the karst springs of Western Carpathians. Our results confirmed presence of 7 MOTU's (molecular operational taxonomical units) of this amphipod recorded in earlier studies and 1 new MOTU for Slovakia that was previously known only from the Apușeni Mountains in Romania. Additionally, our data support the hypothesis that this species complex survived in the Carpathian microrefugia.

Our work is supported by projects VEGA 1/0255/15, 2/0030/17 and Miniatura 1 DEC-2017/01/X/NZ8/01607 (Polish NCN).

Comparison of historical development of three man-made reservoirs in a mining region using subfossil chironomids

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Here we present the results of a palaeolimnological study of artificial reservoirs in a historic mining region (Banska Stiavnica, Central Slovakia). The reservoirs represent a remnant of a former hydro-energetic system providing energy for mining and metallurgical purposes. Like other surface and subsurface structures, the reservoirs became an integral part of the man-modified landscape. Most of the reservoirs were built in the 2nd half of the 18th century, during “the golden age of mining” when Banska Stiavnica, thanks to rich polymetallic ores, belonged to the most important towns in the Austro-Hungarian Empire.

At present, the preserved reservoirs serve mostly for recreation and angling, moreover they can be considered “hot spots” for regional aquatic biodiversity and represent high conservation value. We analysed dated sediment sequences (last ~ 170 – 200 years) for lithology, organic matter and chironomid remains from three reservoirs aiming to reconstruct the past limnological conditions leading to the recent state. As the reservoirs have developed under different management in the last decades, the results could reflect consequences of different anthropic impacts.

Subfossil assemblages indicated two main developmental phases in all reservoirs. The initial phase coincided with intense mining and smelting activities. At that time the accumulated water served as an energy source which was connected with severe water level fluctuations and high sedimentation rate. Low organic matter content in the sediments indicated unproductive conditions. The quantitatively and qualitatively poor chironomid assemblages signaled shallow reservoirs without developed profundal and macrophytes.

The second phase refers to changed management after decline of mining activities in the area and the usage of reservoirs was different. This phase represents stable hydromorphological conditions with higher abundance and diversity of chironomid assemblages and the increase of sediment’s organic content. Chironomid assemblages indicate higher water-level with developed profundal zone and increased nutrient input. Since the 1970s, the reduction of the profundal assemblages was observed as a consequence of depleted oxygen levels in the profundal and the high proportion of littoral taxa indicated further development of the littoral vegetation and increase of habitat complexity. Although the management of the studied reservoirs was different – two water reservoirs became a centre of recreation and angling, while one became a drinking-water source, chironomid succession trajectories were quite similar.

The study was supported by project VEGA 1/0664/15.

Population genetics of diving beetles populations in Tatra Mountains alpine lakes

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Europe's alpine ecosystems, such as Alps or Carpathians, represent an important source of the European biodiversity, yet the composition of their fauna, the structure and diversity of the populations of alpine species, or the trends of the biota evolution in these areas are still poorly known. It is however exactly such data that is crucial for their effective conservation. In this work, we focused on the populations analysis of two diving beetle species of the genus *Agabus* in alpine lakes of Tatra Mountains, the northernmost and the highest mountain system in Carpathians. Both species are typical representatives of alpine aquatic fauna, they are evolutionarily closely related, but have different habitat preferences and dispersal abilities. In the recent years, we collected around 1.500 specimens from more than 130 alpine lakes and ponds and adjacent streams from Tatra Mts and the surrounding area. In the study, two mtDNA fragments (cox, cytb) and twenty one newly developed polymorphic microsatellites were used, compared with the mtDNA data from BOLD and GenBank. The results suggest that the Tatra populations of both species are highly genetically diversified, despite the young age of alpine lakes (ca 10.000 years). Most of the recorded haplotypes were private to the Tatras. Close and unresolved relationships between haplotypes confirm recent origin of the studied species' populations, molecular data also suggest contact (gene flow) with localities in the vicinity. The results also indicate that at least part of the recorded diversity could develop in the Tatra Mountains' environment, suggesting that alpine regions could function as a source of local biodiversity. This is a very strong argument supporting the need for their protection. Nuclear markers (microsatellites) analysis suggested recent history of the populations of both species, possible sources of the Tatra populations, and confirmed recent contact with populations from the regions in the neighbourhood of Tatra Mts, which may indicate the shift of individuals from lower altitudes to higher elevated Tatra lakes due to climate change. On the other hand, microsatellites support the role of the mountain ridges as barriers in the distribution of these beetles.

This study was supported by the Slovak national grant agency VEGA2/0030/17.

Contrasting patterns of cryptic diversity in a disjunctly distributed Carpathian endemic amphipod indicate long-term persistence in northern refugia

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The freshwater amphipod *Gammarus leopoliensis* (Crustacea: Amphipoda) is considered a northern Carpathian endemic, and therefore can be regarded as an appropriate model for testing the hypothesis of Quaternary glacial survival in northern microrefugia. However, 250 km south, in the southwestern Carpathians, we have recently uncovered populations that resemble phenotypically both *G. leopoliensis* and also *G. kischineffensis*, a species distributed across the Moldavian Plateau (eastern Romania and Moldova). Our aims were to investigate the evolutionary relationships among these three taxa and comparatively explore the phylogeography of *G. leopoliensis* and southwestern Carpathian populations. Multilocus phylogenetic analyses using maximum-likelihood and Bayesian inference within a broad phylogenetic context revealed that *G. leopoliensis* and the southwestern Carpathian populations form a strongly supported monophyletic group which we label as *G. leopoliensis* s.l. (*sensu lato*). This group belongs to the large Eurasian *G. balcanicus* clade along with *G. kischineffensis*. Despite high morphological similarity, *G. leopoliensis* s.l. and *G. kischineffensis* are not sister lineages. Using multilocus coalescent species delimitation methods and molecular clock calibrations we have discovered that *G. leopoliensis* s.l. is a species complex that harbours 12 lineages, most of which predate the Pleistocene. Throughout the northern range there are only two widespread and postglacially expanded allopatric sister lineages that diverged about 1.2 Ma ago. These lineages diverged from the southern ones ca. 4 Ma ago, indicating long-term survival in northern microrefugia. Contrastingly, the southwestern Carpathians are inhabited by 10 micro-endemic lineages of Pliocene age (3 to 5 Ma), indicating an even more relict pattern. We conclude that the contrasting diversity observed between the disjunct distributional areas of *G. leopoliensis* s.l. reflects differential survival of lineages across the latitudinal gradient and. Therefore, this species complex offers a promising system for comparing the evolutionary ecology of lineages persisting in latitudinally disconnected microrefugia. These results also fill an important gap in our knowledge of European gammarid biogeography and reveal that all the *Gammarus* taxa that inhabit the Carpathians are ancient and diverse species complexes.

Parsing the effects of weather conditions and species phenology on the flight activity of water beetles and bugs

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Most aquatic insects disperse by flight to reach new habitats. Successful dispersal is especially important for taxa that live in small, non-permanent standing freshwaters. Their dispersal patterns integrate the long-term effects of species-level phenology and short-term environmental filters, including weather conditions that may facilitate or prevent adult flight and hence affect the fitness of individuals and long-term population and community dynamics. Multiple hypotheses have been suggested to explain the observed seasonal and diel patterns of aquatic beetles and bugs. Air temperature, wind speed, light intensity, solar elevation and air humidity have been identified as important environmental filters of their flight activity. However, parsing the effects of species phenology and environmental conditions on flight patterns is difficult due to frequent strong collinearity of environmental variables and their seasonality.

Here we used previously collected fine-scale data on aquatic beetles and bugs in a Hungarian marsh ecosystem to elucidate the quantitative relationships linking weather conditions and species phenologies to the diel and seasonal flight activity patterns of the most common species. We applied novel statistical methods including regression trees and zero-inflated generalized mixed-effect models with temporal autocorrelation to identify most parsimonious models and distinguish between variables that may completely prevent adult flight and those that only modulate the abundance of flying individuals. Our results show that some of the previous hypotheses are difficult to test rigorously due to the strong collinearity and seasonal component of many weather variables, and highlight the need for targeted field or lab experiments. We also discuss how relevant functional traits such as trophic position and body size affect the relationship between weather conditions and adult flight activity in aquatic beetles and bugs.

Up the Danube and beyond with *Gammarus roeselii*. A two-marker story of successful postglacial colonisation.

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Gammarus roeselii is a freshwater amphipod with a wide distribution range in Europe. This morphospecies can be characterized by the presence of dorsal spikes on the metasome. *G. roeselii* is a typical component of the macroinvertebrate fauna in rivers but also in some lakes and it has a wide tolerance to various environmental factors. Its population in Western and Central Europe can probably be derived from the divergent lineages occurring in the Balkan Peninsula. The species diversified there during the Neogene and has probably invaded other parts of the continent very recently, in postglacial or even historical times.

The aim of this study was to (1) identify which lineage(s) colonized Western and Central Europe, (2) what was the possible source region, (3) verify whether the colonisation was associated with the demographic changes. We used one mitochondrial, cytochrome oxidase I (COI), and one nuclear marker, internal transcribed spacer 2 (ITS2), to answer these questions and also to shed light on the spatial genetic structure of the population in the colonised area.

Altogether, 651 individuals from 66 sites for COI and 101 individuals from 56 sites for ITS2 were sequenced respectively. Neighbour Joining tree (NJ) was reconstructed in MEGA 7 to reveal the basic phylogeny. Haplotypic networks for both COI and ITS2 were generated with PopArt v1.7. Neutrality tests (Tajima's D and Fu's F) and mismatch distribution analysis were completed in Arlequin 3.5.1. Extended Bayesian Skyline Plot (EBS) was made in Beast v1.8.2.

We defined 53 haplotypes for COI and 39 haplotypes for ITS2 in the European population of *G. roeselii*. A high level of genetic diversity with three main lineages that diverged in Plio/Pleistocene, was found in the Pannonian Basin. Our analyses showed that one of them has widely colonized the Western and Central Europe. The lineage started to diversify in the early Pleistocene and since the end of LGM it started the demographic and spatial expansion. Our results, combined with the historical data upon the distribution of *G. roeselii* suggests that the onset of its spread from the Pannonian Basin could be a natural post-glacial expansion but, later on, it could be enhanced by anthropogenic factors.

Effects of nocturnal exposure to artificial light and habitat complexity on the fish foraging on amphipods

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Freshwater ecosystems in urban areas are often permanently subjected to elevated light levels due to widespread artificial lighting at night. According to several measurements, nocturnal light intensity in fresh waters tends to be somewhat higher to the moonlight (0.3-2.5 lx). We hypothesized that nocturnal illumination of low intensity (2 lx) would be sufficient to advantage visual predators due to the enhanced foraging success compared to natural night. However, we expected that the effects of nocturnal lighting may be mitigated by the presence of a structured habitat providing refuges for prey. We tested these hypotheses in laboratory experiments using the Eurasian perch (*Perca fluviatilis* L.) as a predator and amphipod *Gammarus fossarum* (Koch) as a prey species. The capture efficiency of perch was examined at dusk and night under two light regimes: natural cycle with dark night and disturbed cycle with artificially illuminated night, in habitats varying in structural complexity: sand and woody debris. To test if alterations in light levels and habitat type modify fish behaviour we also observed the activity of the perch. We found that nocturnal illumination significantly increased the consumption of amphipods by perch compared to natural night. Moreover, perch was as effective predator at illuminated night as at dusk, compensating for reduced visibility through increased activity. The presence of woody debris did not decrease the consumption of amphipods at illuminated night compared to sandy habitat. Woody debris provided an effective refuge only in combination with darkness, as the number of consumed amphipods were lowest at natural night.

Our results suggest that nocturnal illumination in aquatic systems may contribute to the significant reduction in invertebrate population sizes through fish predation. The loss of darkness reduces the possibility of using shelters by invertebrates and the effects of elevated light levels at night could not be offset by an increased habitat complexity.

Chironomid community responses to environmental drivers in man-made lakes of the Dinaric karst

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Reservoirs are man-made water bodies that are usually created by using a dam or lock to store water that can be used for the production of electric energy, irrigation or flood control. The family Chironomidae is widely distributed and often among the most abundant taxa in benthic macroinvertebrate communities of reservoirs, and they are frequently used in the ecological quality assessment of these habitats. Littoral macroinvertebrate samples were collected from May to October 2016/2017 in 21 reservoirs of the Dinaric region in Croatia. With regard to the surface area of the reservoir, from 2 to 6 sampling locations were chosen in analysed man-made lakes. A sampling site covered the length of 25 m lakeshore and a distance of 10 m towards the open water – or alternatively, to the point at which the water depth exceeded 1 m. At each sampling site, a total of ten samples was collected using a benthos hand net (25 cm × 25 cm; 500 µm). In the littoral microhabitat type, the strata are defined as a combination of a depth class and a substrate category proportionate to their coverage in the sampling site. Four water-depth classes were defined: 0–0.25 m, 0.25–0.5 m, 0.5–0.75 m and 0.75–1 m. A total of 490 samples were analysed. Totally 112 358 chironomid larvae were found, belonging to 5 subfamilies and 61 taxa. Bray-Curtis based non-metric multidimensional scaling analysis based on chironomid assemblages clearly separated reservoirs with a very short water retention time. These reservoirs were characterised with the presence of lotic faunal elements, and species such as *Paratendipes albimanus* and *Micropsectra contracta* were present only in these reservoirs. In general, species richness was found to decrease with higher values of pH and water temperature ($p < 0.05$), which is in agreement with previous research. On the other hand, species richness was found to increase with higher values of variables associated with eutrophication (chl *a*, orthophosphate and nitrate concentrations; $p < 0.05$). When compared to lowland reservoirs with organogenic geology, the reservoirs from the Dinaric region are characterised by a low nutrient input. This means that relatively higher concentrations of these elements in the Dinaric karst region represent optimal conditions for most taxa of the chironomid assemblages. Even though benthic macroinvertebrates usually are good indicators of hydromorphological changes there were no significant patterns observed in chironomid larval substrate preference between natural and man-made substrates. There were no observed differences in chironomid assemblage composition regarding depth classes as well.

Behavioural responses of the zebra mussel *Dreissena polymorpha* to conspecifics

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The zebra mussel is an invasive sessile bivalve living in dense aggregations attached to hard substrata. Its gregariousness is often explained by its preferences for conspecifics. However, none of the previous studies clearly demonstrated relations between conspecifics and their presumed preference for one another. We hypothesised that the aforementioned “preferences” were in fact a more complicated phenomenon, which was closely related to a challenging trade-off between the protection from negative environmental factors (e.g. predators and the lack of available hard substrata) on one hand, and deteriorating environmental conditions in a dense colony on the other hand.

Our aim was to check reactions of *D. polymorpha* to conspecifics. We observed horizontal (experiment 1) and vertical (experiment 2) locomotion as well as valve movements (experiment 3) of tested mussels in the presence of other individuals (physically separated, at different densities). Finally (experiment 4), we checked habitat preferences of juvenile individuals (<4mm) for live conspecifics or their shells. In experiment 1 we put a single tested mussel in a square arena containing a separate zone with conspecifics (signal zone). We tested mussel responses to two conspecific densities and at two distances from the signal zone. In experiment 2 we put a tested mussel in a plastic pipe, located above the tank bottom covered by mussels or without them. In experiment 3, a tested mussel was video-recorded and the behaviour analysing software was applied to follow the movements of a colour mark on its shell. In experiment 4 we put nine tested individuals in a sandy arena containing two types of objects (chosen pairwise from: gravel, live conspecifics and their shells of different sizes) arranged in a chequered pattern. After 24 h we noted the number of mussels attached to particular objects.

In the presence of conspecifics, the tested mussels were less mobile and unable to move directionally (exp.1), more often moved upwards (exp.2) and spent more time with widely open valves (exp.3). Juvenile mussels preferred empty shells over other objects, whereas their least selected substratum was live conspecifics (exp.4). These results suggest that zebra mussels avoid a direct contact with conspecifics, whose scent stimulates their escape behaviour to the upper part of a colony. Moreover, wide opening of the valves in the presence of other mussels may indicate some kind of competition for food resources. Thus, zebra mussels do not exhibit profound preferences for their own species and their dense aggregations, commonly found in the wild, are more likely to result from the lack of alternative suitable locations rather than from active selection of mussel beds by conspecifics.

Our study was supported by a grant of the Polish National Science Centre No. 2015/17/N/NZ8/01653 and internal funds of the Nicolaus Copernicus University.

How well do we know caddis fauna? A review on morpho-taxonomic and genetic diversity of Trichoptera from Bulgaria

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Preserving freshwater environments and estimating their ecosystem services as a function of biodiversity are key research questions with global importance. Further, the composition of aquatic biota, such as benthic macroinvertebrates, is crucial for the assessment of the ecological status of the water bodies they inhabit. Numerous biotic indices and metrics have been developed based on freshwater benthic invertebrates. In addition, DNA barcoding is often used as a complementary tool to traditional bioassessment and biomonitoring strategies, often assisting to disentangle hidden and cryptic diversity.

This contribution will focus on the order of Trichoptera, as it includes numerous sensitive taxa with specific requirements to their environment. The aim of the current study is dual. On the one hand, I summarise the current knowledge on morpho-taxonomy of adult and larval stages of Bulgarian caddis based on published and original data. The only checklist of adult Bulgarian caddisflies was published in the 1980s by Kumanski and included 218 species from 76 genera. This checklist was followed by two monographs and numerous scientific papers (mostly by the same author) that by 2007 increased to 258 species the number of known trichopterans from Bulgaria. While adult forms are well studied, not all of the larval stages are currently known or described. This is likely owing to their limited geographical distribution and insufficient number of studies on the aquatic stages of Bulgarian Trichoptera over the last decades. Additionally, some of the representatives of the order are endemic for the Balkan Peninsula or Bulgaria. On the other hand, I review the availability of reference libraries of DNA barcodes of caddis from the region. Thus, this contribution summarises known data on the morpho-taxonomic and genetic diversity of Bulgarian caddis and presents the species with lacking larval description and/or DNA barcodes. I outline potential knowledge gaps that would require future attention by researchers working on caddis from the Balkans.

The attendance of Vesela Evtimova in the 3rd CESAMIR 2018 was supported by the COST Action CA15219 DNAqua-Net within the ITC conference grant.

Surveying estuarine meiobenthos through DNA metabarcoding: a pilot study in the Lima estuary (NW Portugal)

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Meiofaunal communities play a key role in estuarine ecosystems, being responsible for significant trophic, ecological and sedimentary processes. However, meiofauna constitutes a particularly difficult community to be monitored through conventional morphology-based approaches. New emerging tools, such as DNA metabarcoding, facilitate the access to these communities and provide an opportunity to develop routine monitoring programs. Here, we report our first results on taxonomic profiling of meiobenthos by using metabarcoding of environmental DNA (eDNA) isolated from sediments of the Lima estuary (NW Portugal).

Sediments from two sites within the Lima estuary were assessed. The first one, located downstream (salinity 34), was composed of coarse sands with circa 0.28% organic matter. The second one upstream (salinity 6.15) was composed with more fine sands (0.65% organic matter). Afterwards, eDNA was extracted from three different amounts of sediment (0.63, 2.50 and 10.0g) using the MoBio extraction kits. High-throughput sequencing was performed in an Illumina-MiSeq platform, using two primer-pairs targeting cytochrome oxidase I (COI) sub-region (~310-313bp) and three primer-pairs targeting the V1-V2 (~400bp), V4 (~400bp) and V9 (~200bp) regions of the 18S rRNA gene. Customized procedures were applied based on the software mothur for removal of sequencing and PCR errors, de-replication, detection, and discharge of chimeras. OTU clustering was performed in mothur at 97% similarity, and the representative sequences of each OTU comprising more than 8 reads were BLASTed against GenBank nucleotide database. The matching High Scoring Pairs with an alignment length ≥ 200 bp and a query coverage $\geq 90\%$ were kept for subsequent taxonomic assignment, with those $\geq 80\%$ of identity assigned down to the lowest possible rank.

The amount of sediment used for DNA extraction globally seems to relate directly with the number of OTU recovered in the downstream site (10.0g with much higher number of OTUs recovered), but appears to have little or no impact on the upstream site. A fair number of OTUs could not be assigned to phylum or other lower taxonomic ranks, possibly reflecting taxonomic gaps in the reference libraries. Still, results show a different trend between the two sites, both in terms of the total number of taxonomically assigned OTUs, and of taxa composition (richer in the upstream site). The meiofaunal taxa detected differed among the target loci and primer-pair employed, with the primer-pair for the 18S-V4 region and one for the COI sub-region detecting the highest taxa diversity. However, distinct taxonomic groups were detected preferentially by 18S and COI, and no single target region or primer-pair was able to capture entirely the diversity of meiofauna. These results indicate that a fair amount of sediment, and several loci and primer-pairs, should be used in order to assure a more accurate taxonomic profiling.

The attendance of Maria Fais in the 3rd CESAMIR 2018 was supported by the COST Action CA15219 DNAqua-Net within the ITC conference grant.

***Gammarus fossarum* and *Hydropsyche angustipennis* as trace metal biomonitors in the lateral risk assessment – a comparative study**

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The Biała Przemsza river in Upper Silesia, Poland drains a catchment impacted by lead and zinc mining. The catchment continuously receives discharges, such as mine drainage and flotation water from mining and smelting works in the Olkusz area. On top of these, there is also noticeable input of wastewater from dispersed settlements, as well as surface run-off from agricultural land. Elevated trace element concentrations are observed in these discharges, among them cadmium, lead and zinc – metals of significant ecotoxicological concern. Within the catchment, trace metals exhibit a marked gradient from a low background to very high concentrations. Therefore, they are ideal streams in which to study the dose-response relationship of metal toxicity in natural streams. That is why the Biała Przemsza catchment was chosen to study the usefulness of the caddisfly *Hydropsyche angustipennis* and the amphipod crustacean *Gammarus fossarum* as biomonitors of trace metal bioavailabilities, specifically as sentinel species in the lateral risk assessment. The hypothesis tested was whether metal concentrations in the metal-tolerant biomonitors can be used as an indicator of trace metal bioavailability levels that can be correlated with ecotoxicological responses in more sensitive macrobenthos organisms, specifically heptageniid and ephemereid mayflies.

The species in question were confirmed to be good bioaccumulators of trace metals. Generally, they were accumulating cadmium, copper, lead, manganese, and zinc in similar concentrations. Although noticeable differences in bioaccumulated levels occurred in the case of copper, and less distinct in the case of manganese and zinc, both enabled pinpointing sites particularly threatened by elevated load of investigated metals. As for the lateral risk assessment, it has been proven that their bioaccumulated concentrations of particular trace metals could be successfully calibrated against metal-related ecotoxicological changes in local mayfly community structure.

Soft-Bottom Molluscs Diversity of the Southwestern Black Sea (İstanbul-İğneada) in autumn

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Macrobenthic communities show variations in composition and structure across different environmental conditions and habitats. Benthic samples were collected by RV Karadeniz Araştırma of the Recep Tayyip Erdoğan University. Soft bottom macro-zoobenthic communities were determined at 4 depths ($\leq 10-15m$, $\geq 25-30m$, $\geq 45-50m$, $70-m \geq$) of four stations along Southwestern Black Sea (İstanbul-İğneada) in Autumn 2017. A total of 28 molluscan species belonging to 2 classes were identified in 4 transects (including depths of 10, 30, 50, 70, 100 m) located in Şile, Anadolu Feneri, Karacaköy and İğneada. Overall, no significant difference in community parameters such as diversity index, evenness index, and species richness was found among transects. The species abundance showed depth-wise variations.

This research supported by TÜBİTAK (project. number 116Y150).

Assessment of metal exposure in industrially/agriculturally impacted freshwater ecosystem using amphipod *Gammarus fossarum* Koch as a bioindicator

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The present study highlights the relevance of the assessment of soluble metal levels in gammarid tissue and its implementation as an early indicator of metal exposure in the freshwater habitats. Physico-chemical water properties in the Sutla River, an industrially/agriculturally influenced catchment in North-Western Croatia, indicated a disturbed ecological status, which also was reflected on the population scale (more than 50 times lower gammarid density in the Sutla River compared to the reference location, Črnomerec Stream). Since total tissue metal concentrations are not fully reliable in the risk assessment of metal exposure (due to internal metal compartmentalization in organisms), metals in the soluble tissue fraction were estimated as indicators of bioavailable metal levels. Among 28 measured metals, significantly higher levels of soluble toxic metals (Al, As, Cd, Pb, Sb, Sn, Sr) were observed in gammarids from the Sutla River compared to Črnomerec Stream. The soluble metal estimates were supplemented with the common multi-biomarker approach: measurement of acetylcholinesterase (AChE) activity, metallothionein (MT) induction and total soluble protein concentrations. Although there was no MT induction, decreased AChE activity and increased total soluble protein concentrations confirmed stressed environmental conditions for biota in the Sutla River. Our results suggest that prior to the observed toxic impact and specific biomarker response, concentrations of soluble metals in organism tissues could be used as an early warning signs of metal impact in freshwater environment.

The recent environmental history of two Central American lakes: a subfossil chironomid record from lakes Apastepeque and Yojoa

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Central America belongs to the areas where paleolimnology is still fragmentary. The reasons for it are multiple, e.g. issues with logistic, problematic political situation, lack of appropriate lakes, and also insufficient knowledge of taxonomy and ecology of aquatic biota. Here, we present a subfossil chironomid record of two lakes situated in Salvador (Apastepeque) and Honduras (Yojoa). The lakes differ in size and origin: while Yojoa is a big lake (79 km², max. depth 22 m) with strong human influence (fish farming and mining), Apastepeque is a small crater lake (~0.59 km², max. depth 54 m) situated in a natural reserve. The sediment sequences taken have different ages as well: the 38 cm long sequence from Yojoa dates back to ca 1815, while the 30 cm long core from Apastepeque represents ~600 years (originating in ~1390). In general, the lakes differed in chironomid diversity and assemblages structure significantly. While there were more than 30 taxa recorded in Apastepeque, in Yojoa the total number of taxa did not reach even 10. In both lakes Chironominae and Tanypodinae dominated, Orthocladiinae were present in negligible numbers. In Yojoa, changes of the chironomid assemblages indicate two main zones with a transition in ~1947. The bottom zone indicates well developed littoral with dense vegetation, that was also confirmed by cladocerans. The sudden drop in chironomid diversity and increase of Chironominae at the beginning of the second zone suggest significant changes of lake trophy, most likely due to fish farming and intense agriculture. In Apastepeque, two main zones and one oscillation were detected. Changes in the chironomid assemblage structure refer to the end of the little Ice Age and the beginning of more intense human activities, and in turn, higher trophic status mainly reflected in the significant increase of Chironominae. In the most recent sediment sequence the chironomid diversity dropped and assemblage structure changed significantly. We assume that these changes (also visible in other biological proxies) were induced by an earthquake in 2001. Earthquakes, causing erosion and landslides, can change the conditions in aquatic ecosystem via altered light availability, turbulence and higher trophy.

The project was funded by the National Science Centre, Poland, contract no. 2015/19/P/ST10/04048 and no. 2014/13/B/ST10/02534, and the EU Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 665778.

The more the merrier – the extraordinary cryptic diversity in freshwater *Echinogammarus* (Gammaridae, Amphipoda) from Sicily

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Sicily is the largest island of the Mediterranean Sea, which is considered as one of the top biodiversity hotspots in the world. So far, around 120 freshwater species of gammarids have been reported from the Mediterranean Region, with four known from Sicily. Given the very high cryptic diversity discovered recently in European freshwater gammarids and lack of molecular studies on insular species, we conclude that number of species already reported from Sicily may be underestimated.

A set of 161 individuals from 44 locations from Sicily, supplemented by 246 individuals from 39 locations from Apennine Peninsula and Tunisia, which served as reference areas were amplified for COI barcoding region, along with other molecular markers like 16S rRNA and nuclear 28S rRNA. Molecular species (MOTUs) were delimited using different methods: ABGD, GMYC and bPTP and the reconstruction of their time-calibrated phylogeny was done using BEAST2 software.

We have revealed presence of eight morphospecies on Sicily, which belonged to three known members of the genus *Echinogammarus*: *E. sicilianus*, *E. adipatus* and *E. tibaldii*. All of them were monophyletic and exhibited substantial level of cryptic diversity. We identified two MOTUs for *E. tibaldii* (6.9 – 7.5 % K2P), three MOTUs in case of *E. adipatus* (5.0 – 9.5% K2P) and seventeen MOTUs in case of *E. sicilianus* (6.0 – 24.5% K2P), confirmed by all the applied delimitation methods. This high level of cryptic diversity, with extreme case within *E. sicilianus*, is reported for the first time ever for freshwater *Echinogammarus*. Majority of the sites were inhabited with one MOTU only, except Fiume dell'Elsa where 6 different MOTUs co-occurred. The reconstruction of the phylogeny showed that *E. adipatus* and *E. tibaldii* are closely related with the Apennine gammarids, whereas *E. sicilianus* is a sister group to all *Echinogammarus* from Italy, from which it diverged probably ca. 25 mln years ago. Additionally, we revealed presence of substantial level of cryptic diversity in the reference areas, with at least thirteen MOTUs of *Echinogammarus* on the Apennine Peninsula and at least twelve in Tunisia.

The ecology of fear – Impact of short and chronic predation risk on the physiology of native and invasive gammarids

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Predator pressure is a crucial evolutionary force, driving a number of adaptations in prey species. Due to non-consumptive effects of predator pressure, prey organisms allocate resources into induced defence mechanisms, such as modifications of behaviour, morphology and physiology. Moreover, increased metabolism and vigilance may induce physiological stress in prey organisms. In consequence, they limit their vital activities, including feeding, growth and reproduction. We hypothesized that the strength of adverse physiological effects of predation pressure may depend on the level of constitutive defences developed by prey and duration of exposure to the stressor. We exposed two gammarid species: less armoured *Gammarus fossarum* and strongly armoured *Dikerogammarus villosus* to the signal of the European perch *Perca fluviatilis* to test non-consumptive predator effects on prey differing in their level of constitutive anti-predator defence. To check the effect of short-term and chronic predation risk, we tested 3 groups of gammarids. The first group was not pre-exposed to the predation risk before the test. The other two groups were pre-exposed to predation risk for 1 or 7 days before the experiment. We placed 10 gammarids (single species) in a tightly closed Karlsruhe bottle containing water with the predator signal or control water. We recorded their behaviour and respiration for 35 min. of the test. Then, we measured a number of physiological markers of antioxidant defence (SOD and CAT activity; GSH level) oxidative damage (lipid peroxidation, determined as TBARS) and stress proteins (Hsp 70 level). The short-term predator presence induced an increase in respiration rate (indicating an increased metabolism) in both species. Simultaneously, *G. fossarum* suffered a higher oxidative damage than *D. villosus*, though both species mobilised their anti-oxidant defences. After a longer exposure, both gammarids reduced their initial response and did not exhibit any further symptoms of oxidative stress, indicating habituation. Our results suggest that organisms with stronger constitutive defences bear lower physiological costs of immediate responses to the predator presence. On the other hand, the ability to reduce physiological costs of chronic exposure to predators seems independent of the prey defence strategy.

Supported by National Science Centre, Poland 2016/21/B/NZ8/00418.

New data on the mysid species (Mysida, Crustacea) from the Bulgarian section of the Danube River

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Up to now, 14 mysid species (Mysida, Crustacea) have been known from Bulgaria. Twelve species (six Ponto-Caspian species and six Mediterranean species) inhabit the Black Sea, the lagoons, and adjacent river mouths. In the Bulgarian section of the Danube River, only three Ponto-Caspian species are reported in the literature: *Paramysis (Serrapalpis) lacustris*, *Paramysis (Mesomysis) intermedia* and *Limnomysis benedeni*. The latter species is common for both catchments. Recently, most of the Ponto-Caspian mysids have been widely spread and considered invasive in several Central and Western European countries.

The main goal of our study was to collect recent data about composition and distribution of the mysid fauna from the Bulgarian section of the Danube River, between 845 and 375 river kilometers (rkm). The shallow shoreline zone (0–1.5 m depth) was sampled during 2010–2018. Four species were found: *L. benedeni*; *P. lacustris*; *P. intermedia* and *Katamysis warpachowskyi*. The most abundant was *L. benedeni*. It was found at different microhabitats along the river and in some adjacent lakes and reservoirs. Recently, this species has expanded its range in Bulgaria and reported also from the East Aegean Sea basin (Zhrebchevo Reservoir, Tundzha River). *Paramysis (Serrapalpis) lacustris* was recorded as widespread in all the Bulgarian section of the Danube River. It was characterized by low abundance and presented only at a soft bottom substrate (silt, clay). There were only two previous records of this species in the Bulgarian section: at 624 rkm in 1991, and at 532 rkm in 2013, the first locality being reported as the upper border of its native range in the Danube River. Our results confirm its upstream range expansion in Bulgaria; recently, the species has been reported to reach up to 1300 rkm of the Danube River, in the Serbian – Hungarian section. *Paramysis (Mesomysis) intermedia* was found at one locality in our study – near Vardim Island at 546 rkm. Previously, this species was reported in Bulgaria only in the stomach content of the stellate sturgeon (*Acipenser stellatus*). *Katamysis warpachowskyi* was recorded at two localities: near the village of Dolni Tsibar (718 rkm) and downstream of the Kozloduy Nuclear Power Plant canal (687 rkm). These are the first records of *K. warpachowskyi* in the Bulgarian section of the Danube River, although it has already been reported from all other river sections, including the Upper Danube River (up to 2365 rkm). Our results show the necessity of regular monitoring of the distribution and population dynamics of the mysid species in the Danube River and the inland waters of Bulgaria.

Effects of non-indigenous macroinvertebrates on the composition of watercourses' macrozoobenton communities in Hungary according to time and spatial analysis

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The non-indigenous species, with invasive spreading and growing population form one of the major threats – beside anthropogenic effects – which effect the natural communities of wetlands and water courses. The invaders are modifying the natural structure of macrozoobenton communities inhabiting waters, the food web, and degrading the community structure with their – usually explosive – population growth thank to their more effective utilization of the resources. At the same time their spreading mechanism, the vectors responsible for them and their dynamics which are modifying the aquatic macroscopic invertebrate communities in their structure and function are little known.

In Hungary quantitative sampling is regularly done on 10 taxa (Bivalvia, Gastropoda, Hirudinea, Malacostraca, Plecoptera, Ephemeroptera, Odonata, Heteroptera, Coleoptera, Trichoptera) of the aquatic macroinvertebrate communities since 2005 following the basic principles of AQEM protocol and in accordance with the WFD's requirements in the framework of the Hungarian Biodiversity Monitoring System and other campaign-type projects. The standardized sampling method and the validated data handling which covers decades and stored in a database are giving the opportunity to create a relevant image on national scale about the processes related to the spreading dynamics of non-indigenous aquatic macroinvertebrate species found in Hungary and their effects on qualitative- and quantitative parameters of macrozoobenton communities of watercourses.

During the analysis we compared the number of non-indigenous and native species, their density, and the changes in their relative ratio. The presence-absence analysis based on spatial scale and covering decades are showing well the expansion of invaders. However, quantitative analysis on water types points to the fact that the infestation and vulnerability are showing big differences.

Streambed sediment as an invertebrate refuge during the long-term drying

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Climate change brings to many regions more frequent stream drying therefore we studied survival mechanisms of aquatic macroinvertebrate communities on gradient of dry phase duration. We have repeatedly sampled dry streambed sediments from 10 intermittent streams (2-3 Strahler order) in Czech Republic to identify changes in structure of benthic invertebrate community composition related to dry phase duration of 1-151 days. We found significant changes in the community composition connected to number of dry days before sampling date: abundances of surviving aquatic invertebrates (sorted alive from sediment) were gradually decreasing, less resistant taxa vanishing, whilst semi-aquatic and terrestrial species successively enriched the community composition. This turn-over pattern may serve as a tool for drying period estimation.

Even when water flow ceased the streambed retains remarkable proportion of water content (ca 5-20 %) thus this residual moisture enables survival of some aquatic invertebrates. Some aquatic macroinvertebrates are able to survive a long dry period in moist streambed which serves as a refuge. Invertebrates can use either specific drought resistant stages (e.g. eggs and cysts) or can simply persist as larvae or adults. We confirmed presence of resistant eggs in dry streambed by two months laboratory cultivation of re-watered and aerated sediments. During the cultivation we found larvae and emerging adults of species which were even not detected in dry sediment immediately after the sampling. We also investigated sediments from different mesohabitats which revealed evident dissimilarities in their community composition. Thus it is apparent that habitat diversity of dry streambed plays an important role in invertebrate survival and in consequent recolonisation after flow resumption. In study was used data from BIODROUGHT project (www.biodrought.eu) and was supported by INTER-COST project (LTC17017).

The distribution area of thick shelled river mussel (*Unio crassus* PHILIPPSON, 1788) in Hungary and its relationship with the habitat composition

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The *Unio crassus* is among the most important endangered species, which listed in the Habitat Directive, Annexes II. and IV., moreover especially suitable to track the changes in the water quality due to their sensitivity to water pollution. The main objects of our study was to investigate the distribution of thick shelled river mussel, to find out which watercourses consist of the most convenient habitat to this species and determine the composition of these habitats. Different long- and short term investigations were used from the last 25 years which were carried out by our company in the Hungarian surface waterbodies. Faunistical and quantitative survey were also implemented and the used quantitative sampling method has met with the requirements of Water Framework Directive. In total 1441 water system were investigated in 4681 sampling sites 11035 samples from which the *U. crassus* occurred in 594 sampling locations. The distribution patterns shows, that the main populations of this species are located in Hungarian bigger rivers (e.g. Tisa), in its tributaries (e.g. Sajó, Bodrog, Bódva) and in smaller streams (e.g. Tarna, Bene stream) which are in direct connections with them. The populations with the highest density occur in the eastern part of the country in Bodrog, Kettős-Körös, Sebes-Körös and Tisa, in the north in Ipoly and in the western part in Kerka and Pinka. Interesting, that only the upper section of Danube consists of suitable habitats for *U. crassus* while under Budapest only one occurrence is known. Adequate habitats also can be found in the Tisa river, but upstream from the Tiszalök dam (hydropower-station) the population diversity is higher than in the lower section.

But what kind of habitats do these watercourses contain and how these effects the populations of *U. crassus*? To highlight the most preferable habitats by *U. crassus*, correlation analysis were performed, which clearly showed, that higher proportion of microlithal or akal fractions results lower abundance, while with the increase of the psammal fraction, the density of the individual increases as well. Analyzing the abiotic habitats of the sampling sites, significant difference was detected between the proportions of terrestrial plant parts, which reach the water surface. But this negative correlation comes mainly from the biotic habitats of those typical waterbodies where terrestrial plants cover the riverside.

The protection of this mussel has international importance, as all the surrounding countries have their populations and through suitable management practices and international cooperation their populations can be preserved.

Macroinvertebrate pioneers in rewetted, historically dry channels

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We carried out a macroinvertebrate recolonization study in historically dry channels in the Krka National Park. The drying occurred through plant overgrowth. Invasive plant species *Ailanthus altissima* took over a part of the area with several streams at a tufa barrier causing the flow to change. Some of the active tufa-depositing habitats disappeared leading to changes in ecological features of the area. The revitalization and recolonization occurred after removal of the invasive trees. Streams revitalization contributes to the restoration of the balance in aquatic community, food chains and improves the circulation of organic matter, making a positive influence on biodiversity. Our goal was to determine the rate of recolonization for the macroinvertebrate taxa in the rewetted habitat that were completely dry until recently. We sampled the four non-concurrently rewetted sites to 3 cm depth monthly during the initial recolonization period. Simultaneously, we measured the physico-chemical properties of the water at each site. The most dominant recolonization i.e. pioneering taxa were non-biting midges and blackflies. They were among the most abundant taxa in the control site but their abundance was significantly higher in the revitalized channels. Beetles were the second most abundant taxon at the control site but also the taxa that recolonized the least. Judging by the number of taxa, the least favorable for the recolonization were the habitats at the most recently rewetted channel. In addition, this was the channel that suffered the most severe loss of structure. Finally, most of the taxa at the control site were present at the revitalized channel 4 months after rewetting.

No experimental evidence on the active long-range dispersal of the Asian clam [*Corbicula fluminea* (O. F. Müller, 1774)]

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Biotic invasion is considered one of the top drivers for global biodiversity loss. Among the aquatic invasive species, many mollusks are proved to be very successful conquerors, particularly the Asian clam (*Corbicula fluminea*) is one of the species spreading rapidly worldwide. It is known that the passive dispersal of this species is predominantly attributed to anthropogenic activities (e.g., fishermen, boaters, and canoeists), but a possible alternative natural vector of passive dispersal can be fishes. Moreover, the active dispersal is also convincing, however less studied. Our long-term field observation highlighted a very fast (3.5 km/year) upstream spreading of the species in Karasica stream in SW Hungary. The aim of the present study was to prove or refute experimentally the role of active dispersal in this phenomenon. The experiments were conducted between 17.08. and 01.09. of 2017 using 160*80 cm sections of an artificial stream system. After two-week-long pilot studies, in case of the main experiment, each replicates took 48h under standardized conditions (22°C, 10D:14L photoperiod). Based on pilot studies, we defined three different experiments, each with three levels of treatments that could influence the migratory behavior of the specimens. In experiment 1 we used three different sediment types: coarse, fine and coarse with rocks. In experiment 2 we tested three different flow velocities (0.03 ms⁻¹, 0.05 ms⁻¹, 0.07 ms⁻¹) and in experiment 3 we used different starting densities (125, 250, 500). Despite the habitat structure (sediment) as well as the flow velocity significantly affected the displacement of the clams, we found no clear evidence on the active long-distance migration. The average displacement was 28.96 cm (min: 0 cm, max: 81.88 cm) upstream, while downstream it was 27.83 cm (min: 0 cm max: 71.33 cm), which predicts no more than 150 m upstream self-movement in a year as a maximum. Overall, it seems that the large adults of the species are somewhat able to spread without any vector, but this kind of area expansion is much less significant than expected. To conclude, we founde on the fast, long-distance active dispersal capability of adult Asian clams. The very fast upstream invasion might be explained by passive dispersal that have not been investigated in our experiment (e.g. attachment of the pediveligers to fishes).

Aquatic beetles versus restoration dredging: A case study from a Hungarian peat bog

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Aquatic beetles' is a very diverse group of water insects combining a wide variety of beetle families with diverse ecological needs and variability in nutrition. They respond sensitively to any changes in the aquatic habitat and studying them could be useful in monitoring any kinds of positive or negative effects, especially those of major interventions.

One of the most valuable wetland areas in the Danube-Ipoly National Park is the Turján region, where the glacial relict peat bog residue, the Öreg-Turján is a particularly valuable asset. Unfortunately, due to drainage and water shortage, its open water surface highly decreased during the last century and the sedimentation was very advanced. Therefore, in 2011, a restoration dredging was carried out, which resulted in major changes in its appearance: the uniform reed beds have been dismantled, the water management and water retention have been made to be adjustable by using newly created channels and sluices, the open water surface has increased forty times.

In this study four sites (two dredged and two non-dredged areas as controls) had been monitored for 30 sampling occasions between 2015 spring and 2017 summer using bottle-trapping method. At each site we used three bottle-traps baited with fresh chicken liver. Traps were exposed from the evening to next morning, when the beetles captured have been counted and identified. A total of 2824 beetle specimens belonging to 28 species were captured. Due to methodological restrictions, only the big- and medium-sized species of the Dytiscinae, Agabinae and Colymbetinae subfamilies were included in the analyses. Based on the results of Permanova, non-metric multidimensional scaling (NMDS), discriminant analyses (CVA) and MANOVAs, we revealed that larger numbers of individuals and species numbers characterize the treated sites than the untreated ones, but they cannot be clearly separated based on the aquatic beetle assemblage composition. Species level analyses, however, pointed out that there were significant differences in the number of individuals of some species, they preferred the dredged sites against intact ones. It is partly due to the fact that the dredged sites are at least as different from each other as from the non-dredged sites (which were very similar). Dredging affected the sites in two different ways creating great differences in their fauna and blurring the differences between treated and control sites.

Water scarcity – the macroinvertebrate perspective

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Supposedly, there is a process going on called climate change. The issue has been somewhat trumped recently though. Nevertheless, there are data and predictions that precipitation volume and its locations may be altering, and it seems we are witnessing these changes. Simultaneously, temperatures fluctuate and coincidentally or not at similar locations as for aforementioned water dynamics shifts. Water dynamics, consequently may differ from what biota is adapted to in a respective aquatic habitat. That is why many freshwater researchers are focusing their investigations towards this issue. We have done a study in which we mimicked water scarcity at an ecosystem level. At a tufa barrier where normally, aquatic and other vegetation limits the flow, creating lotic channels, we enabled broader flow area by removing the vegetation. With its removal, water level dropped and flow velocity decreased – hence mimicking water scarcity event. We focused research on moss mats at normally open canopy sites and away from removed vegetation to avoid including physical effects of vegetation removal other than the flow change. We sampled the moss mats half a year before the impact and half a year after it. In second study, we observed changes in macroinvertebrate communities in a mountain stream at an artificially broadened site that resulted in similar changes – flow inhibition and water level decrease. In both cases, inhibited flow caused a decrease in macroinvertebrate abundance and diversity. Rheophilic taxa were the most impacted. In addition, we noted an increase in detrital accumulation especially for the fine detritus.

Predicting the effects of climate change on pathogen-host balance in freshwater ecosystems: a case study of indigenous European crayfish and crayfish plague

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Anthropogenically induced climate change has multiple negative effects on ecosystems. Many freshwater organisms are especially vulnerable to climate change-related habitat alterations since animals have limited possibilities to migrate to areas with more favourable conditions. Thus, crayfish as keystone species and ecosystem engineers of many freshwater ecosystems could be negatively affected. Furthermore, it has been shown for multiple pathogen-host pairs that elevated water temperature caused by climate change favours spreading of pathogens. The aim of this study was to investigate whether a 4 °C increase in water temperature (from 18 to 22 °C) will also increase the virulence of *Aphanomyces astaci* (Schikora, 1906), the causative agent of crayfish plague. Transmission of crayfish plague by invasive crayfish species is one of the main drivers of native European crayfish populations declines. We used a highly virulent *A. astaci* strain B (PsI genotype, transmitted by the most successful invasive crayfish) and two indigenous crayfish species: the stone crayfish *Austropotamobius torrentium* (Schrank, 1803) and the narrow-clawed crayfish *Astacus leptodactylus* Eschscholtz, 1823. In their natural habitat in Croatia, the selected species are either in direct contact (*A. leptodactylus*) or in the close proximity (*A. torrentium*) to invasive crayfish and the presence of *A. astaci* was already detected in some populations.

Before the experiment, we have tested all animals for *A. astaci* presence, using a non-invasive PCR method. Only *A. astaci*-free animals were included into the experiment. After acclimatization, we have infected the crayfish with 500 zoospores per mL at water temperature of 18°C (control conditions) and 22°C (increased water temperature - simulation of climate change). After four weeks the results have shown that the mortality of both crayfish species was significantly lower at increased water temperature (22°C). This suggests that the increase of water temperatures caused by climate change will probably not result in the increased spread of *A. astaci* strain B in stone crayfish and narrow-clawed crayfish populations. Results will be discussed in adaptation and evolutionary perspective as well as in the context of *A. astaci* strains that have different water temperature preference. In conclusion, this study presents the first experimental data on the balance between *A. astaci* and indigenous crayfish in the context of climate change. As such, it can serve as a starting point for new research in this area and the development of adjusted conservation programs.

No country for old perennial streams alias Czech drying through the looking glass

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Intermittent streams have been overlooked by limnologists for decades although rising water scarcity induced by climate change accompanied by anthropogenic alterations of catchments, drying impacts on stream biota are now studied more extensively. Supra-seasonal drought in last 5 years strongly altered flow regime in many Czech streams. Thus, in some south-eastern regions it is not easy to find small flowing stream after summer heat waves, if it is not fed by wastewater treatment plant. Some stream channels become a terrestrial ecosystem for prevalent part of a year and they are colonised by terrestrial biota, however specific part of aquatic community is able to survive in moist riverbed sediment. Resistance of such macroinvertebrates is related to humidity but also to substrate structure (permeability), channel morphology and overall diversity of habitats.

By way of contrast, the dry riverbed is new and relatively unique bare habitat for terrestrial invertebrates, which is often missing in many Czech heavily modified rivers. Furthermore, dry channels can be attractive for terrestrial vertebrates either immediately after dry phase onset as source of food or later as easily passable migratory corridor. Residual pools, especially those fed by groundwater, can be an important refuge (especially for fish) and may host specific aquatic macroinvertebrate community, which differs remarkably from communities occurring during the flow phase. Autumn (in last years even winter) flow resumption is delayed to cold part of season when recolonization runs slowly. Thus, repeated extensive stream drying gradually selects the most drying resistant and resilient taxa, which leads towards the whole community transformation. These processes can be further accelerated by impact of anthropogenic pollution associated with hydromorphological degradation and land-use alteration. For ecologist it is very challenging to study these phenomena and suggest suitable catchment management which enables long term survival of this specific biodiversity.

Research was supported by INTER-COST (LTC17017) project and based also on results of BIODROUGHT project (www.biodrought.eu).

Aquatic macroinvertebrate community patterns as a tool prioritization of River Basin Specific Pollutants

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This study was carried out to identify relations between the macroinvertebrate communities and River Basin Specific pollutants (RBS pollutants) in the Danube River. The investigation was performed on 68 sites along 2,500km of the Danube. Forward Selection (FS) method, Canonical Correspondence Analyses (CCA) and the Spearman correlation coefficient (SC) were used to identify the relations between macroinvertebrate dataset and selected biological metrics and RBS pollutants. Out of 20 analysed pollutants, seven (2,4-Dinitrophenol, Chloroxuron, Bromacil, Dimefuron, Amoxicillin, Bentazon and Fluoranthene) were found to be significantly correlated with macroinvertebrate communities. Bentazon, Dimefuron, 2,4-Dinitrophenol, Fluoranthene and Chloroxuron showed negative correlation with total number of taxa and abundance of Trichoptera, Diptera, Oligochaeta, Crustacea and Odonata, as well as abundance of Gastropoda and total number of taxa. To find synergistic influence of RBS pollutants on biota, BIO-ENV analysis was performed and revealed that 3 subsets of environmental variables were highly correlated with biota resemblance matrix, covering combination of same parameters singled out by FA.

Can the food availability determine the reach-scale distribution of the Balkan Goldenring (*Cordulegaster heros*) larvae?

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Dragonflies and damselflies are known to be obligate and generalized predators both in larval and adult stage. The members of Cordulegastridae, represented by the only genus *Cordulegaster* in Europe, are inhabiting only flowing waters, restricted to headwater streams, where larvae act mostly as the top predator. In a previous research our group studied the larval instar distribution of *Cordulegaster heros*, and found that the relative abundance distribution of the larval instars highly differed among the streams and sites. However, it was not possible to explain these differences with abiotic parameters and environmental attributes. Therefore, we hypothesized that biotic factors, among them, the available trophic spectrum is the cause of the different larval population structures found in our streams. To test our hypothesis, we compared the larval dataset with a full-spectrum macroinvertebrate sampling. The quantitative macroinvertebrate samplings (spring, summer, and autumn of 2009) and the recordings of *C. heros* larval distributions (monthly from June 2011 to May 2012) were carried out at the same four sites in the Mecsek Mountains, SW Hungary. The Pearson's linear correlation showed a very strong and significant correlation between the numbers of *C. heros* larvae from the two sampling times. This, along with the fact that this species has a 3–4 years long larval development time, indicated that the two datasets are comparable. Species response curves (SRC), estimated by applying a randomisation procedure to ensure robustness of Generalized Additive Models (GAM), suggest that younger larvae (E, F-3, F-2) responded differently to the available trophic spectrum than the older instars (F-1, F). Spearman rank correlations between the numbers of *C. heros* instars and the available trophic spectrum also revealed differences between younger and older larvae. We also determined the niche position and niche breadth of each instar via Outlying Mean Index (OMI) analyses using the species traits (feeding habits, locomotion type, maximal potential size) of the macroinvertebrate community as habitat condition matrix for the sampling sites. The weighted average niche position of the instars on these ordinations also showed a separation trend between the younger (F-3, F-2) and the older (F-1, F) larvae, while the early (E) instars' position varied. To sum up, our results seem to indicate that the different *C. heros* larval instar distributions found at the sampling sites could be attributed to the different composition of available food sources.

Macroinvertebrate communities of montane standing waters in the Czech Republic and Bavaria: effects of past acidification and littoral zone properties

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Montane standing waters in the Czech Republic and SW Bavaria are rather rare, especially when compared to widespread eutrophic fishponds at low altitudes. Although the montane water bodies are predominantly artificial, built for the purpose of water resource management, timber floating, flood control or fish farming, their littoral habitats can resemble those of natural montane lakes and host specialized communities including rare and relict species. Some of them are protected by law for their ecological value. In this study, we focused on Czech and Bavarian oligotrophic or mesotrophic standing waters located in three mountain ranges (the Bohemian Forest/Šumava in Czech, Jizerské hory Mts., Krušné hory Mts.), which were affected by acidification caused by heavy atmospheric pollution between the 1950s and 1980s. Despite recent chemical and biological recovery, some influence of acidification can still be detectable in some areas. Other recent potential impacts on biota include water level manipulation and fish farming.

The main aim of this study was to describe littoral macroinvertebrate communities across various types of montane standing waters, to evaluate the species composition and biodiversity, and to assess the influence of the past acidification, littoral zone structure, and water level manipulation. Sampling of macroinvertebrates was performed in 2014 and 2015 at 23 waterbodies: natural glacial lakes recently recovering from strong acidification, small reservoirs used for timber transport in the past, ponds or small reservoirs in naturally acidic, peatland areas, and large reservoirs characterized by water level manipulation and different influence of acidification.

The strongest impact on macroinvertebrate communities was water level manipulation, preventing formation of stable vegetated littoral zone. Lakes and ponds with stable sedge-rich littoral zone were inhabited by species rich communities, the composition of which was significantly affected by water pH and proportion of organic substrate in the littoral. Moreover, acidic sites with pH < 5 differed in toxic aluminium concentration, thus, littoral macroinvertebrates of the chronically acidified lakes can be constrained by toxic aluminium more than by acidic pH itself. Organic substrate in the littoral was correlated with the development of sedges in the littoral zone of the lakes.

The study was supported by project of specific research on Masaryk University (MUNI/A/0816/2017) and project INTERREG 26: Silva Gabreta Monitoring – transboundary monitoring of biodiversity and water regime.

Different ways how to survive dry episode: a role of species traits in resistance and/or resilience to stream intermittence

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A significant increase of stream intermittency in the Czech Republic has been reported in the last decades. Temporal and spatial unpredictability of this phenomenon force the macroinvertebrate communities to create strategies for survival. Generally, there are two ways how to cope with the flow abruption: to stand (i.e. resistance) or to flee and return after flow resumption (i.e. resilience). We predicted that i) proportion of resistant macroinvertebrates within community will be related to the extent of dry episode and ii) the proportion of resilient taxa will rise with the time after flow resumption and iii) the general diversity metrics such as total taxa richness or total abundance are related to both –temporal extent of dry episode and duration of flow phase after flow resumption.

We analysed macroinvertebrate assemblages from ten intermittent streams in the Czech Republic sampled between years 2012 and 2015. We compared different species traits representation that promotes resistance and/or resilience of macroinvertebrate communities to intermittence with relation to i) dry episode duration, ii) time span from stream flow resumption to the sampling date and iii) the newly designed metric that combines both and therefore expresses the general impact of dry episode on macroinvertebrate community. The preliminary results show that duration of dry episode plays a major role in macroinvertebrate community composition. Further, our newly designed metric describing overall intermittency impact can explain general diversity indices with great accuracy.

This research was supported by INTER-COST (LTC17017) project, data were collected within BIODROUGHT project (www.biodrought.eu).

Effect of substratum drying on the survival and migrations of macroinvertebrates – laboratory and field experiments

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Water-level fluctuations are the most important factor affecting the living conditions of the bottom fauna in near-shore aquatic zones. Water-level drops cause temporary substratum emersions to air and drying, subjecting bottom inhabitants to environmental stress. Emerged organisms exhibit physiological or behavioural adaptations, such as following the decreasing water level or burying into substratum. Alternatively, they can survive air exposure for some time. The aim of the presented set of studies was to determine the survival as well as horizontal and vertical migrations of the most important groups of near-shore invertebrates during water level decrease and substratum drying. These goals were achieved in a series of laboratory experiments and validated by a field study.

Three laboratory experiments were conducted in tanks with sandy substratum and gradually evaporating water, resulting in the water level decrease and substratum drying. (1) Horizontal migrations were investigated on inclined tank bottoms imitating shore inclination. When the water level dropped, organisms were counted in 3 zones: (i) submerged, (ii) with infiltration water below the substratum surface, (iii) dry. (2) Burying was checked in a 15-cm layer of sand. (3) Survival was tested in trays until all individuals died. Moreover, to validate the laboratory data and relate them to the field situation, the same community was subjected to natural substratum drying under semi-natural conditions in field mesocosms.

Gastropods *Planorbarius corneus*, *Viviparus viviparus* exhibited multiple complex adaptations to water level drop and substratum drying, including high resistance to drying, as well as horizontal and vertical migrations. These species were able to migrate over a relatively long distance (ca. 0.5 m) provided the water level decreased gradually. A sudden water level reduction decreased their activity and made them stay in the emerged zone. Other species exhibited single adaptations: either horizontal migrations (gammarids *Gammarus fossarum*, *Dikerogammarus haemobaphes*) or relatively high resistance to drying (a gammarid *Pontogammarus robustoides*, gastropods *Bithynia tentaculata*, *Physa acuta*, *Potamopyrgus antipodarum*, a chironomid *Stictochironomus sticticus*). Finally, some taxa did not exhibit any adaptations to the water level decrease (a gammarid *D. villosus*, an oligochaete *Potamothrix moldaviensis*). The mesocosm experiment showed that natural drying of the surface layer of sandy sediments in summer at a moderate air temperature resulted in the total fauna mortality after ca. 24 days. It confirmed the high resistance of *S. sticticus* and very low survival of *P. moldaviensis*. This experiment allowed to estimate to what extent the survival time of organisms during emersion in the wild can be extended in comparison to laboratory results.

Our work was supported by an NSC grant NSC N N304 306840.

The influence of predatory behavior on spatial distribution of lentic water mite (Acari: Hydrachnidia) assemblages

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Predation is a biotic interaction that links water mites to different taxonomic groups and life stages of benthic invertebrate communities. Diptera larvae (Chironomidae, Ceratopogonidae) and microcrustaceans (Cladocera, Copepoda, Ostracoda) are determined as most common water mite prey preferences. Although these predation interactions are known from observations and *ex-situ* investigations, the distribution patterns and co-occurrence of water mites and their prey in littoral lentic habitats are not well known. Our goal was to determine if predation was a significant driver in water mite assemblage composition and distribution. Samples were taken from at least two littoral sites of twenty-one man-made lakes in the Dinaric ecoregion of Croatia (larger lakes had up to 6 sites). At every site ten samples were collected with regard to microhabitat composition and shore slope (depth). In total 490 samples were taken. On a longitudinal benthic profile (shoreline to one meter depth) of the littoral zone water mites showed no specific tendencies of grouping according to neither depth ($p > 0.05$), nor microhabitat composition ($p > 0.05$) but rather to other invertebrate groups they are known to prey on. Water mite abundances were found to positively correlate with those of Cladocera, Copepoda, Ostracoda, Ceratopogonidae, Chironomidae ($p < 0.05$). Abundance values were $\log(x+1)$ transformed and tested for regression patterns, with the prey groups representing independent variables and water mites representing dependent variables. The strongest regression was found between water mite and chironomid abundance followed by microcrustations, which is in concordance with *ex situ* research. No regression was determined between Ceratopogonidae and water mite abundances. Predation was determined as a key biotic interaction, governing both spatial distribution and the composition of water mite assemblages.

Environmental gradients and competitive interactions between indigenous and invasive amphipods can lead to stable invasion barriers

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Invasive species pose a threat to native biodiversity by changing ecosystem function, food web structure and engaging in competitive interactions with indigenous species. The invasive amphipod *Dikerogammarus villosus*, has successfully colonized many different freshwater habitats in large parts of Europe and has been reported to have a high environmental tolerance. Field observations and laboratory experiments have revealed a potentially high impact of this species on macroinvertebrates, leading to a special interest in distribution patterns of this amphipod. Its distribution is usually restricted to larger rivers and their side branches, while smaller tributaries are rarely colonized. Somehow, the upstream distribution into small rivers is inhibited and the species seems to be replaced by indigenous competitors. In this study we use both field samplings and laboratory experiments in order to uncover the mechanism leading to such a stable distribution barrier and how environmental gradients modify competitive interactions between native and invasive species. In the field, we measured longitudinal changes of environmental gradients and concomitant changes in abundance and isotopic niches of *D. villosus*, the native *Gammarus pulex* and the indigenous *Gammarus roeselii* in three German streams. Furthermore, we studied interference competition between these species in relation to environmental factors in laboratory experiments, especially with regard to ammonia concentration. Our results shed light on cause-effect relationships between environmental factors and the outcome of competition for food, resources and habitat. These findings contribute to a broadened knowledge regarding the establishment of invasive species which might improve preliminary risk assessment related to the potential further range expansion of *D. villosus*.

How different anthropological impacts affect benthic macroinvertebrate assemblages in the same water body type – preliminary results of a case study on cross-border territory (NW Bulgaria/NE R. Macedonia)

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In the last 20 years the majority of European countries intensively develop evaluation systems of freshwater water bodies as the main objective include the assessment of water quality through the biological elements, including benthic macroinvertebrates. Based on this practice the aim of this study was to provide indicative ecological status assessment of mountainous and semi-mountainous streams which belong to a poorly studied area (a Macedonian-Bulgarian cross-border territory). The focus was on several indices for benthic macroinvertebrates according to the requirements of the EU Water Framework Directive (WFD).

The sampling was conducted in October 2017 at 8 sites at Macedonian and 14 sites at Bulgarian territory, from mountainous and semi-mountainous streams of the Struma River Watershed. The bottom macroinvertebrate specimens were collected with hydrobiological hand net (mesh size 500 µm) applying kick&sweep multihabitat procedure. For indicative ecological status assessment the following metrics were used: Biological Monitoring Working Party (BMWP), Average Score Per Taxon (ASPT), Irish Biotic Index (IBI) and EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa richness. Furthermore, Canonical Analyze (CA) was applied in order to display the variation between/or within the samples most efficiently.

During this study the water quality of the examined sites was assessed from excellent to moderate (I - III class). The most of the studied rivers from Macedonian and few from Bulgarian territory do not achieve a good ecological status due to hydromorphological/habitat degradation (damming/hydropower stations) and/or organic/anthropogenic pollution. Predicting that presence of any kind of habitat degradation or pollutants at any level causes observable changes over benthic composition in the studied sites, the obtained faunistic data were compared with those from non-affected natural sites. The diversity and abundance of Ephemeroptera, Plecoptera and Trichoptera as the most sensitive groups are discussed. The results from the statistical analyses are also commented.

Our results contribute to the knowledge on the current ecological state of some rivers in a poorly studied area and assist the selection of appropriate metrics for water quality assessment based on macroinvertebrates as BQE.

This study was supported by project №DFNP-17-108/28.07.2017 “Implementation of biotic indices BMWP and ASPT in order to evaluate the ecological status of mountain and semi-mountain rivers from the 7th Ecoregion (Eastern Balkans)”, funded by Bulgarian Academy of Science.

A quantitative review on experimental stream systems

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Experimental streams are bounded and partly enclosed experimental units that closely simulates some aspects of natural stream ecosystems. Our general objective is to support practicing stream ecologists in designing experimental streams and in performing studies in them. Particularly, we provide a comprehensive summary on the design and protocol of studies applying experimental streams. We identify also essential but unpublished parameters of designs and protocols in order to improve our research field. Specifically, we examined the following questions: (1) How are experimental streams designed? (2) Is there any connection between the design and the organism studied? (3) Is there any relationship between the research topic and the study organisms? (4) Is there any temporal change in the design or in the protocol? (5) Are experimental designs and protocols properly documented?

We found that the majority of experimental stream studies were done in North America and Europe, mostly in outdoor stream systems. Not surprisingly most studies were performed in linear shaped experimental stream systems (about 85%), but circular (about 10%) and other shapes do also exist. We found that macroinvertebrate, fish and algae are the most frequently used study organisms. Our results showed that fish were mostly used in testing the effect of invasion and biotic interactions, while algae in testing the effects of light manipulation. We observed an increasing number of studies dealing with experimental stream systems. Finally, we identified a list of important, but inadequately documented information on experimental stream systems and experimental protocols.

Inter- and intraspecific chemical communication between native and alien gammaridean species (Amphipoda: Crustacea)

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The invasion of amphipods and the consequences to native ecosystems is a recent discussed topic in limnology. A so far not observed mechanism of invasion is species displacement through interspecific chemical communication with native species. Using *Echinogammarus berilloni* as example, a species that originates from the Basque country and dispersed over France to the Benelux countries and Germany, it was experimentally tested in how far the activity of native und invasive species change by excretion of waterborne chemical cues. As native amphipods in the experiment, *Gammarus pulex* and *Gammarus fossarum* were used, the main natives of rivers and brooks in North - West Germany.

To test the activity, video tracking experiments were conducted with single specimen combinations of native and invasive amphipods. Small glass cubes were divided by a double mesh to two compartments, wherein different combinations of sex and species were tested. The tracking analysis revealed different activity patterns of the species over time, and differences in activity between intraspecies and interspecies setups with a strong gender specific impact to activity. In general, it was shown, that the presence of *E. berilloni* leads to a decrease in activity of the native species, whilst the activity of *E. berilloni* is hardly influenced by possible interspecific chemical cues, which indicates that *E. berilloni* uses chemical cues as allomones to displace *G. pulex* and *G. fossarum*.

Species and trophic structure of macrozoobenthos community in the different types of littoral zone in mesotrophic lake

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The data on species richness, abundance and trophic patterns (feeding type) of macrozoobenthos community were used for comparative analysis for the different types of littoral zone in mesotrophic Lake Obsterno (Republic of Belarus). The littoral zone was divided on three types: silted sand littoral with *Chara sp.*, with rush (*Scirpus lacustris*) and lily (*Núphar lútea*) beds. The samples were collected during May-September in 2016-2017. These biotopes also differed in the type of bottom sediments. The data were analyzed by different beta-diversity indexes and by feeding type of species for sampling dates. The cluster analysis (Bray-Curtis similarity) used for comparison of the different date and biotops.

The differences in the similarity of macrozoobenthos communities between studied biotops are more expressed by feeding type to compare with beta-diversity indexes. This is due to changes in abundance of active filter feeders (*Dreissena polymorpha* and *Pisidium subtruncatum*) and collectors (*Chironomidae*) in studied biotops. Maximal abundance active filter feeders were obtained for silted sand littoral while abundance of collectors in this type of littoral in most cases was minimal. The reasons of these differences are discussed.

Trophic behavior of native and invasive populations of Ponto-Caspian mysids

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Ponto-Caspian mysids were introduced into many temperate ecosystems as high-quality fish food. Such introductions often developed into invasions followed by varying trophic impacts. Predicting trophic impacts of invasive planktobenthic omnivores warrants knowledge concerning plasticity and determinants of their trophic behavior.

Using a stable isotope approach, we estimated the trophic niches of two invasive mysids, *Paramysis lacustris* and *Limnomysis benedeni*, inhabiting 9 lentic ecosystems which included historically inhabited (SW Ukraine) and invaded (SW Ukraine and Lithuania) water bodies. We expected that due to release from intraguild competitors, the mysids exploited a wider trophic niche in invaded ecosystems. We also tested water body morphometry (differentiation in spatial origin of food resources), productivity (food availability) and stoichiometry of suspended particulate organic matter (nutritional value of basal food resources) as potential determinants of mysid trophic behavior.

We indeed found that trophic niches of invasive populations were significantly wider due to higher propensity toward predatory behavior and more diverse spatial origin of exploited resources. Earlier ontogenetic shift towards predatory behavior could have resulted from lower intraguild diversity in invaded ecosystems. However, predatory diet also appeared to be stimulated by low N:P. In invaded water bodies, which were consistently deeper, mysids were able to exploit more resources of pelagic/profundal origin. High C:N was found to encourage this switching to additionally available resources.

To conclude, introductions of Ponto-Caspian mysids may lead to unexpected consequences due to widening of their trophic niche. Predictions of their trophic behavior and impacts should thus integrate knowledge on diversity in spatial origin of available food resources, presence of intraguild competitors, and nutritional value of basal food resources.

First European record of *Cladogonium* sp. parasitic algae common in Taiwanese ornamental shrimp breeding farms and its invasive potential on European crustaceans

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Freshwater Shrimps of *Neocaridina* genera are valuable, ornamental animals in aquarium hobby. Thanks to the wide variety of colours their popularity rose around the globe along with the development of many farms of those invertebrates. Unfortunately seminatural culture of ornamental shrimps creates perfect multiplying conditions for many epibionts among them many species are parasitic.

Ornamental shrimps from Taiwanese seminatural farms intended for export to European countries have been examined. First observation of parasitic algae of *Cladogonium* genera off the Japanese islands was described with detection of them in invertebrates exported to European countries. Additional observations were made in aquarium conditions and statistical analysis allowed to determine parts of the body most prone to infections, of which pleopods were the most common. The research proved occurrence of the infection in crayfish of *Cherax* and *Procambarus* genera as a result of their residing in environment along with infected shrimps.

Due to the presence of both types of researched crustaceans in European inland waters including thermally contaminated waters, there is a high risk of the introduction of a new species of parasite liable to endanger native crustaceans.

Benthic macroinvertebrates as indicators of stream intermittency

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Due to the ongoing climate change which brings unbalanced summer precipitations together with higher evapotranspiration related to rising temperatures, there is an increasing risk of stream intermittency in the temperate zone. Mediterranean region inhabit many species which are well adapted to stream drying due to long term persistence in conditions of natural flow instability. However, the species with such preadaptations that enables survival in repeatedly drying streams can be found even in Central Europe. The populations of drying adapted taxa can raise their abundances in intermittent streams comparing to typical perennial stream.

Our study was conducted on streams of Strahler orders 2-4 within the area of Czech Republic. We classified studied streams to three categories – perennial, near-perennial (dry episode <7 days) and intermittent (dry episode >7 days) in respect to the flow permanence. The 3-min multihabitat kick samples of benthic macroinvertebrates were taken in autumn and spring season. The taxonomic composition of the assemblages were analysed and indicator species analysis was performed in order to reveal the species with significant relationship to stream intermittency. More than 20 taxa from different taxonomic groups were identified as typical indicators of intermittent streams. These taxa dispose of different strategies to survive stream drying. For example they have resistant stages like a diapausing eggs, larvae or adults. Also the temporal fauna inhabiting intermittent streams have frequently synchronized emergence before flow cessation to avoid the dry period. However, in some taxa survival mechanism is not obvious and has to be studied in future.

The study was supported by INTER-COST project INTER-EXCELENCE (MSMT LTC17017).

Comparing spring and stream section in tufa depositing system

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Considering macroinvertebrate's inevitable role in energy flow of ecosystem, they are regarded excellent indicator of total ecological condition. Perceiving and researching both the community structure and biology of specific taxa therein, is fundamental for understanding the complex interactions within ecosystem. Accordingly, the aim of our research was to define and compare macroinvertebrate communities at the spring and at the tufa barrier of Plitvice Lakes (Croatia). Both sites are part of the karst landscape: a cool and environmentally stable, rheocrene spring of Bijela rijeka and a dynamic limestone depositing site at the tufa barrier Labudovac. Secondly, we aimed to determine the size structure and the secondary production of the dominant taxa. Physicochemical parameters of water were stable at the spring site and expectedly fluctuated at the tufa barrier. The most abundant taxon at the tufa barrier was non biting midges whilst stoneflies were dominant at the spring site. Since non biting midges are currently identified to family level, further ecological analyses were not advisable so we focused on the stoneflies. Stoneflies from both sites predominantly belong to *Protonemura* genus. After measuring the width of head capsules, using Scott's formula we found that *Protonemura* develops over a 14 stage cycle and individual mass 83 times during the life cycle. Secondary production calculated using the Size-frequency method was approximately 5 g per m²/year.

The surrogacy potential of pond-dwelling dragonflies in Central Europe

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Small and shallow standing waters (ponds) comprise a major part of continental waters in Europe, significantly contribute to the aquatic biodiversity at the landscape level and offer refugia for many rare and threatened species. Successful conservation and management programs of such abundant, diverse and heterogeneous ecosystems inevitably call for rapid assessment tools and short-cut approaches such as surrogate species. The concept of surrogate species assumes that particular species or group of species (flagships, indicators and umbrellas) are used as proxies for environmental conditions or other taxa that are too difficult or costly to assess directly. Odonata represent a prime example of flagship group helpful for the promotion of awareness and conservation fundraising. However, their indicator and umbrella potential seems to be rather questionable and hard to generalize. Here, we examined surrogacy potential of dragonflies using environmental data and macrophyte data from 91 Central European ponds that span a broad range of habitat conditions along an altitudinal gradient of 1550 m. Specifically, we quantitatively tested the effectiveness of dragonflies as indicators of environmental health, indicators of biodiversity and umbrella species. For this purpose, we used 6 variables representing pond environment (temperature, depth, pH, phosphates, conductivity), three odonate taxa as surrogate groups (all Odonata, Anisoptera, Zygoptera) and tree macrophyte groups as targets (all macrophytes, helophytes, hydrophytes).

Among 36 recorded dragonfly species, nine species were identified as significant habitat specialists. These species showed relatively narrow niche breadths which is an important prerequisite for being considered as useful health indicators. Considering biodiversity indicator potential, we did not find any significant relationship between species richness of investigated dragonfly and macrophyte groups and only a weak evidence for covariance in composition of communities. Finally, potential of threatened dragonflies as umbrellas saving co-occurring threatened macrophytes was rather negligible at both group level (non-significant relationships between diversities of umbrella and target macrophyte groups) and species level (occurrence of a waste majority of examined umbrellas did not provide better potential protection than random selection of sites). We can conclude that pond-dwelling dragonflies showed weak potential for being good biodiversity indicators or umbrella species. However, some species may serve as useful indicators of environmental health.

This work was supported by the Slovak Research and Development Agency (APVV-16-0236) and by the Slovak Scientific Grant Agency (VEGA 2/0030/17). RJG received Institutional support of the Institute of Entomology (Biology Centre of Czech Academy of Sciences): RVO: 60077344.

Thriving through the Ice Age: the surprising story of a freshwater isopod crustacean

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The extant European fauna have been shaped through ages by geological and climatic processes: beginning from the breakup of Laurasia, through continentalisation via orogeny and desiccation of large water bodies, to severe climatic shifts during Pleistocene and recent warming during Holocene. It is commonly believed, that the greatest influence on phylogeographic pattern within modern taxa had Pleistocene glaciations, dispatching most of the species to the southern refugia, where populations diverged in allopatry and in interglacials migrated northwards. Though, it was also proven, that large portion of intraspecific genetic structure is of pre-Pleistocene origin. An example of a freshwater species with deep lineage divergence is *Asellus aquaticus* – a common isopod crustacean, widely distributed nearly in the whole Europe and found in almost all types of freshwater habitats. Its colonization success is due to adaptive abilities, such as high resistance to desiccation and wide tolerance to harsh climatic conditions. The previous phylogenetic studies suggest that this taxon is actually a conglomerate of numerous cryptic species (distributed predominantly in the Southern Europe). On the other hand, one of them – an equivalent to the nominal subspecies *Asellus aquaticus aquaticus* – occurs in the vast area of post-glacial Europe and it is the one with the greatest colonizing potential. In this study we focused particularly on this subspecies, using molecular data from numerous extra-Mediterranean populations. We aimed in revealing in depth the level of genetic diversity, the geographical population structure, historical and present demography, migration patterns and the presence of possible northern glacial refugia. Despite the fact that in general there is lack of spatial genetic structure, we found two different phylogeographic stories involved. Firstly, the periglacial areas (Northern Balkans, Pannonian Basin, Pontic Coast) are inhabited by numerous diversified haplotype groups, that originated in the Pleistocene and suffered by significant population decline during the Last Glacial Maximum (LGM) (25-17 kya). This is just in the opposite that we have preliminary hypothesized, as periglacial region was expected to provide glacial refugia for *A. a. aquaticus*, where the post-glacial recolonization of Northern Europe would begin. On the contrary, the proglacial area (close to the glacier margins, north of the Alps, Sudetes and Carpathians) is occupied by large and widespread group of closely related haplotypes, that raised in Pleistocene and thrived continuously through the LGM – probably in vast network of proglacial lakes and rivers, which played a crucial role in maintenance of genetic diversity, population growth and high dispersal rate. In formerly glaciated areas, along the longitudinal axis, the population genetic structure is absent. The evidences of recent sudden population expansion and surprisingly high migration rate southwards were found.

The enigmatic copepod *Hemidiaptomus amblyodon* and its endangered temporal habitats

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Temporal vernal pools are inhabited by unique invertebrate fauna, including many specialized crustaceans. The calanoid species *Hemidiaptomus (Gigantodiaptomus) amblyodon* (Marenzeller, 1883) is one of the most conspicuous freshwater crustaceans, typical of its large size (up to 5 mm), dark blue color and bright red egg sacs. This Euro-Siberian species is an inhabitant of alluvial vernal pools in larger river floodplains, and in the eastern part of the Czech Republic it reaches its most western distribution. The natural habitats are strongly endangered by river floodplains degradation, agri- and aquaculture and climate change, making occurrence of the species rare. Only recently, we have newly recorded the species also in several pools on agricultural fields, which up to now had been completely overlooked habitats. Despite the species' attractiveness, we still know only a little about its biology and ecology. It probably occurs only in some years but the responsible environmental factors are not exactly known yet. In inhabited pools, this species is usually accompanied by other important rare taxa of temporal waters, including the fairy shrimp *Eubbranchipus grubii*, tadpole shrimp *Lepidurus apus* or clam shrimp *Cyzicus tetracerus*. Thus, *H. amblyodon* might be used as an indicator species for the seedbanks of endangered invertebrate assemblages. Our study shows that the overlooked periodically flooded ephemeral pools on arable soil may serve as a refuge for threatened wetland organisms in the uniform agricultural landscape. Conservation of these habitats and their unique fauna becomes an urgent challenge for the future.

The predation of *Gammarus fossarum* on non-biting midge (Diptera: Chironomidae) larvae

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Omnivory, the utilization of food resources of both plant and animal origin, is common to most aquatic invertebrates except for some specialized predators, parasites or herbivores. According to recent knowledge it does not keep away also from the freshwater shrimp *Gammarus fossarum* Koch 1835, a species traditionally considered a shredder of coarse organic matter.

Gammarus fossarum is common in central Europe in the upper courses of rivers and streams including springs, where it can reach respectable densities around 6000 individuals per square metre. Despite it is not considered a true predator, in such a high density it might exert a significant pressure on smaller representatives of benthic fauna, and larvae of non-biting midges (Diptera: Chironomidae) represent the most abundant and species rich group of the assumed prey. Chironomid larvae usually build some sort of shelters, either tubes, or even transportable cases similar to those known in caddisfly larvae (Trichoptera), but some live freely.

We carried out a set of laboratory experiments to evaluate the danger to which the larvae of Chironomidae are exposed if faced with *Gammarus fossarum* and to what extent their tubes help them to avoid its predation. According to our expectations, the transportable cases worked as the best defence, the tubes attached to the substratum had a lower protective power, and the free living species were the most vulnerable.

Interestingly, we were unsuccessful in replicating the unambiguous results in a follow-up field experiment. Possible reason may be a bad experimental design but also the rugged topography of natural environment may provide prey with much richer possibilities for hiding compared to a Petri dish. Even though *Gammarus fossarum* acted as an effective predator in the laboratory, it is still possible that its predatory effect in nature is not that strong.

However, it still holds true that if there is an opportunity, *Gammarus fossarum* takes advantage of it, just like “opportunity makes the thief”.

This study was financially supported by the Czech Science Foundation (project no. P505/16-03881S).

The effect of habitat heterogeneity and spatial extent on occupancy frequency distribution of freshwater insect species

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The positive relationship between local abundance and regional distribution of species is one of the few general patterns in ecology. Several models were developed to find the underlying processes behind this relationship and to predict the occupancy frequency distribution (OFD) pattern of species and assemblages. For example, the metapopulation model predicts bimodal OFD pattern in which species are either locally abundant and regionally widespread or locally rare and regionally restricted. Thus, bimodality indicates the main role of dispersal processes in structuring assemblage composition. On the other hand, the niche-based model predicts unimodal right-skewed OFD pattern which indicates that assemblages are under environmental control and are driven by niche processes. Beyond these earlier models other mechanisms, including the degree of habitat heterogeneity, spatial extent of sampling area, species specificity, species dispersal ability and the rate of species turnover among sites are likely to influence the shape of OFDs. Bimodality, for instance, is generally associated with sampling within a small, homogeneous area in where all species could reach all potentially available sites. Examining the OFD patterns of assemblages can be an approach to better understand the distribution patterns of species and the underlying ecological mechanisms. The high environmental heterogeneity and the hierarchically nested spatial structure make lotic systems ideal candidates for studying OFDs and their determining processes. Specifically, it is assumed that the relative role of niche and dispersal processes in structuring the community composition could vary depending on the studied temporal and spatial scale.

We examined the effect of habitat heterogeneity and spatial extent of sampling area on the OFD patterns of freshwater insect assemblages in temperate, near-pristine streams in the Mecsek Mountains (Pannon Ecoregion). We compared the form of the OFDs of insect assemblages inhabiting homogeneous and heterogeneous habitat patches along increasing spatial scale (from reach to regional scale) keeping the sample number constant.

We revealed differences in the form and modality of OFDs between two types of habitat patches at small spatial extent. However, this variation in the OFD pattern decreased towards large, regional scale. Bimodal or uniform patterns were detected for homogeneous habitat patches at reach and segment scale implying the importance of colonization-extinction dynamics in structuring assemblages. While, these patterns gradually became unimodal right-skewed as the spatial scale and habitat heterogeneity simultaneously increases as a function of niche-based differences and dispersal limitation.

Dragonfly fauna of calcareous fens in middle-eastern Poland

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Dragonflies of the calcareous fens, which are protected as nature reserves in most cases, were studied in the years 2007-2009 and 2015-2017. Fens located in Garbatówka (51°21'N, 23°6'E) and near of Chełm (51°8'-51°9'N, 23°29'-23°41'E) were investigated in dry and moist periods considering habitat variables and biodiversity.

We recorded 48 spp. of dragonflies: 38 spp. in 2007-2009, 39 spp. in 2015-2017: 19 spp. occurred in both periods. Between periods the differences in species richness were small, however, the decrease in species richness of particular sites was large. Hydrologically untransformed fens in nature reserves and peat excavations proved to be the most important for the protection of dragonflies.

Our data shows that the maintaining the continuity of natural habitats is a key factor for dragonflies. The presence of peat excavation is an important additional factor favouring these insects, especially in habitats susceptible to drying out. These secondary habitats should be considered as a tool for conservation and protection of dragonflies and other environmental elements.

The first comprehensive application of TR-BMWP to evaluate the habitat quality of some streams in ecologically different areas of Turkey

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Fundamentally, the concept of biotic index combines the diversity concept and the indicator species concept together. Since biological communities are a product of their environment, different kinds of organisms have different habitat preferences, and some of them are pollution-sensitive species and some of them are pollution-tolerated species. Basically, biotic indices are based on this fact. For determining habitat quality of running waters, biotic indices based on benthic macroinvertebrate have been used for decades in Europe frequently. Biological Monitoring Working Party (BMWP) score system is of the most used and preferred biotic index among the other biotic indices, such as ASPT, TBI, etc. It was established in the United Kingdom in 1983 to assess water qualities of running waters. However, this index was created according to the macroinvertebrate fauna of the UK. In addition, the river systems in the UK, as an island ecosystem, are ecologically and hydromorphologically different from the other countries. To reduce these differences to minimum, some countries have adapted this index according to their benthic macroinvertebrate fauna by modifying the original BMWP.

As in Europe, BMWP has been the most commonly used biotic index for water quality and biological monitoring studies in Turkey. However, due to the fact that environmental conditions and benthic macroinvertebrate fauna of running waters in Turkey are different from the UK and Europe, the researchers have sometimes encountered incompatibilities when applying the original BMWP. To overcome these problems, a national-based biotic index (TR-BMWP) based on the benthic macroinvertebrate fauna of Turkey was established by modifying the original BMWP in 2016. TR-BMWP biotic index consists of 142 benthic macroinvertebrate families. In TR-BMWP, certain families which are absent in the BMWP were included, and scores for some families were adjusted to suit Turkish river conditions.

In this research, TR-BMWP was applied to some streams in ecologically different areas of Turkey along with the original BMWP and the other BMWP versions such as Spanish Hungarian, Polish, Czech and Greek versions to evaluate habitat quality of the streams. In addition, some diversity indices were also applied. As a result, TR-BMWP scores of the sites were compared with the other BMWP versions, and habitat qualities of the collecting sites were determined.

Geographical ranges and species concepts in leeches (Annelida: Hirudinida)

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The importance of historical, geographical and environmental factors, interspecific competition, and hybridization for speciation and range formation in leeches was investigated and analyzed. The results regarding patterns of distribution, reproductive biology and phylogeography indicate different mechanisms of range formation in species with terrestrial stages in their life cycles and in species that are exclusively aquatic. Speciation and range formation of the species (e.g. *Erpobdella* spp.) that do not have the ability to spread on the land have occurred under the effect of historical factors: the emergence of geographical barriers in the past. Their ranges are restricted by drainage basins and mountain systems. The species with terrestrial stages in their life cycles (*Hirudo* spp.), vice versa, have been affected by various ecological factors (e.g. climate and interspecific competition). That has resulted in their belt-like ranges that extend from the east to the west and correspond to major terrestrial landscapes. Invasions of a few leech species (*Helobdella* spp.) have caused their worldwide distribution patterns and led to some taxonomic puzzles.

The polytypic species concept has been reconsidered. A number of instances supports the concept of a local species. It has been found that geographical morphs and varieties are true species with rather local ranges. Molecular phylogenetic methods have corroborated the taxonomic status of a number of neglected species. On the other hand, intraspecific genetic diversity should be carefully documented and analyzed. The refugial structure of Palaearctic species might be more complicated than considered before. The mode of speciation and pattern of geographical distribution depend on many circumstances of a species' evolutionary history and biological traits that justify a variety of species concepts to apply to different taxa.

Oligochaetes are not only indicators of trophic level

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Aquatic oligochaetes are used for water quality assessments and their abundance are often regarded as characteristic for eutrophication. Most freshwaters in The Netherlands are eutrophic, but may still differ in their community. Nutrients are a necessary condition, but as nearly all surface waters are eutrophic, differences in species composition cannot be explained by trophic conditions alone. Food availability, sediment composition, available substrates, hydrological conditions, temperature and reproduction period also define the oligochaete community.

For many species the concentration of nutrients in the water column doesn't matter, unless when high productive ($> 2 \text{ mg P}_{\text{tot}}/\text{l}$). Some Naidid species benefit from the high algae supply, but only a short period of time during their reproduction period (usually spring). Sediment and other available substrates are most important. If sediments are homogeneous then they will tend to be poor in number of species. *Limnodrilus hoffmeisteri*, *L. claparedianus* and *Ilyodrilus templetoni* are usually the only species present in silty substrates and *Psammoryctides barbatus*, *Potamothrix moldaviensis* and *Spirosperma ferox* appear when it is mixed with sand. In high currents, silt is washed away in the thalweg and this community is also species poor (*Propappus volki*, *P. moldaviensis*), but in adjacent areas with less current and silt deposition previous species appear. In places with filamentous algae there are many Naidids (*Ophidonais serpentina*, *Stylaria lacustris*, *Pristina*) and in places with hard substrates covered with algae (rocks, boulders and wood) other species occur (e.g. *Nais bretscheri*). In all cases, the hyporheic zones are of utmost importance. Groundwater is a refuge for species for food and unsuitable temperature (regime) of the surface waters. Surface water temperature and the connection with the hyporheic zone determine the community to a large extent. It also explains why some species appear in ephemeral water bodies or apparently strange habitats. The presence of a thick silt layer or clay can be a barrier for these exchanges. As species are temperature sensitive the reproduction period may vary with year and geographical region (on world-wide scale). Temperature also regulates the vertical migration between surface and subsurface.

Therefore, Oligochaetes are not only indicators of trophic level, but also of habitat heterogeneity and good hydrological circumstances. A high diversity within a eutrophic habitat can only be reached when there is a large variation in substrates.

DNA metabarcoding from sample fixative as a quick and voucher preserving biodiversity assessment method

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Metabarcoding is a powerful tool for biodiversity assessment and has become increasingly popular in recent years. Although its reliability and applicability have been proven in numerous scientific studies, metabarcoding still suffers from some drawbacks. One is the usually mandatory destruction of specimens before DNA extraction, which is problematic because it does not allow a later taxonomic evaluation of the results. Additionally, metabarcoding often implements a time-consuming step, where specimens need to be separated from substrate or sorted in different size classes. A non-destructive protocol, excluding any sorting step, where the extraction of DNA is conducted from a samples fixative (ethanol) could serve as an alternative. We test an innovative protocol, where the sample preserving ethanol is filtered and DNA extracted from the filter for subsequent DNA metabarcoding. We first tested the general functionality of this approach on 15 mock communities comprising one individual of eight different aquatic macroinvertebrate taxa each and tried to increase DNA yield through different treatments (ultrasonic irradiation, shaking, freezing). Application of the method was successful for most of the samples and taxa, but showed weaknesses in detecting mollusc taxa. In a second step, the community composition detected in DNA from ethanol was compared to conventional bulk sample metabarcoding of complex environmental samples. We found that especially taxa with pronounced exoskeleton or shells (Coleoptera, Isopoda) and small taxa (Trombidiformes) were underrepresented in ethanol samples regarding taxa diversity and read numbers. However, read numbers of Diptera (mainly chironomids) and Haplotaxida were higher in ethanol derived DNA samples, which might indicate the detection of stomach content, which would be an additional advantage of this approach. Concerning EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa which are decisive for the determination of ecological statuses, both methods had 46 OTUs in common with 4 unique to the ethanol samples and 10 to the bulk samples. Results indicate that fixative-based metabarcoding is a non-destructive, time-saving alternative for biodiversity assessments focussing on taxa used for ecological status determination. For a comprehensive picture on total biodiversity, the method might however not be sufficient and conventional bulk sample metabarcoding should be applied.

The influence of anthropogenic stressors on littoral benthic macroinvertebrate communities in man-made lakes

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Reservoirs are heavily modified lentic waters, usually derived from lotic habitats. They are complex systems that represent a transitional ecosystem between lakes and rivers with substantial ecological impact on not only the remaining lotic habitat but also the surrounding terrestrial ecosystem. Specific macroinvertebrate communities, usually consisting of high ratios of resilient euryvalent taxa, inhabit these artificial lentic habitats. Our goal was to test how anthropogenic abiotic factors such as land cover, water fluctuations, and littoral zone depth (slope) influence benthic macroinvertebrate community composition.

Macroinvertebrate communities were studied at 15 reservoirs located in the Pannonian ecoregion of Croatia. Prior to sampling at each reservoir, sites with both “more natural” and “less natural” shorelines were selected. The sampling site covered 25 m of lakeshore length up to a distance of 10 m towards the open water, or to a point where the depth of water surpasses 1 m, depending on the steepness of the shore. Four levels of depth were defined: 0 to 0.25 m, 0.25 m to 0.50 m, 0.50 m to 0.75 m and 0.75 m to 1.00 m and ten samples were collected using a 25 × 25 cm benthos hand net (500 µm mesh) at each site.

Non-metric Multidimensional Scaling Analysis (nMDS) of littoral benthic macroinvertebrate community similarities between reservoirs showed clustering of locations with similar water level fluctuations. One group consisting of reservoirs with water fluctuation above, and the other one with water fluctuation less than one meter. Differences in community composition between these two groups of reservoirs are due to the macroinvertebrate community's ability to adapt to rather harsh conditions of habitats that remain after the water is withdrawn or abruptly inundated. Land cover of the catchment area was examined in relation to the macroinvertebrate community species richness, abundance and alpha diversity. Increased ratios of intensive agricultural surfaces in the catchment area were positively correlated with species richness and alpha diversity ($p < 0.05$). We assume that the nutrient intake in reservoirs coming from the catchment area provided additional food sources that supported more diverse communities but was not as excessive as to cause disturbances in terms of algal blooms. A positive correlation between species richness and deeper parts of the littoral zone was found ($p < 0.05$). This is because, in deeper parts, there are fewer disturbances associated with water fluctuation, wind power, daily temperature ranges, which makes this habitat more stable for macroinvertebrates.

A new insight into the phylogeny and biogeography of the subterranean *Niphargus virei* clade (Amphipoda: Niphargidae) in Western Europe

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Ground water is the main reservoir of unfrozen freshwater, widespread across all continents. As it is difficult to access, its fauna is often overlooked. With over 400 species, the Niphargidae are one of the families with the greatest species richness in groundwater. With a length that reaches 40 mm, *Niphargus virei* Chevreux, 1896, is one of the biggest species. It was described from the French Jura and found later in the Netherlands, Belgium, Switzerland, Germany (Saarland) and the French regions Grand Est, Bourgogne-Franche-Comté, Auvergne-Rhône-Alpes and Occitanie. Other records from Germany are to be referred to *N. enslini* S. Karaman, 1932. In 2006, a phylogenetic analysis of *N. virei* was performed for the first time. Three main clades with several subclades were identified. Species were neither defined nor described.

During a project carried out at the Université libre de Bruxelles, 457 specimens from 32 sites were collected. 56 sequences of a fragment (over 1,000 bp) of the nuclear 28S ribosomal gene and 40 sequences of the mitochondrial COI gene (Folmer fragment, 558 bp) were obtained. Sequences were independently analysed using maximum likelihood and Bayesian methods. Molecular Operative Taxonomic Units (MOTUs), which could represent cryptic species, were detected using threshold, ABGD and bPTP methods. A calibrated timetree was obtained using MEGA software.

Comparing 28S and COI phylogenetic trees gave highly congruent results. The *N. virei* complex resulted to be monophyletic. The split of the *N. virei*-clade from other niphargids was estimated around 55 Ma, while the first split within the *N. virei* clade dates back to 24 Ma. Four of the MOTUs were geographically delimited without overlap: one cryptic species was found in Belgium and in the Netherlands, a second one from Saarland (Germany) to the French Lyonnais, a third one in Switzerland and the Northern part of the French Jura, and finally one putative cryptic species in the South of the French Jura.

More difficult to be interpreted was the situation in the Cevennes, where both markers indicate clearly the co-existence of several MOTUs, some of them co-existing in the same collecting site. Depending on the species delimitation model used, the definition of the number of species allowed a wide range of interpretation.

We decided to formally describe the new species in a forthcoming paper and name them including the cryptic ones to make them easily accessible to researches of non-taxonomic disciplines, like ecology, biogeography, and cave protection.

The attendance of Dieter Weber in the 3rd CESAMIR 2018 was supported by the COST Action CA15219 DNAqua-Net within the ITC conference grant.

The vegetarian side of the killer shrimp

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Dikerogammarus villosus is a very successful invader in European Rivers and assumed to affect biodiversity and food web structure of the invaded ecosystems, especially due to its predatory life style. However, since several field studies suggest that *D. villosus* often acts as primary consumer in river ecosystems, this side of its life style will be explicitly covered in this talk. It is proposed here that the invasion of *D. villosus* induced a shift in feeding type composition and thereby a change in food web structure. Stable Isotope analyses indicate that *D. villosus* uses leave litter to a relatively large extent and due to its high densities it represents an important shredder. We performed a field mesocosm experiment in three different rivers and analysed the effect of *D. villosus* on leave litter decomposition rates and periphyton biomass. We found that *D. villosus* increased leave litter decomposition but did not affect periphyton biomass. In addition, we observed remarkably high consumption rates. To illustrate the potential effect on food web structure, we show the shift of feeding type composition in two rivers due to *D. villosus* invasion. Our results indicate that *D. villosus* may be a strong competitor with primary consumers in benthic food webs of invaded rivers.

Comparison of macrozoobenthos structure of shallow water environments of different types

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The aim of the research was to compare the macrozoobenthos structure of shallow lakes and old river beds and to indicate environmental factors having a significant impact on the quality and abundance of benthic fauna. The research was carried out for a several years in 13 shallow lakes in the Iława Lake District (north-eastern Poland) and in 8 old river beds of the lower River Vistula near Toruń (central Poland). All the studied water bodies are characterized by a high trophic level. Both in the lakes and old river beds three different types of sampling locations were distinguished. The first type (1) included sites where the bottom was in part covered by submerged plants. The second and third types included sites without macrophytes at the bottom, but in the second type (2) the ratio of euphotic depth to the depth of a reservoir was higher than 1, so light reached the bottom, whereas in the third type (3) the above-mentioned ratio was less than 1, so it was dark at the bottom.

Together with collecting benthic samples, selected abiotic parameters of water (transparency, light attenuation, temperature, oxygen concentration, conductivity) and bottom sediments (the amount of light reaching the bottom, water and organic matter content, sediment oxygen demand) were measured.

Both the number of taxa and diversity (Shannon index) of macrozoobenthos were higher in the old river beds than in lakes at all distinguished types of sampling sites. The density and biomass of benthic fauna at both types of sites without macrophytes were higher in old river beds, whereas at sites with macrophytes they were higher in lakes. At sites with light at the bottom (type 1 and 2) in lakes Chironomidae larvae dominated (approx. 60% of the total macrozoobenthos density), while in the old river beds Oligochaeta prevailed (50 and 55%). At sites of type 3 in both types of water bodies *Chaoborus* sp. larvae strongly dominated (approx. 80%). Among Chironomidae, at all distinguished types of sites in the old river beds *Tanytus* sp. and *Chironomus* sp. larvae were the most numerous, while in the shallow lakes different taxa dominated (1- *Tanytarsus* sp. and *Corynocera* sp., 2- *Tanytarsus* sp. and *Einfeldia* sp., 3 – *Chironomus* sp.). Among Oligochaeta, at all sites in the shallow lakes and at sites of type 3 in the old river beds *Potamothrix hammoniensis* dominated, while at sites of types 1 and 2 in the old river beds *Limnodrilus claparedeanus* and *Limnodrilus hoffmeisteri* were the most numerous.

The obtained results demonstrated that the amount of light reaching the water bodies bottom had the strongest impact upon the structure of bottom fauna.

ABSTRACTS

POSTER PRESENTATIONS

What Causes Malformations in Freshwater Sponge Spicules? - Preliminary Research in Serbian Rivers

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Freshwater sponges (Porifera, Spongillidae) owing to some of their characteristics, may be exploited as bioindicators and, as such, are becoming increasingly interesting in ecological studies. Earlier studies have shown that environmental factors have a fundamental impact on Demospongiae spicule size and shape. However, data on spicule anomalies and possible causes of their appearance are quite scarce. The present study aimed to assess the frequency of spicule anomalies in sponges from 10 Serbian rivers, in relation to the species, physico-chemical properties of the streams and presence of pollutants.

In autumn of 2017, 40 sponge samples were collected in ten tributaries of Sava and Danube rivers (Velika Morava, Zapadna Morava, Juzna Morava, Tisa, Kolubara, Porecka River, Mlava, Beli Timok, Crni Timok and Nisava). Basic physico-chemical parameters were registered at every site where sponges were found. After spicule isolation by HNO₃ digestion procedure, the samples were subjected to morphological analysis by light and scanning electron microscopy, and number of anomalies recorded. For other parameters such as heavy metals concentration, nitrates, phosphates, carbonates, bicarbonates, dissolved silicates, etc. yearly values from the Environment Protection Agency were taken into consideration.

Five species were found: *Ephydatia fluviatilis*, *Ephydatia muelleri*, *Spongilla lacustris*, *Eunapius fragilis*, and *Trochospongilla horrida*. The most frequent anomalies were: spicule bending near one end, both ends, or medially, spicules with bifurcations and spicules with bulbous enlargements. The type and frequency of spicule malformations varied greatly within the analyzed specimens. The frequency of anomalies ranged from 1×10^{-3} to 67×10^{-3} , with an average number of 12×10^{-3} . Variations were noted in main physico-chemical parameters (the conductivity ranged from 364 to 603 μ S, the temperature from 12.3 to 21.9° C, the pH from 7.2 to 8.0 and the oxygen concentration from 7.07 to 11.3 mg/l). Similarly, the levels of different metals and other pollutants surveyed in the ten rivers varied considerably, but the permitted concentrations were not exceeded. The highest number of anomalies was found in a specimen of *E. fragilis* collected at Markovac (Great Morava River) and the lowest number was found in a specimen of *E. fluviatilis* from Kanjiza (Tisa River). Although the two “antipode” sites exhibited some differences in concentrations of bicarbonates, Fe, Cr, Ni, Mg, etc., none of the registered concentrations reached Intervention Values.io

From the present study it can be speculated that the propensity of sponges to display aberrant spicules will mostly depend on the species. Besides species-specific intrinsic factors, some exogenous factors are obviously also needed for the development of aberrant spicules, but it remains unclear what these environmental factors are. Some species seemed more tolerant than other to changes of water physico-chemical parameters.

Plecoptera distribution and diversity in the selected streams of the Tatra National Park

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Stoneflies (Plecoptera) are a small but important group of insects. Due to their sensitivity to water quality, they are commonly used as bioindicators. As stoneflies are known to be the most diverse and abundant in the mountains, they were chosen to be one of the first objects of the project "The macrozoobenthos of the Tatra National Park streams" conducted in 2012-2015.

We examined Plecoptera assemblages from the Chochołowski Stream, Roztoka Stream and Sucha Woda Stream together with the headwaters areas. 5-6 sites, representing different altitudinal zones, were chosen at each stream. The sampling took place monthly from June till September 2014 using the standard kick-net sampling method for collecting larvae as well as an entomological net for collecting imagines.

The collected material consists of a total of 4980 individuals from 6 families. Stoneflies from three families (Perlodidae, Leuctridae and Nemouridae) were identified to the species level. The study allowed to map their spatial and altitude distribution ranges in the area of the Tatra National Park. The structure of domination at each site, including the trends of its changes along the studied streams, was also calculated. The biodiversity was estimated by the Margalef index, Pielou Index and TDI. The data allowed to perform the preliminary phenology analysis as well as the estimation of the assemblages similarity and co-occurrence of taxa.

Despite the fact that the study was based only on the morphological identification of Plecoptera, it provides a very important contribution to the knowledge about stoneflies of Central Europe. With the limited time, means and people for sampling and preserving the material, the study could not have been conducted on such a scale that would allow molecular analyses. We believe, however, that our results will provide a base for future studies in this important region.

Macroinvertebrates in small rheocrene springs – sampling and diversity indexing

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Springs are spatially restricted habitats of high biodiversity and conservation value. In most studies, sampling of springs has typically been undertaken over one season, which has raised the question what the most suitable time(s) to undertake sampling it. In this study, we report the results of macroinvertebrate samplings performed in the course of two springs, each surveyed monthly, with the use of a Surber net, in order to determine the most appropriate time to undertake sampling to characterise biodiversity. Diversity indices have revealed that the community of fully aquatic taxa of the studied springs exhibits the highest values in the winter. Insect assemblages remain also more diverse than those of fully aquatic invertebrates. Our study has revealed that the most diverse assemblages in both studied springs appear in February, while the most taxa-rich assemblages are found in the summer and autumn. The results of SIMPER analysis have revealed that when all the assemblages were analysed, the winter communities were the most dissimilar to each other and also to other seasons. However, when *Gammarus balcanicus*, the dominant taxa of the studied spring assemblages, was excluded, this pattern was blurred. The air temperature and conductivity are recognised as the main drivers of phenological changes in communities. In conclusion, our results illustrate that 1 – multiple surveys covering more than one season provide the most comprehensive picture of total biodiversity, and 2 – the most appropriate time to characterise the macroinvertebrate community in small rheocrenes is during the winter and the late summer.

Lessons learned in lab experiments on habitat selection and intraspecific competition of *Aphelocheirus aestivalis* (Fabr.) (Heteroptera: Nepomorpha)

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The final structure of a community or even a population is mostly pre-defined by physical, chemical and hydrological features of the habitat. In small spatial scale, biotic impacts also determine the realized success of species and also can be considered as filters on the population structure and also on the local community composition. Actually, intraspecific competition is likely to be the most important process shaping spatial microdistribution pattern of a population. Our field observations suggest that the larvae and adults of *Aphelocheirus aestivalis* can be found under different microhabitat conditions. The proportion of larvae is higher in muddy, and lower in stony bottom and vice versa in case of the adults. However, it is not clear whether these differences in microhabitat use is induced by real differences in microhabitat preference of adult and larvae, or the adults coerce larvae to move to less suitable microhabitats. The main questions of our study are: Is there any difference in microhabitat selection among the larval stages and adults in the case of single occurrence? Can we see any changes in microhabitat preference in the case of coexistence of larvae and adults? As a starting point, using an artificial stream system, we set up an initial experimental design to collect basic information within a series of pilot experiments, and we addressed further, mostly technical questions: What time is needed to run the experiments? What kind of movements can be detected? How could we follow the movement of animals? How many individuals should be placed into the stream system to see a real microdistributional pattern? How many individuals could we recapture? How could we perform the sampling? How could we keep the individuals inside the stream system and how to prevent escapes?

The results of the pilot study partially support the field observation. It seems reasonable to assume, that adults prefer the larger particle sized substratum, while the larvae inhabit more likely the muddy section as the result of intraspecific competition. However, all stages prefer habitat with larger particle sized substratum in the case of single occurrence. Further investigation is needed to shed more light on the underlying processes that determine the microdistribution of the species.

Composition and diversity of chironomid assemblages in a heavily human-impacted stream in South Hungary

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Recently, the loss of biodiversity due to habitat degradation is one of the most important problems of freshwater ecosystems. It is especially true in the case of small watercourses, which are influenced by a wide range of human activities. Chironomids, a major insect group in freshwaters, are good indicators of habitat quality. However, our knowledge on the chironomid assemblages in human-impacted streams is still limited. The Pécsi-víz is one of the main watercourses in South Hungary. It suffers from strong human impacts because it is a regulated stream running through inhabited and agricultural areas in its whole length. In lack of previous data we hypothesized that the chironomid assemblages of the stream might be poor in species and characterized by low diversity. In 2017, chironomid samples were taken at three characteristic sections of the Pécsi-víz: an upper (PTR), a middle (ZOK) and a lower (KEM) section. Drifting pupal exuviae were collected according to Chironomid Pupal Exuviae Technique (CPET). Considering the phenological characteristics of chironomids, samplings were carried out three times, in spring (30th of April), in summer (4th of August) and in autumn (21th of October). Altogether 63 species belonging to five subfamilies were identified from 3479 collected exuviae. One species, *Linnophyes punctipennis*, proved to be new to the fauna of Hungary. The number of species (15-50) and the number of individuals (713-1513) changed considerably among the sampling sites. Two third of the species (43) proved to be rare with less than 0.5% relative frequency. The species composition also differed remarkably between the sites: only four species have been found at all sites, while 35 species occurred only at one site (7 PTR, 5 ZOK and 23 KEM), with the dominance of *Paratrichocladius rufiventris* at PTR, *Rheocricotopus chalybeatus* and *Rheotanytarsus curtisyllus* at ZOK, and *Cricotopus bicinctus* and *Thienemanniella pe2b* at KEM. The average taxonomic distinctness (avTD), a measure describing the diversity of the assemblages, fit with the expected value in case of PTR and KEM. In case of ZOK it was significantly lower than the expected value, which indicates remarkable habitat degradation at this section. We compared the chironomid assemblages of Pécsi-víz with those of other comparable watercourses (regulated, having similar dimensions, running through inhabited and agricultural areas). The number of species was the highest in the Pécsi-víz, but the avTD did not significantly differ from the expected value.

Our results suggest that the number of chironomid species can also be high in human-impacted streams and the diversity of chironomid assemblages may not decrease due to habitat degradation. However, in lack of data, the comparison of human-impacted and near-pristine Hungarian streams is not possible, and differences from or similarities with natural chironomid assemblages still remain uncovered.

Differences in the mesh size of the filtering apparatus among invasive Ponto-Caspian *Chelicorophium* species (Crustacea, Amphipoda, Corophiidae) indicate niche differentiation by food particle size

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Three species of the Ponto-Caspian *Chelicorophium* genus; *C. curvispinum*, *C. robustum*, and *C. sowinskyi* have colonized several waters throughout Europe since the early 20th century. The three species often co-occur; however, the mechanism of their niche differentiation has not been identified so far. To possibly reveal ecologically relevant morphological differences, I measured the mesh size of the filtering apparatus of these suspension feeding crustaceans collected in the Lower Danube, where they occur natively. I made microscopic preparations of the filtering bristles on the second gnathopod, and took digital pictures under light microscope with 100-fold magnification. Then, I measured the distances between the setae of the bristles (10 measurements per specimen) using digital picture analysis software, and modelled the data in a mixed-effect model taking species identity, body length, and gender into account as fixed effects, and specimens as a random effect. Significant interspecific differences could be observed as *C. curvispinum* had the largest (6.33-18.35 μm), *C. robustum* intermediate (4.68-13.02 μm), and *C. sowinskyi* the smallest (2.64-6.87 μm) filter mesh sizes. The trait increased significantly with body length in all three species (although it reached a plateau in large specimens of *C. robustum*), whereas the effect of genders was not considerable. The results can be interpreted as niche differentiation by food particle size, indicating that the three species together can utilize suspended food particles more efficiently than either one of them alone, and consequently increase the benthic-pelagic coupling in the invaded waters.

Temporal and spatial dynamics in aquatic macroinvertebrate communities along a small urban stream

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Urbanization is a current and increasing threat to biodiversity. We investigated the effects of urbanization on the functional and taxonomic composition of macroinvertebrate assemblages in two seasons along a small urban stream. We demonstrated that the species composition was determined by the rate of urbanization; however, we cannot prove that species richness responds to it. Relative abundance of the sensitive macroinvertebrate groups (EPT%) was negatively related to urbanization. Almost all feeding groups showed a sharp decline in the number of specimens along urbanization gradient. Our findings support the view that urbanization has a negative effect on biological quality of a stream, but this obvious impact can be overridden by different conditions such as modification in streambed morphology. The altered conditions and new circumstances in urban environments lead to the creation of novel ecosystems, inhabited by macroinvertebrate communities with species richness approaching that of low impacted sites. However species composition of these communities could be basically different from that of the natural ones.

Survival under anthropogenic impact: the response of dragonflies (Odonata), beetles (Coleoptera) and caddisflies (Trichoptera) to environmental disturbances in a two-way industrial canal system

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The ecological metrics and assemblages of three orders of aquatic insects (Odonata, Coleoptera and Trichoptera – OCT) in an industrial canal system affected by dredging were studied. Five sites (a river as a control site and canals) were sampled during six sampling periods (2011 and 2013). CCA was used to assess the influence of environmental variables on the distribution of 54 insect species in the following system of habitats – a river feeding the canals, river-fed inlet canals and outlet canals with cooling waters. Additionally, BACI was used to test for the impact of canal dredging in 2011 on the insect response metrics. NMDS analysis differentiated the insect assemblages of the three habitats and SIMPER indicated the species most responsible for the faunistic dissimilarities. Temperature was found to be a key factor governing the presence of insects at the cooling water sites, but the reaction of each order varied. CCAs revealed that EC, salinity, dissolved oxygen and the level of development of aquatic plants had the greatest influence on this fauna. Each group was dependent on different variables, however. Modified ANOVAs showed that dredging significantly affected mean species richness and dominance in canals. The changes in OCT species composition were highly informative; while the OCT fauna responded specifically to different environmental factors and stressors, it is strongly recommended to track the responses on different levels, not only metrics, but above all, species.

Do mining activities influence macroinvertebrate communities? – the Pek River preliminary research

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One of the biggest mining sites in Serbia is located in close proximity of the upper stretch of the Pek River, near the Majdanpek city. In the process of copper extraction from the ore, waste water is produced and discharged into the River. In order to estimate the influence of mining activities we conducted the research of aquatic macroinvertebrate communities along this river. Macroinvertebrate samples were gathered with benthological hand net using multihabitat sampling procedure, in the Summer of 2015. To estimate the influence of the waste waters we had chosen the reference site on the Veliki Pek River, the constituent of the Pek, and five downstream sites along the Pek River course. The second site receives the majority of the pollutants from the mining site. For the assessment of the ecological status, the Asterics software package and the following biological indices were used: Total number of taxa (N), Shannon-Wiener diversity index (H), Zelinka-Marvan saprobic index, BMWP, and ASPT. A total of 76 macroinvertebrate taxa were recorded, with insects being the dominant component both in terms of abundance (89.73%), and taxa richness (72 taxa). The reference site had the highest number of recorded taxa (48) and high values of diversity (H) and evenness (2,38; 0,61, respectively) and was assessed as the site with very good ecological status (I class). In contrast, at the second site which is influenced by the mining discharge, the lowest number of taxa (8) with low diversity values (H=1.15) and very poor overall ecological status (IV class) were observed. The EPT group (Ephemeroptera, Plecoptera and Trichoptera), which constituted 46,30% of the community at the first site, was completely absent at the second site where dominant groups were Diptera (70%) and Oligochaeta (20%). Downstream localities (sites 3 to 6) showed a gradual trend of water quality improvement. At the fifth locality the community showed complete recovery, with far less Diptera participation. Moreover, Ephemeroptera, Trichoptera, and Crustacea comprised over 70% of the community. Diversity and evenness (2,75; 0,8) at this site increased significantly, reaching very good ecological status. The results of our investigation point to strong negative mining impact on the upper river stretch, which reflects on the studied biological elements. However, this medium sized river showed capacity to overcome intensive upstream pollution, and revitalize itself along its course. To determine which negative effects mining activities have on the river biota, and to recommend river protection measures, a more comprehensive investigation should be conducted.

The impact of coal mine water discharge on the diversity of benthic macroinvertebrates in the Kłodnica River (Southern Poland)

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The Kłodnica River, a right tributary of the upper Odra River, is polluted by mine waters from the coal mines of Upper Silesian Coal Basin. Three coal mines drain waters directly into the upper course of the Kłodnica river and eight mines discharge mine waters into its tributaries, i.e. into the Bytomka River, the Czerniawka River and the Bielszowice stream. The Kłodnica River also receives wastewater from municipal sewage treatment plants and industrial plants, as well as runoff from urbanised and industrialised areas in the upper course and from rural areas in the middle and lower courses.

The aim of the study was to assess the impact of saline mine water discharge on the diversity of benthic fauna in the Kłodnica River. The research was carried out from May to August 2017 at 14 sampling sites along the river course from the source in Katowice to the mouth in Kędzierzyn-Koźle and at two sampling sites in the Dzierżno Duże Reservoir, which is located in the middle course of the Kłodnica River.

In total, 33 benthic macroinvertebrate taxa were collected. Among them, six alien species were found – three amphipods (*Chelicorophium curvispinum*, *Dikerogammarus villosus*, *Gammarus tigrinus*), two gastropods (*Potamopyrgus antipodarum*, *Physa acuta*) and one bivalve (*Dreissena polymorpha*). The share of alien species was very high in the lower course of the Kłodnica River (94.9% of the collected macroinvertebrates) and in the Dzierżno Duże Reservoir (99.8% of the collected macroinvertebrates). The lowest share of alien species in benthic fauna was found in the upper course of the Kłodnica River (0.3% of collected macroinvertebrates). Species diversity as expressed by the Shannon-Wiener index H' was low along the entire length of the Kłodnica River and in the Dzierżno Duże Reservoir. It ranged from 0.28 to 1.80.

Canonical correspondence analysis (CCA) showed that conductivity, sulphates, nitrates and phosphates were the parameters that were most associated (statistically significant) with the distribution of macroinvertebrates. Four alien species, i.e. *Chelicorophium curvispinum*, *Dikerogammarus villosus*, *Gammarus tigrinus* and *Potamopyrgus antipodarum* were associated with a higher conductivity and a higher concentration of sulphates. Simuliidae, Enchytraeidae and Naidinae were associated with a higher concentration of phosphates, whereas Erpobdellidae was associated with a higher concentration of nitrates.

Chironomid assemblages in artificial and heavily modified freshwater ecosystems

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To implement the EU Water Framework Directive, all member states must develop national classification of good ecological status/potential and to synchronize it through an intercalibration exercise, what includes intercalibration for all Biological Quality Elements (BQE). Man-made or anthropogenically altered water-bodies are also included in the classification process since most water-bodies have been influenced by human activities in one way or another. They have various use and origin, and differ in hydromorphological characteristics and water quality what reflects in the diversity and abundance of present biota. Macrozoobenthos represents a BQE used in the monitoring and bioassessment procedures in suchlike and in natural aquatic ecosystems. Especially important are the representatives of the dipteran family Chironomidae, often representing more than 50% of the invertebrates within the benthos. Quantitative and qualitative composition of chironomid larvae assemblages can be very indicative of water quality state and changes, considering the presence of indicator taxa. For the purposes of assessment system development of water-bodies in the Pannonian ecoregion in Croatia, samples of macrozoobenthos were taken at two sites in 15 lakes/reservoirs bigger than 0.5 km², during summer 2016. At each sampling site, a total of ten samples was collected using a benthos hand net (25 cm × 25 cm; 500 μm). Chironomid larvae made from approx. 1% to over 90% of the macroinvertebrate assemblages. We identified 66 chironomid taxa distributed into five subfamilies: Tanypodinae, Diamesinae, Prodiamesinae, Orthocladiinae and Chironominae. Least abundant and diverse were Diamesinae and Prodiamesinae including one and two taxa, respectively, recorded at three locations. Chironominae larvae were dominant at all localities, except in lake Biljsko where the larvae of subfamily Orthocladiinae were the most abundant and in lake Novo Čiče, where we found the dominance of Tanypodinae larvae. Most abundant, in total, were representatives of *Cladotanytarsus* spp. (Tanytarsini), often found in shallow waters of reservoirs and lakes. Most abundant Chironomini were *Glyptotendipes pallens* agg. and *Polypedilum nubeculosum*; Orthocladiinae: *Cricotopus intersectus* and *Cricotopus* gr. *sylvestris*, and Tanypodinae *Ablabesmyia monilis* agg. The indication that microhabitat conditions (e.g. substrate type, available oxygen, nutrient input, organic matter) at the research sites, can significantly influence chironomid assemblages' structure, can be useful in creating a monitoring system. Implementation of Chironomidae larvae assemblage structure in whole, can help in improving the use of BQE in the water quality assessment.

Slovak aquatic macroinvertebrate fauna DNA barcoding – status quo

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Long year praxis of monitoring water quality and assessing the biodiversity of freshwater ecosystems in Europe (according to EU Water Framework Directive 2000/60/EC) still brings more and more evidence that the traditionally used morphological identification of monitored and evaluated taxa has several reasonable shortcomings (inaccurate identification, absence of experts, time-consuming). This is also why initiatives, like DNAqua-Net project, were launched in the EU, which aim to support opportunities for the utilizing modern genomic tools in the biological assessment of European waters. One of the activities that the initiative seeks to promote is to improve the status of DNA barcodes reference databases for freshwater taxa. Barcode reference libraries of all major freshwater groups of organisms are being produced within several national campaigns. Unfortunately, in Slovakia the level of available DNA barcode data is still very low.

In connection with the WFD implementation, a first detailed checklist of all macroinvertebrate taxa recorded from Slovak fresh waters, was published in 2003. This list contains 1.700 species of aquatic macroinvertebrates and after several years of the surface waters monitoring, about 50 other species were included. Nowadays, along with sporadic new records and unknown cryptic species, it is estimated that around 2.000 macroinvertebrate taxa can be present in Slovak fresh waters. Within the BOLD (The Barcode of Life Data System) database however, there are only 165 public records of aquatic invertebrate taxa collected in Slovakia covering 60 OTUs (end of 2017) and most of them (95%) are older records extracted from GenBank (NCBI) that cannot be considered entirely reliable. Due to the present gaps and following the goals of the COST DNAqua-Net project's Working Group 1 ("DNA Barcode Database"), our laboratory has begun to create a reference barcode library of the Slovak aquatic fauna in 2016. At present, we focus on the fauna of aquatic beetles, stoneflies and caddisflies. Numerous aquatic macroinvertebrate species from commonly occurring habitats are covered by barcodes produced in other European countries, so we primarily focused on data collection from specific habitats such as alpine lakes and karst springs, as well as less explored areas of Europe, such as the Western and Slovak part of Eastern Carpathians, and here we provide preliminary data. This work is supported by the EU COST Action CA15219 "DNAqua-Net" (Developing new genetic tools for bioassessment of aquatic ecosystems in Europe) and projects VEGA 2/0030/17 and 1/0255/15.

The influence of various forms of aquatic habitats protection on the diversity of benthos fauna in industrial areas

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The studies were carried out in water bodies located within two Natural-Landscape Complexes Żabie Doły and Szopienice-Borki. They are the examples of the traces left by previous industrial activity, fragments of the cultural landscape and habitats with presence of avifauna and amphibian. All of them remain under the local form of legal protection. They have been stocked with fish and some are managed under the auspices of local angling groups. The aim of the studies was to determine whether the form of nature protection being applied in these particular cases has an influence on the biodiversity of benthic fauna, including snails.

Six water bodies located within Żabie Doły and the five in the Natural-Landscape Complex of Szopienice-Borki were investigated. Quantitative and qualitative analysis regarding the benthos collection indicated differences between the structure of the communities within both complexes and between the water bodies in each complex.

Larvae of the Diptera (particularly Chironomidae) as well as Ephemeroptera and Gastropoda were the most numerous in the water bodies of Żabie Doły complex. However, in single reservoirs, their percentages were different and were rather similar to the second complex where Gastropoda and Chironomidae occurred most numerously. The mean density of the zoobenthos in the Żabie Doły complex amounted to 1610 ind./m², including 431 ind./m² of snails. Eleven snail species were found in this complex. The group of eudominant species included: *P. antipodarum*, *G. albus* and *R. balthica* and these species constituted a constant element of the snail collection. *P. acuta*, which rarely occurred in this complex, belonged to the subdominants. Alien species in Polish fauna constituted 64,7% of the snail collection.

The mean density of zoobenthos in the Szopienice-Borki complex was 2232 individuals/m² and was influenced by the high number of *P. antipodarum* that was found in only one water body. In the snail collection, we found the presence of eight species of snails (the mean density – 1577 ind./m²) including three alien species. Their percentage in relation to the native species amounted to 99%. From the analysis of the constancy index, it is not possible to describe the species as a constant element of the fauna in this complex.

Seven snail species occurred in both complexes, but their percentages in the collection as well as their constancy index were different. The obtained results indicated that the biodiversity of the snail fauna of the water bodies located within the two Natural-Landscape Complexes was not higher compared to isolated forest ponds or water bodies located along the roads, which was indicated by the results of our previous studies. Water bodies that are located within the area of the Natural-Landscape Complexes may constitute indirect links in the dispersion of alien species. Undoubtedly, the role of birds in their spreading as well as the way that water bodies are used is of great significance.

Morphological variability in the antipredator defence mechanism of *Gammarus roeselii* (Crustacea, Amphipoda): phenotypic plasticity or local adaptation?

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Gammarus roeselii is a common morphospecies in southeastern Europe, which has successfully spread into central and western parts of the continent during the last two centuries. A characteristic feature of this taxon is the presence of strong spines on the dorsal part of each of its three abdominal segments, forming an effective defence mechanism against predatory fish. These spines are known to be variable in length and number, usually between three and four, but no quantitative studies have been done so far. Knowing that *G. roeselii* is a diverse species complex, our aim was to explore if this wide phenotypic variation observed at local scales is related to distinct evolutionary lineages. We measured body length and the length of each spine of 144 individuals from 10 populations in the Pannonian Basin that exhibited a large amount of variation. Spine length was corrected for body size and data was analysed using multivariate statistics (PCA and MANOVA). Cytochrome c oxidase subunit I (COI) sequence data from two individuals per population was analysed within a broad phylogenetic context by applying maximum-likelihood phylogenetic methods, haplotype networks and coalescent species delimitations using the Poisson tree processes model. Multivariate analyses indicated the presence of three morphological clusters: one group bearing three weakly developed short spines, a group with three to four well developed tall spines, and a morphologically intermediate group bearing three spines. Spine length among these three groups differed significantly. Phylogenetic and coalescent analyses revealed that all of the studied populations are conspecific and belong to a single clade that is widespread in Central and Western Europe. Haplotype networks indicated no link between morphology and specific evolutionary lineages since the same haplotypes were sometimes shared between populations with contrasting morphologies. Therefore, our results reveal the first conclusive evidence that there is a large amount of morphological variation within this species. Considering the well-known anti-predatory role of these spines, it is likely that the observed variation is linked with the presence/absence of fish or intensity of predation pressure. However, experimental proof is needed to determine if this variation is due to phenotypic plasticity or local adaptation to contrasting selective regimes. The observed phenotypic variation likely reflects the wide adaptability of this taxon, which is successful in a wide range of water bodies.

Naturalness indicators as a new bioindication method in biocenosis monitoring, using caddisflies (*Trichoptera*) as an example

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Naturalness indicators are based on theoretical assumptions which differ from diversity indicators of biotic indices used in water monitoring. They take into account alternative life strategies and the ecological valence of species (generalists, opportunists versus specialists). Naturalness indicators (OWS) were applied for the first time to assess the degree of anthropogenic alteration of the fauna of the springs of Germany (Fischer, 1996).

Modified naturalness indicators (Wne, Wni) were used to analyse various types of waters using caddisflies (and for peat bogs, also using dragonflies). The indicators require the identification of invertebrate species and the determination of specific indicators of ecological significance, based on biological features and/or the frequency of occurrence in various habitats (Wze).

All species found in a particular type of waters (e.g. springs, streams, rivers, lakes, etc.) were assigned an individual indicator of ecological significance (Wze). The highest value was assigned to specialised species (16), a lower value to less specialised species (8, 4), the lowest value to eurybionts (2, 1), while saprobiontic species were assigned a value of 0.5. The logarithmic value scale was applied in order to clearly “secure a privileged position” to specialised species. Consequently, the highest indicator value is contributed by specialised species (e.g. crenobionts), while the lowest by the species accidental to a particular type of waters (e.g. crenoxenes), while species associated with pollution (saprobionts) lower the value of the indicator.

Over a period of several years, naturalness indicators were tested in various objects using caddisflies: Janowskie Forests Landscape Park (Czachorowski et al., 2000), springs of the Kazimierz Landscape Park (Buczyński et al., 2003), lobelian lakes, watercourses of the Białowieża Forest (unpublished data); the indicators were also used to assess anthropogenic changes in various types of water bodies (urban area: Złocieniec and Olsztyn, Czachorowski and Pietrzak, 2004). Using naturalness indicators, the fauna of dragonflies of 14 various peat bogs in the Czech Republic and Poland was analysed through examining the correlation with various environmental factors (Dolny, 2003).

The advantage of the method is the use of indicative features of individual species. At the same time, this is a drawback of the method, as it requires identification of the species of all collected organisms. The indicators provide a numerical value and are independent of geographical or regional differences. The indicator enables both the estimation of the naturalness of particular water bodies and objects and the tracking of restoration or degradation processes, using only certain groups of invertebrates.

The diet of 22 fish species in the Belgrade sector of the Danube River

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Fish have different habits and food needs, depending on age, physiological condition of fish, time of day or season. Herbivorous fish are feed on vascular plants (*Ctenopharyngodon idella*), phytoplankton and algae (*Aristichthys* sp., *Hypophthalmichthys* sp.). The most famous predators of Serbian waters are northern pike (*Esox lucius*), wels catfish (*Silurus glanis*), pike perch (*Sander lucioperca*), perch (*Perca fluviatilis*), burbot (*Lota lota*) and asp (*Aspius aspius*).

The catchment area of the Danube River in the Belgrade region (1171.5-1162 river km) is a part of the middle sector of the Danube River Basin, constantly subjected to heavy loading mainly organic origin.

Fish samples were collected during period 2007–2009, on two localities Zemun and Višnjica. Altogether 802 individuals of 22 fish species from Cyprinidae, Esocidae, Percidae, Centrarchidae, Gadidae and Siluridae families have been collected and examined.

Fish were caught with multimesh nets (size 32 – 50 mm) and transported to the laboratory, where the analysis of their intestines for food items was conducted. Determination of the macrozoobenthic organisms recorded in the fish intestines was conducted to the lowest taxonomic level using the appropriate identification keys.

The aim was to analyse intestine content of fish species with different diet habits and needs, and determining the composition of the macrozoobenthos community.

By examination of the 802 fish intestinal tract were identified representatives of macrozoobentos: Mollusca (Bivalvia, Gastropoda), Crustacea (Amphipoda, Gammarida), Annelida (Oligochaeta), Insecta (Trichoptera, Ephemeroptera, Coleoptera, Diptera-Chironomidae, Ceratopogonidae). Within the Bivalvia group, a species *Dreissena polymorpha* has been identified, as well as species *Corbicula* sp. i *Sphaerium* sp. Within Gastropoda species *Bythinia tentaculata*, *Lithoglyphus naticoides* and *Theodoxus fluviatilis* were determined, as well as representatives of genus Valvata and Viviparus. Representatives found within the group Ephemeroptera were *Baetis* sp. and *Ecdyonurus* sp., while group Coleoptera were presented by species *Riolus cupreus*. It also have been found the taxa of algae and phytoplankton.

The most frequent were organisms of macrozoobenthos from the group Annelida and Oligochaeta. All examined fish species, except *Esox lucius* and *Aspius aspius*, were feeding by them. The second frequent bottom fauna group was Crustacea. The fish species fed by representatives of the Amphipod, Gammarida and others, were: *Aspius aspius*, *Abramis brama*, *Abramis ballerus*, *Abramis sapa*, *Barbus barbus*, *Blicca bjoerkna*, *Leuciscus idus*, *Rutilus rutilus* and *Vimba vimba*.

The range of taken food items indicates that the most of examined freshwater fish in Belgrade sector of the Danube River are invertebrate predator, which probably takes food items according to their abundance and seasonal occurrence.

Impact of drying up of streams on population structure and fecundity of freshwater gammarid *Gammarus fossarum*

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Ongoing climate change alters stream flow regime and leads to increasing stream intermittency. Frequent drying up also affects populations of aquatic organisms. One of the strongly impacted species of streams up to 4th Strahler order is crustacean *Gammarus fossarum*, whose populations inhabit such streams in high densities, but do not produce any dry resistant stages. Gammarids can survive on dry streambed only a few hours, and therefore must recolonize the stream mostly from nearest perennial reaches, or from residual pools.

The comparison of 12 pairs of intermittent and perennial streams in years 2012-16 shows, that autumn samples from recolonized intermittent sites have a higher proportion of larger males and a lower proportion of juveniles, comparing to perennial sites. Different population structure in intermittent reaches can be explained by better recolonization abilities of bigger individuals (more efficient migrators) in comparison to not so mobile juveniles.

Fecundity analyses of gammarids in residual pools in 2017 shows a lower proportion of small breeding females with eggs in comparison to females on perennial sites. This difference can be explained e.g. by an increase of predation in overcrowded refuge pools with possible cannibalism or by overall stress in these shrinking habitats that leads to egg loss.

Our results demonstrate substantial impact of longer dry episodes on populations of very important ecosystem engineer of small streams. A gradual decline in reproduction abilities of this key species (leaves shredder and important predator in fishless streams) could have a fundamental impact on the whole community of intermittent streams.

This study is supported by INTER-COST (LTC17017) project and utilizes data from project BIODROUGHT (www.biodrought.eu).

Analysis of macroinvertebrate community and eutrophication assessment of Zelengora karstic lakes

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The mountainous area of Zelengora is positioned in southeast Bosnia and Herzegovina. It is characterized by dense forests (deciduous and coniferous), mountain pastures, barren rock peaks, gorges, canyons, and lakes. Dinaric mountains have karst morphology with underground drainage systems, caves and sinkholes. The amount of annual precipitation is high and continuous through the year. On Zelengora most of the water drains from the Drina River basin. The Lakes of this area have an average depth of 2-3m and are situated over 1400m above sea level, at the forest boundary. During the cold period of the year, they are covered with ice that can last for months.

The study of five Zelengora lakes (the Gornje bare, the Donje bare, the Crno jezero, the Bijelo jezero and the Orlovačko jezero) was carried out in August of 2016. Physico-chemical (temperature, pH, oxygen, conductivity, nitrates, nitrites, sulfates, orthophosphates, and total phosphor) and biological parameters (macroinvertebrates and phytoplankton) were gathered, at each lake. Water samples were taken for measuring chlorophyll concentrations, needed for the assessment of the trophic level by Carlson's and Felfoldy's indices.

Physico-chemical parameters were within expected range in all five lakes, with the exception of total phosphor which had higher values. As orthophosphates were relatively low, high values of total phosphor in the samples indicate that phosphor is mainly bound in organic matter. Regarding benthic fauna, 51 taxa of macroinvertebrates were recorded in total. Highest number of taxa (27) was recorded in the lake Bijelo jezero, and lowest (17) in the lake Orlovačko jezero. Groups with highest taxa richness were Oligochaeta, Gastropoda, Diptera and Odonata. Species *Erpobdella octoculata*, *Valvata piscinalis*, *Cloeon dipterum*, *Aeshna cyanea* and *Pyrrosoma nymphula* were present in all lakes. Considering microhabitat preferences and feeding types, two groups were distinguished. One group consisting of Oligochaeta, Chironomidae and Mollusca that prefer pelal and inhabit deeper parts of the lakes with decomposing organic matter, and the other consisting of representatives from the Insecta group (predominantly Ephemeroptera, Trichoptera and Odonata) which prefer the littoral zone with macrophytes. Qualitative analysis of phytoplankton recorded 68 taxa from 7 phyla. According to both trophic indices, four lakes were oligotrophic to oligo-mesotrophic. The only exception was the Bijelo jezero which was mesotrophic.

These lakes are under no significant anthropogenic influence, and their organic load is a natural consequence of eutrophication. The succession was most evident at the Gornje bare and the Bijelo jezero. All sites have diverse habitats and therefore exceptionally diverse communities. Considering their biological richness, as well as their rare beauty and aesthetic value, these pristine sites meet the criteria to be protected.

The use of pupal exuviae in the research of chironomid (Chironomidae, Diptera) biodiversity in freshwater reservoirs

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Reservoirs and anthropogenically altered water-bodies have features common to both lacustrine and riverine ecosystems, but morphology and water movement are what makes them distinct. Croatian reservoirs include water-bodies of variable physicochemical parameters, depth and different types of substrate, which influence the diversity and abundance of organisms living there. Moreover, there is a limited number of published data on macroinvertebrate diversity in this kind of water-bodies. One of the most important taxonomic groups of aquatic macroinvertebrates are Chironomidae, with essential role in the food webs, energy flow and ecosystem functioning. Due to their considerable diversity, high share in the biomass of total macrozoobenthos, they can also be used as water quality indicators in the bioassessment. We collected chironomid pupal exuviae from 29 reservoirs throughout Croatia, in both Dinaric and Pannonian ecoregion (16 and 13 respectively), during summer 2016 and spring and summer 2017, using the chironomid pupal exuviae technique (CPET). Pupal exuviae were collected using the exuvial net with 300 µm mesh, by skimming the water surface in the areas of the shore with the highest density of accumulated debris. After the separation of exuviae and preparation of the microscopic slides, we identify 116 species, i.e. 166 taxa in total. Identified taxa belonged to five subfamilies: Tanyptodinae, Buchonomyiinae, Diamesinae, Orthocladiinae and Chironominae. Most frequent taxon, recorded in 13 reservoirs, was *Procladius choreus*, a species which prefers stagnant and slow flowing, productive waters. Also frequently found taxa, recorded in more than one third of the reservoirs were: *Ablabesmyia monilis/longistyla*, *Zavreliomyia (Paramerina) sp.*, *Cricotopus spp.*, *Dicrotendipes nervosus*, *Paratanytarsus bituberculatus*, *Tanytarsus brundini*, *Tanytarsus ejuncidus* and *Tanytarsus spp.* A substantial biodiversity was established in the reservoirs Čakovec and Gusić Polje, with more than 30 chironomid taxa recorded. However, these reservoirs had only seven species in common, most likely since they are situated in different ecoregions. We found a higher taxonomic diversity in the water-bodies from the Dinaric ecoregion. The localities with the lowest diversity were: Popovac, Sabljaci, Jošava, Lake Bilje and Lake Sakadaš, with no more than five taxa recorded, all located in the Pannonian ecoregion, except Sabljaci. Although anthropogenically altered water-bodies, reservoirs represent specific aquatic ecosystems with various microhabitats, which can support a development of very diverse chironomid communities, and as such, it is vital to include them in the ecological studies. CPET has proven to be a very useful tool in studying chironomids, their ecology, distribution or for bioassessment and monitoring purposes.

Modelling the distribution of *Cordulegaster heros* and *C. bidentata* (Odonata) and their potential eDNA detection

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The two *Cordulegaster* species occurring in Hungary are both strictly protected by the law, Near Threatened according to IUCN Red List and listed in National Biodiversity Monitoring System as species to be surveyed. Thus, their intensive monitoring is important because their protection requires the knowledge on their distribution and habitat characteristics. The monitoring of these species with traditional sampling methods is mostly difficult, time-consuming and might damage habitats. Therefore, we aim to investigate the method of using eDNA sampling in order to detect the presence of the larvae of these protected aquatic macroinvertebrates. To test the detection accuracy we took eDNA samples from places where (1) neither *Cordulegaster* species are present, (2) only *C. heros* occurs (3) only *C. bidentata* occurs (4) both species occur according to literature data. During the samplings water samples were filtered at each sampling site. To make sure that we avoid contamination distilled water was also filtered at each occasion. In order to make exact positive samples, living specimens of the taxa were also collected at every sampling site. To make easier the monitoring design of eDNA samplings our second aim was to make species distribution models. The applied model by selecting the relevant background variables according to presence data can estimate the suitable habitats of *Cordulegaster heros* and *Cordulegaster bidentata* species. Most of the literary occurrence data comes from the Carpathian Basin, and from additional European online databases. We used the Bioclimatic background variables from the WorldClim database, supplemented with altitude, slope, and aspect variables for the models. Potential species distribution maps were generated in R statistical environment, using biomod2 package using 5 selected model algorithms (Generalized Additive Models, randomForest, Artificial Neural Networks, MAXENT). The results of the selected models were evaluated by using True Skill Statistics, which determined randomForest, GAM and GLM as the most accurate ones. Projections based on these algorithms were summarised on a map, that represents the areas with recent occurrences of species well, but additional data and analyses are needed to clarify the potential distribution.

An attempt to explain caddisfly diversity patterns using classical taxonomy and DNA barcoding along a latitudinal stream gradient (southern Poland)

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Altitudinal and longitudinal zonation of benthic taxa along streams is well studied, yet, ecological drivers responsible for local species diversity in the stream continuum are not clear and need more advanced studies. Therefore, we sampled specimens from two genera of caddisflies in the Stradomka River (southern Poland) between May and June 2017 across a low-mountain range of altitudinal gradient (200-600 m a.s.l.). Our first goal was to compare species patterns based on morphological and DNA-based methods, and then to link this with underlying ecological variables. For the DNA-based analyses, we extracted DNA from 192 specimens and amplified a fragment of the mitochondrial Cytochrome c Oxidase subunit I gene (*COI*). Using this typical barcoding gene and a data comparison to the BOLD database we identified six *Hydropsyche* species. For the genus *Rhyacophila* we found only two species, i.e. *R. nubila* and *R. cf. polonica*, although the latter record has to be verified as limited information is available in BOLD. 15 specimens could not be assigned to species level based on morphological traits (*H. pellucidula* and/or *H. incognita*) whereas genetic evidence was clear in those cases. We found strong divergence of >5% intraspecific pairwise genetic distances for *H. instabilis*, *H. pellucidula* and *R. nubila* indicating either strong population substructure of cryptic species. We discuss the inconsistent results of the integrative study and highlight the potential of including DNA-based identification in such community structure analysis in stream ecology.

In search for refugia in Western Carpathians through DNA barcoding. The case of stoneflies (Plecoptera)

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Western Carpathians are one of the key “biodiversity hotspots” in Europe. The mountain chain uplifted during Alpine orogenesis and is characterized by a complicated geological history. Their current biodiversity was highly influenced by Pleistocene glaciations. Recent studies have shown that cold adapted gammarids (crustaceans), survived the Ice Age in cryptic refugia of the Western Carpathians. Other cold adapted and widely distributed in mountains taxa are stoneflies (Plecoptera). Stoneflies are characterized by limited dispersal capabilities (relatively short living imago) and weak or medium flying abilities, making them a good model in phylogeography studies. Moreover, they are used as bioindicators in the assessment of the aquatic ecosystems quality.

The main goal of the presented studies is the identification of putative glacial refugia using selected Plecoptera taxa in Western Carpathian through DNA barcoding.

The material was collected during joint expeditions with researchers from Slovak Academy of Science in 2015 and 2016 year. Samples were taken from 76 stations, streams and springs, using benthic kick net. Morphological diagnosis of the collected larvae using the available keys was performed. Three genera which were most abundant among samples were selected for the barcoding studies: *Isoperla*, *Brachyptera* and *Leuctra*. Over 200 individuals were barcoded using mtDNA COI marker. In the first step barcode library was created in Barcode of Life Data System (BOLD). Next steps will focus on mapping of the geographical and historical (molecular clock) patterns of diversity.

The studies are funded by grant from the Polish National Science Centre: Miniatura 1 (2017/01/X/NZ8/01607) and project: Slovensko – Poľsko 2015, founded by Slovak Research and Development Agency and Polish Ministry of Science and Higher Education.

Spatial and seasonal oscillation in zooplankton taxonomical and functional groups under distinct environmental scenarios

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In freshwater environments, zooplankton influences the functioning of an ecosystem through its species composition and biomass which affects the structure of other food web components. By using a zooplankton functional groups viewpoint, species can be arranged into classes with distinct ecological roles. The aim of the study was to evaluate the change in zooplankton taxonomical and functional feeding groups among different habitat types, following season and hydro regime replacement. Six sampling sites were chosen: two river stations (Danube, Site 1; Drava, Site 2), one floodplain lake (Lake Sakadaš, Site 3), and three channels placed close to the farm areas (Sites 4-6). Samples were collected on two occasions in 2016: in June during flood and September in low water period. A total of 73 zooplankton species were recorded (53 Rotifera, 14 Cladocera and 6 Copepoda). Among measured environmental variables, water depth and conductivity values varied significantly among sites, while transparency values and concentrations of total nitrogen and total phosphorous oscillated between seasons. All zooplankton taxonomical groups differed significantly among sites, while functional classification revealed spatial oscillation in microphagous species. During low water period cladocerans and copepods strongly correlated with dinophytes and cryptophytes, with the dominance of small-bodied microcrustaceans (*Ceriodaphnia* sp., *Thermocyclops* sp.) known to prefer these algae in their diets. Following flooding condition, rotifers correlated with several phytoplankton groups, especially chrysophytes, chlorophytes and xanthophytes. At sites 3 and 5 significant proportion of cyanobacteria during September influenced the development of bacteria-detritus suspension and minute algae feeding zooplankton species (*Anuraeopsis fissa*, *Brachionus angularis*) with occasional occurrence of raptorial. Algivoracious zooplankton species, especially those feeding on algae ranging in size from 20-50 µm, like *Synchaeta* genera, prevailed at sites where chlorophytes, diatoms and cryptophytes were abundant. The raptorial way of feeding characterised high-flow environments, especially during low water period, while microfilter-feeders marked channel environments. The results of our study point to the significant spatial oscillation of zooplankton functional groups and indicate proper diagnostics of the applied approach in describing the lower trophic levels, in all types of studied environments. Also, our results stress the importance of proper management of all types of water habitats in maintaining biodiversity necessary for proper ecosystem functioning.

Discriminating eaters: sea stars *Asterias rubens* L. feed preferably on *Mytilus trossulus* Gould in mixed stocks of *Mytilus trossulus* and *Mytilus edulis* L.

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Sea stars *Asterias rubens* are important natural enemies of blue mussel *Mytilus* in the North Atlantic. We asked whether these predators distinguish between the cryptic species *M. edulis* and *M. trossulus* that occur sympatrically in the White Sea. In mixed experimental stocks, the odds of being eaten by sea stars were about four times greater for *M. trossulus*. We also showed that *A. rubens* preferred smaller mussels to larger ones, irrespective of their species affinity. Our findings support earlier indirect observations showing that sea stars recognize *M. trossulus* as a more preferable prey than *M. edulis*. Dramatic differences in the vulnerability to sea star predation may explain the segregation of habitats between the two mussel species in contact zones; *M. trossulus* usually tends to occupy habitats where the sea star predators are scarce.

Feeding strategies of larvae *Chaetopteryx villosa* (Trichoptera: Limnephilidae)

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Caddisfly larvae are very important component of the entomofauna associated with freshwater springs. It can be assumed that their abundance and diversity may affect the time and efficiency of decomposition of different leaves. Our aim was to find out the determinants among feeding strategies, sex and outlet of larvae *Chaetopteryx villosa*, and identify feeding strategies of larvae with encoded male and female sex (future female and male). We concentrated also on the influence of food eaten by the larvae on adults weight.

The studies were carried out in the Wolbórka Spring in Central Poland. Food preferences and the amount of processed leaves were checked using *Chaetopteryx villosa* larvae in the laboratory. To reveal the food selected most frequently by larvae, plates with small squares of different leaves species were prepared. They were fed with 4cm² leaf-squares and the amount of consumed food was evaluated every two days. To assess larvae ability of processing leaves, 140 fifth-instar larvae were reared separately.

The experiments indicated *A. glutinosa* as preferred leaf species (62.81% of all choices), followed by the leaf of *A. pseudoplatanus* L. (38.12% of all choices). This can lead to conclusion that 1) leaf species as well as abiotic factors (especially water temperature) influence decomposition rate, 2) *C. villosa* fifth-instar larvae are effective shredders and are able to process up to 57.6 cm² leaves of *A. glutinosa*, 3) *A. glutinosa* and *A. pseudoplatanus* L. are preferred by *C. villosa* larvae as their main source of food.

Distribution and species composition of aquatic oligochaetes (Annelida: Oligochaeta Limicola) from Central Balkan National Park, Bulgaria

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National Park “Central Balkan” is the second largest national park in Bulgaria with a total area of 717 km². There are nine Nature Reserves on its territory. Several large tributaries of the Danube watershed (Vit, Osam, Rositsa and Yantra Rivers) and Aegean watershed (Tundzha River) have their sources in the Park. The main length / parts of these rivers (middle and lower courses) have been well studied in faunistic and hydrobiological aspect. Contrary, their mountain streams are almost completely unstudied.

Therefore, the aim of the present study is to contribute to the knowledge of macroinvertebrate community in these mountain springs and some groundwater sources (fountains) near the rivers. This first purposeful study is focused of Oligochaeta faunistic complex.

The study was carried out during the 2014 (autumn), 2015 (summer) and 2016 (summer). All samplings were carried out within a protected area with no anthropogenic impact: 23 rivers, 7 touristic fountains and 5 troughs of fountains were sampled. Sampling was carried out using hand held (for river sampling), round hand nets (for troughs sampling) and portable filtering nets (for fountain outflows).

A total of 16 oligochaete species were identified. Much of the oligochets found at the bottom of the rivers are common species to this habitat (*Limnodrilus hoffmeisteri*, *Stylo-drilus heringianus*, *Rhyacodrilus coccineus*, *Mesenchytraeus armatus* etc.). One of the relatively rare species found in Bulgarian high mountain waters (*Nais alpine*) was found in the Zavodna River (730m a.s.l.). In the nearby fountains species like *Limnodrilus hoffmeisteri* and *Aulo-forus furcatus* were identified. It is interesting to mention that only species from Naididae (*Nais communis* and *Nais pardalis*) were registered in the trough of the fountains. We have the hypothesis that these are the first species to settle temporarily dry water basins.

Having in mind the species preferences it is interesting to discuss further the origin of the purely aquatic species in the groundwater samples and possible role of the positive reotropism for inhabiting niches with better ecological conditions.

Diversity and spatio-temporal variations in chironomid larvae assemblages in the longitudinal gradient of two headwater streams

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Springs are unique freshwater ecosystems thanks to their relatively constant physical and chemical conditions. However, with increasing distance from springsource these conditions change rapidly resulting in variations in structure and distribution of aquatic organisms. Due to relatively evident short-distance changes within these parameters, the significant zonation in bentic communities can be expected. In our study, we focused on two headwater streams in the Small Carpathians Mts. in western Slovakia. Sampling was carried out in spring and autumn of 2017, with several sampling points in the range of 50 meters in both streams. At each sampling point seven physicochemical (e.g. temperature, conductance, ORP) and five biological (e.g. periphyton, TOM, POM) parameters were measured. Some of them (e.g. pH, ORP) changed mainly in longitudinal profile of stream, while other (e.g. conductance, O₂, periphyton) altered more seasonally. Altogether, 55 taxa of non-biting midges were found with *Polypedillum convictum*, *Trissopelopia* sp. and *Micropsectra* spp. being the most abundant. There was a seasonal shift in diversity in both streams, with higher number of taxa in spring assemblages (37 and 35 taxa respectively). Regarding longitudinal gradient we found no clear pattern in terms of species richness of individual assemblages. However, relationships between the assemblages and other physicochemical and biological parameters of study sites will be examined.

The research was supported by the Slovak Grant Agency VEGA, project no. 1/0255/15.

Macroinvertebrate community of a sub-Mediterranean temporary karst river in the Western Balkans

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Temporary rivers and streams are dynamic ecosystems in which water stops flowing periodically and flows become terrestrial habitats that can contain isolated pools and lakes. Due to great temporal and spatial variability of environmental conditions, they are complex systems, thus they were poorly researched in the past. However, in recent years their importance was recognized and research efforts significantly increased.

This research was conducted along a temporary karst river Krčić, situated in the sub-Mediterranean part of Croatia. Krčić is a small river, about 10 km long and it usually dries up during summer and early autumn months. It is minimally influenced by anthropogenic activities and can thus be regarded as a reference site of temporary rivers in this region. The sampling was performed in 2016 during the flowing phase; in late spring/early summer and winter season, on the upper, middle and lower reaches. At each part of the flow three sampling sites were chosen, where triplicate D-net samples were taken. The sampling encompassed all major microhabitat types. Overall, different size fractions of lithal covered with moss dominated. However, proportion of xylal increased in the lower reaches due to the forest riparian vegetation. Aquatic macroinvertebrate community was highly abundant, however, taxa richness was relatively low and uniform along the whole course of the river. Highest diversity of macroinvertebrates was recorded in the lower reaches, due to increased habitat heterogeneity and availability of various resources. The most abundant taxa were Chironomidae, Ephemeroptera, Plecoptera and Trichoptera, thus their community composition and structure are analysed more in detail. Because of periodically occurring dry seasons, communities were dominated by generalists commonly found in perennial streams and specialists adapted to reduced water capacity or droughts. Since temporary rivers are vulnerable ecosystems, sensitive to water extraction, point and non-point pollution sources and climate change, better knowledge of aquatic and terrestrial communities is important for predicting the changes in these ecosystems and for adequate management and protection.

Macroinvertebrate communities of a salinised river with coal mine water discharge (the Bolina River, Upper Silesia, Poland)

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Mining activity is connected with the discharge of underground water into the surface water, which then inflows into settling ponds or directly into the rivers. This causes a degradation of inland waters primarily through excessive concentrations of chlorides, sulphates, total dissolved solids, nutrients and heavy metals in the water. Anthropogenic salinisation is one of the most important factors that is responsible for biological changes in aquatic biota, particularly in the case of the salinisation of the tributaries of larger rivers. The Bolina River, which flows through Upper Silesia (southern Poland), one of the most industrialised and urbanised regions in Europe, is an example of a salinised river with coal mine water discharge.

The study was carried out in the upper and lower courses of the Bolina River (the Vistula River basins) in 2017-2018. The objectives of the survey were to analyse the structure of the macroinvertebrate communities and to determine the most important environmental factors that have a significant influence on their structure in a salinised river.

The results of the Mann-Whitney *U*-test showed significant differences in the average width of the river, depth, velocity, salinity, conductivity, hardness, concentration of TDS, chlorides, nitrites, organic matter content in the bottom sediments, density and the number of macroinvertebrate taxa between the upper and lower courses of the Bolina River. Statistically significant differences in the average biomass of macroinvertebrates in relation to the different types of substratum were also recorded (Kruskal-Wallis one-way ANOVA test). The maximum density of alien species, i.e. *Potamopyrgus antipodarum* and *Gammarus tigrinus*, amounted to 1452 individuals/m² and 316 individuals/m², respectively. Based on a redundancy analysis (RDA), conductivity, hardness, the concentration of nitrates and organic matter content in the bottom sediments were the parameters most associated (statistically significant) with the distribution of macroinvertebrates.

The Bolina River, which has a salinity of up to 33.55‰ (lower course) can be unique habitat for organisms that are salt-tolerant as well as constituting a route for the spreading of alien and invasive macroinvertebrate species.

Morphometric and DNA barcoding assessment of macrozoobenthos community structure as indicator of water quality in Natural Monument “Skakavac”

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Aquatic macroinvertebrates are an integral part of the zoobenthos living complex that has been studied for many years in order to assess the ecological status of hydroecosystems. Natural Monument “Skakavac” is the first protected area in Canton Sarajevo, Bosnia and Herzegovina, placed in the third category of IUCN protection. So far, the wider region of this ecosystem has been well explored, especially its floristic and dendrofloristic aspect. Earlier studies on macrozoobenthos taxa were based only on traditional morphometric research, however, data on these organisms are still scarce. Unfortunately, molecular genetic data for benthic macroinvertebrates inhabiting this ecosystem are nonexistent and have not been the subject of any research up until now.

This research provides pivotal molecular genetic data on the community structure of macrozoobenthos and ecological status evaluation of Natural Monument “Skakavac” hydroecosystems. In accordance with the EU Water Framework Directive (WFD), AQUEM methodology was used for aquatic macroinvertebrates specimen collection from five (5) sampling sites along “Skakavac” main aquatic ecosystems. Our findings suggest the existence of 18 taxa (predominantly orders Ephemeroptera, Plecoptera, Tricoptera and Diptera) from which total DNA was extracted and the COI barcoding region amplified and sequenced.

Sensible taxa from the EPT group, as well as high percentage of oligosaprobic indicators in the composition of macrozoobenthos were found, confirming high indicator significance and justification for assessing and monitoring the ecological status of this area.

Although different governmental agencies are carrying out biomonitoring of diverse habitats and ecosystems in Bosnia and Herzegovina, it is not performed in systematic, coordinated and standardized manner. Further, it is based only on traditional morphological tools, lacking any molecular methods that might enhance it in terms of species identification, labor and time efficiency and cost effectiveness. The results of our research will serve as a basis for establishing: (a) check lists on macrozoobenthos species relevant to the WFD and, (b) long-term monitoring systems for these organisms in Bosnia and Herzegovina.

The attendance of Jasna Hanjalić in the 3rd CESAMIR 2018 was supported by the COST Action CA15219 DNAqua-Net within the ITC conference grant.

Chironomidae of springs in the Zeta Valley and the adjacent regions

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The Chironomidae belong to the group of Culicomorpha families within Nematocera flies. Whereas many genera have a global distribution, it may be assumed that each freshwater ecoregion reveals its own distinctive fauna composition. Midge fauna of the Balkan Peninsula is poorly explored compared to the other regions of Europe or even to North Africa. Large faunistic and ecological research conducted in the recent years concerned the Danube River Basin (Serbia). Midge spring fauna was investigated in the Cvrcka River Valley (Bosnia and Herzegovina) as well, and also along with other macrobenthos in Croatia and Kosovo. In Montenegro, Skodra Lake, including its coastal springs, is the subject of a large project. As Skodra is a geologically new lake, the midge diversity in Montenegro depends strongly on inland flowing waters and its basin stream and spring system. Springs and small flowing waters support specialised and often little known species. The majority of these species are cold-stenotherms that need cool and permanently flowing water. That is why in the Mediterranean Region they may be refuges for old Pleistocene fauna. The location of small water bodies in the landscape implies its hydrological characteristics, e.g.: discharge, permanence, temperature, water chemistry and bottom substrate. In 2012 and 2014, more than 60 small water bodies were investigated in Montenegro, mainly in the Zeta River Valley. Samples were collected from rheocrenes, large limnocrenes, ditches and streams. The localities were dispersed from the mountain to lowland and coastal areas, including the rural and urban landscape. Most of the collected species belong to the Orthocladiinae subfamily followed by Chironominae, Tanypodinae and Diamesinae. Besides Chironomidae, also Ceratopogonidae and Dixidae were occasionally collected. The collected material indicates good water quality of investigated waters, even in the City of Podgorica and its vicinity.

The above-presented research was supported by CEEPUSCIII-Freemover-1314-68927, CIII-Freemover-1314-68973 and Erasmus placement.

Distribution of Chironomid larvae in Srebarna Lake and Danube River (North-East Bulgaria) in relation to some environmental variables

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The species of family Chironomidae (Diptera) are commonly the most abundant and the most diverse taxa in freshwater ecosystems. Lake Srebarna is a freshwater lake of natural origin situated in the flood terrace of the Danube River (North-East Bulgaria). Its water drains into the Danube by an artificial channel and the water level is regulated by floodgates. We investigated the relationship between the distribution of chironomid larvae and a set of environmental variables (nitrogen forms, ortho-phosphates, oxygen concentration and saturation, temperature, alkalinity, conductivity and location type (river, lake, channel) in several sites within the Srebarna lake and the riparian zone of the Danube River in its part where it is connected with lake.

Endochironomus cf. albipennis, *Glyptotendipes sp.*, *Ablabesmyia monilis* agg. occurred in high percentage in Srebarna, *Kiefferulus tendipediformis*, *Glyptotendipes sp.*, *Ablabesmyia monilis* agg. – in the connecting channel and *Virgatanytarsus sp.*, *Tanytarsus sp.* and *Polypedilum sp. (cf. scalaenum)* – in the Danube River. RELATE analysis showed a significant relationship (0.01) between the distribution of the taxa's abundance and environmental variables. According to BEST analysis ammonia nitrogen ($p < 0.002$), conductivity and alkalinity best explained ($p < 0.01$) the distribution of taxa among sites. *Paratanytarsus sp.* showed a strong negative correlation to ammonia nitrogen ($p < 0.01$). *Cladotanytarsus sp.*, *Tanytarsus sp.* and *Cricotopus (Cricotopus) sp.* correlated ($p < 0.02$) negative to conductivity and positive to alkalinity. ANOSIM test revealed that samples from river and lake differ significantly according to taxa expressed through their abundance ($p < 0.003$). Though the test didn't show significant dissimilarity between location type "river" and "channel", SIMPER test revealed high average dissimilarity (90.21%) between these two groups and a lower one (44.67) between "lake" and "channel".

The results obtained indicate that the samples from river and those from lake and channel share very few common species as expected. The taxa *Virgatanytarsus sp.*, *Tanytarsus sp.*, *Polypedilum sp. (cf. scalaenum)*, and *Cricotopus (Cricotopus) sp.* were typical to the river, *Endochironomus sp. (cf. albipennis)* and *Anatopynia plumipes* – to the lake. A lower oxygen concentration reflects in higher concentration of ammonia nitrogen and this results to significantly low diversity and abundance of chironomid larvae. The larvae of Tanytarsini and Orthocladiinae are more sensitive to the amount of nutrients and oxygen concentration in the water though they do not tolerate higher amounts of dissolved solids, e.g. lower transparency and decreased growth of submerged vegetation. A further deeper research is needed to explain how environmental variables influence chironomid distribution in studied sites.

Acknowledgements The research was funded by "Program for supporting young scientists and PhD students – 2017", Bulgarian Academy of Sciences.

Aquatic macroinvertebrates and other groups of aquatic organisms in the ecological assessment of a river (Vologda, Russia)

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The Vologda River refers to the White Sea basin and is located in the north of the East European Plain, in the subzone of the southern taiga. The length of the river is 150 km, the catchment area is 3030 km². The river is affected by the dam (in the middle course) and by the Vologda city (in the lower course). The anthropogenic load is increasing downstream: the agricultural land, the urbanization and the population density increase in the catchment area. The measurements were carried out at 5 stations: in the upper reaches of the river, in the reservoir, above the city, in the city center and below the city. The samples of phytoplankton, zooplankton and zoobenthos were selected six times from April to October in 2013. In August, a macrophyte study was conducted. The water samples were also taken for the hydrochemical analysis, BOD₅, NH₄, NO₂, PO₄ were examined. The saprobity and Shannon indexes were calculated for each group of aquatic organisms. The Belgian Biotic Index (BBI) and the Oligochaeta relative number were also calculated for the aquatic macroinvertebrates. Concentrations of BOD₅, NH₄, NO₂, PO₄ are increasing downstream.

The number of the aquatic macroinvertebrates species decreases from 94 in the upper reaches to 13 below the city. Ephemeroptera, Trichoptera and Diptera predominate in the zoobenthos in the upper reaches of the river. Mollusca, Oligochaeta and Chironomidae prevail at the other stations. *Limnodrilus hoffmeisteri* dominates in the center and below the city. The saprobity index varies from 1.59 in the upper reaches to 3.43 below the city, the BBI from 9 to 3, the Shannon index from 2.14 to 0.26, and the Oligochaeta relative number from 7% to 92%.

The number of macrophyte species varies from 33 in the upper reaches to 10 in the center of the city, while the amount of hydrophytes decreases from 11 to 1. The largest number of species and quantitative indices of phytoplankton and zooplankton can be observed in the water reservoir, which is more likely due to the hydrological characteristics than to the reservoir pollution. The smallest number of zooplankton species was recorded in the upper reaches of the Vologda river, meanwhile the same number of phytoplankton species was recorded below the city. The Shannon index for phytoplankton and zooplankton at different stations was equal to 1.1-1.8. The saprobity index value for macrophytes, phytoplankton and zooplankton was equal to 1.5-2.1.

Among four groups of aquatic organisms studied, only the aquatic macroinvertebrates show a deterioration in the ecological state of the watercourse due to the increasing anthropogenic load. Phytoplankton and zooplankton depend on the hydrological characteristics and on the organic substances presence.

Integrative taxonomy reveals the new species of *Palaemon* from the Lake Skadar basin

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Skadar Lake, the largest in the Balkan Peninsula, was formed only ca. 1,200 years ago in result of the overflowing of an old polje – marsh area rich in karst springs. The lake is shallow and fed by several rivers and many springs mentioned above.

The endemics of the Skadar Lake basin are inhabiting mainly the river outlets and springs. Many of them are cold-adapted organisms. The warm lacustrine waters are predominantly a barrier to the migration of such species, especially in summer when its water temperature reaches 25-30°C.

During our research in the Lake Skadar basin, conducted since 2006, we found representatives of two shrimp genera: *Atyaephyra* de Brito Capello, 1867 (Atyidae) and *Palaemon* Weber, 1795 (Palaemonidae).

The local population of shrimps of the genus *Palaemon* has been characterized on the basis of morphological examination and molecular marker (mtDNA COI) and compared with other congeneric freshwater species from the Mediterranean area, using Bayesian phylogenetic methods and geometric morphometry. In results, we were able to distinguish a novel species, most likely endemic to the Skadar Lake basin. It constitutes a separate morphological and genetic group in relation to *P. antennarius* and *P. minos*, with which it forms a monophyletic clade. Based on the preliminary time-calibrated reconstruction of phylogeny, we presume that the new species separated from its closest relative, *P. minos*, at ca. 1.2 Ma.

Alien species in the macrozoobentos in the western part of the Vistula Lagoon (Southeastern Baltic Sea, Poland).

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The Baltic Sea is a geologically young postglacial basin. The native fauna and flora concentrations display a relatively low degree of biodiversity with a marked dominance of a few species. Currently, a wide-scale biological reorganisation of the Baltic Sea is being witnessed. It results primarily from human activity and manifests itself in intrusion of new species. Nowadays the principal vectors for the invasion to the Baltic Sea seems to be ballast water transport.

The Vistula Lagoon, part of the southern area of the Baltic Sea, is a shallow (average depth 2.6m), polymictic basin which also undergoes the changes mentioned above. In brackish waters of the Vistula Lagoon 36 non-native species (including 3 cryptogenic) have been found. The research of benthic fauna conducted in 2006-2016 confirmed presence of 15 alien benthic and nekto-benthic macroinvertebrates in the western part of the Vistula Lagoon. In the species composition representatives from five regions were noted (North America, Ponto-Caspian Region, Pacific, China Seas and West Europe - Atlantic coast). In the Lagoon benthic fauna, these taxa have become an important component of abundance and biomass of bottom macroinvertebrates. They are the dominant species or the only representatives of their systematic groups. Their considerable abundance relative to the numbers and abundance of native species testifies to the high level of biopollution.

Morphological diversity of the stone crayfish (*Austropotamobius torrentium*) in Croatia

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The stone crayfish (*Austropotamobius torrentium*) is one of four native European crayfish species inhabiting Croatian freshwater ecosystems. It is distributed at higher altitudes, in smaller waterbodies of both the Black Sea and Adriatic Sea basins. In the last few decades, noticeable declines of stone crayfish populations have been recorded across its distribution range in Europe. Losses are mainly caused by anthropogenic pressure onto stone crayfish habitats, presence and spread of non-native invasive crayfish species, and climate changes. Therefore, stone crayfish is considered a threatened species, protected by national and international legislation. Effective protection of existing populations requires development of conservation and management plans based on the sound knowledge of species, including information on genetics and morphology.

Recent molecular-phylogenetic studies of *A. torrentium* discovered the existence of at least seven divergent monophyletic phylogroups within the species, with the highest genetic variability recorded in the Dinaric region in Croatia. Also, previous preliminary analyses of morphometric features of a few stone crayfish populations indicated their significant differences. This study aimed to test if some morphological characteristics separate among phylogroups. For this purpose 245 stone crayfish, belonging to 5 phylogroups, were analysed through traditional and, for the first time, geometric morphometric analyses. Traditional multivariate discriminant analyses included 24 morphometric features per crayfish, while geometric morphometrics comprised analyses of 22 landmarks on the dorsal side of cephalothorax.

Both methods revealed congruent results, and significant differences among phylogroups in analysed morphometric features were obtained. Applications of acquired results in the future *A. torrentium* conservation programs are discussed.

Do macroinvertebrate and diatom indices indicate same responses to anthropogenic pressures?

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Macroinvertebrate and diatom indices are frequently used for ecological status assessment in freshwaters, but relatively few published works have assessed their effectiveness in assessment and classification schemes. During a four-year survey for the Greek National Water Monitoring Programme, a total of 421 samples, collected from 195 stream sites throughout Greece, were used. The correlation between macroinvertebrate (HESY2), diatom (IPS) and chemical-physicochemical (Ch-Ph) indices was assessed and the environmental parameters affecting biotic indices were examined.

All indices were positively intercorrelated, with IPS showing the highest correlation with the Ch-Ph index, as IPS was affected by nutrient concentration and dissolved oxygen. HESY2 responded to land use, sediment type, river typology, water temperature and PO₄. The two Biological Quality Elements (BQEs), hence biological assemblages, respond differently, therefore they should be distinguished *a priori* when looking at the impacts of anthropogenic stressors. The current study showed that macroinvertebrates were influenced by multiple pressures with their response being dependent on seasonality, whereas diatoms were affected mostly by water chemistry and their response was independent of seasonality. In Mediterranean rivers, where natural variability is pronounced, the selection of the appropriate BQE in biomonitoring programmes to detect impacts of anthropogenic stressors is thus essential.

The investigation of heat shock protein changes (Hsp70) in Caspian Sea gammarus (*Pontogammarus maeoticus*) under heat stress

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Heat shock proteins belong to a big family of proteins which are heat-tension dependent and are inductable by heat-stress. They can save the living organisms against suddenly fluctuation of environmental conditions and cause the stability of other protein. *Pontogammarus maeoticus* is one of the most abundant amphipods at the south of Caspian Sea coast. In this study the presence of heat shock proteins in *Pontogammarus* (male and female species) by treating at laboratory conditions and levels of temperature (20, 25 and 30°C) was investigated. Samplings were carried out at coast of Hassan Rood (Guilan province, Iran). The levels of proteins were determined by Bradford and ELISA methods. Statical analyses of data were carried out by one-way ANOVA and Duncan test. The results showed that by temperature increasing, the levels of Heat- shock proteins and absorption of ELISA were increased and the highest absorbance was observed in treating at 30°C after four hours. Increasing the treating temperature between 5 until 10°C more than the optimal value causes the more synthesis of heat shock protein 70 with molecular weights of 66.5 and 90 KD both in male and female species of *Pontogammarus*. In other words the results of this study express that by increasing the temperature the level of heat shock protein 70 will be increasing.

Geographical distribution and taxonomic status of *Dina stschegolewi* (Lukin & Epshtein, 1960) (Hirudinida: Erpobdellidae)

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Erpobdellid leeches are major invertebrate predators in freshwater communities of the Palaearctic. However, the taxonomy and biogeography of erpobdellids are rather neglected. This is true even for well-known and common species. *Dina stschegolewi* is an erpobdellid species that was described from the Crimean Peninsula. In the South Caucasus, *D. stschegolewi* has been recorded from eastern Azerbaijan to western Georgia. Some researchers have recorded *D. stschegolewi* from Iran, Turkey and Levant. However, most of these records and identifications have been reconsidered taking into account features of a resembling species, *Dina orientalis*. Specimens from Israel and adjacent countries, identified as *D. stschegolewi*, have the specific coloration, very similar to that of another erpobdellid leech, *Dina punctata*. This suggests that previous records of *D. stschegolewi* from the Middle East should be substantiated to determine their taxonomic identity and outline the species' geographical distribution more accurately.

The distribution of *D. stschegolewi* in Europe is still unclear. The species has been recorded for the Crimean Peninsula and the Dniester Delta in Ukraine (this research), the Danube Delta in Romania, and in Poland. Perhaps, records from Poland should be assigned to another species, *Dina apathyi*. This species was described by Gedroyé from western Ukraine and western Belarus and it differs little in its morphology from *D. stschegolewi*. For this reason, *D. stschegolewi* and *D. apathyi* should be compared both genetically and morphologically.

Caucasian and Crimean populations of *D. stschegolewi* differ in some morphological characters. Specimens from the Caucasus are smaller in their maximum sizes, have much darker coloration and less pronounced papillae. Specimens from Caucasian and Crimean populations differ in the shape and length of the atrium, and the angle between atrial cornua. These characters indicate that Caucasian and Crimean populations of *D. stschegolewi* should be assigned to two different species. This hypothesis is confirmed by our phylogenetic analysis of COI gene nucleotide sequences and species delimitation based on Birky's criterion.

The structure and dynamics of the non-biting midge assemblages (Chironomidae, Diptera) in a dinaric karst river, River Dobra, Croatia

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Because of their ubiquity and the large variety of ecological niches in which they exist, the larvae of family Chironomidae are valued as excellent bioindicators. However, the impacts of disturbance events, such as the construction of a hydropower plant dam, on non-biting midge assemblages were sparsely studied in dinarickarst rivers. The aim of this study was to investigate the temporal dynamics of the chironomid assemblages in the moss microhabitats of the Dobra River before and after new large dam construction. The Dobra is a karstic river situated in the central Croatia, characterized by a subterranean flow and numerous unique microhabitats, including moss-covered substrates which represent a refuge from the fast flowing current and potentially trap for food particles, what makes them preferable habitat by smaller macroinvertebrates. Sampling was conducted in the period from 2007 to 2016, with the notable year of 2010 when the hydroelectric power plant Lešće (HEPP Lešće) was finished 460 m upstream from the sampling site. The samples of moss with accompanying macroinvertebrates, were collected with a hand net (mesh size of 200 µm) and preserved in a 70% alcohol. Before sampling several environmental factors were measured using WTW probes: water temperature, oxygen saturation and concentration, pH and electrical conductivity. Collected organisms were sorted and identified to the lowest possible taxonomic level. Analysis of the chironomid assemblages before and after the dam construction revealed important changes. IndVal analysis indicated species *Nilotanytus dubius* and *Tanytarsus* sp. as representative before the construction and *Cricotopus* gr. *tremulus* and *Orthocladius* (*Orthocladius*) sp. as representative taxa for the period after 2010. Larval abundance was found to have the greatest positive correlation with the oxygen concentration in water, water temperature and pH. Although chironomids have high natural and seasonal variability, which have to be taken into account, the changes of the chironomid assemblage structure after the construction of the HEPP, indicates ecological changes of the studied area, since the newly dominant taxa can thrive in the nutrient rich habitats. A dam closure can highly influence the hydrology, temperature regime of the modified water-body and consequently degrade the water quality and influence the benthic organisms.

Gastrotricha in the Arctic: first assessment of diversity using integrative approach

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Gastrotricha comprise microscopic acoelomate metazoans ranging in size from 50 µm to 3500 µm that inhabit all types of aquatic as well as semi-aquatic ecosystems throughout the world. Gastrotrichs comprise more than 820 nominal species and are a common component of meiofauna communities and constitute a constant and abundant part of the benthic psammon and epiphytic ecosystems. No comprehensive taxonomic or phylogeographic data exists on the freshwater Gastrotricha of the Arctic. The aim of our research was to determine what is the species diversity and whether is the morphological and molecular diversity showing the same patterns as well as what are the factors behind observed diversity. Our research was conducted on three transects, at various distances from the forelands of the Hans, Gås and Hyrne glaciers (Spitsbergen, Arctic). During the investigation, we collected samples from 70 localities and found nearly 900 specimens belonging to 41 morphotypes, and about half of these individuals were provided for additional molecular analyses. Our morphological and morphometric data shows that, in some potential taxa, the plasticity between the specimens from various localities is nearly non-detectable; whereas, in other morphotypes, the variability between the specimens from different areas is gradual and increases together with the distance between the sampling sites. However even when two external populations were significantly separated by morphological features we still could find populations with intermediate features. In order to explain this pattern of morphological diversity we are using barcoding COI mitochondrial and two nuclear markers (ITS rRNA, 28S rRNA). Species are delimited using both barcoding gap and coalescent methods. The phylogenetic relationships are resolved using Bayesian and Maximum Likelihood approaches.

The study was funded by the Polish MSHE Grant DI 2014 013844 titled "Gastrotricha diversity and phylogenetic relationships in the foreland of the Arctic glaciers – a consequence of climate change" for MK.

Phylogenetic position of *Bifidochaetus arcticus* (Gastrotricha, Chaetonotida) - Chaetonotidae origin in brackish habitats?

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Chaetonotidae, the most diverse and common family of Chaetonotida (Gastrotricha), are poorly phylogenetically resolved which complicates the understanding of its evolutionary history. The grouping of marine and freshwater species together is especially confusing because it impedes the comprehension of their expansion from marine habitat to freshwater, including reversals. The most accepted hypotheses assume that that freshwater chaetonotids evolved from marine ancestors; the colonization of the freshwater habitats took place only once and resulted in the rapid radiation. Some molecular analyses indicate the marine species *Chaetonotus (Marinochaetus) mariae* Todaro, 1992 or the freshwater species *Aspidiophorus tetrachaetus* Kisielewski, 1986 as the most early branching from so far described Chaetonotidae species; however, in both cases with low statistical support. From a morphological point of view, both species appear to be evolutionarily advanced due to the various types of scales and spines covering the body. High scales type and shapes diversity may suggest that *C. (M.) mariae* is a secondarily marine species whereas *A. tetrachaetus* is the result of a late freshwater radiation. The newly described freshwater genus and species *Bifidochaetus arcticus* shows many features suggesting of its ancient character. The entire body of *B. arcticus* is covered by tin, subtriangular scales, with strongly rounded and convex edges without posterior notches, and with spines. The spine emerges vertically from the scale centre and after short basal section strongly curve and bifid, branches off at the curvature into two separate, thick spines of equal length. This specific set of features probably would evolve into other types of cuticular structures, e.g. in pedunculated scales that are present in the other chaetonotid lineages. Discovering the ancestral lineages of Chaetonotidae could explain the process of new environment inhabitation and the rapid, nearly simultaneous radiation within this paraphyletic group. On our poster, based on molecular data we corroborate our morphological supposition that *B. arcticus* is the sister taxon to the remaining species of the paraphyletic group containing Chaetonotidae, Dasydytidae, and Neogosseidae. Our data placed *B. arcticus* at the base of the Chaetonotidae tree, suggesting that the family is ancestrally brackish and that the marine species evolved secondarily from brackish or freshwater ancestors.

The study was funded by the Polish MSHE grant DI 2014 013844 titled "Gastrotricha diversity and phylogenetic relationships in the foreland of the Arctic glaciers – a consequence of climate changes" for MK.

Biodiversity and ecology of semiaquatic insect larvae in the lakes of the Western Siberia southwest part

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Water larvae of semiaquatic insects are one of the most important structural components of benthos and plankton, as well as an energy link in the transformation of organic matter in aquatic ecosystems. Biological diversity and its population characteristics are used to assess the state of lake ecosystems. Their role is increased in small lakes, due to the increased speed of organic matter turnover and the constant consumption of its available forms, created by water larvae in the links of the food web. Halopreferendum for aquatic insect larvae is 5-12 ‰ in the lakes of the south-west part of Western Siberia (Kurgan region). Their greatest biodiversity and the maximum relative biomass of populations in plankton and benthos of small lakes (an area of 1-2 km², a depth of 2-4 m) are with such mineralization.

In these lakes there are larval stages of 28 species of chironomids, the imago of which does not feed due to the reduction of the oral apparatus. They are part of the genera *Tanytarsus* (*T.gregarious*, *T.mancus*, *T.lanterborni*), *Cryptochironomus* (*C.defectus*, *C.conjugens*, *C.viridulus*, *C.pararostratus*), *Pseudochironomus* (*P.prasinatus*), *Glyptotendipes* (*G.gripekoveni*), *Chironomus* (*Ch.plumosus*, *Ch.semireductus*, *Ch.thummi*, *Ch.bathophilus*, *Ch.salinarius*), *Einfeldia* (*E.pagana*, *E.carbonaria*), *Limnochironomus* (*L.nervosus*, *L.tritonus*), *Polypedium* (*P.nubeculosum*, *P.scalaenum*), *Endochironomus* (*E.tendens*), *Microtendipes* (*M.chloris*), *Tendipendini* (*T.macrophtalma*), *Psectrocladius* (*P.psilopterus*), *Procladius* (*P.choreus*), *Pelopia* (*P.villipennis*, *P.punctipennis*) and *Cricotopus* (*C.algarum*). On them it is possible to establish a typology of faunistic complexes of brackish lakes. This is, first of all, mixed chironomid-gammarus (*Chironomus sp.*, *Cryptochironomus sp.*, *Limnochironomus sp.* + *Gammarus lacustris*) and gammarus-haoborid (*Gammarus lacustris* + *Chaoborus cristallinus* or *Chaoborus flavicans*) complexes.

The second complexes are formed by aquatic larvae of the haborids, which are part of the stagnophilic zooplankton. These are predators actively moving in the pelagic zone of brackish lakes. The trophic spectrum of the larvae changes as it grows. The factor that prolongs the development of the water stages of these species is the sum of the operating temperatures. Departure of the adult is observed in April-September. They are hydrophilic, but do not feed on blood.

The fauna of dragonflies (their aquatic larvae) in lakes is represented mainly (17 species, 61%) by Palearctic species (*Sympetrium striolatum*², *S.pedemontanum*¹, *S.scotica*¹, *S.vulgatum*¹, *S.meridionale*², *S.flaveolum*¹, *Cordulia aenea*¹, *Leucorrhinia dubia*², *Calopteryx splendens*³, *Lestes sponsa*², *Erythromma najas*¹, *Libellula quadrimaculata*¹, *Ortetrum cancellatum*¹, *Ophiogomphus cecilia*¹, *Aesha viridis*², *Calopteryx virgo*², *Epithea bimaculata*¹). Holarctic species represented by one species only (3%, *Enallagma cyathigerum*¹). The rest are represented by West-Central-Palearctic species (36%, *Gomphus flavipes*³, *G.vulgatissima*², *Somatochlora flavomaculata*², *S.metallica*¹, *Leucorrhinia albifrons*², *L.caudalis*², *L.rubicunda*¹, *L.pectoralis*², *Sympetrium sanguenum*¹).

Eurytopic¹ species include 14 species (50%). Limnophiles² are represented by 13 species (45%), and rheophils³ - by only two (5%). Their presence in the lakes indicates of the high quality of the habitat and its saturation of dissolved oxygen. Flying imago of different species appear mainly in two periods - from May to July (20% of species) and from June to August (30%).

Patterns of distribution and abundance of alien and native peracarid crustaceans in Croatian large rivers

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Peracarid crustaceans (orders Amphipoda, Isopoda and Mysida) represent one of the most important group of invaders in European freshwaters that largely contribute to the homogenization of macroinvertebrate fauna. The aims of this study were to investigate distribution, density and assemblages of native and alien Peracarida in Croatian large rivers, their relationship with physico-chemical parameters and their proportion in total density of benthic macroinvertebrates as preliminary assessment of their impact. Hand net sampling (25×25 cm, mesh size 500 µm) was conducted twice (in 2015 and in 2016 or 2017), at 48 locations on four major large rivers (Danube-4 sites, Sava-21, Drava-20, Mura-3). Quantitative samples (20×0.0625 m²) were collected at each site in a shallow bank area of rivers (44 sites) or two reservoirs on Drava (2 sites), while deeper parts of the same reservoirs were sampled using Ekman grab (3×0.0225 m² at 2 sites). In a total, 16 species were recorded, five native (Amphipoda-4, Isopoda-1) and 11 alien species (Amphipoda-8, Isopoda-1, Mysida-2). The highest number (10 spp., all alien species) were found in the Danube River, while subsets of alien species were found in the Sava (5) and Drava Rivers (6). The Mura River and the most upstream reaches of the Drava and Sava Rivers in Croatia have not yet been colonized by invasive peracarids and native species still thrive there. The most widespread alien species, present in the Danube, Sava and Drava Rivers, were isopod *Jaera istri* (29 sites) and amphipods *Dikerogammarus villosus* (24) and *Chelicorophium curvispinum* (22). The most upstream distributed species were amphipod *D. haemobaphes* in the Sava (631 rkm) and *D. villosus* in Drava River (270 rkm). Characteristic species for Sava were *D. haemobaphes* and *C. sowinskyi*, for Drava and Danube *D. villosus* and *C. curvispinum*, and additionally *C. robustum* for Danube. Significant differences were found in peracarid assemblages between all four rivers. Interestingly, extremely cold winter in January 2017 caused decrease of invasive amphipod *D. villosus* and enabled native species *G. fossarum* and *S. ambulans* to become more abundant than *D. villosus* at two sites in Drava. Proximity to the Danube River, as source of all invaders, and colonization history together with physico-chemical parameters, explained observed variation in peracarid assemblage between studied rivers. Proportions of alien Peracarida in total density of benthic macroinvertebrate was very spatially variable with the highest average and maximum values in the Drava River and lowest in the Sava River. Long-term monitoring of the distribution and abundance of invasive peracarid species is essential prerequisite for better understanding of the changes in macroinvertebrate assemblages in Croatian large rivers.

Dynamics in the effects of the species-area relationship vs. local environmental factors in bomb crater ponds

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The species-area relationship (SAR) is a well-investigated subject rising questions nonetheless. We hypothesized that SAR can be modified by naturally extreme conditions (high pH, conductivity and total phosphorus) in small spatial scale. A bombing range was chosen on a highly mosaic alkali landscape as a sampling location with a densely scattered cluster of bomb crater ponds, which are various in size and in extremity to study the hypothesis. Sampling effort was optimized according to pond size. Macroinvertebrate communities from 25 bomb crater ponds were sampled, along with macrophyte community, while pH, conductivity, total phosphorus and size were also registered. A Decision tree was used to separate extreme from normal ponds based on their chemical characteristics. Extremity influenced SAR in a way unexpected: SAR was found to be the dominant driving force shaping the communities in the extreme ponds. However, in the normal ponds, the Small Island Effect was observed, while macroinvertebrate communities and macrophyte community types were congruent. Also, different species of floating macrophytes were found to dominate the extreme and normal ponds, having a different effect on macroinvertebrate communities and the effect of extremity masked the co-correlation between macrophyte and macroinvertebrate communities, when all ponds were examined together.

Our findings imply that rules in ecology cannot be handled rigidly and there are dynamics existing between the factors that influence the composition of a macroinvertebrate community that cannot be ignored at habitat restorations.

The underwater vacuum cleaner A new sampling technique developed by Bureau Waardenburg

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The underwater vacuum cleaner is a sampling device developed by Bureau Waardenburg with which you can sample the sediment in an effective and animal-friendly way with the help of an "airlift". The great advantage of the underwater vacuum cleaner is that large underwater areas can be sampled without the need to bring the sediment to the surface.

Bureau Waardenburg uses this technique for instance in the so-called "riverwood" project in the rivers Lek, Nederrijn and IJssel. For this unique project, which will be succeeded again in 2018, the branches and trunks are sampled for macrofauna using a fixed quadrant. As a result, not only the species composition, but also the density of the macrofauna community can be accurately and reproducibly determined. This method has also been successfully used for sampling shipwrecks in the North Sea.

Furthermore, sampling with the underwater vacuum cleaner in the river Waal helped to discover larvae of the rare river clubtail or yellow-legged dragonfly. It is usually difficult to prove the presence of this species, as the monitoring is often done by searching for its left-behind skin on the shores. Moreover, this method is only applicable in certain seasons and weather conditions. In contrast, the underwater vacuum cleaner can be used year-round and much more effectively for inventories.

Reproduction of *Sinanodonta woodiana* (Bivalvia: Unionidae) – an invasive mussel species in a female-based population

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Sinanodonta woodiana, the Chinese pond mussel, is an invasive species indigenous in Asia, which naturally spreads to new locations as a glochidium parasitizing fish. Human activity has facilitated a continental-scale spread of *S. woodiana*, and now the species occurs in European artificial reservoirs and is beginning to invade natural environments.

This study aimed to investigate the reproductive activity of *S. woodiana* that colonised a riverine channel of a power plant with a cooling water system. We used histological and stereological methods to determine gonad structure, changes in reproductive follicles (acini) during gametogenesis, and brooding periods.

Water in the channel of the “Dolna Odra” power plant (Poland) did not freeze during the winter, and its mean annual temperature was 18.4 °C. The population sex ratio was female biased ($\chi^2 = 25.70$, $df = 1$, $P < 0.0001$). Ovaries and testes in mussels were formed by reproductive follicles (acini). Previtellogenic and vitellogenic oocytes were attached to the follicle wall via the cytoplasmic stalk, and mature ovulated oocytes were present in the follicle lumen. Females incubated the offspring (glochidia) in gill marsupia of outer demibranchs and were characterized by multiple tachytictic brooding periods. In males typical and atypical spermatogenic pathways were identified where the atypical spermatozoa were released from multinucleated cysts. Individuals with mature gonads were present over the whole two-year study period, which indicates the continuous activity of gonads. The research provides the first direct information about the reproductive dynamics of this invasive species outside its original Asiatic range.

The research was financed by the Polish Ministry of Scientific Research and Information Technology (grant to AML, nr. NN303 068 32/2367).

Bioassessment of marine macrobenthic colonization of artificial substrates using morphological and DNA-based methodologies

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DNA barcoding coupled with HTS technologies provides rapid and rigorous assessments for species composition in marine benthos. Artificial substrates deployed in coastal areas act as an enhancer for benthic colonization, facilitating routine access to marine biodiversity. Our main objective is to develop DNA metabarcoding approaches to monitor marine macrozoobenthos and to investigate the patterns of benthic colonization in artificial substrates. Three different types of artificial substrates: slate, polyvinyl chloride and granite were selected. Flat panels substrates (10 x 10 cm) were suspended horizontally ~1.5 m below water surface. In December 2016, 16 replicates of each substrate were randomly deployed close to the dock of the Toralla Island (Spain); in March (3 months), July (7 mo) and October (10 mo) of 2017 and March (15 mo) 2018 replicates of each substrate were randomly removed. Morphological identification and DNA metabarcoding were used to identify the species that colonize the substrates. Here we present the first results obtained for the 5 replicates of slate substrate, collected after 3 months (March 2017). For the three morphological samples, the mobile and sessile fauna were separated and preserved in formaldehyde solution to subsequent identification under the binocular microscope. The two replicates for molecular analyses were processed differently: both were scraped with a spatula, but, while in the first one all algae were removed before preservation, in the second one the bulk sample was preserved directly in ethanol. To improve the detection ability, DNA amplification was performed for two marker loci, a 313 bp fragment of COI and a section of about 400 bp of the V4 region from 18S rRNA gene. Amplicons were sequenced in an Illumina MiSeq platform. Quality and length-filtered reads were submitted to mBRAVE (COI) and SILVAngs (18S) databases. After clustering of operational taxonomic units (OTUs), taxonomic assignments were attributed when displaying $\geq 97\%$ similarity with reference sequences. Compared to DNA-based approaches, morphological identifications resulted in a lower detection success of benthic species, with only a small proportion identified by both methods. The V4 region resulted in more taxa identified in both replicates. However the two different loci were mostly complementary in their detection ability, with only eight taxa identified by both. The use of a bulk sample with algae did not seem to affect the ability to detect the target community. The highest number of taxonomic groups was detected precisely in that replicate, but the number of species detected was higher in the algae-free replicate. Overall DNA metabarcoding captured a higher taxonomic diversity than the morphology-based approach, and provided equal or higher taxonomic resolution in the profiling of macrozoobenthos. However, the use of at least two marker loci is required to capture more realistically the composition of the benthic assemblages.

The attendance of Barbara Leite in the 3rd CESAMIR 2018 was supported by the COST Action CA15219 DNAqua-Net within the ITC conference grant.

A North American invader extends its range in European rivers – the first records of the occurrence of *Gammarus tigrinus* Sexton, 1939 in the tributaries of the upper Vistula River (Poland)

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The amphipod species *Gammarus tigrinus*, Sexton 1939, which is typical of small and large estuaries or creek mouths, is native to the Atlantic coast of North America. The native range of its occurrence includes oligo- and mesohaline brackish waters with salinity of up to 14‰. In Europe, it was found in the brackish waters of the Salwarpe River (the Droitwich district, UK) for the first time in 1931. *Gammarus tigrinus* was deliberately introduced into German rivers and then it began to occur in the inland waters of continental Europe (e.g. the Netherlands, France and Belgium). *Gammarus tigrinus* continued its spread to the Szczecin Lagoon, the Vistula Lagoon, the Odra River and within the Baltic Sea. Our survey was carried out in the tributaries of the upper Vistula River from 2010-2017 (Upper Silesia and adjacent areas, Poland). Upper Silesia is the most urbanised and industrialised region in Poland and constitutes one of the largest coal basins in the world. Three tributaries of the upper Vistula River, i.e. the Potok Gromiecki River, the Gostynia River, the Mleczna River as well as the inflow into the Mleczna River from a coal mine dewatering system were investigated. The waters of these tributaries are characterised by high levels of chlorides, sulphates, biogenic elements or conductivity, which is a consequence of the discharge of mine waters from the coal mine dewatering system into the rivers. This survey uncovered the first occurrence of *Gammarus tigrinus* with the maximum density of 1040 individuals/m² in the tributaries of the upper Vistula River. The occurrence of the invasive alien gastropod species, i.e. *Potamopyrgus antipodarum* (Gray, 1843) was also recorded in such salinised water. Our survey revealed the first occurrence of *Gammarus tigrinus* in rivers with a relatively high conductivity (salinity) of up to 28.8‰. This results showed that the anthropogenically salinised tributaries (coal mine water discharge) of a large river (the upper Vistula River) constitute new habitats for euryhaline species and create new migration routes for alien and invasive species, e.g. for *Gammarus tigrinus* and *Potamopyrgus antipodarum*.

Thermal and ontogenetic dependence of trophic interactions in *Sympetrum* sp.

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In the current climatic change context, temperature increases modify the strengths of trophic interactions between aquatic invertebrates and alter the food web functioning in ponds and wetlands. However, the lack of knowledge about the variations in responses of a species across its ontogeny impedes our abilities to predict efficiently the consequences of temperature on food webs over time. We realized a 4h- predation experiment using *Sympetrum vulgatum* and *S. striolatum* at their 5 last instars, feeding on 6 densities of *Daphnia magna*, at 4 temperatures (16, 20, 24 and 28°C), to identify the shape of the functional responses and associated parameters – attack rate and handling time - for each instar. As expected, larger instars consumed larger amount of prey than smaller ones. However, if smaller instars increased continuously their consumption with temperature, larger individuals' consumption peaked at 24°C and decreased afterward, highlighting a greater sensitivity to warming. Every instar exhibited a type-II functional response (i.e. a decelerating feeding rate with increasing prey density), but temperature increased significantly the attack rate of the smallest instar and decreased more strongly the handling time of intermediate instars than last ones. These results highlighted the variability of responses to temperature across species ontogeny and the necessity to consider these specific responses in stage-structured models of food webs.

Detection of bacterial endosymbionts in new freshwater crustacean hosts species: experimental application of non-degenerate primers designed to amplify bacterial 16S rRNA gene

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We designed a pair of non-degenerate primers which enabled amplification of the bacterial 16S rRNA gene fragment of approximately 500 bp length from different bacterial endosymbiont species. In this way, for a very first time, we revealed the following bacterial endosymbionts in freshwater Crustacea hosts species from astatic ponds: *Wolbachia*, *Methylophilus* and *Candidatus Gortzia* in *Branchipus schaefferi*; *Wolbachia* in *Streptocephalus cafer*; *Methylophilus* in *Moina macrocopa* and additional uncultured presumably bacterial endosymbiont in *B. schaefferi*, *Branchipodopsis wolfi*, *Moina brachiata* and *Triops canciformis*. What is more, endoparasite *Spirobacillus* and *Undibacterium* belonging to symbiotic microbial communities were identified in *B. schaefferi*. In addition, the same haplotype of uncultured bacterium from *B. schaefferi* and *B. wolfi* was identified in samples from Poland and Republic of South Africa. Moreover, we noticed that several host species co-occurring in the astatic pond shared the same haplotype of *Methylophilus*.

The overall efficiency of the WOLBSL and WOLBSR primers to amplify bacterial 16S rRNA gene was 100%. If in the single probes different bacterial species were amplified simultaneously, despite a good quality of PCR products, sequences were not legible. Therefore, we suggest to use our primers at the first stage of endosymbiont bacterial identification, then the genus specific primers should be used. Finally, our fast and simple method for bacterial endosymbionts identification in several invertebrate species will provide a new, valuable data on host-symbiont cospeciation.

Larval data on the occurrence of Odonata species in the Maltase Islands with notes on their breeding sites

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The Maltase Islands, situated in the middle of the Mediterranean Sea, are naturally poor in surface freshwaters due to geological and climatic conditions. Moreover, the aquatic and wetland habitats are degraded by various anthropogenic activities, but man-made water bodies (e.g. artificial ponds, reservoirs, canals) somewhat compensate the loss of the natural habitats. The Odonata fauna of Malta is well known consisting of 19 species, but many of them are migratory and only represented by a few adult specimens. In 2018 we visited 80 sampling sites to collect aquatic macroinvertebrates, among them dragonflies and damselflies. The sampling sites were classified into five groups: (A): larger standing waters (e.g. natural ponds, reservoirs), (B): small standing water with surface area less than 1 m² (e.g. rock pools, puddles), (C): small artificial habitats (e.g. fountains, wash houses), (D): running waters, (E): salt marshes. Odonata larvae were found only 25 sites (31% of the visited sites). The most important habitats were the larger standing waters (larvae were found in 57% of them) and the small standing waters (40%). Odonata larvae were unexpectedly rare in flowing waters (26%). Surprisingly, larvae were collected in some artificial habitats, and no larvae were found in salt marshes. The number of species/site was low in every habitat types, varying between one and four. Eight species belonging to three families were collected (1 Coenagrionidae, 1 Aeshnidae, 6 Libellulidae). Among the most common species *Anax imperator* and *Sympetrum fonscolombii* occurred in all habitat types, while *Ischnura genei* was not found in small artificial habitats and *Crocothemis erythraea* in flowing waters. *Orthetrum coerulescens* occurred only in running waters (4 sites). Two specimens of *Orthetrum trinacria* and 1-1 specimen of *Orthetrum cancellatum* and *Trithemis annulata* were collected, all of them in larger standing waters. Our study provided new larval data to the Odonata fauna of Malta. Although the majority of the results support our previous knowledge, there are some exceptions. Based on former studies the salt marshes might be important for dragonflies as possible breeding sites, but we did not find any species in these habitats. At the same time, our results suggest that small rock pools might be important breeding sites, especially for *I. genei*, *C. erythraea* and *S. fonscolombii*. In addition, this is the first time DNA barcode sequences are obtained from Odonata specimens collected in Maltese Archipelago, as a part of the “Aquatic Macroinvertebrates DNA Barcode Library of Malta” that is being developed on the basis of our samplings.

***Theodoxus* in the South Caucasus: species diversity or morphological plasticity?**

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Our goal was to study samples of *Theodoxus* from South Caucasus to obtain data of species diversity and morphological plasticity of individuals by comparing with samples of *Theodoxus* species from other parts of Pontocaspian basin.

Most common species in the South Caucasus is *Th. subthermalis*, which was described from Lake Paliastomi in Western Georgia. Usually its shell is completely coloured black, however, in a work devoted to the species described by J.-R. Bourguignat, it was shown that in the typical *Th. subthermalis* series there are mollusks with white strips that are visible along the edge of the outer lip of shell. It was revealed that this species can be found in the rivers of the South Caucasus, both the Black Sea basin and the Caspian Sea. In some papers, the form is described as a subspecies of *Th. fluviatilis*.

Theodoxus fluviatilis is a widely distributed European member of the gastropod family Neritidae. In the environs of the city of Kutaisi, we found some mollusks of a color similar to *Th. fluviatilis*. As shown by several studies the shell coloration and its patterns are very plastic in all species of the genus *Theodoxus* and could be influenced by factors like ionic composition of water, type of substratum and nutrition of individuals of this species in various habitats. This is why shell coloration cannot be used for certain identification in contrast to operculum characters that can be used for a proper discrimination of *Theodoxus fluviatilis*. A further detailed study of these specimens was revealed that these mollusks differ in form of operculum from specimens identified like *Th. subthermalis* and are similar to samples of *Th. fluviatilis* from Ukraine. This may indicate that the species *Th. fluviatilis* is locally found in western Georgia. The isolation of this population from other populations of its species may indicate an invasive origin of it but this assumption requires verification by DNA-barcoding phylogenetic analysis.

Hydrological regime and ecological character of the Great Serteya Post-lake Basin based on the multi-proxy research conducted at the Serteya II site (Western Russia)

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The main axis of the Serteya region is the Serteyka River Valley – the tributary of the Western Dvina River in the Baltic Sea Basin. The area is situated within Vitebsk Lakeland or Western Dvina Lakeland. Numerous (ca. 60) archaeological sites from the Paleolithic to Middle Ages have been discovered in the lower, ca. 10-kilometres long, section of the Serteyka River Valley since 1970s. The human settlement of the Serteya region has been developing since the Late Palaeolithic. The researched region is a crucial area for the study of Neolithisation processes of Eastern Europe and the adaptation of Neolithic communities to palaeoenvironmental changes. The present day Serteyka River Valley occupies the subglacial channel which was earlier occupied by a few lake basins developed in the Late Weichselian after the Valdai Ice-Sheet deglaciation. The research on the palaeoenvironmental change is based on detailed palaeoecological analyses (Chironomidae, Cladocera, pollen, plant macrofossils, diatoms, geochemical, sedimentological) of deposits collected from the multicultural archaeological site Serteya II situated within the Great Serteya Post-lake Basin. At the site, the Neolithic pile-dwelling settlement remains are studied and dated to the 4.2 ky BP event. A multi-proxy study allows better understanding of the ancient people's response to local environmental and global climate fluctuations. We can speculate that the local settlement depended strongly on landscape geo- and biodiversity and climate as well as hydrologic fluctuations (mainly 8.2 and 4.2 ky BP events). Based on subfossil Chironomidae, data on water level fluctuation, trophy and average July temperature were obtained.

The research is financed by grants from the "National Science Centre, Poland" based on the decision No. 2017/25/B/HS3/00274.

Searching for effective sampling scheme for estimation of pond dwelling Odonata diversity

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Ponds are very abundant habitats that often serve as hot spots of aquatic biodiversity on regional and landscape level. For pond conservation and management purposes, surrogate groups are often used to measure biodiversity and evaluate conservation significance of habitats. Odonata are an example of often used „umbrella“ or „flagship“ group of pond biodiversity. However, successful application of odonates as surrogates in conservation and management activities requires reliable, well-tested and representative survey methods for estimation of their diversity. We conducted extensive survey with the aim to evaluate the efficiency of five sampling schemes in the estimation of local (α) and regional (γ) diversity of pond-dwelling Odonata. Dragonflies were surveyed in 34 ponds including wide range of sites, varying in origin, age and environmental conditions that were distributed from lowland to mountain zones over the entire territory of Slovakia (Central Europe). Individual sampling schemes varied in timing, number of site visits (multi-season, single visit), and also in the number of life stages that were sampled (larvae, exuviae and adults).

Not surprisingly, extensive multi-season investigation combining survey of all the life stages revealed the highest number of species per pond, the best estimation of regional diversity and had the highest relative sampling efficiency. Multi-stage sampling performed during single visit (either spring or summer) and also single-stage approaches (sampling either larvae or adults) resulted in considerably lower local and regional species richness than multi-season sampling of all the stages. Except exhaustive multi-season survey, efficiency of all the sampling schemes decreased considerably with increasing species richness of studied ponds.

In practical issues, if the best possible estimation of Odonata diversity at multiple sites is the main goal, we strongly advise multi-stage survey repeated throughout the season. To avoid repeated visits of sampling localities, the only surrogate approach would be summer sampling of all three stages, especially when the sites are expected to host communities of similar diversity. In that case, however, lower sampling efficiency must be remembered.

This work was supported by the Slovak Research and Development Agency under contract No. APVV-16-0236 and by the Slovak Scientific Grant Agency (VEGA 2/0030/17).

Chironomidae of North Tunisian wadis – ecology, distribution and diversity

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North African wadis are unique habitats with severe hydrological and thermal regimes. Chironomidae (Diptera) are an important part of macroinvertebrate benthic communities in Tunisian flowing waters. Here new data on distribution, diversity and ecology of midge communities from seasonal wadis in Northern Tunisia are presented.

Preimaginal stages as well as adult males were collected from May 2005 till April 2006. In total, 79 taxa were identified. Investigated streams may be divided into two groups. Group I aggregates smaller streams with higher oxygen content and turbidity but lower conductivity and pH. These habitats are concentrated in the western, mountainous part of the country. All the other sites (gr. II) are mostly larger streams with higher pH and conductivity and lower oxygen concentration.

The pattern of Chironomidae communities is more complicated than environmental characteristics of wadis. Assemblages type A and B are more spread in the western, upland part of the country. They aggregate species typical of small flowing waters and ubiquitous taxa found from clear to more polluted waters. Assemblages type C, D and E are spread through all Northern Tunisia. They aggregate spring and small stream species (type C), larger, lowland and slow flowing water taxa (D) and reophile with ubiquitous (E) taxa.

RDA proves that BOD5, current velocity and water depth are the main factors determining taxa distribution among streams. CVA indicates that water depth, salinity, oxygen content and altitude are the main factors determining the division of communities into 5 groups (A-E). Most of the communities investigated are characterised by low to medium species richness (Margalef) but high evenness (Pielou). The exceptions are assemblages at Amor, Miliane and Barbar that are characterised by high evenness but also high species richness. There is also a group of communities at Ksar Mezouar, Milia (Hm Bourguiba), Mejerda av, Kesseb and Beja that reveals low species richness and evenness.

In conclusion, Northern Tunisia, despite a small area, shows diversity of habitats from lotic environments (on the west side) to lentic environments (on the east side). These habitat changes are accompanied by a variable gradient in the environmental factors that influence the nature and distribution of chironomid fauna.

From an oxbow to a mire – the response of Chironomidae and Cladocera to the long-term changes in Pawłowa palaeolake

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River valleys in Central Poland were undergoing transformations since the Late Glacial to the Neoholocene. Valley stagnant waters such as oxbows changed from small lakes in the Younger Dryas to mires in the Atlantic Period. Paludification is a common process, intensified since the Boreal Period, in Central European lakes. This process is well developed at the Pawłowa site in the Grabia River Valley (Central Poland). The response of Chironomidae (macrobenthic) and Cladocera (planktonic and meiobenthic) communities to the local and regional factors is linked to habitat guilds composition and taxonomic diversity. In the long-term, the summer air temperature and water level are the main drivers of midges' and water fleas' populations. Chironomidae are more sensitive to a water level decrease, and totally disappear in the mid-Holocene dry phase of the mire. Cladocera remain much longer despite advanced paludification. Both groups are used as a proxy for the past mean summer temperature reconstruction. Whereas Chironomidae reveal enough abundant populations for a palaeotemperature estimation only in the Late Glacial, Cladocera samples are almost large enough to obtain valid reconstructions also for the early Holocene. Chironomidae at the Pawłowa site reveal higher species richness and the inferred temperatures are based on multiple taxa. Cladocera-inferred temperatures are based on 20 species. Mesohabitats are the third factor that influences communities of both taxonomic groups. It is interesting to note that most of cladoceran taxa analysed are macrophyte/sediment-associated and three less abundant taxa are clearly sediment-associated. Among Chironomidae, phytophile species play only an accessory role in assemblages, and an overwhelming majority of taxa, including dominant ones, are associated with fine bottom sediments.

The influence of air and water temperature on spring fen macroinvertebrates: are they threatened by climate changes?

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Species closely associated with rare island-like habitats such as groundwater-dependent spring fens can be severely threatened by climate changes due to their limited possibility to disperse. However, only few studies have attempted to determine the effect of climatic conditions and even less is known about the real impact of water temperature on the variation of spring biota. At 30 isolated well-preserved spring fens in the Western Carpathian Mountains, we assembled a dataset on species macroinvertebrate composition along with water temperature, hydrological, hydrochemical, and climatic conditions. From April 2016 to April 2017, we continuously recorded water temperature by two dataloggers (Hobo Water Temp Pro v2) installed at each site, one in a patch of flowing water near the spring source and the other one placed in a patch with standing water. Our results showed that spring fen macroinvertebrates were strongly driven by both air (mesoclimate) and water (local) temperature, with a higher effect of spring-water temperature. Among water temperature variables, July water temperature and water temperature fluctuation explained most of the species compositional variation of aquatic macroinvertebrates, with higher explained variation in habitat specialists than in matrix-derived species. Species-specific responses to spring fen water temperature modelled by GLM functions showed prevailing preference of habitat specialists for colder sites with a low diurnal temperature variation. Some matrix-derived species preferred warm temperature conditions and the other have similar temperature preferences as habitat specialists. Our results thus imply that changing air (mesoclimatic) and water temperatures might cause substantial changes in species composition by warming up spring-water temperature. Such changes can also lead to homogenization of spring fen assemblages by the loss of local populations of specialized spring species.

The study was supported by Czech Science Foundation (project no. P505/16-03881S).

Emerging contaminants in freshwaters: deciphering impact on aquatic macroinvertebrate metabolic response and ecosystem transfer

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The presence of emerging contaminants (ECs) such as pharmaceuticals (PhACs) and endocrine disrupting compounds (EDCs) in the aquatic environment is well known, but the information on their presence and fate in aquatic organisms is still scarce, particularly in macroinvertebrates. Understanding of effects of PhACs and EDCs on aquatic biota is a prerequisite for a thorough assessment of their environmental risk and shaping future environmental policies.

Here we present an ongoing project aiming at advancing our knowledge on: I) endogenous and exogenous metabolic response of selected aquatic macroinvertebrates to mixture of PhACs and EDCs and II) bioaccumulation of these compounds and aquatic-terrestrial food web coupling. These objectives will be approached by combining field based research (*in situ*) and laboratory mesocosm experiments with selected macroinvertebrate taxa, primarily aquatic insects. Last generation analytical methods that include hybrid and high resolution mass spectrometric instrumentation will be used to study metabolomic profiles and to detect PhACs and EDCs in biota samples. Expected outcomes will reveal macroinvertebrate long-term low-dose exposure metabolite response patterns. In addition, time resolved mesocosm experiment will evaluate stress specificity during the time points providing an environmentally relevant temporal metabolite profiling. Furthermore, anticipated results will show dynamics of a whole body ECs concentration throughout the life cycle of aquatic insects, i.e. in all life stages. Furthermore, possible biomagnification scenarios during aquatic insects' emergence will be revealed, providing novel insights into contaminants' ecosystem transfer. Accordingly, we expect that achieved understandings of metabolic profiles of aquatic insects exposed to PhACs and EDCs, but also bioaccumulation and ecosystems transfer of these compounds will have direct application in the environmental risk assessment.

EPT taxa from mountainous and semi-mountainous sites (European river type R5): diversity, threats and conservation status

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Taxa of Ephemeroptera, Plecoptera and Trichoptera (EPT) are key indicators of water quality and are important components of food webs, especially in semi-mountainous and mountainous streams. Their vulnerability to alternations in abiotic factors (habitat degradation, acidification, pollution, climate change, etc.) may lead to their local or global extinction. Considering this, the aim of this paper is to report new data on some rare and endemic EPT taxa, thus improving the knowledge on their geographic distribution, threats and their current conservation status.

As a result of a field survey of mountainous and semi-mountainous streams carried out in October 2017 at 15 sites in Republic of Macedonia and 18 sites in Bulgaria, new data on the distribution of four species of the order Ephemeroptera (*Rhithrogena braaschi*, *Centroptilum luteolum*, *Baetis (B.) melanonyx*, *Procloeon (Pseudocentroptilum) pulchrum*), four species of the order Plecoptera (*Taeniopteryx schoenemundi*, *Dinocras megacephala*, *Nemoura uncinata*, *Chloroperla tripunctata tripunctata*) and two species of the order Trichoptera (*Diplectrona felix*, *Hydropsyche tabacarui*) have been collected. These data could be used to assess the conservation status of the studied species. Moreover, we present the first record of the mayflies *B. (B.) melanonyx* and *P. (Ps.) pulchrum* in R. Macedonia and new data on the distribution of the rare caddisfly *D. felix* in Bulgaria. Our findings indicate that the existing populations of the reported species are not well researched, due to the fact that there are still areas in the Macedonian/Bulgarian cross-border territory that are not properly studied in respect to aquatic insects diversity (e.g. studies on aquatic fauna of most of the small streams of the Osogovo, Ograzden and Maleshevska Mts. are scarce). While historical occurrence data are crucial, on-going future changes in the composition of the EPT taxa in Macedonia and Bulgaria could remain undetected unless current distribution of existing species is frequently updated.

This study was supported by project №DFNP-17-108/28.07.2017 “Implementation of biotic indices BMWP and ASPT in order to evaluate the ecological status of mountain and semi-mountain rivers from the 7th Ecoregion (Eastern Balkans)”, funded by Bulgarian Academy of Science.

The attendance of Vesela Evtimova in the 3rd CESAMIR 2018 was supported by the COST Action CA15219 DNAqua-Net within the ITC conference grant.

Assessment of contaminant concentrations and genotoxicity biomarker responses in bivalve mussels (Unionidae) from Lithuanian rivers

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Anthropogenic pressure on European rivers constantly increases. Among factors which adversely affect riverine ecosystems contamination by compounds of anthropogenic origin plays one of the key roles. A large proportion of such pollutants are potentially genotoxic and carcinogenic substances. Induced by genotoxins genetic disturbances may result in formation of developmental and degenerative diseases and entail decrease of reproductive potential. In the long term, genotoxic impact may cause irreversible changes of population structure and genetic diversity. Genotoxicity assessment and analysis of chemical contamination allows defining the status of aquatic ecosystems and provides early warning information about adverse long-term changes of the environment. A number of studies indicate that frequencies of micronuclei (MN) and nuclear buds (NB) serve as sensitive biomarkers of environmental contamination with genotoxic compounds. In the current study both biomarker responses were assessed in gill cells of mussels *Unio pictorum* and *U. tumidus* from 26 sites of the Nemunas River basin and 4 locations of the Mūša, Venta and Šventoji rivers. Concentrations of PAHs (18 compounds), PCBs (19) and heavy metals (10) were evaluated in sediments and soft tissues of mollusks from 21 stations. The highest levels of genotoxic effects (summed frequencies of MN and NB – up to 13.1‰) were observed in Nemunas mussels – the areas affected by municipal and industrial pollution of Lithuanian towns (Druskininkai and Alytus) and effluents from the Belarus Republic. In the sediments of these stations the increased concentrations of total PAHs (up to 1.43 mg/kg d.w., including dominant naphthalene – 0.847 mg/kg) and metals – Cr (101.91 µg/g d.w.) and Cu (11.843 µg/g d.w.) were observed, together with elevated levels of total PAHs (up to 2.70 mg/kg d.w.) and total PCBs (up to 0.08 mg/kg d.w.) in mussels. Among the tributaries of the Nemunas, the highest level of genotoxicity effects was in the unionids from the Šešupė River (summed frequencies of MN and NB up to – 12.5‰), where also increased concentrations of PAHs and PCBs in mussels were found. The study also revealed areas of the Neris and Mūša rivers where the level of contamination could be considered as close to the background. Using mussel genotoxicity data from these sites, the background level of MN and NB biomarker responses (summed frequency ≤ 6‰) was calculated as the empirical 75% percentile. In each study station, percentage of mussels with summed MN and NB frequencies exceeding the background level was assessed and classified according to a 5-grade scale of genotoxicity risk (0–19% – low, 20–39% – moderate, 40–59% – increased, 60–79% – high, and 80–100% – exceptionally high). For the first time at such extent genotoxicity risk assessment and grading was performed in different sites of Lithuanian rivers. Determined background level of genotoxicity biomarker responses would serve for future monitoring programs.

Distribution and diversity of polychaetes on continental margin in Gulf of Guinea (Ghana's coast)

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Polychaetes are a group of marine invertebrates, which are well - known as a perfect group for environmental assesment. Moreover, they are good indicators of environmental condition changes of oceanic floor. Since now Polychaetes of Western Africa was mainly object of taxonimics research. There are only few ecological research about Polychaetes of this region. Therefore there is a huge gasp in knowlegde about species composition in this area and we can expect many new species to describe.

Gulf of Guinea is the open bay located in the Western part of Africa. Material n obtained from 9 transects located across Ghana's coast. On each transect samples was collected on 6 stations, from shallow part of shelf (25 m) to bottom zone on Continental stock (1 000 m). On each there wastook 4 samples by Van Veen grab (0,2 m²). Sediment was flushed on sieves (mesh diameter 0,3 mm). In collected samples we found 11 543 invididuals, which are grouped in 53 families. Their numer and distribution was analized by physico-chemical factors. Next, we compared dominance between families on each station. The results show significant disturbance in families composition on transect G 8, what is related with estuary of Volta River – the biggest river in Ghana.

Hermaphroditic freshwater mussel *Anodonta cygnea* does not have supranumerary open reading frames in the mitogenome

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Anodonta cygnea (Linnaeus, 1758) is a freshwater mussel from the family Unionidae, distributed in Eurasian waters. The family is several hundred species rich, but most of them are found in North America. They are usually gonochoristic, with the presence of two distinct mitochondrial lineages, inherited under DUI system (Doubly uniparental inheritance). This system has been faithfully operating in freshwater mussels for a long time, leading to extreme divergence of the two mitogenomes. Gender specific anonymous open reading frames (ORF) have been described in both mitogenomes. The few species with secondary hermaphroditism were described, and in case of North American mussels, these always lost the divergent, paternally inherited mitogenome. There were also substantial structural changes in the FORF (now denoted H ORF).

Here we announce, for the first time, the mitogenome of a European hermaphroditic species from the same family. We were unable to find a distinct paternally inherited mitogenome in sperm of this species so we assume the announced mitogenome to be the only one present. The complete mitogenome of *A. cygnea* is 15,613 bp long. This compact, circular DNA contains the set of 37 genes, typical for invertebrate mitogenomes, in the same order and orientation as in maternally inherited genomes of other bivalves from the same subfamily. There are only two unassigned regions longer than 200 bp (266bp and 274 bp) and no indication of any supranumerary open reading frames (ORFs). The predicted protein sequences encoded by the mitogenome differ from the closest relative (*A. anatina* F mitogenome) by approximately 10% (average p-distance, calculated in MEGA7).

A molecular and conchological comparison of *Sinanodonta amurensis* Moskvicheva, 1973 and *Sinanodonta primorjensis* Bogatov and Zatravkin, 1988 (Bivalvia: Unionidae)

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Two species of anodontin freshwater bivalve in the Asian genus *Sinanodonta*, *S. amurensis* and *S. primorjensis*, were compared based on conchological features and the DNA sequences of seven mitochondrial genes coding two proteins, two ribosomal RNAs, and three *tRNAs*. Analyzed specimens of both taxa possess similar parameters of the shell and mitochondrial haplotypes, therefore it was found that all investigated samples belong to one species, *S. amurensis*, and the observed differences in shells and mitochondrial DNA sequences relate to intraspecific morphological plasticity and genetic variability in the species. It was shown *S. amurensis* and *S. woodiana* belong to two separate species.

Diseases and health issues of ornamental shrimps in exhibitions.

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Ornamental shrimp of two genera *Caridina* and *Neocaridina* were studied during international competitions of these crustaceans organized in Warsaw, Paris and Shanghai in 2018. The competition groups comprised of five representatives of the respective breed and variety were assessed for health and occurrence of adverse characteristics such as, presence of epibionts, mechanical damage, genetic defects. The detailed identification of defects was performed using microscopic analysis.

The test groups demonstrated the presence of epibionts representing the 5 following families: *Cladophoraceae*, *Saprolegniaceae*, *Scutarielidae*, *Philiodinidae*, *Vorticellidae*. The observations also allowed the determination of the characteristics recognised by the breeders as genetic deformations, among which were distinguished: impaired proportions of cephalothorax and abdomen, wrapped aerial, undeveloped gillnets covers, undeveloped uropods, as well as various types of mechanical damage resulting from the improper maintenance of animals and epibionts presence. Due to possible differences in the origin of the shellfish and the way in which they were transported before the competition at work, the assessment of stress levels and parameters indicating a weakened shrimp or an initial phase of bacterial or fungal infection. The results obtained were statistically analysed in order to determine the differences between the various contests and the types of shrimp in terms of their health.

It has been observed that shrimps presented in European competitions are characterised by fewer flaws, which can indicate a higher level of welfare for their farmers from this continent.

The biodiversity of macroinvertebrate communities in hyposaline settling ponds in a coal mine area (Upper Silesian Coal Basin, southern Poland)

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To date, research on the diversity of zoobenthos in saline coal mine settling ponds has not been undertaken. The study was carried out in three hyposaline settling ponds located in Knurów (Upper Silesian Coal Basin, Poland). The samples of macroinvertebrates were taken from both unvegetated sediments and the bottoms overgrown by macrophytes.

The water salinity expressed by the content of total dissolved solids was varied and amounted from 4.7 to 6.8 g L⁻¹ in settling pond 1, from 12.9 to 17.1 g L⁻¹ in settling pond 2 and from 16.3 to 21.1 g L⁻¹ in settling pond 3. The bottom sediments of the studied water bodies were slightly contaminated with lead, zinc, cadmium and copper. A higher content of cadmium was only found in settling pond 1 and copper in settling ponds 2 and 3.

In total, 44 macroinvertebrate taxa were found: 33 taxa in settling pond 1, 13 taxa in settling pond 2 and 16 taxa in settling pond 3, respectively. Among them, three species that are alien in Polish fauna were recorded: *Potamopyrgus antipodarum*, *Potamothenis bavaricus* and *Gammarus tigrinus*. *P. antipodarum*, *G. tigrinus* and Chironomidae dominated in settling pond 1, *G. tigrinus* was the most dominant species in settling pond 2, while Chironomidae and *Paranais litoralis* dominated in settling pond 3. In one of the studied water bodies, the corixid species *Sigara assimilis* was reported for the first time in Polish fauna.

The species diversity of the macroinvertebrates expressed by the Shannon-Wiener index H' was low in all of the studied water bodies. The diversity of the fauna was statistically higher in settling pond 1 and 3 compared to settling pond 2. The mean density of invertebrates ranged from 3433 individuals m⁻² in settling pond 3 to 8429 individuals m⁻² in settling pond 2. Only in pond 2 the density of the fauna was statistically higher on the unvegetated sediments compared to bottoms overgrown by macrophytes. The mean biomass of fauna ranged from 4.44 g m⁻² in settling pond 3 to 20.04 g m⁻² in settling pond 2.

Canonical correspondence analysis (CCA) showed that TDS, chlorides, sulfates, nitrates and oxygen were the parameters most associated (statistically significant) with the distribution of macroinvertebrates. *P. litoralis*, Chironomidae, Ephydriidae, Ceratopogonidae and *Ischnura elegans* were associated with the highest concentrations of TDS, chlorides and nitrates. *S. assimilis* was associated with a higher concentration of oxygen, whereas *P. antipodarum*, *Tubificinae*, *L. hoffmeisteri* and *Micronecta* sp. were associated with a higher concentration of sulfates. The study results did not show statistically significant relationships between the total content of heavy metals and the density and biomass of the zoobenthos or between the content of the mobile metal fractions and the density and biomass of macroinvertebrates.

The study has been partially funded by a “Młodzi Naukowcy 2017” grant from the Faculty of Biology and Environmental Protection, University of Silesia.

Non-native species of aquatic invertebrates in the Czech part of the Elbe River basin

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The disturbance of the original communities allows for more rapid propagation of non-native species. At present, there are 36 non-native and invasive species in the Czech part of the Elbe River Basin. The most prominent are the *Orconectes limosus*, which extrudes the original species of crayfish and spreads Crayfish plague - *Aphanomyces astaci*. *Corbicula fluminea* mainly forms on the Elbe downstream of the mass population and extrudes the original mollusc species. *Dikerogammarus villosus* is a predator that directly destroys the original species of Amphipods and Isopods, and then influences the predatory pressure on other aquatic invertebrates. In recent years, crustaceans *Jaera istri*, *Corophium curvispinum* and *C. robustum* have spread. In the summer months, their population grows massively and occupies the area in the litoral of downstream parts of Elbe River. Mollusc *Potamopyrgus antipodarum* spreads in small lowland nutritions polluted brooks. In Czech Republic, non-native species of aquatic invertebrates occur since the mid-19th century (Mlikovsky & Styblo (eds.) 2006). Originally they were introduced with an ornamental trade. Later, when the Danube - Rhine River basin was interconnected, there was a spontaneous spread of non-native species accelerated by shipping. In the Czech Republic, non-native species are currently spreading in the Elbe spontaneously, partly with the contribution of shipping. In the other parts of the Czech Republic, the main source of the spread of the handling of the fish stock and the deliberate release into the wild.

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Habitat requirements and distribution patterns of freshwater snails with special emphasis to Planorbidae: analysis in neighbouring to forest and forest ponds

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Aquatic ecosystems in industrial areas differ in many ways from natural ones, mainly in water chemistry, hydrology, morphology, and the composition of fauna and flora. Freshwater ecology of industrial landscapes has become increasingly important due to the constant formation of man-made ponds. Because of their different origin, they have become a diverse group of habitats. A specific type of man-made ponds are created in forests mainly because of their isolation from other aquatic habitats. This study was carried out in the freshwater man-made ponds located in the Silesian Upland, in the most urbanised and industrialised region in Poland. Research was carried out in environmental gradient to understand the factors that influence community structure and generate heterogeneity in species diversity across various types of human-made habitats (subsidence ponds, sand pits and fish ponds) at forested and non-forested locations. Highlighting the differences of variations in the number of abiotic variables study was conducted with multivariate gradient analysis. Habitat conditions among the types of ponds varied in the water chemistry, bottom sediments, sources of water supply, pond drainage and in terms of dominance patterns and densities. The gradient consisted of the response of a species to different substrates: mainly mud and sand covered with allochthonic detritus e.g. *Segmentina nitida*, *Gyraulus crista*, *Hippeutis complanatus* as well as to the water chemistry what confirms that gastropod composition is strongly influenced by the salinity state. Species belonging to Planorbidae comprised 62.6% of all the snails. Only 3 out of 10 Planorbidae species occurred in all types of urban ponds. Two-way indicator species analysis split the clusters into four groups with respect to substrate type and location. According to TWINSPLAN Planorbidae species were indicators of forest ponds. This study showed that even though there are differences in snail species richness among ponds, each type of studied man-made pond located in an industrial landscape was a suitable habitat for freshwater snails. It can therefore be assumed that the importance of small human made water bodies in shaping the landscape is highly complex and multidirectional and they considerably contribute to freshwater biodiversity.

Leaf litter breakdown in ponds: a role of taxonomic and functional diversity of shredders

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There is a growing consensus that ecosystem level processes are strongly determined by the functional characteristic of organisms involved, rather than by their taxonomic identity. Leaf litter breakdown is a critical and driving ecosystem level process in many terrestrial and aquatic ecosystems. Although the role of leaf litter subsidies to streams have been studied extensively, the effect of leaf litter in lentic systems has received less attention despite the fact that leaf litter may play a crucial role in their functioning (e.g. ponds heavily shaded by riparian vegetation and/or located in forests). Aims of our pilot study were (i) to assess the influence of pond environment on the rate of black alder (*Alnus glutinosa*) leaf litter break-down, (ii) to evaluate the relationships between taxonomic (TD) and functional diversity (FD) of shredding macroinvertebrates and (iii) to quantify the effect of TD and FD on the leaf litter breakdown rate in ponds.

We exposed replicated coarse-mesh (5.0 mm) and fine-mesh (0.5 mm) litter bags in eight ponds in Slovakia. Physico-chemical parameters and leaf AFDM loss were measured at regular intervals for 6 months. TD and FD of pond-dwelling shredders were calculated as species richness and length of dendrogram branches based on two metabolism-related traits (max. body length, number of generations per year), respectively.

Litter breakdown proceeded at exponential rates (k) ranging from -0.0005 to -0.0019 degree-days⁻¹. Environmental characteristics such as temperature, altitude, concentration of oxygen, conductivity and pH did not significantly influence rates of litter breakdown. Altogether, 30 species of shredders from four taxonomic group (Crustacea, Coleoptera, Trichoptera and Diptera) were recorded. The effect of shredders presence on litter breakdown was marginally non-significant ($F_{1,77} = 3.49$, $p = 0.081$). The breakdown rate significantly increased with increasing of shredders density ($F_{1,6} = 4.45$, $p = 0.046$). TD and FD of shredder communities were significantly positively correlated (Spearman $\rho = 0.81$, $p = 0.004$). However, the rate of leaf litter breakdown was significantly influenced by the FD ($F_{1,6} = 4.90$, $p = 0.042$) but not by the TD ($F_{1,6} = 2.03$, $p = 0.144$).

Our results suggest that (1) ponds might be useful model systems for studies of biodiversity effects on decomposition processes since the rate of leaf litter breakdown is largely unaffected by background environmental conditions, (2) shredders do not seem to play such a prominent role in leaf litter decomposition as in running waters, (3) TD and FD are positively related but FD is more tightly linked with ecosystem functioning than TD, as theoretically expected. The results of our pilot study should be considered as preliminary; wider range of sites needs to be sampled to draw broader conclusions.

This work was supported by the Slovak Research and Development Agency under contract No. APVV-0059-11 and by the project IPA 11/2017.

Artificial ponds in the floodplain – More than refugia for amphibians

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The floodplains and its connected wetlands are important aquatic habitats. In Hungary due to the extensive river regulations, a large number of oxbows were established in the 1800s. These habitats are exposed to anthropogenic effects, disturbances and natural succession processes. Our survey on freshwater macroscopic invertebrates was carried out on the floodplain of River Ipoly. Most of the investigated ponds were refugial habitats artificially created in 2015. They have special conservation and ecosystem service values, like serving reproduction place for amphibians. Our aim was to highlight if these habitats provide similarly favourable living conditions for freshwater macroscopic invertebrates too, and if species with important conservation status also appear in the area. Besides the examination of freshwater macroscopic invertebrates, we analysed the chemical (nitrate, nitrite, ammonium, chloride, phosphate, chemical oxygen demand) and physical (temperature, pH, conductivity, dissolved oxygen) parameters of the waterbodies. We also examined macrophyte-vegetation, phytoplankton, amphibian and zooplankton fauna. We classified the thirteen sampling sites into two groups by on their size, origin and water supply. Each group add different aspects to the gamma-diversity of the area highlighting the conservation value of these refugial areas. We also detect close Co-Correspondence between macroscopic invertebrate and phytoplankton communities.

New record of *Ecdyonurus adjaricus* (Ephemeroptera, Heptageniidae) for Turkey and its habitat characteristics

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Ecdyonurus adjaricus is first described by Kluge, Godunko & Apanaskevich in 2012 from Autonomous Republic of Adjara, Georgia. They stated that this species belongs to *Helvetoraeticus* subgenus, which was recently established by Bauernfeind and Soldan (2012) (formerly known as *Helveticus* species-group). In this study, *E. adjaricus* was given as a new record for Turkey from Kaçkar Mountains in the Eastern Part of Black Sea Region, which is a part of Caucasian Biodiversity Hotspot. In addition, habitat characteristics, such as preferences of stream zonation, substrate, altitude, current, habitat, along with physico-chemical variables range, such as temperature, dissolved oxygen, electrical conductivity, pH, PO₄-P, NO₂-N, NO₃-N, NH₄-N and SO₄ were given and discussed.

Methodology and results of aquatic macroinvertebrate communities monitoring in the frame of Hungarian Biodiversity Monitoring System (2001-2017)

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The Hungarian Biodiversity Monitoring System, under the governance of Ministry of Agriculture, follows the changes in status and biological diversity of the threatened aquatic and wetlands habitats by the long-term surveillance of their aquatic macroinvertebrate communities since 2001. This indicator taxa involves a wide range of taxonomic groups with different ecological demands, phenological conditions and life cycle.

Their sampling methods, are in line with international standards and practice, and were adjusted to the Hungarian conditions (e. g. life cycle of target taxa, applicability of method in different water types). At first period (2001-2005) a qualitative method is optimized to length of sampling section and time was applied. From 2006 to meet requirements of Habitats Directive and Water Framework Directive we use quantitative method, the STAR-AQEM protocol (with some alterations) which based on “kick and sweep” technic, and this multihabitat sampling method considers the qualitative distribution of the habitat-types proportionally. Advantages of this multihabitat-type, quantitative method is that can be statistically assess (15 replicates in 3 section, 5-5 samples in each section) and related to surface unit (basic area for one replicates 0.0625 m²). The sample section in running water is 3x10 meter within a 250 meter wandered bed reach in the case of small water courses, and 3x20 meter within a 500 meter wandered bed reach in the case of rivers. In standing waters the sample section is 3x10 meter within a 250 meter wandered bed reach, where reed-grass (aquatic weeds), marsh-vegetation (helophytes) and opened sediment surface habitat types must be sampled. In all case, the wandered reach bed is cannot touch hydrologically modified section. Some habitat background information are also recorded for sampling section using fieldform.

At first 75 sampling plots were designated in country level and surveyed in every 3 years, which were enlarged to 150 plots (from 2017) surveying in every 6 years. Sampling plots covering all water types and the most important water bodies of nature conservation interest. For species of community importance additional sampling plots are surveyed in qualitative or quantitative way.

To follow and assess the changes in status and diversity of macroinvertebrates communities we analyse and compare species composition, density of individual, diversity indexes at the same locations and among the plots belong to a given water type in time. For the assessment of ecological status we apply the ecological qualifying index (Q_{BAP}), which is a multiplying value taking into account the significance, character and quantitative value of each species present in the sample, divided by the maximum value of the given water type.

Macroinvertebrate diversity of a drainage ditch exposed to different anthropogenic pressures

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Drainage ditches are waterbodies characteristic for many lowland agricultural areas, where they remove excess water, thus reducing the flood risk, but can also be used for irrigation. These habitats support highly diverse, although still poorly investigated, biological communities, including benthic macroinvertebrates. Due to high anthropogenic pressure, e.g. nutrient enrichment or pesticide contamination, many drainage ditches are ecologically degraded, resulting in the changes in benthic communities. In this research, carried out in June 2015, we analysed macrozoobenthos using a multi-habitat sampling method at eight sampling sites along a lowland drainage channel in northeast Croatia. Sampled microhabitats included mineral (macrolithal, mesolithal, microlithal, psammal and argyllal) and organic substrates (phytal) which covered more than 5% of the sampling area. Water physicochemical parameters were measured *in situ* and samples of both, sediment and water, were collected for the laboratory analysis of nutrients, organic matter, heavy metals and bacterial pollution. In total, 22 macroinvertebrate taxonomic groups were recorded belonging to Hydroida, Turbellaria, Bivalvia, Gastropoda, Hirudinomorpha, Oligochaeta, Hydrachnidia, Araneae, Isopoda, Amphipoda, Mysida, Collembola, Chironomidae, Diptera (excluding Chironomidae), Coleoptera, Ephemeroptera, Heteroptera, Megaloptera, Odonata and Trichoptera. The most abundant representatives were Chironomidae (73% of total abundance) and Oligochaeta (9% of total abundance), indicating poor water quality and organic enrichment at several sampling locations. Grouping of the sampling sites in the non-metric multidimensional scaling analysis suggests differences of benthos diversity and abundance, reflecting the ecological state at research sites. At the anthropogenically most disturbed sites, characterised by higher concentrations of heavy metals and organic carbon in the sediment and a higher number of faecal coliforms in water, the highest abundance of Chironomidae and Oligochaeta was found. These sites were characterised by the chironomid larvae whose bodies were intensively red coloured, what is characteristic of deficient oxygen concentrations. Also, the colour, texture and smell of the sediment indicated the organic pollution. At sites with more developed macrophyte stands, a higher macroinvertebrate diversity and a higher abundance of taxa were recorded, showing better ecological state and water quality. Our results indicate the possible existence of the point source of pollution in this area, leading to an excessive input of the organic and inorganic substances in the local drainage channels. Therefore, the utilisation of this water for irrigation or similar purposes would not be recommended.

Chironomidae assemblages of running and stagnant waters in the Tatra National Park

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Fauna and flora of the Polish part of the Tatra Mountains is quite well investigated. In the last decades, many high mountain, mainly oligotrophic, lakes have been studied there. Detailed studies of aquatic macroinvertebrates of many other habitats were conducted in that region in the 1970s. In 2012-2015, the macrozoobenthos of the Tatra National Park streams and diverse water bodies were collected and identified. The study also resulted in new data on Chironomidae larvae distribution.

We examined chironomid assemblages of 25 sites in the area of the Tatra National Park. The studied flowing waters included 5-6 sites at different altitudes from the Chochołowski Stream, Roztoka Stream and Sucha Woda Stream together with the headwaters areas. The following standing water bodies were investigated: an oligotrophic lake (Zmarzły Staw), dystrophic lakes (Niżni Staw Toporowy, Staw Smreczyński), and peatbogs (Wielka Pańszczycka Młaka, Wyżni Toporowy Staw, Waksmundzka Młaka and the peatbog near Smreczyński Staw). The samples were collected several times from each site from June till September 2014 using the standard kick-net sampling method.

A total of more than 50 chironomid taxa of 4 subfamilies were identified from the collected material. Besides spatial and altitude distribution, habitat preferences of many species were also specified and correspondence analysis graphs were plotted. The taxonomic richness and the structure of domination at each site were calculated, including the trends of its changes along the studied streams. The biodiversity was estimated by the Margalef index, Pielou index and TDI.

Even though the study was based on the morphological identification of Chironomidae in the larval stage, it is a very important contribution to the knowledge about the Central European mountainous non-biting midges. The study might be treated as the preliminary research preceding complex studies on mountainous chironomids, including morphological and genetic studies of all the developmental stages, phenology analyses, as well as palaeoecological analyses based on subfossil Chironomidae remains from sediment cores.

Preliminary checklist of Mayflies (Insecta: Ephemeroptera) of Kosovo

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Faunistic and taxonomy of Mayflies in the Balkans is still in progress. Only few areas or countries were subject of intensive surveys (mainly Macedonia in the middle of last century and recently Croatia). Virtually no data exist for Kosovo. To fill this gap, we selected 31 sampling sites, covering the main streams and ecological conditions of Kosovo's running waters. Twenty-one sites were monthly sampled from March to October 2017, while the remaining sites were only prospected once during this period. Approximately 3000 specimens were collected, sorted and identified. They were preserved in 96% ethanol and housed at laboratory of Faculty of Mathematical and Natural Sciences in University of Pristina, Kosovo. Based on this material, we were able to establish a preliminary checklist for Kosovo. This checklist encompasses 32 species belonging to 17 genera and 9 families. The most diversified families were Heptageniidae (3 genera and 14 species) and Baetidae (3 genera and 7 species). The following families are for the moment only represented by a single species: Ameletidae, Oligoneuriidae, Potamanthidae, Ephemeridae, and Caenidae.

Kosovo is shared between two ecoregions: Dinaric Western Balkan ecoregion (ER5) and the Hellenic ecoregion (ER6). Approximately half of 32 taxa were present in both ecoregions, 11 species being only recorded in the Dinaric Western Balkan ecoregion and 8 only in the Hellenic ecoregion as well as 13 species recorded for both regions. While *Baetis rhodani* (Pictet, 1843), *Baetis alpinus* (Pictet, 1843) and *Ephemerella parnassiana* Demoulin, 1958 are the most widely distributed species through the country, seven species were collected in a single site: *Metreletus balcanicus* (Ulmer, 1920), *Baetis pentaplebedes* Ujhelyi, 1966, *Habrophlebia eldae* Jacob & Sartori, 1984, *Potamanthus luteus* (Linnaeus, 1767), *Quatica ikonovski* (Puthz, 1971), *Epeorus yougoslavicus* (Samal, 1935), and *Ecdyonurus cf. starmachi* Sowa, 1971.

The future challenges will be to identify the cryptic species within difficult complex of species (*Baetis gr. rhodani*, *Cloeon gr. dipterum*, *Rhithrogena gr. sowai* (?), *Ecdyonurus gr. venosus* (?)). To solve these riddles, rearing in the field as well as barcoding of specimens will be performed. Emphasis on lentic habitats will be made as taxa such as *Caenis spp* and *Cloeon spp* are still under sampled. Finally, we want to clarify the ecological preferences of each species and their degree of vulnerability in Kosovo to offer an essential tool for running water management and river quality assessments.

Age and Sex-related changes in body composition in different parts of body in fresh water crayfish (*Astacus leptodactylus*).

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The main purpose of this work was to provide baseline data on aspects of body composition in different parts of body of during life-stages of the fresh water crayfish (*Astacus leptodactylus*). So they were release about 10000 juveniles in earthen pond. Sampling was done in three different stages of crayfish, after separation as gender different parts of body such as Chelae, carapace shell, viscera and abdomen meat were analyzed for chemical composition.

Based on the results protein percentages were decrease in both genders with increasing age but the amount of ash, fiber and fat increased. The level of fat, protein and fiber in experimental crayfish were estimated 2-3.5%, 37-45% and 33-35% respectively.

Ash values in different parts of body were between 30 - 50 percentages and minimum value of that was determined in abdomen meat with 8%. Sex-related changes were not seen in body chemical composition. There was significantly differences among chemical constituents in various organs of body and the average of body composition indices in each gender was significantly higher in the abdominal muscle and the viscera than the other organs ($p < 0.05$).

Overall, with considering the amount of fat and protein obtained in the both genders, they can be used as baseline data in the crayfish dietary formulation.

Short term research of ecological conditions of lake „Jeziorko Wdzydzkie” after biological bioremediation

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The recultivation of Lake “Jeziorko Wdzydzkie” a trial was carried out in 2016 year. It was by using the bioremediation method using the Aquamar Water Purifikation probiotic, which is a set of assembled microorganisms called primarily effective microorganisms (EM). Before the procedure microbiological, hydrological, hydrochemical and bioindication tests were carried out using plant and animal taxa; to determine the ecological status of the lake. These tests were repeated 11 months after the application, obtaining comparative data. Namely, there was noted: 1. a clear decrease in the concentration of fecal streptococci from the level of 1000-45000 to the level of 60-200 bacterial cells in 100 ml of the sample, and a decrease in the concentration of mesophilic and psychophilic bacteria was noted; 2. decrease in sediment thickness; 3. a definite increase in the transparency of water; 4. decrease in BOD₅ value and electrical conductivity; 5. the appearance of large amounts of *Ceratophyllum demersum* at a depth between 0.6-0.9 m; 6. increase in the LMI (Lake Macroinvertebrate Index) from 0.21 to 0.37; 7. increase in the number of species and abundance of water mites (Hydrachnidia); 8. increase in the number of species and number of ostracodes (Ostracoda); 9. decrease in dominance coefficient and increase of Simpson, Shannon-Wiener and Equivalence indexes. In summary, the observed changes were small but visible. Considering the very short time since the application of the probiotics, these changes are a very good prognosis for the future.

Invasion of benthic invertebrates into the Sea of Azov and the lower reaches of the Don River

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The Ponto-Caspian region is one of the key regions in the study of the processes of biological invasions on a global scale. Being part of large invasive corridors, which are the main ways of alien species expansion, the water bodies of the Ponto-Caspian basin turn out to be concurrently donors and recipients of a large number of invasive species. For the past five years only, the fauna list of invasive species of the Sea of Azov and the Lower Don basin has been supplemented as there are some reports on the registration of several species of benthic invertebrates, namely, the polychaetes *Aracia* sp., *Marenzelleria* sp., *Streblospio gynobranciata*, *Laonome calida*, the bivalves *Corbicula fluminea* and *Arcuatula senhousia*, and the sea anemones of the Edwardsiidae family. Our materials obtained in 2016 and 2017 on the distribution and abundance of alien species give evidence of the naturalization and the successful integration into the recipient communities of most invaders.

Three species of polychaetes (*Marenzelleria* sp., *Aracia* sp., *S. gynobranciata*) and sea anemones show a high rate of expansion. The *Aracia* sp. and *Marenzelleria* sp. were found in the delta of the Don almost simultaneously - in 2013 and 2014. Currently *Aracia* sp. forms clusters with a high density (638 ind./m²) in the delta of the Don, however, the species is observed rarely in the Taganrog Bay (the most freshened part of the Sea of Azov, with its average salinity 9.7-10.0 ‰). The other species, *Marenzelleria* sp., on the contrary, has colonized the Taganrog Bay (186 ind./m²), while in the delta of the Don it is infrequent. The *S. gynobranciata* were found in the southern part of the Sea of Azov in 2015, according to the materials of 2017, the average number of *S. gynobranciata* was 3 ind./m² in the Sea of Azov, in the Taganrog Bay – 5189 ind./m².

In the autumn of 2015 actiniae of the family Edwardsiidae were found in the southwestern and central Sea of Azov. By the autumn of 2016, the range of the invader extended to the eastern part of the Sea of Azov, including the Taganrog Bay. According to the materials of 2017, the average number of actinia was 374 ind./m² in the Sea of Azov, in the Taganrog Bay it amounted to 106 ind./m².

It is also possible to talk about the naturalization of the *L. calida* and the *C. fluminea*. The *L. calida* were found in the Sea of Azov in 2015, in 2017 these polychaetes were sporadically observed in the samples from the Taganrog Bay (2 ind./m²). In January 2017 the *C. fluminea* were found in the Lower Don basin in an abnormal temperature zone (Warm Canal of the Novocherkasskaya hydroelectric power plant). However, in the autumn of the same year several specimens of the corbicula were observed outside the thermal refugium. These data broaden our understanding of the range of the invader, but also leave open the question on what role the anomalous temperature zones play in the invasion of the corbicula into the basin of the Lower Don.

In 2015 the mollusks *A. senhousia* were found in the Kerch Strait. For the time being it is a single find, but given the high invasive potential of the mollusk, one can expect that the integration of this invader in the Azov Sea will also be successful.

Trophic organization of benthic macroinvertebrate communities of the Lyutoga River and its tributaries (South Sakhalin)

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Within one year (from April 2011 to March 2012), changes were monitored in the trophic structure of benthic communities in the Lyutoga River and its two tributaries in the upper (Frikena River) and lower (Partizanka River) reaches of the basin. The trophic groups were classified on the basis of feeding mechanisms and included shredders, collector-filters, collector-gatherers, scrapers and predators (Cummins, 1973). In the watercourses studied the group of collector-gatherers was most numerous by its species composition and constituted 69-101 taxa or 42-47% of the total number of recorded species. In the upper rhithral zone, the basis of the macrozoobenthos biomass was formed by two groups, namely, shredders (the dominant group was presented by the caddisflies *Neophylax ussuriensis*) and scrapers (several species of the stoneflies and Diptera: *Tipula* sp. were predominant there), their total portion averaged 76% of the annual total community biomass. In the middle rhithral zone, the biomass of the bottom community was formed, primarily, by shredders (there dominated such species as Diptera: *Tipula* sp., Plecoptera: *Amphinemura* sp., *Pteronarcys sachalina* and Amphipoda: *Gammarus lacustris*) and predators (Diptera: *Hexatoma* sp., Odonata: *Ophiogomphus obscurus*, Plecoptera: *Kamimuria* sp., Trichoptera: *Rhyacophila* spp.), the total share of which in the average for a year reached 70%. In the lower rhithron, collector-filters were the most important group in the trophic macrozoobenthos structure (Trichoptera: *Stenopsyche marmorata*, *Hydropsyche orientalis* and Ephemeroptera: *Serratella ignita* predominated) and collector-gatherers (representatives of Chironomidae family, mayflies of *Baetis*, *Cinygmula* and *Ephemera* genera dominated). With the large bivalve mollusks *Kurilinaia kurilensis* taken into account, the share of these groups in the total biomass of the bottom community constituted 92%.

Thus, the analysis of distribution of benthic trophic groups along the river bed from upper to lower reaches has shown that shredders and scrapers are predominant in the upper rhithral section, while shredders and predators occur in the middle rhithral, and the lower rhithral is occupied, primarily, by collector-filters and collector-gatherers. That ratio of trophic groups in macrozoobenthos communities is typical of clean submountain waters and can be used to make comparative assessments of changes in the ecological status of Sakhalin rivers affected by human activities.

New wood-boring deep-sea amphipod studied using morphological and molecular methods

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The deep-sea floor is supplied with a very small amount of organic matter. Sunken wood or plant remains have long been known as a valuable source of energy in this area known from low content of nutrients. Wood is widely distributed on the seabed and is found in all oceans and at all depths. This unique habitat is considered as ephemeral but is inhabited by specialized fauna. After mollusks, the second largest invertebrate group inhabiting wood remnants are crustaceans including amphipods. Ten-odd species of wood-associated Amphipoda belonging to five families and six genera were hitherto identified. Three of them belong to the genus *Bathyceradocus* – *B. stephensi* Pirlot, 1934, *B. iberiensis* Andres, 1977 and *B. wuzzae* Larsen & Krapp-Schickel, 2007.

During Kuram-Bio I expedition wood fragments were collected from the abyssal plain adjacent to the Kuril-Kamchatka Trench. The study of the wood-associated amphipod collection revealed the species of the genus *Bathyceradocus*. It appeared to be new to science and is in the process of taxonomic description. *Bathyceradocus* sp. nov. was found at the fresh piece of wood (possibly birch) collected from 5229-5217 m depth. The material consisted of 24 individuals including females (one ovigerous), male and juveniles. From the three known species of this genus, the present one differs among others, in the shape of propodus of gnathopod 1 and 2, shape of basis of pereopods 5-7 and armature of mandibular palp. DNA was successfully extracted from 17 individuals and the study of barcoding gene (cytochrome oxidase subunit I) revealed six haplotypes differing in five positions. This new amphipod species is at the same time the first discovery of genus *Bathyceradocus* from North West Pacific.

The biodiversity and the abundance of zoobenthos on the rocky littoral and below of oligotrophic lake

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Coastal shallows are the zones of the water reservoirs with high biodiversity and the abundance of zoobenthos. Benthic communities on the south-western coast of Valaam island in the Ladoga Lake were investigated to reveal the spatial patterns of benthic community distribution in relation to differences in geophysical parameters and hydrography in the littoral zone. It is typical for the northern part of Lake Ladoga with a rocky littoral and a complex relief of the coastal slope. The area was chosen because there are practically no anthropogenic influence and aquatic macrophytes there.

The research was conducted in July 2014-2017. A detailed description of the coastal slope's relief and grounds was carried out. The research strategy was based on these data. A syringe-sampler was used for the sampling of zoobenthos (including mobile species) and the estimation of benthic abundance on hard and mix grounds (Zuyev, Zuyeva, 2013). The syringe-sampler demonstrated optimal performance and maximum biomass of mobile species in samples on a complex coastal slope relief in comparison with other samplers (Petersen grab samples and quantitative data from sampling frame).

A total of 153 taxa were identified during the study period. A theoretical estimation of the maximum number of species (Heltshe, Forrester, 1983; Smith, van Belle, 1984; Chao, 1987) has shown that the research methods adequately reflect the zoobenthos species composition either on particular grounds or in the whole small bay on coastal slope. Forms and other characteristics of the coastal slope have had a great importance for the formation of abundance and biomass of zoobenthos.

For the first time, the distribution data of many native (*Monoporeia affinis*, *Pallaseopsis quadrispinosa*, *Mysis relicta*) and invasive crustacean species (*Gmelinoides fasciatus*) across the whole littoral range have been obtained.

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