

Book of Abstracts



LIMNOLOGIA2018

XIX Conference of the Iberian Association of Limnology
Inland waters and XXI century challenges: from scientific knowledge to environmental management
24 – 29 June 2018, Coimbra, Portugal

Welcome to LIMNOLOGIA 2018

Inland freshwaters represent only a minor fraction of total waters of our planet; however they comprise a large variety of systems, including lakes, lagoons, ground waters, streams and rivers that greatly differ in size, and water chemistry. Inland waters also support a strikingly and disproportionately high level of the world's biodiversity.

Historically, inland waters are linked to the rise of ancient civilizations. Many ancient civilizations grew and flourished along large rivers or other large sources of freshwaters as centers of intensive anthropogenic activities. Some civilizations collapsed due to environmental changes resulting in water scarcity. Some of the worst recent environmental disasters are related to bad water management (e.g. the collapse of the Aral sea). The misuse of water resources is an ongoing process, with large rivers that run dry (e.g. Colorado, Indus, Yellow) and dubious hydrological plans threatening biodiversity and marginalized human societies (e.g. inner Niger Delta). Unsafe water kills more people than all wars; it is estimated that every year 1.7 million people die in the world because of water related problems.

Inland waters provide ecosystem services to humans, including clean water for consumption, irrigation and hydropower, food, cultural and spiritual values. However, humanity's growing water needs, global climatic change, nutrients and pollutants run-off are exacerbating challenges of water scarcity and quality, which will in turn, increase the pressure we place on our inland waters.

These pressures challenge human societies to better understand rivers to properly manage freshwater resources. The Iberian Limnological Association meeting, to be held in Coimbra in June 2018, will be an interactive platform for scientists, policy makers, environmental managers, industry and all those interested in inland waters to discuss and share their ideas and expertise. We welcome all to the 2018 AIL meeting.



FCTUC FACULDADE DE CIÊNCIAS
E TECNOLOGIA
UNIVERSIDADE DE COIMBRA



MUSEU DA CIÊNCIA
UNIVERSIDADE DE COIMBRA



Venue

University of Coimbra, Polo II
Rua Silvio Lima
3030-790 COIMBRA

40°11'10.98"N 8°24'41.57"W

Organizing Committee

Manuel Graça (President)
Maria João Feio (Secretary)
Verónica Ferreira (Treasurer)
Ana Marta Gonçalves
Ana Pereira
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Beatriz Modenutti, Universidad del Comahue, Argentina
Catherine Pringle, University of Georgia, USA.
Cláudia Pascoal, Universidade do Minho, Portugal
Cedo Maksimovic, Imperial College, U.K.
Fernanda Cássio, Universidade do Minho, Portugal
Isabel Muñoz, Universitat de Barcelona, Espanha
Jesús Pozo, Universidad del País Vasco, Espanha
João M. Neto, Universidade de Coimbra, Portugal
José Lino Costa, Universidade de Lisboa, Portugal
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Marcos Callisto, Universidade Federal MG, Brasil
Margaret Palmer, University of Maryland, USA
Michael Danger, Université de Lorraine-METZ, France
Miguel Cañedo, Universitat de Barcelona, Espanha
Núria Bonada, Universitat de Barcelona, Espanha
Pedro R. Almeida, Universidade de Évora, Portugal
Pedro Anastácio, Universidade de Évora, Portugal
Pepe Barquín, Universidad de Cantabria, Espanha
Sergi Sabater, Universitat de Girona, Espanha
Vítor Gonçalves, Universidade dos Açores, Portugal

WORKSHOP

'Science Communication for Non-Scientific Publics'

24 June 2018, Limnology2018 Congress, Coimbra, Portugal

09h45 Introduction

10h00 *Science Communication Through Writing*, António Piedade, RÓMULO – Centro Ciência Viva, University of Coimbra

11h30 *Storytelling in Science Communication*
Ana Cristina Tavares
Science Museum, University of Coimbra

13h00 Lunch

14h00 *Visual Communication of Science*
José Costa, Faculty of Psychology and Education Sciences, University of Coimbra

15h30 *The "science" of infographics*
José Carlos Alves, Jornal Público

Venue: Room A

Get-together with editors

Meeting with young researchers and editors of scientific journals selected among the senior researchers participating in the congress.

Monday, 25 of June 2018, 18h-19h

University of Coimbra, Polo II; Central Building of the Science and Technology Faculty; Living room.

AGRHYDROM project.

A timely look at effects of agriculture on fluvial DOM: the role of hydrology

Friday, 29 of June 2018, 12:15, Auditorium

During the last years, various projects as 1000 Intermittent Rivers Project, Dryflux, EuroRun or DOMIPEX, have demonstrated how collaborative experiments based on simple and inexpensive methodologies can successfully answer ecological questions that require a broad spatial coverage. In this context, in 2016, the Iberian Association of Limnology (AIL) launched its second call for Collaborative Projects among young researchers with the double aim of funding original research and promoting networking among the young researchers. During the Limnologia 2018 meeting in Coimbra, we will present the preliminary results of the awarded project: AGRHYDROM. A timely look at effects of agriculture on fluvial DOM: the role of hydrology.

Owing to the current scenario of global change, which predicts an increase in both flow intermittency and agricultural practices, in the AGRHYDROM project, we examined the combined effect of seasonal hydrological fluctuations and agriculture on nutrient concentration and dissolved organic matter (DOM) quantity and composition. We analysed the concentration of dissolved organic carbon (DOC) and nutrients (nitrogen and phosphorous), and the DOM composition by fluorescence and absorbance metrics, in 24 agricultural streams and 24 forested streams across the Iberian Peninsula and Europe (Spain, Portugal, Switzerland and Germany) thanks to a team of 66 researchers from more than 20 institutions. Moreover, to understand how flow variations modulated the influence of land use on nutrients and DOM properties, the selected streams were sampled in three phases of the hydrological cycle: base flow, contraction and expansion phases.

We hypothesize a strong interaction between hydrological variations and land use that will modulate the influence of agriculture on fluvial nutrients, DOC and DOM properties through two possible mechanisms: through changes in the buffering capacity of streams, or through the alteration of the connectivity between the streams and their catchments. The results of this project will significantly contribute to a better understanding of the effects of agricultural practices, especially on highly fluctuating small rivers, and will help to design more specific management strategies aimed to avoid the impact of agriculture on streams at times of high sensitivity.

Award for best poster and oral presentations by students

All AIL student members with up-to-date quotas are automatically eligible to the awards. Each communication (oral and poster) will be evaluated by three anonymous researchers who will score from 1 to 10 the abstract, style, content and originality. The three best oral and poster communications will be awarded.

Exhibition: Women in Science

The study of inland waters- the limnology- is filled with passionate and fascinating women, who have vastly contributed to our current understanding of those precious ecosystems. Although being more uncommon during the grassroots of limnology, the female presence in the limnology community has become increasingly important through time. Indeed, currently women represent more than half of the scientists during the training periods. However, as in many other fields, their presence decrease at high research and management positions. In this exhibition, we invite you to meet some of the most relevant female limnologists at the global and at the Iberian Peninsula level. Moreover, we provide insights on the current gender situation and trends in limnology research to have a glance at the future. Join us to this journey!

Auditorium lobby





Margaret A. Palmer

INVITED SPEAKERS

**Restoration, watershed context, and biogeochemical processes:
from streams to wetlands**

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Despite the essential role that water plays in life, humans have degraded ecosystems to such an extent that the quantity or quality of water in streams, rivers and wetlands is at risk worldwide. In response, efforts to restore degraded aquatic systems have grown dramatically. While many restoration projects have focused primarily on ecological structure, restoration in practice has its scientific roots firmly in ecology and related fields that emphasize the role of ecological processes and landscape context in determining the self-sustainability of ecosystems. Without recovery of basic ecosystem processes including interactions at watershed scales, restoration is unlikely to lead to self-sustainability. I will provide a brief overview of restoration approaches and outcomes in the context of hydrologic and biogeochemical processes followed by several case studies as examples. The talk will end with a brief discussion of research needs to advance restoration of aquatic ecosystems. The first case focuses on streams that have been degraded by high population densities and associated impervious cover. While the primary approach to restore urban streams has been to manage the riparian zone or reconfigure channel form, more recent efforts have involved a combination of watershed, channel, and riparian practices that come closer to restoring processes. I will describe research to measure hydrologic, nutrient, and sediment retention processes before and after such projects and the insights we have gained from such research. The second case focuses on upland wetlands that vary in their hydrologic connectivity to perennial stream networks. Many of these wetlands have been altered by human modification including ditching. In some regions, efforts have been undertaken to hydrologically restore wetlands by plugging ditches so that wetlands do not drain quickly but hold surface water a larger fraction of the year. A focus on hydrologic connectivity is important because fluxes of materials from wetlands to downstream perennial waters may be significant. I will describe research to quantify temporal hydrologic connectivity of wetlands and intermittent channels to perennial stream networks and how this influences the concentration and composition of dissolved organic matter to downstream waters. The goal is to understand if hydrologic connectivity influences other processes such as microbial production.



Beatriz Modenutti

Aquatic deserts and the success of mixotrophic ciliates

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Andean-Patagonian transparent ultraoligotrophic lakes have a particular microbial food web, with the presence of large mixotrophic ciliates. These organisms exhibit different features that allow them to colonize either the epilimnion (*Stentor araucanus*) or the metalimnion (*Ophrydium naumanni*). *S. araucanus*, a dark pigmented (stentorin) species resistant to ultraviolet radiation, is always present in the upper layers of the epilimnion. This species needs high light supply to maintain endosymbiotic algal photosynthesis and was favored during years of shallower thermocline and high epilimnetic mean irradiance. In contrast, *O. naumanni* prefer the metalimnetic layers and was more abundant in years with deeper thermoclines, being photosynthetically efficient at low light intensities but susceptible to photoinhibition at epilimnetic light irradiances. This species dominates the photosynthetic biomass in the deep chlorophyll maxima of these lakes. Analysis of food vacuoles revealed a weak niche overlap, thus light climate, created by temporal or spatial variations in thermocline depth, is a key factor modulating relative success these mixotrophic ciliate species. Overall these species are stoichiometrically, carbon to nutrients, more balanced than the bulk seston, but the mechanisms by which each species regulates the elemental balance differ. *S. araucanus* regulates the light inside the organism, thus regulating the carbon fixation, while *O. naumanni* increases bacterivory with light, thus increasing phosphorus uptake. The low Carbon:nutrient ratio of these organisms would represent a very good food source for predators. The link between mixotrophic ciliates and zooplankton revealed that they are eaten by the cyclopoid copepod *Mesocyclops araucanus*. However, the stentorin pigment of *S. araucanus* increases oxidative stress in the predator. Combining field and laboratory analysis we showed that the wide amplitude of the diel vertical migration protects the copepods from stentorin-induced oxidative stress during daytime. Thus, a compound of a mixotrophic ciliate prey item can influence the vertical behavior of predators in order to minimize the negative effect.



Čedo Maksimović

Advanced planning and management of urban lakes and ponds as a part of Integrated BGS (Blue Green Solution)

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Traditional approach in urban planning requires that we “protect the nature/environment” and this usually meant at high irrecoverable cost. According to the Blue Green Solutions (BGS), recently developed within the EU BGD (Blue Green Dream) project, the next generation planning methodology uses “inverse solutions”. In this methodology, instead of “protecting nature”, we bring nature (actually NBS - Nature Based Solutions) to urban environment to protect us, urban dwellers. In this way the nature is also protected but in a more sustainable fashion. As opposed to conventional /opportunistic planning, application of our innovative planning and implementation tools such as GDPM (Goal Driven Planning Matrix) and evidence-based support is used for planning of urban amenities and infrastructure. This includes water, environment, energy, greenery, eco-systems and their services, reduction of natural disasters (flood, drought) and anthropogenic causes of urban heat islands, water and air pollution by catering for sustainability and resilience to climate changes and weather extremes. These are based on engagement of planning and other professionals, all relevant stakeholders as well as local and central government bodies, supporting policy makers from the very early stage of pre-planning. This lecture presents the new planning methodology and the new role of urban water bodies such as lakes, ponds, urban streams, groundwater aquifers, coastal waters. Presented will also be quantified interactions of these assets with other urban contents and integrated management of their functions as well as environmental, financial and other benefits of this approach. Multifunctional beneficial applications will be illustrated by several examples: (i) urban park's stream, used as multifunctional biotope, seasonal recreational facility, interacting with groundwater aquifer for urban flood mitigation, (ii) program for clean-up of tens of thousands of urban lakes, (iii) innovative (urban metabolic hub) wastewater treatment technology supporting urban landscaping and streetscape, urban amenities and reducing negative impacts of climate changes, (iv) multifunctional urban stream clean-up and urban stream rehabilitation program, (v) real time urban pluvial flood forecast and management program in interactions with multifunctional elements of WSUD (Water Sensitive Urban Design), upgraded to meet the BGS planning and management criteria.



Miguel Cañedo-Argüelles Iglesias

Emerging questions in freshwater salinization

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Humans have greatly increased and unbalanced the concentration of ions in freshwater ecosystems (a phenomenon termed “freshwater salinization”). This was already reported as a major water quality problem in the 1930's, but it had been largely neglected by policy-makers, water managers and scientists until the 2000s. Traditionally, freshwater salinization was mainly associated with rising saline groundwaters and irrigation in arid lands, but during the last 15 years many other causes of salinization (e.g. road salt, resource extraction, industrial and urban wastewaters) have emerged all over the world. This has led to a proliferation of studies on the topic that have shown how freshwater salinization greatly reduces aquatic biodiversity, placing it among the top drivers of biological degradation. Here I will summarize what we know so far about the causes of freshwater salinization and its impacts on ecosystems and human welfare, and I will talk about pressing research needs. Some of the questions that need to be tackled and that I will discuss here are: What is the spatial extent of freshwater salinization? How do ions differ in their toxicity to aquatic biodiversity? How does salinization interact with other stressors occurring in freshwater ecosystems? What are the sub-lethal effects of freshwater salinization and what are the implications for trophic interactions? What is the impact of freshwater salinization on ecosystem functioning and services? Does freshwater salinization pose a risk to human health? Answering these questions is crucial to advance towards a proper management and regulation of this global environmental issue. Given future prediction of increased water demand and climate change (e.g. sea-level rise, drought intensification in some regions), actions to prevent, mitigate and remediate freshwater salinization should be implemented as soon as possible.



Catherine M. Pringle

Climate-driven changes in hydrologic connectivity and emergent ecological effects in Neotropical streams: Long-term studies in Costa Rica and Puerto Rico

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Hydrologic connections in the landscape determine ecological patterns and rates of ecosystem processes at local to global scales. Management and policy decisions, on issues ranging from hydropower development to nutrient loading, are often made in the absence of information on how these hydrologic connections structure the landscape. We are further challenged to develop a predictive understanding of how climate-mediated changes in hydrologic connectivity affect the environment. We use the term hydrologic connectivity here to refer to water-mediated transport of matter, energy and/or organisms within or between elements of the hydrologic cycle. Two examples from the wet Neotropics illustrate the importance of long-term research on this issue. The first case study highlights lowland streams draining Costa Rica's Caribbean slope, some of which receive interbasin flows of regional subsurface groundwater. Regional groundwater is rich in phosphate and bicarbonate, which stimulate algal and insect growth rates, and buffer receiving streams against pH declines, respectively. Lowland streams, that do not receive regional groundwater, experience pH declines (as low as 4 for several months) as a result of the influx of local CO₂-rich groundwater following dry periods often associated with ENSO events. This is of concern given that climate models predict declining rainfall in the dry season and an increase in the frequency of ENSO events. The second case study focuses on Puerto Rico, where large dams block the access of native migratory fishes and shrimps to headwater streams that drain 23% of the island's mountainous interior. Extirpation of native biota above dams results in decreased leaf decomposition rates and increased algal biomass at a landscape scale. While streams draining El Yunque National Forest in northeastern Puerto Rico are relatively free-flowing and provide habitat for native biota, they are increasingly tapped for municipal water supplies. This results in reduced stream flow and severe reductions in hydrologic connectivity between the mountains and the sea during droughts. Predicted increases in the incidence of droughts and hurricanes underline the vulnerability of native fish and shrimp in the last relatively free flowing rivers on the island. In summary, the complexity of climate-driven changes in hydrologic connectivity creates interacting layers of emergent ecological effects that become apparent through long-term studies on decadal time-frames.



Alexandre Miró & Marc Ventura

Fish as local stressors of Pyrenean high mountain lakes: arrival process and impact on amphibians and other organisms

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Pyrenean high mountain lakes are naturally fishless due to hydrographic barriers that have prevented the natural colonisation of fish species from lower streams. However, there have been numerous introductions of trout to such ecosystems, both in historical and recent periods. Minnows have also been introduced recently as a result of recreational fishing with live-bait. Trout and minnow introductions can cause large ecological problems and ecosystem change in high mountain lakes, since both fish occupy the top of a lake's food chain. The study had two objectives. First, we wanted to investigate which particular anthropogenic and environmental factors best explained fish presence in the Pyrenean lakes. For that purpose we collected data on trout and minnow occurrence from 520 high mountain lakes >0.5 ha in the southern Pyrenees. The second objective was to investigate the effect of introduced fish on faunal groups such as amphibians, conspicuous macroinvertebrates and planktonic crustaceans. We also considered whether there was a trophic cascade from fish to the littoral epilithic community of these ecosystems. For that purpose we sampled 1736 Pyrenean high mountain lakes and ponds at different levels of intensity. The distribution of *Salmo trutta* in the lakes of the southern slopes of the Pyrenees was best explained by both anthropogenic factors and lake characteristics, while only anthropogenic factors linked to recreational fishing were associated with the distribution of the exotic trout *Salvelinus fontinalis* and *Oncorhynchus mykiss*. In the case of minnow occurrence, previous presence of trout in the lake was the most explanative variable, confirming its association with recreational fishing using it as live-bait. Fish presence was linked with the disappearance of most amphibian species. Minnows also showed a sizeable impact on the pelagic habitat, reducing the abundance of some herbivorous species of zooplankton that appeared to be unaffected by trout. In the case of amphibian species, we found that, although introduced fish had a high local impact, western-eastern patterns of some environmental variables are the main drivers of amphibian species distribution at Pyrenean range scale. In addition, we confirmed the presence of a littoral trophic cascade that defines most of the characteristics of the littoral epilithon of Pyrenean high mountain lakes and ponds through fish predation of tadpoles and hence, by a drastic reduction of grazing activity.



Michael Danger

Ecological stoichiometry in detritus-based headwater streams: current knowledge and perspectives

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Ecological stoichiometry (ES) is a unifying conceptual framework that focuses on how proportions of elements (in particular carbon, nitrogen, and phosphorus) affect organisms and ecosystems. A central tenet of ES is that elemental imbalances between resources and the requirements of organisms determine properties and drive ecological processes at all levels of biological organization, ranging from ecophysiology to population and community dynamics to ecosystem processes. To date, most ES studies have been directed towards the understanding of the herbivore-primary producer interactions. Yet, due to the generally low nutrient content of detritus, stoichiometric imbalances should be maximized at the detritus-decomposer interface. Forested headwater streams represent typical detritus-based ecosystems, where allochthonous detritus (leaf litter, woody debris, soil-derived dissolved organic matter) represent the main source of energy at the basis of food webs. During this presentation, I will propose a quick review of current knowledge on stoichiometric controls of headwater stream functioning. First, despite the large availability of data on detritus elemental compositions and their consequences for detritus decomposition, only a few studies investigated the elemental composition of microbial decomposers (bacteria and aquatic fungi). Due to their elemental plasticity, these decomposers are able to largely and quickly modify leaf litter elemental quality. Second, a growing number of studies investigated the relationships between detritus elemental composition and detritivores life-history traits, showing that elemental imbalances might represent a major determinant of secondary production in these ecosystems. The use of nutrient immobilization capabilities of microbial decomposers might represent an important step towards the proper experimental quantification of the roles of stoichiometry in detritus-based ecosystems, avoiding most biases generally arising in such studies. Finally, I will present the current gaps and some perspectives for understanding all the consequences of stoichiometry for detritus-based headwater streams functioning. In particular, upscaling results from studies carried out at the organism scale to population dynamics and community structures certainly represent a crucial step, requiring specific investigations.

Regular Sessions

- SR1. Ecotoxicology, Biomarkers and multiple stressors**
- SR2. New approaches for environmental assessment and management**
- SR3. Trophic interactions in aquatic ecosystems**
- SR4. Ecosystem Functioning**
- SR5. Ecosystem Services**
- SR6. Biodiversity and Biogeography**
- SR7. Aquatic Invertebrates**
- SR8. Fish Ecology**
- SR9. Primary Producers**
- SR10. Microbial Ecology**
- SR11. Nature Based Solutions (NBS) in Urban Planning and Management**
- SR12. Lakes, Reservoirs and Wetlands**
- SR13. Brackish waters and Estuaries**
- SR14. Global Change (biological invasions, nutrient enrichment, climate change)**
- SR15. Conservation and Restoration**

Special sessions

- SE1. The use of molecular tools in ecological and biodiversity assessment of aquatic ecosystems**
- SE2. Microplastics in aquatic environments**
- SE3. Understanding carbon cycling in inland waters: from microbial function to ecosystem processes**
- SE5. Understanding the consequences of urban pollution on freshwater ecosystems**
- SE6. Bringing interdisciplinary actions for river and riverine management**
- SE7. Advances in freshwater community ecology**
- SE8. Ecology and management of temporary freshwater systems**
- SE9. Hydrology, water resources and ecology of mountain headwaters**
- SE10. Ecohydraulics in the global context of river flow alterations and impacts for freshwater fish**
- SE11. Homenaje a la Dra. Julia Toja: Conservación y gestión de embalses y otros ambientes acuáticos**

Monday, 25

Auditorium

8h00 Check in

9h00 Opening

Margalef Conference: **Palmer M.** Restoration, watershed context, and biogeochemical processes: from streams to wetlands

10h30 Exhibition Women in Science: Inauguration

10h45 Coffee

SE8 - **Barbosa L, Detry T, von Schiller D**

11h15 **Detry T**, Foulquier A, Corti R, von Schiller D, Shumilova O, Tockner T, 1000IRPteam. A global perspective on carbon dynamics in intermittent rivers and ephemeral streams.

11h30 **Arias del Real R**, Muñoz I, Menéndez M. Increased flow intermittency reduces aquatic hyphomycetes richness affecting leaf litter decomposition.

11h45 **Florín M**, Campos A, Cerrillo I, León I, Villanueva JM. Diffuse and point pollution in the highly valuable Mediterranean river Bullaque (Guadiana catchment, Central-SW Spain).

12h00 **Yu S**, Bond N, Bunn S, Xu Z, Kennard M. Quantifying spatial and temporal patterns of flow intermittency using spatially contiguous runoff data

12h15 **Parra G**, Gilbert JD, Jiménez-Melero R, Ortega F, Guerrero F. Yes, tiny things are relevant: the use of zooplankton community in Mediterranean temporary wetland assessment and management.

12h30 **Crabot J**, Detry T. Temporal variability of metacommunities structure in intermittent rivers: interaction with the spatial drying pattern.

12h45 Lunch

Room A

SR12/13 - **Antunes S**

Raposeiro PM, Saez A, Giralt S, Costa AC, Gonçalves V. Causes of spatial distribution of subfossil diatom and chironomid assemblages in surface sediments of a high gradient lake.

Santofimia E, López-Pamo E, Ruiz JM, Mejías M. Modificaciones ambientales en el humedal del Parque Nacional de Las Tablas de Daimiel propiciadas por la actividad de especies exóticas invasoras.

Llorente A, **Seoane S**. Phytoplankton community composition and dominant pigments during mixing period in Lake Sanabria (NW Spain).

Santos JI, Vidal T, Mendes C, Ré A, Gonçalves FJM, Castro BB, Pereira JL. Influence of invasive Asian clam distribution patterns on macroinvertebrate assemblages and water ecological status in a semi-artificial catchment.

Toro M, Seisdedos P, Negro AI, Alonso R, Vega JC, Alonso M, Sánchez-Castillo PM, Monteoliva AP, Marco J, Valero B, Catalan J, Alonso AM, Arias S, Artiñano B, Barreales R, Barreiro F, Bermejo V, Calvete H, Cobo G, Hoyos C, Díaz E, Domínguez A, Fanés I, García H, González P, Hernández N, Leira M, Lizana M, Moreno A, Morales J, Nuño C, Pahissa J, Peg M, Pérez ME, Pla-Rabés S, Rasines A, Roblas N, Robles S, Salvador P, Valiño F, Vargas JL. Estudio limnológico del lago de Sanabria y su cuenca: un proyecto multidisciplinar para evaluar su estado y funcionamiento ecológico.

Baptista GM, Pereira MJ, Vieira MN, Marques JC, Gonçalves AMM. Spatio-temporal composition of phytoplankton community in the Mondego estuary, Portugal.

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9h00 Opening

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10h45 Coffee

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SR12/13 - **Antunes S**

Raposeiro PM, Saez A, Giral S, Costa AC, Gonçalves V. Causes of spatial distribution of subfossil diatom and chironomid assemblages in surface sediments of a high gradient lake.

Santofimia E, López-Pamo E, Ruiz JM, Mejías M. Modificaciones ambientales en el humedal del Parque Nacional de Las Tablas de Daimiel propiciadas por la actividad de especies exóticas invasoras.

Llorente A, **Seoane S**. Phytoplankton community composition and dominant pigments during mixing period in Lake Sanabria (NW Spain).

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Baptista GM, Pereira MJ, Vieira MN, Marques JC, Gonçalves AMM. Spatio-temporal composition of phytoplankton community in the Mondego estuary, Portugal.

Monday, 25

Auditorium

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9h00 Opening

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10h30 Exhibition Women in Science: Inauguration

10h45 Coffee

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Auditorium

Room B

8h45	Danger M. Ecological stoichiometry in detritus-based headwater streams: current knowledge and perspectives.
	SE7 - Sánchez-Fernández D, Gutiérrez-Cánovas C, Bonada N
9h30	Bonada N , Dolédec S. Does the Tachet trait database report voltinism variability of aquatic insects between Mediterranean and Scandinavian regions?
9h45	Belmar O, Bruno D, Guareschi S, Mellado-Díaz A, Millán A, Velasco J . Flow intermittence shapes the effect of flow regulation on macroinvertebrate functional structure and diversity in Mediterranean streams
10h00	Viza A , Garcia-Raventós A, Martín R, Maynou X, Prunier F, Riera JL, Múrria C. Predicting future species distribution of Odonata in Iberian Peninsula under Climate Change.
10h15	Prat N , Acosta R, Cañedo-Argüelles M, Castro D, Cid N, Fortuño P, Gutiérrez-Cánovas C, Múrria C, Soria M, Tarrats P, Verkaik I, Bonada N. Long-term changes in metacommunity assembly mechanisms in Mediterranean rivers.
10h30	Castillo-Escrivà A , Pereira CL, Sroczynska K, Faisca P, Araújo MB, Matias M. Zooplankton responses to environmental changes across a biogeographical gradient.
10h45	Coffee
	SE7 - Sánchez-Fernández D, Gutiérrez-Cánovas C, Bonada N
11h15	Gutiérrez-Cánovas C , Sánchez-Fernández D, Millán A, Velasco J, Cañedo-Argüelles M, Bonada N. Do all roads lead to Rome? Exploring community trajectories in response to anthropogenic salinisation and dilution of rivers.
11h30	Mesquita-Joanes F , Castillo-Escrivà A, Rueda J. Incorporating time effects when analysing (aquatic) metacommunities.
11h45	Pinto R , Mortágua A, Almeida SFP, Serra S, Feio MJ. Diatom size plasticity at the global and regional spatial scales
12h00	Matias MG . IberianPonds: Predicting responses to climate change from genes to ecosystem services.
12h15	AGRHYDROM project Campo R
12h45	Closing session

SE6 - Aguiar FC, Fernandes MR
Aguiar FC , Fernandes MR, Martins MJ, Ferreira MT. Surveying the past on reliquial habitats: the Guadiana River in the post-Alqueva era.
Bergmann M , Caro C, Quirós R, Greni DO. Macroinvertebrados como catalizadores para la gestión ambiental de los ríos.
Zinke P , Dervo B. Implementation of fluvial hydraulics and structure parameters into the nature classification system "Nature in Norway".
Amaral SD , Branco P, Romão F, Viseu T, Ferreira MT, Pinheiro AN, Santos JM. Upstream movements of a potamodromous cyprinid past an experimental broad-crested small weir.
Lozanovska I , Ferreira MT, Aguiar FC. Predictors of functional change in riverine landscapes: multiple ways and approaches.
Coffee
SE6 - Aguiar FC, Fernandes MR
Fernandes MR , Santos A, Aguiar FC, Branco MR, Ferreira MT. Historical cartography as bases for studying changes of pollinator services in riverine landscapes.
Duarte G , Segurado P, Oliveira T, Haidvogel G, Pont D, Ferreira MT, Branco P. The River Network Toolkit.

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12h30	Crabot J , Datry T. Temporal variability of metacommunities structure in intermittent rivers: interaction with the spatial drying pattern.	Baptista GM , Pereira MJ, Vieira MN, Marques JC, Gonçalves AMM. Spatio-temporal composition of phytoplankton community in the Mondego estuary, Portugal.
12h45	Lunch	

POSTERS

Monday 25

SR4

1. **Galera LA**, Augusto FG, Medeiros GG, Figueiredo AF, Martinelli LA. Mesh size interferes in decomposition rates of two plant species in tropical streams of the Atlantic Forest, Brazil.
2. Calderón C, Rezende RS, Calor A, Dahora J, Guedes L, Nasser A, **Medeiros A**. Litterfall phenology structuring the aquatic decomposer community in a low order stream.
3. Canhoto C, Belihu T, Simões S, Oliveira R, **Gonçalves AL**. Can streams salinization affect fungal-mediated leaf degradation and invertebrates' feeding behaviour?
4. Balibrea A, Ferreira V, Balibrea C, Gonçalves V, **Raposeiro PM**. Contribution of shredders to leaf litter decomposition in remote insular streams.
5. **Ramos SM**, Graça MAS. A qualidade física e química da folhagem de espécies ripárias difere entre biomas?
6. Parra-García EA, Picazo A, García C, **Camacho A**. Trophic planktonic relationships and ecological functioning of the photic zone of a high-altitude Andean tropical reservoir in Colombia.
7. Serra F, **Abelho M**. Decomposition of the invasive *Acacia longifolia* in a stream
8. **Sena G**, Júnior JF, Martins R. Leaf-traits control the litter processing by *Phylloicus* (Muller, 1880) of Brazilian Savannah and Tropical Rainforest streams.
9. Pazianoto L, Solla A, Cubera E, **Ferreira V**. Infection by a pathogenic oomycete more than the increase in water temperature affects sweet chestnut leaf litter decomposition

SR6

10. **Benetti CJ**, Santana LO, Pes AMO. Diversity and composition of Hydrophilidae assemblage (Coleoptera) in ponds of Northern Brazil.
11. **Craveiro SC**, Pandeirada MS, Calado AJ. *Kolkwitzella acuta* (Protoperidiniaceae), freshwater member of a mainly marine group of heterotrophic dinoflagellates with an outstanding feeding mode
12. **Sendra MD**, Moschini-Carlos V, Pompêo MLM, Soria X, Soria JM, Vicente E. *Ceratium furcoides* (Levander) Langhans en embalses de la cuenca del Ebro en España y embalses del estado de Sao Paulo en Brasil.
13. **Sendra MD**, Soria X, Soria JM, Vicente E. Diferencias morfológicas de *Ceratium hirundinella* (O.F. Müller) Dujardin en los embalses de la cuenca del Ebro en relación con sus distintas características.
14. **Oficialdegui FJ**, Lejeune C, Clavero M, Boyero L, Green AJ, Kawai T, Klöse K, Sánchez MI. The history of a worldwide invasion: the case of the red swamp crayfish, *Procambarus clarkii*, in Europe.
15. Luz R, **Toro M**, Fonseca A, Gonçalves V. Azorean cyanobacteria checklist: biodiversity and distribution.

16. Fernández-Moreno D, Sánchez-Castillo PM, Delgado C, **Almeida SFP**. *Navicula maiorpargemina* sp. nov. (Bacillariophyceae) a new diatom from a saline wetland in the south of Spain.
17. **Sánchez-Fernández D**, Filipe AF, Hermoso V, Múrria C, Olivero J. Assessing cross-taxon congruence in chorotypes of European freshwater fauna.
18. **Gonçalves V**, Luz R, Cordeiro R, Xavier E, Fonseca A, Neto AI. Azorean Bank of Algae and Cyanobacteria: a resource for biodiversity assessment and biotechnological applications
19. **Esteves KE**, Silva MHC, Nanini-Costa MH, Petesse ML. Organization of fish assemblages in Atlantic Forest blackwater streams (São Paulo, Brazil).
20. **Campelo PH**, Pires-Vieira LH, Cavalcanti Júnior MM, Macedo MA, Sousa NOM, Sversut Dias MS. Dam height and time since damming affect distinct groups of fish fauna.

SR12/13

21. **Rascón J**, Corroto F, Leiva-Tafur D, Torres OAG. Dinámica espacio-temporal del estado trófico en un lago altoandino tropical del Norte de Perú.
22. **Rodríguez E**, Vicentin A, Pompêo M, Carlos VM. Phytoplankton functional groups in tropical reservoirs of São Paulo state: water quality assessment method by Assemblage Index – Q Index.
23. Wieliczko A, **Rodríguez LR**, Motta-Marques D, Crossetti L. Phytoplankton structure is more influenced by nutrient enrichment than by temperature raise: an experimental approach in a subtropical lake.
24. Pinto F, Sousa N, Banha F, Gama M, Anastácio P, Castro BB, **Antunes SC**. Zooplankton dynamics of the reservoirs of the Alqueva Irrigation System.
25. Mízael JOSS, Silva SC, Frascarelli D, Moschini-Carlos V, **Pompêo M**. Ecosystem history of artificial tropical reservoir revealed by phytoplanktonic pigments preserved in sediments.
26. **Alves AS**. Meet the nematodes from the Mondego estuary: taxonomical and functional diversity.
27. **González V**, Menéndez M. Caracterización del estado ecológico en una laguna costera y alternativas de gestión.
28. **Montes-Pérez JJ**, Blanco JM, Rodríguez J, Rodríguez V, Moreno-Ostos E. Limnological features and phytoplankton size-structure in a protected estuarine wetland (Guadalquivir river mouth).
29. **Toro M**, Granados I. Variabilidad morfométrica y distribución de los lagos de alta montaña del Sistema Central (Península Ibérica).

30. García-Murcia A, Romans E, Real M, Rodríguez MJ, Alonso M, Miro I, Julià X, **Noguero J**. Environmental factors influencing the distribution and abundance of littoral invertebrates in Ebro basin lakes.
31. Santos A, **Santos L**. Fish assemblages in the largest Brazilian hypersaline lagoon during a low salinity year
32. Rocha CP, Cabral HN, Nunes C, Coimbra MA, Gonçalves FJM, Marques JC, **Gonçalves AMM**. Variation of the nutritional composition and ontogeny of gilthead seabream and European seabass reared in different Portuguese estuaries.
33. **Soria JM**, Hernández N, Domínguez JA, Erena M. Seguimiento del estado trófico y calidad del Mar Menor durante 2017.
34. **Vicente E**, Sendra MD, Soria X, Sancho-Tello V, Soria JM. Eutrofización, blooms y toxicidad en los embalses de la Cuenca del río Ebro.
35. Bartolomé G, **Negro AI**, Pérez-Rodríguez ME, Fernández-Aláez MC, García-Criado F. Characterization of summer phytoplankton of mountain lakes from the Duero river basin using morphology-based functional groups.
36. **Rodríguez Castillo A**, Rodríguez J, Bopp G, Zelada O, Grados L. Caracterización Limnológica de tres Lagunas Altoandinas en la Región La Libertad, Perú.
37. **Gossen Siani AC**. Valoración del Potencial Ecológico de las aguas del Embalse de Itaipu Binacional.

SE9

38. **Rubio-Romero A**, Granados I. Índices biológicos en un espacio protegido de alta montaña (Sierra de Guadarrama). ¿Son realmente de utilidad?
39. **Niedrist GH**, Füreder L. When the going gets tough get going: the enigma of feeding strategies in harsh environments.
40. Palau-Nadal A, Rocaspana R, Aparicio E, **Palau-Ibars A**. Efectos de las hidropuntas de una central hidroeléctrica sobre la estructura de la población de trucha (*Salmo trutta*).
41. Vericat D, **Palau-Ibars A**, Batalla RJ, Palau-Nadal A. Efectos de las hidropuntas de una central hidroeléctrica sobre la movilidad de los sedimentos fluviales.

SR7

107. Llanos A, **Palau-Nadal A**. Aproximación a la caracterización del microhábitat biofísico del macrobentos en un río de montaña.
108. **Palau-Nadal A**, Palau-Ibars A, Ciutat G. Efectos de las hidropuntas de una central hidroeléctrica sobre la organización y estructura de la comunidad de macroinvertebrados bentónicos.

SR2

42. **Aguiar FC**, Fernandes MR, Ferreira MT. Tools for macrophyte-based monitoring and research.
43. Sanz-Ramos M, Bladé E, Palau A, **Ramos-Fuertes A**. Estudio de la influencia de los macrófitos en la hidrodinámica de un río empleando simulación numérica 2D.
44. **Soria-Perpinyà X**, Durán C, Vicente E, Soria JM. Fluorescencia del CDOM como aproximación a la concentración de DOC en embalses y variables que influyen.
45. **Doña C**, Morant D, Garcia-Picazo A, Picazo A, Rochera C, Santamans AC, Miralles-Lorenzo J, Sánchez JM, Camacho A. Identification and delineation of marginal vegetation in Mediterranean wetlands using several remote sensing techniques.
46. Zaragüeta M, **Goldenberg-Vilar A**, Rodríguez JM, Roldán V, Pérez-Bilbao A, San Juan J, Rebella D, Ortega A, Álvarez-Troncoso R, Robles S, Navarro P. iDIAT-ES. A new diatom index to assess the ecological status of Spanish rivers: Index validation in the Ebro River Basin.
47. **Morales J**, Negro AI, Leira M, Bartolomé G, Núñez L, Hidalgo M, Lizana M. Efectos de la presencia humana masificada sobre zonas de reproducción de *Cobitis calderoni*. Evaluando el estado ecológico de un lago desde las orillas.
48. Cillero C, Delgado J, Díaz Varela RA, Domínguez JA, Hinojo B, **Cereijo JL**, García D, Cheda F, Rubinos M. Desarrollo de herramientas de monitorización de la calidad del agua en pequeños embalses mediante imágenes tomadas con sensores multiespectrales.
49. **Castro D**, Bevilacqua MS, Almeida T, Ribeiro EG, Felix RW, Figueiredo-Barros MP, Guerra V, Esteves FA, Prat N. Evaluación del bosque de ribera del río Macaé (NE, Brasil), a través del índice QBR (Qualitat del Bosc de Ribera).
50. **Gonçalves S**, Kahlert M, Figueira E, Almeida SFP. Freshwater diatom (*Tabellaria flocculosa*) teratologies and Chl c as biomarkers for Cu and Zn contamination.
51. **Peifer Bezerra M**, Garcia ARM, Viana EAP, Amancio RCH, Bezerra-Neto JF, Barbosa FAR. Fluorescência do carbono como ferramenta diagnóstica da qualidade da água: um estudo de caso com a Lagoa da Pampulha (Minas Gerais, Brasil).
52. **Amatí Martins I**, Fein D, Pompêo MLM, Bitencourt MD. Determination of the Trophic State Index (TSI) using remote sensing, bathymetric survey and empirical data in a tropical reservoir.
53. **Campos C**, Salles P, Junior JG. Um modelo qualitativo para a gestão de bacias hidrográficas baseado em processos ecológicos.
54. Fortuño P, Verkaik I, Ladrera R, Soria M, Cid N, Bonada N, Prat N. RiUNet APP: Bridging the gap between citizens and river management, with special attention to temporary rivers.

SR5

55. **Clusa L**, Fernández S, Dopico E, García-Vázquez E. The effect of barriers on the diversity of aquatic fauna: the Nalón River (northern Spain) as a case study.
56. **Herrero S**, Stratmann C, Stephan S, Velthuis M. Urban Algae: Ecological Status and the Perception of Ecosystem Services of Urban Ponds.

SR10

57. **Sipaúba-Tavares LH**, Galatti-Tedesque M, Santos GLM, Scardoeli-Truzzi B. Macrophytes to improve the cultivation of the microalga *Ankistrodesmus gracilis*.

SR14

58. **Rodrigues Capítulo AR**, Paz LE, Ferreira AC, Ocon C, Altieri PS, Colpo KD. Estudio del caracol exótico *Sinotia quadrata* (Viviparidae Caenogastropoda) hallado recientemente en arroyos de la llanura pampeana Argentina.
59. **Roblas N**, Vargas JL. Estudio del nivel de afectación de las masas de agua continentales españolas por trece especies exóticas invasoras de importancia para la Unión Europea.
60. **Vicente de Vera A**, Saz MA, Valero BL. Flujo de sedimento, carbono y metales pesados en un lago de alta montaña durante el último milenio en el Lago Urdiceto (Huesca, Pirineos).
61. Rodríguez JM, Pérez A, Robles S, **Zaragüeta M**, Valle JM. Estudio fenológico de *Dreissena polymorpha* (Pallas, 1771) en embalses del País Vasco.
62. Vendramini B, Ferrarez L, Franca R, **Brandimarte A**. Decomposição e química foliar de espécie ripária em riachos de Mata Atlântica e Cerrado.
63. Vilaverde J, Alonso M, **Marques HS**, Bao R, Hernández A, Saez A, Giralt S, Gonçalves V, Raposeiro PM. Mid to Late Holocene environmental reconstruction based on Cladocera fossils in the sediments of Lake Caveiro (Pico Island, Azores).
64. **Pereira A**, Sobral O, Figueiredo A, Ferreira V. Can the invasion of native forests by *Acacia spp.* affect leaf decomposition in streams?
65. **Caputo L**, Huovinen P, Sommaruga R, Gómez I. Water transparency affects the survival of the medusa stage of the invasive freshwater jellyfish *Craspedacusta sowerbii*
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68. **Gouin N**, Bertin A, Espinosa M, Ali J, Allmon L, Snow D, Kolok A. Pesticide contamination affects genetic diversity and population differentiation of a mayfly species within a Chilean agricultural watershed.

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69. Pazos RS, Bauer DE, **Gómez N**. Microplásticos integrando la comunidad planctónica del sector costero de agua dulce del estuario del Río de la Plata.
70. **Parra S**, Félix L, Santos D, Gago J, Varandas S, Monteiro SM. Catalase biomarker response induced by microplastics, cadmium and their mixtures on the exotic invasive bivalve *Corbicula fluminea*.

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71. **Montagud D**, Soria JM, Soria J, Alfonso T, Vicente E. Utilización de índices basados en el zooplankton como indicadores de estado trófico en embalses de la Confederación Hidrográfica del Ebro.
72. **Céspedes V**, Valdecasas AG, Green AJ, Sánchez MI. Effects of ecto-parasites (Hydracarine: acarí) on waterboatmen (Heteroptera: Corixidae) and interactions with abiotic stress.
73. **Freitas-Teixeira LM**, Crossetti LO, Bohnenberger JE, Ribeiro LR, Motta-Marques D, Schulz UH. Respostas dos atributos funcionais do fitoplâncton à heterogeneidade espaço-temporal em um extenso lago raso subtropical.
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75. **Castro A**, Liliana García L, Pardo I. Flexibility in the diet of river macroinvertebrates along a degradation gradient.
76. **Puche E**, Rodrigo MA, Jiliberto R, Rojo C. How important charophytes (submersed macrophytes) are to the planktonic-benthic interaction web?
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79. Rigotti JA, Pasqualini JP, **Rodrigues LR**. Floating constructed wetland for the treatment of urban surface runoff: an application of a nature-based solution.

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81. **Abril M**, Vendrell L, Colón J, Ponsá S, Llenas L. Decreasing the environmental impact of abandoned mines on freshwater ecosystems: The LIFE DEMINE project.
82. **Bruno D**, Zapata V, Guareschi S, Picazo F, Dettori E, Velasco J, Robledano F, Millán A. LIFE+ RIPISILVANATURA: Effects of riparian restoration actions on aquatic macroinvertebrate community.

SR1.

**Ecotoxicology, Bio-
markers and multiple
stressors**

Assessment of wildfires impacts on aquatic ecosystems: *in situ* bioassays

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The forests in the centre of Portugal are mainly composed of intensive eucalyptus and pine monocultures. This, associated with the climate changes, inadequate forest management and rural exodus, makes these areas highly susceptible to fires that cause impacts not only in the burned areas but also in adjacent systems. Post-fire surface runoff after the first rainfalls events, rich in ash, can be a source of hazardous substances such as polycyclic aromatic hydrocarbons (PAH) and metals. These compounds are known for their toxicity, environmental persistence and tendency to bioaccumulate and bioamplify along the trophic chain. The present work focused on the study of the ecotoxicological effects of wildfires in aquatic systems using *in situ* bioassays. Four sites were selected in a recently burned area (Miranda do Corvo, Coimbra): two, in Ceira river, one upstream the burned area (RU) and another downstream the burned area (RD); and two in streams (S1 and S2) inside the burned area. During the first rainfall events after the fire, distinct groups of organisms were exposed *in situ*, using specific test chambers. These groups included producers: *Raphidocelis subcapitata* and *Lemna minor*; a primary consumer: *Atyaephyra desmaresti*; and a secondary consumer: *Gambusia holbrooki*. For autotrophic organisms, growth was evaluated after 13 days of exposure, while for *D. magna* and for the others heterotrophs, post-exposure feeding inhibition was evaluated after 2 and 4 days of exposure, respectively. The exposure of autotrophs in the sites influenced by the fire (RD, S1, S2) induced statistically significant decreases in the growth rate compared to the reference site (RU). Likewise, a decrease in the feeding rate was observed for heterotrophs in the sites within the burned area (S1 and S2). In fact, these sites are the most affected in the study area revealing the highest values of metals, total suspended solids and nutrients. The reference site (RU), located upstream the burned area, showed no adverse effects. The sublethal responses of these organisms were also evaluated under controlled laboratory conditions and corroborated the results obtained in the field. Hence, these results show that post-fire runoff can compromise distinct aquatic species with potential consequences for the ecosystem functioning. Additionally, *in-situ* assays have proved to be an adequate tool to assess the risks of wildfires in aquatic ecosystems.

Adding habitat selection responses to ecological risk assessments: the heterogeneous multi-habitat assay system (HeMHAS)

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The lines of evidence used in ecological risk assessment (ERA) are essentially three: chemistry, biology (field surveys) and ecotoxicology. Regarding the ecotoxicological component, the risk is mainly based on two indicators: toxicity and bioaccumulation. As each indicator is detectable from exposure to contamination, the fundamental assumption to measure ecotoxicological risks is the continuous and forced exposure of organisms to contaminants. However, when organisms can avoid contamination by escaping to more favorable adjacent habitats, the assumption that exposure is mandatory to pose risk may not match real contamination scenarios. A non-forced exposure approach, using a linear free-choice multi-compartmented system, was previously proposed as a complementary tool to assess contaminant effects on the spatial avoidance/preference responses by organisms. Yet, the linearity of the latter system limits avoidance measurements to one spatial dimension. A novel heterogeneous multi-habitat assay system (HeMHAS) consisting of 18 connected circular compartments (capacity of 320 mL each; 3 compartments on a vertical axis in each one of 6 zones on a longitudinal axis) is here put forward to be used in heterogeneous-habitat selection studies, as it allows to assess the ability of organisms to detect contamination and select more favorable habitats in two dimensions, across compartments and zones. In this pilot study, the avoidance response to copper by the fish *Danio rerio* was tested. A copper gradient of six concentrations (2.0 to 270 µg/L) was formed across the six zones (1 concentration/3 adjacent compartments). One fish was introduced in each compartment (3/zone) and observations of fish displacement were made each 20 min during 2 h. Avoidance occurred to all copper concentrations: from 33% in the lowest (11 µg/L) to 64% in the highest one (270 µg/L). Results obtained within the HeMHAS (AC50: 70 µg/L⁻¹) are statistically (p=0.7289) compared with the avoidance to copper by *D. rerio* in the linear non-forced exposure system (AC50: 79 µg/L⁻¹), in which the same copper gradient was established, but with only one compartment per concentration. Besides, it will be discussed not only the different scenarios that can be simulated in HeMHAS (2D system) but also how it will allow that new ecological concepts (habitat fragmentation, habitat connectivity and metapopulation) can be integrated in the ecotoxicological line of evidence of ERA.

Habitat chemical fragmentation due to contamination: isolation of shrimp population in Guadalete River (Spain)

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In ecological studies, contamination has been considered an important factor to be taken into account due to the effects that it can cause on organisms. Environmental contamination can affect the spatial and temporal distribution of the organisms by generating habitats unsuitable for life. As many organisms are able to detect contamination and move from contaminated towards less impacted habitats, the present study aimed to verify if the contamination originated from urban and agricultural discharges along the Guadalete River (Southwest Spain) could generate a chemical barrier and consequent habitat fragmentation, restricting the displacement (from down to upstream and vice versa) of shrimps. The freshwater shrimp *Atyaephyra desmarestii* was used as test organism in habitat selection assays, which were performed in a free-choice, multi-compartmented, non-forced exposure system, simulating the spatial arrangement of the samples such as their distribution in the environment. Water and sediment were exhaustively characterized by analysing 117 chemical compounds [inorganic elements (metals, metalloids and non-metals), β -blocking agents, antibiotics (sulfonamides), psychiatric drug, analgesic-antiinflammatories, diuretic, lipid regulator, antimicrobials, artificial sweeteners, UV filters, fragrances, endocrine-disrupting compounds, pesticides, polychlorinated biphenyls, flame retardants and polycyclic aromatic hydrocarbons]. Shrimps avoided the most contaminated samples and their spatial distribution was at some extent driven by contamination levels. Thus, preference response followed two patterns: (i) upstream displacement avoiding the sample located at the point of pollutant discharges and those samples downstream this point and (ii) fragmentation of the population with spatial isolation in up and downstream populations. Multivariate analysis indicated that the shrimps' behaviour seemed to be related to the avoidance of contaminants as artificial sweeteners, flame retardants, fragrances, metals, PAHs, PCBs, pesticides and UV filters. In conclusion, the hypothesis of a potential habitat chemical fragmentation, based on the assumption that contaminants can form a chemical barrier that isolates populations, was verified.

Combined effects of increasing temperatures, drought and an insecticide on freshwater zooplankton communities: a microcosm study

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Water scarcity and chemical pollution are two of the main groups of stressors causing ecological impairment in freshwater aquatic ecosystems of (semi)arid regions. Predictions about human and climatic pressure on water resources in these regions reveal that the interaction between these two groups of stressors will increase in the nearby future. In line with that, advances in ecological risk assessment recognise that stress factors harming aquatic ecosystems rarely operate individually. Therefore, new approaches to assess interactions between multiple stressors are needed. In this study we evaluated the combined effects of the insecticide lufenuron and two additional stress factors: increasing water temperatures and droughts. Twenty-seven microcosms were stocked with pond water, sediment, and a homogeneous plankton assemblage. Three environmental scenarios were simulated: 20°C and 28°C without desiccation, and 28°C with desiccation. The experiment was performed in triplicate with three insecticide treatments (Control, Low and High Concentration) in each environmental scenario. The insecticide was applied twice, with a 10-day interval between applications. Test units without desiccation were refilled twice per week with distilled water. Test units exposed to drought stress were not refilled and allowed to desiccate. After that, these units were refilled up to the initial level and maintained for two more weeks. Lufenuron concentrations in water and sediments were periodically measured, together with water quality parameters (DO, pH, T, EC and nutrients). Zooplankton composition was determined on a weekly basis, and the isolated and interactive effects of temperature, drought and lufenuron were evaluated using suitable statistical techniques. Effects were assessed at the community and at the population level. Lufenuron was the main stressor in all the environmental scenarios, with a significant decrease of *Daphnia* sp. and Cyclopoida, and an increase in Rotifera. Still, increased temperature and drought resulted in more pronounced lufenuron effects but faster recovery at community level, with slight changes on community composition. Direct and indirect responses at population level varied between environmental scenarios and explained differences at community level. The results of this study contribute to understand differences in vulnerability of aquatic ecosystems to multiple stressors in (semi)arid regions.

Dietary exposure and temperature affect the toxicity of AgNPs to aquatic invertebrate shredders

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Global warming and the great development of nanotechnologies demand for assessing the effects of increased temperature and contamination by nanoparticles. The combined effects of AgNPs and increased water temperature may have strong impacts on the functioning of freshwater ecosystems by affecting the performances of key players in plant litter decomposition, such as invertebrate shredders. The aim of this study was to determine how leaf consumption by invertebrate shredders is affected by dietary exposure to AgNPs and whether changes in temperature alter these effects. To better understand the mechanisms underlying putative toxicity effects of AgNPs on invertebrates, we examined the responses of oxidative and neuronal stress enzymes under increasing temperatures. To that end, a worldwide distributed species of invertebrate shredder was allowed to feed on leaves contaminated with AgNPs or AgNO₃, at different temperatures (10°C, 16°C and 23°C). After 5 days, the animals were released from the contaminants (AgNPs or AgNO₃) and allowed to feed on non-contaminated leaves. The increase in temperature led to a stimulation in leaf consumption by the shredder. The higher leaf consumption was not only related to increase in temperature but also to the contamination of leaves with AgNPs or AgNO₃. This was also observed after animals had been released from the contaminants. Results from the enzymatic activities demonstrated that AgNP contamination via food can induce oxidative stress in the shredder: the activities of CAT and SOD after exposure and post-exposure feeding were positively correlated with the total Ag accumulated in the animal body. Moreover, GST activity was strongly associated with higher temperatures (23°C). The activity of AChE was inhibited after the release from contaminants at 16°C. Overall results suggest that the indirect exposure (via contaminated food) to AgNPs and increased temperatures influence the toxicity of metal nanoparticles to invertebrate shredders.

Uranium toxicity to freshwater invertebrates

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Uranium mining is an environmental concern because of uranium runoff and the potential for toxic effects on the biota. To investigate uranium toxicity to freshwater invertebrates, we conducted a 96-hour test to determine lethal concentrations (testing concentrations up to 262 mg·L⁻¹) for three stream invertebrates: a shredder caddisfly, *Schizopelex festiva* Rambur (Trichoptera, Sericostomatidae); a detritivorous isopod, *Proasellus* sp. (Isopoda, Asellidae); and a scraper gastropod, *Theodoxus fluviatilis* (Gastropoda, Neritidae). Next, we ran a chronic-toxicity test with the most tolerant species (*Schizopelex festiva*) to assess if uranium concentrations found in some local streams (25 µg/L⁻¹) affect feeding, growth and respiration rates. Finally, we investigated if the alder leaf-litter (food for the shredders) accumulate uranium when exposed to metal and eliminate it when transferred to clean water, and whether *S. festiva* takes up uranium from the water and/or from ingested food. In the acute test *S. festiva* survived up to the highest uranium concentration tested, 262 mg·L⁻¹. LC50-96-h for *Proasellus* sp. and *T. fluviatilis* were 142.00 mg·L⁻¹ and 24.12 mg·L⁻¹, respectively. Specimens of *S. festiva* exposed to 25 µg/L⁻¹ uranium had 43% reduced growth compared with specimens under control conditions (18.20 ± 2.11 vs. 31.81 ± 3.07 µg of mass increase mg animal⁻¹·day⁻¹). Respiration rates (0.29 ± 0.03 µg O₂·h⁻¹·mg animal⁻¹; mean ± SE) and consumption rates (0.39 ± 0.03 µg·µg animal⁻¹·day⁻¹) did not differ between treatments. Leaf-litter accumulated uranium when exposed to 25 µg L⁻¹ up to 84.0 ± 4.8 µg·g⁻¹, but after 12 days in clean water leaves still retained ~60% of the biosorbed uranium. *S. festiva* accumulated uranium from the water (10.64 ± 1.13 µg·g⁻¹), from ingested food (6.90 ± 0.51 µg·g⁻¹), and from combined pathway (water + food) (13.14 ± 2.22 µg·g⁻¹). Our results indicate that uranium adsorb to the leaf-litter rapidly and release slowly, leading detritivorous stream invertebrates to an extended exposure to the metal. At environmental sublethal concentrations in the water and in the food, uranium can impair physiological processes such as growth. Further research on the dietary × water uranium exposure to aquatic biota will be advantageous to evaluate effects on bioaccumulation and propagation across food chains.

Are microbial insecticides environmental friendly? Effects on a freshwater insect species

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The accelerating growth of human population associated with increased food demand while protecting the environmental quality is one of the greatest challenges of the century. It is crucial to establish a compromise, focusing on a sustainable pest management. Microbial insecticides (MI) have been increasingly used as environmental safe alternatives to chemicals. Their global market has been increasing, being predicted to reach \$1.66 billion by 2022. MI use microorganisms (e.g. bacteria and fungi) and their toxins as active ingredients. These pathogens occur naturally in the environment, contributing to the regulation of their hosts and are thought to pose minimal ecological impact. Nevertheless, recent studies have been questioning the safety of these compounds, as not only they may pose direct toxicity to non-target species and they may also affect indirectly other trophic levels. Freshwater ecosystems, adjacent to agricultural areas are likely to be contaminated by MI through runoff, spraying or direct application to water bodies. However, more knowledge is required on the ecological effects on non-target species and to improve the risk assessment and a biosafe use of these compounds. Chironomids are considered the most sensitive taxa among the non-target species and given their chief importance in freshwater food webs, the impact of these compounds needs to be evaluated. The effects of MI were assessed in the non-target species *Chironomus riparius*, concerning life-history traits and immune response. Genetic variation in the tolerance was also measured by using a full-sib family split design. MI affected larval survival, development and emergence but not imagoes weight, and this was related with the genetic variation among families. Adverse effects were observed under environmental relevant exposures, which may reflect in population effects. Phenoloxidase (PO) activity in *C. riparius* larvae was promoted when exposed to the MI, suggesting the activation of the immune system. PO activity increased at concentrations of MI much lower than the ones producing lethal effects, showing the relevance of this immune parameter as an early warning indicator of stress to these compounds. MI may pose a risk to chironomid populations potentially affecting organisms from other trophic levels. Further effects at community and ecosystem level as well as the evolution of tolerance urge to be evaluated.

Ecotoxicological effects of wildfires on freshwater decomposers

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Mediterranean forests are highly susceptible to wildfires, and it is expected that this will be exacerbated under the ongoing climate change. Wildfires can cause impacts not only on burnt forested areas, but also on surrounding ecosystems. The wash out of soils and ashes from burnt areas by surface runoff may transport to streams pollutants and contaminants like pyrolytic substances, including polycyclic aromatic hydrocarbons and metals, which can be toxic to aquatic organisms. After exposure to runoffs from wildfires from pine and eucalyptus forests, the biomass of aquatic fungi and the rates of litter decomposition by microbes and invertebrate detritivores decreased. The structure of microbial communities, based on DNA fingerprinting or fungal spore counting, changed after runoff exposure. In invertebrate detritivores, the activity of the oxidative stress enzymes, namely glutathione peroxidase, glutathione reductase and glutathione-S-transferase increased in a concentration-dependent manner, while the activity of the neuronal stress enzymes cholinesterases decreased. Our results provided evidence that wildfires may impact the stream biota by affecting the activity and diversity of microbial communities associated with leaf litter, as well as, the feeding and physiological behavior of invertebrate detritivores.

Contribución al estudio de contaminantes emergentes en aguas superficiales

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El objetivo de este trabajo fue evaluar la presencia y distribución de contaminantes orgánicos emergentes en 15 arroyos tributarios del río Rivera de Huelva (SO España) y su relación con los usos del suelo desarrollados en cada una de sus cuencas vertientes. Se desarrolló y validó una metodología analítica para la determinación de 71 contaminantes orgánicos, procedentes de diferentes familias en agua. Los resultados obtenidos constataron la presencia, en diferentes niveles de concentración (0.04 ng/L - 488.4 µg/L), del 89 % de los contaminantes estudiados, destacando los sulfonatos de alquilbenzeno lineales (LAS), los nonilfenoles (NPE), el di(2-etilhexil) ftalato (DEHP) y algunos principios activos farmacológicos, por su frecuencia de aparición y sus mayores concentraciones, explicables por su abundante uso doméstico e industrial. Tales concentraciones fueron atribuibles a fuentes concretas de contaminación por aguas residuales urbanas depuradas que afectan a algunos de los arroyos, así como a fuentes de contaminación difusa, que se podrían relacionar con las actividades agrícolas y ganaderas en las zonas próximas a los cursos de agua. Para la mayoría de los afluentes, se observaron concentraciones mayores de los compuestos estudiados coincidiendo con los periodos de primeras lluvias, achacable al efecto de lavado y arrastre de los vasos fluviales. Los resultados, globalmente, han mostrado el buen estado de preservación de estos arroyos del río Rivera de Huelva, en comparación con las concentraciones de contaminantes emergentes encontradas en los estudios de otros sistemas acuáticos similares realizados en el ámbito internacional. Además han permitido cuantificar los potenciales riesgos ambientales y sanitarios que entrañan la presencia de estos compuestos y apuntar una propuesta de soluciones mediante medidas preventivas y correctivas. Todo lo anterior con el desarrollo de herramientas analíticas, transferibles a otros laboratorios, para la vigilancia y el control de este tipo de contaminación en escenarios similares.

Effects of continuous exposure to increased salinity in the amphibian skin bacterium *Erwinia toletana*

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Amphibians constitute the class of vertebrates with the highest proportion of endangered species; chemical contamination being a main factor for their populations and species decline. The skin bacterial community of amphibians may help them to cope with such chemical contamination. If skin bacteria may increase their tolerance to chemicals, then they could be used for bioaugmentation in amphibians to help them cope with contamination. This work aimed at assessing if an amphibian skin bacterium could increase its tolerance to NaCl after long-term exposure to low levels of salinity. *Erwinia toletana*, isolated from the skin of *Pelophylax perezi*, was selected as the model species. Clonal populations of this bacterium (5 replicates) were exposed for 46 days to LB medium (Et-LB) or to the effective concentration of NaCl causing 10% of growth inhibition (Et-NaCl; 18g/L). To assess the capacity of recovery from long-term exposure to NaCl, after the 46 d period, Et-NaCl was transferred to LB medium and cultured for a period of 16 d (Et-R). The Et-LB isolate also continued to be cultured in LB medium for further 16 d. The tolerance of ancestral and evolved populations to NaCl was assessed by exposing them to 6 NaCl concentrations (5, 10, 15, 20, 25 and 35 g/L) plus a control (LB medium). Effects of NaCl on bacteria growth and metabolic mechanisms (as degradation of carbon compounds) were monitored. Genotypic alterations were assessed using a PCR-based molecular typing method (BOX-PCR). Results of growth shown that long-term exposure to NaCl slightly increased the tolerance of *E. toletana* to this salt, EC₅₀ for growth were: 22.5g/L (8.64-36.4) for Et-LB; 30.3g/L (23.2-37.4) for Et-NaCl, and 26.1g/L (19.3-32.9) for Et-R. Though, as confidence limits overlap, tolerance increase was not considered significant. Furthermore, differences in metabolic processes were observed between Et-LB and Et-NaCl, suggesting the use of different carbon sources. This could be associated with the activation of detoxification mechanisms or energetic demanding mechanisms to cope with osmotic stress. Genotypic alterations were not observed, indicating that *E. toletana* increased tolerance to NaCl could be due to membrane plasticity mechanisms to cope with osmotic stress. The tendency shown by *E. toletana* to acquire increased tolerance to low levels of salinity could constitute a promising bioaugmentation tool in amphibian's skin, aiming the improvement of these organisms tolerance to chemicals.

Impacts of Primextra Gold®TZ and copper sulphate on the fatty acids profile of the estuarine species *Cerastoderma edule*

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In the last decades was observed an intense degradation and loss of coastal and estuarine ecosystems related with anthropogenic pressures. The hydrological and ecological complexity of these systems, make them extremely sensitive to the action of several stressors. According to the agricultural cooperatives of the Mondego valley, Primextra Gold®TZ is one of the 20 best-selling herbicides in Portugal, being widely used in corn fields, whereas copper is one of the main constituents of fungicides, herbicides, molluscides, and pesticides. *Cerastoderma edule* is a bivalve species, present in the Mondego estuary, extremely appreciated as food source. Given its large filtration capacity and ability to accumulate a large amount of environmental pollutants, *C. edule* is widely used as an environmental bioindicator. Thus, the aim of this work is to evaluate single effects of the herbicide and the metal at lethal and biochemical levels in two size classes (large and small) of the bivalve species. The organisms were caught in the Mondego estuary and transported to the lab, where were maintained in filtered sea water at 20 psu, without food, for depuration. Bioassays were performed using organisms exposed to one negative control plus 8 treatments of Primextra (from 0.0 mg/L to 60.0 mg/L) and 6 treatments of copper sulphate (from 0.0 mg/L to 2.1 mg/L), with ten replicates per treatment, during 96 hours, under 12hL:12hD photoperiod at a temperature of $20 \pm 2^\circ\text{C}$. The organisms were observed everyday and the lethal effect concentration was calculated based on the mortality rate. At the end of the bioassays surviving organisms were stored at -80°C to fatty acids analysis. Results showed that the organisms are more tolerant to Primextra Gold®TZ action than to copper sulphate, considering organisms from both size classes. However, the nutritional content of fatty acids of individuals of large size exposed to the metal is more impaired than in the small organisms, whereas these ones when exposed to the herbicide are more affected than the organisms of large size. This information is valuable for future risk-assessment procedures of organic and inorganic contaminations, can assist in the determination of the effects for higher trophic levels and can help in the assessment of estuarine and marine ecosystem health.

Assessing Zn and Cu impacts on freshwater diatoms: physiological, biochemical and metabolomic responses of *Tabellaria flocculosa* (Roth) Kützing

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Metals are recognised as a threat to aquatic organisms but the impact of metals such as Cu and Zn on benthic freshwater diatoms is poorly understood. Our study aimed to elucidate: 1) cellular targets of Cu and Zn toxicity; 2) mechanisms cells resort to counteract toxicity and to increase tolerance to Cu or Zn; 3) specific cellular markers indicating contamination by these metals. A concerted approach analysing the biochemical, physiological and metabolome alterations was conducted by exposing the freshwater diatom *Tabellaria flocculosa* from low to high concentrations of Cu and Zn. *T. flocculosa* showed a distinct response for each metal and for each level of stress imposed by the increasing metal concentrations. At low concentrations (0.3 $\mu\text{gCu/L}$, 30 $\mu\text{gZn/L}$) few alterations in the metabolome were observed for Zn with induction of antioxidant systems, which protected cells from oxidative stress. Cu was toxic at 0.3 $\mu\text{g Cu/L}$, a common concentration in environments. The metabolome of *T. flocculosa* changed significantly, especially at high concentrations (6, 10 $\mu\text{gCu/L}$ or 500, 1000 $\mu\text{gZn/L}$). Cu toxicity was counteracted by increasing extracellular immobilization (EPS, frustulins), antioxidant (SOD, CAT) and detoxifying (GSTs) enzymes activity and low molecular weight antioxidants (GSH). These mechanisms were fuelled by higher energy production (increased ETS activity). At 10 $\mu\text{gCu/L}$, these processes were specially enhanced in an attempt to restrain the oxidative stress generated by high intracellular Cu concentrations. On the other hand, at 500 $\mu\text{gZn/L}$ the main changes occurred in the metabolome with a moderate increase in cell damage (LPO and PC). The concerted action of all these mechanisms resulted in a non-significant decrease of growth, explaining the survival of *T. flocculosa* in an environment with 500 $\mu\text{g Zn/L}$. At 1000 $\mu\text{g Zn/L}$ the increase of antioxidant systems and the induction of extracellular ion chelation (EPS, frustulins) were the main responses to the increase of Zn toxicity. However, for both metals these mechanisms were unable to effectively abrogate cellular damage (LPO, PC) and growth reduction was observed. Moreover, the decrease in hydroxylamine and unsaturated fatty acids and the increase in saturated fatty acids, 2-palmitoylglycerol, glycerol and diterpenoid compounds should be tested as specific markers of Cu toxicity and the decrease in sucrose and especially in lumichrome should be tested as specific markers of Zn toxicity in future studies.

Toxicity of binary mixtures of ionic liquids and salts to the microalga *Raphidocelis subcapitata*

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Ionic liquids are often described as green solvents, given their advantages over conventional solvents. However, their “greenness” character is not unanimous, as they can have high toxicity to some organisms. Given their wide applications, they can reach aquatic systems, affecting biota. However, species are exposed not only to ionic liquids but, simultaneously, to other pollutants. Thus, the main goal of this work was to assess the toxicity of binary mixtures of ionic liquids (choline bitartrate, choline dihydrogencitrate, choline bicarbonate and benzyl dimethyl ammonium chloride) and salts (potassium phosphate and sodium citrate) to the microalgae *Raphidocelis subcapitata*. Algae were exposed to these chemicals individually and as equitoxic mixtures of each ionic liquid and each salt, during 96h, and their growth rate was measured to calculate EC50 values. The toxicity of the ionic liquids varied by a factor of 10, highlighting the role of the anion in the toxicity of the ionic liquid. The toxicity of the ionic liquids increased in the following order: benzyl dimethyl ammonium chloride (EC50=1060.3 mg/L) < choline bicarbonate (EC50=649.2 mg/L) < choline bitartrate (EC50=138.2 mg/L) < choline dihydrogencitrate (EC50=100.8 mg/L). Concerning salts, potassium phosphate was less toxic (EC50=598.0 mg/L) than sodium citrate (EC50=393.9 mg/L). Mixtures of each ionic liquid and salt revealed synergism and antagonism among the mixture components. Among the most pronounced cases of synergism there was the mixture of choline bicarbonate and potassium phosphate – a mixture of these chemicals in the concentration 161.5 mg/L and 154.5 mg/L, respectively, cause a 50% inhibition in the growth rate of the alga (EC50). This work raises concern about the toxic effects of mixtures of ionic liquids and salts to microalgae, namely concerning synergistic effects. These results suggest that the toxicity of ionic liquids might be underestimated when tested individually. Ultimately, this work highlights the importance of testing the toxicity of mixtures given their ecological relevance in aquatic systems.

Responses of ciliates and micrometazoans to chemical and physical stressors in artificial rivers

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Climate change is associated to higher severity of drought events and higher temperatures, especially in Mediterranean climate regions. These climatic alterations will affect agricultural practices, because of increased intensity and frequency of pest events, increased sensitivity to stress and, diseases and changes in phenology. This will be probably associated to a higher use of pesticides and, in consequence, higher risk of freshwater pollution. Ciliates and micrometazoans may be both receptors and indicators of desiccation events and pesticide inputs, since they inhabit sediments of freshwater ecosystems and play an important role in the processing of organic matter and as basal resource for consumer organisms. Still, the joint effects of these environmental and chemical stressors on these communities are not fully understood. We performed an experiment to determine the relevance of desiccation (D), warming (T) and a realistic environmental mixture of pesticides (P) on the communities of ciliates and micrometazoa in river sediments. The taxonomic and functional diversity of Ciliophora and micrometazoa communities were studied in experimental indoor channels applying a factorial design (24 channels, 3 replicates, 8 experimental conditions). Natural sediments from an unpolluted river were used as inoculum for these communities. The community was exposed to the stressors for 7 weeks, and sediments were sampled twice during the experiment (one week before and after 7 weeks of exposure). Taxonomical composition and functional groups, based on feeding strategies, were studied. Significant changes in community composition and function between pre- and post-exposure were observed in all treatments. After the exposure, percentage of predators diminished respect pre exposure conditions and community was dominated by micrometazoans. However percentage of ciliates increased in the treatments with physical or chemical stressors. At the end of the experiment the total density was significantly higher than the controls in D, DP and TDP treatments ($p < 0.001$ Dunnett's test), while diversity was significantly higher in D, TD and TP conditions ($p < 0.001$ Dunnett's test). Flow reduction was the most important factor causing significant differences in community composition and feeding strategies (PERMANOVA $p < 0.001$). However, the mixture of pesticides did not cause any significant effect on the studied communities after 7 weeks. Our results suggest that flow reduction is the main driver for changes in micrometazoa and ciliate communities, while pesticides and temperature produce significant effects only in combination with desiccation.

Oxygen consumption of *Daphnia magna* under different conditions of salinity and temperature

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Global warming and human activity are among the most important threats affecting freshwater ecosystems around the world. These drivers have large influences on freshwater systems, affecting environmental factors such as salinity and temperature, with consequent impact on freshwater communities. The cladoceran *Daphnia magna* is a widespread zooplankton which has been considered as a keystone species. It is a eurytopic species which inhabits a wide range of environmental conditions (particularly of salinity and temperature). This species has been widely used in experimental assays and ecotoxicological tests. Respiration rate could be related to the activity and physiological status of an organism and could be affected by different factors. In order to estimate the oxygen consumption in *D. magna* under different conditions of salinity and temperature, wild individuals of this species were collected in the Albufera of Valencia lake (Valencia, eastern Spain) in winter 2018 (water temperature: 10°C; salinity 1.4 ‰). Our aim was to evaluate the effects of salinity and temperature on the oxygen consumption rates of *D. magna*. Using a multicell oxygen meter Strathkelvin SI929 to measure respiration, 5 replicates with 10 organisms each, have been exposed to different salinities (0.1, 0.5, 1, 3, 6 and 10 ‰) and temperatures (5, 10, 15, 20 and 25 °C). At 10 ‰ salinity, all organisms died during the period of acclimatization. Oxygen consumption significantly increases with increasing temperature ($P < 0.001$); no significant effect was neither observed for salinity ($P = 0.814$) nor for the interaction between salinity and temperature ($P = 0.780$).

A biochemical approach to understand how abiotic alterations related to climate change can affect early life stages of Iberian green frog

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Global climate change has profound implications on biota, posing a concerning threat to a wide range of species. Amphibians are among the most affected species due to their already reported relative vulnerability to abiotic changes. Thus, it is crucial to find tools to assess the influence that abiotic factors, most affected by global climate changes, may have on amphibian species. To provide further knowledge over these potential impacts, we evaluated morphologic and physiologic responses of *Pelophylax perezi* larvae exposed to different stressors (temperature, population densities and pH levels). Morphologic traits (e.g. size) were analyzed and oxidative stress related endpoints were used to tackle how these parameters can influence the antioxidant system of amphibians. For this, glutathione peroxidase (GPx), glutathione reductase (GRd), glutathione-S-transferase (GST) activities and lipid peroxidation (LPO) were determined. Larvae exposed to the highest temperature (28 °C) developed faster and attained higher lengths compared with the ones exposed to the lowest temperature tested (16 °C). Furthermore, larvae from the highest temperature treatment group presented reduced LPO levels compared to the other groups. The animals exposed to pH levels 5.5 and 6.5 achieved higher lengths and revealed lower LPO levels. In the density test, the individuals from the lower density groups achieved the highest lengths and revealed an increase of the antioxidant capacity, when compared to the ones exposed to higher densities. Our results revealed that parameters directly or indirectly associated with global climate changes could have a direct impact on development and on mechanisms associated with important physiological responses to other stressors. The results obtained provide a better understanding of how global climate changes can provoke fitness impairment and how they might be connected to amphibian's population declines.

Biomarkers response of three commercial fish species from a southern estuarine system to drought and flood events

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As a consequence of Global Climate Change (GCC), flood and drought flood and drought events are increasing in frequency throughout the world. Nevertheless, knowledge of the effects on fish species related to oxidative stress is still scarce. The present study aims to examine biochemical and physiological responses of three commercial fish species over two contrasting environmental conditions: an extremely dry (2012) and flood (2014) years, in a shallow temperate southern European estuary, the Mondego Estuary (Portugal). The temporal and seasonal structure of the physiological and biochemical biomarkers was evaluated by a principal component analysis (PCA), which allowed to distinguish two distinct annual antioxidant responses and loss of seasonality along each year. During the drought event the organisms showed the worst physiological state, as well as an increase of Glutathione reductase (GR) and Glutathione S-transferase (GST) levels, strongly associated with salinity and dissolved oxygen fluctuations and low food availability. On the other hand, during the flood event no alterations of the physiological conditions of the organisms were observed. Although in this flood year, high levels of Glutathione peroxidase (GPx) were verified in all studied species, possibly due to the increase of toxic substances related with higher water-runoff from the tributary discharges of the Mondego estuary. However, the impact of GCC-related factors during the period of extreme drought seems to indicate a more evident induction of antioxidant responses for flatfish species, while in the extreme flooding event all species presented lower antioxidant activity levels, more evident in the seabass. It seems that GCC-related factors stimulate the antioxidant responses in fish, especially in the extreme drought event. Still, the Mondego estuary has a good ecological status, and surely, higher impact of these variables may occur when in interaction with severely contaminated ecosystems. More research has to be conducted around oxidative stress in aquatic organisms, involving environmental dynamics, in order to predict and quantify the effect that this may cause on the antioxidant defence system of the aquatic organisms.

Effects of salinity and temperature variations on respiration rates in *Chirocephalus diaphanus* Prévost, 1803 (Crustacea: Branchiopoda)

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The duration of the hydroperiod is a fundamental variable in aquatic system dynamics. In temporary waters, adaptations to desiccation and habitat unpredictability include strategies such as migration, dormancy or diapausing eggs. Fairy shrimps (Anostraca) include a high number of non-marine species adapted to very short hydroperiods, which may hatch during shortly after the filling of the pond, and complete their life cycle before others lowlier-developing taxa exclude them by competition or predation. Within the framework of the METACOM project, that aims to study metacommunities of different groups of organisms in temporary ponds, we intend to study how shifts in salinity and water temperature could be a stress factor to the anostracan *Chirocephalus diaphanus*. Juveniles were collected with a 63 m mesh plankton net from Benirrama temporary pond (Vall de Gallinera, Eastern Iberian Peninsula) in February 2018, located in an agricultural and Mediterranean shrub land landscape, and used by livestock. Measured pH was c. 7.4, conductivity 333 $\mu\text{S}/\text{cm}$, and oxygen concentration close to 89% saturation percentage. The collected specimens were acclimated to laboratory room temperature and algal food for one week. Using a multi-cell oxygen meter Strathkelvin SI929 we measured respiration rates of five replicates of four individuals each at different temperatures (5, 10, 15, 20 and 25°C) and salinities (0.01, 0.2, 0.5, 1.0, 2.0 and 3.0‰). We found no significant differences in oxygen consumption rates related to salinity ($p = 0.613$). However, oxygen consumption rates increased significantly with increasing temperature ($p < 0.001$). Although we cannot ascertain that salinity could be a stress factor for the tested species, our results suggest that the fitness of *C. diaphanus* may be negatively impacted by water temperature raise, especially in a climate change scenario.

Acute toxicity of a commercial sunscreen for the aquatic snail *Biomphalaria glabrata*

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Over the last few years there has been a significant increase in the use of sunscreens, mainly due to pathologies and adverse effects caused by sun exposure such as photocarcinogenesis and solar erythema. Consequently the occurrence in aquatic environments of ultraviolet filters, active substances of these products, also increased. The presence of these substances in the environment is a matter of concern since several ecotoxicological studies show their adverse effects on aquatic organisms such as fish, amphibians, insects, crustaceans, zooplankton and phytoplankton organisms, among others. Most of the available studies focus on testing with UV filters and not in commercial products. The Brazilian Health Regulatory Agency (ANVISA) through RDC 69/2016 regulates which substances can be used in the products and their maximum concentrations; however, there are no recommendations of public health agencies on the proper use of sunscreens. The objective of the present study is to evaluate the acute toxicity of a commercial sunscreen for the aquatic snail *Biomphalaria glabrata*. Tests were carried out from the exposure of adult individuals, with shell diameter between 12 ± 15 mm, to solutions of the material in synthetic soft water with a hardness of 40-42 mg/L in calcium carbonate (CaCO₃). The exposure was semi-static with solution renewed every 24 hours and ending at 96 hours. Groups of 10 organisms were exposed to concentrations of 3.0, 6.0, 9.0 and 12.0 g/L of the commercial sunscreen solutions. Using the Trimmed Spearman Karber method, LC50 obtained in 48 and 96 hours were 8.3 g/L (5.6-12.2 g/L) and 6.1 g/L (4.4-8.3 g/L), respectively. The results indicate that concentrations sufficient to cause mortality of individuals in short periods are relatively high when compared to that found in the environment; however, the possibility of chronic effects of the substances present in sunscreens for *B. glabrata* cannot be ruled out.

Bioprospecção fitoquímica das folhas da macrófita aquática *Nymphaea rudgeana* G. Mey no lago do Campus Cauamé, Boa Vista, Roraima, Brasil

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Macrófitas aquáticas apresentam grande relevância em ecossistemas lóticos e lênticos, produzindo quantidade significativa de matéria orgânica e participando ativamente da ciclagem de nutrientes. Algumas espécies têm sido utilizadas na medicina popular para o tratamento de diversas enfermidades, porém há poucos estudos sobre sua composição e suas atividades biológicas. A família Nymphaeaceae é constituída por herbáceas aquáticas de distribuição cosmopolita, incluindo seis gêneros e cerca de 60 espécies. Considerando-se a importância de pesquisas e necessidade de novos fármacos antimicrobianos, aliada à interação contínua de vegetais aquáticos com microrganismos perifíticos, este trabalho teve como objetivo desenvolver estudos sobre a composição química do extrato etanólico de uma espécie de macrófita aquática (*Nymphaea rudgeana*) deste bioma, dentro do módulo do Campus Cauamé. Este sistema é localizado ao Norte de Boa Vista, apresenta uma área útil de 498 ha de savanas entrecortadas por dois pequenos cursos d'água, com a presença de um grande lago e um banhado próximo ao rio Cauamé. O material coletado, constituído da parte aérea do indivíduo em estudo, foi encaminhado à produção de exsiccatas, para determinação do gênero e espécie da planta. Estas exsiccatas foram enviadas ao herbário do Centro de Estudos da Biodiversidade UFRR/Boa Vista-RR para a identificação do material vegetal e registro de depósito. As folhas foram secas a temperatura ambiente com auxílio de sílica, triturado e submetido à extração a frio com etanol (7x). A solução etanólica foi submetida a rotaevaporação sob pressão reduzida à temperatura média de 60°C para obtenção do extrato etanólico. No final, o extrato resultou numa massa superior a 100 g, quantidade considerada significativa para realização de marcha cromatográfica e testes por reações químicas, objetivando o isolamento e a elucidação estrutural de um constituinte químico. Realizado o estudo de bioprospecção do extrato etanólico da folha da espécie de macrófita aquática, *N. rudgeana*, detectou-se a presença de alguns metabólitos secundários como fenóis, taninos pirogálicos, esteróides livres, saponinas, antocianidinas, antocianinas, chalconas, auronascatequinas, flavonóis, flavanonas, flavanonóis e xantonas. Com estes resultados sugere-se que esta espécie seja explorada em maior profundidade com relação à presença verificada, através de técnicas fitoquímicas de purificação e fracionamento biomonitoramento do extrato.

Species sensitivity distribution of standard and non-standard organisms to 3,5-dichlorophenol, potassium dichromate and lead

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The variation of species sensitivity in a community or an assemblage towards one or more toxicants can be expressed in terms of cumulative distributions known as Species Sensitivity Distributions (SSD). These distributions are based on selected benchmarks obtained from single-species bioassays, and have been commonly used by environmental agencies worldwide towards the environmental risk assessment of chemical stressors. SSD are increasingly employed in the determination of chemical concentration protective for most species in the environment, usually by calculating the Hazardous Concentration promoting noxious effects in 5% of the species (HC5) and sparing 95% of species in natural assemblages. SSD are most commonly built based on standard species that typically represent lotic freshwater ecosystems, and thus their use to address environmental hazard in lotic ecosystems is somehow limited. This study addresses the problematic by aiming at integrating the responses of non-standard species representing lotic ecosystems in SSD characterizing standard chemicals. These standard chemicals were selected to represent common pollutants found in freshwaters of organic and inorganic origin and are generally used for quality control in standard ecotoxicological testing batteries: potassium dichromate, 3,5-dichlorophenol and lead chloride. SSD were built with standard species and with species representative of lotic environments to compare their sensitivities to the substances tested and to infer about the protective capability of these tools in the estimation of safety threshold values for lotic environments.

Feeding behaviour of *Corbicula fluminea*: a sensitive endpoint for ecotoxicological assessment and refinement of chemical control

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The Asian clam *Corbicula fluminea* is a powerful filter-feeder, which is one of its putative advantages as an invasive species in freshwater ecosystems. Filtration in bivalves is responsive to external stimuli and regulated by valve closure as a defensive strategy to avoid exposure to adverse environmental conditions. We hypothesise that the filter-feeding behaviour of the Asian clam should be highly efficient, promoting the high success of the species and the resistance to chemical control attempted in fouled industrial settings. In this way, it is likely that inhibition in filtration rates can be a sensitive indicator of environmental quality, as well as a screening endpoint for preliminary assessment of the potential efficacy of chemical control strategies. The specific objective of this study was hence to assess the sensitivity of *C. fluminea* filtration rates to different chemicals, including general environmental contaminant representatives and biocides potentially used as control agents. Clearance rates and proportion of algae removed were measured using a simple and reproducible protocol, with a large proportion of food particles being removed within 60-120 min, despite some variation across individuals and size classes. Algae removal was sensitive to the array of model contaminants tested: eight out of nine tested substances were detected at the $\mu\text{g l}^{-1}$ or mg l^{-1} range and triggered valve closure, decreasing filter-feeding in a concentration-dependent manner. A good agreement between mortality and feeding was observed in most cases, demonstrating that a 120-min assay can be used as a protective surrogate of acute toxicity (96-h assay). Chemosensing mechanisms and valve closure behaviour can be chemical-specific, this being a potential avenue worth exploring in the design of improved chemical control strategies targeted at the biofoulers in closed or semi-closed industrial settings.

Proteomic approach to assess the impacts of engineered nanoparticles on freshwater fungi

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Emerging chemical contaminants (ECCs) have been detected in the environment, mostly because wastewater treatment plants, using conventional treatments, are unable to eliminate ECCs. Engineered nanoparticles (ENPs) are among the ECCs in freshwaters, raising concern about their potential risk to ecologically important non-target biota. Fungi play a key role in carbon and energy transfer from plant material to higher trophic levels in streams. Sublethal impacts of nanosilver (nano-Ag) and ionic silver (Ag⁺) were assessed by proteomic responses in two fungal strains of *Articulospora tetracladia*, one isolated from a clean stream (At72) and the other from a metal-polluted stream (At61). In presence of At72, the particle stability of nano-Ag increased with lesser agglomeration along time; whereas in presence of At61, the nanoparticle agglomeration increased. A total of 361 proteins were significantly altered after exposure to nano-Ag or Ag⁺, of which 101 proteins belonged to strain At72 and 189 belonged to At61; only 71 of altered proteins were common in both strains, suggesting that the biological pathways involved in the responses to Ag⁺ or nano-Ag exposure were different in these two strains. At61 had ~25% more proteins than At72 which were induced by both forms of silver, which was consistent with the background of this fungal strain and corroborates its higher tolerance against both metal forms. In At72, proteins involved in protein homeostasis were induced by Ag⁺ exposure, while proteins related to nutrient transportation, energy production and DNA repair was induced by nano-Ag. On the other hand, nano-Ag exposure induced proteins involved in energy production and protein synthesis in At61, whereas both silver forms significantly increased the content of the proteins involved in cellular-redox and protein homeostasis, nucleic acids metabolism and biomass and spore production. Additionally, stress-responsive proteins were significantly induced by both form of silver. Overall results suggest that proteomic approach is useful to get a mechanistic insight on the sublethal stress induced by ECCs in fungi and can help to discriminate effects of nanoparticulate and ionic forms of silver.

Impact of metals on aquatic fungal metabolites and gene expression

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Aquatic hyphomycetes are the major decomposers of plant litter and play an important role in organic matter turnover in streams. *Nectria lugdunensis* is one of the common widespread aquatic fungal species found in freshwaters globally. The main goal of this study was to evaluate the metabolomic fingerprints and cellulase gene expression of *N. lugdunensis* during colonization of Alder (*Alnus glutinosa*) leaves under mine drainage stress. Ten strains of *N. lugdunensis* were isolated from streams affected by mine drainage and also from non impacted sites. The fungal plugs were treated with reference stream water and with metal contaminated stream water mainly rich in As, Cd, Cu and Zn in microcosms containing alder leaves for eight weeks. Fungal plugs were removed and metabolites were extracted from the mycelia of the fungi. The metabolites were separated through ultra-high performance liquid chromatography coupled to mass spectrometry (UHPLC-MS). For metabolic characterization, a targeted analysis of, approximately, 250 metabolite species (lipids and amino acids) were detected and analysed. To study the cellulase gene expression, total RNA was extracted from leaf disks, cDNA was synthesized and qPCR was performed using primers for cellobiohydrolase gene. The PCA scores plot of metabolites shows a clear separation between the fungal strains treated with metal contaminated and non-contaminated stream water indicating that metals exerted a major impact on the metabolome of the fungal strains. Nearly a half of the studied metabolites changed significantly when fungi were exposed to metal polluted water. Further, a number of intraspecific differences were also observed among the strains. Interestingly, fungi exposed to metal polluted water presented a marked, gradual increase in the concentration of triacylglycerols with shorter acyl chains and less unsaturations when compared with fungi treated with non-polluted water. This result may be considered a biomarker of metal pollution exposure in fungi. In addition, cellobiohydrolase expression of *N. lugdunensis* was down-regulated upon exposure to mine drainage water when compared to control group by a mean factor of 0.636. *N. lugdunensis* also showed intraspecific variability in cellulase gene expression.

Overall, in this study, we demonstrate the impact of mine drainage on fungal metabolome and cellulase gene expression. As observed, intraspecific variability of aquatic hyphomycetes plays a key role in coping with metal stress and shaping their ecological functions.

PAH effects on the sexual reproduction and offspring of a freshwater planarian

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PAHs are nearly ubiquitous in freshwaters and sediments, mainly as a result of human activities such as industrial processes and burning of fossil fuels. Many PAHs have been classified as contaminants of special concern, due to their toxicity to aquatic invertebrates and mammals. Given the potential for chronic toxicity and possible mutagenic and/or carcinogenic effects of some PAHs, long ecotoxicological exposures that evaluate endpoints such as reproduction are fundamental to better understand potential impacts on freshwater populations. One interesting animal model to study such compounds is the freshwater planarian *Dugesia tigrina*, given its sensitivity to PAHs and wide range of reproduction related endpoints that can easily be measured. *D. tigrina*, can reproduce sexually, with adults being hermaphrodites with simultaneous cross-fertilization. After mating, each animal deposits cocoons containing several fertilized eggs, from which new borns usually emerge after 2 to 3 weeks. To study the effects of PAHs on the reproduction endpoints of *D. tigrina*, adults were exposed to a range of 4 concentrations of pyrene and benzo[a]pyrene (B[a]P) in single exposures of 21 days. Cocoons were collected to clean media and were monitored for up to 1 month to evaluate hatching success. Emerging newborns were counted and evaluated for any morphological and behavioral defects. Pyrene exposure reduced cocoon production for the 75 and 18.75 µg/L treatments. This reduction resulted in a lower number of emerging newborns, but their behavior and morphology were mostly normal. B[a]P exposure reduced cocoon production in the 37.5 µg/L treatment. Also, emerging newborns presented anomalies in the 2.34, 9.38 and 37.5 µg/L treatments, totaling 4%, 15% and 41% of emerged animals, respectively. Most of the detected anomalies were behavioral disorders, such as uncoordinated movements, contractions or sudden twists and curls of the body. Nevertheless, morphological defects, such as altered number of photoreceptors or extra tails, were also observed. These results indicate that PAH exposure might have serious impacts on the reproduction of planarians, leading to populational declines, not only by affecting adults and their reproductive output, but also newborns and their fitness. These results provide relevant data on the toxicity of PAHs to invertebrates at environmentally relevant concentrations and further demonstrate the usefulness of planarians for ecotoxicological studies.

Effects of copper stress on three metabolic pathways in *Daphnia magna*: a gene expression profile

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The exposure of aquatic organisms to contaminants stills a cause for environmental concern despite the worthwhile amount of dose/response studies. Although all data gathered on the effects of contaminants is essential to ecosystems safety, the toxicants mode of action is not always understood. Consequently, it is required to focus research on how toxic substances disturb cell machinery. In the present study we used quantitative PCR (q-PCR) to investigate the expression of eight target genes in after exposure to 6µgL⁻¹ of copper, in some life stages of *Daphnia magna* (from neonate up to the first reproductive stage with eggs in the brood pouch). We selected the genes according their association with copper tolerance and to cover three key metabolic pathways in response to contaminant stress: Metal transporters [metallotionein (Mt), ferritin (Fer)], cell signalling [inositol monophosphatase (IMP), vitellogenin (Vtg), and ecdysone receptor (EcR)], and glycolysis and electron transport [citocrome-c-oxidase (COI), NADH dehydrogenase (ND2), and lactate dehydrogenase (LDH)]. Primers and nested primers were designed with Prime3 and tested in silico with FastPCR software. Total RNA was extracted, purified and quantified before cDNA synthesis. The first approach to determine the baseline variability of target genes revealed that most of the genes were upregulated at 72 and 144 hours, which correspond to eggs provisioning at 1st and 2nd brood, meaning that ovaries maturation is a complex process involving various genes and metabolic pathways. Fer and Mt were affected by copper, down and up regulated at 12 and 96 hours, respectively. COI, ND2 and LHD had the most fluctuating gene expression values, with high variability among biological replicates. The most responsive gene was IMP, up regulated at 6, 24, 48, 72, and 168 hours and down regulated at 120 hours. EcR and Vtg were down regulated at 6 hours and 72 hours, respectively. In conclusion, copper provoked significant actions in several metabolic pathways, even at concentrations underneath measurable effects on *Daphnia magna* growth and reproduction, predominantly in the cell signaling pathway. Our results shed some light on the impact of copper on the gene expression profile of aquatic organisms and open a door for the use of *Daphnia magna* gene expression pattern in the monitoring of copper contamination in natural environments.

Effects of 5 pharmaceutical substances on bryophyte *Fontinalis antipyretica* Hedw biomarkers and growth

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Potential risks associated with the release of pharmaceuticals via sewage treatment plant (STP) effluents into the environment have become an increasingly important issue for environmental regulators. This concern has been driven by widespread detection of pharmaceuticals in environmental samples as a result of improved analytical performances and the realisation of focused fields surveys. Varying levels of pharmaceuticals (less than a ng to several µg/l) have been detected in many countries in STP effluents, surface waters, seawaters, groundwaters and some drinking waters.

In order to help prioritise future research efforts within the EU, the DIADeM project suggests developing and spreading out a cross-border multidisciplinary approach to improve the diagnosis and the chemical and biological (biomarkers) monitoring of freshwaters using the river Meuse, in Belgium and France, as a case study.

Within the DIADeM project, a monitoring procedure based on the use of ecotoxicity biomarkers will be developed. The exposure of representative species of flora and fauna (a crustacean, a mollusc, a moss and a fish species) of the river Meuse will be measured by chemical analysis and the effect on the selected biomarkers will be studied. As a partner of this project, ULiège has focused on the aquatic moss *Fontinalis antipyretica*.

Five substances were chosen: diclofenac, carbamazepine, naproxen, paracetamol and irbesartan. The mosses have been exposed to a mixture of these five compounds at three different concentrations. The lowest one corresponds to the median concentrations measured for these compounds in Wallonia in a previous project (between 25 and 100 ng/l depending on the molecule). Moss specimens from an uncontaminated site were exposed to these 3 concentrations for exposure times of 4 weeks in laboratory and 5 months in the experimental rivers. The concentrations of each substance in water were monitored along with some physico-chemical parameters. The tissue concentrations of these substances in the moss specimens were then measured. The growth of the moss was evaluated and compared. The effect on selected biomarkers was studied. The results related to the monitoring of substance concentrations in water and in the tissue of moss specimens will be presented and the effect on biomarkers and morphological traits will be also discussed.

Biomarkers early-warning response of caddisfly larvae to copper and uranium

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Copper and uranium are of environmental concern because of mining. Here, we used copper and uranium as toxicants for sublethal exposure. We determined the responses of *Calamoceras marsupus* larvae to exposure of uranium and copper, using a set of biomarkers. The aim of this study was to identify potential biomarkers as early warning signals in ecotoxicological studies. We hypothesized that enzymatic responses would decrease with increasing concentration of stressors. Specimens were reared in groups of 10 in 1.5 L (3 replicates) using standard moderate hard synthetic water, and fed with alder leaf discs previously stream-conditioned. We tested two treatments of copper (35 and 70 µg L⁻¹) and uranium (25 and 50 µg L⁻¹) plus one negative control. Laboratory bioassays were performed under constant temperature 15.7 ± 0.6°C and photoperiod (12:12 h light/dark) for 35 days. We measured the activity of five enzymes in specimens exposed to all treatments: glutathione-S-transferases (GST), acetylcholinesterase (AChE), lactate dehydrogenase (LDH), catalase (CAT), and sodium-potassium adenosine triphosphatase (Na⁺/K⁺-ATPase). All enzymes' activities were expressed as nmol min⁻¹.mg⁻¹ of protein, with Na⁺/K⁺-ATPase expressed as nmol of inorganic phosphate (Pi) min⁻¹.mg⁻¹ of protein. Catalase activity significantly increased with the increase in copper concentration (F= 12.7, df=2, 8 p= 0.003) from 0.20 ± 0.04 to 1.10 ± 0.21 nmol min⁻¹ mg⁻¹ protein (mean ± SE). Na⁺/K⁺-ATPase activity was affected by uranium, with lower activity (0.11 ± 0.02 nM Pi min⁻¹ mg⁻¹ protein) at high U concentrations (50 µg U L⁻¹) and higher activity (0.15 ± 0.02 nM Pi min⁻¹ mg⁻¹ protein) at lower concentrations (Control and 25 µg U L⁻¹; ANOVA – F=5.49, df=2, 8, p=0.029;). No significant differences were observed in the activities of LDH, GST and AChE among the uranium or copper treatments. Changes in enzymes' activities have been used as biomarkers to assess the stress induced by chemicals and other environmental changes. Through the present research we found that CAT and Na⁺/K⁺-ATPase seem to be promising biomarkers for use as ecotoxicological endpoints for monitoring stress conditions of copper and uranium respectively, in freshwater systems.

Selección de hábitat como línea de evidencia para evaluar las perturbaciones ambientales en un sistema lótico

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Los ensayos de ecotoxicidad son utilizados con el fin de evaluar los riesgos ecológicos a los que los organismos pueden estar expuestos. Para los organismos acuáticos capaces de moverse, la exposición a la contaminación no es necesariamente constante, pues ellos pueden desplazarse hacia hábitats adyacentes menos perturbados. Por lo tanto, la selección de un determinado hábitat puede ser un indicativo de su mejor calidad. En este estudio, se ha utilizado un sistema multi-compartimentado de exposición no forzada, en el cual los organismos son simultáneamente expuestos a diferentes muestras de agua y, por lo tanto, pueden seleccionar aquellas con menor grado de perturbación. La respuesta de selección de hábitat se ha evaluado mediante el comportamiento de preferencia del pez cebra (*Danio rerio*) expuesto simultáneamente a distintas muestras de agua de dos ríos del Ecuador con niveles de perturbación aparentemente distintos: el río Pescadillo (muy perturbado) y el río de Oro (moderadamente perturbado). Se distribuyeron las muestras de agua de cada río en los diferentes compartimentos interconectados del sistema de exposición no forzada según su secuencia espacial en el campo, permitiendo que los organismos se desplazaran libremente entre las muestras y, así, poder evaluar la selección de hábitat de *D. rerio*. Se plantearon tres escenarios diferentes: i) exposición a las muestras del río Pescadillo, ii) exposición a las muestras del río de Oro y iii) exposición simultánea a las muestras de ambos ríos. Para cada uno de los escenarios se ha observado que los organismos: i) prefirieron las muestras de agua río abajo, ii) prefirieron las muestras de agua río arriba y iii) se movieron del río Pescadillo hacia el río de Oro. Dado que los ríos están conectados, la preferencia por el Río de Oro puede indicar una potencial depresión en las poblaciones de peces en el río Pescadillo debido a su mayor deterioro. La inclusión de la selección de hábitat, a través del uso de un sistema de exposición no forzada, mostró ser una herramienta capaz de identificar diferentes niveles de perturbación ambiental, que podría ser incorporada como una línea de evidencia en estudios de impacto ambiental.

Effects of Bisphenol A on spatial displacement of the fish *Poecilia reticulata*

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Bisphenol A is widely found in aquatic environments due to its use in the manufacture of many products. The presence of BPA in water bodies is of concern, because they can cause lethal and sublethal toxic effects in aquatic organisms. Chronic effects in aquatic organisms have been reported to occur at concentrations from 500 to 780 $\mu\text{g L}^{-1}$. The vast majority of research focusing on the adverse effects of BPA has involved the use of concentrations many times higher than those found in natural water bodies (0.0005 to 0.41 $\mu\text{g L}^{-1}$ in surface waters). However, there is no information concerning how a BPA contamination gradient could affect the spatial displacement of organisms. We hypothesized that fish might be able to detect an environmentally realistic BPA contamination gradient and avoid potential toxic effects due to continuous exposure. Therefore, the objectives of this work were: (i) to determine whether BPA could trigger an avoidance response in the freshwater fish *Poecilia reticulata*, inducing its displacement to less contaminated areas; (ii) to assess whether BPA drives avoidance occurred at environmentally relevant concentrations; and (iii) to estimate the population immediate decline (PID) at the local scale. Avoidance tests were conducted in a multi-compartment system in which a BPA contamination gradient was simulated. At environmentally relevant concentrations ($< 1 \mu\text{g L}^{-1}$), under non-forced exposure, BPA elicited avoidance responses in *P. reticulata*. The concentration that caused 50% of avoidance in the exposed population ($\text{AC}_{50} = 0.2 \mu\text{g L}^{-1}$) was 15 times lower than the values established as safe by the European Union (1.5 $\mu\text{g L}^{-1}$) and Japan (1.6 $\mu\text{g L}^{-1}$). If the AC_{20} (estimated from the avoidance data) is taken to be a potentially safe concentration to prevent BPA-driven avoidance, a value of 0.004 $\mu\text{g L}^{-1}$ is obtained, which is lower than the concentration of 0.175 $\mu\text{g L}^{-1}$ considered safe by many international governments. PID was mainly determined by the avoidance response. The approach used in the present study represents a valuable tool for use in environmental risk assessment strategies, providing a novel and ecologically relevant response.

Not all the formulants considered inert are truly inert – a case study with the commercial formulation Winner Top®

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Plant Protection Products (PPP) are formulations combining one or more active substances (a.s.) with a set of safeners, synergists or co-formulants (generally referred to as formulants). The agrochemicals industry claims using these formulants to promote the product's efficiency but fails in its disclosure in the PPP documentation. Actually, they are identified only if bear a human health or environmental hazardous potential per se. However, the assessment of putative interactions among formulants within each recipe of the formulation and consequent effects are demanded by the PPP regulation. Frequently, neither all the formulants of the recipe neither the results of possible mixture interactions are available, challenging the transparency of the licencing process. The herbicide Winner Top® (Selectis®, Portugal) was selected as model commercial formulation to evaluate if the formulants can contribute to the overall ecotoxicity of the product. The specific objectives of the study were: (i) to characterise the aquatic toxicity of this PPP towards sensitive eco-receptors (two microalgae, *Raphidocelis subcapitata* and *Chlorella vulgaris*, and two macrophyte species, *Lemna minor* and *Lemna gibba*), as well as that of its a.s. nicosulfuron and terbuthylazine; (ii) to compare the ecotoxicity among the commercial formulation, the corresponding mixture of its a.s. and this a.s.'s mixture increasingly enriched with the formulants. Single chemical testing with the a.s. revealed that microalgae grew less in the presence of terbuthylazine, contrary to the macrophytes that were more sensitive to nicosulfuron. On the other hand, Winner Top® was consistently less toxic than the corresponding mixture of the a.s., suggesting that formulants (composing 72.9% of the product) are not inert and rather interact with the a.s., in this case by promoting less than additive effects in the selected organisms. Importantly, this environmentally protective effect of the formulation compared to the a.s. mixture can be apparent. Because macrophytes share most physiological features with the weeds targeted by Winner Top®, it is likely that increased application doses are required to reach desired efficacy levels with the consequent detrimental increase of PPP residues load in edge-of-field freshwater ecosystems. This study evidences formulants may not be as inert as they are supposed to be and reinforces the need of evaluate the interaction among all substances within pesticide formulations.

Bacterial community as a complementary tool to WFD in Ecological Quality Assessment of Caima River

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Freshwater ecosystems have been suffering severe degradation and loss of biodiversity, caused by human disturbances such as agriculture, industry, mining, urban development and climate changes. Therefore, the European Union implemented the Water Framework Directive (WFD), with the main goal of reach a good ecological status in all water bodies. However, WFD is very complex, methodologies are time-consuming and costly. Thus, the development of complementary strategies that could assist the WFD approach by e.g. highlighting hazardous scenarios is an up-to-date research avenue. In this way, the main objective of this study is to develop a rapid and cost-effective approach, by studying the bacterial community composition by flow cytometry, as a complementary methodology to WFD. To achieve this, we studied 3 sites at Caima River encompassing seasonal variation (winter, spring and summer), with different levels of environmental impacts. WFD methodologies were applied and then multivariate analysis for macroinvertebrate, periphyton and bacteria communities were explored. Results showed that not always the macroinvertebrate and periphyton communities were sensitive to an increased nutrient input, resulting in an ecological status record based on biotic indicators higher than expected by physico-chemical elements' analysis. On the other hand, community structure analysis for macroinvertebrates and periphyton was very discriminatory, associating high levels of nutrients and metals with more tolerant organisms in impacted sites, and sensitive organisms with high levels of dissolved oxygen corresponding to oligotrophic, nearly pristine environments. Bacteria community analysis revealed a clear separation of Low DNA and High DNA content bacteria in sediment according to the different environmental stress scenarios, making it possible to dissociate the majority of the impacted sites from cleaner sites and highlighting DNA as a good indicator of contamination. These results suggest that the bacteria community in sediments provides a reliable indication about the impacts in lotic ecosystems, but further investigation is needed to confirm the feasibility of this new method as a complementary tool in water quality assessment.

SR2.

**New approaches
for environmental
assessment and
management**

Tools for macrophyte-based monitoring and research

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Macrophytes are important components of superficial water bodies and their diversity and abundance provide steady responses to abiotic factors and especially to nutrient enrichment, sedimentation and stream flow alterations. They have the capability of incorporating the effects of successive anthropic disturbances over long periods of time, which was recognized in the EU-Water Framework Directive (WFD). Here, we make a brief overview of the various assessment systems and metrics developed in Portugal for the assessment of ecological status of rivers and focused on the official national method for the implementation of the WFD. The Biological Macrophyte Index for Rivers, IBMR was accepted as an official national method in six EU countries of the Mediterranean Geographical Intercalibration Group for the classification of the ecological status of highly-seasonal rivers (European Community Decision of 20 September 2013). This metric has been tested for transferability within biogeographical regions and national river types of Portugal and harmonised for standardization of ecological quality. The IBMR is applicable in all river types of Portugal (except for large rivers) and has national harmonised boundaries for nine river types (temporary rivers are not included). The Portuguese Environment Agency (APA I.P.) and the Forest Research Centre (CEF, University of Lisbon) developed an on-line user-friendly platform (<http://www.isa.ulisboa.pt/proj/ibmr/index.php>) for the automatic calculation of IBMR values, classification of ecological quality and to assist research across national rivers and streams. The protocol of sampling has been recently published (). The platform provides information on the indicator taxa (species name; abundance; stenoecy coefficient; indicator value) and classifies all taxa into Angiosperms (hydrophytes, helophytes, hygrophytes, other), Bryophytes (mosses, liverworts), Pteridophytes or Macroalgae. An automatic summary report can be printed out including site photo, floristic lists, indicator taxa and ecological classification. The IBMR-Portuguese platform offers a tool for a standardized calculation of the national metric, enabling technicians and researchers to work in a comparable environment and to homogenize sampling records.

Temporal variability of stream macroinvertebrate community size-spectra

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Community size-spectra are defined as the biomass, or abundance distribution as a function of individuals size. Linear in a log-log space, slope is related to trophic efficiency of energy transference from one trophic level to the next, whereas the intercept refers to the level of richness of an ecosystem. Size-spectra have been proposed as non-taxonomic, largely free from biogeographical constraints, indicators of structure and function of foodwebs. Its performance as indicator is here addressed by testing the following hypothesis: size-spectra parameters are consistent through time among several sites within a small homogeneous catchment. To do this, macroinvertebrate community size-spectra were compared among five similar little impacted sites. To test the consistency of the parameters through time, samples were collected every three weeks between February and April 2017 (4 campaigns). Intraclass correlation coefficient (ICC) was calculated as an index of inter-campaign reliability of parameter values, and F-test were conducted. Slopes and intercepts significantly differed among sites and campaigns, respectively (Kruskal-Wallis, $p < 0.05$). Intercept showed a poor consistency (ICC=0.373), whereas slopes showed a fairly higher consistency through time (ICC=0.549). Size-spectra slope, as an indicator of trophic efficiency, might be a better discriminant of site conditions than intercept; being the former more stable throughout the season than the latter.

IDIAT.ES: THE NEW SPANISH DIATOM INDEX INTERCALIBRATION EXERCISE

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The development of the new diatom index iDIAT.ES (2016) brought forward a specific tool for water quality assessment in the Iberian Peninsula because allows the identification of ecologically meaningful differences among diatom assemblages. The index integrates the effects of multiple stressors on streams and provides information related to the “relative distance” from the non-impacted state, a requirement defined in the Water Framework Directive to assess ecological status in European streams. The new index allows to calculate biological assessment values of all river typologies (32) in the Spanish Iberian peninsula and integrates the natural variability of the river basin communities by evaluating the ecological distance from one station to the ideal “image community”. Within the scope of this work, an intercalibration exercise was developed for all the Geographical. Intercalibration Groups (GIGs) information available in CIRCA- Alpine, Central Baltic and Mediterranean under the “Procedure to fit new or updated classification methods to the results of a completed intercalibration exercise” Guidance Document No. 30, Technical Report - 2015 - 085”. The results of the intercalibration exercise are the iDIAT.ES status boundaries based on definitions of reference criteria and the application of the Boundary Setting Protocol (BSP). As a result of the intercalibration exercise, the boundaries of high-good and good moderate status were defined for the index values according to WFD definitions for status class boundaries for each quality specified. In the case for SDI calcareous and siliceous, it was compared with the boundaries defined in Guidance Document No. 30 and adapted and harmonized for fitting the recommendations for the new method.

On-line “catches”: information collection opportunities regarding fish invasions in freshwaters

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Freshwater anglers are a recognized vector for invasive fauna. In the Iberian Peninsula, about one million people practice this activity. Furthermore, anglers now frequently use social media to share their experiences through online platforms, which increases the amount of information about non-native fishes. We used online information regarding angler catches to detect new invasive fish species and assess their distribution, and used social media to apply a survey regarding invasions. For fish species detection and distribution assessment, an extensive search for corresponding records was performed using different sources of information, namely literature, online resource databases and search engines, and angler’s websites. To implement the survey on-line, a bilingual survey (Portuguese and Spanish) was created and made available online using the Google Drive® tool for online surveys. It was advertised in eight Portuguese and seven Spanish angling forums, covering all the different freshwater angling techniques. Two new fish species were detected in Portugal by checking online information, the channel catfish (*Ictalurus punctatus*) and the European perch (*Perca fluviatilis*). The first was detected along the river Guadiana, from the Spanish border to Mértola; the second was found in a small near Castelo Branco, Portugal. Spatial distribution patterns of the non-native species *Silurus glanis* and *Ictalurus punctatus*, from multiple online sources was reconstructed in Tagus and Guadiana River, respectively. For both catfishes the majority of records were from angler forums. Dispersal was predominantly downstream but several records showed movements or , only possible by human intervention. Our on-line survey showed, that in both countries, the preferred fish species were invasive. Most anglers recognize that introductions have environmental impacts and that anglers have an active role in intentional introductions. , these findings from on-line anglers’ sources showed invasive dispersal patterns, anglers perceptions and risk behaviors. This approach may be used to model invasion risk and to improve monitoring and awareness campaigns led by governmental agencies, being an easy to implement and low cost method.

Um modelo qualitativo para a gestão de bacias hidrográficas baseado em processos ecológicos

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Indicadores de qualidade ambiental são ferramentas fundamentais para a gestão eficiente dos recursos naturais. No caso de ambientes aquáticos, indicadores estruturais e funcionais podem ser utilizados para avaliação da saúde dos ecossistemas. Embora indicadores funcionais, como a decomposição, sejam menos utilizados, há estudos que comprovam sua eficiência em avaliar os efeitos dos impactos antrópicos em bacias hidrográficas. A decomposição da matéria orgânica particulada constitui o principal caminho de transferência de energia nos rios, sendo considerada um bom indicador por ser um processo integrativo e de fácil medição. Apesar do reconhecimento científico da importância dos processos ecossistêmicos na avaliação ambiental, autoridades gestoras de recursos hídricos ainda não os utilizam, seja por desconhecimento dessa abordagem ou por não compreenderem como aplicá-la diretamente na gestão das águas. Nesse contexto, como uma primeira tentativa de explorar o uso de processos ecológicos na gestão de recursos hídricos, o presente trabalho propõe o desenvolvimento de um modelo conceitual, baseado em Raciocínio Qualitativo (RQ), área da Inteligência Artificial relacionada ao raciocínio simbólico sobre quantidades. Este método permite explicitar relações causais entre fatores como eventos de estresse em bacias hidrográficas, condições do corpo hídrico e ações do governo e da sociedade, onde a decomposição será o indicador chave da integridade ecológica. O modelo apresentado no presente estudo foi desenvolvido no simulador qualitativo DynaLearn (www.dynalearn.eu) e adota a abordagem proposta pela teoria qualitativa dos processos. Os cenários estabelecidos e as simulações realizadas com o modelo demonstraram que ações do governo voltadas para a recuperação das bacias hidrográficas podem levar as taxas de decomposição a valores mais próximos de seu valor de referência. Aspectos estruturais, tais como a composição da comunidade de invertebrados, a biomassa de microrganismos, a diversidade de habitat e a qualidade físico-química da água influenciaram a taxa de decomposição nos diversos cenários, e a sociedade mostrou-se importante para estes resultados ao pressionar o governo. Deste modo, o modelo proposto conseguiu demonstrar, simplificada, o potencial do uso de indicadores funcionais na gestão das águas.

Evaluation of the community of benthic macroinvertebrates. The first step to construct an overall protocol to determine the ecohydrological state of the Pesquería River (NE, Mexico)

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The National Council of Diversity (CONABIO) has located the Pesquería River (northeast of Mexico) as a priority case to study due to the anthropogenic impacts it has suffered. CONABIO recommends the characterization of water and its ecological status. Currently, in Mexico, there is no general regulation that includes the state of the riparian vegetation, the physicochemical parameters and benthic macroinvertebrates as bioindicators, to determine the ecohydrological status of rivers. From this, the main objective of this study is to know how the benthic macroinvertebrate communities are responding to anthropogenic impacts and use them as indicators of the ecological state of the Pesquería River. In addition, we applied the quality of the riparian forest index (QBR) and the stream habitat assessment index (IHF) to complete an overall ecohydrological protocol in the Pesquería River. This study will provide the first step to evaluate the current ecological status of the Pesquería River, as well as the restoration and conservation plans of this ecosystem.

Evaluación del bosque de ribera del río Macaé (NE, Brasil), a través del índice QBR (Qualitat del Bosc de Ribera)

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Actualmente el río Macaé desempeña un papel importante en el desarrollo socioeconómico de Brasil. La cuenca hidrográfica a la que pertenece abastece a más de 200 mil habitantes del municipio de Macaé además de subvencionar gran parte de las actividades relacionadas con la extracción de petróleo del país. Hoy en día problemas como la deforestación causada por un sistema agrícola poco sustentable, la descarga de aguas residuales, la quema de basura y el turismo desmedido, además de la rectilinizción realizada en 1940 de la parte baja de su cauce, han alterado profundamente el estado ecohidrológico del río. Este conjunto de acciones han reducido fuertemente la biodiversidad en los bosques de ribera y los manglares, que garantizan la conservación de diferentes especies acuáticas. Para poder conocer el estado actual del bosque de ribera del río Macaé se adaptó y aplicó el índice de Calidad de Bosque de Ribera (QBR) en conjunto con el Índice de Hábitat Fluvial (IHF), para el ecosistema de Mata Atlántica. La evaluación del río mediante la adaptación del QBR y la aplicación del IHF, indica que dichas herramientas muestran una aproximación del estado ecohidrológico actual del río Macaé. Los resultados de la adaptación del índice de calidad de bosque de ribera para el ecosistema de Mata Atlántica en Brasil, permiten identificar y evaluar diversos panoramas de una problemática ambiental que antes era percibida de una manera más homogénea.

Consistent, congruent or redundant? Organisational response of lotic communities to disturbance

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Although different organisms and metrics are applied in aquatic ecosystem assessment, deciding which organism group(s) or community level to apply is usually based on the local level of taxonomic expertise, rather than the discriminatory power or precision of a given response to specific stressors. We compare the response of two different organism groups (fish and invertebrates) and ecological traits (fish guilds and invertebrate traits) to putative stress gradients, in 9 sites spread by 4 northern main catchments as a case study. The rivers covered a quality gradient ranging from reference conditions to high levels of disturbance across classes of ecological status within designated Water Framework Directive monitoring networks. We tested three hypotheses: 1) Ecological traits respond better to human impacts at a regional level (e.g. land use), while taxa better respond to local factors (e.g. habitat changes or water quality); 2) Invertebrate traits or fish guilds respond to a wider range of anthropogenic disturbances compared to a taxa and are not as strongly affected by temporal variations; 3) these two communities responded differently along the studied gradients. We used canonical correspondence analyses, including partial correspondence analysis and principal response curves to analyse changes in composition and metrics and the relative contribution of environmental variables for each biological data set. We carried out analyses not only between sites but also along the temporal gradient, complemented also by linkage trees and logistic regressions. Conclusions are more complex than the formulated hypotheses. Although both invertebrate and fish communities revealed a similar ability to assess impairment, invertebrates responded better to local disturbances, whereas the fish composition or traits/guilds were more sensitive to larger scale variation. Results for temporal variation analyses suggested that invertebrate traits more accurately detected fluctuations of environmental factors but variation in the composition of fish species stronger expressed temporal gradient. The differences on the response of these two communities reinforce the importance of a combined approach, using different ways of expressing community data, to detect environmental impacts.

Embalse de Abegondo-Cecebre. Un sistema de abastecimiento humano monitorizado en continuo mediante sondas de alta frecuencia

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El Embalse de Abegondo-Cecebre, localizado en el NO Península Ibérica (20.9 hm³; 355 ha; Z_{max}=17.8 m; Z_{med}=5.9 m; AC:AL=72.6), es la única fuente de agua potable de la ciudad de A Coruña y sus ayuntamientos limítrofes (~400.000 habitantes). Está gestionado por la Empresa Municipal de Aguas de La Coruña, EMALCSA. Es un sistema eutrófico, con un régimen de mezcla monomítico y que presenta una alta demanda. En momentos de estrés hídrico se ha visto afectado por procesos de anoxia hipolimnética e incremento de la concentración de metales en el hipolimnion, así como floraciones algales episódicas de cianobacterias tóxicas. Dentro del sistema de abastecimiento de agua para la población está prevista la conexión de este embalse con el Lago de Meirama, situado en la cabecera de la misma cuenca vertiente, un lago artificial producto de la inundación de forzada de una mina de lignito pardo. Toda la cuenca que incluye el sistema de abastecimiento (Cuenca Mero-Barcés), incluidos los afluentes, ha sido dotada por parte de EMALCSA de una amplia red de sensores que permiten el control en tiempo casi-real de parámetros físico químicos. Dicha red incluye un sistema perfilador automático, 3 sondas multiparamétricas, 1 estación meteorológica y 4 estaciones de aforo. A ello se suman otros sensores dotados en el entorno del Lago de Meirama. El embalse ha sido objeto de estudios limnológicos previos que revelaron la vinculación del régimen de precipitación y temperatura con la intensidad de los blooms algales y procesos hipolimnéticos. Con la actual intensidad de estudio de la cuenca Mero-Barcés se pretende profundizar en el estudio de los patrones estacionales hallados. En la actualidad el Embalse de Abegondo-Cecebre es el primer sistema de la Península Ibérica en incorporarse a la Red Global de Observatorios Ecológicos GLEON.

Desarrollo de herramientas de monitorización de la calidad del agua en pequeños embalses mediante imágenes tomadas con sensores multiespectrales

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En la Unión Europea, la Directiva Marco del Agua (2000/60/CE) obliga a la realización de monitorizaciones periódicas en los embalses y masas de agua. En la actualidad la mayor parte de los programas de monitorización de embalses están basados en medidas puntuales tomadas encampo con los que resulta difícil capturar la variabilidad espacial y temporal de fenómenos tales como los "blooms" de cianobacterias, con patrones espacio-temporales irregulares. El uso de teledetección para la determinación de ciertos parámetros indicativos de calidad del agua (temperatura, transparencia, turbidez, concentración de pigmentos fotosintéticos, materia orgánica coloreada disuelta, etc) se ha mostrado eficaz la hora de capturar esta variabilidad en ecosistemas acuáticos mediante el uso de imágenes de satélite procedentes de sensores como MERIS o de las diferentes misiones LandsatTM/ETM+, y más recientemente Landsat 8 y Sentinel 2. Con el objetivo de aumentar la resolución espacial y temporal obtenida mediante imágenes de satélite en la monitorización de masas de agua, especialmente aquellas de pequeño tamaño, se implementó un sistema complementario basado en el análisis de imágenes tomadas desde UAV (Unmanned Aerial Vehicle) orientado a sistemas con problemáticas detectables por imagen (blooms algales, turbidez). En este trabajo exponemos los primeros resultados de un ensayo realizado en septiembre de 2017 en un pequeño embalse (4,5 Ha., 0,24 Hm³) de abastecimiento humano afectado de forma recurrente por la presencia de cianobacterias. Se tomaron imágenes con un octocóptero dotado con un sensor multiespectral (RedEdge Miasense) y una cámara térmica (FLIR TAU2 640) de forma sincrónica a la realización de mediciones "in situ" y a la toma de datos radiométricos. La herramienta se considera coste-efectiva dado que permitió tener información espacial en un sistema acuático de menos de 5 ha en un momento de estado declarado de alerta por sequía y por presencia de cianobacterias en el que no se dispuso de imágenes de satélite válidas por un período de 24 días consecutivos. Los dos vuelos realizados fueron efectivos en la evaluación de las condiciones de escasa biomasa fitoplanctónica y turbidez del día de muestreo (chl_a=1,3-2,7 µgr/l, ficocianina=0,13-0,24 µgr/l, TSS= 1,2-6,8 mg/l, ZDS= 1,5 - 2,0 m), pero la metodología será implementada de nuevo para valorar su eficacia en distintas condiciones de turbidez y biomasa y composición de fitoplancton.

Monitoring hydrological patterns in Lake Alcahozo by remote sensing techniques and meteorological data

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The Biosphere Reserve of La Mancha Húmeda is one of the most threatened wetland areas in Europe due to human activity, mainly related with groundwater overexploitation due to an excessive irrigation water use. This area is one of the biggest lake districts in the Iberian Peninsula, comprising a set of temporary saline lakes, including Lake Alcahozo. The water level of this lake fluctuates seasonally, with water inflows mainly coming from direct precipitation and the very small catchment. This lake is an endorheic system, with water withdrawal mainly through evaporation. Understanding the dynamics of water in lakes helps the goal of conservation and recovery of these ecosystems. In this work, we have estimated the temporal variation of the flooded area in Lake Alcahozo, using remote sensing techniques, as well as its associated hydrological patterns related to the seasonality of precipitation and evapotranspiration (ET₀). A recently created remote sensing methodology was used, including specific algorithms developed by genetic programming. This approach allowed us to discern between water and non-water pixel using the near infrared band of Landsat 5-TM and Landsat 7-ETM+ sensors. Satellite images for the period 1999 – 2017 were used, and the flooding patterns related to the meteorological patterns nearby. Preliminary results show significant relationships ($p < 0.01$) between the flooded area pattern of Lake Alcahozo and the rainfall in its catchment integrated for periods of 14, 30 and 90 days, showing R² values around 0.7. Similar regression coefficients were also obtained using ET₀ and periods of 7, 14 and 30 days. These results show the potential of these techniques to study the hydrological trend of seasonal water bodies in semiarid areas, which might be useful for management and lake conservation, and specifically to accomplish the goals of both the Water Framework and the Habitats Directives.

Identification and delineation of marginal vegetation in Mediterranean wetlands using several remote sensing techniques

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Marginal vegetation communities have an essential role in the wetland structure and functions. They provide several benefits to the wetland ecosystems, such as nutrient retention, food and shelter provision to biodiversity, avoidance of siltation, and climate mitigation contribution, among others. Additionally, and according to the European Habitats Directive, vegetation cover should be assessed as a criterion to determine the conservation status of the Habitats of Community Interest. Remote sensing techniques allow to estimate the area covered by the marginal vegetation, enabling an accessible and accurate spatial study. A wide range of free available products with enough quality allow to carry out spatial and temporal vegetation analyses, as well as to identify some plant communities. The aim of this study was to evaluate four vegetation identification and cover delineation methodologies in two types of wetlands, coastal marshes and inland temporary saline lagoons. These methods were tested by estimating the vegetation cover in a past and a recent image, in order to show the differences within a specific period of time. Landsat images and orthophotos were used in a coincident or closest time to the sensors overpass in the different methodologies. One of the studied methods was based on the manual delineation by GIS and specific geoportals using free orthophotos and aerial images. Another method was based on the vegetation delineation on the available images in Google Earth Pro portal with its polygon calculation tool. The third method was the application of the Normalized Difference Vegetation Index (NDVI) on Landsat images. The last one was the use of a specific product developed in a Satellite-based Wetland Observation Service (SWOS) Geoclassifier software in Landsat images. Furthermore, distinction between helophytes and halophilous plant communities was carried out when possible. Each method had a particular level of precision, difficulty, and time requirement for image analyses. However, results showed that all these tested methods were useful for the vegetation delineation and estimations did not strongly differ. Consequently, the use of these methods would allow to fill gaps in the different reporting requirements, as well as to contribute in many ecological studies.

Drones y Limnología

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Desde que en el 2007 aparecieron los drones aéreos o vehículos aéreos no tripulados (UAV) con cámaras fotográficas y coste asequible al público en general, se ha generalizado su uso como herramienta en ingeniería y en estudios del medio ambiente. Los ecosistemas acuáticos ofrecen grandes oportunidades para la teledetección. En la actualidad se puede desarrollar cartografía temática de diversos ámbitos en el campo de la limnología gracias a la resolución espacial de los sensores instalados en drones, que varía desde milímetros hasta metros a un coste asumible. El presente trabajo ilustra la aplicabilidad de los drones aéreos en el campo de la limnología, como la detección en tiempo real de vertidos térmicos, eutrofización, vegetación bentónica, batimetría, macroinvertebrados, densidad de peces, etc. A partir del estudio de las propiedades ópticas de los ecosistemas acuáticos a diferentes rangos espectrales se puede determinar la metodología a utilizar para la obtención de los diversos mapas temáticos. En este trabajo evaluamos las ventajas e inconvenientes de cada desarrollo metodológico.

iDIAT-ES. A new diatom index to assess the ecological status of Spanish rivers: Index validation in the Ebro River Basin.

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The iDIAT-ES index (Índice de Diatomeas Español) was developed based on the structure, composition and organization of diatom assemblages from almost 1000 Spanish rivers. In order to explore the accuracy of the index, a validation test was carried out using data from more than 350 samples collected in the Ebro River Basin during the period 2015-2016. The goal was to test the suitability of the iDIAT-ES as a tool for ecological assessment in rivers considering a new dataset not used during the index development process. In terms of index suitability, the following aspects were studied: (1) Composition and frequency of the diatom community; (2) Percentage of diatom species contributing to the index calculations; (3) Statistical correlations with other biological index and environmental variables; (4) Adequacy of the established status class boundaries and its influence in the assessment of the biological status. The results obtained from the evaluation in the Ebro River Basin showed good response and agreement to the biological quality categories based on other diatom indices such SPI (Specific Pollution Sensitivity Index). The evaluation gives a better understanding of the suitability of the new index and reveals ways for improvement bringing up new opportunities to refine the tool in further versions.

From science to practical applications: Diatom growth forms in relation to disturbance gradients in the Tagus basin

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Diatom communities colonize substrates following a successional scheme from flat-celled species to erect life forms, motile or tube forming species that extend into the water. The study of diatom growth forms in relation to environmental variables has received increasing attention in the last decade, as it has been found to indicate variation on water quality conditions as well as anthropogenic or physical disturbance. Moreover, studies indicate that such growth forms show a more consistent response to environmental variables than individual species. While strong evidence comes from microcosm experiments and controlled experimental designs, a reduced number of studies tested the response of diatom growth forms in relation to water quality conditions using large datasets. The present study tests the relationship between different diatom growth forms, environmental variables and water quality (IPS diatom index) comprising 255 samples taken in the Tagus basin in 2016. The study shows that diatom growth forms were strongly related to water quality and environmental variables such as nutrient enrichment and physical disturbance. Motile and low profile forms are the most sensitive groups displaying an opposite and predictable behavior along nutrient gradients. The potential use of diatom growth forms in ecological assessments and its inclusion in routine water quality monitoring is emphasized: diatom growth forms allow water quality assessments when reference conditions do not exist and the comparison of ecological status in streams over large geographical areas. In addition, the use of diatom growth forms to assess environmental disturbances supposes an enormous simplification of the diatom data in terms of taxonomic resolution, while keeping a strong ecological value.

Freshwater diatom (*Tabellaria flocculosa*) teratologies and Chl c as biomarkers for Cu and Zn contamination

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Metals, such as zinc (Zn) and copper (Cu), are not only essential micronutrients, but also one of the main anthropogenic pressures in aquatic ecosystems. Still, metal stress on the biota isn't detected with European standard environmental assessment methods, so new tools need to be developed. Diatoms are routinely used for bioassessment in freshwater. Nevertheless, the effect of metals on benthic freshwater diatoms is poorly understood and thus *Tabellaria flocculosa* (a freshwater diatom species), isolated from a Zn and Cu contaminated stream was studied. *T. flocculosa* was exposed to different concentrations of Zn and Cu, and the metal effects were assessed by measuring physiological and morphological parameters: growth, pigments content: chlorophylla (Chl a), c (Chl c), carotenoids and teratological forms. We found that at environmental stream concentrations occurring in Europe, Zn and Cu induced toxic effects on *T. flocculosa*. Zn effects were only observed at high concentrations (500 µg/L and 1000 µg/L), resulting in increases of Chl c and higher frequency of teratological forms, specially of deformed and extremely deformed cells, which increased significantly in relation to control conditions. Increasing Cu exposure increased Chl a and c, while carotenoids' cellular content decreased. Cu also increased significantly the number of *T. flocculosa* frustule deformations. Our results showed that the frequency of diatom teratologies could potentially be used to assess Zn and Cu stress. Additionally, the analysis of diatom pigments could potentially separate the effect of Zn and Cu.

Control y vigilancia entomológica de mosquitos vectores de enfermedades humana y animal en Galicia

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Los mosquitos (Diptera: Culicidae) son insectos que se alimentan de sangre y, como consecuencia, constituyen uno de los vectores más importantes en la propagación de patógenos y parásitos a humanos y animales, algunos de los cuales son verdaderamente peligrosos para la sociedad al ser responsables de enfermedades tan devastadoras como la malaria, la filariasis, la fiebre amarilla, el dengue, el virus del Nilo Occidental y la fiebre del Zika. Entre los mosquitos del género *Aedes* se encuentran dos especies altamente invasoras, *Aedes aegypti* y *Aedes albopictus* (o mosquito tigre), propias de regiones tropicales y subtropicales. Sin embargo, actualmente y debido al cambio climático y el constante aumento de las temperaturas, la expansión de estas poblaciones de mosquitos ha aumentado en todo el mundo convirtiéndose en un importante problema de salud pública internacional. Ante esta creciente amenaza la prevención es fundamental, por lo que cada vez es más necesario la implantación de redes de vigilancia y control ecológico eficaces frente a este tipo de vectores. Por ello, en 2017 Galicia se ha sumado a este reto en gestión ambiental, ya iniciado en otras regiones de España como Madrid y Canarias, así como en Portugal; mediante una red entomológica de vigilancia y control sanitario desarrollada por la Xunta de Galicia en asociación con las Universidades de Vigo y Santiago de Compostela. Para ello se han distribuido trampas especialmente diseñadas para detectar la presencia de este tipo de vectores durante sus periodos de mayor actividad en puntos estratégicos de la comunidad donde estos insectos tienden a instalarse y poner los huevos, así como en posibles zonas de entrada del mismo tales como carreteras principales, puertos y aeropuertos. Por ahora, los resultados analizados no confirman la presencia de estos vectores, pero sí permiten analizar la distribución de las poblaciones de otro tipo de insectos, entre los que destaca la familia Sciaridae por su abundancia.

Determination of the Trophic State Index (TSI) using remote sensing, bathymetric survey and empirical data in a tropical reservoir

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The reservoirs are important freshwater reserves, but may suffer with domestic and industrial wastes, causing qualitative and quantitative changes in their physicochemical composition, as well as causing fauna and flora impacts. One of the consequences is eutrophication, a process characterized by increased concentration of nutrients in aquatic ecosystems, mainly phosphorus and nitrogen. In order to classify waterbodies according to their trophic degrees, chlorophyll-a and phosphorus concentration, data are usually obtained in water samples, feeding an equation to obtain the Trophic State Index (TSI). The method used at the present work aim to determine the trophic degree based on remote sensing, by using the ratio between the near infrared and red bands images to infer the chlorophyll-a concentration and their ranges for TSI, in wet and dry seasons. This method allows a synoptic vision of the reservoir, providing support for decision-making process at low cost, especially when large amount of data are available/generated, increasing quality in consonance with technological development. However, it is to consider the influence of the bottom of shallow areas when using orbital images to evaluate waterbodies conditions, since the emerging radiation of the euphotic zone is responsible for the results reliability. Therefore, we determine the Secchi depth by using an index that includes the ratio between the near infrared and blue bands images to obtain a euphotic zone mask. This mask was compared with an empirical mask, obtained by empirical Secchi depth data and bathymetric survey (submerged relief and depth). Thus, it is possible to exclude the shallow areas (bottom effects) which may compromise the satellite images spectral response, before it is used to perform the TSI thematic map. Then, two thematic maps of TSI (wet and dry seasons) were created. The next step was the validation of TSI maps comparing the remote sensing results (observed) with empirical data (expected) obtained in 28 geocoded points along the riverine-transition-lacustrine gradient. The comparison was performed using the chi-square test that shows how much difference exists between the observed and the expected. Both seasons presented $\chi^2=1$, $df=27$, with critical value (0.005) of 49.64. Therefore, no differences was found between the observed and the expected probably because that reservoir is located at the end of forth reservoirs system and maintained with the same volume.

Efectos de la presencia humana masificada sobre zonas de reproducción de *Cobitis calderoni*. Evaluando el estado ecológico de un lago desde las orillas

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La Lamprehuela o Verdemã do Norte (*Cobitis calderoni* Bacescu, 1962) es un pequeño pez bentónico catalogado en peligro de extinción tanto en Portugal (desde 2005) como en España (desde 2011). La pérdida de hábitats, el aterramiento de fondos, falta de depuración de aguas residuales y la presencia de especies exóticas invasoras son reconocidas como causas importantes de su declive poblacional. La última evaluación IUCN (2006) incrementó su riesgo de amenaza desde Vulnerable "VU" en 1996 hasta En Peligro de extinción "EN, A2ace+3ce". En las cuencas de los ríos Tera y Negro (Zamora, NO de España) presenta actualmente poblaciones importantes con distribución continuada en todos los cauces permanentes aguas arriba de grandes embalses, lo que ha producido su fragmentación y aislamiento desde hace al menos 5 décadas. La población del lago de Sanabria y su entorno ha sido estudiada en detalle en 2016-17 durante las actuaciones del Seguimiento Limnológico Bidual Intensivo [AELS, <https://aulaestudiolagosanabria.info>] para conocer su estado ecológico en base a la Directiva Marco del Agua. La presencia y uso selectivo del hábitat que hace *C. calderoni* en este lago, muy frecuentadas por el turismo de verano y pescadores, en relación con la disponibilidad de hábitats de alimentación y reproducción fue el objetivo del estudio. La ocupación intensiva de tramos litorales someros del lago de Sanabria para actividades de baño, navegación turística y pesca deportiva degradan los hábitats litorales por pisoteo y abrasión de los fondos. Estas actividades afectan tanto a la pérdida de frezaderos como a las comunidades del epilíton y el fitobentos de las que dependen para alimentarse. Otros efectos negativos detectados fueron la reducción del caudal de estiaje, el calentamiento del agua en zonas sin aliseda y la formación semipermanente de banda árida. La especie ocupa selectivamente aquellos tramos de menor presión e intensidad de presencia humana, abandonando en gran medida parte del litoral que presenta por lo demás buenas condiciones de sombreado, de calidad del agua y sustratos adecuados en el biotopo bentónico. Las poblaciones del lago de Sanabria comparten hábitats y recursos en sintopía estricta con el gobio (*Gobio lozanoi*), y desde hace poco tiempo con gambusias (*Gambusia holbrooki*) que han sido introducidas en un tramo del río Tera, y que suponen un serio competidor por los lugares favorables de alimentación y reproducción.

Occurrence of cyanobacteria and cyanotoxins in Portuguese freshwater systems

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Cyanobacteria are a group of microorganisms that inhabit our planet for over 3 billion years. Present in a wide amplitude of ecosystems they also tend to occur in freshwater habitats. In these they produce dense blooms associated with the release of toxic compounds (cyanotoxins) that threaten the life of humans and animals that inhabit those waterways. Due to this elevated risk it is required prompt methodologies in the environmental assessment of toxic cyanobacteria and of their toxic compounds in freshwater systems. They allow through the application of molecular schemes the characterization of the toxic species or genera present (taxa composition) and also of the cyanotoxins potential (cyanotoxicity). In order to better characterize the community of cyanobacteria and its toxic potential in Portugal seven freshwater systems (lakes, rivers, lagoons) with relevant economic and social impacts (drinking, irrigation, recreational) were surveyed from April to September of 2017. Water samples were collected and processed for the molecular identification of three cyanobacteria species (*Microcystis aeruginosa*, *Cylindrospermopsis raciborskii*, *Planktothrix agardhii*), one genera (*Dolichospermum*) and of four main cyanotoxins (*microcystins*, *cylindrospermopsins*, *anatoxin-a*, *saxitoxins*). Data collected from our study permitted to evaluate on the presence of toxic cyanobacteria and of their respective cyanotoxins potential in Portugal. In this study molecular methods have proved to be a good tool in the study of the ecology and biodiversity of cyanobacteria.

Proposição de índice de qualidade da água para irrigação (IQAI) com base no monitoramento da água superficial em ambientes rurais do Distrito Federal, Brasil

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A agricultura irrigada se expandiu mundialmente sendo atualmente responsável pela produção de quase metade dos alimentos no mundo. Os índices de qualidade da água (IQA) têm sido amplamente utilizados como ferramenta para o gerenciamento de recursos hídricos, mas geralmente são focados na qualificação de água para o abastecimento público. No entanto, admite-se a necessidade de avaliar a qualidade da água de irrigação para evitar ou minimizar os impactos na produção agrícola e na saúde humana. Diante disso, o objetivo do presente trabalho foi propor um índice de qualidade da água para irrigação (IQAI) com base na seleção de variáveis de qualidade da água de três corpos d'água inseridos em ambientes rurais do Distrito Federal (DF), Brasil. Foram selecionados nove pontos de coleta em três corpos d'água, Córrego Capão Comprido, Córrego Sarandi e Rio Jardim. As amostras foram coletadas entre maio de 2012 e abril de 2013. Para cada amostra coletada, foram realizadas determinações de 22 variáveis físicas, químicas e microbiológicas de qualidade da água. A partir dos dados de monitoramento, evidenciou-se que importantes variáveis indicativas de poluição rural, como amônio, fosfato, sulfato e fósforo total, obtiveram valores abaixo do limite de detecção para todos os períodos analisados nos três corpos hídricos. As outras variáveis não apresentaram grande variação de suas concentrações entre os períodos hidrológicos (seco e chuva) para os três rios. Através da análise de componentes principais (PCA) foi possível selecionar: pH, condutividade elétrica (CE), dureza total (DT), razão de adsorção de sódio (RAS), nitrato (NO₃) e coliformes termotolerantes (CT) para compor o IQAI. Essas variáveis apresentaram maior carga fatorial entre outros critérios relevantes. As águas superficiais nos nove pontos de amostragem foram consideradas adequadas à prática de irrigação ao longo do período estudado. Todos os pontos foram classificados como "sem restrições", isto é, sem risco de toxicidade para a maioria das plantas e sem risco de contaminação por coliformes termotolerantes. Conclui-se que o IQAI apresentou uma boa adequação para medir a qualidade da água dos três rios, e pode ser perfeitamente utilizado na avaliação da qualidade da água superficial de corpos d'água com características semelhantes.

Aplicação de um plano diretor em um campus universitário como instrumento de gestão visando o uso racional de recursos hídricos

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Um plano diretor se caracteriza pelo conjunto de princípios e regras que orientam as ações dos agentes responsáveis por construir e utilizar os espaços urbanos. Atualmente, o uso de um plano diretor como instrumento básico para orientar a política de desenvolvimento sustentável e de ordenamento da expansão urbana do município tem sido cada vez mais comum em diversos países. Contudo, ainda não é comum o uso desse instrumento para a gestão de grandes universidades, principalmente nos campus universitários que ocupam grandes áreas urbanas ou áreas experimentais agrícolas, chegando a ter problemas de gestão ambiental do espaço tal qual uma cidade. No campus da Universidade de São Paulo, cidade de Piracicaba, Brasil, considerada a melhor escola de ciências agrárias da América Latina, existe um Plano Diretor Socioambiental Participativo (PDS), que abrange diversas áreas socioambientais de trabalho, dentre elas a temática água. A demanda por este plano diretor surgiu a partir de um Termo de Ajustamento de Conduta entre a prefeitura do campus e a Agência Nacional de Águas, que exigia a adequação ambiental das áreas de preservação permanente e a instalação de hidrômetros nos prédios universitários. Dentro do PDS existe um grupo de trabalho responsável pela gestão de recursos hídricos que analisa quali-quantitativamente os corpos d'água que abastecem o campus e recebem seus efluentes. Este trabalho buscou acompanhar os projetos desse grupo e a supervisão das obras de infraestrutura de captação, tratamento de água e esgoto e rede de abastecimento de água, na qual contaram com a instalação de hidrômetros em uma parte dos prédios universitários. Foi feito o acompanhamento da elaboração das novas diretrizes para minimizar os problemas socioambientais ligados à água visando o seu uso racional, detectados na fase de diagnóstico. A proposta de monitoramento hidrológico contínuo dos corpos hídricos do campus resultou na criação de um banco de dados inédito dessas áreas. Levou também à criação de um grupo de estudos em limnologia e gestão hídrica entre os alunos de graduação e pós-graduação intitulado "Grupo de Estudos e Práticas para o Uso Racional da Água" que vem complementando a formação de dezenas de alunos. O PDS se mostrou uma ferramenta eficiente na gestão dos recursos hídricos no campus universitário em Piracicaba, principalmente pelo fato de ser revisado a cada oito anos, trazendo novos diagnósticos e desenvolvendo soluções que atendam as demandas atuais.

Fluorescência do carbono como ferramenta diagnóstica da qualidade da água: um estudo de caso com a Lagoa da Pampulha (Minas Gerais, Brasil)

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Identificar a saúde e a qualidade da água de um ecossistema requer a determinação de influências naturais e antrópicas nos seus processos biogeoquímicos. Um bom traçador dessas influências é o carbono orgânico dissolvido (COD), por ser um integrante crítico em vários ciclos biogeoquímicos, controlar a disponibilidade de luz e oxigênio no meio e conectar o ambiente terrestre ao ambiente aquático. O papel do COD varia com os seus diferentes tipos e fontes, esses podem ser identificados mediante mensurações espectrais de fluorescência comumente coletados como matrizes de excitação e emissão (EEM). A Lagoa da Pampulha (Minas Gerais, Brasil) é um reservatório urbano e eutrófico com um histórico de entrada de esgotos via tributários. Desde 2016, o reservatório passa por uma recuperação de sua qualidade da água via processos químicos e biológicos. Os objetivos desse estudo foram: (1) caracterizar a variação espacial da concentração, composição e fontes do COD na Lagoa da Pampulha; (2) discutir as implicações ambientais dessas mensurações e (3) elucidar a utilização da fluorescência do carbono como ferramenta de monitoramento da qualidade da água de um ecossistema aquático. No verão de 2018 foram coletadas amostras de água superficial de 18 pontos do reservatório incluindo seus principais tributários e, além do COD, clorofila e nutrientes também foram analisados. Uma EEM foi identificada para cada um dos pontos e foram calculados índices de fluorescência. A concentração do COD dos tributários variou de 7,6 mgL⁻¹ (córrego Bom Jesus) até 35 mgL⁻¹ (córregos Ressaca e Sarandi), já na lagoa os valores foram de 11 até 24,6 mgL⁻¹. O SUVA apresentou uma alta variação nos tributários de 0,6 a 4,5 mg C L⁻¹ m⁻¹ e na lagoa os valores não passaram de 1,6 mg C L⁻¹ m⁻¹. O índice de fluorescência (FI) variou de 1,6 a 2,1, indicando que fontes autóctones de carbono dominaram em todos os pontos. Além disso, também foram encontrados valores altos para o índice de fluorescência biológica (BIX) indicando contribuições microbiológicas recentes. As altas concentrações de carbono e a forte influência autóctone e microbiana refletem a ocorrência de florações de algas e entrada de esgotos no sistema. Os resultados evidenciam que a oligotrofização do reservatório, objetivo do projeto de recuperação para esse corpo d'água, ainda está longe de se tornar uma realidade, possivelmente devido à forte influência dos tributários, que permanecem poluídos.

Estudio de la influencia de los macrófitos en la hidrodinámica de un río empleando simulación numérica 2D

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La regulación de un cauce fluvial puede venir motivada por diferentes razones: desde la necesidad de almacenar agua para el abastecimiento humano o para el riego, hasta disponer de una barrera física para controlar las avenidas y reducir así el riesgo de inundación aguas abajo. Sin embargo puede tener consecuencias negativas para con la calidad hidromorfológica e hidrobiológica de los ríos. El curso fluvial del Bajo Ebro (España) ha experimentado en las últimas décadas un incremento muy importante de vegetación acuática, sobre todo de macrófitos. La clarificación de las aguas debido a la retención de sedimentos por el sistema de embalses Mequinenza-Ribarroja-Flix y el aumento de nutrientes inorgánicos debido a la agricultura, ha propiciado la proliferación masiva de macrófitos. Desde 2002 se realizan periódicamente avenidas controladas con el fin de reducir, o por lo menos controlar, la población de macrófitos. La efectividad de estas avenidas es función de las características del hidrograma y de la resistencia al flujo que ejerce la vegetación de ribera, en especial los macrófitos. Las avenidas requieren de un gran volumen de agua, por lo que su aplicación no es frecuente (1-2 veces/año). En este sentido, la simulación numérica se postula como una herramienta muy útil. Sin embargo es necesario disponer de un modelo numérico capaz de reproducir con detalle el funcionamiento del sistema. Es por ello que se ha empleado el modelo numérico de simulación hidráulica bidimensional Iber (www.iberaula.es). El modelo, tras su calibración y validación con datos de campo, se empleó para evaluar la hidrodinámica del tramo de estudio considerando tres escenarios: sin macrófitos, con escaso desarrollo de macrófitos y con alto desarrollo de macrófitos. Los resultados mostraron diferencias notables en los niveles de agua (diferencias por encima de 1,5 m) cuando se evalúa el tramo sin y con macrófitos y, además, debido a su ubicación (en los márgenes del río) provocan un efecto de vía de intenso desagüe (la circulación del flujo es más rápida) por aquellas zonas donde su presencia es recudida, sobre todo para caudales bajos. Se puede concluir que i) el modelo numérico representa adecuadamente el campo de velocidades (proceso de calibración), ii) el tramo es altamente dependiente de la distribución y estado de desarrollo, iii) los resultados obtenidos deben permitir el diseño de avenidas controladas más eficientes y eficaces para reducir los efectos negativos de los macrófitos.

Measuring the effects of dam removal on Ecosystem Services using Fuzzy Cognitive Maps

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Spain is one of the countries with the largest number of longitudinal obstacles in its rivers. Recent studies estimate the existence of about 20,000 barriers in the Spanish rivers including both dams and weirs. This is a serious problem for the longitudinal connectivity of rivers, the fish communities and the sediment transport. Among the river management actions, dam removal has proven to be one of the most effective to recover the natural processes of the river. However, this action should be done taking into account multiple environmental, social and economic factors. The use of Fuzzy Cognitive Maps (FCM), a methodology useful in modelling complex systems, is proposed to measure the effects of dam removal on river Ecosystem Services (ES) and Human Welfare indicators. This analysis was conducted through interviews to experts in fluvial issues, generating a matrix of correlations in which the causal relationships between variables are weighted. After that, pre and post barrier removal simulations have been compared obtaining a weighted value to each variable in order to establish a rank between environmental and social variables. For the simulations, we have studied several cases of dam and weir removal in the Spanish rivers. This allows developing a cost-benefit analysis of dam removal, dealing with the inconvenience of applying an economic concept to quantify environmental and social values. Our goal is to propose a management methodology that allows assessing dam removal effects in Mediterranean rivers not depending exclusively on the economic valuation of these effects on Ecosystem Services and constituents of human wellbeing, but attending also to plausible management scenarios based in expert knowledge.

Metodología para la evaluación del potencial de contaminación de las aguas superficiales de los residuos mineros abandonados

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Los residuos mineros abandonados suponen un importante problema ambiental en nuestro país. Se estima que existen unas 14.800 instalaciones de residuos cerradas o abandonadas, de diferente entidad, sobre las que no se han desarrollado (o tan solo parcialmente) medidas de rehabilitación. Los residuos mineros presentan, por lo general elevadas concentraciones de metales y metaloides, cuya disolución y arrastre pueden contaminar o disminuir la calidad de las aguas superficiales. El máximo exponente en cuanto al riesgo de contaminación de las aguas superficiales es la formación de lo que se denominan drenajes ácidos de mina (DMA). El potencial de contaminación de las aguas superficiales de los residuos mineros abandonados se puede prolongar durante décadas si no se adoptan las medidas oportunas. El IGME ha desarrollado una metodología que utiliza métodos simples y estandarizados para evaluar el riesgo asociado a las instalaciones de residuos mineros abandonados basada en la existencia de efluentes de carácter contaminante o en la probabilidad de que se produzcan debido a la naturaleza química de los residuos. Estos efluentes, cargados con metales u otros elementos tóxicos disueltos pueden liberarse, contaminando cauces o masas de aguas superficiales. El muestreo y análisis de surgencias a pie de talud o escorrentías procedentes de los residuos es la medida más directa para evaluar este potencial. La evaluación se complica cuando no existen estos efluentes, cuando es necesario llevar a cabo la valoración a partir de datos analíticos de los residuos. La metodología se sirve del índice denominado cociente promedio de peligrosidad (CPP), que se calcula en base a la concentración de metales y metaloides en un extracto de lixiviación con agua desionizada de los residuos. La valoración de los resultados se realiza con respecto a un estándar de calidad de aguas, tal como el de agua de consumo humano o preservación de la vida acuática y mediante la comparación con límites de emisión de efluentes mineros. Este trabajo describe la metodología diseñada para evaluar el potencial de los residuos mineros abandonados para contaminar las aguas superficiales y su aplicación a 50 balsas de lodos, de diferente naturaleza, localizadas a lo largo de todo el territorio español. Se ha podido comprobar que el índice proporciona una buena estimación de la toxicidad potencial, y puede ser útil para priorizar las actuaciones sobre las instalaciones de residuos.

Long-term ecological monitoring of a hypertrophic lake using sentinel-2 images

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Albufera of Valencia is an hypertrophic lake extensively studied since the 1980s, but efforts to revert the system to a clear state have not yielded the expected results because the growing pressure (increase in nutrient rich waters from tributaries inputs, decreased precipitation and increased evaporation). The current lake state requires constant monitoring. One of the main biological parameters used in ecology and water management to monitor and control the ecological status of aquatic ecosystems is chlorophyll-a. In this sense, remote sensing is an optimal tool for the continuous monitoring of the state of the water mass through [Chl-a] and to understand its spatial dynamics. Therefore, this work aims to validate an algorithm to process the images provided by the Sentinel-2, the new Earth observation satellite of the European Space Agency, with a spatial resolution of 10 m and a temporal frequency of 5 days - values unthinkable until now as regards to open access images. The study was carried out with images from 2016 and 2017, but only 40 images out of the 81 taken by the satellite could be used mainly due to unfavorable weather conditions. Downloaded images were processed with the SNAP 5 software. Using the Sen2cor tool they were corrected atmospherically and with the algorithm developed by Soria et al. 2017 [Chl-a] of the lake was estimated. Estimated data were validated against field samples. A total of 18 sampling sorties was carried out and 92 samples were taken to measure the [Chl-a]. In addition, to better interpret results, data on conductivity and Secchi disc depths measurements were taken in the field and hydrological, precipitation and wind data were collected. Linear correlation between field data and estimates were high ($R = 0.8$), confirming the robustness of the algorithm. Thematic maps allowed to infer that the temporal evolution in [Chl-a] variations follows an annual bimodal pattern, where the decrease in [Chl-a] is determined either by a significant increase in water renovation of the lake or by the depletion of water nutrients due to the excessive growth of phytoplankton.

Fluorescencia del CDOM como aproximación a la concentración de DOC en embalses y variables que influyen

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El carbono orgánico disuelto (DOC) constituye la mayor reserva de carbono orgánico de los ecosistemas acuáticos y juega un papel importante en el ciclo biogeoquímico global del carbono, clave en los modelos climáticos globales, para los que es necesaria una alta resolución espacial y temporal de los datos de concentración de DOC. La fluorescencia *in situ* permite determinar la concentración del DOC a través de su componente ópticamente activo, la materia orgánica disuelta cromofórica (CDOM). El objetivo de este estudio es buscar una relación entre el DOC y el CDOM en los embalses de la Cuenca Hidrográfica del Ebro para el período estival y definir las condiciones en las que dicha relación es más significativa. Se muestrearon 83 embalses en los veranos de 2011 (26), 2012 (25) y 2013 (32) tomando una muestra integrada de la columna de agua de la zona fótica, determinada mediante un luxómetro de PAR. El CDOM se medía mediante un sensor fluorométrico conectado a una sonda multiparamétrica (Sea-Bird 19 plus V2) y el DOC mediante un analizador de carbono. El tiempo de residencia hidráulico (TRH) mostraba una buena relación DOC-CDOM para embalses con un TRH inferior a 3 meses ($r=0,863$, $p<0,0001$, $n=35$) y la clorofila mostraba buena relación DOC-CDOM ($r=0,742$, $p<0,0001$, $n=51$) en embalses con una [Chl-a] inferior a $4 \mu\text{g L}^{-1}$. La [Chl-a], como fuente de materia orgánica autóctona, y el TRH, como determinante de la materia orgánica alóctona, son las variables que más influyen en la relación entre el DOC y el CDOM, especialmente para valores bajos de [Chl-a] y TRH.

RiuNet APP: Bridging the gap between citizens and river management, with special attention to temporary rivers

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RiuNet is an app for smartphones and tablets to be used by citizens to assess the hydrological status and ecological quality of a river following the guidelines of the EU Water Framework Directive. Using a simplified and interactive approach, this app guides the user for the current aquatic phase of the river by the time of sampling, the classification of the river's hydrological regime (e.g. perennial, intermittent, ephemeral), the river's hydrological status, and the assessment of the ecological status with the hydromorphological and biological quality tests. With data obtained from the official monitoring program performed by the Catalan Water Agency (ACA), further analyses were done using a subset of RiuNet assessments placed in the inland basins of Catalonia. Compared with the ACA regular monitoring sites, the average distance to the RiuNet sites was 1.2 Km, showing that most of them were very near (22 m the closest) with some remoter sites (27 Km the farthest). A total of 46 RiuNet records were not placed within 1Km radius distance of an ACA water body and are considered then as new assessments. Regarding the other assessments, and compared with the latest available ecological status, 31% matched with the same ecological quality, other 38% upgraded the status, while the rest were downgraded. These results show that citizens can contribute with relevant information about the ecological status of the river through the territory and provide more exhaustive assessments in space and time than from those that offer the official monitoring programs. With the combination of new technologies and the phenomenon of citizen science, RiuNet is a pioneer tool with far more implications: (1) draw attention to the degradation of our rivers, (2) increase public awareness about the need for their protection and restoration, (3) promote scientific engagement and data contribution of the citizens, and (4) improve the level of understanding of river ecosystems, including those with poor social recognition such as intermittent rivers or ephemeral streams.

iDIAT-ES. A new diatom index to assess the ecological status of Spanish rivers

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Diatom species have particular autoecological requirements in different geographical areas and understanding this variation is an important aspect for the use of diatoms as environmental indicators. Based on the information provided by diatom assemblages in non-impacted sites, the distance of each diatom community from its specific reference community can be calculated in order to assess the ecological status in rivers. The iDIAT-ES index (Índice de Diatomeas Español) was developed with biological and physicochemical data (years 2008-2014) collected from almost 1000 sampling locations distributed all around the Spanish Iberian Peninsula. The index value indicates the distance, on a scale of 0 to 5, of each diatom community from its specific reference community according to 3 groups: siliceous, calcareous and Tinto river. A high index value represents a non or less impacted site while a low index value represents a more heavily impacted site. The results show a good correlation between the iDIAT-ES and the SPI (Specific Pollution Sensitivity Index) and the BDI (Biological Diatom Index) but also with different stressors related with eutrophication and organic pollution in rivers. Thus, this new index is considered a suitable tool to evaluate the ecological status of our rivers under the scope of the Water Framework Directive.

iDIAT-ES. A new diatom index to assess the ecological status of Spanish rivers: Index validation in the Ebro River Basin

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The iDIAT-ES index (Índice de DiatomeasEspañol) was developed based on the structure, composition and organization of diatom assemblages from almost 1000 Spanish rivers. In order to explore the accuracy of the index, a validation was carried out using data from more than 350 samples collected in the Ebro River Basin during the period 2015-2016. The goal was to test the suitability of the iDIAT-ES as a tool for ecological assessment in rivers considering a new dataset not used during the index development process. In terms of index suitability, the following aspects were studied: (1) Composition and frequency of the diatom community; (2) Percentage of diatom species contributing to the index calculations; (3) Statistical correlations with other biological index and environmental variables; (4) Adequacy of the established status class boundaries and its influence in the assessment of the biological status. The results obtained from the evaluation in the Ebro River Basin showed good response and agreement to the biological quality categories based on other diatom indices such as SPI (Specific Pollution Sensitivity Index). The evaluation gives a better understanding of the suitability of the new index and reveals ways for improvement bringing up new opportunities to refine the tool in further versions.

SR3.

**Trophic interactions
in aquatic
ecosystems**

Consumption and post-consumption effects of *Echinogammarus berilloni* resource selection: relevance of the duration of the incubation

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Seasonality and changes in land use affect the amount, quality and diversity of food resources in streams. Consumers' feeding preferences should have direct consequences on their fitness, but literature shows that selection and consumption are not always correlated to their body condition, gross growth efficiency or reproduction. Here, we present a mesocosm experiment in which *Echinogammarus berilloni* (Catta) was subject to five different resources encompassing a gradient of food quality (beech, oak, hazelnut, ash and alder), with or without an additional high quality resource (alder). All food resources were first conditioned during two weeks on stream water (filtered through 100 µm). Thereafter, *E. berilloni* was incubated individually for 2, 4, 8, 16 and 32 days after which we measured the consumption rates of each material. Growth rate, body mass, RNA, DNA concentrations and lipid content of the amphipod were measured to determine individual body condition. Consumption rates were influenced by leaf litter quality and had consequences on lipid content and RNA: Dry mass ratio. Only after incubating animals for 16 days we were able to observe consumption and physiological responses that were related to the quality of the resources (C:N:P), with within-treatment variation steadily decreasing with time. The additional high quality resource seemed to have weak effect on amphipod feeding preference and body condition. Consumption should not be taken as a proxy of resource quality as post-consumption effects, such as changes in individual body condition, should also be considered.

Revisión del Índice Trófico del Fitoplancton en Embalses (PRTI) en la cuenca del Ebro a partir de la densidad y biomasa algal

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El presente estudio se basa en el análisis de los índices biológicos para la determinación de la calidad de las aguas en aplicación de lo dispuesto en la Directiva Marco del Agua, más concretamente trata de observar en qué unidades (biomasa o densidad algal) responden mejor estos índices. Para ello se ha estudiado los datos fisicoquímicos y biológicos de 62 embalses heterogéneos; todos pertenecientes a la demarcación territorial de la Confederación Hidrográfica del Ebro. El muestreo de dichos embalses fue realizado durante los años 2013, 2014, 2015 y 2016, y de ellos se extrajo los datos de un total de 8 variables medioambientales y de 145 especies de algas fitoplanctónicas pertenecientes a diez clases taxonómicas diferentes. El índice utilizado en el presente estudio es el PRTI (Phytoplankton Reservoir Trophic Index) el cual clasifica a los diversos embalses en cinco categorías diferentes atendiendo a su estado ecológico y que está basado en muestras cualitativas de densidad relativa del fitoplancton así como en la tolerancia de dichas especies algales a la eutrofización, obtenida a partir de un análisis de correspondencias canónicas. Este índice fue formulado específicamente para la Confederación Hidrográfica del Ebro utilizando los datos de densidad fitoplanctónica y cuya validación y puesta en práctica ya ha sido realizada por dicho órgano. Se ha aplicado el índice al total de los 62 embalses considerados de dos formas diferentes, utilizando unidades de densidad y de biomasa, y validando los resultados a posteriori mediante el TSI de Carlson (Carlson 1977) basado en la concentración de clorofila de tipo "a". Los resultados han sido concluyentes, demostrando que los índices basados en unidades de biomasa responden mejor a la realidad ecológica. Además, acorde a los buenos resultados obtenidos en este estudio, se propone la modificación del PRTI para la determinación de la calidad de las aguas.

Trophic interactions between macroconsumers and insect shredders: understanding the role of freshwater shrimps in leaf processing

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Trophic interactions in detritus-based food webs may influence the processing of organic matter in streams because macroconsumers can feed on both leaf litter and insect shredders. The objective of this study was to evaluate the influence of the freshwater shrimp *Macrobrachium potiuna* on the shredding activity and survival of larvae of *Triplectides gracilis* and *Phylloicus major*, typical caddisfly shredders in Atlantic Forest streams that build their cases with different organic materials (sticks and leaves, respectively). We hypothesized that the presence of *M. potiuna* would (i) reduce leaf decay rates and production of fine particulate organic matter (FPOM) promoted by shredders, and (ii) affect more the survival of *P. major* than *T. gracilis* because of the higher protection afforded by the case built with sticks. Laboratory trials were carried out in feeding arenas divided in half to allow only the visual and chemical stimulation of shredders by the presence of shrimps. For both treatments (*T. gracilis* and *M. potiuna*; *P. major* and *M. potiuna*), 01 larva and 01 shrimp were placed in each arena and leaf discs of *Miconia chartacea* were offered to the larvae only. The survival rates of both shredders were determined in a second experiment with the same treatments, in which the arenas allowed the interaction between organisms. Control treatments containing one individual of a single species were set in both experiments. In the presence of *M. potiuna*, leaf decay rates and production of FPOM promoted by both shredders did not differ from control treatments. In addition, survival rates of *T. gracilis* and *P. major* differed. While all larvae of *T. gracilis* remained alive in the presence of shrimps, the survival of *P. major* was 35.7%. None of the larvae died in the control treatments. The obtained results suggest that although the larvae of *P. major* are more susceptible to predation, the presence of *M. potiuna* does not influence the activity of both shredders. Therefore, the cases built by these species may reduce the predation risk in different ways. While the cases of *T. gracilis* are more resistant and offer better protection to the larvae, the cases of *P. major* may avoid predator detection by camouflage because they match with leaf patches on the streambed.

How important charophytes (submersed macrophytes) are to the planktonic-benthic interaction web?

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The relationships, both trophic and non-trophic, of submerged macrophytes with other components of aquatic ecosystems are complex and include exploitation competition with other primary producers, allelopathic interactions, providing refuge for zooplankton and zoobenthos, facilitation of support and resources for periphyton, etc. Therefore, they play an intense control over the benthic-planktonic food web related to them, the hereafter called horizontal interaction web (HIW). Currently, the vulnerability of charophyte meadows to global change is a matter of concern. How will the HIW change if charophytes disappear? Where will this change be most pronounced, in shallow lagoons with complex plankton-benthos interactions or in larger lakes with less interaction between the charophytes and plankton? To answer these questions, we built complex networks of interconnected relationships with charophytes using the Gephi© software. We selected four aquatic ecosystems, two lakes from central Spain and two shallow ponds from the Mediterranean coast. We obtained the descriptive parameters (i.e. number of trophic units, number of links, connectance, modularity and nestedness) with the Brain Connectivity Toolbox for MATLAB®. The populations considered were from bacteria to microinvertebrates and we expressed the abundance of each of them in carbon units. To build and characterize the complex horizontal interaction web, the biomass of the different populations was distributed in trophic units (nodes) and both trophic and non-trophic (positive and negative) relationships were established. We included the composition of the benthic community (that living on the charophytes) and the planktonic community inhabiting the free water surrounding the charophyte meadows. Moreover, the planktonic community for the pelagic zone was incorporated in the web of the lakes. Once the webs were constructed and described, we analyzed the effect of decreasing the density of charophytes on the rest of the web nodes (Net Effect Analysis, NEA). The lakes' HIWs show greater modularity, more nodes and links than those from shallow systems. However, in the latter, HIWs have higher connectance and mean number of links per node. The NEA demonstrated that the decrease in charophyte density has the greatest positive effect on the carnivores (the top in the HIW) and it was more noticeable in shallow systems' HIW. These preliminary results endorse the study of the HIW to predict changes in aquatic ecosystems.

Effects of ecto-parasites (Hydracarine: acarii) on waterboatmen (Heteroptera: Corixidae) and interactions with abiotic stress

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Interactions between parasites and environmental stressors are of general interest in Ecology and Environmental Sciences because they both have an important role shaping the health and life history traits of organisms. However, studies are still limited, particularly those including different parasite and host life stages. Here we studied the individual and combined effects of ectoparasitic water mites and salinity on survival and fecundity of the water boatmen Corixidae by performing laboratory experiments. We showed for the first time that mite parasitism (by *Hydrachna skorikowi*) reduced nymphs survivorship and interfered with the completion of the host life cycle (mouling to adult stage) in *Sigara lateralis*. In adult corixids (*S. lateralis* and *Corixa affinis*) fitness was reduced at high salinities and by *H. skorikowi* infection, both in terms of survival and fecundity. Parasite and salinity effects interacted, with the impact of parasites being particularly strong at higher salinities. We also studied the effect of salinity and temperature on the survival of adult free-living water mites *Eylais infundibulifera*. Mite survival was greater at higher temperature (29 vs 25°C) and at lower salinity. The interaction between these two factors was also significant, with the strongest impact of salinity being at lower temperature. Based on our results we confirm that the impact of water mite parasites in freshwater communities and at competitive interactions among corixid species is more important than previously reported, when taking into consideration the environmental conditions where the host-parasite interaction occur.

Coprophagia can mitigate low food quality for *Echinogammarus* in lowland headwater streams invaded by *Arundo donax* L. (Poaceae)

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Riparian areas have experienced long term anthropogenic impacts including the effects of plant invasions. The giant reed *Arundo donax* is one of the most common invasive species of lowland riparian corridors in the Iberian Peninsula. *A. donax* displaces native vegetation and can alter fluvial food webs. *A. donax* is often reported as a poor nutritional resource for aquatic invertebrates due to its high toughness and silicon concentrations, but low nitrogen contents, in contrast to native species such as *Populus* spp. Taking this into account, we tested the presumed low nutritional value of leaf litter from *A. donax*, compared to *Populus alba*, for the shredder *Echinogammarus obtusidens*. Furthermore, we tested if coprophagia (auto and heterospecifics) could be an appropriate strategy to mitigate the poor nutritional value of *A. donax* leaf litter. We conducted a laboratory experiment and examined growth, energy reserves (lipids and glycogen) and survival of *E. obtusidens* when fed on six diets: leaf litter of *A. donax*, leaf litter of *P. alba*, faeces from *E. obtusidens* fed on either *A. donax* (EAD) or *P. alba* (EPA), and faeces from the coexisting gastropod *Melanopsis praemorsa* fed on either *A. donax* (MAD) or *P. alba* (MPA). Values of C:N were significantly lower for *P. alba* leaf litter (21), MPA (19), EPA (23) and EAD (24), compared to *A. donax* leaf litter (78), with intermediate values for MAD (37). Mortality was relatively low (<15%), and did not differ among treatments fed on *P. alba* leaf litter, EPA, MPA or MAD, but was significantly higher (45%) when fed on *A. donax* leaf litter. Relative Growth Rate (RGR) was not significantly different among treatments. Lipids reserves were significantly higher in individuals fed faeces from *M. praemorsa* eating *P. alba* (MPA), compared to those fed on *A. donax* or *P. alba* leaf litter. Glycogen reserves were significantly higher in individuals fed on MAD compared to those fed on *A. donax* litter or EPA. These results suggest that coprophagia can be a successful feeding strategy for *E. obtusidens*.

Differences of sensitivity to resource richness and body size of two strains of the rotifer *Keratella cochlearis*

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The ability to exploit high vs. low resource availability constitute an important aspect of grazer-resource interactions. In zooplankton, body size is the primary determinant of variation in foraging efficiency. Recognition of ecological trade-offs among traits is key to understanding the role of biodiversity in community and ecosystem function. Here, we performed common garden experiments with two strains of one of the most widespread rotifer species in zooplankton, *Keratella cochlearis*. Two strains with fixed-spine were isolated from two lakes that differ in trophic state, Tinaja (TIN, oligotrophic) and Cueva Morenilla (MOR, meso-oligotrophic) in the Ruidera National Park (central Spain). The purpose of our experiments was to test whether they differed in their fitness responses across a broad food quantity gradient (clone-resource interaction) and whether there was a relationship between the shape of these fitness reaction norms and their lorica size and posterior spine elongation. We found a significant clone x resource interaction, indicating that the clones differed in their fitness response to this array of resources. TIN *K. cochlearis* displayed very high fitness in the poorest resource conditions compared to MOR *K. cochlearis*. However, under the highest resource condition tested MOR *K. cochlearis* displayed higher fitness compared to TIN *K. cochlearis* suggesting that TIN clone is less efficient than MOR clone at using high resources. Moreover, the two *Keratella cochlearis* populations differed in body size and spine index. Despite they had similar average lorica length, the TIN population had significantly wider lorica and much higher spine index than those from MOR population. In summary, our results suggest a trade-off between competitive ability and vulnerability to predation within rotifer species *Keratella cochlearis*.

Recovery rate of zooplankton community structure after stop of fish predation

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Planktivorous fish predation affects the community structure of both zooplankton and phytoplankton communities by means of trophic cascades. How quickly zooplankton community structure returns to the unaffected patterns once predation stops and how it cascades down to phytoplankton community is not clear, although this could have implications on the functioning of aquatic ecosystems. To assess the time the zooplankton community structure need to re-establish after a short interval of planktivorous fish predation and to explore the cascading trophic effects on phytoplankton communities, we conducted a mesocosm experiment during summer 2016, consisting of 10 enclosures, 6 with fish and 4 without fish. Plankton communities from a natural lake were used to establish phytoplankton and zooplankton communities in the mesocosms. Fish were allowed to feed on zooplankton for four days. After that, we removed fish and observed the re-organization in the zooplankton community and their effect on phytoplankton community for five weeks. We explored changes in the community composition, total biomass and abundance of plankton communities. Our preliminary results showed a decrease in total zooplankton abundance, total zooplankton biomass and biomass of large zooplankton, such as *Calanoida* and *Daphnia*, just after fish predation in enclosures with fish compared to controls. However, 2 weeks after fish removal we observed a quick recovery of zooplankton biomass which is related to increase in temperature and resource availability throughout the season. Moreover, abundance and biomass of large Cladocera increased and continued to increase until the last sampling (30 days after fish removal). Thus, our results could indicate that interactions between biotic and environmental factors (e.g. seasonality, resources) could affect the recovery of zooplankton from fish predation.

Efeito de borda e sazonalidade sobre a biomassa fúngica e taxa de decomposição foliar em floresta sazonalmente inundada no Cerrado do Brasil

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Em ambientes aquáticos, terrestres ou alagáveis a decomposição foliar é essencial, pois disponibiliza novamente ao solo o carbono. Nas florestas temporalmente inundadas, a vegetação reduz a entrada de luz solar, mas também é responsável por fornecer materiais e conseqüentemente energia no sistema. Os ecossistemas de fragmentos florestais temporalmente inundados aqui estudados como a Planície do Médio Araguaia no Cerrado do Brasil tem ocorrência natural e restrita. Os ambientes alagáveis, atingidos por pulsos de inundação, são importantes para o armazenamento de carbono, uma vez que produzem grandes quantidades de biomassa vegetal. Nosso trabalho monitorou a decomposição de detrito vegetal composto pela espécie arbórea dominante, *Callophylum brasiliense*, durante 300d no centro e borda de três fragmentos florestais circulares, iniciando-se no período seco, passando pelo chuvoso até novamente ao início da estação seca. Folhas de *C. brasiliense* coletadas previamente, foram colocadas em porções de $5,0 \pm 0,3$ gramas em sacos de malha (20x20 cm, malha de 10 mm). Em cada tempo amostral, foram retirados três sacos de malha em cada centro e borda das ipucas, em cada tempo amostral. Foram tomadas medidas de perda de massa (AFDM) e biomassa de fungos estimada pela concentração de ergosterol. Os valores da constante de decomposição (k) são baixos, $-0,0008 \cdot \text{dia}^{-1}$ para o centro das ipucas e $-0,0009 \cdot \text{dia}^{-1}$ para suas bordas (Tabela 2). Comparando ao proposto por Petersen & Cummins (1974), que categorizou os coeficientes de decaimento em uma série contínua de três intervalos: lento (0 a $0,005 \cdot \text{dia}^{-1}$), médio ($0,005$ a $0,010 \cdot \text{dia}^{-1}$) e rápido ($0,010 \cdot \text{dia}^{-1}$ ou superior), observamos que a decomposição nas ipucas, tanto centro quanto borda, ocorre muito lentamente. Após o início das chuvas ocorreu uma queda considerável da biomassa fúngica nas folhas incubadas. Tal diminuição ocorreu primeiro na borda da "Ipuca" e posteriormente no centro, mostrando a importância da borda como amortizadora das alterações que acometem aquele ambiente. Observou-se uma queda acentuada de massa foliar no início do período de incubação entre zero e 7d, seguida por uma estabilidade no decaimento até aos 120d, que correspondeu ao aumento da precipitação. Entre 120 e 150d, ocorreu outra acentuada queda no % de massa foliar remanescente. Isso indica que o pulso de inundação é favorável para o processo de ciclagem de nutrientes nas ipucas.

Utilización de índices basados en el zooplancton como indicadores de estado trófico en embalses de la Confederación Hidrográfica del Ebro

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El presente estudio pretende estudiar cuatro índices de estado trófico realizados recientemente, basados en la densidad del zooplancton y diseñados para la estimación del estado trófico de las aguas continentales. Estos índices fueron dos cuya formulación se basa en cocientes o ratios, el R_{chl} y el R_{zoo-chl}a que se propusieron y validaron en el proyecto europeo ECOFRAME (Mosset al., 2003), y dos cuya formulación se basa en la incorporación de una análisis estadísticos de correspondencias canónicas (CCA), el Wetland Zooplankton Index propuesto en el año 2002 por investigadores de la Universidad McMaster de Ontario (Lougheed & Chow-Fraser 2002) y el Zooplankton Reservoir Trophic Index, índice diseñado recientemente por la Confederación Hidrográfica del Ebro y del cual el presente manuscrito representa su primer artículo científico al respecto. Dichos índices fueron estudiados y aplicados en 53 embalses heterogéneos de la Confederación Hidrográfica del Ebro. Además, todos ellos fueron validados a posteriori mediante el Trophic State Index de Carlson basado en la cantidad de clorofila a, observándose diferencias significativas entre ellos.

Flexibility in the diet of river macroinvertebrates along a degradation gradient

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Stream macroinvertebrates are a major component of stream food webs as they connect basal resources with higher trophic levels. Human intensification of land use in freshwater basins can change the quality and quantity of instream available basal resources. In order to assess the effect of land use intensification on macroinvertebrate's diet, the gut contents of 4 taxa corresponding to different functional groups was analysed in spring of 2015. Invertebrates were collected with Surbers in 8 rivers of the British Columbia (Canada), selected for the dominant land use in their basins (forest, cropland or urban), equivalent to a gradient of degradation. In general macroinvertebrate's diets coincided with their assigned functional feeding group. Meanwhile, our results showed changes in diet composition along the intensification gradient. *Baetis* spp. (scraper – collector gatherer) consumed more algae ($p < 0.05$) in forested streams. *Hydropsyche* spp. (collector filterer) ate more diatoms ($p < 0.05$) in cropland streams and more amorphous detritus in urban streams. *Zapada* spp. (shredder) consumed more diatoms ($p < 0.05$) and leaves in urban streams. The predator Tanytopodinae ingested more fungi ($p < 0.05$) and less prey in urban streams, and ate more algae ($p < 0.05$) in cropland streams. This study identifies the impact that different human activities may have on the diet of primary and secondary consumers in river food webs, suggesting invertebrate's feeding flexibility along the studied degradation gradient.

Respostas dos atributos funcionais do fitoplâncton à heterogeneidade espaço-temporal em um extenso lago raso subtropical

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Análises de comunidades biológicas que levam em conta apenas a identificação e quantificação das espécies e suas contribuições relativas, na maioria das vezes, não refletem suas funções ecológicas, especialmente considerando-se a ampla variação espacial e temporal de extensos lagos rasos. Este trabalho teve como objetivo analisar a influência da heterogeneidade espaço-temporal na estrutura funcional do fitoplâncton em um extenso lago raso subtropical. Foram realizadas amostragens sazonais, em 2010 e 2011, em 19 pontos amostrais distribuídos ao longo de toda a extensão do lago, compreendendo as zonas litorânea e pelágica das regiões norte, centro e sul da Lagoa Manguieira. Esse extenso lago raso costeiro ($Z_{max} = 7$ m, $Z_{média} = 2,6$ m) tem 90 km de comprimento e 3-10 km de largura. Foram analisadas variáveis abióticas e atributos funcionais do fitoplâncton (volume, máxima dimensão linear, formas de vida e grupos funcionais) como medidas de diversidade funcional. Os resultados demonstraram que não houve organização espacial dos atributos funcionais do fitoplâncton no período estudado. Formas de vida coloniais não flageladas, organismos com volume celular entre 10^3 e $10^4 \mu\text{m}^3$ e maiores que $10^4 \mu\text{m}_3$, e com máxima dimensão linear variando entre 21 e 50 μm prevaleceram em todas as zonas e regiões estudadas. Os grupos funcionais fitoplanctônicos responderam à variação nos recursos, especialmente aumentando sua variedade e contribuição nos meses de primavera e verão, segregando o norte da lagoa, independente das zonas estudadas (pelágica e litoral). A organização espacial da estrutura funcional do fitoplâncton na Lagoa Manguieira não foi observada. O predomínio de organismos relativamente grandes e a homogeneidade espacial registrada na estruturação funcional do fitoplâncton refletiu a influência dos processos hidrodinâmicos deste extenso ecossistema raso para o desenvolvimento da biota local.

Understanding trophic structure of freshwater ponds across macroecological gradients using stable C and N isotopes

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Climate change alters food webs by changing the strength of biotic interactions and community composition with direct effects on ecosystem function. The consequences of such changes depend on existing food web structure, predator-prey interactions and species composition, although it remains uncertain whether these responses can be generalized across environmental and biogeographical gradients. We studied food webs' structure in freshwater mesocosms across biogeographical gradients (Arid, Mediterranean, Temperate and Alpine environments) within Iberian Peninsula. Food webs were inferred from C and N stable isotopes measured in all possible food sources (of both allochthonous and autochthonous nature) and wide range of selected consumers, collected from the mesocosms. Consumers ranged from zooplankton through intermediate herbivore species and ended with large predatory macroinvertebrates such as dragonfly or beetle larvae. Additionally, we studied phytoplankton, zooplankton and macroinvertebrate communities at these mesocosms together with their body sizes, which are indicators of potential predator-prey interactions. By combining data on community composition with functional traits (body sizes) and data on isotopic signatures we infer food web structure across and within regions. Preliminary results indicate that trophic relationships in freshwater mesocosms are strongly dependent on species composition across regions and local environmental conditions. These results will be used to establish how baseline food web structures change through space to predict patterns in shifts of aquatic communities across different climatic zones.

SR4.

Ecosystem Functioning

Is CNP ratio in leaves a main driver of leaf litter decomposition?

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The aquatic microbial decomposition of leaf litter has been the subject of many field studies throughout the world. However, in field experiments it is impossible to separate the effects of the multiple biotic and abiotic factors involved in the process. In this laboratory experiment, we controlled the abiotic factors and the fungal decomposer community during decomposition of alder, oak and eucalypt leaf litter in order to determine if variation in leaf C:N:P ratios during decomposition was similar among the three species. Initial C:N:P values differed among the three species with alder being the N- and P-richest species (C:N=14; C:P=363) and oak being the poorest (C:N=47; C:P=690) species. In all leaf species, nitrogen was immobilized during decomposition (final < initial C:N ratios), while phosphorus was released (final > initial C:P ratios). Final C:N:P values were the lowest in alder (C:N=10; C:P=968), final C:N was the highest in oak (40) while final C:P was the highest in eucalypt (2914), denoting a change in the ranking of species regarding P. The comparison of final with initial C:N:P values showed that species were similar regarding C:N (final/initial values 0.7 to 0.8) but C:P decreased more in eucalypt and oak than in alder (final/initial values of 5.9, 3.9 and 2.7, respectively). The lowest decrease in P of alder leaves may explain the highest mass loss observed in this species, most probably due to a higher fungal colonization despite the controlled fungal decomposer community. In conclusion, CNP ratio in leaves seems to determine its fate during decomposition.

Decomposition of the invasive *Acacia longifolia* in a stream

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Detrital inputs from the riparian vegetation are the basis for the aquatic food webs in streams which rely on the decomposition of this allochthonous organic matter as an energy source. *Acacia longifolia* is one of the invasive tree species of worldwide concern; in Portugal it is an invader of dune but also of riparian systems, causing reduction in native biodiversity, ecosystem change, habitat alteration and changes in hydrology and fire regimes. Invasive riparian tree species may alter the amount and the seasonal distribution of allochthonous inputs to streams, with consequences to stream ecosystem functioning. These consequences will be more pronounced if in-stream decomposition proceeds differently from local species. In this study we compared decomposition and invertebrate colonization of the invasive *A. longifolia* and the autochthonous *Alnus glutinosa*, a common riparian tree which, like *A. longifolia*, is also a nitrogen-fixer. The experiment was carried out in two sites of a 4th order stream (Ribeira dos Covões, an affluent of the Mondego River) located at the periphery of Coimbra (Central Portugal) using the litter bag technique (5 mm mesh) during 42 days. Invertebrate abundance was similar in *A. longifolia* and in *A. glutinosa*, but colonization was lower in site 2 where a flooding event occurred by day 28. Decomposition rates of *A. longifolia* were significantly slower ($k=0.0083$ to 0.0195 day⁻¹) than decomposition rates of *A. glutinosa* ($k=0.0489$ to 0.0521 day⁻¹), suggesting that the invertebrates colonizing *A. longifolia* did not contribute to mass loss. Decomposition of *A. longifolia* was similar in the two sites while decomposition of *A. glutinosa* was faster in site 2 than in site 1, showing that *A. glutinosa* was more susceptible to abiotic fragmentation than *A. longifolia*. These results show that the replacement of the riparian vegetation by the invasive *A. longifolia* (i) increases the decomposition time of leaf litter, and (ii) may result in the decrease of appropriate food sources to aquatic macroinvertebrates.

Dinámica limnológica en un tramo transicional de la cuenca del río Huallaga (Huánuco-Perú)

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La limnología fisicoquímica de los ríos de piedemonte andino-amazónico ha sido poco estudiada, desconociéndose en gran medida su patrón de cambio espacio temporal. Se evaluó dicho patrón en un tramo de la cuenca media del río Huallaga en dos sectores de su lecho (H) ,H1 y H2 y un afluente de H1(río Tambo, TAM, sistema Huallaga), dos afluentes (sistemas y ríos Malgotingo-M- y Santa Clara -SC-) con muestreos en la cuenca alta (MA y SCA), media (MM y SCM) y baja (MB y SCB). Se muestreó en 2014-2015 en setiembre-octubre 2014 (T1, bajante), noviembre-diciembre (T2, seca-creciente), febrero de 2015 (T3, creciente) y mayo de 2015 (T4, creciente-bajante). Los patrones espacio-temporales fueron sumarizados con ACP. La temperatura (T), oxígeno disuelto (OD), conductividad (COND) y TDS aumentaron en sentido MA-MB (14.77-19.5 °C; 7.2-7.82 mg/l; 28.96-47.15 µsiemens y 14.48-23.58 ppm) y SCA-SCB (15.3-19.92°C; 7.45-7.9mg/l; 462.97-595.82 µsiemens y 231.34-297.91 ppm). COD, SS, turbidez(TURB) y PO4 aumentaron de MA a MB (4.90-7.49 mg/l; 10.70-46.88 mg/l; 13.93-53.48 NTU y 0.14-0.27 mg/l, respectivamente), mas disminuyeron de SCA a SCB (7.28-3.55 mg/l; 44.34-11.83 mg/l; 37.42-16.68 NTU y 0.36-0.25 mg/l). En general, COD, SS, TURB y PO4 aumentaron en M y SC desde T1 a T3 y T4 principalmente en MM (0.1-5-9.3 mg/l; 10-35.5-18 mg/l; 12-22.32-16 NTU; 0.16-0.2-0.41 mg/l), MB (0.4-25-4.17 mg/l; 5-163.5-14 mg/l; 5-170-26.7 NTU y 0.24-0.32-0.36 mg/l) y SCB (0.3-7.3-5.8 mg/l; 19-20.5-5.88 mg/l; 25-26.5-14.2 NTU; 0.15-0.22-0.34 mg/l). En el sistema Huallaga se observó diferenciación entre H1, TAMy H2, en función de COND, TDS y SS(302.55-608.99-234.16 µsiemens, 151.28-304.50-117.08 ppm, respectivamente). T, COND y TDS disminuyeron desde T1 hasta T3 y T4. (19.41-18.9-17.1°C; 439.67-395.94-335.63 µsiemens; 219.93-197.97-167.81 ppm). OD, SS, TURB y PO4 aumentaron de T1 a T3 y T4.(7.33-8.70-8.46 mg/l; 83-225.48-192.50 mg/l; 31.67-232.79-306.9 NTU, 0.38-1.68-1.71 mg/l; 0.87-16.77-6.75 mg/l, respectivamente). Especialmente los sistemas y tramos se asociaron por altos valores de conductividad (SCB, SCM, SCA, TAM), altos valores de SS, TURB, COD y PO4 (H1,H2) y bajos valores de éstos paámetros (MA,MM,MA). EnT1 y T2los sistemas y tramos se individualizan por diferencias en COND. En T3 y T4 H1, H2, TAM y MB se hacen disimilares por el incremento de SS, COD, PO4 y TURB. La geología particular de cada cuenca las hace limnológicamente independientes.Sobre este patrón, el incremento del caudal,SS COD, PO4 y TURBen T3 y T4,sobre todo en H y las partes bajas de los afluentes, los hace aún más disimilares de los otros ambientes de la cuenca.

Fluxos de CH₄ e CO₂ e suas relações com poluição urbana em reservatório da região metropolitana de São Paulo, Brasil

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As áreas alagadas fluviais desempenham um papel essencial na ciclagem de carbono nos continentes e são fontes de gases para a atmosfera, principalmente CO₂ e CH₄. O processo de eutrofização é um dos fatores externos que interferem nos fluxos desses gases. Assim, o objetivo deste estudo foi determinar os fluxos de CO₂ e CH₄ em regiões localizadas em reservatório da Região Metropolitana de São Paulo, Brasil, e verificar sua relação com diferentes graus de carga poluidora. Foram selecionadas na represa Billings 8 estações com diferentes graus de poluição: estações E5 e E7 com menores graus de poluição, locais preservados; E1, E3, e E8 com maiores graus de poluição e; E6 próxima à captação de água para abastecimento. E2 e E4 grau de poluição intermediário. A periodicidade da amostragem acontece em escala sazonal (chuvoso fevereiro/2018 e seco maio/2018). Amostras de água e gases na interface água-ar (concentrações de CO₂ e CH₄) foram coletadas em triplicatas para determinações químicas e físicas. Na água, *in situ*, foram determinadas: temperatura, pH, oxigênio dissolvido, condutividade elétrica, amônio e nitrato utilizando uma sonda multiparamétrica. Em laboratório foram realizados análises de fósforo, nitrogênio e carbono na água, de acordo com Standard Métodos. Dentre os principais resultados destacam-se que as estações que apresentaram os menores valores de nitrato foram as estações E5 (5,66 mg/L), E6 (4,64 mg/L), E7 (4,51 mg/L) e E8 6,26 mg/L, enquanto que as estações E1, E2, E3 e E4 variaram de 10,47 mg/L a 16,26 mg/L. Para os valores de NH₄⁺ não foram observadas diferenças significativas entre as estações E1 a E7 (variando de 19,70 a 13,83 mg/L), enquanto que a E8 apresentou altos valores de NH₄⁺ 166,46 mg/L. Menor valor de oxigênio dissolvido foi encontrado na estação E8 no período chuvoso (5,47 mg/L). Para os dados dos gases analisados até o presente, destacam-se que no período chuvoso as emissões de CO₂ nas estações E6 e E7 e E8 foram respectivamente 2440 mg/m².d, 4226 mg/m².d e 6540 mg/m².d. O CH₄ não foi detectado nas estações E6 e E7 e em E8 foi de 354 mg/m².d. Conclui-se que no ecossistema se encontraram relações entre as variáveis limnológicas e os fluxos dos gases estudados, ficando evidente a relação com a estação E8, que apresentou maior carga poluidora, advinda, principalmente, de descarga de esgotos domésticos clandestinos, ocasionando uma maior oferta de matéria orgânica, refletindo no enriquecimento das áreas alagadas.

Trophic planktonic relationships and ecological functioning of the photic zone of a high-altitude Andean tropical reservoir in Colombia

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Reservoirs are elements of water retention with characteristics of both river and lake, reflecting events occurring in their drainage basins. Detritus, as well as biotic elements, such as bacterioplankton, phytoplankton and zooplankton, are basic parts of their aquatic food webs. Consequently, the study of relationships between the components of planktonic communities in a reservoir showing spatial differences in its trophic status provides a first approach to understand its ecological functioning, distribution of energy, community structure and processes. The Riógrande II reservoir shows greater eutrophication near the main river inlet, receiving domestic, industrial and agricultural discharges, whereas it evolves to lower trophic status when approaching the dam. A static model, using Ecopath software, showed the planktonic trophic structure responses to development of the system in relation to spatially-explicit differences in the trophic status. In general, ecosystem attributes, such as the ratios related to total flow, primary production and respiration in the photic zone of the system, classified this reservoir as an immature system. This model can be used to improve the strategies of management, conservation and appropriate use of water resources in this reservoir, which is among the most important water supply sources for the city of Medellín.

Do the so-called functional traits relate to ecosystem functions?

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Functional traits now available in public database have been claimed to reflect ecosystem processes by several researchers. We used macroinvertebrate community data collected in reference and non-reference sites and measures of sediment respiration and total decomposition rates of leaf litter (alder) as well as the relative importance of autotrophs vs. heterotrophs (autotrophic index) to compare and relate functional trait responses in community (in terms of composition and functional diversity) and the above ecosystem functions. Sediment respiration rates were significantly higher in disturbed sites (r -squared=20.4%, $p<0.015$) whereas litter decomposition rates were higher in reference sites (r -squared=13.5%, $p<0.008$). In contrast, the autotrophic index did not show any significant change between reference and disturbed sites ($p>0.05$). Trait composition significantly differed between reference and disturbed sites (overall=14.1%, $p<0.001$; 1st PCA axis=28.6%, $p<0.001$; 2nd PCA axis=14.4%, $p<0.020$) with a prominence of shredders and scrapers, univoltine, crawlers of intermediate size in reference sites and greater proportion of individuals being ovoviviparous, plurivoltine and deposit-feeders in disturbed sites. The first trait composition axis was significantly related to sediment respiration rates (30.0%, $p<0.001$) whereas the second axis was significantly related to the autotrophic index (18.9%, $p<0.020$). In addition, functional diversity (RaoQ) was significantly lower in reference sites (24.4%, $p<0.003$) despite a slightly higher taxonomic richness (9.7%, $p<0.040$) suggesting redundancy. Litter decomposition rates were significantly related to functional richness (FR, $\rho=0.324$, $p<0.048$) whereas autotrophic index was negatively related to FR (0.343, $p<0.044$). RaoQ was significantly related to the sediment respiration rates (0.500, $p<0.003$). Combining abiotic variables with either PCA trait axes or functional diversity values did not improve correlation significantly with the exception of sediment respiration rates that could be best explained using a combination of FR, RaoQ and pH (48.1%, $p<0.001$). Our results thus suggest that functional traits used in public database partly reflect ecosystem functions.

Streams in eucalyptus plantations – still heterotrophic but no longer the same

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Forest change is a major environmental problem worldwide. Forest streams, with their large aquatic-terrestrial interface and strong dependence on terrestrially-derived organic matter, are highly sensitive to forest change. Eucalyptus plantations, in particular, cover large areas worldwide (> 90 million ha, mostly from 35°S to 35°N) but their effects on stream functioning have been addressed only in the Iberian Peninsula, which limits generalization to other regions. The replacement of native forests by eucalyptus plantations can lead to changes in the characteristics of the organic matter entering the streams and to changes in hydrology and water characteristics. These changes can affect aquatic communities and ecosystem processes. We assessed the effects of eucalyptus plantations on microbial-driven (in fine mesh bags) and total (microbial + macro detritivore-driven; in coarse mesh bags) decomposition of alder (*Alnus glutinosa*) leaf litter by comparing streams flowing through native forests and eucalyptus plantations in seven regions in the Iberian Peninsula, Central Africa and South America. Native and eucalyptus streams in each region were paired and the effect size of forest change on leaf decomposition was estimated and analysed by meta-analytic techniques. Overall, leaf decomposition in fine mesh bags was not significantly affected by plantations, while decomposition in coarse mesh bags was significantly inhibited by 23%. The response of leaf decomposition to plantations significantly differed across regions for fine mesh bags, with a significant stimulation by 110% in Central Brazil and by 32% in Uruguay and non-significant effects for the remaining regions (for Kenya the effect was marginally non-significant: mean inhibition by 48%). The response of leaf decomposition to plantations did not significantly differ across regions for coarse mesh bags although a significant inhibition was found for Spain (-41%), South Brazil (-31%) and Uruguay (-36%), while no significant effects were found for the other regions (for Portugal the effect was marginally non-significant: mean inhibition by 50%). The variation in the response of leaf decomposition to plantations across regions prevents generalizations across regions and highlights the need to take into account climate, relative contribution of macroinvertebrate detritivores and changes in water and litter when assessing forest change effects on stream functioning.

Infection by a pathogenic oomycete more than the increase in water temperature affects sweet chestnut leaf litter decomposition

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Climate models predict increase of global mean air temperature up to 6.4°C by the end of this century. Among the effects of temperature increase there is the expansion of the distribution range of several pathogens, including the oomycete *Phytophthora cinnamomi*, which has been associated with decline of natural forests around the world. It is hypothesized that this pathogen can modify the functioning of riparian zones by altering the nutritional quality of leaves of infected trees. Headwater streams are especially vulnerable to these changes as they depend directly on the input of terrestrial material. In these environments, the decomposition of organic matter is a key process, and combined effects of temperature and infection will probably affect ecosystem functioning. We aimed to evaluate the effects of *P. cinnamomi* infection on the nutritional quality of sweet chestnut (*Castanea sativa*) leaf litter and on its subsequent decomposition and associated microbial activity, and to assess whether these effects can be changed in a warmed future. We performed a microcosm experiment (62 days duration) with senescent leaves from chestnut trees with three categories of infection by *P. cinnamomi* (Healthy – H, Moderate Infection – MI and Advanced Infection – AI) at two water temperatures (13°C and 18°C) simulating current average temperatures and future projections for streams in central Portugal. Leaf polyphenolics concentrations and initial toughness differed significantly among infection degrees, with the highest values for AI. There was also a non-significant trend for higher carbon, nitrogen and lignin concentrations in AI leaves. Decomposition and microbial respiration rates were affected by the degree of infection, independent of temperature. The decomposition rates (k/day) ranged 0.008–0.0011 and were significantly lower for AI treatments. Microbial respiration rates were also the lowest for AI treatments, especially at 13°C. No significant effects of infection or temperature were found for leaf toughness, a proxy of microbial maceration. The results suggest that *P. cinnamomi* infection affects the nutritional quality and decomposition of chestnut leaves, independently of temperature, which can have impacts on stream systems since chestnut is a dominant tree species in deciduous forest in temperate regions.

Mesh size interferes in decomposition rates of two plant species in tropical streams of the Atlantic Forest, Brazil

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Leaf breakdown is an important process in providing energy and nutrients for aquatic systems, mainly in forested headwater streams that shows low within-stream primary production and depends on allochthonous detrital inputs. Leaf breakdown studies are usually based on the use of litter bags which if made with different mesh sizes can exclude the influence of certain factors during the experiment. The goal of this study is to compare the effect of mesh size in the breakdown of leaves of two species in streams. The experiment was conducted in two streams located in the Brazilian Atlantic Forest. Litter bags of fine (0.5 mm) and coarse (10 mm) mesh sizes were filled with senescent leaves of *Mollinedia schottiana* and *Brachiaria brizantha*. The experiment was repeated twice (2013 and 2014). The initial mass and the remaining mass after around 60 days of breakdown were weighed. Physicochemical characteristics of streams and leaf litter initial nutritional quality were determined. The average percentage of remaining mass of *Mollinedia* was of 56% for the fine mesh and 31% for the coarse mesh ($p < 0.05$), indicating that the exclusion of both macroinvertebrate activity and physical abrasion caused by the stream flow were important factors in the leaf breakdown rate of this species. Furthermore, the average percentage of remaining mass of *Brachiaria* was approximately 29% for the fine mesh, and 20% for the coarse mesh ($p > 0.05$), indicating the decreased importance of the exclusion of those factors, and suggesting that the leaf breakdown was performed mainly by microorganisms. The absence of statistical significant difference in the *Brachiaria* mesh size treatments indicates that this species might have been shunned by the macroinvertebrates, while the *Mollinedia* was preferentially consumed. These results are in accordance with other studies, which demonstrate that the absence of macroinvertebrates and physical abrasion decreases leaf breakdown rates in lotic environments. This fact highlights their influence in the cycling of energy and nutrients of tropical streams.

Can streams salinization affect fungal-mediated leaf degradation and invertebrates' feeding behaviour?

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Salinization of freshwaters is a growing worldwide environmental problem whose consequences are still underidentified. In this laboratorial study we evaluate the effects of salt-contamination (NaCl; 4g/L) on the activity of key drivers of litter decomposition in streams: fungi (aquatic hyphomycetes) and shredder invertebrates. We specifically assess (a) fungal growth and sporulating capacity of three species of fungi (*Articulospora tetracladia* (ARTE), *Heliscus lugdunensis* (HELU), *Lemonniera aquatica* (LEAQ)), (b) single-fungal mediated decomposition of oak (*Quercus robur*) leaves and subsequent (c) leaf consumption by the shredder *Sericostoma vittatum*. All fungal species were tolerant to the presence of salt (4g/L), but none was able to sporulate in contaminated media. Growth rates of LEAQ were negatively affected by salinity, but not ARTE or HELU. When colonized by a single fungal species, mass loss of oak was not different across species; the presence of salt tend to decrease leaf degradation only when colonized by ARTE or LEAQ. Oxygen consumption was species specific and consistently depressed by the presence of salt in the media. Consumption tests indicated that invertebrates are able to respond differentially to leaves colonized by distinct fungal species consistently consuming oak leaves colonized by ARTE>LEAQ>HELU in control or salt-contaminated media. Exposure to NaCl (i.e. via water and detritus) seems to stimulate (> 2x) shredder consumption. Such response maybe related to a salt-induced physiological stress affecting larval assimilation or to a consistent compensatory food intake triggered by a decreased palatability of the single-fungal conditioned leaves. We can hypothesize that the presence of salt may determine a species-specific fungal biomass reduction, a decline of the hyphae degradative capacity and activity and/or an altered mycelium chemical composition. In spite of the recognized vegetative tolerance of fungi to salinization, adverse effects in terms of biodiversity and nutrient cycling can be expected in salt-contaminated streams.

Are fungal strains from salinized streams functionally more efficient than their conspecifics from reference streams?

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In forested streams, decomposition is the pivotal ecosystem-level process. It is mainly carried out by fungi - aquatic hyphomycetes - that link leaf litter and invertebrate consumers. Human-induced salinization of watercourses is a globally growing problem of which the consequences on stream function remain largely unknown. Here we evaluated the effects of salinization (6gL⁻¹ NaCl) on leaf mass loss and associated microbial parameters promoted by mono- and multispecies assemblages of fungal strains of *Heliscus lugdunensis* (HELU), *Tetrachaetum marchalianum* (TEMA) and *Flagellospora curta* (FLCU) isolated from a reference (R) or salinized (S) stream. Fungal growth and ecological interactions established in both contexts were also assessed. Salt contamination tends to inhibit oak leaf decomposition and associated fungal biomass but no differences were observed between species, strains or assemblages. Sporulation rates were not affected by the presence of salt, but were different among species (FLCU > HELU > TEMA), with S strains usually releasing more conidia. Despite mixed fungal assemblages not showing significant differences in total conidia production (either between strains or media), the dominance of species was affected by salt addition in the medium. In the presence of salt, sporulation was dominated by HELU, which consistently presented the highest growth and antagonistic behaviour. TEMA (R or S) was the least antagonistic species and had the lowest salt-tolerance. Results suggest that fungal communities, irrespective of their origin, are able to maintain their functional efficiency in salinized streams, thereby guaranteeing leaf incorporation into secondary production. Antagonism seemed to be stronger in the presence of salt, and tended to be similar across species and strains (except HELU-R). Cascading effects throughout stream food webs are expected considering the losses of diversity and potential changes in leaf litter quality to leaf-consumers that can be expected in salt-contaminated stream.

Hydromorphological conditions of rivers in Madrid Region (Central Spain)

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Hydromorphological (HYMO) conditions of rivers represent the main physical context for supporting biological communities and ecological status. Their assessment has been strongly reinforced by the Water Framework Directive and is included in the River Basin Management Plans, who mainly address the achieving of good ecological status through measures based on HYMO conditions. Water administration from the Madrid Regional Community has paid much attention to improving rivers and riparian zones in the last decades, and has proceeded with the study of their hydromorphological conditions as a first stage for setting up river restoration strategies and implementation of measures. We present the results of this hydromorphological study, based on the analysis of 55 river sites located along the main 9 rivers of the Region. Flow regime (mean annual flows and maximum and minimum annual flows) was analysed along three different periods encompassing pre- and post- river damming periods. Morphological conditions (valley type, channel width, bed substratum, channel forms, bank conditions, artificial features) and riparian vegetation (corridor width, corridor coverage, species composition and species abundance, vegetation succession, artificial features) were assessed by orthophotos analysis from different years and by field work. Different hydromorphological indices (QBR, RQI and modified MQI) were applied. Madrid Rivers showed strong regulated flow regimes by more than 16 large dams in their basins, most of them used for domestic water supply. Annual seasonality and maximum annual flows have been strongly reduced while minimum annual flows have increased in nearly all the cases. Channel width variability has decreased in all rivers and in-channel geomorphic units (i.e., gravel bars) have nearly disappeared in the last twenty years. Vegetation encroachment is a common response to flow regulation observed in most of the cases. Riparian corridors have enlarged their area and coverage, and a gradual replacement of pioneer species (e.g. *Salix* shrubs) by late-seral species (e.g. *Fraxinus angustifolia*) at the previously most dynamic riparian zones is currently observed. Recovery of flow regime variability seems to be unavoidable to reverse these poor hydromorphological conditions, that at the same time offer more safely hydrological conditions in terms of smaller flood risk and greener river landscapes.

Estudo do efeito da descarga de duas ETAR's na estrutura da comunidade de macroinvertebrados bentônicos do rio Tinto (Portugal)

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A diretiva quadro da água (DQA-2000/60/EC) estabelece como um dos objetivos principais a obtenção de um bom estado ecológico das águas e introduz o conceito de "estado ecológico" de um ecossistema o que inclui o estudo de um amplo conjunto de parâmetros e fatores na determinação da saúde de um ecossistema. Este trabalho é parte de um projeto cujo principal objetivo é a reabilitação de um pequeno rio do norte de Portugal, que corre ao longo de uma área urbana e que apresenta um elevado nível de degradação ambiental e tem como objetivo estudar o efeito das descargas de duas estações de tratamento de águas residuais (ETAR's) na estrutura das comunidades de macroinvertebrados bentônicos do rio Tinto. O estudo compara resultados (métricas e índices) obtidos a partir da análise de amostras de macroinvertebrados bentônicos recolhidas em troços do rio a montante e a jusante das descargas das ETAR's entre outubro de 2015 e setembro de 2017 e alguns valores parâmetros hidro-morfológicos e físico-químicos. Os resultados permitem verificar que apesar de as comunidades de macroinvertebrados bentônicos se encontrarem muito condicionadas pelo estado mau estado ecológico geral do rio Tinto, nas áreas a jusante das ETAR's as mesmas apresentam-se ainda mais perturbadas.

Decomposition and Diversity in streams: a global experiment (GLOBE-DecoDiv)

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Understanding how stream ecosystems function are affected by human activities is of major importance, as they play a significant role in the global carbon cycle and provide us with fundamental services. Key stream ecosystem processes such as leaf litter decomposition are often affected by biodiversity loss in riparian forests, but it is uncertain whether such effects vary across climatic gradients globally. A previous study conducted at 24 sites distributed across a 90° latitudinal gradient showed that plant phylogenetic diversity in litter mixtures might enhance decomposition in tropical streams but might have the opposite effect at higher latitudes. We test this hypothesis in 'DecoDiv', a litter decomposition experiment that is being conducted at 54 stream sites globally distributed across 110° of latitude in all continents except Antarctica. DecoDiv is being implemented by the Global Lotic Breakdown Experiments (GLOBE) network, which is active since 2006 and has produced pioneer studies on litter decomposition at the global scale. The study uses 6 types of litter mixtures of either low or high phylogenetic diversity, made from different combinations of 9 riparian plant species from 3 families (Betulaceae, Moraceae and Fagaceae) collected from different locations in Costa Rica, Ecuador, France, Kenya, Portugal, Spain, USA and Sweden. Litter mixtures are placed within coarse- and fine-mesh litterbags and incubated in 54 permanent headwater streams draining forested catchments for 4-6 weeks. Litter mass loss during the experiment was used to estimate total, microbial and detritivore-mediated decomposition rates in the different mixtures, providing an opportunity to examine the effects of plant phylogenetic diversity on decomposition and the potential underlying mechanisms of such relationship across climates. Furthermore, the use of current climatic gradients as surrogates for future changes in temperature and other environmental factors allows us to predict how stream ecosystem functioning will be affected by climate change. International collaborative studies such as DecoDiv are a powerful tool to understand how ecosystems function and how vulnerable they are to anthropogenic impacts.

Contribution of hydrologic opportunity and biogeochemical reactivity to the variability of nutrient retention in river networks

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In-stream nutrient retention results from the interaction between hydrological and biogeochemical processes involved in downstream transport. While hydrological processes set the opportunity for nutrient retention to occur, metabolic activity and abiotic processes determine the potential biogeochemical reactivity of streams. Yet a comprehensive assessment of the relevance of hydrological opportunity versus biogeochemical reactivity on the variability of nutrient retention across streams is still missing. For this talk we compiled an extensive data set of existing studies on nutrient retention for ammonium, nitrate, and soluble reactive phosphorus to explore how variability in hydrological opportunity and biogeochemical reactivity explain nutrient retention. We quantified the relative contribution of hydrological opportunity and biogeochemical reactivity to the observed variability in stream nutrient retention using a linearization of the retention equation, which allows for an exact partitioning of the variance associated with residence time and nutrient uptake rate. Finally, we explored potential patterns of nutrient retention along the river network resulting from the interaction between hydrological opportunity and biogeochemical reactivity. Our results show that biogeochemical reactivity has a more relevant role on nutrient retention variability than previously thought, explaining over 66% of the variability in nutrient retention. Among the studied nutrients, retention variability of ammonium was the most subjected to biogeochemical reactivity controls. Furthermore, our results provide insights on controls of longitudinal patterns of nutrient retention along river networks, indicating that retention per unit length for the three nutrients will most likely decrease from headwaters to river mouth because of a decrease in water residence time.

The colder best: In Brasil, subtropical zones increase the aquatic hyphomycetes diversity compared to tropical zones

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Aquatic hyphomycetes, known to be the mainly leaf litter decomposers in streams, are generally scarce in terms of diversity in many tropical systems. In these systems decomposition rates are much slower when compared to what is described in the literature for temperate countries. We hypothesized that (1) the community of aquatic hyphomycetes reached in species in the Brazilian Atlantic Rain Forest compared to Savannah and (2) that community of aquatic hyphomycetes will be more latitudinally structured (higher in low temperature sites) along the tropical gradient when compared to the intra-local seasonal variation. We selected five low order streams located in Brazilian subtropical: P1 = Rio Grande do Sul and P2 = Paraná, and tropical localization: P3 = Espírito Santo, P4 = Distrito Federal and P5 = Bahia. Portions of *Nectandra megapotamica* (Spreng) Mez leaves were incubated in the streams in fine mesh bags (0,05 mm). Bags were retrieved after 15, 30 and 60 days of incubation to determine fungal sporulation rates, the community structure of aquatic hyphomycetes and leaf litter remaining mass. A total of 15 species of aquatic hyphomycetes occurred in streams, with the highest richness and density of aquatic hyphomycetes in P1 and P2 (subtropical) and the lower value in P3 (all of them in Atlantic Rain Forest). The most common aquatic hyphomycete was *Anguillospora filiformis*. Some species were found only in a single river such as *Campilospora sp.*, *Clavariopsis aquatica*, *Clavatospora tentacula*, *Culicidospora aquatica*, *Alatospora acuminata* in P1; *Crucispora ponapensis* and *Tricelophorus myrti* in P2; *Camposporium pellucidum*, *Tricladium crucisporum* and *Subulispora curvata* in P4. The P3 and P5 sampling points do not have exclusive species. The remaining mass was highest in P1 (Atlantic rain forest, subtropical) and P5 (Savanah, tropical). This result suggest that, in spite of the highest aquatic hyphomycetes richness were found in the streams from subtropical zones, the higher decomposition occurring in P5 can be driven by another group of fungi that are not the aquatic hyphomycetes.

Litterfall phenology structuring the aquatic decomposer community in a low order stream

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The seasonal variations in quantity and nutritional quality of litterfall may modify the exploitation behavior of the decomposer community and, consequently, affect the ecological process of litter breakdown in low order streams. Therefore, the objective of this study was to introduce the “Phenology-facultative” hypothesis as an attempt to explain the decomposer community adaption to the allochthonous organic matter (AOM) phenology. This postulates that the decomposer community should present a localized/retarded and opportunistic exploitation behavior according to Dry and Rainy season, respectively. The hypothesis was tested by means of the intra-annual patterns of litter decomposition and the associated decomposer community, simultaneously with the biomass and chemical content variation of AOM from the riparian vegetation. The litter remaining mass showed a negative relationship with precipitation, suggesting that rainfall rates, enhancing physical and biological factors, would drive the entire process of AOM dynamics in tropical streams, from litterfall to decomposition. The Collectors functional group exploited the available resource regardless of the ecosystem temporal fluctuations, implying its opportunistic behavior; the scientific exploration of its predominance over the AOM resource may provide potential investigation paths. The nutritional input, according to the AOM total chemical composition, presented an intra-annual balance that may be determinant for the ecosystem functioning stability. The decomposer community, in general terms, presented a localized/retarded exploitation behavior during the more stable periods (low precipitation and high AOM biomass of low quality); sustaining partially the “Phenology-Facultative” hypothesis.

Hidrología del humedal del Parque Nacional de Las Tablas de Daimiel (Ciudad Real, España)

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Las Tablas de Daimiel se generan en la confluencia de los ríos Gigüela y Guadiana. En régimen natural, el primero aportaba caudales de agua muy variables, esporádicos y relacionados con los periodos húmedos; el segundo daba lugar a un aporte hídrico mucho más continuo y estable, ligado a la descarga de agua subterránea de un acuífero de gran extensión, unos 5.000 km², conocido como Sistema Acuífero 23. Este gran acuífero ocupa la zona central de la región natural de La Mancha y tiene su principal área de descarga de aguas subterráneas en los denominados Ojos del Guadiana, un conjunto de manantiales que van incrementando el caudal del río y constituyen el nacimiento del Guadiana y el principal aporte de agua al humedal. En régimen natural, el valor medio anual, para el tramo desde el nacimiento del Guadiana hasta la estación de aforo de Zuacorta, era de unos 66 hm³/año, para la serie temporal 1914/15-1940/41. Así, el río constituía un aporte vital y continuo de agua hacia el humedal que, debido a la gran inercia hidrogeológica del sistema acuífero, paliaba los periodos de aridez que se producían periódicamente, manteniendolo permanentemente encharcado. Esta situación comienza a modificarse sustancialmente a partir de la década de los 70 del pasado siglo, cuando los regadíos intensivos generan un descenso piezométrico que modifica progresivamente la dinámica regional del flujo subterráneo, hasta que se produce la desecación total de los Ojos del Guadiana a partir del año 1983, momento en el que se alteran las condiciones naturales del acuífero y se pasa a una situación hidrológica modificada por la acción antrópica, de manera que no se produce aporte natural alguno de agua al humedal.

Los Ojos del Guadiana permanecieron secos durante casi 30 años, hasta enero de 2012, en que, como consecuencia del periodo húmedo 2009-2013, se empiezan a detectar encharcamientos aislados. Posteriormente, desde la primavera de 2013, comienza un periodo con escorrentía superficial, alcanzando un caudal máximo de casi 1.500 l/s, en abril de 2014, lo que, no obstante, supone aproximadamente un 20% del caudal medio en régimen natural. Se puede establecer que la supervivencia del Parque Nacional de Las Tablas de Daimiel está ligada a la evolución hidrológica del Sistema Acuífero 23, actualmente, según el plan hidrológico de la demarcación hidrográfica del río Guadiana, subdividido en tres masas de agua subterránea: Mancha Occidental I, Mancha Occidental II y Rus-Valdelobos.

BIODIVERSITY AND STREAM ECOSYSTEM FUNCTIONING UNDER GLOBAL CHANGE: INSIGHTS FROM DETRITAL FOOD WEBS

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Over the past 2 decades there has been a remarkable increase in the number of studies in ecology aiming at assessing the impacts of biodiversity loss on freshwater ecosystem functioning. We used plant-litter decomposition, a key-ecosystem process, fungal decomposers and invertebrate detritivores as a tractable model system to assess biodiversity and ecosystem functioning relationships and to unravel if global change affect those relationships. Our results have shown that biodiversity loss reduces the efficiency by which biological communities capture resources, produce biomass and decompose organic matter. Positive effects of biodiversity have been found across trophic levels (plant litter, microbes and invertebrates). These have been mainly associated to mechanisms of complementarity, but the presence of certain species appears to have a large influence on ecological processes as well. Moreover, biodiversity and ecosystem functioning relationships were generally nonlinear and achieved saturation above a certain diversity level, suggesting considerable functional redundancy. Finally, we found evidence that diversity effects are modulated by environmental factors (e.g., temperature, eutrophication or chemical contaminants) as shown by data retrieved from experiments along environmental gradients.

DIVERSION: Multi-scale consequences of water diversion and its interaction with pollution on river ecosystems

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Water diversion for hydropower generation is a common activity in streams and rivers, which will intensify in the near future as fossil fuel availability decreases worldwide. Discontinuities created by big dams in rivers have been widely regarded in freshwater literature, but the effects of small weirs are still poorly known. The project DIVERSION assesses the impacts of water diversion on river biodiversity and functioning, as well as the interaction between water diversion and pollution. Combining field and laboratory experiments, different structural and functional properties of rivers are addressed. A first experiment focused on the impact of water diversion on ecosystem functioning in 4 rivers ranging from unpolluted to extremely polluted. Free flowing reaches upstream and downstream from the diversion weir were compared and a range of ecosystem-level processes (nutrient retention, organic matter breakdown, gas emission and whole ecosystem metabolism) were examined. Water diversion was related to channel narrowing and streambed substrate coarsening, but these geomorphic effects had weak consequences for ecosystem functioning. Contrary to our expectations, an interaction between water diversion and pollution level did not arise.

A qualidade física e química da folhada de espécies ripárias difere entre biomas?

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São bem conhecidas as diferenças na decomposição da folhada em riachos de diferentes regiões. Em algumas regiões tropicais, os fungos aquáticos e os fragmentadores são menos abundantes do que nas regiões temperadas. Esta diferença pode ter a ver com diferenças na qualidade da folhada entre zonas. O objetivo deste trabalho é comparar a qualidade de folhas senescentes de espécies ripárias (30 spp no total) dos biomas: Floresta Caducifolia- FC (Portugal), Floresta Estacional Semidecidual - FE (Mata Atlântica, Paraná), Floresta Ombrófila Densa - FO (Mata Atlântica, Paraná) e Cerrado – (CE, Brasília); estes 3 biomas no Brasil. As espécies do CE foram mais duras (penetrância= 139g) do que as demais (FC= 124g; FO= 99g; FE= 85g). Em termos de SLA (specific leaf area) as espécies da FO apresentaram um valor significativamente mais elevado (ou seja, menos duras) do que as restantes ($p < 0,001$; variação entre 14,5 e 9,6 mm²/mg). Os valores mais elevados de P ocorreram nas espécies da FE (0,38%) seguidas de CE (0,21%), FC (0,16%) e FO (0,06%) (ANOVA, $p < 0,05$). Em termos de N, os valores mais elevados ocorreram em FE (2,34%), seguidos de FO (2,21%), FC (1,17%) e CE (0,76%) (ANOVA, $p < 0,001$ FO > CE). Os valores para a C:N foram similares entre FE e FO (87 e 70) e entre CE e FC (31 e 33). As folhas com uma maior quantidade de polifenóis foram as de FC (9,62 %) seguida de FO (5,98%), CE (5,05%) e FE (1,98%) (ANOVA $p < 0,05$). As espécies com uma maior concentração de lignina foram as de FO (40,4 %), seguida de CE (36,7%), FE (32,2%) e FC (31,8%). Concluímos que há diferenças na qualidade química e física das folhas entre os biomas avaliados. O próximo passo será determinar se essas diferenças se traduzem em diferenças nas taxas de decomposição e consumo por detritívoros.

Contribution of shredders to leaf litter decomposition in remote insular streams

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Leaf litter from riparian vegetation is the main energy for forest streams. Litter is decomposed mainly by microbial and detritivore macroinvertebrates, thus diversity and abundance of decomposers will be determinant of litter decomposition. Oceanic freshwater systems tend to be species poor but rich in endemism due to their physical isolation. The consequences of this reduced diversity in the functioning of these isolated ecosystems are not well known. Furthermore, litter decomposition in many islands seems to be essentially driven by microbes. The low abundance and richness of shredders in these isolated systems may be the reason of their low contribution to litter decomposition in oceanic islands. However, what would happen if the abundances of shredders were greater? Would they play an important role in litter decomposition in these isolated systems? Here we try to answer the previous questions evaluating the effects of different detritivore abundances in litter decomposition in oceanic freshwater systems. The study was carried out in six streams with a gradient of shredder abundance located at São Miguel Island, Azores Archipelago. The dominant endemic tricoptera on these streams, *Limnephilus atlanticus* (Limnephilidae), was the target species. Three leaf species, *Alnus glutinosa*, *Clethra arborea* and *Cryptomeria japonica* were placed in the streams in bags of two mesh sizes (coarse mesh: 10 mm mesh size; fine mesh: 0.5 mm mesh size) used to assess the relative contribution of macroinvertebrates and microbes to litter decomposition. Over a period of 50 days, mass loss of leaf litter differed between the two bag types. Streams with high abundance of shredders showed higher leaf decomposition rates than those with low abundance of shredders, suggesting that macroinvertebrates may play an important role in litter decomposition when their abundance is high. In addition, there was no difference in mass loss of leaf litter between bag types in streams with no shredders. Decomposition rates were highly species-specific suggesting that these shredders are selected feeders preferring high quality leaves for their diet. Despite low diversity of detritivores species in insular streams, our results confirmed that when they are present, they play a key role as active shredders in litter decomposition as in many continental freshwater ecosystems.

Leaf-traits control the litter processing by *Phylloicus* (Muller, 1880) of Brazilian Savannah and Tropical Rainforest streams

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Tropical riparian zones have natural leaf litter input fluctuations in quality and quantity that would influence energy flow and nutrient cycling on receiving streams. Leaf litter decomposition plays an important role in the stream food webs with a great contribution provided by shredders processing. Here we tested the influence of nutritional quality and quantity of leaves on consumption of *Phylloicus* sp. (an important and common Neotropical shredder) under controlled conditions of microcosms. Experiments were performed with standard methods in Brazilian Savannah and Tropical Rainforest sites. Leaf litter of *Maprounea guianensis* and *Inga laurina* previously conditioned for seven days at each local stream, were cut into discs, freeze-dried and weighed. Containers were used with a single individual of *Phylloicus* sp. coming from each stream. Five leaf discs proportions of both species (100-0%; 75-25%, 50-50%, 25%-75% and 0-100% to *M. guianensis* and *I. laurina*, respectively) making a quality gradient from high to low were used to evaluate the effect of litter quality. The higher mass loss (33.2% ± 3.7) found on Savannah stream experiment was in 100% of *M. guianensis* while *I. laurina* was the lower (6.5% ± 0.8) compared to others treatments. We also observed a similar pattern in litter quality effect on the Tropical Rainforest experiment, where the treatment of *M. guianensis* (26.5% ± 5.5) showed the higher mass loss. To assess the effect of litter quantity, the five proportions described above were repeated in two treatments having the first four leaf disks (lower quantity) and the second 12 leaf disks (higher quantity) in each container. We found a higher mass loss in treatment with lower litter quantity (23.6% ± 2.2) compared to higher quantity (15.4% ± 1.7) in Brazilian Savannah, and no statistical difference in mass loss in both treatments (lower 16.9% ± 4.3; and higher 11.7% ± 3.5 litter quantity) in Tropical Rainforest experiment. The higher quality proportion was the main factor for explaining the litter used by organisms from different origins. This also indicate that leaf-traits controls litter processing and how litter availability may alter the processing of organic matter by *Phylloicus* sp. on Brazilian Savannah and Tropical Rainforest.

Leaf litter decomposition: drivers in estuarine systems

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Estuarine systems are dynamic areas largely shaped by river discharge and tidal cycles. In these interfaces, food webs are supported by a diverse pool of organic matter that includes senescent leaves of distinct quality, being this terrestrially derived material supplied by the riparian areas or downstream flow (especially during floods), before deposition in the sediment. Decomposition patterns and drivers of leaf litter in these areas are still poorly known. In this study we compared leaf mass loss of alder (*Alnus glutinosa*) and poplar (*Populus nigra*) and associated microbial, meiofauna and macroinvertebrate colonization in an estuarine area of the Mondego River (Portugal), a warm temperate polyhaline system. Poplar, the most recalcitrant leaf, decomposed faster than alder ($k = 0.09 \pm 0.001$ d⁻¹ vs. 0.07 ± 0.010 d⁻¹). Although fungal biomass was negligible in both leaves, bacterial abundance was more than 4 times higher in poplar than in alder. An absence of significant differences was observed between leaf species regarding meiofauna abundance, though important differences emerged in meiofaunal community composition, presenting a higher proportion of nematodes (> 27%) in poplar leaves. Macroinvertebrates were almost absent in the litter bags, suggesting a reduced importance of this group in leaf degradation in this environment. Results suggest that leaf decomposition in estuarine systems is mainly driven by bacteria and nematodes, that seem to profit from tougher substrates that allow the development of a thicker and more stable biofilms. It is suggested that nematodes do not seem to be directly related with the mechanical process of decay but likely respond to detritus chemical changes and bacteria development, highlighting the importance of both groups in the recycling dynamics of organic matter and transference of energy in estuarine systems.

Intra and interspecific functional variability of aquatic hyphomycetes

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Biodiversity plays a key role for ecosystem functioning even in situations where global change is not crucial. To date, research dedicated to ecosystem functioning has significantly focused on the role of species diversity. However, considerable intraspecific trait variation is common and may overlook key processes governing ecosystems if intraspecific variation is ignored. In forested streams, plant litter decomposition is a key ecosystem function. Fungi, especially aquatic hyphomycetes play an important role in plant litter decomposition in streams. The role of aquatic hyphomycete species in litter decomposition is widely recognized but very few studies focus on the consequences of intraspecific variability on ecosystem functioning. Therefore the aim of this study was to evaluate the impact of intra and interspecific functional variability of aquatic hyphomycetes on plant litter decomposition. To this end, ten strains of five aquatic hyphomycete species (*Lemmoniera terrestris* Tubaki (LETE), *Anguillospora crassa* Ingold (ANCR), *Tetracladium marchalianum* De Wild (TEMA), *Articulospora tetracladia* Ingold (ARTE) and *Heliscus lugdunensis* Sacc. & Therry (HELU) were isolated from pristine streams for this study. Litter decomposition experiment was conducted in microcosms using alder leaves for 70 days and leaf mass loss was assessed. One-way Permutational Analysis of Variance was used to determine the effects of intra and interspecies diversity on leaf mass loss. The paired tests were used to analyze the significant intra and inter-species differences. Mass loss was significantly different between species ($F= 28.209$; $p < 0.01$). Among the species, TEMA promoted greater mass loss, in the range between 38 - 65%, followed by ARTE (27 - 65%), LETE (23 - 60%), ANCR (27 - 50%) and HELU (12 - 31%). The mass loss was not significantly different between ARTE and LETE ($p = 0.16$) and between ARTE and TEMA ($p = 0.16$). However, the mass loss significantly differed within LETE, ARTE and HELU ($p < 0.02$) strains but not among the strains of ANCR and TEMA ($p > 0.05$). Overall, the results suggested differences in leaf degradation ability among and between aquatic hyphomycetes, which suggest an absence of functional redundancy, calling for a greater understanding of the functional role of these microorganisms in a changing environment.

How phylogenetic diversity influences litter decomposition

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The loss of plant species from riparian forests can alter key stream ecosystem processes such as leaf litter decomposition, but the mechanisms underlying those effects are unclear. One unresolved question is whether plant phylogenetic diversity (PD) in litter mixtures – potentially a good proxy for leaf litter trait variability – can influence litter decomposition rates and the way these rates are affected by tree species loss. We addressed this question in a field experiment in northern Spain, taking advantage of an international collaborative project that was carried out in 50+ streams across a 110° latitudinal gradient (GLOBE-DecoDiv). We incubated coarse-mesh and fine-mesh litterbags containing litter of 9 plant species from 3 families within a stream for 28 days. Treatments consisted of 3 low-PD mixtures (i.e., mixtures containing 3 species of the same family), 3 high-PD mixtures (i.e., 3 species of different families), and the 9 monocultures (i.e., each species separately). We assessed decomposition rates, changes in litter chemical composition (C, N and P) and associated fauna. Additionally, our design allowed us partitioning diversity effects into complementarity and selection effects in the mixtures. Our preliminary results suggest that (1) decomposition rates are strongly correlated with initial litter quality, especially when the process is mediated by detritivores; (2) most litter mixtures decompose at a lower rate than expected (i.e., there is a negative net diversity effect); and (3) PD – which is strongly correlated with litter trait variability – influences the relative role of different mechanisms underlying diversity effects on decomposition (i.e., complementarity vs. selection) when detritivores are present. The influence of PD on decomposition thus appears to be driven by litter quality and the presence of detritivores, which may benefit from the concentration of preferred resources rather than from resource variability.

SR5.

Ecosystem Services

Sistemas naturales de tratamiento de agua para disminuir la vulnerabilidad climática en el Departamento del Cauca, Colombia

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El recurso hídrico es esencial para la vida y es clave en el desarrollo económico de los países. No obstante, la calidad y provisión del agua a nivel mundial ha sido impactada por las actividades humanas en menor o mayor escala, por lo que se han buscado nuevos métodos y tecnologías para su tratamiento y reutilización. La creación o restauración de humedales y las franjas de vegetación riparia son ejemplos de sistemas naturales de tratamiento con un elevado potencial de integración en el paisaje y en el funcionamiento ecológico de los ríos, los cuales, también contribuyen a mejorar los servicios ecosistémicos de provisión, protección y calidad del agua. En este estudio, se evaluó la calidad ecológica de la vegetación riparia con base en la aplicación de los índices RQI, QBR y CERA-S y se utilizó el Kit de Herramientas para las Evaluaciones de Servicios Ecosistémicos (TESSA, por sus siglas en inglés) para el análisis de los servicios ecosistémicos hidrológicos en microcuencas abastecedoras de cinco municipios (Bolívar, Popayán, Santander, Suárez y Timbío) del Departamento del Cauca, Colombia. Este método participativo permitió diagnosticar e identificar actividades que podrían estar impactando en la calidad y cantidad de agua en cada una de las microcuencas. Además, se identificaron zonas estratégicas para la creación o implementación de humedales y franjas de vegetación con base en los resultados de los índices, el muestreo de parámetros fisicoquímicos de agua en diferentes puntos de las microcuencas y la aplicación de escenarios alternativos, analizados con Costing Nature y AguaAndes/WaterWorld. Los resultados demuestran la utilidad de la guía TESSA y el uso de herramientas de modelación para llevar a cabo evaluaciones rápidas y de bajo costo de algunos de servicios ecosistémicos en sitios donde la información puede ser limitada o de difícil acceso. Por otra parte, contribuye al conocimiento de la zona para apoyar a los responsables de las decisiones políticas y de gestión en la toma de decisiones relacionadas con el uso y manejo del recurso hídrico.

Manipulación nutricional en el camarón *Macrobrachium borellii* como recurso en la alimentación humana

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Los ambientes dulciacuícolas aportan servicios a la sociedad, y entre estos el nutricional es valorado y requerido. Los crustáceos, particularmente los camarones, proveen al hombre un potencial alimento con características nutricionales reconocidas por su alto contenido proteico. El camarón dulciacuícola *Macrobrachium borellii* habita el río Paraná (América del Sur) en altas densidades, y es considerada una especie omnívora y oportunista, obteniendo los nutrientes necesarios del ambiente que se reflejan por ejemplo en el perfil de aminoácidos (AA) que caracteriza a esta especie. En el contexto del servicio ecosistémico, el objetivo del trabajo fue evaluar el perfil de AA del músculo del camarón *M. borellii* (porción comestible) alimentados con diferentes dietas proteicas en función de promover su cultivo para consumo humano. Ejemplares de *M. borellii* fueron cultivados en tanques durante tres meses, utilizando una dieta peletizada que contenía harinas de: camarón, pescado, vegetal (D0) y en otros una dieta isoproteica de harinas de: pescado, vegetal (D1). El perfil de aminoácidos de las dietas administradas y del músculo de los camarones cultivados fueron analizados por HPLC y comparados con el requerimiento de AA indispensables para adultos (FAO 2007). El contenido de AA en D1 fue mayor a D0 en relación a AA azufrados (Cist+Met), ramificados (Val+Leu+Ile), aromáticos (Tir+F) y aminados (Lis+Arg), mientras D0 fue mayor en His, Pro, Asp+Glu. El músculo del camarón *M. borellii* presentó 16 aminoácidos, de los cuales ocho fueron AA indispensable. Los AA Ala, Cis y Val estuvieron presentes en mayor concentración en aquellos camarones alimentados con D1. Al comparar el patrón de AA indispensables para el hombre (adulto), calculado con un valor de requerimiento proteico promedio de 0,66 g/kg/d (FAO), con aquellos provistos por el músculo de los camarones alimentados con ambas dietas no se encontraron AA limitantes. La porción comestible de los camarones cultivados cubre los requerimientos de AA indispensables para el hombre, por ende el cultivo de esta especie con dietas artificiales constituye una herramienta potencial para ser utilizada en la nutrición humana como otro recurso que se suma al servicio ecosistémico que brinda el río Paraná.

The effect of barriers on the diversity of aquatic fauna: the Nalón River (northern Spain) as a case study

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Aquatic ecosystems are at risk due to human activities, including the introduction of exotic species, and the increasing need for water resources. Studies suggest that reservoirs are more susceptible to biological invasions than natural systems. Here we explored the effect of damming on aquatic fish fauna, taking Nalón River (south Bay of Biscay) as a case study. We combined environmental DNA analysis, data from sport fishing and conventional electrofishing surveys to determine the aquatic fish diversity in river areas differently affected by five dams. Four native species were identified from electrofishing: brown trout *Salmo trutta*, European eel *Anguilla anguilla*, thicklip grey mullet *Chelon labrosus* and sea lamprey *Petromyzon marinus*. All of them are diadromous species and were found only in the accessible river area (downstream the first dam), except the brown trout, whose presence upstream is explained from sedentary natural populations and stocking in the last century. Six exotic species were also identified: Northern straight-mouth nase *Chondrostoma duriense*, the cyprinid *Cobitis paludica*, the Iberian gudgeon *Gobio lozanoi*, the minnow *Phoxinus phoxinus* and the northern Iberian chub *Squalius carolitertii*. Atlantic salmon *S. salar* was detected from eDNA and confirmed from anglers' catch. *Squalius carolitertii* was monitored upstream the impassable dams from anglers' catch.

Species scoring higher in ecosystem services were found principally in the accessible zone of the river, with the exception of *Salmo trutta*, whose 19.4% of River Nalón population was located upstream dams. On the other hand > 50% individuals from low-score species were found in the inaccessible zone between dams, including all the *C. duriense* and *C. paludica* individuals. In this case study, the proportion of exotic species was positively associated to the accessibility of river areas. None of the exotic cyprinids were found upstream the uppermost dam, which could be acting as a barrier preventing the access of exotic species to head tributaries. More studies should be done to monitor native and exotic species in order to design management strategies to deal with damming in regions severely affected by introduced species.

Urban Algae: Ecological Status and the Perception of Ecosystem Services of Urban Ponds

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The 2nd Collaborative European Freshwater Science Project for Young Researchers ("FreshProject"), a joint initiative by the European Federation of Freshwater Sciences (EFFS) board, the European Fresh and Young Researchers (EFYR) and representatives of the Fresh Blood for Fresh Water (FBFW) meetings, awarded the project Urban Algae in March 2018. This project addresses the ecological status of urban ponds and societal perception of their ecosystem services while simultaneously increasing the interactions and collaborations among young freshwater researchers across Europe. The concept of ecosystem services is a widely used tool, which shows how important ecosystems like urban ponds are to society. However, the citizens' perspective of urban ponds varies for different ecosystem services. Ecosystem services are often dependent on and affected by the ecosystem functioning of the ponds. Primary producers are key players in aquatic ecosystem functioning (nutrient recycling, carbon sequestration). In urban environments, primary producers are however influenced by multiple stressors, and as a consequence the community structure and diversity of these producers varies drastically. In turn, the community of primary producers can have repercussions for both the ecosystem functioning and ecosystem services. Thus, citizen perception of urban ponds may be used as a quality indicator. We hypothesize that a good ecological status of urban ponds' water will be reflected in the perception of the public by a high valuation of ecosystem services. This project will merge citizens' perception and urban ecology along an urbanization and latitudinal gradient across Europe. For this purpose ca. 25 teams from multiple locations across Europe will sample urban ponds to determine the ecological status and perform online citizen surveys based on images of the studied ponds. The outcomes can then be used to disentangle the relationships between ecological status and perception of the public of urban ponds. In the light of increasing urbanization, the development of tools for stakeholders for the effective and efficient management of urban ponds is important. With the Urban Algae project, we contribute to increase the knowledge to this field and simultaneously foster the interdisciplinary collaboration between young scientists in Europe.

Managed ecosystems in the Mediterranean: is it possible to have it all?

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The rural exodus and the abandonment of agropastoral activities in the Iberian Peninsula has resulted in the replacement of cropland and pastures by woodland and an inevitable homogenization of the landscape. Consequently, the fires and the surface burnt in the European Mediterranean region increased. In addition, runoff has also declined in Iberian headwater streams. And, because of the decline of the primary sector in Catalonia, the tourism has become an alternative economical activity. Managed areas such as the Sant Llorenç del Munt i l'Obac Natural Park (Barcelona) experienced many of these landscape changes as shown for the 5 sub-basins here studied. During the last 50 years the afforestation of abandoned crops and shrubland was clear but the net forest cover shows little increase because of burned areas during these years. Given the current management model in the Park, which attempts wildfire prevention, forest and river conservation, we evaluate if all this together is possible. The future management of the Mediterranean forested basins, such as the ones studied here, will depend on the ecosystem services that are prioritized.

Integrating habitat conservation and hydrological services for improved river management: assessing spatial congruence and trade-offs in N Portugal

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River ecosystems provide several goods and services to human societies such as drinking water, energy and food. Simultaneously, river ecosystems are biologically diverse and among the most threatened worldwide. Therefore, river ecosystems combine conservation importance with high socio-economic relevance. In addition, biodiversity and hydrological ecosystem services spatially converge in watercourses and are influenced by local and landscape-scale processes. Thus, effective river management must address spatial congruence between biodiversity, conservation value and ecosystem service provision. This work aims to investigate spatial congruence between high conservation value river habitats and key hydrological ecosystem services. The work was developed in Northern Portugal region, focusing on two protected habitats 91E0* (Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*) and 3260 (Water courses of plain to montane levels with the *Ranunculus fluitans* and *Callitriche-Batrachion* vegetation). The ecosystem services targeted were water provision and sediment retention. The spatial distribution of the target habitats in the study area was modelled within R environment with the species distribution modelling (SDM) package biomod2. The supply of the target ecosystem services was assessed with InVEST software, namely water yield and sediment delivery models. Spatial congruence analyses were performed with ArcMap 10.5. We found a resolution mismatch between the publicly available habitats distribution dataset and the relevant resolutions and scales for ecosystem services modelling. However, we were able to bridge the gap between the two datasets, by modelling the distribution of the target habitats for the study region with an SDM approach. The climatic and vegetation heterogeneity in the study area translated into a spatial heterogeneity in service provision. Preliminary results, suggest that there is spatial congruence between the target services and habitat occurrence in mountain areas of the study region. The identification of key areas for conservation and ecosystem services, individually and collectively, allows for the design of spatial solutions that accommodate conservation objectives and sustainable use of water resources. Therefore, similar approaches may enable the operational articulation between conservation and management instruments, and in doing so, improve freshwater ecosystem management.

SR6.

**Biodiversity and
Biogeography**

***Navicula maiorpargemina* sp. nov. (Bacillariophyceae) a new diatom from a saline wetland in the south of Spain**

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Studies on diatom biodiversity of saline waterbodies are scarce and therefore many species are missing in the available floras. Zarracatín, an inland shallow hypersaline wetland, one of the biggest in the South of Spain (Seville), presents high conductivity (around 51.6 mS. cm⁻¹), high salinity (33.9 g/l) and an alkaline pH (8.05). Sediments were sampled in summer of 2006 by suction with a Lund tube. A new diatom species, *Navicula maiorpargemina* Fernández-Moreno, Sanchez-Castillo & Almeida, was described from the epipelagic samples of the Zarracatín wetland. Despite the extensive literature on the genus *Navicula* from freshwaters and inland waters, little is known about *Navicula* species from marine and brackish waters. A detailed description of *Navicula maiorpargemina* sp. nov. was based on light and scanning electron microscopy after comparison with morphologically and ecologically related *Navicula* species (*N. pargemina*, *N. abscondita*, *N. dilucida*, *N. concentanea* and *N. groschopfii*). The bigger size and the coarser striae of *Navicula maiorpargemina* clearly distinguish the newly described taxon from *N. pargemina*. Both species show similar valve shapes (generally linear or narrow lanceolate) and preserve the valves in pairs even after the oxidation process, with one valve in face view and the other in girdle view. *N. pargemina* is found in intertidal mud-flats of estuaries whereas *N. maiorpargemina* were found in brackish to saline wetlands. The other mentioned *Navicula* species were described mostly from marine environments but are morphologically less related to the new species. It is expected that human pressures on lakes and wetlands challenge the function and quality of these ecosystems. Greater knowledge about wetlands is needed for a better management and conservation of these highly susceptible environments to rapid climate change.

On the structure of rotifer metacommunities in temporary ponds from Costa Rica

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Rotifers are one of the main groups of zooplankton in freshwater lentic habitats; despite their small size, they play a key role in the structure of aquatic ecosystem communities. These animals survive to environmental stressors (as desiccation in temporary ponds) by producing resting eggs, which are, in addition, the dispersal agents that can be transported by different vectors (water, air, animals). This survival strategy combined with their small size, allowed rotifers having a very good dispersal ability. Thus, the distribution of the rotifer species is expected to be mainly limited by environmental factors more than by spatial ones. Within the framework of the METACOM project, that aims to study and compare the metacommunities of different groups of organisms in temporary ponds from Tropical and Mediterranean ecosystems, we studied 28 temporary ponds in Costa Rica, 7 in the Atlantic watershed and 21 in the Pacific one. At each pond, we measured a set of biotic and abiotic variables, and we took quantitative samples of zooplankton. A total of 72 rotifer species were identified. Occurrences reaching 10% were considered as rare; 32 species were in that case. Some species were found recurrently, for example *Lecane bulla*, with an occurrence of 71.4% of ponds, or *Bdelloidea* which was present in all of the ponds. We found an average species richness of 15.3 species per pond (from 24 to 6 species per pond). Average density was 137 individuals per liter (from 1021 to 2.6 individuals per liter). In terms of specific richness, littoral species were dominant over strictly planktonic ones. Preliminary results point out the absence of significant relationship between the distance of the ponds and the rotifer assemblages. Multivariate ordination analyses reveals that environmental variables, fundamentally water temperature, oxygen saturation, vegetation types, altitude and conductivity, appear to explain a high percent of the observed variance.

Diversity and composition of Hydrophilidae assemblage (Coleoptera) in ponds of Northern Brazil

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Ponds are diverse and productive ecosystems and are essential for biodiversity conservation and very important for the dispersal of species. These ecosystems have undergone a serious decline worldwide, mainly by the human pressure, resulting in biodiversity loss. Among the invertebrates inhabiting these habitats, Coleoptera is one of the most diverse and useful groups when assessing the ecological conditions of the ecosystems. Hydrophilidae one of the richest and most abundant Coleoptera families in freshwaters. The aim of this study was to assess the diversity and composition of Hydrophilidae assemblage in 26 ponds in Roraima, Northern Brazil. The survey was carried out in June of 2015 in the wet season. Specimens were sampled using an entomological net with 500 μm mesh. Sampling was standardized to three minutes in each pond. We took 10 samples in each pond equally split between the different meso-habitat on the shore. The structure of the assemblage was evaluated for the ecological parameters of richness, abundance, diversity and evenness. The similarity between sites was evaluated with non-metric multidimensional scaling (NMDS), using the Bray-Curtis similarity index. Then, we grouped the ponds according to three factors: size, distance and connectivity with other water bodies. To determine whether the established groups differed significantly, we used the Analysis of Similarity (ANOSIM). A total of 1627 specimens were collected, belonging to 35 species and 10 genera (*Berosus*, *Chasmogenus*, *Crenitulus*, *Derallus*, *Enochrus*, *Hydrobiomorpha*, *Hydrophilus*, *Paracymus*, *Phaenonotum* and *Tropisternus*). In general, ponds presented high richness and diversity values. *Berosus* was the richest and the most abundant genus with 19 species and 1237 specimens collected. The genera *Crenitulus*, *Chasmogenus*, *Derallus* and *Hydrobiomorpha* were represented by only one species. The last one was the less abundant genus with only two specimens collected. The NMDS analysis non-showed a clear separation into groups for any of the factors studied and according to the ANOSIM, the assemblage composition of Hydrophilidae shows non-significant differences in faunal composition related to any of the factors. This study shows the high biodiversity of these ponds in Northern Brazil and the usefulness of water beetles in establishing habitat typologies.

Declínio populacional de cetáceos neotropicais dulcícolas promovidos pela implantação de usinas hidrelétricas

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O tamanho populacional é controlado por parâmetros como natalidade, mortalidade, imigração e emigração. Estes por sua vez são afetados fatores como interações interespecíficas e fatores abióticos. Populações de espécies topo de cadeia são as primeiras a serem impactadas por alterações em seus ecossistemas. O presente trabalho tem por objetivo fazer uma revisão, detalhando de que forma as alterações nos ecossistemas onde se distribuem populações de botos (*Inia sp*) afetam seu tamanho populacional, sobretudo o barramento de rios. Os trabalhos publicados mostram que essa espécie tem sua biologia relacionada com os ciclos de cheia dos rios. Durante a estação de seca, com baixa pluviosidade, o rio alcança seu menor nível, coincidindo com a estação reprodutiva de botos, época em que as fêmeas e machos potencialmente reprodutivos se encontram no curso principal do rio. Na época da cheia, os indivíduos se distribuem pelos complexos de áreas alagadas adjacentes ao rio, em busca de outros hábitat e de maior oferta de alimento, fator potencialmente importante para o recrutamento. Dessa forma, a interrupção e controle da vazão dos rios por meio da implantação de usinas hidroelétricas torna a movimentação, tanto de presas quanto de predadores, impossível, uma vez que se altera os ciclos de enchentes. Adicionalmente, o barramento também proporciona isolamento populacionais de botos, e a redução da abundância de peixes, o que reduz a diversidade genética desses cetáceos, bem como sua oferta de alimento. Diversos trabalhos tem abordado o declínio populacional de cetáceos dulcícolas tanto ao redor do mundo quanto para os botos da América do Sul. Nota-se que o grupo de cetáceos dulcícolas contemporâneas é constituído de poucas espécies, e que o declínio populacional causado por estes empreendimentos pode não extinguir imediatamente uma espécie, mas pode tornar sua população inviável, de forma com que desapareça com o tempo. Portanto, é preciso elevar os esforços para detectar padrões de declínio populacional nestes animais para que se possa mitigar os efeitos do barramento sobre as populações de cetáceos de água doce.

Dam height and time since damming affect distinct groups of fish fauna

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Dams promote direct and indirect effects on riverine habitats, such as changes in biological assemblages and local species extinctions. Despite the scarce existing knowledge, some dam features, such as the surface area, dam height or time since damming, may explain local fish diversity. Using a published data set from 55 dams throughout five main Brazilian watersheds, we evaluated the effects of the dam features on fish species richness. We applied Generalized Linear Models to test the relationship between several metrics related to species richness (total richness, dominant species and rare species) and dam features (area, height and time since damming), controlling for the sampling effort and the identity of river basins. Total, dominant and rare species richness were positively related to the dam surface area. In contrast, dam height influenced negatively the richness of dominant species whereas rare species richness were mainly and negatively determined by the time since damming. Our models suggest a decrease of two species per decade after damming and one species decrease per each 50 meters of dam height. Overall, our findings point to a drastic homogenization of fish assemblages presumably related to habitat modification and fragmentation after damming. Considering that the Neotropics harbors the largest number of freshwater fish endemic species of the world, and a high number of non-described species, our results show that dams might promote considerable loss of global biodiversity.

Phylogeny and genetic patterns over time and space in the species complex of *Daphnia pulex-pulicaria* from Sierra Nevada lakes (Spain)

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The crustacean *Daphnia* has become a promising model organism to study many biological phenomena and to investigate paleolimnological changes. The species complex *Daphnia pulex-pulicaria* includes two groups that are nearly morphologically indistinguishable and that usually occupy different but geographically overlapping habitats. Due to the complexity of this complex, its genetic structure and distribution needs to be clarified. We analyse the phylogeny and genetic diversity of this complex in Sierra Nevada lakes (Southern Spain) by studying its genetic variation in space and time and in relation to environmental variables. We sampled active populations in Sierra Nevada lakes and ephippium banks from sediment samples of the last 50 years. Additionally, we studied the morphometric and physico-chemical characteristics of the lakes. For the genetic analyses, we used mitochondrial sequence data and microsatellite markers. We also used regression matrices to analyse genetic structure in relation to environmental and spatial differences. Results showed that all populations belong to European *D. pulicaria* lineage, except one located in Borreguil Lake, which is related with an invasive North American *D. pulex* lineage. Using F_{ST} to establish genetic differentiation between lakes, we observed that populations of *D. pulicaria* in Cuadrada and Caballo lakes were significantly differentiated from the rest. Nevertheless, globally, genetic diversity of *D. pulicaria* was low. Environmental variables such as pH and the spatial localization of the lakes seem to have influence in the observed differences. No clear temporal difference in genetic structure was observed, suggesting great plasticity, reduced variation capacity, or a combination of both. This study provides important information for the understanding of distribution patterns of this species complex.

Azorean cyanobacteria checklist: biodiversity and distribution

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The study of cyanobacteria from the Azores islands started in the late XIX and early XX centuries, when the islands were visited by several naturalists during the scientific expeditions crossing the Atlantic Ocean. However, at that time only a few sites were sampled and very few species were found. More recently, due to anthropogenic impacts, lake eutrophication has become a major environmental concern in the Azores islands, with increase cyanobacteria abundance and the occurrence of harmful cyanobacterial blooms. This work presents a checklist of cyanobacteria found in Azores islands since 1874 based on previously cited cyanobacteria species and new samplings and cultivations from 2015 to 2017. Species taxonomy was updated according to the most recent literature. Cyanobacteria diversity and distribution was analysed regarding islands and habitats characteristics. A total of 200 species of cyanobacteria was found in the Azores islands, including 11 new species from recent briopropection work. Six orders (Chroococcales, Nostocales, Oscillatoriales, Pleurocapsales, Spirulinales and Synechococcales), 28 families, and 64 genera of cyanobacteria are represented in the checklist. The most diverse order is Nostocales, which includes 42% of the identified species. Most of the species (177) were identified from freshwater habitats, and only 17 from thermal habitats and 14 from marine waters. Island size and habitat diversity seems to be the most important factors determining species richness in each island. São Miguel, the largest island of the archipelago, has the higher number of cyanobacteria species. On the other hand, the Flores Island, despite its small size, has more species than other larger islands due to its great diversity of freshwater habitats. The species accumulation curve shows that more species of cyanobacteria are still to be discovered in the Azores. Efforts should be directed to less studied environments, such as extreme environments, marine waters, and terrestrial habitats.

Kolkwitzia acuta (Protoberidiniaceae), freshwater member of a mainly marine group of heterotrophic dinoflagellates with an outstanding feeding mode

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Dinoflagellates are a very diverse group of protists that are widespread in freshwater and marine environments. Several nutrition strategies are found in the group, ranging from photosynthesis, sometimes combined with particle ingestion – mixotrophy – and strict heterotrophy. Heterotrophic dinoflagellates are particularly diverse and abundant in the plankton of marine environments. Several feeding mechanisms are used by heterotrophic (and mixotrophic) dinoflagellates, most commonly direct engulfment of food particles and apparent suction of parts of food items through a feeding tube. A somewhat different mechanism is the use of a flexible pseudopod that thinly envelops the prey and digests it *in situ*, leaving no recognizable food particles to be carried into the dinoflagellate cell. This specialized pseudopod has been termed ‘feeding veil’ and is currently known as the ‘pallium’. Feeding with a pallium seems to be restricted to close relatives of *Protoberidinium* and to the diplopsaloids, which group together in phylogenetic reconstructions forming the family Protoberidiniaceae. All of these pallium feeders have fairly robust thecae and most are marine; *Kolkwitzia acuta* (= *Diplopsalis acuta*) is one of the few freshwater representatives of the family. Details of the cell machinery used for pallium feeding are known from only two species of *Protoberidinium*, and have never been described for a diplopsaloid. The pallium in *K. acuta* is supported internally by a row of 60–80 microtubules, accompanied by numerous vesicles, many of which with electron-opaque contents. It emerges from the cell through a wide opening in the sulcal region, located between the emergence points of the transverse and longitudinal flagella. These emergence regions are supported by a complex system of interconnected striated collars. A system of large vesicles inside the cell appears to be related with the pusular system: one of the vesicles is connected with the longitudinal flagellar canal by a long tube reinforced by a fibrous layer. This type of tubular connection between vesicles associated with pusular elements brings to mind a tubular structure found in species of the freshwater genera *Sphaerodinium* and *Naiadinium*; however, the resemblance may be the result of convergence, as the three genera do not appear to be closely related. The detailed, 3D-reconstruction of the whole character-rich ventral area of *K. acuta* will serve as a comparison point with other groups of dinoflagellates.

Organization of fish assemblages in Atlantic Forest blackwater streams (São Paulo, Brazil)

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Understanding and predicting the key factors that organize fluvial ecosystems and the ways that these factors influence the organisms present is essential for the management and use of riverine ecosystems services. Despite the increase in mesohabitat studies in several neotropical streams, blackwater Atlantic Forest streams are poorly studied and the composition and organization of their fish communities little known. The objective of this study was to explore mesohabitat use by fish species in a low-diversity assemblage of typical well-preserved Atlantic Forest blackwater streams. These are typical sluggish, slow flowing and low pH streams which drain the alluvial plains of the “restinga”. Composition, structure, and distribution of fishes were studied in 14 streams located in three sub-basins of the Baixada Santista, and one in the Northern Coast of the State of São Paulo. Mesohabitats were classified according to the substrate (sand, leaf-litter, and trunks), and a physical characterization of the habitats performed. Fish were sampled in 41 mesohabitats with an electrofishing equipment. The Principal Components Analysis (PCA) of the physical and hydrological data indicated similarities between the mesohabitats, although leaf-litter was associated with higher canopy cover and depth. The PCA revealed that leaf-litter and trunks presented higher fish density and biomass, which may relate to its greater structural complexity, food availability and shelter opportunities. Of the fifteen recorded species, *Mimagoniates microlepis* was the most abundant, presenting a wide distribution. According to the cluster analysis, *Astyanax taeniatus*, *Geophagus brasiliensis* and *Cyphocharax santacatarinae* were restricted to the leaf-litter mesohabitat. It is concluded that blackwater river mesohabitats present greater homogeneity than those of clear water Atlantic Forest streams, which reflects in some fish community attributes. However, there are similarities with Amazonian Blackwater Rivers, where leaf-litter sites are considered those of highest fish density and biomass.

Freshwater fungal diversity along an anthropogenic gradient in Hawaiian streams

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Aquatic fungi play a pivotal role in detrital decomposition in freshwaters. The Hawaiian archipelago is the most geographically isolated group of islands on Earth, and knowledge about its aquatic fungal diversity is scarce. We assessed the diversity of fungi colonizing Hau leaves (*Hibiscus tiliaceus*) placed in 11 streams on Oahu, representing a gradient of anthropogenic pollution. Fungal diversity was assessed by high throughput sequencing of the internal transcribed spacer 2 region (ITS2) of rDNA. The majority of operational taxonomic units (OTUs) belonged to Ascomycota, and several species are new records for the Hawaiian archipelago. The number of OTUs varied by an order of magnitude between streams, and the structure of fungal communities also differ significantly between streams. Variables indicative of human influence, namely nutrient concentration in stream water and anthropogenic land cover, were strong correlates in the community ordination. Overall, human disturbance seems to be a driver of structural variability of fungal communities in Hawaiian streams.

Landscape resistance to dispersal and local environment determine metacommunity patterns of neotropical headwater streams

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Understanding how communities are linked by species dispersal (i.e. metacommunities) is crucial for the conservation of regional biodiversity. Stream macroinvertebrate metacommunities are shaped by a combination of local factors (i.e. environmental filters) and landscape features (i.e. dispersal limitation). Land use and cover is one of the most important threats to biodiversity worldwide and it is expected to affect species dispersal. However, despite of the growing number of freshwater metacommunity studies combining dispersal proxies, none have addressed directly the effects of land use and cover so far. Here we considered the effects of land use and cover, in terms of landscape resistance to dispersal (i.e. a cost distance), to explain distance decay relationships (DDRs) in metacommunity patterns of stream macroinvertebrates. We sampled 183 Brazilian neotropical savanna headwater stream sites along gradients of land use and cover and environmental variation (i.e. physical habitat and water quality). We classified taxa according to aerial and aquatic dispersal ability and water pollution tolerance to explore if these groups show contrasting responses. We assessed the importance of environmental, geographic, river network, topographic and land use and cover distances to explain DDR using multiple regression models for distance matrices. Local environmental conditions and land use and cover were the most important factors explaining DDRs, indicating the importance of land use and cover as an overland dispersal barrier. Weak dispersers were mainly affected by environmental and land use and cover distances, irrespective of their pollution tolerance. Moderate dispersers showed different patterns depending on their pollution tolerance. Sensitive taxa were affected by environmental, land use and cover, and network distances, whereas tolerant taxa were only affected by environmental conditions. Strong dispersers were mainly affected by network and land use and cover distances showing dispersal limitation to these distances. Our results show the importance of cost distances to understand the stream metacommunity patterns regardless of organism dispersal ability and pollution tolerance. These results highlight the need to mitigate land use and cover effects by securing hospitable dispersal routes for flying stream macroinvertebrates and for protecting regional biodiversity.

Azorean Bank of Algae and Cyanobacteria: a resource for biodiversity assessment and biotechnological applications

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Microalgae and cyanobacteria represent an enormous reserve of genetic and functional diversity. They are important sources of bioactive molecules with multiple biotechnological applications in pharmacology, food technology, agriculture, among others. Macaronesian islands have a high biodiversity, and endemism is common. This is mainly due to the diversity and special features of oceanic island ecosystems which include coastal, freshwater, terrestrial and thermal environments. In particular, the Azores possesses a great variety of aquatic habitats including lakes, ponds, peat bogs, permanent and intermittent streams, springs and high-temperature systems such as fumarolic fields, which are important habitats for microalgae and cyanobacteria. Studies on the diversity of microalgae in Macaronesia are scarce, although international guidelines indicate the need to conserve natural heritage as a priority strategy. Taking this into account, a culture collection of native cyanobacteria and microalgae of the Azores, the Azorean Bank of Algae and Cyanobacteria (BACA), was created in University of Azores as part of the REBECA project (INTERREG MAC/1.1a/060). BACA already counts with 252 strains, of which 144 cyanobacteria and 108 microalgae. Cyanobacteria collection comprises more than 40 species isolated from different habitats. The majority of cyanobacterial strains come from lakes (100), but the collection includes also cyanobacteria from thermal waters (37), brackish waters (2) and other habitats (5). The microalgae collection includes 104 isolates from lakes and ponds, comprising 54 species from Chlorophyta (39), Ochrophyta (10), Charophyta (3), Euglenozoa (1) and Cryptophyta (1). Twenty nine species of both cyanobacteria and microalgae constitute new records for the Azores. The bank will continue to grow by the incorporation of new strains resulting from bioprospection of cyanobacteria and microalgae in several habitats in all Azorean islands. BACA will serve as a platform for biodiversity and taxonomic research and, through the assessment of valuable compounds of biotechnological interest. BACA aims at being a solid base for the development and implementation of an innovative industry based on the cultivation of microalgae and cyanobacteria.

Ecoregional features explain invertebrate diversity at local and regional scales in rivers from the Colombian Orinoco basin

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Geological and climatic events such as the Andean orogeny and glacier retreat have shaped unique combinations of river forms and riparian ecosystems in Colombia, which are discernible at regional-scale. Amongst the five largest basins of the country there are meandric rivers surrounded by well-developed rainforest in the Amazonian region; rivers with constrained channels surrounded only by shrubs at Páramo regions; rivers with gorge channels, steep slopes, and Andean forest at Piedmont regions. The unique features of each one of these ecoregions could act as large-scale constraints for macroinvertebrate species occurrence. If so, we would expect a higher inter-ecoregion dissimilarity (high gamma diversity) driven by differences in the taxonomic diversity in each river (alpha diversity) and between rivers (beta diversity). We used the three components of diversity (alpha, beta, and gamma) across rivers from the same and distinct ecoregions to understand in which manner the ecoregional-context modifies the assembly process in Neotropical rivers. We therefore characterized the invertebrate communities and environmental characteristics of 29 rivers grouped in six ecoregions, separated by altitude, slope, form, flow history, and the structure of the riparian vegetation. At the regional-scale, we found that the turnover of taxa (beta diversity) was higher across than within ecoregions. This suggests that rivers from the same ecoregion share a similar pool of taxa notwithstanding their spatial proximity. Although each ecoregion had a distinct gamma diversity, we also observed a small overlap between ecoregions in terms of taxa composition; specifically, between assemblages inhabiting woody debris or sand. At the local-scale, ecoregions of Andean origin had a small intra-river variability compared to other ecoregions, probably because steeper slopes and unpredictable spates constrained the local diversity in those rivers. Meanwhile, the greater flow stability in other ecoregions would favor the establishment of a greater number of taxa, including those non-adapted to resist spates. Collectively, these results suggest that ecoregional features of rivers are crucial to understand biodiversity patterns at local and regional scales.

The last shall be first: potential distribution and conservation assessment of the Iberian endemic mayfly *Eurylophella iberica* Keffermüller and Da Terra 1978 (Ephemeroptera, Ephemerellidae) under current and future climate scenarios

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Eurylophella iberica Keffermüller and Da Terra, 1978 is an endemic mayfly of the Iberian Peninsula whose distribution has been poorly studied to date, with rather old and scattered records. Here we compiled existing distribution records and add new records from recent sampling activities (expanding its distributional range to the south). We used this updated distributional information along with environmental data (climate and geology) to estimate both current and future potential distributions in different climate change scenarios. Moreover, we evaluate the vulnerability or extinction risk of this species applying two methods (IUCN criteria and other focused on invertebrates). We found that currently ca. 50% of the total Iberian region could present suitable environmental conditions for *E. iberica* (all the Iberian Peninsula, save the most eastern and some Mediterranean areas). However, the potential distributions estimated when considering future climate change scenarios showed a marked reduction in the areas with suitable environmental conditions for the species, especially the newly discovered populations in the south. Thus, the northwest part of the Iberian Peninsula will be a crucial zone for the future survival of this endemic species. We also detected that most populations occurring in areas with suitable (both current and future) environmental conditions fall outside the Natura 2000 network of protected areas. IUCN assessment indicates that the species seems not particularly at risk. However, following the categorization system, *E. iberica* was identified as being moderately vulnerable. Our results represent the first attempt to estimate the potential distribution and extinction risk of this endemic species providing important insights for its conservation.

Modelos de equações estruturais para comunidades de plantas aquáticas em ecossistemas rasos tropicais

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Ambientes aquáticos rasos apresentam uma baixa complexidade espacial, possibilitando a formação de bancos extensos de macrófitas aquáticas de diferentes formas biológicas. A distribuição e a abundância dessas plantas podem estar relacionadas tanto com as variáveis bióticas como abióticas, que estabelecem relações mútuas e complexas afetando de forma diferente cada tipo biológico. Desta forma o presente estudo propôs verificar a relação das macrófitas submersas e flutuantes, como também a relação dessas plantas com a transparência da água, concentrações de clorofila-a, disponibilidade e balanço de recursos em ambientes aquáticos rasos tropicais por meio de modelos de equações estruturais. O estudo foi conduzido em 28 reservatórios no estado da Paraíba, Nordeste do Brasil, onde foram estabelecidos transectos para avaliação da cobertura vegetal. Dados de secchi, temperatura da água, pH, oxigênio dissolvido e turbidez foram coletados de cada corpo aquático, assim como amostras de água para determinar a concentração dos nutrientes e da clorofila-a para caracterização dos ecossistemas e elaboração dos modelos. As relações bióticas entre as formas biológicas das macrófitas aquáticas, assim como as abióticas como transparência, clorofila-a, disponibilidade e balanço de recursos foram testadas através de modelos de equações estruturais. As plantas submersas apresentaram 31% de explicação, sendo influenciadas pela transparência ($\sigma = -0.34$) e pelo balanço de recursos ($\sigma = -0.38$), enquanto que as flutuantes apresentaram 29% de explicação e estabeleceram relações com disponibilidade e balanço de recurso ($\sigma = -0.35$ e 0.45 , respectivamente). Assim, constatamos que o efeito biótico entre as plantas não foi significativo, contudo as variáveis abióticas são os principais fatores norteadores da estrutura das comunidades de macrófitas aquáticas em ambientes tropicais rasos.

The history of a worldwide invasion: the case of the red swamp crayfish, *Procambarus clarkii*, in Europe

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Biological invasions are one of the most serious threats to global biodiversity. Understanding how introduced species succeed and become widely distributed within non-native areas is critical to reduce the threats posed by them. Propagule pressure (i.e. the size and number of introduction events) is thought to be one of the key elements driving invasion dynamics. Over the last 45 years, Southern European freshwaters have been widely invaded by the North American red swamp crayfish, *Procambarus clarkii*. It is generally reported that European invasion was originated from only two large crayfish batches, legally introduced from Louisiana (US) to Spain in 1973 and 1974. In order to confirm the “official” history of the red swamp crayfish invasion process throughout Europe, we aim to (1) determine whether there had been unrecorded introductions into Europe; (2) establish the genetic structure of European populations; and (3) compare their haplotype diversities in relation to the native area. To do this, 1416 crayfish from 122 sampling sites in the Northern Hemisphere were analysed using mitochondrial gene sequences (COI). A total of 65 haplotypes were found, 16 of which were shared between at least two populations. As expected, our results showed that the native area has the highest haplotype diversity (Hd: 0.90). However, diverse hotspots in some invaded areas, such as United States (Hd: 0.80) or South-western Spain (Hd: 0.66 and 0.72) were lower than native area, indicating bottlenecks due to the propagule pressure. These highly diverse non-native populations could have arisen due to introductions involving a large amount of founding individuals, to several introduction events, to introductions from highly diverse populations (e.g. admixed populations) or to a combination of them. Within Europe, haplotype diversity decreased with geographic distance to Southern Spain. These results suggest a large and/or diverse population for the initial introduction event and a spread involving several subsequent secondary introduction events thereafter with losses of genetic diversity, possibly due to the accumulation of population bottlenecks. However, the finding of one haplotype, which was only present in central Europe, but not in Spain, also suggests that additional translocations of crayfish other than those introduced into Spain in the 1970s may have been introduced. Any such additional introductions have so far not been well documented in the literature.

Microinvertebrados planctônicos de riachos de cabeceiras do Cerrado, Brasil central

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A região nuclear do Cerrado está localizada no Planalto Central do Brasil e abriga nascentes de principais bacias hidrográficas do país. Representa um grande divisor de águas para o país e para a América do Sul. Muitas destas nascentes estão localizadas em áreas de proteção ambiental integral, o que confere uma relevância para a conservação da biodiversidade. O presente estudo foi realizado em riachos de cabeceira de quatro áreas de proteção localizadas no Distrito Federal do Brasil (15°31'16.26" e 15°57'5.63"; 47°34'4.83" e 48° 1'16.67"), em agosto e setembro de 2015. Cladocera obteve a dominância, com 12 dos 18 táxons registrados distribuídos nas famílias Bosminidae, Chydoridae, Daphniidae e Ilyocryptidae; outros três Copepoda (Cyclopoida, Calanoida e Harpacticoida) e três espécies de rotíferos. A densidade numérica das populações permaneceu bem reduzida (<20 ind./L); a maior densidade foi obtida na APA do Gama e Cabeça-de-Veados (123 ind./L) e, em seguida no PNB (85 ind./L). Houve uma tendência de registros de espécies adaptadas a correnteza e hábitos bentônicos e microfiltradores. Mesmo em áreas de estudo bem próximas, diferenças da biota entre estas áreas foram identificadas, como a ausência de rotíferos em alguns pontos e mais abundantes em outros. E a predominância da riqueza de Cladocera, e em especial em uma determinada área. O estudo indica a influência de atividades humanas sobre a diversidade biológica de microcrustáceos em riachos de cabeceira, apesar dos córregos ainda apresentarem boa qualidade ambiental.

Latitudinal variation in species body size: does Bergmann's rule apply to aquatic insects?

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Body size variation has long been, and still remains, of central concern to macroecologists. Since the formulation of Bergmann's rule (BR), the classic ecogeographic principle relating body size of endotherms with environmental temperature (or latitude), intra and interspecific latitudinal clines in size have been reported for many taxa, including ectotherms. However, the generality and direction of the pattern (i.e. increase or decrease of body size with latitude, BR or converse BR, respectively) are far from being consistent across taxa, and the underlying mechanisms remain unclear. Among the numerous studies of Bergmann's cline in insects, few have focused on aquatic groups, and these are mostly intraspecific. We tested Bergmann's rule using body size (length), distribution and phylogenetic data compiled from previous studies for 93 species of four different genera of water beetles (*Ilybius*, *Deronectes*, *Graptodytes* and *Hydroporus*, fam. Dytiscidae). The relationship between body size and latitude was explored using simple regression and phylogenetic generalized least squares (pgls) in order to control for phylogenetic relatedness. We did not find a relationship between size and latitude after phylogenetic correction in three of the four genera studied. However, for *Hydroporus* species, this relationship was significantly negative (i.e. converse BR). When all studied species were pooled together, a BR cline (i.e. a positive relationship of body size with latitude) was detected. Thus, our results show that the taxonomic level and phylogenetic effects need to be considered when exploring latitudinal clines in body size. We discuss possible mechanisms behind the observed patterns (other than climatic factors), such as differential species dispersal abilities mediated by freshwater habitat stability.

Recent advances to our knowledge of dinoflagellate diversity in fresh waters of continental Portugal

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A recently published checklist recorded nearly 50 species of dinoflagellates found in Portuguese continental waterbodies. The list included records from previously published work, as well as additional species observed during our own investigations in central Portugal. The generic-level classification adopted in that list differs extensively from the one used in recent freshwater dinoflagellate floras and includes 15 taxa assigned to 11 genera established during the last 25 years. These pronounced taxonomic changes are the result of progressing from a classification based almost exclusively on superficial morphological features, such as the presence of plates forming an armour on the cell surface or the position and orientation of the cingulum, to one derived from phylogenetic relationships inferred from molecular sequences, combined here and there with fine-structural features obtained from scanning and transmission electron microscopical observations. A novel higher-than-genus level classification of species reported for Portugal is presented here. Latest additions to our knowledge of dinoflagellate biodiversity in Portuguese fresh waters include the transfer of species to the recently defined genera *Nusuttodinium* (species with kleptochloroplasts derived from cryptomonads), *Naiadinium* and *Apocalathium*; reassignment of the species previously reported as *Borghiella dodgei* to *Borghiella andersenii*, newly described from strains found near Aveiro, Portugal, and near Oban, Scotland; two new species of *Tovellia* described from places around Aveiro (and a third one to be described soon); and a new peridinioid genus and species, notable for producing resting cysts enveloped in a layer of calcified crystals, a feature not previously found in any freshwater dinoflagellate. The present note highlights the remarkably fast pace at which taxonomic changes currently accumulate and will hopefully serve as an appropriate background for further developments, notably the extension to the whole Iberian Peninsula of detailed knowledge on freshwater dinoflagellate distribution.

Diversidade de fungos (*sensu lato*) zoospóricos de corpos d' água do Mosaico de Unidades de Conservação Juréia-Itatins, São Paulo, Brasil

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De agosto/2016 a outubro/2017 foram amostrados diferentes locais do Mosaico de Unidades de Conservação Juréia-Itatins, importante fragmento preservado de Mata Atlântica do estado de São Paulo, Brasil, a fim de se estudar a diversidade de oomicetos, aqui denominados de fungos *sensu lato*. Estes organismos heterotróficos, possuidores de esporos flagelados, estão hoje inseridos dentro do Reino Straminipila por apresentarem características bioquímicas, genéticas e morfológicas que os distinguem dos fungos verdadeiros. Nos ecossistemas de água doce são frequentemente encontrados como sapróbios e/ou parasitas de algas, peixes, invertebrados e de outros oomicetos, assumindo assim um importante papel na reciclagem de nutrientes e na dinâmica da cadeia alimentar. Para o estudo da diversidade destes organismos foram coletadas, em cada local escolhido, quantidades padronizadas de água (aprox. 200 mL), folhas submersas (aprox. 100g) e sedimento de fundo (aprox. 100 g) de rios, riachos e cachoeiras, as quais foram submetidas à técnica de iscagem múltipla com diferentes tipos de substratos. Além disto, foi utilizada a técnica de iscagem em campo, onde frutos de *Malus* sp. ficaram submersos por 30 dias dentro de recipientes de plástico perfurados para permitir a entrada de água e a iscagem dos oomicetos. De cada local também foram coletados, quando possível, gravetos e frutos em decomposição. De 145 amostras analisadas (45 de água, 45 de folhas, 45 de sedimento e 10 de frutos submersos) foram obtidos 268 espécimes. Vinte espécies foram identificadas, até o presente momento, com base na caracterização morfológica e molecular (regiões ITS e 28S do rDNA), sendo uma representante de Leptomitales, seis de Peronosporales *sensu lato*, duas de Rhipidiales e 11 de Saprolegniales, com duas novas citações para o Brasil e uma nova espécie para a ciência. Nossos resultados demonstram a importância dos estudos de diversidade de fungos brasileira e a disponibilização de sequências gênicas, especialmente de representantes da América do Sul, onde o conhecimento deste grupo de organismos ainda é pequeno, tendo em vista o número de espécies conhecidas mundialmente. Auxílio financeiro: FAPESP.

Leaf litter decomposition and fungal biodiversity assessed by high-throughput sequencing across Mediterranean streams

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We assessed leaf litter decomposition and fungal biodiversity by high-throughput sequencing in streams from four Mediterranean regions in the Iberian Peninsula, namely Sierra Nevada (SN), Alcornocales (AL), Cazorla (CA) and Semiarid Lowland (SL). At each region, a set of four streams were selected, in which we immersed a set of four leaf species for 40 days during winter to allow fungal colonization. DNA was extracted from colonized leaves and hypervariable ITS2 region of fungi was amplified, purified, pooled and pair-end sequenced in Illumina MiSeq® sequencer followed by analyses with bioinformatics pipeline (PRINSEQ version 0.20.4, AdapterRemoval version 2.1.5). Operational Taxonomic Unit (OUT; 97% similarity threshold) generation and taxonomic identification were performed using QIIME package version 1.8.0. Among the four regions, maximum similarity in stream fungal communities was observed between SN and AL (about 35%), followed by CA (~30%). Fungal communities in the streams within each region showed high similarity (SN >60%; AL and CA ~40%; SL <40%). Principal component analysis confirmed that environmental variables (altitude, temperature, thermal amplitude, conductivity, oxygen, pH, alkalinity and nutrients) varied strongly among the regions, but varied less among streams within each region (except for SL). Canonical correspondence analysis showed that the structure of fungal species in streams of SL region were mainly influenced by N-NO₃⁻, total N, conductivity and temperature; whereas fungal communities in SN were mainly associated with P-PO₄⁻ and thermal amplitude. Fungal diversity and leaf mass loss were negatively correlated with altitude, oxygen and thermal amplitude, and positively correlated with temperature, conductivity, alkalinity and total nitrogen. Leaf mass loss correlated significantly with fungal diversity and evenness. Multiple regression models further validated the influence of topological and environmental factors to the fungal community structure and functions.

Assessing cross-taxon congruence in chorotypes of European freshwater fauna

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Chorotypes can be defined as statistically significant groups of organisms with coincident areas of distribution. They may represent consistent biogeographical responses among subsets of species, and may thus be useful for deconstructing patterns of biodiversity and biogeographical processes underlying these patterns. Our aim was to investigate mechanisms shaping the current distribution of European freshwater biodiversity by exploring the congruence among different sets of chorotypes independently identified for several groups of freshwater fauna. We hypothesized that congruence of chorotypes should be high across different taxa when they have experienced similar responses to effective past and contemporary environmental conditions, otherwise, taxon-specific chorotypes would occur. To test our hypothesis, we used distributional data for more than 1200 European native species from five taxonomic groups: freshwater fishes (488), Odonata (114), molluscs (636), shrimps (18) and crayfish (5). Species distributions were sourced from the International Union for Conservation of Nature (IUCN) and were categorised as presences/absences across 1228 pre-defined river/lake catchment units in Europe (HydroBASINS level 6). These spatial units are the most appropriate for inland waters as they best reflect biogeographical boundaries. Fuzzy logic tools were used to identify chorotypes of each taxonomic group using the software RMacoqui 1.0 software (<http://rmacoqui.r-forge.r-project.org/>). The number of resulting chorotypes was not predefined (i.e., all groups of distributions that were significantly clustered were considered chorotypes), ranging from 5 in the case of crayfish to 57 for molluscs. Once the congruence of chorotypes was checked, current and historical environmental variables were analysed to disentangle their effect on the resulting chorotypes. Overall, our findings provide new insights for understanding the role of history and the geographical context in the definition of the current distributional pattern of European freshwater fauna.

Ceratium furcoides (Levander) Langhans en embalses de la cuenca del Ebro en España y embalses del estado de Sao Paulo en Brasil

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El presente estudio compara las características morfológicas del dinoflagelado *Ceratium furcoides* procedente de embalses de la cuenca del río Ebro y del estado de Sao Paulo. Se estudiaron las características físico-químicas para determinar el estado trófico de cada embalse y establecer así sus tipologías. Contrariamente a *Ceratium hirundinella*, *Ceratium furcoides* es una especie poco común en la comunidad fitoplanctónica de los embalses de la cuenca del río Ebro, si bien en fechas recientes ha sido el responsable de un bloom mono-específico en el embalse de El Val. Sin embargo, consideradas estas dos especies invasoras en América del Sur, *Ceratium furcoides* ha desplazado a *Ceratium hirundinella* en los embalses del estado de Sao Paulo, alcanzando grandes densidades, llegando a formar en algunos casos blooms mono-específicos. El análisis morfométrico, realizado en microscopía óptica y electrónica (NIC y SEM, respectivamente), muestra diferencias significativas en: i) la longitud total de la célula, ii) la longitud de los cuernos y, iii) la presencia o no de un cuarto cuerno. Si bien el estudio microscópico permitió determinar diferentes morfotipos en función de la tipología de los embalses, un estudio utilizando técnicas de genética molecular en las diferentes poblaciones de *C. furcoides* permitiría una mejor comprensión de su dinámica en relación al estado trófico del embalse.

Diferencias morfológicas de Ceratium hirundinella (O. F. Müller) Dujardin en los embalses de la cuenca del Ebro en relación con sus distintas características

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El presente estudio se basa en la observación de las distintas características morfológicas que presenta el dinoflagelado *Ceratium hirundinella* a lo largo de los embalses de la cuenca del río Ebro. El grupo de las dinofitas no es de los grupos dominantes en estos embalses y son de poca abundancia en dichas masas de agua, pero, por su gran tamaño en comparación al resto de algas de los grupos dominantes, aportan mucho biovolumen para la densidad que presentan. *Ceratium hirundinella* es una especie común en la comunidad fitoplanctónica y una de las pocas especies que presenta gran variación en su morfología. El análisis de las características morfométricas y biométricas de los individuos observados en los distintos embalses tanto mediante técnicas de microscopía óptica (NIC) como microscopía electrónica (scanning), pone de manifiesto diferencias significativas referidas tanto a la longitud total de la célula como a la longitud de sus cuernos, la presencia o no de un cuarto cuerno y el ángulo que forman entre ellos. De ese modo, se observan desde las células de menor tamaño y con el cuarto cuerno muy poco desarrollado (embalse de Grado) a células más grandes con el cuarto prácticamente inexistente (Rialb) o muy bien desarrollado (Ortigosa) hasta embalses con las células de mayor tamaño, cuernos muy bien desarrollados y grandes ángulos entre ellos, divergentes (embalse de Pajares). Todas estas diferencias se observan en embalses con distintas características físico-químicas, biológicas y diferente estado trófico.

Ecological profile of the Pyrenean Desman (*Galemys pyrenaicus*) in the Sistema Central (Spain)

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The Pyrenean desman (*Galemys pyrenaicus*), one of our most emblematic aquatic species in the Iberian Peninsula, it is mainly located in the upper reaches of mountainous rivers in the Pyrenees, the Cantabrian Mountains, the Iberian System, and the Sistema Central. The populations of the Sistema Central are classified as endangered (EN) by national environmental authorities. When trying to develop plans for conservation of species, it is fundamental to have a strength previous knowledge about several fundamental issues, like ecological needs and limitations. The objective of this study was: 1) To describe the ecological profile of the Pyrenean desman, and 2) To evaluate the most suitable reintroduction locations. Fieldwork was carried out during the summer of 2017. Sixty two watercourse sites were sampled along the Sistema Central Mountains (Tagus and Duero basins). A 200-300 m section of the stream was sampled in each site. Desman habitat suitability was determined by benthic macroinvertebrates biomass measurements Trophic indices: (EPT Biomass>10 mm, EPT Biomass and Total Macroinvertebrate Biomass>10 mm) and Biotic indices: (IMMI-T and IBMWP). Physico-chemical water parameters (T, pH, CE and DO) and a hidromorphological assessment indices (QBR and IHF) were considered too. A data logger was deployed in each site for continuous temperature measurement (15 minutes interval) and water speed and flow were also recorded. Desman and its predators feces prospection was carried out for a presence/absence determination (after genetic confirmation in lab). At the same time, river bank suitability for potential burrows presence was tested. Compiled information was analyzed applying Generalized Linear Models, selecting variables which better fit the presence of *G. pyrenaicus* in the studied area. The ecological profile of the Pyrenean desman according to the selected variables is presented. Finally, data collected about distribution together with climatic variables and several global climate change scenarios, was used to apply a species distribution model under future climate change scenarios. The information obtained can serve as a base to identify most suitable sites for future reintroductions or translocations of the species.

SR7.

Aquatic Invertebrates

Characterization of freshwater mussel communities in the Sado basin (Portugal)

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Freshwater mussels are a key component in aquatic ecosystems. Due to increasing pressures to these systems, this group is declining globally. In Portugal, the conservation status of the species remains to be evaluated, and the absence of long term systematic studies prevents an accurate trend assessment either generally or at the basin level. The present work presents the results of a snapshot study of the freshwater mussels' assemblages in the Sado basin; the most exhaustive undertaken so far and was promoted by EDIA, as a Follow-up process under the frame of an Environmental Impact Assessment procedure. The communities were sampled during the spring of 2015 in 31 locations distributed along the main river (18), as well as in the tributary streams Marateca (8), Roxo (2) and Xarrama (3). The data collected was used to analyse the spatial variation of the community structure and population dimensional structure. Sampling allowed the identification of 4 species, *Anodonta anatina*, *Potomida littoralis*, *Unio delphinus* and *Unio tumidiformis*, corresponding to the maximum diversity found in the southwest of the Iberian Peninsula. The four species were identified in the main course of the river Sado, two (*A. anatina* and *U. tumidiformis*) in the Marateca stream, and none in the Roxo and Xarrama tributaries. The species *U. delphinus* had the widest distribution in the Sado River, although mussel beds were more regular and presented more complex structures in the downstream sector. *P. littoralis* showed the most restricted distribution, being present only at two locations. However, the study allowed to increase the known area of occupancy in the basin for the species, and to detect recent recruitment. Results for *A. anatina* and *U. tumidiformis* in the Marateca stream also showed existence of recruitment unlike the Sado river populations, where captures of *U. tumidiformis* were scarce. The results point to an extremely fragmented distribution of all species, and the regression of populations, that is more or less pronounced according to the species. This is likely to be linked with the generalized habitat degradation observed in the Sado basin. These results raise the relevance of implementing conservation actions for safeguarding the Sado freshwater mussel community, which are more imperative after the particularly severe drought that affected the basin in 2017.

Compilation of historical analysis using macroinvertebrates communities for water quality assessment in regulated rivers in Galicia (NW, Spain)

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Freshwater biodiversity is globally threatened by a multitude of factors, pollution, agriculture or the flow regulation are the most common threats for rivers. The Orographic characteristics of Galician rivers allowed the installation during the last 30 years of hydroelectric power stations (Sarasúa, 2009) of different characteristics in most of them, that have been causing an important socioeconomic impact for the community but also represents a threat for freshwater biodiversity (Naura et al., 2011). Thus, the objective of this study is to evaluate the impact of these constructions and their functioning over the freshwater ecosystems and its macroinvertebrates biodiversity by using historical data of benthic macroinvertebrates communities (Tavzes et al., 2006) from different Galician rivers from the last 15 years: Tambre, Deva (Ourense), Tuño, Tea, Deva (Pontevedra), Limia and Fragoso rivers. To carry out the monitoring work, three different sampling points were selected for each river: one site considered and used as control located upstream the dam, in the source of the river, the second was situated immediately after the dam and the third point was at least 1 Km downstream of the hydroelectric power station. In addition, additional data from the physic-chemical parameters measurements were used as well as data from the different seasons of the year. The evaluation of results and the main conclusions will be shared in the communication of this work.

Changes in aquatic macroinvertebrates community after the restoration of riparian vegetation in the Brazilian Atlantic Forest

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The contribution of material from the riparian zone is important in the provision of energy and nutrients to the small forested streams. Changes in land use may result in direct light reaching stream beds, modified energy resources and nutrient flows between aquatic and terrestrial environments. Restoration of riparian forests is a 1st step for reestablishing the structure and function of the ecosystem. Aquatic macroinvertebrates are widely used in monitoring water quality, due to their sensitivity to environmental conditions. They can therefore be used to measure recovery. The objective of the study was to evaluate changes in the community of aquatic macroinvertebrates in streams located in different microbasins in the Semideciduous Seasonal Forest in the State of São Paulo, Brazil. Two microbasins were selected: one with pasture and another one in a 8 years old restored area, with native plant species. Benthic macroinvertebrates were collected with the surber sampler and the physical-chemical water parameters were measured. The collection was performed in August 2017. Macroinvertebrates were identified and classified into functional feeding groups (FFG). Greater abundance and richness were found in the restored area, but the diversity was not different between areas. In the restored area were found 1222 individuals from 44 taxa, while in the pasture, were found 988 individuals from 28 taxa. In both streams, the most abundant group was Chironomidae (70% of organisms) while other groups were not higher than 10%. There were differences between streams in terms of function feeding groups. More shredders and predators were found in the restored area (27% and 42%, respectively) than in the pasture (22% and 38%, respectively) and more collectors and scrapers were found in the pasture (33% and 7%, respectively) than restored area (28% and 3%, respectively). In summary, after just 8 years of recovery forest streams differed in terms of macroinvertebrates functional structure. Thus, the recovery of riparian forests is important for the rehabilitation of streams and the monitoring and study of these areas are important for a better understanding the restoration process and its influence on aquatic environments.

Spatial position and riparian vegetation affect the functional feeding groups of stream Trichoptera in Southern Brazil

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Streams are naturally hierarchical and heterogeneous ecosystems with multiple habitats, as well as diverse environmental and spatial variations. Variations in the geology of the drainage basin, climate, current velocity, water physical and chemical conditions, light availability, among others, may affect the dissimilarity of aquatic communities. These variations regulate the taxonomic or functional composition of aquatic communities. The availability of food resources (e.g. allochthonous and/or autochthonous) is one of the main factors that determine functional feeding groups (FFG) abundance of aquatic organisms. In addition, aquatic communities become less similar with increasing geographic distance between the occurrence environments. Caddisflies are highly sensitive to aquatic ecosystem changes and have relatively low dispersal capacity, as well as a wide variety of FFG. Our objective was evaluating the composition and distribution of Trichoptera FFG assemblages in small-order streams in altitude fields (> 1200 m a.s.l.) located in southern Brazil (28°36'S, 49°56'W). Larvae were collected in 41 streams, 22 with arboreal riparian vegetation and 19 streams without arboreal riparian vegetation. We collected a total of 2407 Trichoptera larvae distributed in 22 genera. The genera *Smicridea*, *Oxyethira* and *Protophila* comprised 53% of the total abundance. On the other hand, 14% of the genera presented abundances lower 5 individuals. The organisms were classified into five FFG: collectors-filterers (37% of the total abundance), scrapers (29%), collectors-gatherers (18%), shredders (11%), and predators (5%). With a classification analysis, we observed a tendency of groups to occur according to the presence of riparian vegetation. The spatial variability affected positively the composition of caddisfly FFG. Spatial variation can be caused by limitation in organism dispersion capacity, which are normally correlated with space. In addition, among the environmental variables, only dissolved oxygen, and the presence of riparian vegetation along of streams buffer zones were the environmental factors that influenced Trichoptera FFG, except the collectors. We conclude that in environmentally similar landscapes (e.g. altitude fields), the presence of forest vegetation and streams spatial position in drainage basin are important structuring factors of caddisfly assemblages.

Macroinvertebrate functional responses to multiple stressor gradients of water scarcity and oxygen depletion: a trait-based approach in mesocosm

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River ecosystems are most often subject to multiple co-occurring anthropogenic disturbances. Mediterranean streams are particularly affected by water scarcity and organic loads that commonly lead to slow flowing waters and high oxygen deficits in the water column. In the present study, alterations in trait proportions of drifting macroinvertebrate communities were used to evaluate the effects of these common stressors interacting in regions affected by water scarcity. A mesocosm system was used to test flow velocity decrease and oxygen depletion increase in a full factorial design. Our main findings confirmed that the impact of the two combined stressors are beyond community level and can be implicated in alterations of ecosystem functions as result of the changes obtained in specific biological traits categories. Overall, our results showed that the single effect of flow velocity reduction and a higher oxygen depletion promoted a shift in the set of selected traits. In more detail, biological traits describing organism's dispersal and respiration showed an overall stronger response, in which respiration mode discriminated between stressors showing effects mainly to low flow, whereas dispersal was clearly affected by the stressors combination. Also, resistance through egg forms revealed a response to the single effect of flow decreasing, while swimmers relative abundance increased in individuals that drift after exposure to stressors combination. Thus, while flow reduction alone is expected to specifically filter out the gill breathers and the egg producers' as resistance form, the combination of stressors will impact more drastically organism's dispersal and swimmers. Such changes in biological traits can result in variations in ecosystem functioning through, for example, local changes in biomass, secondary production, stream metabolism as well as resulting in biodiversity losses or alterations of its distribution patterns.

Invertebrates conservation in headwater streams along an altitudinal gradient in a snow-free tropical mountain

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Benthic macroinvertebrates in tropical headwater streams act in crucial ecological processes as component of ecosystem functioning, including leaf breakdown and aquatic food webs linking energy flow from riparian vegetation to freshwater biodiversity conservation and ecosystem services. We assessed the patterns and drivers of beta diversity in headwater streams along an altitudinal gradient in the second oldest South American mountain cordillera, comprising a mosaic of savannas, dry woodlands, mountane vegetation and moist forests. The Serra do Cipó offers nearly pristine streams as natural laboratories for ecological studies including climate changes by human changes on freshwater biodiversity. The altitudinal gradient influences species richness, spatial and temporal beta diversity of aquatic invertebrates. This study aimed to assess the beta diversity of aquatic benthic macroinvertebrates along an altitudinal gradient focusing on the main drivers in different spatial scales including land use, riparian vegetation integrity, in-stream physical habitat and ecological water quality. The Espinhaço Cordillera freshwater biodiversity includes 27 endemic fish species, 162 fish species that inhabit small creeks, 12 fish species threated of extinction, 105 anuran species, living in acid (pH 4.5-6.0) and nutrient poor (< 30 uS/cm conductivity) waters. In-stream physical habitat metrics influence composition and abundance of aquatic insects as much as human pressure thresholds in cobble, gravel and leaf litter deposits. The altitudinal gradient is direct related with the alfa and beta diversities of sensitive, tolerant and resistant indicators of water quality. The obtained results evidenced that in neotropical savanna headwater streams bottom leaf deposits are hotspots of benthic invertebrates diversity offering refuge and food for their maintenance. These results are part of the Brazilian Long Term Ecological Research Program and contributes with ecological conceptual framework and future perspectives for decision makers.

Grazer introduction to restore and preserve the hydraulic performance of infiltration basins clogged by benthic biofilms

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In large regions of Europe, human populations rely on groundwater as drinking water source. Managed aquifer recharge based on infiltration practices is widely used to increase groundwater resources. However, the hydraulic performance of infiltration systems can decrease by physical and biological clogging. The present study aims at testing an ecological engineering approach based on grazer introduction to limit clogging of infiltration basins by biofilms. We experimentally quantified the influence of the gastropod *Viviparus viviparus* on hydraulic conductivity of three basins characterized by contrasted benthic biofilms. We measured biological (algal biomass, bacteria abundance, total organic carbon, gross photosynthetic and hydrolytic activities) and physical characteristics (proportion of silt and clay particles) of the top layer of the infiltration media in enclosures with and without introduced gastropods. Results showed that: (i) grazers increased hydraulic conductivity in the three basins; (ii) the initial biofilm biomass did not significantly influence the effect of the grazer; and (iii) grazer effects could be caused by physical activities like bioturbation (pelletization and sediment reworking). This study highlights the importance of considering ecological solutions to improve hydraulic performance of infiltration basins using the trophic and/or the bioturbation activities of animals.

Could eDNA really help in changing current assessment of freshwater quality bioindicators?

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Rivers are an essential resource for human wellbeing. To reduce the human impacts on water bodies, the European Union has established an essential regulatory framework for protection and sustainable management (WFD; 2000/60/EC). In this strategy, reliable and economic bioindicators are a fundamental component. Characterization of benthic macroinvertebrates communities in rivers are the most widely used bioindicators through all the European countries. However, their conventional assessment currently entails serious cost-efficiency limitations. The use of genetic tools in environmental samples offers an alternative way to evaluate rivers status. Uses of eDNA (environmental DNA) metabarcoding have increased in the last years for different purposes, showing also its effectiveness for macroinvertebrates monitoring. In the current study, genetic based assessment of benthic macroinvertebrates was validated through the Nalón River case study, Asturias (Northern Spain). The results obtained suggested that the eDNA-based methodology using a metabarcoding approach would improve rivers assessment, showing the usefulness of genetic tools as the alternative way to monitor river ecosystems, a beginning in rivers monitoring transformation.

Estudio de la variación de la calidad del agua del río Furnia (2008-2017) mediante el uso de macroinvertebrados bentónicos como bioindicadores

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Los ecosistemas acuáticos y la biodiversidad que albergan están amenazados a nivel global, esto hace que sea necesario establecer una red de vigilancia ambiental y que se realicen estudios de forma periódica para evaluar el estado de conservación de estos ecosistemas a lo largo de los años. El objeto de estudio en este trabajo es el río Furnia, localizado íntegramente en el municipio de Tui (Pontevedra), Sur de Galicia. El río tiene una longitud de 9 km, desde el punto en el que nace hasta que desemboca en el río Miño, del que es afluente. Históricamente este río ha sido considerado como uno de los mejor conservados de la comunidad Gallega, por ello el objetivo de este trabajo es evaluar el estado actual de conservación del río y comprobar cómo ha variado la estructura de la comunidad de macroinvertebrados bentónicos que sustenta. Para la toma de muestras, se seleccionaron 3 estaciones de muestreo (Ponte Liñares, Sobrada y Amorín) y en cada una de ellas se ha llevado a cabo un muestreo cualitativo, de forma que para cada uno de los diferentes hábitats (cantos, musgo, arena etc.) se desarrolló un esfuerzo de muestreo de un minuto. Para la captura de los macroinvertebrados se utilizó una manga entomológica de 500µm de luz de malla, 30 cm de diámetro y 60 cm de fondo. Los macroinvertebrados fueron conservados en alcohol 70° para su traslado al laboratorio, donde fueron identificados a nivel de familia mediante las claves de Tachet et al. (2003) para poder calcular el IBMWP. Además se tomaron medidas de la velocidad de la corriente, pH, temperatura y conductividad. Para este estudio se han comparado los resultados obtenidos en primavera del 2008 con los de primavera del 2017. En el caso del 2008, el grupo de organismos más abundante resultó ser el de los insectos (89%) seguido por los crustáceos (8.9%), además de obtener un valor del IBMWP superior a 150 para cada una de las estaciones, lo que es indicativo de un buen estado de conservación del río. Los resultados obtenidos para el 2017, así como las conclusiones extraídas tras la comparación de ambos años serán expuestos en la comunicación del congreso.

Transgenerational effects of salinity stress in *Daphnia magna*: the role of epigenetic mechanisms

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The salinization of freshwaters is a serious ecological issue that has been receiving increased attention by the scientific community. Salinity is a serious threat to freshwater ecosystems and a relevant form of environmental perturbation affecting freshwater biodiversity through the impairment of their development and fecundity. Environmental change can lead to epigenetic marks in organisms, which in turn influence their responses. Although the transgenerational inheritance of epigenetic marks has been experimentally shown or theoretically postulated, this phenomenon remains barely explored in several keystone aquatic species. An example of this knowledge scarcity are the epigenetic responses in *Daphnia*, which is a key organism in studies addressing the ecology of freshwater lentic ecosystems, as well as in aquatic toxicology, including within regulatory frameworks. In the present study, we exposed one generation of *Daphnia magna* to high levels of salinity and found that the exposure provoked specific methylation patterns that were transferred to three subsequent non-exposed generations. These transgenerational effects occurred in four genes that encode for proteins PAXIP1-associated glutamate-rich protein; DET1- and DDB1-associated protein; Prefoldin subunit 3; 60S ribosomal protein L36) that have important roles in the organisms' response to environmental change: DNA damage repair, cytoskeleton organization and protein synthesis. Our results highlight the relevance of epigenetics in environmental sciences and the potential role of epigenetic transgenerational inheritance in the gene × environment interactions of *Daphnia*.

Do seasonal changes in leaf vertical inputs influence the composition of leaf patches and invertebrate assemblages in Atlantic Forest streams?

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Seasonal variation in litterfall may influence the composition and availability of allochthonous organic matter in streams and, consequently, the structure of invertebrate assemblages. The objective of this study was to determine the effects of seasonality on leaf litter inputs, and composition of leaf patches and associated invertebrates in Atlantic Forest streams. We measured leaf vertical inputs over 2 years and sampled leaf patches in pools reaches of three streams of the same catchment to determine the biomass and taxonomic composition of leaves and associated invertebrates. We hypothesized that (i) leaf vertical inputs would be positively correlated with rainfall and (ii) the biomass and composition of leaf patches would influence the structure of invertebrate assemblages, as well as the abundance of shredders. In total 58 leaf taxa (25 families) were found and the taxonomic composition did not differ throughout the year in the vertical inputs. Values of leaf biomass and richness differed across sampling periods and higher values were found during the rainy season (November and February). The biomass of leaf patches was also higher on the rainy season but values of invertebrate density, biomass and abundance of shredders were higher on the dry season (May and August). The taxonomic richness of leaves and invertebrates in leaf patches did not differ across sampling periods. The composition of invertebrate assemblages followed the same pattern. *Chironominae*, *Triplectides*, *Phylloicus*, *Tanypodinae* and *Elmidae* were abundant in leaf patches and were the taxa responsible for the high similarity observed in the assemblages sampled during the study period. The obtained results suggest leaf vertical inputs are high throughout the year in the studied streams and are positively influenced by rainfall. In addition, because the composition of leaf patches did not differ across seasons, the structure of invertebrate assemblages seems to be more influenced by seasonal differences in the retention sites than leaf availability on the streambed.

Contribuição ao conhecimento dos gêneros de larvas de Odonata em cinco municípios do estado de Roraima, Brasil

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Larvas de Odonata podem ser encontradas em ambientes lênticos e lóticos em diferentes tipos de substrato (areia, cascalho, folhas, macrófitas, etc.). Embora o estado de Roraima possua uma variedade de paisagens e potencialmente uma biodiversidade importante, os Odonata desta região até agora são pouco conhecidos, apresentando 85 espécies e 64 gêneros, o que é pouco se comparado com Amazonas e Venezuela, regiões vizinhas com 164 e 527 espécies, respectivamente. O objetivo deste trabalho foi contribuir com o conhecimento dos gêneros das larvas de Odonata que ocorrem em diferentes ambientes do Estado de Roraima e também aumentar o conhecimento sobre o micro-habitat das larvas desta ordem. As coletas foram realizadas em igarapés, rios e lagos nos municípios de Amajari (3°46'51.37"N; 61°43'19.28" O), Boa Vista (2°52'39.22" N; 60°43'14.43" O; (2°39'39.15"N, 60°50'00.00"O; 3°01'13.94"N; 60°46'31.26"O), Cantá (02° 22' 133" N; 60° 33' 171"O; 2°34'4.49" N; 60°38'6.63"O), Rorainópolis (0°51'27.71"N 60°21'47.22"O) e Mucajá (2°12'13.7"N 60°58'09.4"O). As amostragens foram realizadas utilizando uma rede entomológica tipo D, passada de maneira aleatória nos substratos disponíveis em vários cursos d'água. Após a coleta, as larvas foram identificadas no Laboratório de Invertebrados Aquáticos (LIA) e relacionadas com o substrato onde foram encontradas. Foram coletadas 289 larvas de Odonata distribuídas em 11 famílias e 39 gêneros. Destes 39 gêneros, sete são novas ocorrências para Roraima, sendo eles: *Cyanallagma Kennedy*, 1920, *Oxyagrion Selys*, 1876, *Psaironeura Williamson*, 1915 *Aphylla Selys*, 1854, *Cacoides Cowley*, 1934, *Epigomphus Hagen in Selys*, 1854 e *Neocordulia Selys*, 1882. As famílias mais representativas foram *Libellulidae* com 12 gêneros e *Coenagrionidae* com seis gêneros. As larvas encontradas foram registradas nos seguintes micro-habitats: folhiço submerso, folhiço submerso de correnteza, macrófitas aquáticas, raízes submersas, pedras de correnteza, sedimento arenoso e argiloso. Os resultados de micro-habitat corroboram a bibliografia, exceto *Heteragrion Selys*, 1862, que foi encontrado em área com correnteza, *Castoraeschna Calvert*, 1952, encontrada em raízes submersas e área em correnteza e *Perithemis Hagen*, 1861, encontrada em macrófitas e folhiço submerso. Esses dados mostram que Roraima possui um grande potencial para ampliar o conhecimento sobre a diversidade, bem como os micro-habitats das larvas de insetos da ordem Odonata.

Analysis of the spatial and temporal variation (2001-2016) of the macroinvertebrate communities in Fragoso River (NW Spain) associated with the activity of the small hydropower plants

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Fragoso River, located in Ourense (NW of Spain), runs from A Franqueira at 942 m high to the Limia River. Since 2002 its channel is regulated by a small hydroelectric power plant built by the company Grupo Adelanta, reason why it is now under study. Thus, the main objective of this work is to analyze the spatial and temporal variation of macroinvertebrate communities in the river, as well as the possible impact caused on their abundance and composition associated with the activity of the small hydropower plant. Samples have been collected at different sites of the river (head, mid and lower river sections), in spring and autumn, at two crucial moments in relation to the operation of the power plant: before its start-up (2001-2002) and after several years operating (2015-2016). In addition physical and chemical have also been included; which with the resolution of the IBMWP index, reveal the ecological status and water quality of Fragoso River over the studied years. The results show, in general, a decrease in the ecological status of the river in the areas closest to the regulated sections.

Respuesta de las comunidades macrobentónicas al cambio de temperatura del agua en el alto Manzanares y su posible relación con el cambio climático

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El tramo alto del río Manzanares, ubicado en la Sierra de la Pedriza al norte de la Comunidad de Madrid, es una zona que alberga grandes densidades de invertebrados bentónicos, siendo además un área especialmente sensible a los efectos del cambio climático. Los objetivos se centraron en el análisis de la variación de la diversidad taxonómica y funcional de macroinvertebrados en el alto Manzanares, así como su respuesta a la evolución del hábitat térmico fluvial en la Sierra de la Pedriza. Durante el periodo comprendido entre noviembre de 2016 y noviembre de 2017, se realizó un registro continuo de la temperatura del agua y se llevó a cabo un muestreo de macrobentos en tres tramos del río Manzanares situados entre 900 y 1700 metros de altitud. En este trabajo se cuantificaron las variaciones de la temperatura del agua en gradiente altitudinal, así como los cambios registrados desde 1986. Asimismo, la respuesta de las comunidades macrobentónicas se evaluó por comparación con los datos anteriores. Los resultados obtenidos mostraron que desde los primeros registros en 1986 se han sucedido diversos cambios en la comunidad de macroinvertebrados. Mientras que algunos taxones no han sido registrados actualmente, (*Erpobdella*, *Pisidium*, *Asellus*, *Caenis*, *Hydrometra*, *Aphelocheirus*, *Limnephilus*, *Anomalocheirus*, *Tipulidae*, *Diamesinae*, *Stratiomidae*), otros se han detectado por primera vez en esta zona (*Cordulegaster*, *Dytiscidae*, *Curculionidae*, *Rhagionidae*, *Tabanidae*, *Dixidae*). Además, ciertos taxones están desplazados en su distribución original a tramos más altos del río. En relación a las temperaturas se ha visto un aumento acusado de la temperatura del agua en los meses de primavera y verano en todos los tramos muestreados. Los resultados obtenidos ponen de manifiesto el impacto del aumento de temperatura en ecosistemas fluviales y resaltan la necesidad de adaptar las medidas de gestión en áreas protegidas a los nuevos escenarios climáticos.

Caracterización de los humedales de montaña de las cordilleras Béticas andaluzas a partir de las comunidades de macroinvertebrados

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Los humedales mediterráneos son ecosistemas altamente dinámicos y de extremada fragilidad, habiendo sido incluidos entre los hábitats prioritarios en la Directiva Hábitats 92/43/EEC. En Andalucía, excluyendo los humedales de alta montaña de Sierra Nevada, existe escasa información sobre otros humedales localizados en zonas de montaña de gran significación. Con objeto de mejorar el conocimiento de los mismos y como paso previo a la adopción de medidas que posibiliten su conservación y posterior gestión, se ha procedido a estudiar las comunidades de macroinvertebrados de 23 humedales de montaña (en altitudes comprendidas entre 387 y 2068 m s.n.m.), localizados en las cordilleras Béticas (provincias de Cádiz, Sevilla, Málaga, Granada, Almería y Jaén). Se ha realizado un único muestreo en primavera (mayo-junio de 2017), aplicando un esfuerzo de muestreo equivalente en todos ellos. Para cada humedal se han registrado las variables físico-químicas: turbidez, conductividad y nutrientes (TN y TP). Los resultados muestran la presencia de 81 taxa distribuidas en Hirudíneos, Bivalvos, Gasterópodos, Anostráceos, Hemípteros, Efemerópteros, Odonatos, Quironómidos, otros Dípteros y Coleópteros. El número de taxa por humedal osciló entre 3 y 23, siendo los Hemípteros el grupo más frecuente y abundante (presentes en un 95% de los humedales, con 1853 ejemplares), seguidos por Quironómidos (87% y 1478 individuos), Coleópteros (78,3% y 141 individuos) y Efemerópteros (73,9 % y 1566 individuos). Por el contrario, los Anostráceos (4,3 % y 26 individuos) y los Hirudíneos (8,7 % y 8 individuos) fueron los grupos menos frecuentes. Posteriormente, con los datos de presencia-ausencia se realizaron un análisis Cluster (UPGMA) y un análisis de Correspondencia Canónica (CCA), que permitió agrupar los humedales en función de las variables ambientales y la estructura de sus comunidades. Entre los resultados, es significativo destacar la disyunción derivada de la presencia de *Plea minutissima* Leach, 1817. Con todo ello se pone de manifiesto la singularidad y relevancia de estos ecosistemas acuáticos, particularmente al actuar como puntos de notable importancia para la conservación de la diversidad de especies especialmente vulnerables a cambios aperiódicos en las condiciones locales de los hábitats.

Estudio de la comunidad de simúlidos (Diptera, Simuliidae) en la Sierra de Segura (Jaén)

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Se ha realizado un seguimiento de la dinámica poblacional de simúlidos basada en la observación de fases larvianas y pupas en tres localidades de la Sierra de Segura (Arroyo de los Molinos, Arroyo Orcera y Río Trujala) durante el periodo marzo –septiembre de 2014. Se registraron las características físico-químicas: temperatura, conductividad, oxígeno disuelto y pH (multisonda 556 MPS (YSI Inc.); velocidad de corriente (correntómetro FPIII – Global Water™) y concentración de P y N total (test NANOCOLOR, Macherey-Nagel®). Con objeto de valorar las poblaciones de simúlidos se recurrió a instalar en los cauces indicados cuatro puntos de muestreo en cada uno de los cuales se han situado tres réplicas de un dispositivo que soporta hojas de caña común (*Arundo donax*) dispuestas para servir de sustrato de fijación para las larvas y pupas de los simúlidos. Las hojas han sido parcialmente reemplazadas en periodos de 15 días para el recuento de larvas o 30 días para el recuento de pupas. Una vez retiradas, se procedió a coleccionar el conjunto de simúlidos presentes en dichas hojas y se valoró la superficie de las mismas con objeto de expresar los resultados por unidad de superficie. En el estudio taxonómico de las larvas se han excluido los ejemplares < 1 mm de longitud (2724 ejemplares). Se han determinado 1576 larvas (684 procedentes de Orcera y 892 de Molinos) y 523 pupas (187 procedentes del arroyo Orcera y 336 del arroyo Molinos). En el río Trujala no aparecieron simúlidos. Señalamos la presencia de 9 especies de simúlidos. En el caso de las larvas dominan las pertenecientes al complejo *S. (S.) ornatum/intermedium* (63,9 % en Molinos y 83,6% en Orcera), seguida por *S. (E.) velutinum* (17,4 y 7,0 % respectivamente) y *S. (N.) cryophilum* (16,4 y 8,6 % respectivamente). Las larvas de *S. (T.) bezzi* no superan el 2%. En el caso de las pupas, las especies del complejo *ornatum/velutinum* ya son diferenciables, siendo la dominante *S. (S.) ornatum*, que constituye el 87,7 y 89,0% en Orcera y Molinos respectivamente. Las especies menos abundantes son *S. (E.) petriculum* y *S. (S.) argireatum*, escasamente representadas en el Orcera y *S. (S.) xanthinum* y *S. (W.) pseudoequinum*, de aparición esporádica en el Molinos.

Aproximación a la caracterización del microhábitat biofísico del macrobentos en un río de montaña

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Frente a la reconocida capacidad de los macroinvertebrados bentónicos de actuar como indicadores de la calidad ecológica de los ecosistemas fluviales, no existe demasiada información que relacione la composición y estructura de esta comunidad con las características del medio biofísico (factores físicos y biológicos) donde reside. Utilizando técnicas de cuantificación del hábitat físico se pretende analizar, en base a la obtención de curvas de preferencia, la existencia o no de relaciones aparentes entre algunas variables biofísicas potencialmente relevantes a escala de micro-hábitat y la composición y estructura del macrobentos. El estudio se ha llevado a cabo en un tramo medio-alto del río Cinca (609 m snm; Huesca) con un régimen hidrológico y una morfología relativamente poco alteradas. Sobre una sección transversal de cauce de unos 80 m² de superficie se establecieron 3 parcelas sobre los tres tipos de ambientes hidromorfológicos distintos existentes (tabla rápida, rápido y tabla lenta). En cada parcela se preservó un espacio central para la obtención de 3 muestras de macrobentos, mediante una red surber (0,09 m²; 500 µm). Tanto en el espacio reservado para la caracterización del macrobentos en cada parcela como en el resto de su superficie, se procedió a la determinación de la distribución de la profundidad, la velocidad del agua (superficial, media y de fondo), el esfuerzo cortante, el tipo de sustrato y el recubrimiento de materia orgánica (perifiton y detritus) e inorgánica del sustrato. Sobre las muestras de macrobentos se ha determinado su composición a nivel de familia, la densidad, la biomasa, las clases de tamaños y las unidades sistemáticas más representativas. En esta comunicación se presentan los primeros resultados obtenidos en forma de curvas de preferencia para la profundidad, la velocidad de fondo, el tipo de sustrato y el esfuerzo cortante. Estos resultados preliminares indican que existen rangos de estas variables cuya manifestación diferencial puede contribuir a explicar diferencias en la composición y estructura del macrobentos. Estos mismos resultados apuntan que el conocimiento de la interrelación entre el microhábitat biofísico y la comunidad de macroinvertebrados bentónicos presente, requiere una muy alta intensidad de muestreo del microhábitat físico y, posiblemente, la obtención de curvas de preferencia complejas obtenidas de la combinación de variables biofísicas, en la línea de lo previsto en el presente estudio.

Assessment of Sousa River's Ecological Quality

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Freshwater is undeniably an essential life-sustaining element. It is a key ingredient in the health and well-being of humans and ecosystems, and for socio-economic development. Therefore, it becomes essential to manage, in a balanced way, this natural resource. The Sousa River belongs to the hydrographic basin of the Douro River, located in the north of Portugal, extending for approximately 95 km. The study's main goals were to evaluate the ecological status and quality of the Sousa River through the analysis of biological components (benthic diatoms and macroinvertebrates), as well as physicochemical and hydromorphological parameters. Research was performed during 9 months (November 2016 to July 2017), in four sampling stations. The sampling included physicochemical and hydromorphological parameters as well as biological parameters. Samples were collected every three months, except in winter. Hence, through the assessment of the physicochemical water quality, it was recognized that high levels of organic pollution existed, especially during spring and summer. The evaluation of the physical habitat revealed slight transformations in the channel of the river and the poor ability for the riparian zone to function as a barrier to the anthropogenic impacts. Moreover, the study of the benthic macroinvertebrate community indicated that the river is somewhere between slightly contaminated to moderately contaminated presenting, in some sampling sites, "Good" to "Poor" Quality. The benthic macroinvertebrate diversity was high with populations dominated mostly by tolerant taxa to organic pollution. Regarding, the diatom community, these indicated that the Sousa River presented a "Reasonable" quality throughout the seasons and sampling sites, with populations dominated mainly by tolerant and ubiquitous taxa. The results obtained were important since they may serve as an incentive to the elaboration of future research works that can provide integrated management solutions of the natural resources.

Most frequent errors in the identification of macroinvertebrates in Proficiency Test

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Participation in proficiency tests (PT) is a requirement for the implementation of quality management systems based on ISO/IEC standard 17025, in laboratories and organizations working on the determination of macroinvertebrates quality indexes. In order to help different organizations to fulfill these requirements, LABORATORIOS TECNOLOGICOS DE LEVANTE organizes a PT on a regular basis since 2009. The PT supports the implementation of the Water Framework Directive 2000/60/EC (WFD), which aims at achieving a long-term high level protection of the aquatic ecosystems. The scope of the PT is to assess the performance of technicians in the taxonomic identification of macroinvertebrate. In all editions a homogeneous prepared sample is sent to every participant with representative macroinvertebrate taxa individuals that typically occur in freshwaters from the Mediterranean/Central Europe regions. The results of the different PT indicate which are the families of macroinvertebrates that are misidentified more frequently: Odontoceridae (Trichoptera), Hydraenidae and Elmidae (Coleoptera), Scathophagidae (Diptera), Dugesiididae and Planariidae (Tricladida). It is important to determine which are the most frequent errors in order to establish adequate training programs that guarantee the quality of the macroinvertebrate taxonomic determinations.

Macroinvertebrados Bentónicos como Bioindicadores de Calidad de Agua de dos Lagunas Altoandinas, Región La Libertad, Perú

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Las lagunas altoandinas El Toro (7° 59' 12,90"S – 78° 14' 53,13"W) y Los Angeles (7° 58' 58,83"S – 78° 14' 34,18"W) son próximas entre sí, están ubicadas en la cuenca El Santa, Vertiente Pacífico, Región La Libertad, Perú; a una altura de 4021 y 4071 msnm respectivamente. Estos humedales se encuentran amenazados por la minería y el pastoreo, por lo que los macroinvertebrados se constituyen en importantes organismos bioindicadores de calidad de agua que reflejan con mayor rapidez las alteraciones del ambiente y por su sensibilidad a los factores de perturbación. Las muestras de macroinvertebrados fueron colectadas con una red Surber de 250 um y fijadas con alcohol al 96%. La determinación de calidad de agua se realizó según la valoración de índices BMWP y EPT de las familias de macroinvertebrados. Los análisis *in situ* se realizaron con un multiparamétrico HACH, los análisis químicos se determinaron en base a APHA, 2012 y EPA, 1999. La familia Corixidae es la más frecuente para ambas lagunas, la familia Tipulidae es la menos frecuente en ambas lagunas. La valoración según el índice BMWP para las lagunas El Toro y Los Angeles en los meses de enero, marzo y agosto 2015 fue de clase III (aguas contaminadas) y en el mes de junio 2015 fue de clase IV (aguas muy contaminadas), además, según el índice EPT clasifica a ambas lagunas como aguas de mala calidad. Según el índice BMWP la contaminación de las lagunas podría estar relacionado a la minería y al pastoreo, así como la crianza de trucha en la laguna El Toro; en el índice EPT no se registraron Plecopteros y Efemeropteros.

The unmet promise: Tackling problems in predicting aquatic insect abundance and distribution using functional traits

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Traits define how species cope with their surrounding environment. Under the habitat templet concept, ecologists expect that species traits would be related to environmental changes more tightly than species-based metrics. However, some studies have documented stronger species composition-environment than trait-environment relationships. Here we addressed these unexpected results through the investigation of two hypotheses. First, the optimum trait values for species fitness can vary in non-linear ways along an environmental gradient. Such non-linearity would hardly be detected using multivariate methods that assume linear responses (e.g. RDA, RLQ). Second, traits are interrelated and could show different responses along environmental gradients which can obscure reponse patterns when aggregating multiple traits responses into multivariate analyses. This trait interrelationship also implies that several species can respond similarly to the environment despite having different sets of traits. Thus, even strong trait-environment relationships would not be detected by commonly used analyses. To tackle these ideas, we first illustrated an empirical composition-environment relationship (using Redundancy Analysis) and a trait-environment relationship (using RDA in a Community-Weighted Mean trait matrix and Fourth-Corner correlations) using data of stream mayflies from Brazil. Then we simulated virtual communities using scenarios associated with the two hypotheses of interest. In our empirical case we found stronger composition-environment relationship than trait relationships and also a lack of correlations between individual traits and environmental variables using Fourth-Corner correlations. These results were not mirrored by our simulations when simulating habitat filtering acting in a singular trait with non-linear response, but only when several traits influenced community assembly and each trait responded differently to the gradient. Overall, our results suggest that multiple trait responses to environmental change could blurry the signature of habitat filtering using commonly used multivariate analyses.

Caracterização dos grupos funcionais alimentares na colonização de detritos em riachos de Mata Atlântica e Cerrado

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O processamento de material vegetal alóctone é essencial na ciclagem de nutrientes e envolve diversos organismos. A caracterização dos organismos em grupos funcionais alimentares permite entender a contribuição relativa de cada um dos grupos ao longo do processo de decomposição. Esse estudo (Processos CNPq N° 133984/2016-8 e FAPESP N° 2016/22264-8) avaliou a participação de invertebrados aquáticos e diferentes grupos funcionais no processo de degradação de folhas de *Croton cf floribundus* em dois riachos subtropicais de Mata Atlântica e Cerrado. Por meio da exposição de litter bags contendo cerca de 8 gramas de folhas em um riacho de cada bioma, foi possível acompanhar a colonização do detrito, com retiradas do material aos 7, 15, 30, 60 e 90 dias. Os organismos foram identificados no nível de família e de gênero (no caso específico dos Chironomidae, por ser dominante em ambos os riachos). Nos dois ambientes, houve a predominância de coletores-catadores, que representou 85% do total de organismos coletados nos dois riachos. Os demais grupos apresentaram menores porcentagens de contribuição. No riacho da Mata Atlântica, os predadores foram o segundo grupo mais representativo (12,55%), estando presentes em maior número entre 7 e 30 dias, seguido dos fragmentadores (8,50%). No de Cerrado, os predadores foram o segundo grupo de maior relevância (18,08%) principalmente no intervalo entre 60 e 90 dias, seguidos pelos fragmentadores (10,76%). Os táxons mais relevantes nos dois ambientes foram os Diptera da família Chironomidae e os Ephemeroptera das famílias Baetidae e Leptophlebiidae, e o riacho de Mata Atlântica apresentou ainda alta incidência dos crustáceos Amphipoda (*Hyalella*). Como observado para outros riachos em condições ambientais semelhantes, o presente trabalho também encontrou baixa contribuição dos fragmentadores, grupo de participação relativa maior em ambientes temperados, uma vez que a colonização por tais organismos demanda a alteração bioquímica prévia do material foliar promovidas pelos demais grupos funcionais. Esse processo é retardado nos trópicos devido à baixa atratividade química das folhas, aliada ao fato de que em temperaturas mais quentes os fragmentadores perdem a eficiência em razão da proximidade ao máximo de tolerância termal dos organismos. Adicionalmente, a presença do grupo de predadores indica que parte dos organismos usufruem do detrito não como alimento direto, mas sim como abrigo e local para coleta de presas.

SR9.

Primary Producers

Turnover ficoperifítico: influência do substrato ou dos fatores abióticos?

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As macrófitas fornecem microhabitats para o desenvolvimento do ficoperifíton, onde as algas respondem pontualmente às flutuações que ocorrem no ambiente, alterando sua estrutura. O trabalho objetivou verificar se o turnover estrutural do ficoperifíton é influenciado pela variação espaço-temporal da biomassa do substrato ou pelos fatores abióticos. O estudo foi realizado em um reservatório no semiárido através de amostragens bimensais, durante um ano (Agosto/2013 a Agosto/2014). Foram selecionados seis bancos de macrófitas a 1 m de profundidade, nestes foram coletados os dados abióticos e um fragmento intermediário de *Egeria densa* para obtenção do perifíton. Foi arremessado um gancho de 0,5 m de diâmetro para a captura da *E. densa* e determinação da biomassa. No laboratório foi realizada a raspagem do perifíton e a triagem das macrófitas. A biomassa de *E. densa* mais o substrato ficoperifítico foram secos em estufa para determinar o peso seco (g.m⁻²). O peso do substrato com a contagem das algas em microscópio óptico estabeleceu a densidade absoluta ficoperifítica (ind.gPS-1). Foi feita análise de PERMANOVA para verificar se havia diferença na estrutura do ficoperifíton e da biomassa de *E. densa* na relação espaço-tempo. Foram testadas as relações de dissimilaridade entre a estrutura ficoperifítica e a biomassa de plantas através do teste de Mantel e uma análise de redundância (RDA) incluindo a biomassa de *E. densa* para verificar quais fatores influenciam a estrutura do ficoperifíton. A PERMANOVA indicou que não houve diferença estatística no espaço para a estrutura do ficoperifíton e *E. densa* ($p > 0,05$, $R^2 = 0,059$ e $0,067$), mas sim para o fator tempo ($p < 0,05$, $R^2 = 0,66$ e $0,57$). Através do Mantel, foi observado que a estrutura anual do ficoperifíton não foi alterada em função da biomassa do substrato ($r = 0,048$, $p > 0,05$). A dissimilaridade do ficoperifíton aumenta com a mudança nos fatores abióticos e a biomassa de *E. densa* não interfere nessa relação ($r = 0,159$, $p > 0,05$). Os dois eixos da RDA foram significativos ($p < 0,05$). As variáveis nitrato, fósforo total, vento e transparência foram selecionadas e significativas ($p < 0,05$), explicando 54% da estrutura ficoperifítica. As análises indicam que as variações na estrutura do ficoperifíton encontradas no período anual não estão relacionadas com as flutuações encontradas na biomassa de *E. densa*. Portanto, as variáveis químicas, físicas e climáticas foram determinantes para explicar o turnover estrutural do ficoperifíton.

Assessment of the microphytobenthic community dynamics in Sousa River

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Anthropic actions may cause changes in the functional and structural changes in rivers biota, including the microphytobenthos (MPB). Microphytobenthos is one of the biological elements required by the water framework directive (WFD). The Sousa River (95 km long) is located in the Douro basin (Porto, Portugal). The Douro river's basin is affected by intense agricultural activities which run off adds nutrient and pollutant in the water. Moreover, public and industrial sewerage are also discharged in the river. The objective of this work is to evaluate the response of MPB to fluctuation of environmental condition, including stressors. We seasonally measured several physicochemical parameters. These values were correlated with several phyto-benthic community metrics. The samplings were done between November 2016 and July 2017. We identified 104 taxa; diatoms followed by green algae were the most representative groups. Most taxa were considered sporadic and/or infrequent. We found that, despite of the similarities in the microphytoplanktonic composition across sites, the cellular density varies according to the environmental condition, making clear the prevalence of generalist functional groups (FG) with a high tolerance in environments with a higher fluctuation of nutrients. GFs varied according to agricultural fields, industries and water treatment plants.

SR10.

Microbial Ecology

The interplay of allelopathy and nutrient competition as drivers of phytoplankton community dynamics

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In this work, we present a proof of principle that allelopathy could be a mechanism promoting diversity in planktonic communities. This was shown in many previous theoretical models, but never demonstrated experimentally. Here, we also suggest that, in our system, allelopathic effect has a strong dependence on availability of the limiting resource (nitrate). We performed long-term interspecific competition experiments in continuous cultures using the allelopathic cyanobacteria *Phormidium* sp. and the chlorophyte *Ankistrodesmus falcatus*. We ran the cultures during 60-90 days until the outcome of competition was observed. We manipulated the initial abundances (in the inoculum) of each species. This ratio of initial abundances determines the relative importance of allelopathy and interspecific competition for nitrate as drivers of the dynamics in our system. Our system can show three contrasting outcomes: i) exclusion of the worst resource competitor (the allelopathic species); ii) coexistence and iii) exclusion of the best resource competitor (the non-allelopathic species). The system undergoes a transition from states i) to iii) as the initial relative abundances of the species changes in favour to the allelopathic species. A mechanistic model of population dynamics accurately predicts the dynamics observed in the system both qualitatively and quantitatively. However, this model needs a non-linear function to describe the production of allelopathic compounds. We ignore the biological process that could be causing a behaviour predicted by this function. In order to learn more about this, we performed new experiments obtaining daily measures of the nitrate concentration and the allelopathic activity in the medium. With these data, we were able to detect a strong positive relationship of allelopathy with nitrate availability. This relationship is the basis that can explain all the dynamic properties of this system.

Effects of taxonomic and functional diversity of hyphomycetes on leaf litter decomposition

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Climate change may affect aquatic ecosystems altering freshwater biodiversity and ecosystem processes. The activity, diversity and productivity of hyphomycetes, the principal agents of decomposition of CPOM in headwater streams, depend on many factors which, in general, can be grouped into two categories: physico-chemical characteristics of leaf litter and in-stream environmental factors. We hypothesize that increasing temperature would lead to a decrease in taxonomic fungal diversity. However, due to, perhaps, a high functional redundancy of microbial decomposers, we expect no significant changes in leaf litter decomposition in future scenarios of elevated temperature. Moreover, higher temperature sensitivity of more recalcitrant substrates may compensate the negative effects of temperature on leaf litter quality. We performed a field experiment using four native and dominant leaf litter species—alder, ash, giant cane and rhododendron—as representative of riparian vegetation from streams in four regions widely differing in water mean winter temperature (range 4-17°C) and conductivity (range 60-3000 $\mu\text{S cm}^{-1}$). Species can be arranged in two quality classes: high and low quality (regarding SLA, toughness and nutrients content). Fungal diversity was examined by PCR-DGGE fingerprinting and conidia production. The functionality of the fungal community on decomposing leaves was evaluated using FF microplates (Biolog), which measures the abilities of fungi to utilize 95 discrete substrates. Mass loss was higher for high quality litters, with a general positive effect of temperature on the process, which also favored a higher fungal biomass. Taxonomic diversity, but not richness, was negatively affected by temperature, as also was found for functional diversity and richness. Results suggest that an increase in temperature could favor the dominance of certain species and a reduction of functional diversity, with a tendency to favor the decomposition of more complex substrates, such as polymers.

Spirostomum teres planctónico en el hipolimnion anóxico

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Contra los axiomas de la limnología, los lagos tropicales muestran diferencias en el papel del picoplancton autótrofo (APP) dentro del circuito microbiano, en relación con los ciliados. En este estudio analizamos la relación del ciliado *Spirostomum teres* con el APP durante 13 años de estudios en el lago Alchichica (Puebla/Veracruz, México), adicionando datos sobre microestratificación en oxiclina/hipolimnion. En esta capa abundan las picocianobacterias y por debajo los consorcios de procariotas incluyendo aquellos fotosintéticos anoxigénicos. *S. teres* se reconoce como un ciliado aerobio reportado desde la sobresaturación de oxígeno disuelto (OD) hasta la anoxia, pero típicamente en el límite de la anoxia. Anteriormente, no se había caracterizado un patrón en su dinámica en Alchichica por el reducido número de muestras del hipolimnion. En este estudio se evaluaron los perfiles de temperatura, OD y la radiación fotosintéticamente activa (PAR). Se aumentó la frecuencia de toma de muestras en la capa de transición; las muestras se fijaron 1:1 con paraformaldehído (4%). *S. teres* presentó su máxima abundancia integrada de la columna durante la estratificación bien establecida (Julio-Agosto), aparentemente debido al mayor grosor de metalimnion permitiendo un gradiente de OD y PAR amplio. Durante la estratificación tardía, el ciliado se concentró en el techo hipolimnético en una capa mucho más restringida. *S. teres* se reconoce también por su gran diversidad de endosimbiontes procariotas adquiridos por fagocitosis. A los experimentos de depredación se adicionó la presa marcada (FLB; *Synechococcus sp.*) a la muestra. En los de dilución, ciliados concentrados sobre el tamiz de 20 µm se incubaban en agua filtrada por 0.2 µm, reducida en OD (técnica candle jar). El contenido de las vacuolas se evaluó con microscopio de epifluorescencia en espectros de ficobilinas y clorofilas y con una cámara sensible en infrarrojo. Como presa dominante se identificó a las picocianobacterias; las nanodiatomeas (*Cyclotella choctawhatcheeana*) y las bacterias fotosintéticas también formaban parte estable de su dieta; además observamos individuos que seleccionaron nanoclorofitas (*Monoraphidium spp.*). En los experimentos de dilución se observaron vacuolas alimenticias con contenido mixto que disminuían en número y en su contenido; también se han observado vacuolas con un único tipo de contenido, de cierto tamaño y forma. ¿Podría ser un eslabón hacia simbiosis con las picocianobacterias?

Macrophytes to improve the cultivation of the microalga *Ankistrodesmus gracilis*

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In this study, we investigated the effectiveness of three macrophytes, *Azolla caroliniana*, *Lemna minor* and *Salvinia auriculata*, as culture media to the growth of microalga *Ankistrodesmus gracilis* in batch-culture. *Ankistrodesmus gracilis* strain was obtained from the culture collection 005CH, originally retrieved from the Broa Reservoir, Brazil, at 22°15' S; 47°19' W. The effects of macrophyte culture media on the growth of *A. gracilis* were simultaneously investigated during a 28-day period under similar growth conditions. Approximately 5 kg wet-weight of each plant was washed gently in tap water to remove detritus and epiphytes. They were sun-dried and then dried in an oven at 60°C, overnight. Dried plant material was homogenized in a grinder and boiled in distilled water for one hour. The hot extract was filtered and autoclaved at 120°C during 20 minutes. A 70-mL sample was collected and cooled. It was diluted with distilled water up to 1.4-L; 2.5 mL NPK were added. Samples were analysed weekly (1, 7, 14, 21, 28 days) for quantify growth and other variables during the study period. Results showed significant differences ($p < 0.05$) in cell density, chlorophyll-a and lipid content between *L. minor* and other macrophyte culture media. Macrophyte culture media of *A. caroliniana* and *L. minor* were similar ($p > 0.05$) with regard to the total organic carbon, total length, cell volume and protein. *Salvinia auriculata* medium had the lowest values for the measured parameters to microalgae growth. Physico-chemical characteristics of water used for the culture media were similar. Total nitrogen in the aquatic plants was two to three times higher than total phosphorus. The microalga grew in all macrophyte media. Best growth conditions for *A. gracilis* occurred with *L. minor* as culture medium. Although growth rate, total organic carbon and protein levels in the *A. caroliniana* culture medium were satisfactory, not all macrophytes yielded the best conditions for the growth of *A. gracilis*. Overall, macrophytes may be implemented as a culture medium due to their availability in tropical countries. The optimization of appropriate cultivation is important so that cultivation conditions and medium composition achieve the best cell growth of microalgae.

SR12.

**Lakes, Reservoirs
and Wetlands**

SR13.

**Brackish waters and
Estuaries**

Meet the nematodes from the Mondego estuary: taxonomical and functional diversity

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Nematodes are the most diverse and numerically dominant metazoans in aquatic habitats, with a distributional range varying from pristine to extremely polluted habitats. Their ubiquity, high abundance and diversity often provide more robust data sets than can be obtained from most larger-sized organisms. They present remarkable advantages for researchers, both during sampling, since their high density in sediments allows the collection of small but statistically significant samples, and during operations to analyze fixed specimens since sorting procedures and identification steps are facilitated by elutriation processes and by pictorial keys, respectively. Recently, the role of nematodes as indicators of ecological quality and their integration in impact and monitoring studies has been valued, being thus essential to understand the distribution patterns of these communities. The Mondego estuary (Portugal) is a polyhaline system influenced by a warm-temperate climate. It is 21 km long and has been under environmental pressure since the early 1990's due to different anthropogenic stresses (harbour, agricultural runoff, industries). This study explores data on nematode communities from the Mondego estuary, aiming to enhance knowledge regarding the ecological status and functioning of estuarine systems. Spatial and temporal diversity of the subtidal nematode community, based on taxonomic and functional approaches showed a reflection of the estuarine gradient, with salinity and grain size composition controlling the distribution of assemblages. Moreover, the application of Biological Traits Analysis highlighted the role of oxygen concentration in the distribution of nematode communities, increasing the knowledge of the functional structure and characterization of nematode communities in the estuary. Furthermore, intertidal communities were analysed following the program of mitigation measures in the estuary in its terminal area. Results revealed a similarity in nematodes' composition from areas that were under different pressures, revealing that the system has recovered from the early situations and that nematodes were following typical estuarine gradients. The potential role of nematodes as ecological quality indicators was recognized, and critical features that could be used in an accurate classification of transitional systems were identified.

Assessing the water quality in reservoirs: use of zooplankton as biological element, the forgotten link in WFD

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European water policies aim to achieve a good ecological status in all water bodies. The Water Framework Directive (WFD) defined a group of biological elements to assess water quality. In reservoirs and lakes, phytoplankton is the only biological element used for water quality evaluation. However, zooplankton is an important link in the trophic web, since it is able to control the phytoplankton community. On the other hand, zooplankton is a good bioindicator of several aquatic stresses, namely eutrophication processes and diffuse pollution. The main goal of this work is to demonstrate the ability of zooplankton communities to be used in the evaluation of water quality in reservoirs. A group of several reservoirs in the north of Portugal (Paradela, Alto Cávado, Alto Rabagão, Venda Nova and Torrão) were sampled during one year, to assess the water quality. Physical and chemical parameters and phytoplankton communities were studied according to the metrics proposed by the WFD for this typology of water bodies. Additionally, zooplankton communities were sampled in each reservoir, to understand if their seasonal dynamics is influenced by alterations of the water quality in the reservoirs. Results show that the reservoirs present a good ecological potential, according to WFD reference values. The results observed in the dynamics of zooplankton communities show that this biological element is more sensitive to small alterations in the aquatic ecosystem. Therefore, the metrics proposed by WFD to evaluate water quality, seem to be insufficient to understand all the alterations that occur in the aquatic ecosystems.

Zooplankton dynamics of the reservoirs of the Alqueva Irrigation System

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The Alqueva Global Irrigation System is an established network of dams that ensures water availability for agriculture and population needs in the Alentejo region in southern Portugal. According to previous studies, this system has been shown to be under a process of eutrophication with high phytoplankton abundance. However, information about the zooplankton community is missing, despite its position as the primary food source for planktivorous fish and its key role as a grazer on algae and bacteria. This work intended to evaluate the dynamics of the zooplankton communities in the Alqueva catchment, studying its seasonality and spatial distribution as a mean to assess overall water quality. To achieve this, sampling was performed monthly, during one year, in 18 sites (9 in the Alqueva reservoir, and 9 in small reservoirs of this system). At each site, water and zooplankton samples were obtained via pumping at a depth of 2 m. Copepod nauplii and cyclopoids were the most abundant taxa, with pronounced seasonal variation of *Daphnia longispina*, *Bosmina longirostris* and other cladocerans. The most noticeable event was at the start of summer, when there was a drop in abundance and the almost complete disappearance of *D. longispina*, most likely due to predatory pressure. In turn, there was a gradual increase of small cladocerans, such as *B. longirostris* and *Ceriodaphnia* sp. and, the decrease in competition by *D. longispina*, allowed the increase in abundance of *Diaphanosoma* sp. This community succession and the high abundance of cyclopoids and *B. longirostris* are typical of eutrophic systems. Spatially, sites in the Alqueva reservoir had a lower overall abundance and a lower richness, something which may be explained by higher eutrophication rate within the reservoir. The cladoceran community provided important information regarding predation pressure and, the structure of phytoplankton community, reinforcing zooplankton as a good bioindicator for water quality analysis in lentic systems.

Spatio-temporal composition of phytoplankton community in the Mondego estuary, Portugal

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Phytoplankton communities are highly sensitive to environmental modifications, and, due to their short life cycles, it is relatively easy to observe how they are affected by these variations. These communities are considered important indicators to evaluate the ecological status of aquatic systems. Furthermore, phytoplankton is an important component of estuaries that are one of the most productive systems in the world. The Mondego estuary is located in a warm temperate region, on the western coast of Portugal, and it is divided in two arms, south and north, with different hydrodynamic characteristics. The present study examines the spatio-temporal variation of phytoplankton community and descriptors associated to the community's predominance in the Mondego estuary, from May 2012 to April 2013. Sampling was performed monthly, in six stations along the estuarine salinity gradient, at high tide, at the surface and in the bottom. Samples were collected with a Niskin bottle and physico-chemical parameters were measured *in situ* with a multi-parameters probe.

Euglenophyta and Chlorophyta revealed to be the dominant groups during cold and flood periods and related with the freshwater flow into the estuary, whereas Dinophyta was dominant during warmer periods and was related with marine phytoplankton dynamics. Heterokontophyta – Bacillariophyceae occurred in all periods along the estuary. Diatoms presented a seasonal distribution determined by the natural contribution of freshwater after first autumn rains, during winter and spring and according to environmental conditions characteristic of their occurrence, and at specific sampling stations. As expected, freshwater species were predominant in the rainy period, correlated with low salinity and temperature values, while marine species were mainly restricted to higher values of salinity and temperature. The relationship between species distribution and environmental parameters suggests adaptive strategies to hydrological variations which explains species abundances.

Macroinvertebrados y diatomeas como herramientas en la gestión de la calidad del agua desembalsada

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El Boletín oficial del estado de 29 de diciembre de 2016 publicó el Real Decreto (RD) 638/2016, por el que se modifica el Reglamento del Dominio Público Hidráulico en materia de gestión de riesgos de inundación, caudales ecológicos, reservas hidrológicas y vertidos de aguas residuales. El RD añade el Artículo 49 quáter "Mantenimiento del régimen de caudales ecológicos", cuyo punto 7, referido a la calidad de las aguas desembalsadas, dice: "Los caudales desembalsados para mantener el régimen de caudales ecológicos deberán ofrecer unas condiciones de calidad, y en especial de oxigenación, que no pongan en riesgo los objetivos ambientales de la masa de agua superficial situada inmediatamente aguas abajo de la presa que los libera por causa de las operaciones de suelta de estos caudales. Por otra parte, la masa de agua que recibe los caudales ecológicos no deberá registrar un deterioro en su estado o potencial como consecuencia de recibir unos caudales ecológicos en peores condiciones cualitativas que las de entrada al embalse que los libera". En el Parque Natural de la Serranía de Cuenca, entre Uña y Beamud (Cuenca), se localiza el embalse de La Toba (construido en 1925), que representa el primer elemento de discontinuidad del río Júcar. La calidad de las aguas que desembalsa es clave para la conservación del estado ecológico del tramo fluvial, del entorno natural y para la repercusión sobre otros ecosistemas cercanos como la laguna de Uña. Aunque anualmente se determina el estado ecológico, no existe mucha información sobre la naturaleza de las aguas desembalsadas ni de la afección aguas abajo (salvo favorables informes de la Hidroeléctrica). El objetivo de este trabajo fue valorar la calidad biológica aguas abajo de la Toba, atendiendo al estudio de las comunidades de macroinvertebrados y diatomeas así como la definición de los puntos de control representativos antes y después del embalse que proporcionen información para poder ejecutar medidas de gestión. Los resultados indican empeoramiento aguas abajo. Además de definir adecuadamente los puntos de control y los índices y parámetros utilizados, el trabajo ofrece una propuesta a la mejora de la calidad del agua desembalsada en función del punto de desembalse, en este caso por un canal en lugar de por el fondo.

Biological and chemical interplays: The role of organic matter in mercury methylation

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Mercury and, in particular methylmercury (MeHg), represent serious threats to ecosystem and human health worldwide. The formation of MeHg is biologically mediated by some members of the sulphate-reducing bacteria, iron-reducing bacteria, methanogens and Firmicutes. But there is still an incomplete understanding of the biological and abiotic factors controlling the process. We used next generation sequencing-based amplicon analyses to describe total bacterial communities and the mercury methylating community subsets as well as pyrolysis-gas chromatography mass spectrometry to characterize the molecular composition of sedimentary organic matter. We used inorganic mercury isotope tracer incubations to quantify mercury methylation. Fresh phytoplankton derived organic matter controlled *in situ* bacterial activity mercury methylation rates. In contrast, lakes dominated by terrigenous organic compounds featured much lower methylation rates but presented nevertheless high methylmercury concentrations because of import from the surrounding catchment. *hgcA* amplicon analyses suggested that archaea and *deltaproteobacteria* (sulfate and iron reducers) were involved in the methylation process. Our findings provide important new information on factors controlling methylmercury formation and concentration in lake sediments.

Variation of the nutritional composition and ontogeny of gilthead seabream and European seabass reared in different Portuguese estuaries

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The nutritional composition and potential ontogenetic variations were assessed for European seabass and gilthead seabream specimens reared in semi-intensive culture systems in two Portuguese estuaries, the Sado and the Mondego. Differences on the nutritional value of the same species reared in four different aquacultures (two aquacultures in each estuary) were assessed through the quantification of total protein, carbohydrate, and fatty acid profiles. No significant differences were found among groups of both species regarding protein content. The rearing site influenced significantly European seabass regarding saturated (SFA), monounsaturated (MUFA) and highly unsaturated fatty acid (HUFA) contents, either between estuaries and within each estuary. Regarding gilthead seabream specimens, SFA, MUFA, polyunsaturated fatty acid and HUFA contents were also influenced by the production site. The content of eicosapentaenoic, docosahexaenoic, arachidonic and linoleic acids in adult specimens were dependent on the fish rearing site. In general, the fatty acid content of seabass and seabream was higher in organisms reared in the Sado estuary, compared to conspecifics reared in the Mondego estuary. Carbohydrate analysis also showed a significant influence of the rearing site on free sugar and polysaccharide content in fish of both species. Differences between development stages were found in the fatty acid and carbohydrate content of all the groups studied. The present work supported the existing evidence that semi-intensive rearing systems are poorly controlled and susceptible to the variability of extrinsic factors, such as anthropogenic pressures to which the systems are subjected to, causing fluctuations in water quality and composition, which may influence the nutritional value of the same species produced in different sites. From the consumer's perspective, those differences may come as a disadvantage, as it is expected for a product to provide equal nutritional properties regardless its origin. From the producer's perspective, such vulnerability requires close monitoring of the extrinsic parameters within the facilities, in order to avoid product losses due to water quality fluctuations. Further studies would allow the definition of the parameters that should be regulated and monitored in semi-intensive systems to obtain the product with highest quality.

Caracterización del estado ecológico en una laguna costera y alternativas de gestión

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Las lagunas costeras en el Mediterráneo suelen estar sometidas a una gran presión antrópica, como el exceso de urbanismo y de infraestructuras viarias o la agricultura intensiva, que provoca un aporte excesivo de nutrientes y otros contaminantes. A día de hoy, estos ecosistemas se encuentran en recesión siendo así aún más importante su conservación. El área del estudio se sitúa en la zona de la desembocadura del río Foix, en el municipio de Cubelles (60 km al sur de Barcelona), donde se genera una laguna costera permanente. El objetivo de este estudio es caracterizar el estado ecológico de este sistema y proponer alternativas para su gestión. Además de un exceso de frecuentación, puntualmente esta laguna recibe vertidos de agua residual sin tratar. Éstos, se producen durante episodios de fuertes lluvias, cuando se supera la capacidad de una estación de bombeo que expulsa agua procedente de la red de alcantarillado del municipio. Para su estudio y caracterización, se han analizado 4 puntos diferentes de la laguna para obtener una mayor representación de su estado, a lo largo de un año. En cada punto, se ha medido la concentración de oxígeno disuelto, la conductividad y el pH con una multisonda. Se ha determinado la concentración de amonio, nitratos, nitritos, fósforo reactivo soluble y de pigmentos fotosintéticos presentes a partir de muestras de agua. Se ha utilizado el Índice QAELSe2010 (ACA, 2010) como índice biótico. El estudio incluye también la realización de un inventario faunístico de la ictiofauna y la avifauna, así como un inventario de vegetación. Los resultados indican que el aporte puntual de agua residual, tiene una importante incidencia en la calidad del agua, afectando sobre todo a la producción primaria y facilitando episodios de eutrofia. La zona más cercana a la estación de bombeo es la que presenta peor calidad. Para mejorar su estado, se proponen medidas como evitar o disminuir el número y el volumen de los vertidos y asegurar la conexión al mar para evitar el estancamiento del agua, sobre todo en los episodios de fuertes lluvias. Se propone también, entre otras medidas, realizar o fomentar actividades de educación ambiental para dar a conocer los valores de este espacio.

Valoración del Potencial Ecológico de las aguas del Embalse de Itaipu Binacional

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El Embalse de la Represa Hidroeléctrica de Itaipu se encuentra situado en un tramo de Río Paraná entre los países de Paraguay y Brasil en Sudamérica, con un volumen a nivel máximo de $29 \times 10^9 \text{ m}^3$ y una extensión de 170 km. En el trabajo consiste en la aplicación de los criterios para la valoración del potencial ecológico de la masa de agua del embalse de Itaipu Binacional, en función a la Directiva 2000/60/CE, conocida como la Directiva Marco de Agua (DMA). Se toma como base metodológica los criterios establecidos en la normativa española a través del Real Decreto 817/2015 "Por el que se establecen los criterios de seguimiento y evaluación del estado de las aguas superficiales y las normas de calidad ambiental" de España, así como la memoria de la Red de Seguimiento de masas de agua muy modificadas de la Confederación Hidrográfica del Ebro (2015). Se evalúan los aspectos de tipología de embalses, las características hidromorfológicas, fisicoquímicas y biológicas en toda su extensión, así como los niveles de estado trófico. Se abarca un periodo de 5 años y un total de 17 campañas de monitoreo en 3 puntos del cuerpo principal del embalse. Los resultados obtenidos son relevantes y se expresan en función al Potencial Ecológico, el cual conjuga las distintas características biológicas y fisicoquímicas del embalse, el cual es definido como una masa de agua muy modificada en su estructura, funcionamiento y naturaleza, para así englobar la calidad del mismo. Se presentan además las ventajas y principales limitaciones para la aplicación de la metodología de la Directiva Marco de la Comunidad Europea en el marco de la valoración de un embalse situado en zona subtropical de América del Sur.

Limnological features and phytoplankton size-structure in a protected estuarine wetland (Guadalhorce river mouth)

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The Guadalhorce estuarine wetland constitutes a salt marsh area (67 ha) confined between the two Guadalhorce river branches and the Mediterranean sea, and located nearby Málaga (South Spain). It is a natural site with exceptional environmental value and it was declared Paraje Natural, a very restrictive protection figure, by the Andalusian Government. Actually it is formed by ten permanent endorreic shallow lagoons depicting a marked sea-to-land salinity gradient. Accurate knowledge of this ecosystem structure and function is of paramount relevance to guide its management and conservation policies. In this presentation we contribute to improve this knowledge, describing for the first time the main limnologic characteristics of the Guadalhorce river coastal lagoons, recorded during a two years survey. These include physic-chemical variables (water temperature, oxygen concentration, salinity, pH, turbidity), dissolved inorganic nutrients concentration (nitrate, nitrite, ammonia, phosphate and silica), pigments concentration (Chl-a), phytoplankton biovolume, and a very special attention to the phytoplankton communities size-abundance spectra (SAS). For phytoplankton SAS building we combined size-abundance distributions obtained from flow cytometry and microscope image analysis. Picoplankton ($< 2 \text{ mm}$ equivalent spherical diameter, ESD), ultraplankton (2-5 mm ESD) and large nanoplankton (5-20 mm ESD) cell size and abundance were determined on fresh samples using a flow cytometer previously calibrated using phytoplankton cultures, standard calibration beads and natural samples. Phytoplankton $> 20 \text{ mm}$ ESD size and abundance was counted and measured using an inverted microscope and specific image analysis software. The obtained SAS for the Guadalhorce lagoons were typically continuous, slightly linear, bumpy, and showed slopes ranging between -0.43 and -0.89. They revealed a marked biomass accumulation in the nanoplankton and phytoplankton $> 20 \text{ mm}$ size range, and low picoplankton biomass and contribution to total phytoplankton biomass. Our results suggest that a combination of physical, chemical, and trophic interactions processes determines the phytoplankton SAS in the studied lagoons, a community feature closely related to numerous ecosystem properties, including energy flow, food-web organisation, matter cycling and stability.

Characterization of summer phytoplankton of mountain lakes from the Duero river basin using morphology-based functional groups

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Functional classifications of phytoplankton are increasingly being applied in many limnological studies. Functional and morphological groups are related to environmental factors and trophic status, and facilitate the study of water bodies, its management and implementation of bioindicators, which has particular interest in routine monitoring works. In this study summer phytoplankton communities of 39 mountain lakes of the Duero river basin were characterized from samples taken in 2007 and 2008, in order to check if these water bodies can be grouped into different types according to both taxonomic composition and morphology-based functional groups. It was also analysed the relationship between environmental factors and phytoplankton composition. For this purpose, cluster, ANOVA, NMDS, and ordination analyses were performed with data of 13 environmental variables and two phytoplankton classifications, a morphologically based functional classification (MBFG) following Kruk et al. (2010), and a taxonomic classification (species level). The results obtained with the cluster analysis allowed us to distinguish 5 groups of lakes with the MBFG classification ($S=0.128$, NMDS), differing each other mainly by variables related to trophic status (chlorophyll a , $p<0,001$; Secchi depth, $p<0,05$; ANOVA). No clear lake grouping was detected with the species classification. Ordination analyses with MBFGs also showed that the trophic status (Secchi depth and PT) is the main gradient explaining the variability in the composition of phytoplankton between lakes ($p<0.01$). In contrast, the main gradient in ordination analyses with species composition was water mineralization (pH and alkalinity) ($p<0.05$). The results suggest that a morpho-functional classification of phytoplankton could be a good tool in the study and management of mountain lakes of the Duero river basin, particularly for the evaluation and monitoring of its trophic status.

Environmental factors influencing the distribution and abundance of littoral invertebrates in Ebro basin lakes

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Invertebrate samples were collected and analyzed for 83 lakes within the framework of the monitoring programs of the Ebro basin, between 2007 and 2013, in order to establish their ecological status. These lakes belong to 16 types that encompass a broad range of environmental features, i.e. from high mountain lakes with acid waters to hypersaline lowland lakes. Most lakes were visited between two and four times during this period whereas some others were visited once, and a few up to five times. During field campaigns, pressures and impacts were assessed in all these lakes according to the Water Framework Directive guidelines. Anthropogenic pressure descriptors included about fifteen landscape and hydromorphological variables, such as inflow regulation, water abstraction, hydroelectric use, nutrient loadings and land use, among several other variables. Impact descriptors included several chemical variables related to nutrient loadings (phosphate, nitrate, nitrite, ammonia, total phosphorus). Up to 113 taxa were identified among littoral invertebrates. The commonest and more abundant species were *Chydorus sphaericus* and *Alona affinis*. Species diversity was significantly lower in those lakes belonging to type 23 (temporal hypersaline lakes) in relation to the other types (excepting type 20, permanent lakes with high conductivity, whose species diversity variability was high). Impact and pressure effects on littoral invertebrates were evaluated using redundancy analysis (RDA). Lake types were also added as explanatory variables. Furthermore, partition of variance (pRDA) was performed as some pressures and impacts had been proved to be lake type specific in previous works (García-Murcia et al. 2014), i.e. livestock and hydroelectric use are found in high mountain lakes whereas nutrient enrichment is found in floodplain lakes. Lake types were the explanatory variables that accounted for most of the species variance, followed by pressure descriptors. Nutrient enrichment explained a lower variance of the species matrix. Invertebrate littoral communities responded to those hydromorphological pressures that implied changes in water level and constrained their habitat preferences.

Ecosystem history of artificial tropical reservoir revealed by phytoplanktonic pigments preserved in sediments

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One of the alternatives for quality management is to evaluate the contamination history through environmental reconstitution studies through sediment analysis, since this compartment retains previous information that allows better understanding of ecosystem dynamics. By means of a paleolimnological approach this work had the purpose of evaluating the history of anthropic impacts through the analysis of nutrients, photosynthetic pigments and sedimentation rates in the Itupararanga reservoir area (São Paulo, Brazil). Three sediment profiles (cores) with an average length of 30 cm were collected, sliced every 2 cm and stored in hermetically sealed plastic pots. One of the cores was used for granulometric analysis by laser diffraction, and for organic matter (OM), total phosphorus (TP) and total nitrogen (TN) quantification. Another one was destined to decay dating of ²¹⁰Pb by alpha spectrometry. The latter was used for the analysis of chlorophyll a (chl-a), beta-carotene (bet), fucoxanthine (fuc), lutein (lut) and zeaxanthin (zea) pigments using high performance liquid chromatography (HPLC) with UV and FLD. The sedimentary profile presented uniform coloration and allowed dating back from 1927, 13 years after starting the operation of the reservoir, in 1914. The sedimentary profile was characterized as organic (17.54±2.3 %) with predominance of fraction > 63 µm (69.42±10.8 %). Sedimentation rates remained constant over the years (0.69±0.79 cm/year) with a peak at the beginning of the 1990s (2.9 cm/year) possibly associated to the uses and occupation around the reservoir because of the urban expansion in the region. TN indicated an average value of 2.72±0.92 mg/g and TP 0.67±0.11 mg/g. The levels of the pigments of chl-a (27.89±31.99 µg/g OM), lut (189.89±180.85 µg/g OM) and zea (184.84±200.84 µg/g OM) presented a significant coefficient of variation (average 104%) with an increase from 1994. The highest values for chl-a and lut occurred in 2015 (108.4 and 518.9 µg/g OM respectively) and for zea in 1995 (629.0 µg/g OM). The highest values for fuc were found in the 2003 sediment layer (36.21±27.8 µg/g OM). This upward trend suggests an increase in trophic activity in the environment. The pigment bet had levels below the limit of detection. The increase in sedimentation rates over time as well as in pigment contents was probably associated with anthropic activities such as the increase of the eutrophication process and the increase of the uses and occupation of the soil.

Causes of spatial distribution of subfossil diatom and chironomid assemblages in surface sediments of a high gradient lake

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Until recently, the distribution in the surface of lake sediments of the diatom and chironomid assemblages and their attributes (species richness/diversity) in relation to water depth and sedimentary environments have been identified but not quantified. The influence of environmental variables on assemblage distribution and taxa richness in a high gradient, shallow to deep, monomictic lake in São Miguel Island are significant and has been assessed. Attention is given to community variation along a water-depth gradient. Seventy-five sediment core samples distributed along three transects from the shoreline to the deep basin of the lake at a resolution of 1 m water depth were analysed for diatom content, chironomids, and % of sand grain-size clastic particles. Linear and unimodal regressions were used to test taxon richness, taxon diversity and taxon evenness versus water depth in each transect. A hump-shaped relationship between species richness and water depth was noted, with a peak occurring at mid-depth, meaning that samples located at that depth represented best the total subfossil assemblage in lake Azul. Moreover, data indicate that processes of clastic transport, depending on the lake bottom morphology, and littoral alluvial inputs influence both biological assemblages and taphonomic effects in Lake Azul. Results from this study allow us to access the spatial distribution of biological assemblages in clastic-dominated lakes with a high topographic gradient. This distribution should be considered as the principal criteria for the selection of coring locations in high gradient lakes to capture the true species diversity.

Dinámica espacio-temporal del estado trófico en un lago altoandino tropical del Norte de Perú

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El lago Pomacochas se localiza en la región de los bosques montanos del norte de Perú. Se encuentra en un área de gran importancia agropecuaria y piscícola, actividades que representan la base de la economía local. La población establecida en sus márgenes descarga parte de sus efluentes cloacales, sin tratamiento, en el lago. El principal objetivo del estudio fue determinar la dinámica espacio-temporal de este ecosistema léntico evaluando las condiciones tróficas y ambientales durante las épocas seca y lluviosa, y su relación entre ellas. Se calcularon, en 15 estaciones de muestreo, los siguientes índices tróficos: Índice de Estado Trófico de Carlson (IETC), IET modificado de Aizaki et al. (IETA), IET modificado de Toledo et al. (IETT) e Índice de Estado Trófico de Vollenweider et al. (TRIX); además de parámetros ambientales como Profundidad (m), Concentración de Clorofila a ([Cloa]), Temperatura (°C), pH, Conductividad ($\mu\text{s}/\text{cm}$), Saturación de Oxígeno (%OD), Turbidez (NTU), Nitratos (NO_3^-), Nitritos (NO_2^-), Amonio (NH_4^+), Nitrógeno total (NT) y Fósforo reactivo (PR). Los índices IETC y IETA clasifican tróficamente al lago desde α -Mesotrófico a β -Eutrófico, mientras que el IETT lo hace desde α -Mesotrófico a α -Eutrófico. El TRIX, ubica el sistema entre una calidad de agua mala, altamente productiva y un nivel trófico muy alto. Todos los índices tróficos clasifican al lago Pomacochas en el mismo nivel trófico, constatando la existencia de una fuerte tendencia hacia la eutrofia. Los resultados obtenidos revelan que el IETA describió mejor el estado trófico del lago Pomacochas, mientras que el TRIX fue el que peor lo hizo. Se observó que el lago mostró una variación temporal pero no espacial tanto para los parámetros ambientales como para los índices tróficos. Los análisis estadísticos también indican que al menos ocho parámetros fisicoquímicos determinan las variaciones de los índices IET, y ocho las variaciones del índice TRIX. Todos estos resultados fueron estadísticamente significativos ($p < 0.05$). Por tanto, el lago Pomacochas se encuentra en un estado de eutrofia muy avanzado, marcado por la estacionalidad climática y las actividades agropecuarias.

Phytoplankton functional groups in tropical reservoirs of São Paulo state: water quality assessment method by Assemblage Index – Q Index

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The present study aimed to evaluate the ecological status of reservoirs in São Paulo state through the application of the phytoplankton functional group approach and using the assemblage Q-Index to investigate the spatial dynamics and analyse their influencing factors. Water samples integrating the water column (photic zone) were taken in the lotic, central and dammed areas of the Igaratá, Atibainha, Paiva Castro, Rio Grande, Itupararanga, Broa, Barra Bonita, Guarapiranga and Salto Grande reservoirs in July 2015. Physical, chemical and biological parameters of water were analysed in all reservoirs. The analyses showed high values of electrical conductivity, nitrate, nitrite and orthophosphate in Salto Grande, Barra Bonita, Guarapiranga and Rio Grande reservoirs. The total phosphorus and total nitrogen were higher in the Salto Grande and Barra Bonita hyper-eutrophic reservoirs. Altogether, 14 functional groups and 32 descriptive species were identified. The dominant functional groups were LM (*Microcystis aeruginosa* (Kützing) Kützing), H1 (*Aphanizomenon gracile* Lemmermann), K (*Aphanocapsa incerta* (Lemmermann) G.Cronberg & Komárek, A. elachista West & G.S.West), J (*Scenedesmus obtusus* Meyen) and MP (*Stauroneis* sp.). The Q-index rating ranged from bad to excellent. A divergent relationship between the Trophic State Index and the Q-Index was observed. The CCA showed that biomass of the functional groups LM, H1, and K was associated to the parameters, suspended solids, pH, total nitrogen, orthophosphate, total phosphorus, State Trophic Index, Photic zone, Chlorophyll-a, electrical conductivity and Secchi depth, related to the reservoirs Broa, Barra Bonita and Salto Grande, the most eutrophics. The Assemblage Q-index presented consistent results when used in tropical environments. In general, the main environmental factors that interfered in the phytoplankton functional group dynamics, in the reservoirs studied here, were: photic zone, electrical conductivity, total phosphorus and nitrogen and the trophic state.

Phytoplankton structure is more influenced by nutrient enrichment than by temperature raise: an experimental approach in a subtropical lake

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Global climate change will cause changes in aquatic ecosystems functioning. The objective of this study was to evaluate the isolated and combined effects of increased temperature and nutrients enrichment (nitrogen and phosphorus) on phytoplankton community structure in a large, oligo-mesotrophic subtropical shallow lake (Lake Mangueira, southern Brazil). The study was conducted in microcosms with samples of winter and summer with increase temperature and NP enrichment. Phytoplankton total biomass, species richness and diversity did not vary significantly under the manipulation of temperature neither in winter nor in summer. Cyanobacteria biomass was the only which increased significantly with the temperature increase, in winter experiments. In summer, phytoplankton total biomass, species richness, Bacillariophyceae and Cyanobacteria increased significantly under the enrichment of NP combined. The interaction between temperature increase and nutrient addition did not promote any significant effect on the studied phytoplankton attributes. The isolated temperature increase was not strong enough to promote structural changes in phytoplankton community. Instead, nutrients addition demonstrated to be the most significant influence in most of the phytoplankton attributes, even though the turnover of bloom-forming cyanobacteria has not been observed. In this sense, more studies emphasizing the resilience of aquatic ecosystems regarding the climate changes may contribute to the conservation and management of these environments.

Caracterización Limnológica de tres Lagunas Altoandinas en la Región La Libertad, Perú

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Las lagunas altoandinas Las Verdes (V1: 78° 141 29,99"S - 7° 581 36,10"W), (V2: 78° 141 41,42"S - 7° 581 42,06"W) (V3: 78° 141 19,24"S - 7° 581 42,01"W), son tres sistemas lacustres proximas entre si, estan ubicadas en la cuenca El Santa, Vertiente Pacífico, Región La Libertad, Perú; a una altura de 4079, 4081 y 4099 msnm respectivamente. Estos humedales altoandinos son fundamentales para el consumo humano y la agricultura principalmente; sin embargo, en la actualidad se ven amenazados por la minería; debido a la fragilidad de estos ecosistemas, surge la importancia de evaluarlos limnologicamente para ver en que medida son afectados en su calidad. Los análisis fisicoquímicos *in situ* se realizaron con un multiparamétrico HACH, los análisis químicos se determinaron en base a APHA, 2012 y EPA, 1999. Las muestras de fitoplancton fueron colectadas con una red estándar de 15 μ m y fijados con formol al 5%; los macroinvertebrados fueron colectados con una red Surber de 250 μ m y fijados con alcohol al 96%. La morfometría se determinó con el software del Drone Inspire 1, el cual utiliza una aplicación Area Calculator, según coordenadas y conexión de puntos se determina las principales características morfométricas. Los tres sistemas no presentaron diferencias significativas en sus características fisicoquímicas; se debe resaltar que las concentraciones de plomo no son conformes para la legislación peruana. Las tres lagunas presentaron especies de la división Bacillariophyta y Chlorophyta, las lagunas Verdes 1 y 2 presentaron especies de la división Cyanophyta y Xanthophyta. Las lagunas verdes 1, 2 y 3 presentaron tres, siete y siete familias de macroinvertebrados respectivamente. El impacto de la actividad minera se ve reflejado a través de las especies de fitoplancton y las familias de macroinvertebrados encontrados, así como, la concentración de plomo, sobre todo en la laguna Verde 1 que es la que esta más cerca a la compañía minera.

Modificaciones ambientales en el humedal del Parque Nacional de Las Tablas de Daimiel propiciadas por la actividad de especies exóticas invasoras

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El humedal del Parque Nacional de las Tablas de Daimiel presenta fuertes fluctuaciones interanuales en su nivel de agua, lo que incide directamente en su hábitat. Durante el periodo 2006-2009, el humedal se desecó debido a las escasas precipitaciones. Tras este periodo el humedal alcanza una espectacular recuperación hídrica y el ecosistema presenta aguas cristalinas y amplios tapices de carófitas (*Chara spp.*) en el fondo. En el año 2011 tiene lugar un cambio abrupto y se observa una pérdida de la vegetación sumergida junto con un aumento de la turbidez en el agua. El objetivo del trabajo es evaluar las causas que han llevado al humedal a alcanzar este estado, con la consecuente pérdida de biodiversidad. Con tal fin se han estudiado una serie de variables que pueden incidir en el desarrollo de las carófitas (hidroquímica del agua superficial y subterránea, nutrientes, turbidez, fitoplancton y radiación solar), y la influencia que tiene sobre las mismas, la abundante población de peces que ha sido identificada, que incluye varias especies exóticas invasoras (*Lepomis gibbosus*, *Ameiurus melas* y *Cyprinus carpio*), conocidas por su alta capacidad de modificar el medio. Tras el estudio de la calidad del agua se puede afirmar que las concentraciones de los compuestos químicos inorgánicos (iones mayoritarios, elementos traza y metales), orgánicos (herbicidas y plaguicidas) y nutrientes no superan los valores máximos recogidos en las legislaciones medioambientales vigentes. Por otro lado, la alta actividad de los peces bentónicos parece que está generando un fuerte impacto en el medio acuático, observándose: i) un incremento de la turbidez, debido a la suspensión del sedimento, presentando cierta tendencia estacional por una mayor actividad de los peces en verano, ii) estas especies además, destruyen la vegetación sumergida por ingesta o desenraizamiento, iii) la ausencia de vegetación reduce la cohesión de los sedimentos favoreciendo su re-suspensión tanto por la actividad de los peces como por el viento, vi) la re-suspensión de los sedimentos puede aumentar los nutrientes en agua y favorecer el desarrollo del fitoplancton, aumentando la turbidez y v) la turbidez genera una fuerte atenuación de la radiación PAR, condicionando seriamente el crecimiento de las carófitas. Este conocimiento es fundamental para abordar cualquier intento de restauración y recuperar la biodiversidad habitual de este importante humedal (RAMSAR, ZEPA y Reserva Reserva de la Biosfera).

Influence of invasive Asian clam distribution patterns on macroinvertebrate assemblages and water ecological status in a semi-artificial catchment

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Invasive species often pose a threat to freshwater ecosystems, as they may modify physical conditions and cause adverse ecological alterations on habitats. The Asian clam *Corbicula fluminea* is one of the worst invasive species in Europe, affecting many trophic levels once established. This study aimed at a deeper understanding of the clam dispersion and its influence on benthic communities and water ecological status in a semi-artificial drainage catchment with dikes and intercommunicating ditches. This drainage system is characterised by high connectivity and presence of human activities (irrigation, fishing) that can promote clam dispersal, in contrast to the frequent presence of dikes that constitute putative dispersal barriers. Distribution patterns of the clam and its impact on benthic macroinvertebrate communities were studied in 40 sampling sites, along with hydromorphology, sediment analysis and ecological status (sensu Water Framework Directive). *Corbicula fluminea* was found unevenly distributed across the study area, being absent in two sub-catchments and in some upstream tributaries in the remaining sub-catchments. Clam distribution was found to be unrelated to sediment characteristics and only partially influenced by physico-chemical characteristics of water and channel hydromorphology. Spatial distribution of *C. fluminea* in the study area confirmed the occurrence of passive downstream dispersal of smaller individuals and the lack of discontinuity across dikes proves the ability of young juveniles to travel with the overflow and overcome physical barriers. Benthic assemblages seemed to be poorly related to clam distribution: community structure was apparently more influenced by environmental variables than by presence or density of clams. However, clam abundance appeared to be positively correlated with the distribution of some functional feeding groups (scraper-grazers and collector-gatherers). Similarly, ecological status was unaffected by the presence of *C. fluminea*, hinting the possibility of inadequacy of this methodology to detect the impact of this invasive species. Overall, this study demonstrated the reduced ecological impacts and broad ecological competence of the Asian clam, but also its dependence on human vectors for upstream dispersal.

Fish assemblages in the largest Brazilian hypersaline lagoon during a low salinity year

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Located in the North of Rio de Janeiro State (Southeastern Brazil), Araruama is the largest Neotropical hypersaline lagoon in the world. Despite its great ecological and socioeconomic importance, especially for fisheries, and episodic desalinization events, which lead to changes in the entire ecosystem and its biota, there is, surprisingly, no published paper that inventoried the fish assemblages in Araruama Lagoon. In this study, gillnet sets (eight replicates per season) were installed quarterly from February to October 2011 to describe the major fish species at the hypersaline zone of Araruama Lagoon. Nine hundred and twenty-two fish were caught, belonging to six orders, 11 families, and 21 species. Perciformes (i.e. five families and 12 species) and Clupeiformes (i.e. one family and three species) accounted for most fish recorded (~83.3% of total abundance). Comparing to an earlier unpublished work, our study recorded lower species richness, which could be related to the increasingly adverse anthropogenic impacts, especially desalinization, in the lagoon. The current dominance of planktivorous fish species is also probably associated with the intensification of desalinization and eutrophication processes in Araruama Lagoon.

Artificial habitats as attracting devices (FADs) for alien game fish control in a Neotropical reservoir

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The use of fish attracting devices (FADs) in Neotropical reservoirs is barely known, and few studies have tested how specific features of these structures affect fish attraction. Artificial structures mimicking aquatic macrophytes were deployed into a 30-km² Brazilian reservoir, to assess whether native and alien game fish will respond to changes on habitat complexity and location of FADs in the water column. Lajes Reservoir was chosen because it is dominated by alien game fish and lacks natural submerged structures during most of the year. Each FAD was built by tying polypropylene ribbons (20 ribbons = 1 bunch) to ropes, which were radially attached in the PVC pipe frame (1.8m in diameter; 2.5m² surface area). Two levels of complexity (dense, 120 bunches per m²; middle, 40 bunches per m²) and two locations in the water column (bottom; midwater) were tested. A total of 53 structures was deployed but only 12 FADs (i.e. three replicates per treatment) were randomly sorted and sampled monthly from April 1999 to March 2000 through standardized angling. PERMANOVA was performed to compare the abundance of native and alien fish through seasons and among FADs (i.e. four treatments) and natural habitats (N = 3 replicates) located in a nearby area and often used by local anglers (a balanced design; all factors considered as fixed). Four fish species were caught and the introduced peacock cichlid *Cichla ocellaris* Bloch & Schneider, 1801 and the native pike characin *Oligosarcus hepsetus* (Cuvier, 1829) were the dominant species (42.3% and 34.6% of total abundance, respectively). The abundances of native and invasive game fish were overall higher in midwater-dense FADs and during spring ($p < 0.05$ for all), probably due to the extra refuge provided by the vertical profile of these structures and fish spawning peaks. The pike characin was more abundant in midwater-dense FADs and during spring and summer, whereas the peacock cichlid preferred midwater FADs over other structures ($p < 0.05$ for all). The introduced redbreast tilapia *Coptodon rendalli* (Boulenger, 1897) was more abundant in summer, and no seasonal or habitat-use pattern was found for the native trahira *Hoplias malabaricus* (Bloch, 1794). Our results stress the potential of man-made habitats to be used as FADs and to help controlling alien game fish in Neotropical reservoirs, but their effectiveness is species-specific and decreased with water level elevation, when the availability of natural habitats is high.

Phytoplankton community composition and dominant pigments during mixing period in Lake Sanabria (NW Spain)

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A social controversy about the eutrophication of the Lake Sanabria, presumably related to nutrient inputs, has been developed during last years. In order to detect changes in the phytoplankton community according to reference studies realized in the 90's and possible differences between zones with, a priori, different nutrient inputs, we integrated the classic phytoplankton counting method and the pigmentary technique of HPLC to obtain a global image of the community structure. The results showed a substantial change in the community structure comparing with the observations made three decades ago, with a large dominance of diatoms and consequently of fucoxanthin among accessory pigments. It was remarkable the unexpected dominance of *Asterionella formosa* Hassall, with percentages up to 90% in biovolume, which experienced increasing abundance throughout the mixing period. As for the comparison between zones, the analyses carried out did not show variability in taxonomic composition, reflecting a structural homogeneity among the studied zones.

Seguimiento del estado trófico y calidad del Mar Menor durante 2017

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El Mar Menor es la laguna costera más grande de la Península Ibérica y una de las mayores del Mediterráneo. Tiene una superficie de 135 km² y se encuentra separada del Mar Mediterráneo por una restinga arenosa en su mayor parte urbanizada llamada La Manga. La profundidad máxima es de 7 m y la media de 4 m. La comunicación entre la laguna y el mar se realiza por tres canales denominados Golas, de escasa anchura y profundidad, por lo que el intercambio de agua es restringido y la laguna tiene un carácter hiperhalino, oscilando el valor de salinidad entre 38 y 48 según la climatología, precipitación y evaporación. Esta laguna ha tenido un carácter oligo-mesotrófico en función también de la estación del año y la meteorología, de tal manera que su fondo estaba cubierto permanentemente de praderas de vegetación variada. Sin embargo, en el último decenio se ha producido una importante transformación agraria en su cuenca hidrográfica de tal manera que la laguna ha sufrido un proceso de eutrofización que ha hecho cambiar su estado trófico. Paulatinamente se ha perdido la transparencia del agua (el Disco de Secchi ha bajado de 5,6 a 1,3 m), aumentó la turbidez del agua y durante el verano de 2015 desaparecieron súbitamente las praderas de la zona profunda, perdiéndose la oligotrofia. Con el fin de estudiar la evolución del estado trófico de la laguna, el gobierno regional promovió trabajos de seguimiento del estado trófico, en los que se enmarca el presente estudio. En la laguna se ha estudiado a lo largo del año en varios puntos la transparencia del agua, la turbidez, la concentración de clorofila en el perfil vertical, así como las poblaciones fitoplanctónicas. Esta información se ha utilizado para calibrar la información obtenida mediante sensores remotos en plataformas satelitales, que permiten evaluar con más detalle espacial y temporal el estado trófico. Los resultados fueron que durante 2017 el ciclo comenzó con un estado deficiente, que fue mejorando hacia el verano, para empeorar a finales de verano de nuevo. Los valores de turbidez han oscilado entre 0,21 y 2,55 NTU. La concentración de clorofila a promedio ha sido de 4,5 µg/L, con valores máximo de 13,0 µg/L en septiembre y mínimo de 0,3 µg/L en junio. Según la normativa de calidad, valores del pigmento por encima de 7 µg/L indican ya un estado deficiente, que se ha observado en los meses de septiembre y octubre, mientras que los valores de muy bueno (< 3,8 µg/L) se observaron en primavera de 2017.

Estudio limnológico del lago de Sanabria y su cuenca: un proyecto multidisciplinar para evaluar su estado y funcionamiento ecológico

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La Confederación Hidrográfica del Duero coordina desde 2015 un Proyecto multidisciplinar para el Estudio del lago de Sanabria y su cuenca, cuyo objetivo es evaluar su estado y funcionamiento ecológico. Las tareas principales comprenden: 1) El estudio limnológico del lago y su cuenca (24 meses), abarcando el ecosistema en su conjunto, tanto el componente abiótico (agua y sedimentos, y su dinámica espacio-temporal) como biótico (macrófitos, invertebrados bentónicos, fitoplancton, zooplancton y fitobentos), lo que permitirá valorar su estado trófico y ecológico con índices y métricas oficiales y aceptadas por la comunidad científica; 2) Realización y validación de un modelo hidrodinámico del lago para el cálculo de flujos no constantes y fenómenos de transporte debidos a factores meteorológicos; 3) Realización y validación de un modelo hidroquímico de la cuenca basado en el balance y cuantificación de la carga de nutrientes (P/N/Si) procedentes de distintas fuentes (vertidos, ganadería, turismo, precipitación y depósito atmosférico, escorrentía y lixiviados del suelo); 4) Estudio sísmico y desarrollo de un modelo sedimentológico tridimensional basado en los aportes estimados de la cuenca y el estudio de procesos de sedimentación; 5) Reconstrucción paleolimnológica de la evolución reciente del lago y su respuesta a factores externos; 6) Análisis de toda la información obtenida y de otros estudios previos o programas de seguimiento (C.H. Duero y P.N. Lago de Sanabria de la JCYL), y de su evolución espacio-temporal reciente, desarrollando un modelo conceptual del funcionamiento ecológico del lago; Y 7) Actividades y creación de un espacio didáctico para la difusión y divulgación del conocimiento sobre este ecosistema (<https://aulaestudiolagosanabria.info/>). Los trabajos de campo mensuales e instalación de equipos e instrumentación para la toma de muestras y datos ambientales se han llevado a cabo entre septiembre de 2015 y noviembre de 2017. Durante 2018 se realizará una cartografía de hábitats y vegetación acuática de la cubeta lacustre, así como el análisis de datos y las distintas modelizaciones con la información obtenida.

Variabilidad morfométrica y distribución de los lagos de alta montaña del Sistema Central (Península Ibérica)

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El estudio y caracterización de la morfometría de los lagos es esencial para comprender el funcionamiento, la estructura, los procesos y los flujos de materia y energía en estos ecosistemas, así como su diferente respuesta frente a cambios en el clima o presiones externas. Son varios los factores que determinan la morfometría y la distribución espacial de los lagos de alta montaña: la estructura y litología del sustrato, la ubicación geográfica (altitud, latitud y longitud) y topográfica (orientación en los valles y circos glaciares), la geomorfología local y el clima, entre otros. En el Sistema Central de la Península Ibérica pueden contabilizarse las siguientes lagunas por su tamaño o relevancia, compartiendo todas ellas su origen glaciar: 3 en la Sierra de Guadarrama (> 0,5 Ha y > 2000 m), 19 en la Sierra de Gredos (> 0,1 Ha y > 1600 m) y 12 en Sierra da Estrela (>1 Ha y > 1500 m). Algunas de ellas han sido alteradas morfométrica e hidrológicamente para su aprovechamiento hidroeléctrico u otros usos. El presente trabajo, basado en los reconocimientos batimétricos realizados en la mayoría de las lagunas de las Sierras de Gredos y Guadarrama, muestra la caracterización y variabilidad morfométrica, la distribución espacial de las lagunas, y cómo los parámetros morfométricos influyen o determinan otras variables hidrológicas o físico-químicas (ej. tiempo de residencia, la temporalidad, el régimen térmico, o la formación de la cubierta de hielo).

Eutrofización, blooms y toxicidad en los embalses de la Cuenca del río Ebro

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En el presente trabajo se analizan los datos fisicoquímicos y biológicos correspondientes a embalses de la cuenca del río Ebro para determinar su estado trófico y evaluar la calidad de sus aguas. Para la obtención de los datos biológicos se ha estudiado tanto la composición del fitoplancton como del zooplancton en dichas masas de agua durante la época estival. Entre los grandes grupos algales cabe destacar el de las cianobacterias y en casos más contados los dinoflagelados que, aunque no presentes en todos los embalses estudiados, pueden alcanzar grandes proporciones en algunos en los que se encuentran presentes e incluso ser el grupo más abundante en determinadas ocasiones formando blooms muy aparentes. La capacidad de ciertas especies de cianobacterias de producir cianotoxinas, al igual que la capacidad tóxica de algunos dinoflagelados, hace que sus proliferaciones sean consideradas un riesgo tanto en los embalses destinados a abastecimiento de agua potable como en los de uso recreativo. La Directiva 2006/7/CE sobre aguas de baño obliga a evaluar la propensión a la proliferación de cianobacterias en las aguas de baño y a realizar un control que permita la identificación oportuna de los riesgos para la salud. Esta directiva se transpone a la legislación española en el R.D. 1341/2007. También la legislación española sobre la calidad del agua de consumo humano (R.D. 140/2003) hace referencia a estos grupos algales, fijando unos límites máximos permitidos en cuanto a la concentración de las toxinas producidas por estas algas. Por tanto, en condiciones eutróficas sumadas a determinadas condiciones ambientales que tienen lugar precisamente en la época estival, la dominancia de estas especies potencialmente tóxicas podría suponer un alto riesgo. De ahí la necesidad del seguimiento del estado trófico de los embalses con especial atención a su relación con la presencia y desarrollo de ciertas especies con capacidad para producir toxinas.

SR14.

Global Change

**(biological invasions,
nutrient enrichment,
climate change)**

The invasive Chinese mitten crab (*Eriocheir sinensis*) in the Tagus estuary (Portugal)

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This study characterizes the population structure and reproductive dynamics of the Chinese mitten crab (*Eriocheir sinensis*, Milne Edwards, 1853) in the Tagus river estuary. The Chinese mitten crab is a highly invasive catadromous species for which there is insufficient data regarding this invaded area. Strong differences to other European populations should be expected since it is at a much lower latitude, and this may affect the choice of management strategies. From September 2013 to October 2014, *E. sinensis* bycatch was obtained on an approximately monthly basis in the upper Estuary, using fyke nets. We analyzed population structure, fertility, condition, female gonad development and growth. Sex ratio oscillated significantly along the year and its mean value was 1.54 (M/F). Ovigerous females were present from March to May, but were most abundant in May during a period of low flow and high salinity (3-7 PSU). The mean number of eggs per female (36350) was low when compared with most areas with the species. A large proportion of the crabs (44%) presented loss of appendages, potentially reducing its commercial value. We concluded that this is a well-established, short lived population, with low fertility and this may explain why so far there have been no noteworthy population explosions. We recommend the period from April to July as the most appropriate for seasonal control measures to decrease the risk of larvae transport by ballast water from the Tagus to other nearby estuaries

Chironomidae na colonização de detritos em riachos de Mata Atlântica e Cerrado

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Uma das possíveis consequências das mudanças globais é a savanização de florestas tropicais, de modo que, eventualmente, a fauna de riachos de Mata Atlântica se defrontará com a degradação de detritos vegetais oriundos do Cerrado. Este estudo (Processos CNPq N° 133984/2016-8 e FAPESP N° 2016/22264-8) comparou a taxocenose de Chironomidae em riachos de Cerrado e Mata Atlântica, em diferentes fases de degradação de folhas de *Croton cf floribundus*, espécie comum na área de transição entre Cerrado e mata ciliar. Litter bags contendo 8 gramas de folhas foram dispostos em um riacho em cada bioma e sua colonização foi acompanhada, com retiradas aos 7,15,30,60 e 90 dias. Os indivíduos foram identificados ao nível de gênero e suas abundâncias nos dois biomas foram comparadas pelo teste U de Mann-Whitney. O coeficiente de similaridade de Jaccard foi usado para avaliar a constância da fauna em períodos sucessivos de colonização. A estrutura trófica foi avaliada por meio de grupos funcionais de alimentação. Em ambos os riachos o número total de indivíduos tendeu a aumentar de modo aproximadamente linear até 60 dias, diminuindo a partir de então. A abundância de indivíduos foi significativamente maior no riacho de Cerrado durante os quinze primeiros dias (7 dias: U = 0 e p = 0,0051; 15 dias: U = 4,5 e p = 0,0367). Foi observado um total de 37 gêneros, 22 dos quais comuns aos dois riachos; 10 ocorreram apenas no Cerrado e 5 apenas na Mata Atlântica. *Corynoneura* e *Tanytarsus* foram os gêneros com maior percentual em ambos os riachos, sendo que a contribuição do primeiro tendeu a diminuir ao longo do tempo, enquanto o segundo apresentou tendência inversa. Endotribelos e Labrundinia também ocorreram ao longo de todo o processo, com porcentagens relativamente altas no Cerrado. Na Mata Atlântica, além de *Labrundinia* também houve percentual relativamente alto de *Nanocladius* e *Phaenopsectra*. A constância da taxocenose na Mata Atlântica tendeu a diminuir ao longo do período e o oposto foi observado no Cerrado. Embora a estrutura e a composição da fauna tenham apresentado diferenças entre os dois ambientes, o mesmo não é verdade quando se trata dos grupos funcionais. Ambas as taxocenoses apresentaram dominância de coletores-catadores, seguidos por predadores ao longo de todo o período. Deste modo, pode-se aventar a hipótese de que o efeito dos Chironomidae na degradação das folhas de *Croton cf floribundus* seja similar nos dois riachos.

Decomposição e química foliar de espécie ripária em riachos de Mata Atlântica e Cerrado

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Detritos alóctones oriundos da vegetação ripária são fonte relevante de matéria orgânica em riachos. O entendimento da química deste material e de seu processamento pela biota auxilia na compreensão de diferenças na dinâmica de decomposição. Este trabalho (Processos CNPq N° 133984/2016-8 e FAPESP N° 2016/22264-8) comparou a degradação de folhas de *Croton cf floribundus*, espécie comum na borda de mata ciliar em Cerrado, em áreas deste bioma e de Mata Atlântica, a qual está sujeita à savanização em função das mudanças globais. Para tanto, 8 gramas de folhas foram colocadas em litter bags expostos em um riacho em cada um dos biomas, e recolhidos após 7, 15, 30, 60 e 90 dias. Foram determinadas a perda de massa e taxa de decaimento (k) e a concentração de macronutrientes. As trajetórias de perda de massa não diferiram entre os ambientes, com porcentagens finais muito próximas: 27,89% de massa remanescente na Mata Atlântica e 21,70% no Cerrado. Esses valores apontam para a menor qualidade nutricional da espécie, pois folhas com alta qualidade sofrem degradação total com menos tempo de exposição. As taxas de decaimento foram de $k=0,0145$ para Mata Atlântica e $k=0,0161$ para o Cerrado, ambos os valores estando dentro do intervalo de decaimento rápido (k superior a $0,0100$ d⁻¹). A porção orgânica correspondeu de 69 a 89% da massa total remanescente. O carbono apresentou porcentagem máxima de 41,36% na Mata Atlântica e 42,46% no Cerrado. A concentração de nitrogênio manteve-se entre 1 a 2% da fração orgânica nos dois riachos. Para o ambiente de Mata Atlântica houve aumento gradativo da concentração, enquanto que no ambiente de Cerrado observou-se um pico de concentração aos 30 dias de experimento, seguido de queda. Para o fósforo, as concentrações se mantiveram abaixo de 1% em todo o período. Os baixos teores de nitrogênio e fósforo encontrados indicam baixo condicionamento das folhas por micro-organismos, o que retardaria sua decomposição. Por outro lado, os valores de lignina, uma das barreiras químicas mais relevantes para os detritívoros, são baixos, e variam de 5 a 7% nos dois ambientes, podendo, portanto, ser um facilitador para o decaimento de massa. Conclui-se que para *Croton cf floribundus* a perda de massa é a mesma em Mata Atlântica e Cerrado, o que também pode ser afirmado tanto em termos de composição química quanto processamento e transformação ao longo do tempo.

Structural and functional responses of invertebrate communities to climate change and flow regulation in alpine rivers

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Understanding and predicting how communities respond to climate change is critical for assessing biodiversity vulnerability and guiding conservation efforts. Freshwater ecosystems are experiencing biodiversity declines far greater than terrestrial and marine ecosystems. Alpine rivers are one of the most sensitive ecosystems to climate change, and are therefore often considered as sentinel systems providing early warning of wider-scale changes. However, there is minimal understanding of how biological communities are influenced by climate change in a context of flow regulation, which is common in alpine systems. The current work sheds light on this issue disentangling the structural and functional effects of climate change by comparing environmental and aquatic invertebrate data collected in the 1970s and 2010s in regulated and unregulated alpine catchments. Given that climate is turning warmer and drier in the region, we hypothesized a replacement of psychrophilic by thermophilic taxa, resulting in a high temporal and spatial turnover in species and trait composition, along with reduced taxonomic and functional diversities. More biological responses were expected in regulated rivers due to additive or synergistic effects between flow regulation and climate change. Divergent structural but convergent functional responses were found between free-flowing and regulated catchments. Although psychrophilic taxa decreased thoroughly, greater colonization and spread of thermophilic species was found in the free-flowing catchment. Consequently, greater spatial and temporal turnover was found causing increases of taxonomic diversity in the free-flowing catchment but decreases in the regulated one due to biotic homogenization. The spread of taxa with new functional features (i.e. polyvoltine taxa with small body size, resistance forms, reproducing by clutches and dispersing by air) and the former presence of some inhabiting tolerant taxa increased functional diversity but decreased functional redundancy, which could jeopardize the ability of aquatic communities to face an intensification of ongoing climate change or new anthropogenic disturbances

Cumulative impact of multiple global-change drivers on primary production change their net effect along an optical gradient

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Currently it is not assessed how the interaction between future complex global-change conditions and environmental context i.e. underwater light environment (KdPAR) could impact food webs of aquatic ecosystems. Thus, we hypothesize that a multi-drivers scenario, with increased nutrient (nut) and carbon dioxide (pCO₂) concentrations under vertical mixing (mix) and high ultraviolet radiation (UVR) levels will cause a greater negative impact on primary producers, from more opaque than clear environments, by a potential higher sensitivity of them to inhabit in a more protected and darker environment. To test our hypothesis, we developed a complex approach in which first, we established, through published literature and remote-sensing analysis, the global KdPAR gradient experienced by phytoplankton in aquatic ecosystems worldwide. Secondly, from an extensive literature (1979-2017) and experimental analysis we establish the nature and magnitude of the single effects of UVR, pCO₂, mix and nutrients on phytoplankton from inland waters; and third, we established a multifactorial experiment with natural communities from nine oligotrophic lakes, covering the global-scale KdPAR gradient, which were exposed to joint effect of increased UVR, pCO₂, and nutrients. UVR was the main driver that exerted a negative effect on primary production (PP) over the KdPAR, and that the environmental context is a key modulator of the net impact that multiple global-change drivers could have on phytoplankton. In addition, and contrarily to our hypothesis, we found that the interaction effect index (IEI) was markedly antagonistic on PP and excreted organic carbon (%EOC) with increasing KdPAR; notwithstanding, the magnitude of this multi-drivers scenario was significantly higher on %EOC than on PP. Thus, we conclude that it is mandatory to consider the environmental context and multi-driver scenarios in upcoming experimental and modeling attempts, as it is likely to alter future projections about the effects of global-change on the biological pump functioning.

Water transparency affects the survival of the medusa stage of the invasive freshwater jellyfish *Craspedacusta sowerbii*

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The jellyfish *Craspedacusta sowerbii* is a global invader of freshwater ecosystems and recently, it has been recorded in the northern Patagonia region of Chile. The environmental characteristics that allow or limit the invasion of this species are not well known. We hypothesized that water transparency and thus, exposure to UV radiation are relevant for the colonization success of this relatively transparent invasive hydroid. Here, we studied short-term effects of natural solar radiation (outdoor exposures) and artificial UV radiation (laboratory exposures) on the free-living medusa stage of *C. sowerbii* across natural and simulated water transparency gradients in three Chilean Patagonian lakes. Short-term exposure of the jellyfish to artificial UV radiation under low Dissolved Organic Carbon (DOC) treatments induced mortality and caused sublethal effects such as swimming anomalies and production of reactive oxygen species. Outdoor exposure of jellyfish to full solar radiation in the most transparent water (Lake Ranco; DOC= 0.6 mg L⁻¹) resulted in almost complete mortality. However, higher DOC contents provided partial or almost complete protection against the adverse impact of UV radiation. Overall, our findings provide evidence of the role of underwater light conditions in the underlying mechanisms that may favor the invasion of this gelatinous alien species in inland waters. The results imply that under the current “brownification” of lakes, an increase in water color might provide more favorable conditions for the invasion process of this hydroid.

Higher phenoloxidase activity in invasive than in native water boatmen infected by water mite parasites and consequences for the invasion

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Immunity-mediated interspecific interactions among native and invasive species can have big consequences for biological invasions, but have rarely been studied. We examined the variation in a key component of immune function (phenoloxidase, i.e. PO, activity) and condition (fat storage) of five species of native and invasive water boatmen (Corixidae) in relation to water mite ectoparasites, combining field and laboratory observations in southern Spain. We aimed to establish the influence of mites on the invasion of the alien *Trichocorixa verticalis* from North America. Mite infection was associated with a general decrease in corixid immune function (but not of fat stores), but to a different extent in different host species. PO decreased with the number of parasites. Immunosuppression was generally higher in males from the field (which had a lower prevalence than females) and when mites were attached to the head or hemelytra instead of other positions. Immunosuppression was particularly high in the alien species, and this was consistent with particularly high prevalence of mites in this species both in the field and in laboratory infections. This suggests that mite infections explain the low abundance of the alien species in low salinity ponds, where native species dominate and mites are abundant. Uninfected *Trichocorixa verticalis* had a lower immune function than most native species, probably because the alien is adapted to higher salinities where ectoparasites are absent, supporting the “cost of immunity hypothesis”. Similarly, the most halotolerant native species *Sigara stagnalis* had the lowest immune function. Our results are not only relevant in the context of biological invasions, but also for the broader field of ecological immunity providing insights into the interactions between immunity and ecological conditions, sex, and intensity of infection.

Heat and cold stress effects on leaf litter decomposition rates

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Climate change is increasing the occurrence of exceptionally high and low temperatures worldwide; these extreme events are now more intense, frequent and unpredictable. Leaf litter from terrestrial origin – a basal resource for stream ecosystems – can be exposed to different temperature conditions before entering the stream, potentially affecting its physicochemical structure and, subsequently, its decomposition rate within the stream. We tested this hypothesis in a field experiment where leaf litter of three common riparian species in southern Chile (*Luma apicula*, *Nothofagus obliqua*, *Nothofagus dombeyi*), previously exposed to different temperature and humidity treatments [including heat stress (40°C), cold stress (-20°C) at dry and wet conditions, and a control at ambient temperature (20°C)], was incubated within coarse-mesh and fine-mesh litterbags for 30 days. We also examined the leaching of soluble compounds within microcosms in the laboratory for 48 h. We found that (1) neither heat or cold stress affected leaf litter decomposition rates in the field in the absence of invertebrates (i.e., in fine-mesh litterbags); (2) heat stress increased decomposition by 37%, with no effect of cold stress, in the presence of invertebrates (coarse-mesh bags); and (3) the leaching of soluble compounds increased both with heat stress and with cold stress on wet conditions (55% increase in both cases). These results indicate that, even if both high and low temperatures have the potential to alter the physicochemical properties of leaf litter, heat stress has greater effects than cold stress on the rates of leaf litter decomposition by invertebrates, thus potentially being of greater importance to stream communities and ecosystem functioning.

Distribución geográfica de especies exóticas invasoras acuáticas en Andalucía

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Según la Agencia Europea de Medio Ambiente, las especies exóticas invasoras (EEI) “presentan riesgos más importantes para la biodiversidad, la salud humana y las economías, que los estimados previamente en Europa”. Dicha agencia ha estimado el impacto económico de las EEI en alrededor de 2 billones € por año en Europa. Así mismo, producen un impacto en los ecosistemas amenazando seriamente a la biodiversidad existente. De las 395 especies europeas en riesgo crítico de extinción inscritas en la Lista Roja de la Unión Internacional para la Conservación de la Naturaleza, 110 se ven en riesgo debido a la presencia de EEI en sus hábitats. En Andalucía, donde el sector económico se basa principalmente en la agricultura y el turismo, se ve afectado por la presencia de EEI, sobre todo en sus ecosistemas acuáticos, produciendo efectos negativos sobre la biodiversidad existente, el funcionamiento de los ecosistemas, la productividad agrícola, el comercio y la salud. Conscientes de la necesidad de crear y potenciar estrategias o planes de gestión integral de las EEI, la Consejería de Medio Ambiente puso en funcionamiento el “Programa Andaluz para el Control de las EEI”; Programa dinámico constituido por la suma de las diversas acciones emprendidas para gestionar dichas especies en Andalucía. En el marco de dicho programa, se puso en marcha un proyecto con el objeto de realizar una síntesis actualizada así como una cartografía de la distribución de las siguientes EEI en el territorio andaluz: *Dreissena polymorpha*, *Corbicula fluminea*, *Mytilopsis leuphocaeta*, *Cordylophora caspia*; así como Briozoos con carácter invasor. La recopilación de la información relativa a la distribución geográfica y a las condiciones ambientales en las que se encuentran dichas especies, se ha llevado a cabo a partir de dos fuentes: (i) trabajos publicados anteriormente y (ii) informes elaborados por agentes involucrados en el impacto y seguimiento de las EEI. En Andalucía, dichas especies han sido localizadas en ríos, embalses, sistemas de refrigeración, balsas de riego, tuberías de riego, rejillas de canales, filtros anillas, filtros de malla, goteros, etc. El objetivo del presente trabajo es presentar los resultados obtenidos en el proyecto desarrollado en el marco del Programa Andaluz para el Control de las EEI, donde el inventario realizado presenta un carácter novedoso e interesante pudiendo ser considerado como punto de partida para evaluar el seguimiento de las EEI en Andalucía.

Changes in land use and nutrient level in streams from a region subjected to agricultural intensification (Argentine Pampas) between 2003 y 2015

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In the last two decades, the Pampean region is undergoing a process of agricultural intensification that can potentially impact stream water quality. In this study, we compared nitrate (NO₃) and soluble reactive phosphorus (SRP) concentrations in 41 streams of the Buenos Aires province between 2003 and 2015. In addition, we analyzed changes in land use and cover in stream basins during the same period. The percentage of agricultural land use in the basins increased between 2003 and 2015, while the percentage of land used assigned to cattle breeding was reduced, but these differences were not significant. SRP concentration significantly increased in the streams in 2015 compared to 2003, and this increase was not associated to changes in flow or agricultural cover but to the decrease of pH and carbonate concentrations during the same period. This suggests that adsorption of phosphorus to mineral particles may be an important process controlling SRP concentration in stream water. On the contrary, NO₃ concentrations were not significantly different between 2003 and 2015, and their variability was best explained by regional features and agricultural land use in the basins. Considering that phosphorus is the limiting nutrient in streams of the Pampean region, it is important to elucidate the causes of SRP increase to implement measures for lessening the risk of eutrophication in Pampean waterbodies.

Invasive species distribution modelling: effectiveness of different environmental/ antropogenic variables and forecasts of climate change impacts

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Global biodiversity is at risk owing to climate change and invasive species combination effects, and freshwater ecosystems are expected to suffer the most. Niche-based models (NBMs) are being increasingly used to predict species distribution, and how different environmental variables determine habitat adequability. Recently, combination of single-models into an ensemble modelling approach has been suggested as a more robust and reliable method, that reduce the predictive uncertainty of individual predictions. Here, we aim to determine how different topographic, climatic and anthropogenic pressures influences habitat suitability for the invasive asian clam (*Corbicula fluminea*) and red eared slider (*Trachemys scripta elegans*). The effectiveness of this methodology to forecast climate change impacts was also determined using different climatic scenarios. Species distribution modelling was based on nine algorithms in BIOMOD2, summarized in ensemble forecasting approaches using topographic (altitude, slope, cti), climatic (related to temperature and precipitation variables) or anthropogenic pressure variables (pet shop density, distance to urban areas, human density). To predict climate change impacts, three time-frames (current, 2050 and 2070) were modelled using four increasing CO₂ emission scenarios. Results suggest that coupling topographic and environmental variables improves model performance. Climate change may favor the expansion of *C. fluminea* into new river basins, especially at higher latitudes, and future climatic scenarios may double the suitable area for *Corbicula fluminea*. Additionally, we observed that by using variables associated to propagule pressure, model performance is improved, in the case of *T. scripta elegans*, even though these are much less used than bioclimatic variables. These results may be extremely useful for managing invasions, namely identifying high invasion risk areas where management efforts should be prioritized. By providing this type of information to stakeholders, local communities or government organizations, the cost-efficiency of invasion management actions could be improved.

Evaluating nature-based adaptation options to sea level rise and benefits to agriculture in a deltaic area

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Sea level rise (SLR) is threatening low-lying coastal areas such as deltas by increasing the risks of flooding, coastal retreat, and salt intrusion. The Ebro Delta is particularly vulnerable to SLR, due to significant sediment retention (up to 99 %) behind dams in the upstream river catchment, thereby dramatically reducing the capacity for deltaic sediment accretion with SLR. 66 % of the delta area is used for rice production, the main economic activity, which is negatively affected by SLR because of flooding and soil salinization. Therefore, it is necessary to develop appropriate adaptation measures to preserve rice production and the delta's morphological and ecological integrity. We coupled data from Geographic Information Systems with Generalized Linear Models to predict the impacts of SLR on the Ebro Delta, which zones are prone to flooding and increased soil salinity, and what is the sediment deficit, i.e., the amount of sediment necessary to raise the land in order to compensate this flooding and soil salinization. We modeled different SLR scenarios, and analyzed the feasibility of reintroducing fluvial sediments retained in the lower reservoirs into the delta plain rice fields to maintain land elevation and rice production. We made a simplified economic analysis, by estimating the costs related to different sediment reintroduction measures and their benefits in terms of avoided loss of income from rice production. Our flood model predicted that 36 to 90% of the rice field area will be flooded in the best and worst SLR scenarios considered (SLR = 0.52 m and 1.8 m by 2100, respectively), corresponding to a sediment deficit ranging from 130 to 442 million tonnes by 2100 (1.4 to 4.9 million tonnes per year). The proposed nature-based adaptation measure would also have a positive effect on rice production and can be considered an innovative management option for maintaining Ebro Delta ecosystem services under SLR.

Population dynamic of bloom-forming *Microcystis aeruginosa* in the presence of the invasive bivalve *Limnoperna fortunei*

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Aquatic ecosystems have been severely altered by invasive species and a connection has been observed between bivalve invasions and an increase in frequency of cyanobacteria toxic blooms. In South America, the invasive golden mussel, *Limnoperna fortunei*, has caused serious environmental and economic impacts, because of its high filtration rates, high population densities and rapid dispersion. Changes in the plankton community have been detected at sites invaded by this species. The aim of the present study was to investigate the possible effects of this mussel on the growth of the bloom-forming cyanobacterium *Microcystis aeruginosa*, in laboratory experiments under controlled light and temperature conditions. The cyanobacterium *M. aeruginosa* and a chlorophyte (*Pseudokirchneriella sp.*) were used either together or alone as food for the mussels. Density measurements of *M. aeruginosa* and *Pseudokirchneriella sp.* growing in vessels with and without mussels were performed daily, and nutrient concentrations in the water were assessed at the beginning and end of the experiment. The results indicated that *Pseudokirchneriella sp.* acted as a competitor, contributing to reduce densities and growth rates of *M. aeruginosa*. These effects, however, did not occur in the presence of the golden mussel, when the densities of *Pseudokirchneriella sp.* were significantly lower, possibly due to selective grazing. Phosphate and nitrate concentrations were always higher in the presence of the bivalves. As previously observed for other invasive mollusks, our results suggest that the golden mussel may have a positive effect on *M. aeruginosa* by the exclusion of potential competitors as well as by increasing nutrient supply.

The impact of recent global changes on remote oceanic island lakes – a paleolimnological perspective

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During the second half of XX century, lake eutrophication has become a matter of concern all over the world. The increase in lake productivity has been mainly related to inputs of nutrients, particularly phosphorus (P) and nitrogen (N), originated by local human activities. However, evidence of lake eutrophication on remote areas with no significant watershed disturbances highlighted the possibility of atmospheric N contamination as the cause of lake nutrient enrichment. Other studies pointed out that recent global climate warming could be behind ecological changes in lakes. Several lakes in the Azores, a group of nine volcanic islands in the middle of the Atlantic, undergo eutrophication that has been associated with nutrient inputs from livestock farming. In this work we analyzed the evolution of diatom assemblages in the sediments of Azorean lakes. Diatom assemblages showed several asynchronous changes among lakes during the last 700 years. Contrarily, the last major change in diatom assemblages occurred almost at the same time in all lakes. Between 1980 and 1990 diatom assemblages exhibited one of the most significant changes observed in the recent history of the lakes, independently of lake characteristics and location. In deep stratified lakes an abrupt increase in the planktonic species *Aulacoseira ambigua*, *Asterionella formosa*, *Fragilaria tenera* and *Fragilaria crotonensis* was observed. In a shallow macrophyte-dominated lake a sharp increase in the tychoplanktonic species *Staurosira aff. venter* was detected. A generalized decrease in species richness and diversity was also found. This synchronous change in all lakes suggests a common driver. Two main factors might be underlying these changes: i) the recent global warming and/or ii) the atmospheric deposition of N. Although atmospheric N fertilization is difficult to disentangle from N loading from the catchment, the increase in N concentration and decrease in $\delta^{15}\text{N}$, even in lakes with reduced human impact, support this hypothesis. An alternative explanation for diatom community changes is the recent global warming, which started in 1975, according to local instrumental data. Temperature increase may have changed thermal and mixing properties of the lakes, favoring fast growing species and sinking resistant species, which explains diatom assemblages shifts. The analysis of other proxies should help to clarify the individual or combined effects of these drivers on lake functioning and biodiversity.

Diatom-based environmental reconstruction in Lake Caveiro (Azores archipelago) during the Mid and Late Holocene: preliminary results

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Environmental reconstructions based on lacustrine sedimentary records are important tools to assess long-term changes in lake conditions and correlate these changes with environmental drivers, such as climatic fluctuations, volcanic activity and anthropogenic disturbances. Here we present the main impacts of these drivers on Lake Caveiro (Pico island, Azores archipelago) using a diatom-based environmental reconstruction over the last ca 6000 yrs. A 952 cm long sediment core retrieved in 2015 from the offshore zone of the lake was analyzed for diatoms, X-ray fluorescence (XRF) core scanning and elemental and isotope geochemistry on bulk organic matter. Diatom habitat preferences changed along the sequence suggesting changes in the lake level. Higher abundances of benthic epipelagic species over planktonic species (4000-5850 cal yr BP; 1400-3500 cal yr BP; 750 cal yr BP – present) indicate lower lake level phases. Conversely, increases in the planktonic over the benthic epipelagic species indicate a highstand lake phase between 3500 and 4000 cal yr BP. These changes appear to be associated with climatic fluctuations ruled by the North Atlantic Oscillation (NAO). Periods with low (high) lake levels were dominated by positive (negative) NAO conditions. Furthermore, the negative dominance of NAO between 3500 and 4000 cal yr BP corresponds with enhanced terrigenous inputs, which are reflected by higher values of XRF, TOC/TN ratios, and inversely. Very rapid sedimentation events are rarely present throughout the sequence, defined by sediment gravity floods and slumps. These instantaneous events are reflected in the sedimentary record by increases in the aerophilic diatoms. The last phase of the lake (from 750 cal yr BP to present) seems to be mainly associated with anthropogenic changes. An increased lake primary production starting around 750 cal yr BP, reflected by high diatom accumulation rates, low TOC/TN and XRF values, could be associated with forest clearance and introduction of fishes. Changes in terrigenous inputs and lake productivity were also confirmed by $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ variation along the sedimentary sequence. These results highlight diatoms as powerful indicators in environmental reconstructions and the relevance of climatic and anthropogenic drivers in the evolution of lake ecosystems.

Mid to Late Holocene environmental reconstruction based on Cladocera fossils in the sediments of Lake Caveiro (Pico Island, Azores)

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Cladocera occupy an intermediate trophic level in aquatic food webs, responding to bottom-up and top-down control of the food web. Furthermore, Cladocera shells are resistant to degradation and their remains often accumulate in lake sediments. Therefore, Cladocera fossil remains from lake sediments can be used to assess past environmental conditions related to climate, hydrological and anthropogenic changes. In this study, we performed a Cladocera-based environmental reconstruction in Lake Caveiro (Pico Island, Azores) using a 952 cm long core record collected in 2015, covering the last 8200 years. The cladoceran assemblages are dominated by littoral species, both in terms of species richness (14 species) and abundance. Open-water planktonic species are represented by four taxa and have lower abundance than littoral species throughout the entire sequence. Cladocera remains are rare in both the volcanic dominated lower part of the core (849 – 952 cm, 8200-6000 yr cal BP) and layers of instantaneous sedimentation events. The high abundance of aerophilic diatoms confirms the terrestrial-alluvial origin of sediments of these layers. The cladoceran assemblages found in the lacustrine sediments were grouped in five zones. The lowest zone, ca 6000 yr cal BP, is characterized by low diversity and the dominance of the pioneer *Chydorus brevilabris-sphaericus*. This zone has been interpreted as indicative of low and oscillating lake level conditions, most probably related to the onset of permanent lacustrine conditions in the Caveiro basin. From ~5700 to ~600 yr cal BP, climate fluctuations seem to be the main forces of change in the Cladocera community. Assemblages dominated by macrophyte-associated species with taxa indicative of warmer waters present in high organic matter production environments suggest warmer periods (~5700-3100 and ~1600-600 yr cal BP), whereas the dominance of planktonic species in low organic matter production environments and the presence of cold-water taxa suggest a cold period between ~3100-1600 yr cal BP. From ~600 yr cal BP to present a rapid increase in the abundance of *Alonella nana* and a reduction both in species richness and diversity, mainly related to the disappearance of planktonic species, was coincident with the beginning of anthropogenic impacts (e.g. deforestation, fish introduction). Cladocera community changes in Lake Caveiro highlight the importance of climatic and anthropogenic forces in lake evolution.

Connecting landfills with natural wetlands: gulls as example of toxicant transporters

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Waterbirds are able to import external compounds such as nutrients (N,P) and heavy metals into aquatic ecosystems. In Andalusia, the Lesser Black Backed Gull (*Larus fuscus*) population has been increasing in recent decades to such an extent that it has become the second most abundant wintering waterbird. This population increase, in combination with their regular daily movements between foraging areas (e.g. landfills) and roosting places, means that a large source of external contaminants and nutrients can be imported into aquatic ecosystems. Our aim is to report and quantify such biotransport by *Larus fuscus* in Fuente de Piedra Lagoon (Málaga). This is a Ramsar site and the most important roosting site for this bird in Andalusia, with up to 29,000 birds in winter. We used movement ecology data from 25 individuals tagged with GPS transmitters. We quantified the average time spent per month in the lagoon and foraging time in roosting places for winters ranging 2010-2017. Total N and P nutrient content, as well as a 12 different heavy metals and metalloids were analyzed in fecal samples. These data were combined with monthly counts to quantify the total external loading effect for different winters. Such external loading may have an effect in the ecosystem dynamics, which is likely to change as the water level of the lagoon varies over time.

Assessment of macroinvertebrates communities responses across regulated and non regulated sites

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One of the direct consequences of flow regulation is the alteration of flow and stream temperature conditions, but studies describing and quantifying the response of biotic elements to changes in both variables have been sparsely done. This study analyzes macroinvertebrate community responses to flow regulation, through the study of discharge and stream temperature variability across two regulated rivers (Esla and Porma Rivers) and one non regulated river (Curueño River), all of them located in the Upper Esla basin (Duero Basin). Two sampling reaches were selected in each river located at the same latitudinal range. Discharge variability was measured in all rivers. Stream temperature records were collected from each reach sampling site at 2 hour intervals using HOBO temperature loggers between summer 2013 to summer 2016. Macroinvertebrates were collected in autumn and summer and individuals were subsequently identified to genus level, except for Diptera which was identified to sub-family level and Oligochaeta which was identified as such. We quantified macroinvertebrate community abundances, functional traits and some community indices: Richness, Shannon diversity and EPT (abundance of Ephemeroptera, Plecoptera and Trichoptera families). Macroinvertebrate functional traits were processed from Tachet et al. (2003) database. Similarity percentages (SIMPER) analysis were implemented to find the most sensitive taxa and traits, together with analysis of similarities (ANOSIM and PERMANOVA) to quantitatively explore the relation between regulated and non-regulated sites. Preliminary results show a higher dissimilarity in macroinvertebrate communities between regulated and non regulated sites in summer, while there is no regime effect on autumn samples. This could be explained by the higher discharge and the lower stream temperature found in regulated rivers during summer, as a consequence of the dam regulation purposes. Regulated rivers showed a higher richness and Shannon diversity. Some taxa as *Micrasema*, *Gammarus*, *Glossiphonia* or *Pisidium* were only found in regulated reaches. The Porma river showed the highest regulation intensity and contained the most rich and diverse macrobenthos. Our results show that flow regulation effects on macrobenthos are site-specific and in some cases may imply the improvement of their flow and temperature conditions along the summer months.

A multidisciplinary study to understand inter- and intraspecific agonistic interactions between two invasive species of freshwater crayfish

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Invasive species are one of the most important threats to biodiversity globally, with freshwaters being one of the most susceptible ecosystems. Freshwater crayfish are among the world's most successful aquatic invaders. Crayfish play a key role within trophic networks and are often important ecosystem engineers. In recent years, different invasive crayfish species have expanded rapidly throughout Europe, and their distributions overlap. Thus, complex interactions among invasive crayfish may be occurring, which could have consequences for the fitness and/or the invasion success of the different species. To date, most of the research on interactions among crayfish species has focused on ethological studies of agonistic struggles or competition for resources. However, studies exploring the mechanisms underlying such interactions remain very limited. In this study, we combine an ethological approach with the study of the gut microbiota and the proteome to explore proximal mechanisms of species interactions. There is increasing evidence that gut microbiota can modulate the host behaviour and can be altered by biotic stress (e.g. presence of a competitor). Stressful factors can also cause changes in protein expression, which can result in behaviour modifications. To study these mechanisms we used two of the most widespread invasive crayfish species in Europe: signal crayfish (*Pacifastacus leniusculus*) and red swamp crayfish (*Procambarus clarkii*). We registered inter- and intraspecific interactions during one-day experiments. Upon completing the experiment, we extracted digestive tract, hepatopancreas and gills from each crayfish to analyse the proteome and to quantify bacteria and viruses from the gut microbiota by flow cytometer. Here, we present the results of: (1) a quantitative description of agonistic interactions; (2) gut microbiota characteristics (quantification of virus and bacteria) and its relationship with host-behaviour; and (3) proteome under different stress scenarios caused by the presence of competitors where statistical descriptive analyses (gel analysis, cluster and PCA) on 1D gels showed discrimination between species, sexes and treatments. Overall, the results of this study provide a better understanding of the underlying mechanisms explaining the competitive interactions between invasive species.

Litter decomposition and associated fungal decomposers are affected by forest streams invasion by *Acacia* spp

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Invasion of native forests by exotic species is occurring worldwide. In central Portugal, native deciduous forests dominated by oaks and chestnuts are being invaded by *Acacia* species. These fast-growing species have the capability to fix atmospheric nitrogen (N), accumulate high biomass and out-compete native plants. Forest streams highly depend on litter inputs from terrestrial origin. Thus, native forests invasion by *Acacia* species, and subsequent change in litter characteristics can have strong effects on ecosystems integrity. Here we assessed the effects of litter identity/quality and dissolved nutrient concentrations on litter decomposition and associated fungal decomposers in laboratory microcosms simulating stream conditions. Leaves of two native (alder, *Alnus glutinosa* and oak, *Quercus robur*) and two invasive (mimosa, *Acacia dealbata* and acacia, *Acacia melanoxylon*) species were enclosed in fine-mesh bags (0.5 mm) and immersed for conditioning in 3 'native' and 3 'invaded' streams in Serra da Lousã (central Portugal). After 1 week, leaf-discs from alder, oak and acacia leaves and leaflets from mimosa were transferred into microcosms containing water from native/invaded streams and incubated for 14–70 days. Litter decomposition differed between species, in the order alder > oak > acacia ~ mimosa. Acacia leaves decomposed slower most likely because they were tough and had a thick cuticle that acted as a physical barrier for microbial colonization. For mimosa the reason for slower decomposition is not clear as leaflets were soft, nutrient-rich and fully colonized by microbes. Fungal sporulation/biomass and microbial respiration were higher in alder and mimosa, suggesting that decomposers feed preferentially on soft, nutrient-rich leaves. Microbial activity differed between stream types (native vs invaded): invaded streams had higher microbial respirometry and fungal sporulation, suggesting a stimulation of microbial activity due to increased N concentration. Aquatic hyphomycete community structure differed between litter species and stream types. This could be attributed to the higher number of fungal species recorded for alder, mimosa and oak leaves in invaded streams, and to the lower fungal sporulation in acacia. Results suggest that invasion by *Acacia* species may affect litter decomposition in streams, via changes in litter inputs (identity/quality) and water chemistry, thus changing ecosystem functional parameters.

Can the invasion of native forests by *Acacia* spp. affect leaf decomposition in streams?

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The invasion of forest habitats by exotic plant species is a serious problem worldwide, and *Acacia* spp. is among the most problematic invaders in Portugal. Forest streams are particularly vulnerable to changes in the surrounding vegetation, given their high dependence on the input of litter from terrestrial origin. Litter decomposition is a fundamental ecosystem process, carried out mainly by microbes and invertebrates. Among microbes, aquatic hyphomycetes play a pivotal role by degrading plant cell walls and improving leaf palatability to invertebrate shredders. In a first experiment, we assessed if leaf decomposition in streams was affected by the invasion of riparia forests by *Acacia* spp., and if this effect was mediated by litter quality, diversity or dissolved nutrient concentration. For that, senescent leaves of two native species, alder (*Alnus glutinosa*) and oak (*Quercus robur*), and one invasive acacia species (*Acacia melanoxylon*) were used. Leaves were enclosed in fine-mesh bags (0.5 mm) and immersed in three reference and three 'invaded' streams in Serra da Lousã (Central Portugal) for 14–98 days. Leaf decomposition rates differed significantly between species, in the order alder > oak > acacia. This suggests that microbial decomposers prefer high quality leaves. Decomposition rates were significantly higher in invaded than reference streams only for alder leaves, suggesting that invasion effects are more pronounced in high quality leaves. In a second experiment, we assessed the individual and combined effects of leaf diversity on leaf decomposition. For that, acacia (A) and chestnut (*Castanea sativa*; C) leaves were enclosed in fine-mesh bags (0.5 mm), in a total of five treatments (100%A, 75%A+25%C, 50%A+50%C, 25%A+75%C, 100%C), and immersed in a reference and an invaded stream for 7–77 days. Decomposition rates differed significantly between treatments, with decomposition decreasing with increasing acacia proportion. Thus, litter decomposition can be affected as acacia invasion progresses. When considered individually, decomposition rates of chestnut and acacia leaves were not affected by treatments, suggesting additive effects of litter diversity on litter decomposition. Our results suggest that the invasion of native forests by *Acacia* spp. can affect litter decomposition and consequently the functioning of aquatic ecosystems.

Cladoceran and diatom assemblage distribution in alpine lakes of Sierra Nevada (Spain) and its relationship to environmental variables

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Surface sediments from 17 high-mountain lakes in the Sierra Nevada (Spain) were analyzed for diatom and cladoceran assemblages in order to evaluate the relationships between species assemblages and environmental variables. According to multivariate techniques, %LOI550 is the most important explanatory variable of diatom assemblages although the explained variance is <10% probably because the low diatom variability across Sierra Nevada lakes, where all diatoms are benthic species. Distribution of cladoceran assemblage is mainly associated to morphometric variables (the presence of inlets and outlets in the lake basins and the % shoreline in contact with the alpine meadows). Among cladoceran taxa, *Alona quadrangularis* was strongly associated to open lakes (with permanent surface outlets) and surrounded by meadows, both lake features may imply a higher input of material within the lake from its catchment. *Alona quadrangularis* and *Chydorus sphaericus* relative abundance showed a significant negative relationship. Higher abundance of *C. sphaericus* was found in closed (without surface outlets) and open-closed (with temporary surface outlets) basins with less or no meadows surrounding the lake. This is mainly associated to their advantage to inhabiting littoral and water pelagic column, particularly in these relatively small Sierra Nevada lakes. Additional analyses further support a strong influence of two morphometric variables (maximum depth and presence of outlets) on *Daphnia* presence. The absence of *Daphnia* in open systems may be related to the negative effect of dilution on *Daphnia* population development associated to a high water renewal in these lakes. Our results indicate the strong influence of morphometric variables on the distribution of cladocerans in Sierra Nevada lakes and suggest that the intense predicted warming for this region could affect the trophic food web by means of abundance changes of *Daphnia* and slow-growing zooplankton species. Results of previous limno- and paleolimnological analyses support this hypothesis.

Modulation of the horizontal food web mediated by the response of charophytes to global change stressors: a mesocosm experiment

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Charophytes (submersed macrophytes) constitute a key group in freshwater ecosystems, highly vulnerable to global change. They play an intense control over the benthic-planktonic food web related to them (called hereafter horizontal food web, HFW) by means of several mechanisms, e.g. allelopathic interactions. This fact highlights the importance of unravelling how the affection of charophytes due to global change-related factors could disturb the HFW and, thus, the structure and function of the ecosystems they inhabit. Furthermore, the effects of global change are expected to be more noticeable in the Mediterranean region, where, in addition, freshwater ecosystems are often shallow water bodies or small lakes. With this background, a mesocosm experiment was carried out with the cosmopolitan charophyte species *Chara hispida* collected from a Mediterranean interdunal pond. Twelve 200L mesocosms, filled with tap water and sediment and an inoculum of water from the origin site, were used to allow the development of charophyte meadows. Three conditions resulting from the interaction of two factors related with global change (i.e. temperature and ultraviolet radiation UVR) were tested: i) 21°C-NO UVR addition, ii) 26°C-NO UVR addition and iii) 21°C+UVR addition (2.2 W m⁻²). All the conditions had a dose of photosynthetic active radiation (PAR) of 89 μmol photons m⁻² s⁻¹. The experimental set-up was maintained time enough for charophytes to form a dense meadow and for a benthic-planktonic community to be established. Physical and chemical variables were monitored weekly in the mesocosms to ensure the maintenance of experimental conditions and to confirm changes in a variable related with the system's function such as the partition of the nitrogen compounds (in water, biota and sediment). Furthermore, the charophytes' physiological state (growth, morphology and pigments) was assessed weekly. The main target variables of this study were: the composition of the benthic (on inert substrate such as mesocosms walls, sediment, and on charophytes) and planktonic communities (from bacteria to macroinvertebrates). We expressed the abundance of each population in carbon units to build and characterize the complex HFW. The comparison of these HFWs in the different experimental conditions allowed us to determine the stabilizing role of charophytes in the aquatic community.

Thermal response of Sanabria Lake to global change (Duero catchment, Zamora, Spain)

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Are large water bodies able to act as sensors of global change? As accumulators of water and heat, some of their thermal characteristics might be altered by long term (decadal) hydrometeorological changes and thus be used as indicators of the effects of global change on fluvial ecosystems. The project Reservoirs and Climate Change focuses on the study of the incidence of global change (climate change plus change of water and land uses) in the internal organization of large water bodies, specifically in its thermal annual cycle. The project studies the existence of temporal trends in the thermal behaviour of a selection of Spanish water bodies through the analysis of historical field data. In this communication we present the results of the first study case: Sanabria Lake (Duero catchment, Zamora, Spain), where monthly water temperature profiles are available since 1986. Sanabria Lake, the largest glacial lake of the Iberian Peninsula, is not subject to water flow regulation nor to water level changes, being an adequate case of study for the methodological development. Data analyses include non-parametric statistic techniques to evaluate long term and seasonal patterns of hydrometeorological and thermal variables. The preliminary results corresponding to this and other study cases point out to significant trends indicating that these large water bodies integrate the changes that occurred in their basin, despite the full understanding of the processes involved, would require larger spatial scales of study. These results might contribute to define indicators of the effects of global change on fluvial ecosystems. In the case of reservoirs, it is planned to design management criteria that contribute to adapt their exploitation to new scenarios of global change.

Estudio del nivel de afección de las masas de agua continentales españolas por trece especies exóticas invasoras de importancia para la Unión Europea

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La introducción de especies exóticas invasoras (EEI) es, según la UICN, una de las principales amenazas para la conservación de las especies autóctonas y de los ecosistemas en general. Es por ello que tanto a nivel estatal como de la UE existe normativa desarrollada para controlar y combatir este problema. En este contexto, el Centro de Estudios Hidrográficos del CEDEX, viene trabajando en la identificación temprana y seguimiento de EEI de fauna y flora en ecosistemas acuáticos continentales. Los objetivos del estudio que aquí se presenta han sido: 1) Establecer el nivel de afección de las masas de agua continentales identificadas en España en cumplimiento de la "Directiva Marco de Aguas" por trece de las EEI preocupantes para la UE. 2) Estudiar la evolución de dichas especies desde su introducción en España hasta la actualidad. La información sobre las especies se ha obtenido mediante la revisión exhaustiva de trabajos publicados. A partir de ella, se ha creado un S.I.G. donde se incluyen todas las citas encontradas en España sobre las especies estudiadas: *Eriocheir sinensis*, *Orconectes limosus*, *Pacifastacus leniusculus*, *Pseudorasbora parva* y *Procambarus clarkii*, *Baccharis halimifolia*, *Eichhornia crassipes*, *Hydrocotyle ranunculoides*, *Lagarosiphon major*, *Ludwigia grandiflora*, *L. peploides*, *L. repens* y *Myriophyllum aquaticum*. Los resultados obtenidos muestran que al menos el 45% de las masas de agua consideradas están afectadas por alguna de estas especies. Con diferencia, es *Procambarus clarkii* la especie más extendida, estando presente en un total de 1534 masas de agua. Desde la primera cita hallada, de 1976, la especie se ha expandido llegando a afectar al 31 % de las masas de agua españolas. En el caso de *Pacifastacus leniusculus*, fue citada por primera vez en 1994, y actualmente está presente en 672 masas de agua. La aparición en España de *Pseudorasbora parva* es mucho más reciente y su distribución mucho más reducida. Fue citada por primera vez en el año 2001 y ya se encuentra en 34 masas de agua. *Eichhornia crassipes* se detectó por primera vez en 1988 y aparece al menos en 30 masas de agua. *Baccharis halimifolia* se encuentra en 25 masas de agua. El grado de expansión del resto de las especies estudiadas es incipiente, ya que se localizan en un número muy reducido de masas de agua.

Estudio del caracol exótico *Sinotaia quadrata* (Viviparidae Caenogastropoda) hallado recientemente en arroyos de la llanura pampeana Argentina

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Sinotaia quadrata, es un caracol vivíparo originario de Asia que fue registrado en 2015 en un arroyo periurbano de la llanura pampeana. Con el objetivo de determinar si la población está establecida se realizaron muestreos mensuales durante 2016 – 2017. Por otra parte para evaluar si existe solapamiento del nicho trófico y el potencial desplazamiento del gasterópodo nativo *Pomacea canaliculata* (Ampullaridae), se analizaron algunos rasgos biológicos de ambas especies (ciclo de vida, fertilidad y tipo de alimentación). Los muestreos se llevaron a cabo en sitios del arroyo donde están presentes ambas especies por medio de cuadrados de 0.065m². Se relevaron asimismo parámetros fisicoquímicos, hidrológicos y la cobertura de las diferentes especies de macrófitas. Se calculó la densidad de ambas especies y se realizó la disección del tubo digestivo para determinar el solapamiento del nicho trófico (Índice de Schoener). Se realizaron experiencias de laboratorio para evaluar la fertilidad mensual. Se pudo determinar que *S. quadrata* se encuentra establecida en los sitios estudiados y presentes en diversas especies de plantas acuáticas. En uno de los tramos canalizados con elevada contaminación orgánica, se observó un aumento significativo de la densidad de la especie exótica, evidenciando su mayor tolerancia a diferentes calidades ecológicas. El estudio de la dieta de ambas especies, evidenció valores altos del índice de Schoener, indicando un solapamiento de nicho trófico principalmente en primavera (PS=0,99). El estudio del ciclo de vida mostró que el gasterópodo exótico se reproduce todo el año (en primavera: 11±7 juveniles/ hembra) y no presentó período de hibernación, a diferencia de la especie nativa con reproducción en primavera-verano (381 ±165 huevos/ hembra) y un período de hibernación (otoño invierno) donde se introduce en el sedimento. Los rasgos biológicos de *S. quadrata* analizados junto con su amplia tolerancia a la contaminación orgánica, podrían ser una ventaja adaptativa de esta especie exótica. No obstante aún se desconocen muchas de sus características ecológicas y tolerancia a perturbaciones en esta latitud. Es importante resaltar que los arroyos de la zona presentan características y grado de impacto similares, convirtiéndolos en ambientes susceptibles de ser colonizados por esta especie exótica. Por lo tanto su monitoreo resulta relevante para desarrollar estrategias de manejo y prevención.

Flujos de sedimento, carbono y metales pesados en un lago de alta montaña durante el último milenio en el Lago Urdiceto (Huesca, Pirineos)

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El estudio multidisciplinar del registro sedimentario de un lago de alta montaña (ibón de Urdiceto, 2369 msnm) en la cabecera del Cinca (Pirineo Central, España) ha permitido la reconstrucción del impacto que han tenido sobre los flujos de sedimento, el ciclo del carbono y la deposición de metales pesados, factores como el clima y las actividades antrópicas durante los últimos mil años. Las técnicas utilizadas incluyen análisis sedimentológicos, elementales (Carbono Orgánico Total, Carbono Inorgánico Total y Azufre) y con escáner de fluorescencia de rayos X. El modelo de edad está basado en dataciones radiométricas absolutas (210Pb y 14C) y ha permitido reconstruir la dinámica sedimentaria del lago durante el último milenio. Las series climáticas (precipitación y temperatura) que se han utilizado provienen de datos instrumentales recientes y series climáticas reconstruidas mediante técnicas dendrocronológicas. Los sedimentos son limos de finos a gruesos con materia orgánica y con abundantes capas de arenas finas que se presentan ocasionalmente en secuencias granodecrecientes. Estas facies sedimentarias reflejan los cambios en la producción y transporte de sedimentos de la cuenca que responden a la variabilidad de la escorrentía controlada esencialmente por los cambios en el clima. Durante los periodos más fríos las capas de arenas son más frecuentes, mientras que los limos finos más orgánicos dominan en periodos más cálidos. La construcción de una presa para su explotación y aprovechamiento hidroeléctrico en 1930 cambió la dinámica sedimentaria que pasó a estar fuertemente condicionada por el régimen de explotación; los niveles de lago más elevados desde el cierre de la presa en 1940 han favorecido sedimentación de limos más finos y mayor acumulación orgánica. El aumento de Pb en los sedimentos marca un periodo de contaminación por metales pesados a finales del siglo XIX y durante la primera mitad del siglo XX asociado a mayor intensidad de la minería y la metalurgia a escala local y regional y un descenso a finales del siglo XX debido probablemente a la prohibición de las gasolinas con Pb. La secuencia de Urdiceto demuestra la sensibilidad de la dinámica sedimentaria de los ibones pirenaicos a cambios climáticos a escala decadal o centenaria durante el último milenio, el gran impacto de la construcción de las presas en estos ecosistemas y el alcance de la contaminación por minería y metalurgia en ambientes remotos del Pirineo.

Estudio fenológico de *Dreissena polymorpha* (Pallas, 1771) en embalses del País Vasco

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El mejillón cebra (*Dreissena polymorpha*) es considerada como una de las especies exóticas invasoras acuáticas más dañinas. Las primeras poblaciones estables de esta especie en la Península Ibérica fueron detectadas en 2001 en el tramo bajo del río Ebro (Tarragona). Desde entonces se ha dispersado rápidamente por toda la península Ibérica, llegando al País Vasco en 2006, cuando apareció en el embalse de Sobrón (Álava). En 2011 se detectaron larvas en los embalses de Urrunaga (Álava) y Undurraga (Bizkaia). El presente trabajo, realizado por Cimera Estudios Aplicados, S.L. para la Agencia Vasca del Agua, profundiza en el análisis de las características fenológicas de la especie a través del seguimiento de su presencia en estos dos embalses en el periodo comprendido entre 2011 y 2013. El patrón de distribución temporal a lo largo de cada año se ajusta a la perfección a las preferencias de la especie respecto a las condiciones fisicoquímicas y rangos de tolerancia mostrando una marcada relación con la temperatura. Igualmente, la concentración larvaria en términos absolutos evoluciona a lo largo del periodo de estudio hacia dinámicas de población típicas para la especie en estas latitudes.

SR15.

**Conservation and
Restoration**

Decreasing the environmental impact of abandoned mines on freshwater ecosystems: The LIFE DEMINE project

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Mining activities cause serious environmental damage to their surroundings, with considerable impacts on freshwater ecosystems. These impacts occur mainly through the discharge of polluted effluents, which may contain high concentrations of heavy metals or salts, depending on the type of mine. This environmental problem is especially critical for abandoned mines, because there is no company in charge of treating these mining effluents, leaving a legacy of local and global pollution. Indeed, abandoned mines are a major concern, as reflected by the Mining Waste Directive (2006/21/EC), and the unregulated loading of metals and salts from abandoned mines hinders the achievement of good chemical and ecological status in surrounding water bodies, in accordance with the Water Framework Directive (2000/60/EC). Currently, no real solution exists for this significant environmental problem and proper management solutions are urgently needed. In this context, the main objective of the LIFE DEMINE project is to demonstrate and disseminate the technical and economic feasibility of decreasing the overall environmental impact caused by abandoned mining effluents in freshwater ecosystems. This will be done by adopting an innovative and versatile treatment process that will include existing and widely known technologies based on membrane processes and electrocoagulation, with the global aim of obtaining a non-polluting final effluent. After a first optimization process at bench scale, two pilot plants will be implemented at Frongoch (UK) and Menteroda (Germany), which are abandoned mines that generate polluting effluents rich in metals or salts, respectively. The efficiency of this new technology in reducing the ecological impact caused by mining effluents will be assessed in laboratory and mesocosm experiments by comparing the short-term response of stream biofilm and macroinvertebrates communities to stream water containing untreated and treated mining effluents. In addition, the LIFE DEMINE project will characterize the composition of several mining effluents from different European region, review the current state of knowledge regarding the ecological impact of abandoned mines on freshwaters, and increase awareness of this problem among stakeholders. Results from this project will contribute to deal with this global environmental problem, increasing the sustainability of the mining sector while vastly improving the quality of affected water bodies.

DESEMBALSE: effects of decommissioning a large reservoir (Enobieta, Navarre, Iberian Peninsula) on stream biodiversity and ecosystem functioning

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Abstract. In the last decade dam removal has gained momentum as a tool for river restoration, although still little is known on its impacts on and benefits to river ecosystems. The Enobieta Reservoir (Artikutza, Navarre, 42 m tall), built in the 1950's to supply drinking water to the province of Gipuzkoa, has been unmanaged since the Añarbe Reservoir was built further downstream in 1976. Structural problems, aggravated by decades of neglect, prompted the municipality of Donostia – San Sebastian to decommission the dam (the largest so far removed in Europe) by digging a tunnel through it. Project DESEMBALSE will investigate the effects of this major work on sediment dynamics, river biological communities and ecosystem functioning following a before-after-control-impact (BACI) design. The main hypothesis is that the emptying of the reservoir will produce geomorphological changes both upstream and downstream from the dam, which will affect both riverine communities and ecosystem functioning. We predict that upstream of the dam a lotic habitat will be restored whereas downstream of the dam sediment transport will cause channel aggradation with significant changes in hydraulics. Given the high dynamism of the rivers in the area, a rapid recovery is expected as the sediments are distributed downstream. The results obtained from this study will provide comprehensive information on the interaction between biological and geomorphological effects after emptying the reservoir.

LIFE+ RIPISILVANATURA: Effects of riparian restoration actions on aquatic macroinvertebrate community

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Invasive alien species are among the top five causes of biodiversity loss. In particular, giant reed (*Arundo donax*) has progressively colonized the riparian zones of Mediterranean rivers with detrimental effects on riparian and aquatic biodiversity. Hence, different methods have been traditionally used to control it. We assess the effect of a non-evaluated restoration action (i.e. repeated pruning combined with the plantation of native riparian species) on the aquatic macroinvertebrate community and the values of biomonitoring indexes in the context of the project LIFE13BIO/ES/001407 RIPISILVANATURA. Thus, we evaluate if aquatic macroinvertebrates show significant responses to restoration measures through annual biomonitoring (sampling before and after the restoration from 2015 to 2018) in a set of representative sampling sites compared to a set of reference localities. Ordination (NMDS) and classification (Cluster) analyses were performed on the different years to check the evolution and response of aquatic macroinvertebrate composition to restoration actions. Permutational multivariate analysis of variance was also done to look for significant compositional differences between reference and restoration plots. We applied mixed-effect models to analyze the change in taxonomic richness and quality status (IBMWP) through time and to identify the riparian variables that could be underpinning it (such as native species richness, coverage, riparian quality and height and density of giant reed). During this preliminary assessment, an increase in aquatic macroinvertebrate abundance and richness, as well as IBMWP values were observed in response to restoration actions. These trends seem related to the significant reduction of the giant reed height, the increase of riparian vegetation species richness and the improvement of the ecological status. These changes mainly occurred two years after the execution of restoration actions. Although some general improvement was observed, restored sites are still far from reference values so both the treatment and monitoring should be extended in time to reach stronger results and conclusions.

Un modo de vida frenético: selección de hábitat y de dieta por el desmán ibérico

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El desmán ibérico (*Galemys pyrenaicus*, Geoffroy 1811) es un insectívoro acuático endémico de la Península Ibérica que se encuentra en declive en toda su área de distribución. Aunque sus requerimientos ecológicos se conocen a grandes rasgos, se sabe poco de cómo utiliza el hábitat y el alimento a escala de tramo, lo que limita las posibilidades de gestión. Por ello, comparamos la selección de hábitat y de dieta por esta especie amenazada en dos arroyos, uno (Elama) en excelente estado de conservación y otro (Leitzaran) afectado por explotaciones hidroeléctricas y forestales. Realizamos el radioseguimiento de 31 individuos, comparando la utilización con la disponibilidad de hábitats. Además, realizamos análisis metagenómicos de sus excrementos para comparar la dieta consumida con la disponible en cada tipo de hábitat (rápidos, tablas o pozas). El desmán mostró una gran preferencia por los rápidos y una preferencia negativa por las pozas, siendo la selección de hábitat más intensa en el arroyo más alterado. Su dieta resultó consistir principalmente en macroinvertebrados acuáticos, aunque también aparecían especies terrestres con cierta frecuencia. Los resultados sugieren que las centrales hidroeléctricas tienen un impacto negativo para el desmán, ya que reducen la superficie utilizable su área de campeo y la abundancia de rápidos, su hábitat preferido.

Rehabilitation scenarios for reservoirs: predicting aquatic communities through machine learning

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In present study, we tested the applicability of a machine-learning tool (HYDRA) to simulate rehabilitation scenarios of reservoirs. The HYDRA was used to build a “dirty-water” predictive model based on 129 training sites from semi-arid reservoirs of SW Brazil, covering a gradient of disturbance, and including predictive variables translating anthropogenic disturbance (contrary to those based on the Reference Condition Approach). Then, the model was used to simulate the effects of the rehabilitation measures (treatment of the urban effluents discharging into the reservoirs or associated rivers) in the macroinvertebrate communities, through the manipulation of predictive variables related to eutrophication (phosphorus, soluble reactive phosphates, transparency and chlorophyll-a, dissolved oxygen, total dissolved solids and turbidity). Two different rehabilitation scenarios were built (D1 = lower improvement, 25% of change; D2 = higher improvement, 75% of change); and three initial levels of disturbance were considered (Severely disturbed-SD, Intermediately disturbed-ID, Least Disturbed-LD), based on PCA analyses. The effects were analyzed in terms of changes in Expected taxa (E) against Observed (O) richness (OE ratios), communities’ composition, biotic and trophic status indices and spatial distribution of sensitive taxa. The “dirty-water” model had a high accuracy in taxa prediction (mean > 0.73; sd 0.15-0.19) and precision: O/E = 0.78 (SDOE = 0.17); OE linear regression R² = 0.89, slope = 0.86, intersection = -0.75. All simulations resulted in the significant improvements (PERMANOVAs: p<0.001) for all disturbance levels and indicators (trophic status index, biotic index for invertebrates and total richness). Sensitive taxa from Trichoptera, Ephemeroptera and Diptera expanded their distribution across the reservoirs. The greatest differences in richness were found for the SD sites but richness reached higher levels in LD sites under D2 scenario. The simulations showed also that rehabilitation measures even in artificial systems such as the reservoirs could result in a higher biodiversity, biological quality and water quality. In addition we showed that there is still room for improvement in communities even at the least disturbed sites. The HYDRA tool and the “dirty-water” models showed a high potential for management and conservation purposes, enabling the determination of the most cost-effective rehabilitation measures and their follow-up.

Spatial variability of *Salmo trutta* at river network scale. What variables are influencing population structure?

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Brown trout, *Salmo trutta* (Linnaeus, 1758), has a great cultural, economic and environmental importance all throughout the world, as it is the fish top-predator in many freshwater ecosystems. Several biotic and abiotic conditions can affect *Salmo trutta* populations, thus, it is essential for their conservation and management to identify the main factors influencing its distribution and spatial patterns in river networks. The purpose of this study is double. First, to explore the effect of different environmental variables (climatic, habitat, basal resources type, etc.) on the variability of the abundance of brown trout population for its different stages of development (fry, juvenile and adult) in the Deva-Cares catchment. Second, to analyze how important are Euclidean and/or hydrological distances on the spatial distribution of the brown trout abundance. The study area (1200 Km²) is located in northern Spain and a large part of the catchment is located within the Picos de Europa National Park. Our analysis is based on field data samples collected in 76 sites distributed throughout the river network in 2014 during the low flow season (August to October). To achieve our aims and to analyze fish abundances we used spatial statistical methods for river networks based on covariance structures. Our results show the influence of different environmental variables on the density for each stage of development, (fry, juvenile and adult). In this regard, the most important covariates in the spatial model for fry are the density of adults, the catchment area and the mean annual temperature in the sub-basin, for juveniles are the mean bankfull width of the river reach and for adults are the mean annual precipitation in the sub-basin. Of the total variance explained by the spatial models, the euclidean spatial component is important for fry, while hydrologic spatial components are important for juvenile and adult, showing how our data exhibit patterns of spatial autocorrelation. These results allow us to improve our understanding of how fish densities change in a river network considering spatial structures, which is essential in dendritic networks for their conservation and management.

Tasa de sedimentación en una laguna de alta montaña: variabilidad temporal e implicaciones paleolimnológicas

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Se analiza mensualmente el proceso de sedimentación en la Laguna de Peñalara (Parque Nacional de la Sierra de Guadarrama, España) en el periodo 1997-2017. Este periodo (20 años) incluye una época inicial en la que los márgenes de la laguna estaban sometidos a una fuerte erosión, así como el periodo post-restauración ecológica. La tasa de sedimentación se obtuvo utilizando trampas de sedimento instaladas en el punto de máxima profundidad (4.5m), analizándose del material recogido el peso seco (DW) y la pérdida en ignición (LOI). Se observa un claro patrón anual con los máximos de sedimentación en los meses estivales (menor tasa de renovación) y los mínimos durante la época con cubierta de hielo. Durante los años en los que la orilla estaba fuertemente erosionada se registraron valores entre 41 y 191 mg cm⁻² año⁻¹, mientras que los valores tras la restauración presentan un rango de 9.1-30.7 mg cm⁻² año⁻¹. Estos resultados han permitido establecer unos valores de alerta para la tasa de sedimentación (como indicador de la erosión) en el sistema de seguimiento del Parque Nacional. En general, el porcentaje de materia orgánica (LOI) es menor cuanto mayor es la tasa de sedimentación, lo que parece indicar una mayor entrada de terrígenos frente al material endógeno (producción primaria principalmente) de la laguna en esos periodos de mayor sedimentación. Estos resultados tienen implicaciones además para la interpretación de análisis paleolimnológicos: en condiciones de elevada erosión de la cuenca, la fracción del total anual correspondiente exclusivamente a un corto periodo estival puede llegar a suponer más del 85%. De esta manera, la señal correspondiente al periodo invernal (e.g. la NAO, duración de la cubierta de hielo) podría quedar apenas reflejada en el sedimento de la laguna.

Preservation and environmental assessment of the Minho river cross-border

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Freshwater ecosystems are globally threatened by multiple factors, which results in a continuous degradation of the habitat for different species, natural resources and ecosystem services. These threats have become more important in recent years, so, to guarantee a sustainable development it is necessary the development of different environmental policies and monitoring programs. The Minho river, with a final section comprising the southern Galicia-northern Portugal border, is the most important river in the North-West of the Iberian Peninsula and it is under a great anthropic pressure; urban effluents from river basin, pollution from factories, agriculture, navigation, flux regulation, invasive species introduction, overfishing and a massive tourism are the most important threats for Minho river and its estuary. Since 2014 it is in force an Interreg project (0044_VISIT_RIO_MINHO_1_P), in which Galicia and North Portugal are working together with the objective of preserving and valuing the cultural and natural resources of the river and surrounding areas. Since January 2018, some research groups of the University of Vigo are performing the scientific part of the project. A study of the current conservation state of the river by gathering information from previous works will be carried out and several field campaigns will be developed to obtain complementary information. The main effort will be on themes such as identifying the most important threats and pollution sources, making an inventory of the invasive species or identifying the most important zones for biodiversity, which may be potentially useful to promote ecotourism. The obtained results will be shared in the communication of this work.

Use of different adsorption materials to remove the diuretic drug Furosemide

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High pharmaceutical consumption rates in the present times impose a major pressure influencing Wastewater treatment plants efficiencies (WWTPs). Pharmaceutically active compounds (PhACs) have been found in the effluents of these facilities showing that they cannot completely remove these pollutants. Additionally, in appropriate disposal of pharmaceuticals in landfills is another source of PhACs pollution. Together, these pollution sources can threaten river ecosystems as well as sensitive water bodies i.e. reservoirs and underground waters. However, the implementation of buffer zones in vulnerable systems such as WWTP discharge points or along river channels could prevent pollution diffusion. Incorporation of materials with high adsorption rates in the soil in these buffer zones can improve retention capacities allowing degradation mechanisms to act and remove pollutants from the water. The present work compared two different materials (Light Expanded Clay Aggregates (LECA) and Cork granulates) on their adsorption capacity to remove the PhAC Furosemide from water. Anti-hypertensive drugs are highly consumed in Europe. Furosemide, a diuretic drug used to treat edemas and high blood pressure, was ranked 15th out of the Top 100 active substances distributed in 2014 with the highest number of packages sold in the Portuguese National Health System. Three different concentrations of Furosemide in an ultrapure water matrix were tested to study the materials adsorption behaviours. The adsorption materials were submerged for 7 days in water spiked with the drug. Light exposure was avoided during the experiment to prevent photodegradation of the PhAC. Water samples were analysed by HPLC-UV. LECA showed a higher removal efficiency compared to Cork granulates, with minimum removal performances of 89.2% and 72.9% respectively. Nevertheless, Cork granulates showed a faster initial removal rate in the first 24h. The materials clearly showed different adsorption behaviours for Furosemide. Both materials showed positive results and their combination could promote pollutants removal from water.

Designing a Green Infrastructure Network (GIN) for three Cantabric mountain catchments

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According to the Millennium Ecosystem Assessment, Europe's landscapes are the most altered and fragmented in the world due to its long history of urbanization, agriculture, river management and extensive rail and road transportation systems. This has led to impacted aquatic and riparian ecosystems, reduction in ecosystem services, loss of biodiversity and increased exposure to climate change effects. To reduce these impacts, restoration strategies must strategically target key watershed processes and attributes in aquatic, riparian and upland environments but in ways that also support local communities. EU's "Green Infrastructure" initiative (2013) is designed to address this challenge, including as a linked network of restoration activities to enhance a wide range of ecosystem services. Green Infrastructure Networks (GINs) allow optimizing investments in order to move our system closer to its natural functioning. The main goal of this study was to design a GIN for three Cantabric mountain watersheds (Pas, Miera and Asón rivers) in order to improve the following ecosystem services: flood risk mitigation, fish biomass and water for civil uses (quantity and quality). The following GI elements were used, considering biodiversity, connectivity and ecosystem functioning criteria: aquatic habitats, floodplains, riparian zones, upland sources of erosion, road drainage upgrading and hillside vegetation (forests). This study proposes a multi model approach combining several spatial analysis tools (using NetMap software) with an habitat mapping approach based on remote sensing and habitat distribution models. This methodology allowed to combine different elements in order to locate landscape hotspots for the target ecosystem functions and landscape connectivity, developing a watershed context for the implementation of green infrastructure components. It was based on an optimum discretization of the territory, contemplating and combining restoration and conservation alternatives (e.g. afforestation, rewilding, floodplain restoration) to ensure the ecosystem service delivery conservation in the catchment. The selection of areas and actions was economically constrained for more realism. The final configuration of the GIN was decided using an objective multicriteria analysis which was defined by the particularities (strengths and constraints) of each territory.

Understanding the effects of hydro-morphological restoration measures on nitrogen cycling in riverine landscapes

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River restoration measures aim to improve and sustain ecosystem services of degraded river systems. Typically, these measures increase the hydrological connectivity between the river channel and the floodplain water bodies, enhancing nitrogen (N) retention and processing but potentially creating hotspots for *in situ* nitrous oxide (N₂O) production.

At present, the effects of river – floodplain restoration measures on nutrient cycling and N₂O emissions in riverine landscapes remain a source of uncertainty. To improve our understanding of these effects, a study is being conducted in River Traisen (Lower Austria), where an ecological restoration project took place (completed in 2016). In the frame of this project, large-scale flooding zones were restored, converting the formerly regulated river into a diverse floodplain landscape.

To understand how changes in hydro-morphological settings affect N cycling and N₂O emissions, and what are the environmental drivers leading to changes in intermediate and end products in the restored riverine landscape, the nutrient status of water, sediment and soil samples was evaluated. At the restored area, transects were defined to cover a flooding-frequency gradient, including dry, periodically and permanently flooded plots. Further, the spatially-replicated transects aimed at investigating sites differing in both N sources (Traisen vs. Danube, rivers with contrasting N contents) and carbon sources (forest vs. grassland). Soil, sediment, gas and water samples were collected on a monthly basis, from May to November 2017.

The chamber method was used for measuring N₂O fluxes. Soil and sediment samples were analysed for exchangeable ammonia and nitrate, dissolved organic N, dissolved organic carbon (DOC), soluble reactive phosphorous, organic matter content and dissolved organic matter (DOM) quality. Water samples were analysed for total N, total phosphorous, DOC and DOM quality. Preliminary results on nutrient status point to differences along the flooding gradient, with the periodically flooded plots showing marked sensitivity to the flooding events, and between sites due to different carbon sources.

Knowing the nutrient dynamics and N₂O emissions from restored river – floodplain areas allows for a better understanding of the role of restoration in nutrient management and N₂O production, and to better predict the impact of human activity in freshwater ecosystems.

Análise isotópica como instrumento no estudo da restauração de nascentes

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A crise hídrica na região sudeste do Brasil entre os anos de 2014 e 2015 refletiu negativamente no volume das bacias dos rios Piracicaba, Capivari e Jundiá (PCJ) (região com cerca de 4,5 milhões de habitantes) e também nos reservatórios do sistema Cantareira (principal responsável pelo abastecimento de 8 milhões de pessoas na região metropolitana de cidade de São Paulo). No entanto, desde a década passada o colapso do sistema hídrico já era previsto, e em 2007 na bacia do ribeirão das Posses (1200 ha) teve início o projeto “Conservador das Águas”, cujo intuito foi promover a restauração dos cursos hídricos e nascentes no local. O Posses é um pequeno tributário na zona de cabeceira do rio Jaguari (principal afluente do rio Piracicaba e do Cantareira), de uso da terra caracterizado por pastos de gramíneas para gado de corte (~ 70% do total), com pequenos fragmentos de florestais remanescente (Florestas semidecíduas). Com o objetivo de monitorizar os resultados das ações de restauração, entre jan/15 e jan/16, foram realizadas coletas de água em nascentes em restauração (3), tributários (3) e no canal principal do ribeirão (7), distinguindo-se o período seco e chuvoso na bacia. Através da peneiração (63µm) e filtragem (45µm) da água, obteve-se, respectivamente, o material particulado em suspensão grosso (MPSG) e fino (MPSF), parcelas distintas do material particulado em suspensão (MPS). Este estudo verificou os efeitos das ações de restauração nos corpos hídricos do ribeirão das Posses, através da análise isotópica do carbono ($\delta^{13}C$) e do nitrogênio ($\delta^{15}N$) da matéria orgânica do MPS. Nas nascentes os valores de $\delta^{13}C$ do material particulado foi característico de gramíneas – planta C₄, refletindo o uso da terra predominante, já nos tributários, quanto maior percentual de cobertura florestal, mais próximo ao $\delta^{13}C$ de plantas C₃, sinalizando o efeito de vegetação arbórea. No canal do ribeirão o $\delta^{13}C$ foi transicional, no entanto, os resultados $\delta^{15}N$ no período seco evidenciaram a presença de algas em trechos específicos, identificando a ocorrência de eutrofização. Esses resultados $\delta^{13}C$ indicaram que os corpos hídricos ainda sofrem influência da pastagem do entorno, notoriamente nas nascentes e que esse efeito depende da cobertura florestal, já o $\delta^{15}N$ identificou um aporte de matéria orgânica excessivo, o que levou à eutrofização, provavelmente devido à presença de gado no leito do canal.

Hidden threats of sharing habitats: interactions between native and invasive cyprinids

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The bleak (*Alburnus alburnus*) is an invasive fish occurring in high density in many streams and rivers of the Iberian Peninsula, namely in the Portuguese basin of the Guadiana River. This species poses a major threat to native cyprinid species, due to their high phylogenetic proximity. One of these species is the Iberian-roach (*Squalius alburnoides*), whose populations have been declining over the past few years. This study aimed to evaluate the potential impacts of *A. alburnus* on *S. alburnoides* populations, considering the patterns of habitat use and hybridization risk. Habitat use, selectivity and overlap were quantified. The genetic profile of captured fish with intermediate morphological features was analysed to confirm potential hybrids between the two species. *S. alburnoides* exhibited habitat preferences for slow riffles and runs and *A. alburnus* showed preference for medium/deep pools and runs, resulting in a high habitat overlap between both species. Both species tend to use similar substrate type and vegetation elements, revealing the potential relevance of the aquatic refuge. The occurrence of hybrids between the two species was confirmed in two sub-basins of the Guadiana River and one sub-basin of the Sado River. The obtained results show that *A. alburnus* can negatively affect *S. alburnoides* populations, throughout habitat overlap and genetic intrusion. This study emphasizes the urgency of implementing effective measures to prevent *A. alburnus* spread and contribute to native fish fauna conservation, namely through habitat rehabilitation.

SE1.

**The use of molecular
tools in ecological
and biodiversity
assessment of
aquatic ecosystems**

The application of eDNA and HTS as tools to analyze the biodiversity in fragile ecosystems

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The Mediterranean Sea has interacted with human civilizations and their trade routes since antiquity, and being a semi-enclosed sea, exotic species can spread across the entire region very rapidly affecting the biodiversity. Overmore, coastal and estuarine systems are often heavily impacted by human activities such as shipping and boating; aquaculture; the aquarium trade and live seafood and bait fisheries, making these areas major vectors for introductions and biodiversity changes. Traditional methods are not always sufficient to detect new coming species and analyze the biodiversity deeply. Nowadays, environmental DNA (eDNA) together with high throughput sequencing (HTS) are a well known tool very useful to understand what is happening in an ecosystem.

Thirty different locations included in ten French south Mediterranean coast lagoons, some of them included in Natura 2000 Network, were sampled in order to analyze the biodiversity and the possible new coming species present in these fragile ecosystems. In this study, we have tested the reliability of metabarcoding as a tool to record lagoon biodiversity using samples from eDNA extracted from water of these ten lagoons; comparing the results with the records of species previously detected using traditional tools. Two barcodes (V4 region within the nuclear 18S rDNA, and a fragment of the mitochondrial COI gene) were amplified and sequenced using an Illumina platform.

Molecular evidences of biofilm responses to multiple-stressors: community shifts induced by flow stagnation, organic loads and grazing

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Freshwater ecosystems are commonly impacted by discharges of organic effluents from wastewater treatment plants and indirect sources. Mediterranean rivers typical hydrological regime comprises water scarcity with decreasing water flows in stagnant pools which may worsen organic contamination effects on stream communities. Within these systems, stream biofilms play an important ecological role, as they are implicated in key ecosystem processes such as primary production and nutrient cycling. As biofilm have a relatively fast reproduction rate, short life cycles, large distribution and high biomass allied to their capability to absorb contaminants, they are expected to reflect short-term impacts and sudden disturbances in the ecosystem through shifts in community structure and composition. Also, the relative composition of microbial species in the biofilm potentially can influence their quality as food resource. Thus, our main goal was to investigate the effects of water scarcity, organic contamination and grazing on the main constituents of stream biofilm (i.e. bacteria, fungi and algae) by assessing communities' relative abundance through Denaturing Gradient Gel Electrophoresis (DGGE) operational taxonomic units (OTUs). In this regard, biofilm were submitted to the 3 stressors, in a full factorial design (2 flow conditions x 2 organic contamination levels x 2 grazing conditions) resulting in a combination of eight different treatments, tested in a mesocosm system in a 5-week experiment. Molecular data showed a clear effect of the treatments in all biofilm components. Bacterial relative abundance was higher under organic contamination and decreased under grazing activity. The same pattern was observed for the algae component, while fungi responded mainly to contamination by increasing its relative abundance. Our results indicate that overall, fungi and algae are the biofilm assemblages that respond strongly to the stressors. We showed that the combination of two important stressors (nutrient enrichment and flow velocity decreasing) common in rivers and streams of the Mediterranean region can lead to changes in biofilms and consequently interfere in ecosystem functions but also that grazers seem to be able to compensate for the higher growth of bacteria and have thus an important role in balancing the ecosystem functioning in the presence of those pressures.

eDNA for detection of highly invasive molluscs in Europe

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Biological invasions are an important threat to biodiversity especially in aquatic ecosystems, and their frequency is generally higher near urban areas. Potentially invasive non-indigenous molluscs were deliberately introduced into European waters for food (*Corbicula fluminea*) and biocontrol (*Melanooides tuberculata*), and unintentionally introduced by ballast water (*Mytilopsis leucophaeata*, *Corbicula fluminea*), stock contamination (*Sinanodonta woodiana*), accidental escapes from aquaculture (*Sinanodonta woodiana*), aquarium trade releases (*Melanooides tuberculata*) and even attached to aquatic birds (*Corbicula fluminea*). Three rivers from the Iberian Peninsula were monitored near the three most populated cities to evaluate the presence of these invasive molluscs through PCR amplification using taxon-specific primers from eDNA. New primers were designed within 16S rRNA and cytochrome oxidase subunit I genes, tested in silico from BLAST methodology and experimentally in vitro before application in the field.

C. fluminea was found in Ebro River (near Zaragoza); *M. leucophaeata* in Guadalquivir River (near Sevilla); *M. tuberculata* and *S. woodiana* were found from enclosed areas (lake and reservoir respectively) upstream, respectively, Zaragoza and Madrid. The new tools designed are ready to be used in other European regions where these species are also invasive.

Azorean extremophile cyanobacteria and their cyanotoxin production potential

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Cyanobacteria can be found in a variety of habitats, including lake, stream, marine and terrestrial habitats as well as in extreme environments. These are among the few prokaryotes that survive extreme conditions of temperature, pH and salt concentration. The presence of cyanobacteria in the Azores has been reported for more than a century. However, little is known about their biodiversity and toxin production, especially in thermal waters. In order to assess the cyanobacteria biodiversity and cyanotoxins production potential, 21 thermal water sampling sites (hot springs, thermal pools, streams and hydro thermal vents) from São Miguel island, ranging from 30 °C to 99 °C of temperature, were sampled. Cyanobacteria isolation was done by inverted microscopy, after adaptation in BG-11 medium. DNA extraction was carried out directly in environmental samples and in isolated strains, prior to PCR amplification of cyanotoxins producing genes. Microcystin, Saxitoxin, Anatoxin-a and Cylindrospermopsin genes (*mcyA*, *mcyB*, *mcyC*, *mcyD*, *mcyE*, *mcyG*, *sxtA*, *anaC*, *aoaA*, *aoaB* and *cyrJ*) were targeted using specific primer pairs. Cyanobacteria from seven genera were isolated, e.g. *Chlorogloeopsis*, *Leptolyngbya*, *Mastigocladus*, in a total of 40 strains. All isolated strains are maintained in unicyanobacterial cultures in the Azorean Bank of Algae and Cyanobacteria created in the framework of the REBECA project (MAC/1.1a/060). Only Saxitoxin producing genes were amplified in environmental samples and in isolated strains. This approach brought new information regarding cyanobacteria and cyanotoxins since this is the first report for saxitoxin production potential in thermal waters in the Azores. Furthermore, we enhanced the importance of molecular tools for the detection of secondary metabolites prior to its production.

Phytoplankton community before and after ice-and-snow cover formation in a South Central Siberian mountain lake

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The estimates of species composition of environmental phytoplankton communities are known to be technique-biased when assessed using DNA metabarcoding or morphological determination. As a result, comparability of historical morphological datasets to contemporary high-throughput molecular datasets is hampered. Despite some studies successfully compared both approaches, assigning DNA barcodes to morphospecies and providing information on DNA extraction and primer-specific influence on phylogenetic bias, a need for further empirical comparison has been recurrently claimed. In this study, we used both, microscope and the SSU 18S V4 region, to assess protist/phytoplankton community in the N-limited mountain lake Oiskoe (1418 m.a.s.l.), in the Ergaki mountain ridge, West Sayan mountains. To our knowledge it was the first study of phytoplankton diversity in lakes from the upper Yenisey basin during the mentioned season, as well as the first protist environmental DNA assessment in this biogeographic area. Lake Oiskoe was dominated by Cyanobacteria in September and Bacillariophyceae in November, with a significant contribution of Chlorophyceae in both months, according to pigment analysis. An impressive algal bloom ($24 \mu\text{g Chl} \cdot \text{l}^{-1}$), mainly constituted by *Pandorina morum*, was detected in the water layer directly under the ice sheet, in November, under light-limited conditions. Mostly Cryptophyta and Chrysochromulina but also Chrysophyta were widely more represented using DNA metabarcoding whereas diatom diversity turned out to be higher according to morphological analysis. DNA metabarcoding showed intra genus molecular variability in both *Peridinium* and *Gymnodinium* genera, but we failed to univocally assign diatom morphospecies to their corresponding DNA barcodes. Overall, community differences between samples were equally detected either using DNA metabarcoding or morphological identification.

Metabarcoding of meiobenthic estuarine communities: optimization of protocols

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Benthic biodiversity surveys are crucial for assessing the ecological status of estuarine ecosystems. Nonetheless, an accurate identification may be problematic for small and cryptic organisms, such as those belonging to meiofaunal communities. Many of these hurdles may be circumvented by using DNA-based tools. In particular, the combination of DNA barcoding, where DNA sequences (barcodes) are used as proxies of species identification, with high-throughput sequencing (HTS), renders metabarcoding the capacity to bolster current biodiversity assessments. However, despite its potential, this approach remains largely unexplored. In the current study, we have assessed the performance of metabarcoding in surveying meiofaunal communities using the Lima estuary as study area (North of Portugal). The specific aims were to test: i) the amount of sediment sample used for eDNA extraction and ii) the target region and primer-pairs used for PCR amplification, as well as their impact on taxonomic profiling. In this regard, eDNA was extracted from different amounts of intertidal sediments (0.63 to 10.0 g) collected in the Lima estuary, and meiofauna surveyed by using 5 primer pairs targeting 2 different markers: the cytochrome c oxidase I (COI) and the 18S ribosomal RNA (18S rDNA) gene regions. Amplicons were afterwards sequenced in an Illumina-MiSeq platform. Reads were processed using customized procedures in mothur, OTU-clustered at 97% similarity, and subsequently BLASTed against the full GenBank database. As expected, the highest number of OTUs was recovered in the 10.0 g sediment sample. Various taxonomic groups were exclusively or preferentially detected by a target region or primer-pair. The results indicate that our estuarine meiofaunal community was not entirely captured by either using one single target region or primer-pair. This suggests that the amount of starting material for DNA extraction and simultaneous use of several target regions should be considered for a comprehensive assessment of meiofaunal communities in estuarine ecosystems. Actions developing innovative tools for efficient inventory-taking and monitoring of biodiversity are mandatory for an improved assessment of the ecological status of estuarine ecosystems.

Delineating freshwater monitoring networks using eDNA metabarcoding

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Environmental DNA (eDNA) and metabarcoding are potentially useful tools for assessing water ecological status and for detecting rare freshwater species, including species that are threatened or were recently introduced. While collection of biotic data of good quality is essential to inform managers, the widespread application of eDNA metabarcoding in freshwater monitoring is still hindered by the lack of standardised field, lab and bioinformatic protocols. Here we aim to illustrate the eDNA metabarcoding workflow developed under the FRESHING project for monitoring the ecological status of running waters and detecting rare species. The Douro Basin watercourses (Spain and Portugal) were used as a case study since the region covers a range of environmental conditions and human stressors. We first selected a collection of sampling sites that represent the main gradients of environmental conditions and human stressors in the basin using GIS datasets available online and from ordination techniques. We then visited the selected sites during early summer 2017, filtered water for collecting eDNA, and simultaneously performed conventional methods to sample fish, mussels and other benthic macroinvertebrates with the joint efforts of other ongoing projects. We also collected fin tissues from the fish species occurring in the study area to complete DNA reference collection at InBIO-CIBIO. In a further step, we used those tissues to sequence *Cytb*, *COI* and *12s* genes, if not available in GenBank or BOLD databases. Finally, we present future steps of the project, including the development of eDNA metabarcoding field and lab protocols and the design of an optimal network to monitor ecological status and the occurrence of rare species in the Douro Basin watercourses.

Multiple introductions and first record of *Phoxinus phoxinus* in the Douro Basin revealed by molecular data

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Biological invasions are a major threat to global biodiversity. Freshwater ecosystems are particularly vulnerable to anthropogenic introductions, including in the Iberian Peninsula where the number of introduced species has been increasing during the last decades. This is the case of the minnows (*Phoxinus genus*), which have been used as a live bait since the 1900s. Until recently, *Phoxinus phoxinus* was thought to be distributed across most of the European watercourses, including the Iberian Peninsula in the Ebro Basin and some streams of the Cantabrian region. In 2007, these Iberian populations were identified as *Phoxinus bigerri*, including the translocated populations in the Douro Basin near Burgos (Spain). Currently, little is known about the distribution of *Phoxinus bigerri* in the Douro Basin. During early summer 2017, we sampled 75 stream reaches using electrofishing across the Douro Basin (Portugal and Spain). We identified 267 individuals as the Pyrenean minnow *P. bigerri*, and we clipped and stored fin tissues from 153 individuals in 96% ethanol for DNA reference collection. Among those, 26 were barcoded for cytochrome oxidase I (*COI*) and cytochrome b (*Cytb*) genes to confirm the taxonomic identification at the species level. Results confirmed, for the first time, the presence of the common minnow *P. phoxinus* in the Douro basin, being five individuals collected in the western Douro (Portugal near Porto) closely related to populations from Adour Basin in France. The remaining 21 individuals from eastern Douro (Spain near Brugos) were identified as *P. bigerri*, as expected. Our study is the first record of *P. phoxinus* in the Douro Basin, which can be easily misidentified when using only morphological identifications. The study highlights the value of using molecular approaches for detecting new introductions and tracking spread histories, which can be relevant for designing proper management plans dealing with eradication, control or containment of invasive species. Importantly, the *P. phoxinus* introduction in western Douro river (Portugal) seem to be related with human activities (sport fisheries by Portuguese immigrants living in France) rather than geographical proximity.

Development of bait capture for DNA enrichment for metabarcoding purposes: a robust alternative to PCR-based methods?

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Developments in molecular biology help to enhance our understanding of community assembly rules and patterns. Among them, metabarcoding is a promising and reliable tool to detect and identify species in multiple samples. However, metabarcoding generally fails to address quantitative aspects due to the biases induced by PCR-based methods leading to misestimates of species abundances. Here, we developed and tested a RNA bait capture protocol to detect benthic invertebrate species and conserve their relative abundance in multiple samples. For this, we designed RNA baits based on COI of over 1500 benthic invertebrate species. First, we tested the accuracy of bait capture to detect rare species and estimate abundances in 8 mock communities of 10 species with two different species biomass gradients. Then, we assessed our capacity to detect all species in complex samples on 10 mock communities of 52 taxa of similar biomass. The results were then compared with those of PCR-based methods. Finally, we discussed the potential of bait capture in metabarcoding approaches and the benefits and pitfalls of this novel and promising approach.

Pesticide contamination affects genetic diversity and population differentiation of a mayfly species within a Chilean agricultural watershed

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Global biodiversity is changing rapidly as a complex response to several human-induced changes in the global environment. By showing declines in biodiversity that are far greater than those observed in the most affected terrestrial ecosystems, fresh waters stand out as the most endangered ecosystems. It is therefore crucial to better understand the effects of such anthropogenic pressures on the aquatic organisms. This study aimed at evaluating the effects of environmental and landscape features on neutral and adaptive genetic variation in populations of the mayfly *Andesiops torrens* (Insecta, Ephemeroptera) within a Chilean agricultural watershed, with the objective to detect if agricultural activities may affect this species. We selected 30 study sites, sampled 20 specimens per site and characterized the local habitat and water physico-chemical features, including pesticide contamination. The area of land used for agricultural activities above each site was also assessed using a digitalized land use map. Traces of pesticides were found in 11 sites. We used a clustering of variables around latent variables approach to reduce the number of environmental variables (30), retaining four water parameters (temperature, and calcium, iron and pesticide concentrations) and one habitat characteristic (river width). Genetic analyses were carried out using a set of 2056 SNP markers generated with the NextRAD method. We produced a dataset of 1765 neutral SNPs by removing 291 outlier loci detected with four approaches. Genetic diversity was relatively low (mean $H_o=0.219$). Population differentiation was also low (mean $F_{st}=0.004$), and little structured spatially, suggesting high gene flow across the study area. Using linear models, we found that allelic diversity was correlated with water temperature, calcium and pesticide concentrations ($F=6.9$, $df(num,den)=3,26$, $p=0.001$). We used a genotype-environmental approach to identify which of the 291 outliers could be potentially under selection. Potential associations between allele frequencies and environmental predictors were revealed for six loci. After controlling for spatial structure, four of them remained statistically significant. In all cases, pesticide concentration was the only involved environmental predictor, being thus the most important environmental surrogate for putatively adaptive genetic variation. In conclusion, our study confirmed the impact of pesticide contamination on this mayfly species.

Improving freshwater biodiversity assessment: application of molecular tools on preservative ethanol from macroinvertebrate bulks

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Traditional biodiversity assessment methods rely on morphological identification of bioindicator species such as benthic macroinvertebrates. This is the case of the Water Framework Directive (WFD), the key legislation for the protection and sustainable use of European freshwater resources (2000/60/EC). The possibility of identifying all life stages is particularly relevant, but it requires high levels of specialization and expertise and entail procedures that are expensive and time consuming. Also, the majority of these bioindicator taxa are in their larval stage, which imposes constraints on their morphological identification at lower taxonomic levels (e.g. genus or species). Advanced molecular tools, such as metabarcoding, allow the processing of complex multi-species assemblages at greater resolution (up to species level), by combining DNA taxonomy with high-throughput DNA sequencing. Here, we demonstrate the potential use of preservative ethanol from macroinvertebrate bulk and metabarcoding tools to assess macroinvertebrate communities and biological quality of surface water bodies. We examined ethanol samples collected from five macroinvertebrate bulks of Tua sub-basin (Douro) and morphologically identified organisms down to the lowest practical taxonomic level. Our results showed that 60% of the taxa found in ethanol were macroinvertebrate taxa targeted by WFD, while the remaining percentage was identified as e.g. Bacteria, Stramenopiles, terrestrial invertebrates, amphibians and fishes. In comparison with morphological identification, molecular methods detected in average 70% of the WFD families and 86% of the EPTO (Ephemeroptera, Plecoptera, Trichoptera and Odonata) families. Yet, the percentage of families matching between ethanol metabarcoding and morphological identification increased when rare families (<5 individuals) were excluded (80 and 92.2% respectively) and was maximum on groups well represented in DNA reference databases, such as the order Trichoptera. Also, 113 species were successfully identified from ethanol samples but only half was detected morphologically. Ethanol metabarcoding can potentially be a faster, low-priced and more refined approach for assessing biological quality than traditional methods, by increasing taxonomic resolution and thus sensitivity of metrics to fine variations in stream ecosystem functioning. Nevertheless, further validation is needed as well as expanding the existing DNA reference databases.

Análisis por NGS de la estructura de la comunidad bacteriana en el sedimento de lagunas ibéricas con marcados gradientes tróficos, hídricos y salinos

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En contraste con los estudios clásicos de análisis de la diversidad bacteriana en sedimentos, el uso de técnicas de NGS, aunque es relativamente reciente, ha supuesto una revolución por la mejora en la profundidad y el grado de conocimiento de la diversidad bacteriana no sólo en sedimentos, sino en una gran variedad de ambientes, además de ofrecer un nivel de detalle marcadamente superior. Estos tipos de estudios en el sedimento de los humedales españoles son relativamente escasos a pesar de que permiten una mayor comprensión no sólo de la diversidad microbiana sino de diferentes procesos biogeoquímicos que tienen lugar en el sedimento, como la sulfatoreducción, y de su interrelación con los diferentes microorganismos que los llevan a cabo. En este trabajo se muestra la diversidad bacteriana del sedimento de 17 lagunas localizadas en la Reserva de la Biosfera de la Mancha Húmeda junto con la de 2 marjales costeros valencianos. Las lagunas manchegas presentan entre sí un marcado gradiente de salinidad, además de poseer un ciclo hidrológico con unos contrastes muy importantes. Además, muchas de ellas presentan una importante alteración en su estado trófico. Por otra parte, los marjales valencianos se encuentran en un tipo de clima diferente y presentan mayor estabilidad hídrica a lo largo del año, aunque también muestran diferentes grados de alteración antrópica. Para la determinación de la diversidad bacteriana en los sedimentos, se ha realizado una secuenciación por NGS con MySeq en base a librerías específicas del 16S rRNA. A partir de los resultados obtenidos en la secuenciación, se definieron exhaustivamente las comunidades de cada humedal y se realizaron diferentes análisis de ordenación para comparar los diferentes sedimentos entre sí y para relacionar la diversidad bacteriana con diferentes variables ambientales. Los análisis resultantes muestran que a niveles filogenéticos bajos hay una relación entre la tipología de laguna o las diferentes alteraciones antrópicas que presentan las lagunas con los microorganismos que se encuentran en su sedimento, por lo que se pueden establecer relaciones entre la diversidad bacteriana y los metabolismos predominantes en los sedimentos de las lagunas analizadas.

DNA metabarcoding approach as a complementary technique for assessment of Portuguese rivers using diatoms

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Bioassessment of rivers and streams is based on a diatom autoecological index, the Índice de Poluosensitivité Spécifique (IPS) officially adopted for Portugal. This index requires a high level of taxonomic expertise for morphological identification individuals. Advances in genomics, such as the DNA metabarcoding combined with high-throughput sequencing (HTS) offer a promising alternative to classical methods, limiting expertise requirement and therefore reducing time and costs. The aim of this study is to test the potential of DNA metabarcoding of diatoms in bioassessment by comparing the IPS classifications obtained with morphological and DNA metabarcoding approaches. A total of 89 samples collected from rivers in central Portugal were sampled in spring 2017 following Water Framework Directive (WFD) standards. The morphological approach comprised taxonomic identification of at least 400 valves, under the light microscope. DNA metabarcoding approach included DNA extraction followed by DNA high-throughput sequencing (Illumina MiSeq) using a diatom-specific 312bp rbcL DNA barcode. Sequences were analysed with Mothur software, producing Operational Taxonomic Units (OTUs) that were taxonomically assigned using the RSyst::diatom reference library. Preliminary results for a sub-sample of ten sites, covering two different typologies (Littoral and the Northern type N 1 <=100 km²) and a quality gradient (High, Good, Moderate and Poor), showed that 40% of the samples obtained the same quality class using both approaches. In other 40% of the cases, metabarcoding decreased quality in 1 class; and the opposite in 10% of the cases. These differences could be due to an incorrect quantification of taxa. Yet, the percentage of "unclassified" species using this new method varied between 14 and 84% due to incompleteness of the reference library regarding Portuguese flora. Although there is still work to do on this new approach, if applicable, it would become a useful and innovative alternative to classical methods for Portuguese rivers' bioassessment.

Metagenomic analysis of macroinvertebrates along the Llobregat river (NE-Iberian Peninsula) and its use for biomonitoring

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The advent of the massive parallel sequencing technologies have empowered DNA barcoding tools to automatize species identification for an entire community. Metabarcoding data provide cost and time efficient, fine-scale taxonomical resolution, which will facilitate applying biological indices to determine ecosystem health under the EU-Water Framework Directive (WFD). In this study, we compared estimates of the ecological status using traditional morpho-taxonomy against high-throughput DNA sequencing of (1) bulk sampling, (2) eDNA (water samples) and (3) invertebrate drift sampling (intervals of 1 hour). We sampled five sites along the well-studied Mediterranean Llobregat river (156 km length) from headwaters to river mouth. The sites included a pollution gradient from pristine headwater reach, through site located downstream of a big reservoir or salt mining, to urban and agricultural landscapes at lowlands. In this talk, we provide details of the sampling techniques, sample pre-processing, DNA extraction, genetic markers used and bioinformatic pipelines for sequence filtering, delimitation of MOTUs and taxonomic assignment. Our results confirm the finer taxonomic resolution obtained by metabarcoding analysis and therefore the usefulness of the method to determine macroinvertebrate biodiversity. We provide new insights on the new genomic tools for replacing the traditional bioassessment protocols used in biomonitoring programs under the WFD.

Development of novel metabarcoding approach to benthic macroinvertebrates species identification

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The main objective of this project is to develop a DNA metabarcoding protocol that can be routinely implemented in environmental monitoring and assessment of the ecological status of European rivers. The protocol should consider experimental design, sampling planning, method of preservation of environmental samples for genetic analysis and method of extraction of the DNA samples from benthic macroinvertebrates. For that, firstly is necessary to validate the DNA metabarcoding methodology at European level, to confirm that it can be applied to all the Member States because the methods to calculate Biotic Indexes and to assess the Ecological Status of a river (once the benthic macroinvertebrates have been identified) are completely different from one country to another. The objectives of the project are: (1) to select a representative river in three Biogeographical Regions of Europe (Boreal, Continental and Mediterranean); (2) to verify that the European benthic macroinvertebrate species identification after applying metabarcoding tools is the same that the identification obtained after applying the traditional morpho-taxonomic methodology, in each region; (3) to use DNA metabarcoding identifications to calculate the Eco-genomic Indexes and compare the results with the traditional Biotic Indexes; (4) to use those Eco-genomic and Biotic Indexes to assess the respective Ecological Status assessment, and compare results; (5) to develop the standardized DNA metabarcoding protocol to do biological assessment of European rivers. Three countries are involved in the project: Finland, German and Spain. The determination of all collected macroinvertebrates will be performed according to the criteria defined in Meissener et al. (2016) for Finland, Haase et al. (2006) for German and IBMWP (2013) from Spain, with the objective to obtain a definitive list of common and cosmopolitan species. Results of the water quality assessment based on morphologically determined species and species identified by the metabarcoding methods will be compared in detail.

Diatom metabarcoding for biomonitoring: an overview

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Diatoms are siliceous, unicellular algae of the phylum Bacillariophyta. Their ubiquity and sensitivity to physical and chemical parameters as well as their short generation time make them good indicators of the ecological status of aquatic ecosystems. Since 2000, the use of diatoms in routine monitoring programs to assess the ecological status of rivers and lakes is mandatory in Europe, as part of the WFD. Although diatoms are reliable indicators of water quality, their use in monitoring programs requires unambiguous identification at species level, which relies on the morphological characteristics of their silica cell walls. This is time consuming and requires specialized taxonomic knowledge especially when dealing with closely related taxa. To overcome these limitations, a new approach for diatom identification has been developed in recent years based on a standardized DNA fragment (312 pb *rbcl* gene) and High Throughput Sequencing, making diatoms identification enabled by means of a DNA reference library (R-Syst::diatom database). This new approach allows the sequencing of millions of DNA fragments from many samples simultaneously, reducing costs and time in the use of diatoms as bio indicators compared to the morphological approach.

The INRA (UMR Carrel) develops the DNA metabarcoding approach since 2010 and several studies have been conducted in the last years to optimize each step of the process (biofilm sampling, DNA extraction, PCR amplification, sequencing method and analysis of data sequencing). The suitability of the molecular approach to assess the ecological status of water ecosystems has been tested in rivers from a French tropical island (Mayotte) and Lake Bourget in France. The evaluation results obtained with both approaches were compared and the differences observed were mainly due to the incompleteness of the R-Syst: diatom database and the link between diatoms cell biovolume and the *rbcl* gene copy number. To avoid the first gap, diatom indexes based on molecular OTUs data were developed. For the second gap, a correction factor based on diatom biovolume was developed. These changes allowed a better correlation between the evaluation results obtained with both approaches, showing the potential of metabarcoding for biomonitoring purposes in particular when the R-Syst diatom database is more complete. Nowadays the molecular approach is being validated at national level in many French rivers.

The use of eDNA in river ecosystems to design environmental indices

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To date, the biological monitoring of aquatic ecosystems to determine the ecological status or conservation status has consisted in the sampling of different parts of the aquatic habitat and the morphological identification of the indicator species by specialist taxonomists. Thus, according to the Water Framework Directive, these indicator species belong to phytobenthos, phytoplankton, macrophytes, aquatic insects, and fish. Although the design of this monitoring programs have numerous advantages associated with simplicity sampling protocols and the identification of organism in field for most of the groups, this is not always reliable at very detailed taxonomic levels, especially in mountain aquatic ecosystems where the identification of many species (endemic, cryptic or larval stages) is difficult. Therefore, monitoring programs dealing with the state of conservation of aquatic ecosystems would benefit by incorporating new techniques that are more reliable and that would also allow improving knowledge of aquatic biodiversity. Here, we propose the use of the environmental DNA (eDNA), i.e. genetic material (nuclear or mitochondrial DNA) obtained directly from environmental samples (soil, terrestrial and aquatic sediments, water, etc.), as an emerging tool for environmental research, monitoring and conservation of aquatic ecosystems. Furthermore, this tool facilitates the characterization in detail of the entire aquatic biodiversity (i.e. from bacteria to vertebrates) by detecting organisms that escape to traditional identification or that are present in very low densities. In this study we have compared the diversity of two rivers (under polluted and pristine conditions respectively) after the identification of water and biofilm samples by shotgun sequencing. Differences have been observed not only in the composition but also in the number of obtained sequences for primary producers, macroinvertebrates, and fish between both rivers. In addition, important differences have been found regarding the microbial fauna providing essential information on the ecological status of both water courses. Thus, deepening the study of bacterial diversity and primary producers, together with metagenomics, could result as an efficient alternative in the monitoring programs because of their potential use as indicators of different ecosystem functions (e.g. organic matter degradation or primary production under different conditions).

SE2.

Microplastics in aquatic environments

Acute effects of microplastics and mercury, individually and in binary mixtures, on the swimming performance of the juvenile European seabass (*Dicentrarchus labrax*)

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Aquatic ecosystems are frequently impacted by anthropogenic pollution. A large number of organic and inorganic substances have been widely introduced in marine and freshwater ecosystems all over the world threatening their health and integrity. Among the pollutants present in aquatic ecosystems, microplastics and mercury are both of great concern, especially regarding their effects on the biota, including potential adverse effects on fish behavior (e.g. social behavior, predatory performance, swimming capacity, among others). The objective of the present study was to investigate the effects of polymer microspheres ($\approx 1-5 \mu\text{m}$, used as microplastics model) and mercury, individually and in mixtures on juveniles of the European sea bass (*Dicentrarchus labrax*), a key species in European estuaries and at other marine ecosystems that is of great commercial interest. After acclimation to laboratory conditions, 81 seabass juveniles were randomly distributed per 9 treatments (9 fish per treatment): control (filtered seawater), two single concentrations of microplastics (low and high), two single concentrations of mercury (low and high), and all the mixtures in a full factorial experimental design. Fish were exposed individually in glass beakers, with continuous aeration, and no food was provided during the exposure period. After 96 h, the post-exposure swimming performance of fish was assessed by determining the swimming velocity and the swimming resistance. Moreover, videos were analyzed to verify possible behavior changes. Microplastics alone, mercury alone and all the mixtures caused significant reduction in swimming velocity and resistance time of fish. In addition, changes in behavioral responses were observed. In general, our results provide an initial contribution on the effects of microplastics combined with another contaminant of global concern on swimming performance of *D. labrax* juveniles.

Microplásticos integrando la comunidad planctónica del sector costero de agua dulce del estuario del Río de la Plata

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La producción de plásticos ha aumentado considerablemente desde el desarrollo de polímeros sintéticos a mediados del siglo XX. La información sobre su presencia y consecuencias ambientales en ecosistemas de agua dulce es menos frecuente que en los marinos. Una vez que los microplásticos ingresan en los ecosistemas acuáticos, comienzan a interactuar con las comunidades biológicas, entre las que se encuentra el plancton. Como muchos de los microplásticos flotan y pueden imitar a los microorganismos y confundirse como alimento este contaminante resulta una amenaza para los ecosistemas. En estudios recientes, realizados en el sector de agua dulce del estuario del Río de la Plata (<0.5 UPS), se hallaron microplásticos en el contenido intestinal de peces. Esta evidencia nos ha conducido a explorar en muestras de plancton la abundancia, tamaño, tipos (fibras y fragmentos), colores de microplásticos y los factores que modulan su distribución conjuntamente con las características del plancton (composición específica, tamaño y morfología). Para ello se realizaron muestreos en septiembre-noviembre de 2016 y en abril-junio de 2017 en diez sitios de muestreo ubicado a lo largo de 150 km de la costa argentina del estuario, influenciados por diferentes actividades antropogénicas. En cada sitio de muestreo se filtraron por una red de plancton de $36 \mu\text{m}$ de poro 100 litros de agua; una alícuota de 5 ml fue destinada al análisis del zooplancton y el resto fue destinado al estudio de los microplásticos; también se recogieron 125 ml de agua para el análisis de fitoplancton. Todas las muestras se extrajeron por triplicado. Para el análisis de los microplásticos se realizó una oxidación de la muestra, para eliminar la materia orgánica, luego se realizó una separación por densidad y se filtró el sobrenadante para su posterior observación con un microscopio estereoscópico. En campo se midieron parámetros físico-químicos y también se recabaron datos mareológicos y meteorológicos. Las tallas de los microplásticos más frecuente fueron los inferiores a los 1 mm, la abundancia promedio fue de 139 microplásticos/m³, predominando las fibras (69%). Estos microplásticos integraron una comunidad planctónica conformada principalmente por nano-picofitoplancton filamentosos-cenobial y un micro-mesozooplancton caracterizado por herbívoros, omnívoros y filtradores. La distribución de los microplásticos estuvo modulada por el aumento de la urbanización, las descargas cloacales y el frente de máxima turbidez del estuario.

Effects and recovery of microplastics exposure over generations in *Daphnia magna* populations

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Microplastics (MP) pollution is a global challenge. The long-term effects of such particles on populations and communities are not known. Here, the transgenerational (F0, F1, F2, F3) effects of MP (1-5 µm diameter) and the post-exposure recovery were investigated in model populations of the crustacean *Daphnia magna*. The model populations were: control population (clean medium), microplastics exposed population (medium with 0.1 mg/l of MP), and recovery population (population initiated with female juveniles produced by F0 females exposed to MP). In each generation, 21-day chronic bioassays were carried (n = 10 – 40 individuals per treatment). Effect criteria were somatic growth, several reproductive parameters, and population growth rate. Among other adverse effects, exposure to MP for 21 days only was enough to cause significant ($p \leq 0.05$) decrease of the reproductive fitness and of the population growth rate. The MP exposed population was extinct in the F1 generation. Females descending from those exposed to microplastics and cultured in clean medium presented some recovery but up to the F3 generation they still showed significantly ($p \leq 0.05$) reduced population growth rate. Overall, these results indicate that long-term exposure to microplastics can cause population extinction in a reduced number of generations. Moreover, if chronic exposure is stopped, the post-exposure recovery may take several generations. These findings have implications to ecosystem and human health because the worldwide environmental contamination of the air, water, soil, and biota (including species consumed by humans as food) with MP.

Reproductive and developmental effects of microplastics, gold nanoparticles and their mixtures in the crustacean *Daphnia magna*

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Microplastics are global environmental contaminants that have been raising concern regarding environmental and human health. Knowledge about their ecotoxicological potential is still scarce, especially when in mixture with other emerging contaminants, such as nanoparticles. The present study evaluated the chronic effects of mixtures of 1-5 µm microplastics and » 5 nm gold nanoparticles in *Daphnia magna*. Both microplastics and nanoparticles, when exposed individually, induced reproductive toxicity and mortality and, when exposed simultaneously in mixtures, caused higher toxicity in a way that suggests toxicological interactions between both types of particles.

Catalase biomarker response induced by microplastics, cadmium and their mixtures on the exotic invasive bivalve *Corbicula fluminea*

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Microplastics (MPs) are a widespread contaminant originated from the breakdown of plastic debris or directly manufactured on a millimetric or submillimetric size. Some studies demonstrate that MPs are ubiquitously and persistent in aquatic systems, representing an increasing threat to organisms and ecosystems. MPs ingestion has been described in several marine species, including invertebrates and fish, thus suggesting a trophic transfer. Studies with benthic filter feeders provide an evidence that MPs are taken up into tissues and cells, but data on toxicological risks remain scarce. Several contaminants such as heavy metals are able to adsorb to MPs surface, becoming bioavailable to organisms, with unpredictable ecological consequences. Considering this, more research is needed in a mixture context, to clarify their potential toxicity. The Asian clam, *Corbicula fluminea*, has often been used in field and laboratory studies to assess the effect of contaminants to aquatic species. Hence, this study (Interact - Integrative Research in Environment, Agro-Chain and Technology, NORTE-01-0145-FEDER-000017, in the research line BEST) aimed to evaluate if the exposure to MPs, cadmium and their mixtures affect the stress oxidative response of *C. fluminea*. For this, bivalves (n = 45) were exposed to four experimental conditions, in triplicate: control, cadmium (10 µg Cd L⁻¹), MPs (2 mg MPs L⁻¹; ca. 250 000 particles/mL) and Cd+MPs (2 mg L⁻¹; 250,000 particles / mL) during a seven days period. Considering that catalase (CAT) is an enzyme that shows high activity when the organism is under oxidative stress, its activity was evaluated in three organs: gill, digestive gland and gonad. In the gonad of the animals exposed to the mixture, an increase in CAT activity (p<0.05) was observed. A significant increase was also registered in the digestive gland of fish exposed to Cd alone. However, no significant changes were observed in gills. The results suggest that the Cd concentration may be toxic and the MP presence may increase cadmium bioavailability and induce oxidative stress in reproductive organ, thus compromising population sustainability.

Abundance and distribution of microplastics in Antuã River (Portugal)

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Microplastics, defined as particles with < 5 mm, are considered one of the most emerging aquatic pollutants. These micro debris (MPs) can also differ in their shape, colour, density and polymer type as well as in their origin (primary or secondary). Due to their ubiquity, high persistence and insufficient management MPs can accumulate in aquatic systems reaching high densities and interacting with biotic and abiotic components of ecosystems. Currently, research in freshwater systems has been increasing, since they play an important role as carriage systems within environments, and temporary sinks of MPs. Hence, the present study aims to fill this knowledge gap providing new insights into MPs abundance and distribution in Antuã River (Portugal). For that, water and sediment samples collected in March and October 2016, in three sampling sites, were subjected to a MPs isolation methodology (wet peroxide oxidation with addition of zinc chloride). Results showed that Antuã River is severely influenced by MPs, especially in water compartment, ranging from 5 – 8.3 mg m⁻³ or 58 – 193 items m⁻³ in March and from 5.8 – 51.7 mg m⁻³ or 71 – 1265 items m⁻³ in October. In sediments, the abundance ranged from 13.5 – 52.7 mg kg⁻¹ or 100 – 629 items kg⁻¹ in March and from 2.6 – 71.4 mg kg⁻¹ or 18 – 514 items kg⁻¹ in October. São João da Madeira and Aguincheira showed the greatest abundance in water and sediment samples, respectively. According to methodological approaches, seasonal and hydrodynamic conditions and the proximity to urban/industry areas, spatial and temporal distributions showed different patterns. Based on Fourier transform infrared spectroscopy (FTIR) analysis, polyethylene (PE) and polypropylene (PP) covered more than 50% of all polymer types identified. The low medium high oxidation ratio was similar in both seasons indicating that fewer particles are highly oxidized [56:22:22 (%) in March and 61:31:8 (%) in October]. Although of varying abundances during the study period, foams and fibers were the most abundant types of MPs in São João da Madeira, while fibers and fragments were the most abundant in Aguincheira and Estarreja, in water and sediment samples, respectively. This study emphasizes the importance of further investigation in rivers identifying point sources in order to mitigate the MP contamination in freshwater systems.

Single and combined effects of microplastics and an antimicrobial on the exotic invasive bivalve *Corbicula fluminea*

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Microplastics (MP) and antimicrobials are worldwide dispersed environmental contaminants. They are very common in industrialized, urbanized and food production areas, and they may cause adverse effects in aquatic organisms. The main objective of the present work was to investigate the effects of the antimicrobial florfenicol and MP on the exotic invasive bivalve *Corbicula fluminea*. The organisms were exposed, for 96h, to 2 concentrations of the antimicrobial (1.8 and 7.1 mg/l) and 2 concentrations of MP (0.2 and 0.7 mg/l). After 96 h, all animals exposed to treatments had florfenicol in their body and MP were found in the connective tissue, hemolymphatic sinuses, gut, lumen of the digestive gland and gills surface of bivalves. Both individual pollutants caused significant neurotoxicity through cholinesterase (ChE) activity inhibition. Mixtures caused significant feeding inhibition (57–83%), neurotoxicity (44–57%), oxidative stress and energy related alterations. The overall results indicate that *C. fluminea* take up florfenicol and MP from the water and accumulated or at least retained it in their body for some time. In addition, both MP and florfenicol were toxic to *C. fluminea*, with mixtures, containing both, being more toxic. These findings have implications to environmental, animal and human health.

SE3.

**Understanding
carbon cycling in
inland waters: from
microbial function to
ecosystem processes**

Organic matter ageing in lakes: exploring the link between water residence time and microbial function

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Dissolved organic matter (DOM) originating from terrestrial ecosystems is effectively lost during transport in inland waters. However, the multiple controls on DOM decay rates hamper the prediction of its fate in freshwaters and therefore, the amount of DOM mineralized and released to the atmosphere during its transport remains uncertain. Decay rates across freshwaters present a strong relationship with the water residence time (WRT) of a water body, which is in agreement with DOM compositional changes across boreal lakes. Currently, is still a major challenge to understand the links between the microbial functions controlling decay and the myriad of compounds comprising DOM (i.e. its chemodiversity). In theory, each DOM compound could be function-specific and thus intrinsically linked to a metabolic pathway impacting bulk DOM decay. Here, we aim to link DOM chemodiversity with changes in microbial functioning and diversity along a WRT gradient, considering WRT a proxy of the accumulated exposure of DOM to degradation pathways or “aging”. We sampled 20 boreal lakes ranging a wide gradient of WRT (between 1 month and 70 years) during summer 2016. Additionally, we sampled 3 peats as soil endmembers and 7 streams and rivers as sites of very short WRT. We modelled DOC degradation through reactivity continuum models and tracked the changes in DOM molecular composition along the WRT gradient through high resolution mass spectrometry (FT-ICR-MS) and optical spectroscopy. Moreover, we measured several functional descriptors such as bacterial production and respiration rates, extracellular enzymatic activities, carbon substrate utilization rates as well as characterized the bacterial community composition and active bacterial taxa through DNA and RNA analysis. Our results show that both the community composition and active bacterial taxa were related with the WRT of the systems. Accordingly, bacterial growth efficiency increased with WRT, associated with lower bacterial respiration and glucosidase activities. Moreover, the utilization capacity of phenolic compounds decreased with WRT, despite the diversity of substrates consumed increased. Those functional changes occurred linked to a relative gain of carboxylic acids and the reduced presence of phenolic and humic compounds in DOM. As hypothesized initially, the aging of DOM along the continuum corresponds to changes in its chemical diversity that reduce (but diversify) the functional performance of the bacterial community.

Effects of catchment land cover on fluvial dissolved organic matter composition

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Dissolved organic matter (DOM) represents the largest source of organic carbon in fluvial ecosystems. The majority of DOM has been shown to have terrestrial origin, what indicates that most of the compounds in DOM leach directly from vegetation components (e.g. leaves, twigs, fruits) or from decomposed organic matter in catchment soils. This makes DOM composition highly dependent on vegetation cover and extremely sensible to the land uses in the territory. One of the most predominant land use changes in many mountainous regions is the land abandonment linked to the reduction of agricultural fields and in livestock grazing pressure. This land abandonment is leading to natural secondary succession processes that are causing a land cover change: the displacement of shrubs and pasturelands by native forest expansion. Vegetation and soil properties are both strongly affected by land cover alterations; however, the transformations of vegetation occur on a shorter time scale than the consequent transformation of soil organic matter characteristics. Although this suggests that previous land cover might have a strong effect on DOM properties, how past land cover affects DOM properties has not yet been described. Therefore, to assess the effect of catchment land cover on DOM properties and examine the effects of land cover history, we analyzed DOM quantity and composition in 26 streams in the Cordillera Cantábrica (northern Spain). The selected streams followed a gradient of contemporary land cover in their catchments (from grasslands to highly forested catchments). Moreover, some of these catchments have increased in forest cover during the last 30 years, what allowed us to account for land cover history. Although terrestrially derived compounds dominated in all streams, catchment forest cover strongly determined stream DOM quantity and composition. A greater forest cover was related to more oxygenated and slightly more aromatic terrestrial DOM reaching the streams, what was associated with the increase in highly decomposed DOM from catchment soils (i.e polycyclic aromatic compounds), and the decline of younger soil and fresh vegetation materials as oxygen-poor aliphatic compounds. Nevertheless, preliminary results showed no effect of forest cover increment on DOM composition, what suggests that while land cover defines fluvial DOM composition on long time scales, recent changes in land cover (e.g. forest cover increment in 30 years) might not affect DOM composition.

Understanding microbial and macrofaunal decomposition across different Biogeographic regions within the Iberian Peninsula

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Litter decomposition is a key ecosystem service within aquatic ecosystems, having a central role in carbon, nutrient and energy fluxes across trophic levels. Decomposition is a complex process, including physical, chemical, animal and microbial interactions which are sensitive to environmental factors, such as temperature, nutrient availability and substrate quality. The role of microbial and macrofaunal (e.g. insect larvae) decomposers, and how it changes across environmental gradients is not yet fully understood. In recent studies, it has been shown that macroinvertebrates, particularly shredders, have an important role in decomposition through the consumption and fragmentation of litter material. In this study, we measured decomposition across 6 biogeographical regions using the Iberian Pond Network, to determine the role of macroinvertebrates in this key ecosystem service. Decomposition was estimated using standardized cotton strips, a proxy for leaves, which were deployed in the mesocosms of each region. The role of macroinvertebrates was tested using bags of differing mesh sizes to allow (5 mm) or prevent (0.1 mm) the access of macroinvertebrates to the cotton strips. After a period of 64 days, we collected the cotton strips and measured mass loss and tensile strength. A parallel experiment was conducted to provide realistic decomposition rates in natural ponds. We found large differences in the rate of decomposition across regions. Results indicate that species composition plays an important role determining decomposition rates from region to region with implications for generalizations. Therefore, predicting ecosystem-level responses to climate change will require greater knowledge of the distribution of traits in each region and their role in maintaining ecosystem functions.

Carbon cycling in a boreal temporary stream: insight from an experimental hydrological manipulation

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Climate and land use changes are expected to increase the occurrence of intermittency and alter flood regimes worldwide. Such changes have widespread implications for stream ecosystems, including their capacity to transform organic carbon (C). Here we manipulated discharge from a boreal lake to test the effects of drying and flooding on C cycling along the 1.4 km outlet stream. Flow manipulation created a longitudinal gradient in drought severity over a 18-day period, which we terminated with an experimental flood. In response, we estimated stream metabolism and quantified C gases in the stream surface and subsurface water. Drying and flooding modified the hydrological mechanisms that regulate C delivery to the stream and the residence time by which these C resources are processed under different redox conditions. Where most severe, drying induced a transition from oxic to anoxic conditions in hyporheic sediments that increased methane concentrations in the stream surface water (from 10.1 to 53.7 µg/L). Drying also interacted with groundwater inputs to create heterogeneity in metabolic rates and C gas concentrations along the experimental reach. This study emphasizes the sensitivity of stream C cycling to extreme flow events in the boreal region. Given the predicted trends toward more extreme and unpredictable hydrological events, better understanding these responses is essential for predicting how future climate change may influence the biogeochemical role of stream in northern landscapes.

Effects of alkalinity and trophic state on the relationship between metabolism and carbon fluxes in lakes

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Several lines of evidence suggest that dissolved inorganic carbon (DIC) dynamics and carbon dioxide (CO₂) emissions in lakes are not always primarily linked to changes in metabolic rates, but can be associated to exogenous DIC inputs from the watershed, as well as interactions with the dissolved inorganic carbon equilibria. Alkalinity has been described as a determining factor regulating the relative contributions of biological and inorganic processes to carbon dynamics in lakes. Here we analyze the relationship between the net ecosystem production (NEP) and DIC at different time scales (i.e., seasonal and episodic) in nine lakes of contrasted alkalinity and trophic state. We use high frequency data from automatic monitoring stations to explore how water-atmosphere CO₂ fluxes respond to seasonal variations as well as to evaluate the effects of episodic events (such as storms or algal blooms) on the NEP-DIC relationship. Results suggest that high precision sensor technology is necessary to properly characterize DIC variability at sub daily scales. Specifically, DIC dynamics appear to be mostly driven by aquatic metabolism at low alkalinity whereas this relationship weakens with increasing alkalinity. Direct external DIC inputs, as well as calcite precipitation are likely the main processes explain the previous patterns. Our results are compared with direct data on calcite precipitation as well as with expectations on the joint effect of calcite precipitation and aquatic metabolism to changes in DIC equilibria.

CO₂ and CH₄ fluxes in Mediterranean reservoirs: oxygen and methane sobresaturation coupled in epilimnion

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La degradación de la materia orgánica, autóctona y alóctona, en los sistemas acuáticos continentales es una fuente de CO₂ y CH₄, gases que en parte son emitidos hacia la atmósfera. En el caso de embalses, los estudios sobre flujos de CO₂ y CH₄ se han realizado mayoritariamente en zonas tropicales y templadas. Sin embargo, permanecen escasos los estudios en la región Mediterránea, especialmente en el caso de los flujos de CH₄. En este trabajo, hemos cuantificado los flujos de CO₂ y CH₄ y sus concentraciones en la columna de agua en doce embalses de la región Mediterránea durante el período de estratificación y el de mezcla. Estos embalses difieren en cuanto a sus características físicas, químicas, tróficas, de paisaje y año de construcción. Los flujos se midieron de forma directa y simultánea con un analizador PICARRO dotado de un analizador espectroscópico de atenuación en cavidad (Cavity Ring-Down Spectroscopy- CRDS) conectado a una cámara flotante. Así mismo, la concentración de CH₄ en la columna de agua se determinó mediante cromatografía de gases (CG). Los flujos de CO₂ variaron entre -131.97 (actuando como sumideros) y 393.11 mgC m⁻² d⁻¹ en el periodo de estratificación, y entre -52.51 y 149.62 mgC m⁻² d⁻¹ en el período de mezcla. En el caso del CH₄ los embalses siempre actuaron como emisores, tanto en estratificación (entre 0.51 y 678.84 mgC m⁻² d⁻¹) como en mezcla (entre 0.10 y 4.41 mgC m⁻² d⁻¹). La emisión de CH₄ máxima se midió en un embalse bastante somero y con una elevada contribución por ebullición. Los flujos medidos de CO₂ y CH₄ en este trabajo están dentro de los rangos publicados anteriormente. Parámetros físicos como el viento y la temperatura mostraron una relación significativa con los flujos de CO₂ y CH₄. En cambio, la edad de los embalses no parece ser un factor determinante de las emisiones de estos gases a la escala regional estudiada. La concentración de CH₄ disuelto en superficie (0.5m) siempre estuvo sobresaturada en todos los embalses, variando entre 2576 y 339999% en estratificación y entre 827 y 37818% en mezcla. Esta extremada sobresaturación de CH₄ superficial explicó el 85% de la variación de los flujos de CH₄. Es destacable, la existencia de una relación positiva y significativa entre la saturación de CH₄ superficial y la saturación de oxígeno, así como entre la concentración superficial de clorofila-a y de CH₄. Estos resultados sugieren de la existencia de metanogénesis en presencia de oxígeno, una mecanismo vinculado a organismos fotoautótrofos ya descrito en otros sistemas acuáticos como lagos y océanos.

Carbon dynamics in drying sediment from the Siurana Reservoir, Catalonia, Spain

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Drought and water management decisions frequently cause reservoirs to go dry. For instance, the Siurana Reservoir in Catalonia, Spain has dropped from 60% of capacity to just 13% of capacity in the past 3 years. Sediments in reservoirs and lakes are considered a significant carbon (C) sink, with global organic C burial in reservoir sediment estimated between 0.16-0.6 Pg C/yr. However, the fate of this buried organic carbon in newly exposed sediment as reservoirs go dry remains unknown. Thus, it is critical to determine the role of drying sediment on the global C cycle. Here, we performed incubations using sediment collected from Siurana to monitor C fluxes as formerly submerged reservoir sediment dries under controlled laboratory conditions. The drying sediment cores averaged CO₂ emissions of 208 ± 112 mmol CO₂ m⁻² day⁻¹ across replicate cores, while previously exposed sediment displayed net CO₂ consumption over the first 20 days of incubation (-79 ± 140 mmol CO₂ m⁻² day⁻¹). These results were contextualized by comparisons of mineralogy and total organic C content in the sediment before and after incubation. The high C fluxes in drying sediments and the dual role they can play depending on precedent exposure time warrant further investigation as a component of the inland water carbon cycle.

Characterization and transformation of dissolved organic matter in a pampean stream

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Dissolved organic matter (DOM) transformations depend on its chemical composition, which is modulated by the sources that provide organic matter. Temporal dynamics of stream DOM are usually governed by the discharge regime. Understanding the chemical composition of DOM is important, because chemically different DOM pools have different susceptibility to biogeochemical transformation processes within streams. The aim of our study was; (i) to characterize the composition of DOM in stream water and their potential sources (groundwater, overland flow, subsurface flow and rain water) and (ii) to determine net in-stream retention/release efficiencies of dissolved organic carbon (DOC) under different hydrological conditions. This study was carried out in Las Flores stream, a third-order stream located in the Luján River basin in the northeast of the Buenos Aires province, Argentina. We selected a 2.2 km reach of Las Flores stream, which originates at the confluence of two tributaries (B1 and B2). On each sampling occasion, we collected water samples at the end of a reach (site A), at two upstream tributaries (B1 and B2), and at the potential hydrological contributors to stream flow (groundwater, overland and subsurface flows and rainfall). We determined DOC concentration and DOM optical properties in the stream and end members by combining absorbance-fluorescence spectroscopy techniques. At baseflow conditions, when stream flow is mainly maintained by groundwater inflow, DOM is predominately composed by a mixture of compounds derived from microbial activity (protein-like components) and compounds derived from the terrestrial landscape, which are transported to the stream during storm events. DOC concentration and inputs of humic substances from the riparian zone increased with discharge at high flow conditions. Mass balance estimates revealed that the study reach is as a source of DOC. Protein-like compounds mainly derived from groundwater contribution and in-stream production at baseflow, while humic-like fractions derived from materials washed out during storm events and transported to the stream. However, part of humic-like fluorescence could originate from the breakdown of highly productive macrophyte communities. In conclusion, DOM chemical characteristics in Las Flores stream are mainly modulated by a differential contribution of end members to stream water depending on hydrological conditions. Stream DOM consists of a mixing of proteinaceous and humic compounds.

Cambios en el perfil metabólico de las comunidades microbianas acuáticas de diferentes lagunas de España a lo largo de un gradiente de salinidad

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En este trabajo se muestra el patrón del perfil metabólico de las comunidades microbianas acuáticas de diferentes lagunas de España según su posición dentro de un gradiente de salinidad. Para su determinación se han utilizado Placas Biolog – Ecoplates con 31 fuentes de carbono diferentes. La metabolización de cada compuesto se puede seguir en el tiempo mediante espectrofotometría, y permite conocer el grado de uso de cada una de las 31 fuentes de carbono por parte de los microorganismos acuáticos, generándose un perfil metabólico propio de cada laguna. Mediante el análisis de este perfil, se pueden agrupar las lagunas según su semejanza o sus diferencias, y se puede relacionar ese perfil con diversas variables ambientales. Los resultados obtenidos en este trabajo muestran que las comunidades microbianas acuáticas de las lagunas más salinas presentan un perfil metabólico completamente diferente al de las comunidades correspondientes a las lagunas menos salinas. Así, la microbiota acuática de las lagunas más salinas tiende a utilizar pocas fuentes de carbono, pero con un grado elevado de uso, mientras que las comunidades de las lagunas menos salinas pueden metabolizar una gran variedad de sustratos pero sin un uso muy preferencial de ninguno de ellos. Estos resultados muestran que las variables ambientales características de las lagunas son capaces de regular el perfil metabólico de las comunidades microbianas acuáticas que las habitan, pudiéndose diferenciar entre ellas gracias a los sustratos que son capaces de utilizar.

Current Rates of Carbon Processes and their Response to Climate Change in Mediterranean Coastal Marshes

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Coastal marshes are important ecosystems in climate control as they behave like natural carbon sinks. However, changes in environmental features, such as increased temperatures or reduced rainfall due to the climate change, could modify the response of these systems and alter their mitigating capacity, as they are among the most vulnerable ecosystems to the expected changes in the Mediterranean region. The aim of this study was to evaluate the current rates of the carbon processes in the Valencian Mediterranean coastal marshes, as well as their possible response to the predicted climatic shifts. For that purpose, the rates of the main processes linked to the carbon cycle were studied both in the field and under conditions-controlled laboratory experiments. These included measurements of benthos and plankton aerobic respiration and primary production, methane production, carbon chemical precipitation and carbon fixation by helophytes. Specific algorithms to estimate the carbon balance were calibrated with the field data. The response of these processes to changes in the temperature, salinity and flooding conditions was experimentally determined by incubating replicated representative samples at the different conditions. Then their trend towards the different future scenarios was statistically analysed. Finally, the carbon balance was modeled taking into account these patterns in order to extrapolate to the four RCP IPCC climate change scenarios for 2050 and 2070. Hydrological patterns and meteorological data were included in the model as determining factors. Results were extrapolated to the entire surface occupied by the coastal marshes inventoried in the “Valencian Wetland Inventory” and that was delineated by remote sensing methods. Wetland carbon sink effect for the entire Valencian region was then calculated and evidenced its aid in climate change mitigation. However, models forecasted a decrease of the carbon sink effect and an increment of the greenhouse gas (GHG) emissions, especially methane, under the different climatic scenarios, due to the increase of temperature, and a loss of the water cover during a more accentuated period. Hereby, the role of the Mediterranean coastal marshes in a climate regulatory effect could be weakened.

How much of the total allochthonous input and autochthonous production is incorporated into the A(metazoan) food chain of streams? Not much!

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There are many studies of allochthonous input into stream ecosystems and the subsequent processing of this material. Many studies of leaf breakdown or leaf processing consider only the “disappearance” of organic matter; fewer studies include the fate of this material in terms of respiration by microbes, particulate matter export, secondary production of consumers, etc. We tend to study the actions of metazoan consumers (“shredders”, etc.) by experimentally excluding them and deducing that any subsequent decrease in organic matter processing is attributable to the consumers. Similarly, the actions of consumers (herbivores) on primary production can be studied by excluding them and measuring the resultant increase in periphyton algae. However the actual flux of carbon to the consumers and transfers of material in the system are mostly neglected. In our research program in small, forested, streams in Rio de Janeiro, Brazil, we approach carbon flux in several ways: 1. Measurement of whole-stream metabolism and flux of coarse and fine particulate and dissolved organic material, 2. Modelling of carbon flux along the stream, 3. Monthly sampling of litter and associated macroinvertebrates and estimation of secondary production, 4. Experiments to quantify food-web relationships and consumption of basal food sources, 5. Stable isotope analysis to assign carbon sources in the food web, 6. Modelling of carbon flow to secondary production, 7. Synthesis of the parts into a whole-ecosystem model of carbon flux. We found that a relatively small proportion of leaf litter was “processed” by consumers, and of that, an even smaller proportion was incorporated into secondary production (1.7% in one study). Autochthonous primary production appeared more than adequate to support the consumer food web, even in shaded reaches, and only a relatively small percentage of production flowed to consumers (7% in one study). This implies that a large part of the apparent processing seen in experiments -- disappearance of leaf mass and appearance of periphyton -- is bioturbation or non-trophic consumption. As we approach a quantification of the fluxes we are seeking to understand the controls and constraints. Top-down control of the food web appears important at least at the level revealed by experiments.

When size matters: net carbon footprint of hydropower is highly impacted by in-reservoir carbon fluxes

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Reservoirs are currently seen as relevant sources of carbon to the atmosphere. However, the role of biogenic carbon dioxide (CO₂) and methane (CH₄) emissions has been poorly integrated in assessments of the carbon footprint (CF) of hydropower, particularly in small- to medium-size reservoirs outside tropical latitudes. Here we present a life-cycle assessment of the CF of hydropower, defined as the ratio between greenhouse gas emissions and energy produced, in a set of hydropower reservoirs in the northern Iberian Peninsula. We quantified the net CF by including emissions derived from land flooding, as well as emissions related to dam construction, maintenance and decommissioning, at a temporal scale of 100 years. The emissions related to land flooding included estimates of the emissions from terrestrial ecosystems prior to dam construction as well as current biogenic emissions (i.e., diffusive and ebullitive emissions from the reservoir surface, emissions downstream the dam, and negative emissions by organic carbon burial in reservoir sediments). Despite the high variability observed, the highest emission fluxes were those from water (mostly as ebullitive CH₄ fluxes), and from air-exposed sediments of the reservoirs (as CO₂). Biogenic fluxes dominated the emission budget over construction and maintenance emissions. Carbon burial in sediments is highlighted as a key component of the CF of hydropower in small to medium reservoirs.

C-Hydrochange. Carbon dynamics in lakes and reservoirs under a changing hydrology: ecosystem metabolism, gas fluxes, and sedimentary sinks

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C-HydroChange (CGL2017-86788-C3-1-P) is a new coordinated project funded by the Spanish National Research Plan, involving the University of Málaga (UMA, project coordinator), the University of Barcelona (UB) and the Catalan Institute for Water Research (ICRA). C-HydroChange overall aim is to understand how recurrent and long-lasting hydrological extremes affect carbon (C) cycling in lakes and reservoirs, and how projected changes in hydrology in a warmer world will modify C dynamics in these ecosystems. Lakes and reservoirs play a significant role in global C exchanges by regulating the transport of C from continents to oceans. They maintain high autotrophic and heterotrophic metabolic rates, emit carbon dioxide and methane to the atmosphere, and accumulate large quantities of C in their sediments. Changes in hydrological patterns are one of the major impacts of global change. These changes will also impact hydrology in lakes and reservoirs, which will modify the regime of incoming materials, water residence time, and the exposure of sediments to air. However, we are far from having an integrated picture of the impacts of a changing hydrology on the C cycling in lakes and reservoirs. This compromises not only our ability to anticipate changes in C stocks between Earth System compartments, but also hinders the definition of appropriate strategies to face water quality management in future conditions, an issue particularly relevant in reservoirs. The project C-HydroChange will study the impacts of a changing hydrology on C cycling in lakes and reservoirs stressing four main facets: (i) Recurrent hydrological extremes and water column metabolism, (ii) Recurrent hydrological extremes and C emissions from lakes and reservoirs, (iii) Recurrent and long-lasting hydrological extremes and the remobilization of sedimentary C sinks, and (iv) Projecting impacts of hydrological changes on C cycling in lakes and reservoirs.

SE5.

**Understanding the
consequences of
urban pollution
on freshwater
ecosystems**

Student monitoring of the ecological quality of neotropical urban streams

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Urban streams are the main source of water for human consumption in Latin America. However, population growth and untreated sewage disposal degrade water quality, with negative effects for biodiversity and ecosystem services. Mobilizing society to monitor the quality of urban watercourses (i.e., citizen science) allows diagnosis and facilitates training for further discussing the implementation of mitigation and management strategies. Hence, the training of students and teachers in participative monitoring of the ecological evaluation of water quality in urban watersheds is a doubly effective strategy. Participatory monitoring of urban water quality was performed using biological and multimetric indexes adapted for application by 54 schools. The students assessed 46 stream sites along a gradient of urban influence [high (N = 11), medium (N = 16), low (N = 9)] and in 10 sites deemed as being in the best ecological condition available in the upper reaches of the São Francisco Basin, Brazil. Student results were verified by our scientific measurements and the validated metrics are appropriate both for school monitoring and for environmental education. Our data indicate that physical habitat quality was degraded in 83% of the sites and water quality standards were violated in 54% of the sites. Degraded physical habitat and water quality influenced the composition and structure of benthic macroinvertebrate assemblages in 87% of the sites. Engaging schools in citizen science has altered the relationship between human disturbance and urban streams in four ways. 1) It encouraged initiatives related to the maintenance of riparian forests. 2) It increased social pressures for sewage treatment and basic sanitation. 3) It amplified public participation in political-environmental meetings. 4) It improved the maintenance of urban protected areas. The practice of citizen science with schools can compensate for the inability of government action and the lack of qualified personnel to diagnose and monitor the ecological quality of streams. The scientific potential of participatory monitoring is an alternative to promote greater community awareness in proposing mitigation and rehabilitation actions, as well as the maintenance of ecosystem services provided by urban watercourses.

Succession of biofilm colonization during an experiment in a eutrophic urban pond

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Biofilm is an important component of aquatic ecosystems, their composition varying with water temperature and nutrients, among other factors. In addition, biofilms' response to variation in water composition is fast due to diatoms' short life cycles. The process of colonization and species succession over time is still not well studied, and even less in urban aquatic ecosystems. Our main objective was to observe diatom's succession along time to identify changes in diatoms traits and temporal patterns in diatom communities. We studied the process of biofilm colonization on substrates at two sites in a eutrophic urban pond. Water feeding the pond ran from site 1 to site 2, and nutrients (mainly N and SO₄²⁻) were higher at site 2. During four weeks we analyzed: periphyton and biofilm production, diatom assemblages and ecological quality assessments (IPS index). The substrates were gradually collected at days 7, 14, 21 and 28 (n = 24). Our analysis confirmed that the diatom assemblages at the two sites were different (45.8% dissimilarity), with *Achnanthydium pyrenaicum*, *Gomphema truncatum*, *Encyonema minutum* and *E. silesiacum* appearing only at site 1, and *Stauronema venter*, *Gomphonema saprophilum* and *Rhoicosphenia abbreviata* only at site 2. A shift in species also occurred during the colonization period. In site 1, *Achnanthydium pyrenaicum* and *A. minutissimum* were replaced by *G. parvulum*, *Nitzschia amphibia* and different species of *Cyclotella*; while in site 2, *Amphora pediculus*, *Planorhynchium frequentissimum* and *Gomphonema sp.1* were replaced by *Grunowia solgensis*, *Eolimna minima* and *Cyclotella meneghiniana*. In both sites Shannon-Wiener diversity values (H') were ca. 3, while the IPS values ranged from 15.8 to 7.5 in site 1 and in site 2 from 10.8 to 8.9, decreasing over time at both sites. Biofilm production increased with incubation time; biomass values ranged from 2.4 to 10.5 g/m² in site 1, and from 7.25 to 42.3 g/m² in site 2. Chlorophyll a values ranged from 14.4 to 42.4 mg/m² in site 1, while in site 2 maximum values were reached at day 14. This study highlights the existence of changes in biofilms and algae communities, including species loss, with the increasing period of exposure to water quality degradation. A better understanding of this process in urban ecosystems is important to assess services that can be provided by biofilms, such as nutrient assimilation or biomass and energy supply to higher trophic levels.

Dinâmica espacial de córrego explorado para abastecimento público no Brasil, região sub-tropical

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As alterações antrópicas em córregos explorados para o abastecimento público podem ocasionar mudanças ao longo do seu gradiente longitudinal. O ribeirão das Pitangueiras, Barretos, SP, Brasil (20°33'33"S and 48°34'8"W) possui 40 km de extensão e é o principal curso d'água usado para o abastecimento público, além de receber efluentes domésticos, industriais e da agropecuária. O objetivo deste trabalho foi determinar as características limnológicas do córrego Pitangueiras visando a compreensão da sua dinâmica espacial. A cada 60 dias (durante 180 dias) foi determinada as concentrações de oxigênio dissolvido (OD), sólidos em suspensão (SS), nitrogênio inorgânico (NI) e Kjeldahl total (NKT), P-ortofosfato (P-PO₄) e total (PT) nos trechos de nascente, médio e foz. As concentrações de OD foram menores na foz (2.4 mg/L) em relação à nascente (5.4 mg/L) e trecho médio (3.8 mg/L). Por outro lado, a concentração de SS foi maior no trecho médio (52.2 mg/L) seguido da foz (44.3 mg/L) e nascente (12.1 mg/L). Em relação ao nitrogênio e fósforo, as maiores concentrações ocorreram na foz. A concentração de NI foi em média 3 vezes maior na foz (228.4 µg/L) em relação à nascente (75.4 µg/L) e 2 vezes maior no trecho médio (118.3 µg/L). Para NKT, a concentração na foz (10.5 mg/L) foi, respectivamente, 5.8 e 1.6 vezes maior em comparação à nascente (1.8 mg/L) e trecho médio (6.5 mg/L). O efeito negativo das atividades antrópicas na foz do córrego é mais expressivo ao comparar as concentrações de fósforo. A concentração de P-PO₄ foi 23.8 vezes maior na foz (119.7 µg/L) em comparação à nascente (5.0 µg/L) e 2.1 vezes maior em relação ao trecho médio (56.5 µg/L). Para PT, a diferença da concentração observada na foz (187.9 µg/L), em relação aos trecho médio (69.7 µg/L) e nascente (8.0 µg/L), foi semelhante ao observado para P-PO₄. O impacto ocasionado pelas atividades antrópicas ao longo do gradiente longitudinal do córrego Pitangueiras proporciona o aumento das concentrações de nitrogênio e fósforo e reduz a disponibilidade de OD. Essas alterações comprometem o uso múltiplo do córrego Pitangueiras e, pode desencadear mudanças na dinâmica temporal das comunidades aquáticas.

Mineralization of sediment organic matter to CH₄ and CO₂ in urban freshwater bodies

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Organic matter (OM) mineralization in sediments of shallow water bodies is a major driver of CO₂ and CH₄ fluxes across sediment-water and water-atmosphere interfaces. In urban areas, most chemical and physical characteristics of sediments are profoundly altered as water bodies are subject to anthropogenic impacts resulting from close hydrological and other connections with their catchments (e.g. discharge from wastewater treatment plants, industrial activities and sealed urban surfaces such as roads and roofs). Yet, effects on the microbial mineralization of sediment OM to CO₂ and CH₄ are essentially unknown. Here we present data on CO₂ and CH₄ production in sediments of 25 urban water bodies (lakes, streams, and ponds) distributed across the metropolitan area of Berlin, Germany. We analysed the sediments for OM content, concentrations of major nutrients (N, P), metals and organic pollutants (pharmaceuticals), and measured potential production rates of CO₂ and CH₄ by incubating sediments under anoxic conditions. Our preliminary results show extreme spatial heterogeneity of carbon mineralization rates (mean and SD for CO₂: 838 ± 841, CH₄: 267 ± 370 mmol g⁻¹ sediment dry mass d⁻¹). Potential gas production was mainly explained by sediment OM content, which averaged 20% but ranged from 0 to 77 % across the 25 sites. Low ratios between potential production rates of the two gases in ponds suggest that methanogenesis is a major process of OM mineralization in these urban water bodies. Porewater concentrations of CO₂ and CH₄ were related to redox conditions. Two of the sites showed no CH₄ production during the anoxic incubations, although all sediments were over-saturated with both gases. Concentrations in sediments of several trace metals (Cd, Cr, Pb and Zn) were also elevated, but negative effects on OM mineralization were not detected, nor were concentrations of pharmaceuticals at a level that affected sediment OM mineralization. Thus, our findings suggest that (i) high variability of OM content in sediments accounts for much of the variability in OM mineralization encountered in water bodies of the Berlin metropolitan area, whereas (ii) the different types of water pollution expected in urban areas had little impact.

Effects of wastewater treatment plant effluent on the detrital Pathway

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Pollutants that enter streams via point sources are considered one of the main stressors of aquatic ecosystems. Alterations caused by the introduction of nutrients, organic matter and other pollutants that are more difficult to degrade in wastewater treatment plants (WWTP) are responsible for altering stream biota and ecosystem functioning. In this study we assessed the effects that WWTP effluent produces at different concentrations through a mesocosm experiment and an additional semi *in situ* experiment in Apraitz, a small stream in Elgoibar (Gipuzkoa). In both cases, alder (*Alnus glutinosa* [L.] Gaertn.) leaf disks were incubated with and without macroinvertebrates for microbial and consumer level responses. Microbial decomposition, respiration and exo-enzymatic activities were analyzed together with growth, consumption and, RNA and DNA content of the amphipod *Echinogammarus berilloni* (Catta). In the mesocosm experiment, six different wastewater dilutions were tested, ranging from 0% to 100% of wastewater effluent. In the semi *in situ* experiment, fine-mesh bags (0.5-mm pore size) were incubated in two stream reaches (Control and Impact), Before and After the start of the effluent addition to the Impact reach, following a BACI design. Preliminary results show that the WWTP effluent created a subsidy effect rather than a toxic one in the laboratory experiment. Incubation in the field revealed minimal effects, supposedly due to the dilution of the effluent in stream water.

Change of a stream ecosystem function along a forest-to-urban gradient transition: Integrating riparian and in-stream characteristics

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Subtropical stream ecosystems of the southern region of Brazil are critically threatened by a rapid urban development. Worldwide, the development of cities has been associated with permanent land-use conversion, including replacement of riparian vegetation by pasture, loss stream impairment that reduces biodiversity and negatively affects ecosystem processes and habitat. Through a replicated litter-bag experiment (0, 7, 15, 30, 45 and 60 days of incubation), we studied the influence of land use (forest–pasture–urban) on stream physico-chemical variables and leaf-associated macroinvertebrates and we examined also how variation in those sites conditions (forest–pasture–urban) affect to leaf litter breakdown process. Bags containing 3 grams of dry leaf of *Alchornea triplinervia*, a dominant riparian vegetation at southern region of Brazil, were deployed on forest (n=1), pasture (n=2) and urban streams (n=2). We found that pH, water temperature, and dissolved oxygen increased along the land-use gradient. Taxonomic composition of leaf-associated macroinvertebrates was significantly different between of land use (forest–pasture–urban). Also, major differences in the structural and functional composition of leaf-associated macroinvertebrates were mainly promoted by land use in both ecosystem types. Forested stream showed higher diversity than pasture streams, sustaining more shredder, scraper, and predatory invertebrates. Specifically, the shredder richness and abundance were lower in pasture than forest stream and totally absent in urban stream. Significant variations were found in the leaf litter breakdown process (loss mass) among streams type (forest–pasture–urban). The values of decay constant, k , varied from 0.0086 in forest stream to 0.0066 in the pasture stream and 0.0031 in the urban stream. Leaf litter breakdown became slower as forest land use changed from natural to pasture and urban stream and were determined by dissolved oxygen, water temperature and leaf-shredding invertebrates. Our study provides evidence for multiple direct and indirect pathways by which urbanization can decrease leaf-litter breakdown rates in subtropical streams, mainly through negative effects on stream physico-chemical variables and leaf-associated macroinvertebrates.

Change of a stream ecosystem function along a forest-to-urban gradient transition: Integrating riparian and in-stream characteristics

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Effects of waste water treatment plant (WWTP) effluents on stream ecosystem functioning: insights into the Subsidy-Stress hypothesis

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Effluents from wastewater treatment plants (WWTP) are discharged in many streams and rivers, to the point that in many cases they become most of the circulating water flow. This situation is particularly common under water scarcity; however, there still is a lack of clear understanding of the effects on ecosystem functioning. WWTP effluents consist of complex mixtures of assimilable and toxic compounds, which can subsidise or stress ecosystem processes depending on their composition and final concentration in the receiving water body. We approached this issue by performing an experiment using 24 indoor artificial streams receiving an increasing WWTP effluent contribution to the river flow. The exposure lasted for 32 days, and we later allowed the recovery for another 23 days, by changing the circulating polluted water to unpolluted new water in all the artificial streams. We measured different processes, including alder leaf breakdown, benthic metabolism, biofilm exoenzymatic activities and the biofilm capacity to retain phosphorus. The response to the pollution gradient varied among processes. Leaf breakdown was lowest at medium concentrations and highest in the most polluted treatments. Metabolism showed higher production than respiration, being this ratio higher at medium concentrations. Finally, biofilm exoenzymatic activities and phosphorus uptake showed a monotonic decrease as effluent concentration increased. The recovery pattern of all variables after cessation of effluent inputs was idiosyncratic, as each variable followed a different recovery path. Leaf breakdown was higher than in the exposure phase, but it did not show any pattern according to the pollution legacy. Metabolism showed higher production rates than in the exposure phase, achieving the highest values in the treatments previously exposed to medium concentrations. Finally, biofilm exoenzymatic activities and phosphorus uptake were also higher than in the exposure phase, showing a clear capacity to recover, especially in the most polluted treatments. Overall, our results point to a complex response of stream ecosystem functioning to urban pollution, depending mainly on the process and the temporal scale we are looking for.

Subsidy-stress response of river biofilm communities to wastewater treatment plant (WWTP) effluent and its interaction with desiccation

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Discharge from wastewater treatment plants (WWTPs) has major detrimental effects on freshwater ecosystems worldwide. Effluents from WWTPs contain a mixture of assimilable and toxic compounds, which concentration ultimately determines the effect of the mixture on freshwater biota. Moreover, increased human pressure on freshwater ecosystems is leading to increased temperature and recurrent desiccation events. The present study used 24 experimental channels in a replicated regression design to evaluate how a gradient of WWTP effluent concentration affects river biofilm community composition and functioning. Additionally, we assessed how this concentration gradient interacts with desiccation to shape the response of the river biofilm community. Using real-time quantitative polymerase chain reaction (qPCR) and targeted 16S rDNA amplicon sequencing, we assessed the effects of a WWTP effluent gradient on biofilm community structure and ecologically-relevant microbial groups, such as those involved on photosynthesis, nitrogen cycling and methanogenesis. WWTP effluents strongly influenced river biofilm community and major microbial groups. Results indicate a strong subsidy effect on river biofilm community at intermediate WWTP effluent concentrations, while high concentrations tended to act as a stress.

Evaluación y gestión de la calidad del agua en un río transfronterizo

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El río Bravo/río Grande es el río más grande de Norte América y uno de los principales ríos de México y Estados Unidos, por ser un cuerpo de agua transfronterizo, ha tenido particular importancia por la creciente preocupación por el desarrollo económico de la zona fronteriza y por los problemas de contaminación que han sido identificados por la falta de saneamiento en varias poblaciones de ambos países. El estudio fue diseñado para identificar las fuentes de contaminación a través de cuatro campañas de monitoreo de calidad del agua en el Bajo Río Bravo/Río Grande, que a través de la iniciativa entre ambos países apoye un modelo de gestión binacional de calidad del agua para el tramo comprendido desde aguas abajo de la presa Internacional Falcón hasta la desembocadura al Golfo de México, abarcando aproximadamente 450 kilómetros. En reuniones binacionales se acordó seguir los protocolos y metodologías que cada país tiene autorizadas a través de normas, criterio o estándares, para Estados Unidos por las Agencias de Protección Ambiental (EPA) y para México la Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT). Un total de 7140 análisis de agua se realizaron (físicoquímicos, metales pesados, plaguicida, microbiológicos y compuestos orgánicos) en el cauce principal y en las descargas de aguas residuales identificadas en México. Las descargas y plantas de tratamiento analizadas no cumplieron con los límites máximos permisibles de la norma (NOM-001-SEMARNAT-1996) para Demanda Bioquímica de Oxígeno, Grasas y Aceites, Sólidos Suspendidos Totales, Nitrógeno Total y Coliformes fecales. En el río los parámetros como sulfatos, sulfuros y sólidos disueltos para el uso como fuente de abastecimiento de agua potable (Uso 1) se encontraron arriba del criterio. La zonificación para atender y controlar la contaminación al Bajo río Bravo/río Grande, se ubica en las dos principales ciudades del norte de México (Reynosa y Matamoros en el Estado de Tamaulipas); mientras que para Estados Unidos en los condados de Brownsville e Hidalgo, Texas, EU.

Polluting a stream for the sake of science: an ecosystem manipulation experiment on the ecological effects of WWTP effluents

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Waste Water Treatment Plants (WWTP) greatly reduce point-source pollution from urban and industrial sources. However, WWTP effluents still contain complex cocktails of pollutants, whose ecological effects are far from clear. To assess the ecological effects of a WWTP effluent in real conditions, we performed a BACI (Before-After, Control-Impact) experiment. Specifically, we diverted part of the effluent of a large, urban WWTP into the lowermost 100 m of a small, unpolluted tributary stream. We used a 100-m long reach upstream from the diversion point as a control, and studied both reaches for a year prior and a year after the effluent diversion. Microbial activity increased whereas nutrient uptake decreased, but there were no changes in metabolism, litter breakdown and invertebrate survival. Overall, these results point to a weak effect of the studied WWTP effluent on the receiving stream. How other streams are affected will depend on the quality of the WWTP effluent and its degree of dilution in stream water.

SE6.

Bringing

interdisciplinary

actions for river and

riverine management

Surveying the past on reliquial habitats: the Guadiana River in the post-Alqueva era

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Hydrological alterations and land use and land cover (LULC) changes alter river and riparian ecosystem functions and processes. We studied ecological and hydromorphological alterations in Guadiana River, Southeast Portugal impaired by Alqueva dam, one of the largest irrigation dams in Western Europe. We performed a temporal comparison using pre-dam (1990) and post-dam (2013) information collected using planform image analysis and field surveys. We positioned 45 circular sampling units in three sections of the river: upstream of the dam, downstream of the dam and in the area occupied by the reservoir. We collected information on LULC, riparian cover and geomorphological structures using high resolution airborne images in both periods. We collected floristic data in comparable dates (1987-1999 and 2017, respectively). We used landscape metrics and analysed whether the means in the three sections, between pre-dam and post-dam periods were significantly different, using paired t-tests. We classified the recorded species into functional groups related to species origin, plant growth-forms, or resources. We performed Non-metric multidimensional scaling to assess the pairwise dissimilarity between locations and periods. We observed significant riverine landscapes changes in all river sections but they were especially evident in the area occupied by the reservoir. Flow regulation by Alqueva dam resulted in large alterations in hydromorphological setting and dramatic declines in riparian abundance and biodiversity values, especially in the woody strata. The disrupted sediment and flow regime altered significantly the river channel and the number and area of geomorphological features such as islands and banks. Riparian zones suffered a dramatic decline of native and Iberian endemic woody species (*Salix salviifolia* subsp. *salviifolia*, *Flueggea tinctoria*, *Nerium oleander*) and an increase in alien plant species both upstream and downstream of Alqueva dam. However, we found some 'reliquial habitats' in adjacent wetlands nearby the reservoir holding species-rich communities of riparian herbs. The mitigation of impacts of regulation and LULC changes should rely in the knowledge of the interactions between surrounding lands, ecological, geomorphological and hydrological components of rivers.

Upstream movements of a potamodromous cyprinid past an experimental broad-crested small weir

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Unlike the numerous studies of the impacts of dams on fish populations, the impacts of small weirs have received much less attention. Although far more numerous than dams, small weirs have been considered as "a priori permeable" to fish movements but, the presence of these barriers changes the hydraulic environment, alter water depth and water velocity patterns, and creates vertical drops that may partially or totally block fish migratory routes. Potamodromous cyprinid species can be particularly affected by the presence of small weirs due to their need to perform seasonal migrations. This study aims to evaluate the upstream passage performance of a potamodromous cyprinid, the Iberian barbel (*Luciobarbus bocagei*) when encountering small weirs, considering the interaction of key parameters: waterfall height (H), plunge pool depth (D), width of the weir crest (W), and flow discharge (Q). Initially, 16 configurations were tested considering the combination of waterfall height (H = 5, 10, 15, 25 cm) and plunge pool depth (D = 10, 20, 30, 50 cm) at a constant flow discharge of 50 L/s, and a crest width of 20 cm. Subsequently, another 2 crest widths (W = 40, 80 cm) and 3 new discharges (Q = 25, 75, 100 L/s) were implemented on the configuration that had the highest passage success. Hydraulic environment downstream of the weir was characterized with a 3D Acoustic Doppler Velocimeter to assess the effects of hydrodynamics on fish behaviour. Results demonstrated that parameters D, H, their interaction D×H, and Q, were significantly correlated with the number of successful upstream passages (PERMANOVA, $p < 0.01$). As for parameter W, and the interaction W×Q, there was no evidence that influenced upstream passage of fish. Contrary to what was assumed, increased passage did not occur at higher plunge pool depth in association with a lower waterfall height, although the combination D50H05 provided reasonable results. Moreover, the increase of the crest width did not compromise the successful negotiation of the weir. Thus, this study showed that successful passage of small instream obstacles seems to be a more complex phenomenon, where these key hydraulic variables (D, H, W, Q) interact to set the most favourable hydrodynamic conditions for fish to overcome the obstacle. The outcomes of this work are expected to be useful to identify potential migration obstacles for potamodromous cyprinids, and to define design criteria for the requalification of small barriers.

Macroinvertebrados como catalizadores para la gestión ambiental de los ríos

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La gestión ambiental de los ríos requiere de la participación de personas con conciencia ambiental. A través de este trabajo se busca demostrar la importancia que tienen los macroinvertebrados para facilitar la generación de conocimientos, ejecución de acciones y creación de actitudes positivas hacia los ríos en un tiempo relativamente corto, al permitir el establecimiento de una relación cercana de un elemento de la naturaleza, como son los macroinvertebrados, con las personas. La metodología incluyó el análisis de tres estudios de caso, cada uno con características particulares, en países diferentes: Brasil, Costa Rica y Uruguay. En Costa Rica el objetivo fue mejorar la percepción que tenían del río 42 niños de la Reserva Natural de Nosara, a través de ejercicios de observación del paisaje y colecta de macroinvertebrados, utilizando como instrumento de evaluación un cuestionario aplicado antes y después de la actividad. En Brasil, se hizo una evaluación rápida de la calidad del agua del Río Santo Cristo (Rio Grande do Sul), con 92 personas que identificaron macroinvertebrados y los asociaron a mediciones de pH y temperatura. En Uruguay se desarrolló una propuesta de educación en ciencias formal con niños de 11 años a partir de la presencia/ausencia de macroinvertebrados en tres zonas del río Canelón Chico y su correlación con variables fisicoquímicas del agua (protocolos del Programa GLOBE www.globe.gov) y las actividades humanas. En los tres casos se tuvo como resultado que los macroinvertebrados mejoraron el acercamiento de las personas a la ecología de los ríos, siendo evidente la necesidad de seleccionar el tipo de macroinvertebrados a usar según los objetivos que se pretenda lograr con ellos. En relación a mejorar la percepción en base a salidas de campo, como en Costa Rica, se deben usar especies conspicuas (grandes y coloridas). Si el objetivo es comprometer a las personas en actividades de monitoreo participativo como en Brasil se deben seleccionar las especies más abundantes. En una propuesta de educación formal, los macroinvertebrados demostraron ser excelentes catalizadores para mejorar el aprendizaje de la importancia de los ríos al ayudar a relacionar el aprendizaje con problemas reales cercanos.

The River Network Toolkit

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Effective research in freshwater ecology requires the ability to contextualise different types of information, such as climate, landscape features, and hydromorphology, within the hierarchical nature of river networks. The current technological progress translates into better documented and increasing digital availability of such information. Specific tools tailored to deal with the singularities of hierarchical river networks, and to integrate landscape information with this specific type of networks are still rare. Some have been implemented as geographic information systems (GIS) extensions with limited functionalities, and normally more focused on creating networks based on digital elevation models or topologically managing and improving existing digital river networks. Moreover, performing summarisations or automatized calculations considering the directed, hierarchical pathways of a freshwater network in such tools leads to long processing times and demanding hardware requirements. Here, we present the River Network Toolkit (RivTool), an innovative user-friendly software of universal applicability developed to effortlessly deal with these challenges. This software allows users to generate information characterising the freshwater network based only on its topographic nature, extract different types of data resulting from up and downstream summarisations and obtain new data via mathematical calculations taking into consideration the hierarchical network nature of these systems. This table-driven software is time effective even with large datasets, has a set of ready to use libraries for the European continent, and is freely available at the RivTool website (www.rivtoolkit.com) and at a repository of the School of Agriculture from the University of Lisbon (<http://www.isa.ulisboa.pt/proj/rivtool/>). RivTool reduces the time required for extracting and integrating multiple types of data with freshwater networks. Therefore it may contribute to increase efficiency and accurateness of freshwater research on large-scale patterns and processes in river networks, helping to design more effective management strategies.

Portuguese Historical Fish Species Database – PHish-DB

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Freshwater ecosystems represent only 0.01% of the planet's surface but are considered one of the most endangered ecosystems worldwide and home to about 9.5% of animal species. In the European continent, 13 native fish species have disappeared and 40% have experienced regional extinction. In the Iberian Peninsula, where numerous endemic and native species occur, has experienced a decline in freshwater ichthyofauna populations. Despite some limitations, collecting historical data about species, prior to numerous highly impactful human activities, can provide important knowledge about species ecological requirements. Though ecological considerations and interpretations must be carefully taken, the insights provided by this type of data may be of critical importance. To generate the PHish database, 159 historical sources (charters, inquiries, donations, monastic chronicles, chorographies, historical-geographical memos and dictionaries) were examined, resulting in 1544 records for inland Portugal. It covers a time-span of one millennium, between 11th and 20th centuries, with more data for the second half of the millennium and particularly for the 19th century. Records were encountered for 27 basins, 218 sub-basins and 312 segments, and are spatially heterogeneous since they are more numerous in the northern and central areas of Portugal. Three international river basins (Douro, Minho, and Tagus), one Portuguese river basin (Cávado), and two river sub-basins, Tâmega (Douro) and Zêzere (Tagus), have the highest amount of records. Data encompasses 18 distinct taxonomical groups, with "*Salmo trutta*", "*Petromizontidae*" and "*Alosa sp.*" showing the highest number of records. This database will definitively improve current knowledge, by complementing existing data from Spanish sources, thus avoiding analysis of a meaningful biogeographical entity such as Iberia to be hindered by political borders.

Historical cartography as bases for studying changes of pollinator services in riverine landscapes

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Historical cartography can provide relevant data for the assessment of landscape changes in riverine ecosystems. In this study, we compared historical maps (1898) with contemporary datasets (2016) to assess how land-use land-cover (LULC) changes in the surrounding lands of Minho River affect pollination services. The study area comprises 67 km along the river, in a 300 m buffer including the riparian zone and adjacent lands. A proxy-based method, using expert-knowledge and field data, was used to derive the capacity of distinct land-uses to support pollination services. A collection of 59 historical maps* were georeferenced using ArcMap's Geo-referencing Toolbar and projected to the European Terrestrial Reference System 1989 (ETRS89). For the contemporary dataset we used the national LULC layer (COS 2007) combined with high-resolution satellite imagery (pixel size with 50 cm) using ArcGIS Online World Imagery map (2016, Copyright © Esri). We identify 14 land-use classes divided in three main types: artificial surfaces, agricultural areas and forest and semi-natural areas. Minho River was partitioned into 35 contiguous sampling units (SU) each one with 2000m long and 300 wide, in both historical and contemporary datasets. LULC data were evaluated by percentage of area occupied within each SU. We observed a global and significant decrease in the pollination services between 1898 and 2016 mainly related with the conversion of broadleaved-forests to artificial surfaces and managed forests dominated by maritime pine and eucalyptus. However, in the middle section of Minho River, we detected a local increase of the pollination services associated with the intensification of scrublands, riparian forests and other semi-natural areas. The interplay of image planform approaches with landscape history may bring novel insights about the effects of LULC changes on the availability of ecosystem services in riverine areas, thus contribute for the sustainable management of riparian and river ecosystems.

*historical data was provided by the Portuguese National Library

Predictors of functional change in riverine landscapes: multiple ways and approaches

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Functional diversity indices are increasingly being used to describe plant community assembly processes and predicting ecosystem responses to changing environments. However, the use of these indices in riparian plant ecosystems is largely unknown, despite this emergence of multiple functional diversity measures. In this communication, we summarize and evaluate the application of the functional measures in riparian forests. We extracted data from 70 case studies world-wide referring functional diversity and riparian forests in the last 20 years (up to August 2017), aiming to assess: a) type, number and justification for the traits used; b) the most frequent factors driving functional trait composition; c) geographical and temporal trends of functional diversity measures; d) dichotomy between guilds and functional diversity indices and e) predictive power of the functional diversity measures. We found the prevalence of soft traits over hard traits, with Specific Leaf Area, plant height and seed mass being the most commonly applied. Average number of traits was 8.4 per study, mainly with the goal of describing ecosystem processes. The effects of environmental stress, namely hydrological alterations were addressed more frequently than land-use change. In general, the uses of functional diversity measures have been increasing since the last two decades. However, there have been a higher number of studies using the guild-approach (groups of species with similar traits) than functional diversity indices. The exponential application of functional diversity indices was particularly evident for Europe, where there is a growing interest on modeling riparian vegetation to understand climate change impacts. Among the indices, functional richness that corresponds to the functional space occupied by species was the most used metric, usually coupled with indices, which incorporate trait abundance such as functional evenness, functional divergence, functional dispersion and functional redundancy. More than 75% of case studies using functional diversity measures provided successful results to the proposed goals, suggesting their applicability to link species composition, functional traits and ecosystem processes in riparian forests. Further application of the functional diversity approaches can be used in earth system models, such as spatial projections of riparian forests functional composition and associated ecosystem services as a response to contemporary global change.

Floating constructed wetland for the treatment of urban surface runoff: an application of a nature-based solution

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Urban surface runoff strongly contributes to the degradation of river ecosystems. Innovative, nature-based solutions have been applied to face such environmental problems. Constructed wetlands – a low-cost green treatment technology – represent a successful solution that brings social and environmental benefits. Floating Constructed Wetlands (FCW) consist of emergent macrophytes planted on floating mats constructed of buoyant material. FCW have been tested to treat wastewater and stormwater, but few studies assessed their capability during periods of short retention time and under hydraulic shock-loading. We assessed the performance of a FCW to treat simulated urban surface runoff. The removal efficiency of nitrogen (TN) and phosphorus (TP) was investigated for two macrophytes: *Typha domingensis* and *Schoenoplectus californicus*. Total organic carbon, chlorophyll a, DO, pH, ORP, conductivity, temperature and turbidity were also measured. A commercial floating mat without growth media was employed. The experiment utilized batch mesocosms, firstly with 7-day and 24-hour retention time and secondly under hydraulic shock-loading with 2 h and 4 h retention time. The results were analyzed by PERMANOVA based on distances using software Primer 6 (version 6.1.15). The results for 7-d batch indicated that *T. domingensis* was more efficient than *S. californicus* (removal efficiency of TP= 47.2%, TN=77.6% and TP= 7.1%, TN=20.0%; respectively). Nutrient removal by *T. domingensis* decreased significantly when retention time was reduced from 24 to 4 h. No significant reduction was found in *S. californicus* when retention time was less than 7 d. The experiment revealed the relation between removal efficiency and the retention time.

Implementation of fluvial hydraulics and structure parameters into the nature classification system “Nature in Norway”

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In 2005, the Norwegian Biodiversity Information Centre initiated a national project to develop a classification system for the ecological variation found in Norway. The system “Nature in Norway” (NiN; <https://www.artsdatabanken.no/NiN>) intendsto provide a common terminology for all communities and institutions working with nature. NiN aims to serve as a tool for the description of nature variation and for the mapping nature types in Norway providing a base for working with the red listed nature types. NiN covers the terrestrial and aquatic environments of the entire country. It has a hierarchical structure with living environment, nature system and landscape as the three main levels of nature diversity. Three different levels within each nature diversity level by means of “local complex environmental variables” (LCE), which are identified as “one among a few local environmental variables that contribute substantially to the variations in species composition”. In addition, there is a description system allowing a more detailed characterization of nature variation, for example with respect to human impacts. Since the publication of the first versions of NiN (2009 and 2016), many comments and inputs were received, and tests were done for improvement. In particular, the freshwater part of the system was recognized as insufficient, with drawbacks related to the choice of LCE for rivers, the appropriate mapping scale for highly dynamic river systems, and the use of relevant thresholds for river substrate, flow velocities and structure elements, amongst others. An on-going project deals with the implementation of fluvial hydraulics and structure parameters into the NiN part for the description of riverine nature and habitat. It includes an overview of the NiN principles and the problems related to their application for riparian systems. The suitability of parameters such as hydromorphic river type, river width, elevation, stream power, and bank vegetation as LCE is analyzed for selected rivers. Different options for the further development of NiN are currently under discussion.

SE7.

**Advances in
freshwater
community ecology**

Does the Tachet trait database report voltinism variability of aquatic insects between Mediterranean and Scandinavian regions?

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Labile traits are those biological features that are not constrained by phylogeny and should respond directly to the environment through local adaptation or phenotypic plasticity. For example, voltinism is a labile trait that has been consistently related to latitude and, in particular, to temperature and photoperiod changes. Current trait databases include several labile traits that, at best, are coarsely coded to include potential intraspecific trait variability obtained from different literature sources. Given that these databases are used across large regions with contrasting environmental conditions or in small regions with particular environmental conditions, the reliability of these studies could be compromised at least for labile traits because of interpopulation variability. Based on a review of the literature on the life cycles of 317 insect species, we compared their potential number of generations per year (i.e., voltinism) in two regions with contrasting environmental conditions (the Mediterranean Basin and Scandinavia) with the information published in 2010 by Tachet et al. (hereafter TAC). We found the expected higher prevalence of multivoltine life cycles in the Mediterranean Basin, whereas univoltine and semivoltine life cycles showed trends of prominence in Scandinavia. In addition, the life-cycle profiles of the genera included in TAC database were situated between those found in the Mediterranean Basin and Scandinavia, suggesting that this database properly represents voltinism variability across Europe. However, the use of this database exclusively for the northern or southern regions may be challenging because TAC is not able to accurately represent the life cycles of the species in these regions, especially for univoltine and multivoltine species. Future studies in stream ecology should thus put efforts into quantifying and understanding the role of intraspecific trait variability in community assembly, at least for labile traits, to better understand trait-environment relationships.

Dynamics of temporal distribution of two aquatic macrophytes species in a neotropical river

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In the coastal plain of the Itanhaém River basin (south coast of the São Paulo State, Brazil), rivers are colonized by different species and life forms of aquatic macrophytes. A river stretch of 13 Km of one of the affluents of Itanhaém River is colonized by two native rooted submerged species (*Cabomba furcata* and *Egeria densa*). These species form monospecific and mixed stands with both species. In March/2012 we carried out an evaluation of the stands distribution. We navigated on a boat with reduced speed along the river margins and we registered the macrophytes stands with GPS (Garmin/GPSMAP 62). We observed mixed stands occurring most of the stretch and few *E. densa* stands at the end of this. In March/2014 we repeated the same evaluation (same method) and we observed predominance of *E. densa* stands and a few of *C. furcata* and mixed stands. We made a new evaluation in April/2016 and we observed the predominance of *C. furcata* stands and a few *E. densa* and mixed stands. In November/2016 *C. furcata* stands were again predominant and *E. densa* stands were not observed. The predominance of *C. furcata* stands remained in March/2017, when mixed stands were also abundant and some *E. densa* stands reoccurred. In May/2017 *E. densa* stands came back to predominate and we observed some mixed and *C. furcata* stands restricted to the beginning and the end of the stretch. Large interannual rainfall variations occurred between 2012 and 2017. The mean rainfall in January and February/2012 (275 mm) was lower than the historical mean (1938 - current) of 310 mm. In the year 2014 it was much lower (188) and in 2016 (469) it exceeded the historical mean. The rainfall interannual variations probably have caused changes in current velocity and water depth that in certain periods can favor one or another species. Experimental studies will help us to understand the distribution variation of these submerged macrophytes.

Zooplankton responses to environmental changes across a biogeographical gradient

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Community composition and structure have usually been studied considering spatial variation among sites, such as differences in environmental conditions and stochastic processes. However, few studies focused on temporal variation of different communities, due to a scarcity of databases monitoring several sites. The Iberian Ponds Network provides a great opportunity to study aquatic ecosystems using uniform and standardized field mesocosms distributed along a biogeographic gradient. The mesocosms are installed in six experimental stations: Murcia, Toledo (semiarid regions), Évora (mediterranean), Porto (temperate), Jaca and Peñalara (alpine). In each station, we have 32 mesocosms with a capacity of 1000 L., initially inoculated with soil and water from surrounding natural ponds (achieving a representative regional pool). In this talk, we will present data on spatial and temporal variability of zooplankton in these mesocosms, evaluating the effect of environmental alterations like droughts and freezing. We collected zooplankton samples with a net of 53 µm of mesh size in each mesocosms in both 2016 and 2017 in spring. Multivariate analysis were performed to describe patterns of variation (e.g. Principal coordinate analysis) and test for differences across mesocosms, stations and years using permutational multivariate analysis of variance (PERMANOVA). We also carried out an analysis of multivariate homogeneity of group dispersions (PERMDISP) to determine variation in beta-diversity between 2016 and 2017 in each station. Species composition significantly changed in all stations. Generally, species associated to permanent waters were replaced with species from semi-permanent or temporary ponds. Beta-diversity decreased in 2017, though the differences were not significant in some stations. These variations could be related to niche filtering of the pioneers (which were manually transported from the surrounding natural ponds), due to drought (in Murcia, Toledo and Évora) and freezing (in Jaca and Peñalara). This study contributes to advance our understanding of how environmental changes (i.e. drought) affects biodiversity patterns across different biogeographical regions, which is fundamental to develop general predictive models of the effects of future environmental changes in aquatic ecosystems.

Do all roads lead to Rome? Exploring community trajectories in response to anthropogenic salinisation and dilution of rivers

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As a result of global change, the ion concentration of rivers is changing worldwide. Many freshwater rivers are being salinised by anthropogenic salt inputs (e.g. salt mines, de-icing salt), whereas many naturally saline rivers are being diluted by human activities that reduce their salt concentration (e.g. agricultural drainages). As aquatic organisms show a strong specificity along the natural salinity gradient according to their differential tolerance to osmotic pressure, both impacts are driving potent changes in the diversity and community composition of river ecosystems. However, it is unclear if the resulting communities at salinised and diluted rivers would follow the same trajectory as observed along the natural salinity gradient or they would promote novel communities. We hypothesise that altered communities could resemble natural communities with the same salinity if the original taxa is replaced by the organisms better adapted to such osmotic pressure, outweighing opportunistic, generalist colonisers. Alternatively, altered communities could differ from natural communities if opportunistic, generalist colonisers tend to replace original communities. Here, we test these hypotheses using macroinvertebrates collected in Mediterranean rivers under reference (freshwater and naturally saline rivers) and altered conditions (salinised and diluted rivers). To this end, we compare the taxonomic and functional diversity patterns and composition similarity among these groups. Our results will help to better understand the role of resistance and resilience processes and predict the trajectories of biological communities in response to natural and anthropogenic pressures.

IberianPonds: Predicting responses to climate change from genes to ecosystem services

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Climate change ranks amongst the greatest threats to biodiversity across the Earth's biomes. Following changes in the climate, communities disassemble and reassemble in seemingly unpredictable ways. Still, the question of whether species respond to environmental changes individually or whether there is synchrony at higher levels of organization (e.g., food webs) remains unresolved preventing us from accurately predicting ecosystem-level responses to climate change. Addressing this gap in knowledge requires closer integration between empirical, experimental and computational approaches, conducted at appropriate scales for understanding of global change processes. In this introductory talk, I will present IberianPonds – Predicting responses to climate change from genes to ecosystem services –, a multi-disciplinary project (i.e. Biogeography, Ecology, Biogeochemistry, Physiology and Environmental genomics) to improve predictions of changes in aquatic ecosystems under simulated climate change. I will present the rationale and some preliminary results from the IberianPonds experiments (i.e. 192 artificial ponds distributed in six locations across the Iberian Peninsula) and large-scale biodiversity surveys, from arid to mountain-top locations.

Incorporating time effects when analysing (aquatic) metacommunities

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The development of metacommunity theory at the beginning of this century boosted empirical tests using field data, mostly focused on the relative importance of spatial vs. environmental factors for the explanation of metacommunity structures. Yet few works deal with time per se as a component in explaining these patterns, even when repeated samples are analysed. We consider essential to take the variable “time” into account explicitly for the study of metacommunity dynamics, as many biological processes (e.g. ontogenetic development, reproduction and population growth, migratory movements...) depend on the amount of time spanned. We review the (uncommon) evaluation of the importance of time in empirical metacommunity analyses using variation partitioning, and provide examples from aquatic invertebrate metacommunities where pure temporal effects (i.e. excluding the overlap with environmental and spatial influences) are found to significantly affect their assembly. Previous studies showed reduced pure effects of time (~2%) in the organization of aquatic invertebrate metacommunities. Our analyses of macroinvertebrates from Mediterranean streams and ponds show a variable influence, varying between 1 and 8 %. These percentages were lower in a stream metacommunity compared to ponds, and highest in the smallest area studied (with less spatial effects), and with shortest temporal resolution (1 month sampling period), with even higher explanatory power than pure environmental effects. It is therefore important to consider temporal effects in metacommunity analysis for further developing ecological theory and looking for causal explanations of the heterogeneous distribution of species.

Does environmental heterogeneity determine species and life form richness of aquatic macrophytes in tropical coastal rivers?

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São Paulo State Coast (Southeastern Brazil) is marked by the presence of a mountain range with altitudes up to 1000 meters, called “Serra do Mar”, and several coastal plains of different extensions. Therefore, rivers located in this area are influenced by the variation in topography and altitude. The aim of this study was to assess if macrophyte species and life form richness and composition is related to environmental heterogeneity. We established 100 sampling sites in eight rivers (between 9 and 19 sampling sites per river) along the São Paulo Coast. At each site we recorded macrophyte species occurrence and limnological (nutrients and salinity of water and sediment) and river channel (sediment type and salinity, margin declivity, river width, mouth and coastline distance) data. In each river basin we estimated coastal plain extension and slope, and determined the extent that the rivers run through the plain. We applied an ordination analysis (PCA) to the abiotic data matrix. We found that limnological variables did not explain the environmental heterogeneity, but river channel variables did. Environmental heterogeneity was positively related to coastal plain extension and to river extension, and negatively related to coastal plain slope. We recorded the occurrence of 46 aquatic macrophyte species that were classified into six life forms: emergent, amphibian, free floating, rooted floating, free submerged and rooted submerged. Local species richness varied between 3 and 25. The most heterogeneous river showed the greatest richness however, we did not find relationship between macrophyte richness and environmental heterogeneity for the other rivers. The highest values of local life form richness of aquatic macrophytes (6 and 5) were found in the two most heterogeneous rivers. In the other rivers we recorded the occurrence of only emergent and amphibian species. Using cluster analysis (UPGMA method) we observed that the two most heterogeneous rivers had greater similarity in species composition, whereas similarity of the other rivers was not related to environmental heterogeneity. We suggest that a larger set of spatial factors acts on aquatic macrophyte communities in these coastal rivers, once no relationship was observed between environmental heterogeneity and macrophyte species and life form richness and composition.

Diatom size plasticity at the global and regional spatial scales

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Studies based on diatom traits are increasing but most of them are based on database information from other geographical regions whereas data on direct measurements of individuals are lacking. The aim of this study is to check if diatoms' species sizes in Central Portugal region are similar among river types and comparable to those from other areas of the world. For this study, species found in 60 sites belonging to four Portuguese river types (northern mountain streams - M; littoral rivers - L; small northern streams - N 1 <=100km²; large northern rivers - N 1 >100km²) were studied. Only species with a relative abundance >2.5% were measured (length and width) and the length/width ratio was calculated, resulting in a total of 79 taxa and ≈3600 specimens measured. In parallel, a revision of published information on the sizes of the same species was done considering published information and databases from Central and Northern Europe, North and South America, Asia, Africa and Antarctica. In general, significant differences were found between species sizes from Central Portugal and Northern Europe (t=2.6036; p=0.01) and between North America and Northern Europe (t=1.9581; p=0.039). At the regional scale, diatoms differed between river types of Central Portugal in length (Pseudo F=13.155; p=0.001), width (Pseudo F=2.8901; p=0.039) and ratio (Pseudo F=4.7117; p=0.006). Generally, considering all species we found that: diatom lengths (t=5.9135; p=0.001) and widths (t=2.7328; p=0.005) in littoral rivers were significantly larger than those of northern streams; in mountain streams, the lengths were generally larger than in small northern streams (t=2.9451; p=0.003); length/width ratios were larger in northern small streams than in larger rivers (t=2.7341; p=0.007). Yet, considering individual species different patterns occurred in some cases, which were also detailed analyzed. Our results produced more adjusted information on the trait diatoms species size for Central Portugal and suggest also that factors such as climate, geomorphology, catchment dimension and altitude, that are responsible for large and small-scale differences in streams, influence diatom size. Our conclusions indicate that not considering traits' plasticity in diatoms' ecological studies can result in incorrect conclusions and thus further studies are needed to investigate the spatial variability of diatom biological traits.

Estrutura da comunidade de organismos zoospóricos na coluna d'água e sedimento superficial de três reservatórios brasileiros

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Os organismos zoospóricos dos filos Blastocladiomycota, Chytridiomycota e Oomycota são determinantes nos processos de ciclagem de nutrientes e manutenção do fluxo energético nos ecossistemas, ao atuarem como decompositores de uma ampla variedade de substratos e/ou parasitas de diferentes hospedeiros. Embora ainda pouco estudados com relação à diversidade e preferências ecológicas, alguns poucos estudos desenvolvidos em ecossistemas lênticos os apontam como componentes fundamentais de zonas pelágicas e sedimentos de reservatórios. O presente estudo teve por objetivo relacionar a estrutura da comunidade destes organismos com algumas variáveis abióticas. Para isso, quatro coletas foram realizadas em três reservatórios localizados na Bacia Hidrográfica do Médio Tietê/Alto Sorocaba, Brasil, entre os anos de 2014 e 2015, os quais possuem características morfológicas muito distintas. Em cada ponto de coleta foram amostradas diferentes profundidades da coluna d'água (superfície, meio e fundo), além do sedimento superficial e mensuradas algumas variáveis físico-químicas da água (temperatura, pH, condutividade, oxigênio dissolvido, nitrogênio total e fósforo total), as quais foram compiladas em uma análise de componentes principais. Durante o período de estudo, 48 táxons de organismos zoospóricos foram identificados, sendo cerca de 80% da diversidade de fungos zoospóricos (Blastocladiomycota e Chytridiomycota) observada no sedimento superficial, enquanto a de Oomycota preferencialmente ao longo da coluna d'água. Dentre os gêneros de fungos zoospóricos, *Nowakowskiella* se destacou pela elevada riqueza de espécies e frequência de ocorrência, sendo o mesmo observado para o gênero *Pythium*, dentre os Oomycota. Os dois primeiros eixos de uma análise de componentes principais explicaram 91% da variabilidade dos dados abióticos, sendo o pH, o nitrogênio total e o fósforo total, as variáveis que mais explicaram a variação total dos dados. Duas novas espécies de Chytridiomycota foram encontradas e identificadas nestes reservatórios, além de um táxon de Oomycota (*Plectospora gemmifera*) citado pela primeira vez para o Brasil. Este estudo é o primeiro a investigar a diversidade de organismos zoospóricos em sedimentos de reservatórios do Brasil, além de ser um dos poucos a correlacionar a diversidade destes grupos com variáveis físico-químicas da água e do sedimento superficial.

Long-term changes in metacommunity assembly mechanisms in Mediterranean rivers

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Metacommunities are explained by a combination of local environmental factors, dispersal limitation and stochastic events. Most metacommunity studies aim at understanding assembly mechanisms in space, considering metacommunities as relatively stable units. However, recent studies have shown that metacommunity assembly mechanisms can vary considerably in time, especially in highly dynamic ecosystems (e.g. Mediterranean streams). So far, these studies have exclusively focused on seasonal changes, neglecting interannual variability. Mediterranean rivers are characterized by hydrological patterns that vary seasonally and interannually, with wet and dry seasons and years, respectively. This situation provides a unique opportunity to assess metacommunity dynamics at different temporal scales. We analysed long-term changes in macroinvertebrate metacommunities collected in 15 unimpacted sites sampled twice a year since 1996. We hypothesized that local environmental factors and stochasticity should be more important during wet years because stream network connectivity would be favoured, whereas dispersal limitation would be more relevant during dry years due to a loss of flow connectivity leading to habitat isolation. Our results will contribute to understand and mitigate the effects of water scarcity on Mediterranean freshwater biodiversity. This is especially relevant for future scenarios of increasing water demand and climate change.

Flow intermittence shapes the effect of flow regulation on macroinvertebrate functional structure and diversity in Mediterranean streams

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Rivers and streams in Mediterranean regions are strongly regulated by dams, mainly used for water irrigation, which produce important alterations on natural flow regimes. Two main types of human-driven flow alteration were identified in the Segura River Basin, one of the most arid and regulated catchments of the Iberian Peninsula: a) sudden and unpredictable water releases downstream dams from perennial rivers to provide water for irrigation in summer; b) drying intensification due to intense water diversions from upstream dams in seasonal and intermittent streams. Using Linear Mixed-Effect Models, we assessed the effects of human-driven flow alteration and natural flow intermittence (including those caused by their interaction) on functional features (biological traits and functional diversity indexes) of macroinvertebrate communities. Hydrologic alteration was assessed for each stream reach using the irrigated area, the number of dams and their regulatory capacity in the drainage basin. The degree of flow intermittence was assigned in function of their natural flow regime. Flow alteration entails a loss of specialized taxa with semivoltine or univoltine cycles, and the replacement by generalist ones, with multivoltine cycles. Similar effects were observed for natural flow intermittence. Interaction of both factors produced antagonistic effects on the reduction of long life cycle taxa, as well as in shredders. However, synergetic effects were observed in short life cycles, aquatic adult stage and tegument respiration. Functional richness (FRic), Rao's quadratic entropy (FD), functional dispersion (FDIs), and functional redundancy (FR) decreased significantly with human-driven flow alteration, showing a non-random response, except FRic. Synergetic interaction between human-driven flow alteration and natural flow intermittence was found in FRic and FR. In summary, both human-driven and natural disturbances impacted macroinvertebrate communities, resulting in its functional simplification and homogenization. The effect of hydrological alteration was more pronounced in perennial than in intermittent streams, probably because natural flow intermittence imposes an eco-evolutionary pressure on the biota, selecting those traits that confers co-tolerance to human-driven flow alterations.

Predicting future species distribution of Odonata in Iberian Peninsula under Climate Change

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How species will respond to current rates of climate change is a critical question in biodiversity conservation. Climate change has the potential to modify habitat characteristics and, consequently, it is predicted that: 1) many species may shift their distribution ranges to higher latitudes or altitudes to remain in a similar environmental niche; 2) those species with high evolutionary adaptation, phenotypic acclimation or plasticity are expected to have the ability to locally face new conditions, and 3) species with poor dispersal abilities or adaptability are vulnerable to extinction. In this study, we focused on the evolutionary history, functional traits and species distribution models of Iberian Odonata to assess changes in their potential distribution and the role that traits would play in the future species responses under Climate Change. Our hypotheses were based on five models of geographical range responses: a) Expansive, b) Displaced, c) Non-change, d) Reduced and displaced and e) Reduced. The results showed that predicted higher temperature and frequency of drought events will impact on the environmental niche of odonates and all species will shift their current potential distribution (the "Non-change" model was discarded). Functional traits similarity between species was decoupled from their phylogenetic divergence (i.e., ecological niche is not conserved), and therefore evolutionary history cannot predict the ecological responses of species. In contrast, four functional traits discriminated between the remaining models of range responses. "Expansive" species had North-Africa and Mediterranean origins and showed preferences for temporary waters and oviposition on water (without substrate), whereas "Reduced and displaced" and "Reduced" had mainly Central-European origins, inhabited mostly perennial waters and were characterized by oviposition on floating plants and submerged or aerial leaves. Overall, this integrative approach reveals species-specific responses of odonates facing climate change, which are strongly associated with ecological traits rather than evolutionary history.

SE8.

**Ecology and
management of
temporary freshwater
systems**

Increased flow intermittency reduces aquatic hyphomycetes richness affecting leaf litter decomposition

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Climate change is increasing aridity in some parts of the world along with the increasing demand of water, leading many streams to suffer or increase the intermittency of their water flow. Reduced flow could alter the structure and dynamics of aquatic communities, ultimately affecting ecosystem functioning. Here, we used observational and experimental data to 1) evaluate the effects of flow reduction on aquatic hyphomycetes community richness and 2) analyse how these changes would translate into leaf-litter decomposition rates. For the first objective, we selected 15 stream across Catalonia (NE Spain) showing a flow intermittency gradient, from perennial to ephemeral streams. For the second objective, we used a microcosm approach where a flow intermittency gradient -according to the duration of the drought period- was simulated. Aquatic hyphomycetes richness was significantly higher in the permanent streams compared to intermittent and ephemeral streams. Furthermore, under simulated flow patterns, richness of aquatic hyphomycetes had a significant effect on leaf-litter decomposition rates. The results of this study suggest that an increase in flow intermittency will decrease the aquatic hyphomycetes richness affecting leaf litter decomposition, nutrient cycling and energy flow to higher trophic levels in streams.

Phytoplankton communities in stone tanks in the Brazilian semi-arid region

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Phytoplankton dynamics in temporary ecosystems are influenced by environmental filters such as desiccation and inundation periods. These factors can select species more tolerant to disturbances. The main question associated with the present study was: Which environmental filters determine phytoplankton community structure? Samplings were conducted in 11 rock pools in the Brazilian semi-arid region during June 2016-July 2017. Eighty-three species were recorded and included in seventeen functional groups (GFs). The J, F, and X1 GFs were the most important in biomass, mainly represented by the unicellular and colonial green algae, respectively. Tendencies observed through multivariate analyses indicated that dominance of the J group was associated with the relatively warm, alkaline waters with low transparency and high phosphorus concentrations. In conclusion, the results suggested that local filters (abiotic variables) were fundamental in structuring the phytoplankton community in these environments, selecting species more tolerant to the disturbances and typical of shallow and turbid ecosystems.

Current rates and potential effects of climate change effects on methane emissions in Spanish temporary saline lakes

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Wetland are ecosystems with very high potential biological activity because of the permanent or temporal presence of water. Due to the high biological activity, and despite they cover smaller surface on Earth than other types of ecosystems, they play an important role in the global carbon cycle. Aerobic and anaerobic respiration processes commonly release CO₂, however under very low redox conditions most electron acceptors are lacking, and methanogenesis merges as the main respiratory process. Methane production in wetlands, resulting from anaerobic respiration of organic matter, accounts for an important part of natural sources of methane. In this work we have evaluated the methane release rates of temporary saline shallow lakes located in Central Spain, some of which maintain natural conditions, whereas other are hydrologically altered, dropping its salinity, or present trophic alterations. We used sediment core plus water incubations to determine the release of methane from the studied lakes to the atmosphere, integrating both diffusion and ebullition processes, as well as to determine the effects of temperature and salinity on methane production. The saline lakes released methane at rates within the lowest range reported for temperate lakes and wetlands, though in unaltered hypersaline lakes these rates were much lower than in hydrologically altered lakes that have dropped their salinity. Models built with the specific response of methane release rates to temperature according to RCP climate scenarios predicted significant increases of these rates for the future, which could almost double current methane release for some of the studied lakes under the most pessimistic mitigation scenario (RCP8.5).

Effects of non-flow period on pigment composition, physiology and resistance structures of permanent and temporary streams

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The growing loss of stream flow continuity as a consequence of water abstraction and climate change is increasing the number of temporary streams. For this reason, understanding the resistance and resilience of stream ecosystems to non-flow periods is essential to predict the effects of water losses in stream ecosystems and manage them adequately. In the present study, we compared the resistance and resilience of biofilms from temporary and permanent streams to flow intermittency using artificial streams. We translocated stream cobbles with intact biofilm communities from four temporary and four permanent streams to the artificial channels, and exposed them to a non-flow event of 31 days using a factorial design. We measured the structural resistance and resilience of these communities using pigment composition, physiology and resistance structures. Chlorophylls and carotenoid pigments were extracted from biofilm samples and analyzed using high performance liquid chromatography (HPLC), physiology and resistance structures in cells were analyzed by microscopic observations. Non-flow period promoted life forms better adapted to these conditions and the synthesis of resistance structures, reduced photosynthetic pigments concentrations and increased photoprotective ones. Nevertheless, there were differences between the response of temporary and permanent biofilms such as, greater presence of resistance structures and some photoprotective pigments during non-flow period in temporary ones. These results indicate that flow intermittency affects differently permanent and temporary streams and that those original conditions are important to manage them adequately.

Temporal variability of metacommunities structure in intermittent rivers: interaction with the spatial drying pattern

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The metacommunity framework has brought new highlights on the local and regional mechanisms shaping ecological communities and many studies aim today at examining the role of environmental filtering and dispersal processes on biodiversity organization in space. Lines of evidence suggest that metacommunity mechanisms in highly dynamic ecosystems vary over time leading to contrasted spatial patterns of biodiversity. As such, we expect to observe temporal shifts of the metacommunity structuring forces in response to disturbances. In intermittent rivers, characterized by a frequent loss of flow and/or surface water, these shifts might also depend on where drying occurs due to the dendritic structure of the network and the unidirectionality of water, organisms and solute transport. Hence, some sites in the networks are more isolated and would require more time to recover from drying, except if resistant species and forms predominate. We hypothesize catchments with headwater drying present stronger temporal shifts of assembly mechanisms compared to mid and downstream drying catchments, with an overwhelming role of dispersal at upstream sites. We analyzed invertebrate metacommunities at ten different dates across a set of French intermittent river networks with contrasted drying spatial configurations. We used Distance Decay Relationships to explore the metacommunity structuring forces and a new statistical correction was computed to account for the spatial autocorrelation of environmental variables. At all the catchments and as expected, the relative importance of environmental filtering and dispersal processes varied greatly over time. In addition, this variability was influenced by the spatial pattern of drying, with stronger dispersal limitation at headwater drying catchments than at the others. These preliminary results could have major implications for conservation plans by allowing to better understand the main drivers of metacommunity structure for each catchment and the management initiatives to prioritize.

A global perspective on carbon dynamics in intermittent rivers and ephemeral streams

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Half the channel length of the world's river network comprises intermittent rivers and ephemeral streams (IRES), which cease to flow at some time of the year. Compared to perennial rivers, IRES function as pulsed biogeochemical reactors, where accumulation, transport and processing of material are punctuated in space and time. For example, during dry phases, large quantities of particulate organic matter (POM; e.g. leaves, algal biofilms, herbs) accumulate, and, when flow resumes, pulse of CO₂ and dissolved organic matter (DOM) accompany POM mineralization by decomposers. In addition to POM, it has also become evident that IRES sediments are biogeochemically active during both dry phases and upon rewetting, with significant fluxes of CO₂ accompanying mineralization by decomposers. Unfortunately, global models of carbon cycling and estimates of CO₂ release from inland waters are limited to perennial rivers hence missing at least 84,000 km² of river channels by overlooking IRES. Are our understanding and estimates of carbon processing in river networks still accurate when IRES are not included? Supported by an international research network (http://1000_intermittent_rivers_project.irstea.fr/), we measured the carbon content of sediments and the amount of POM accumulated on dry riverbeds from 211 IRES, quantified carbon storage during dry phases, and downstream DOM fluxes and CO₂ emissions during rewetting events. We then extrapolated these estimates at the global scale using the COSCAT segmentation scheme and challenged current estimates of how much carbon is being processed in inland waters. We show that IRES contribute substantially to the global carbon fluxes and that their inclusion into global carbon cycle models is urgent.

Preconditioning of leaves during the dry period alters ecosystem functioning in intermittent streams upon rewetting: an in-situ BACI experiment

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In intermittent streams, allochthonous particulate organic matter (POM) typically accumulates on dry riverbeds during dry periods. Differences in the exposure conditions during these periods (i.e. preconditioning) can affect the chemical composition of POM and thus, the quality of dissolved organic matter (DOM) and nutrient availability from POM leachates upon flow resumption. Here, we investigate how chemical differences associated with leaf litter preconditioning can further influence stream ecosystem functioning during the rewetting period. For that, leaf litter of *Populus nigra* was exposed for 60 days to either sunlight or shaded conditions during a simulated dry period. As expected, we obtained leaf litter leachates with contrasting chemical quality: leachates from leaf litter under shaded conditions were more biodegradable than those from leaf litter under open conditions due to the higher accumulation of humic-like DOM compounds in the last ones as a result of the exposure to higher solar irradiation and temperature. The response of the stream to the inputs of leaf litter differing in preconditioning was assessed by two before-after, control-impact (BACI) experiments. We introduced the two leaf litter types in two different reaches of the same stream and analysed changes in stream water quality and the functional response of benthic biofilms. The inputs of leaf litter significantly increased the concentration of dissolved organic carbon and nutrients regardless of the preconditioning. These increases fostered primary production and reduced alkaline phosphatase activity of biofilms in both leaf litter types. Evidence of altered biofilm heterotrophic activity with an increase of β -glucosidase activity and biofilm biomass was only found with addition of leaf litter exposed to sunlight. Our results suggest that differences in the exposure conditions of leaf litter during the dry period can alter the in-stream processing of DOM and nutrients leached from leaf litter upon rewetting. This can have important implications for both the autotrophic and heterotrophic activity of stream microbial assemblages. Thus, our results highlight the importance of considering environmental conditions during dry periods to understand the role of leaf litter inputs on ecosystem functioning of intermittent streams.

Diffuse and point pollution in the highly valuable Mediterranean river Bullaque (Gadiana catchment, Central-SW Spain)

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The Bullaque river is partially regulated, but shows a surprising hydrogeomorphological quality. The stream hosts fish and mollusc endemisms, together with a large number of valuable communities and species, all in one deserving protection as a number of habitats and Sites of Community Importance under the Habitats Directive of the EU. Although cultural identity of the catchment population is tightly linked to the stream, river channeling, wastewater inputs, intensive irrigation agriculture, and leisure activities are threatening both its natural and cultural values. The aim of the study was to identify the major sources of pollution to the Bullaque river in a stretch where different sources were present, i.e. agriculture, cattle raising, domestic and industrial wastewater. Five different subcatchments flowing into the stretch were identified, and estimations were done for N and P inputs to every subcatchment or substretch. Runoff and nutrient export coefficients were estimated. Data on the surface area occupied by the different activities and the river discharge were obtained from National Institute of Statistics and Gadiana Hydrographical Authority. Results show that agriculture inputs of N and P account for more than 50% of nutrient loads to the rivers, followed by cattle raising, with less than 45%; input from industrial and domestic effluents are dismissable, i.e. slightly higher than 2% and 0,3%, respectively. Some heterogeneity was recorded, with cattle raising balancing agriculture in one subcatchment and overcoming it largely in another one; however, wastewater inputs were more or less homogeneous in all cases. These figures prove that neither the reiterated programs of investment in wastewater infrastructures building and maintenance, and treatment, nor a pretended project for the restoration of the Bullaque river have been successful. Local populations still claim against the bad quality of bathing areas, whilst many stretches remain channelised, avoiding self-purification by stream communities, especially riparian ones. Specific measurements are proposed to reduce nutrient loading both at source and at the river system.

Elemental stoichiometry and contribution to nutrient retention of four species of helophytes receiving water inputs from a wastewater treatment plant effluent

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Helophytes are aquatic plants adapted to freshwater ecosystems exposed to high nitrogen (N) and phosphorus (P) concentrations in water and unstable substrates. In this sense, helophytes are used as green filters in wastewater treatment and as elements to stabilize river banks in stream restoration. In this study, we examined the elemental stoichiometry (C, N and P) of different helophyte species (*Phragmites australis*, *Typha angustifolia*, *Scirpus lacustris* and *Iris pseudoachorus*) and how this varies among different plant compartments. Our objective was to evaluate the ability of these helophyte to retain N and P from receiving water, which in this case was from an effluent of a wastewater treatment plant (WWTP). The experiment was conducted at the Urban River Lab experimental facility (www.urbanriverlab.com), where helophytes were grown during 10 months (being planted in winter 2015) in triplicated artificial channels receiving subsurface water flow from the effluent of the WWTP. On average, elemental stoichiometry showed small variation among helophyte species, while higher variation was observed among compartments. Leaves of the 4 species showed the lowest C/N ratio (average \pm standard error: 18 ± 1), as expected considering that leaves are photosynthetically active tissues with high protein content. In contrast, roots from the 4 species showed the highest C/N ratio ($33,8 \pm 2,5$), as expected for compartments playing a more structural role. The N standing stocks accumulated during the course of the experiment indicated that N retention was the highest for *I. pseudoachorus* ($0,9 \text{ g N m}^{-2}$), and that 30 % of the stored N was allocated in the belowground compartment (roots and rhizomes). Considering all the species, the N standing stock in helophytes contributed to the 10 to 20 % retention of the dissolved N flowing through the channels. Current analysis of P standing stocks will allow unveiling the contribution of helophytes, and the particular role of different compartments, to P retention from receiving water. Together, results from this study are of direct transfer to bioengineering companies providing quantitative information on the capacity of helophytes as nutrient filters to increase the water quality of effluents from WWTP before they reach recipient streams.

Revival of rain-pool habitats in Israel

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For the past thousands years rain pools were valuable natural water bodies that seasonally provided water as well as fresh grass around them for cattle and sheep that were herded across the open land in Israel as well as in neighboring Mediterranean countries. Since the establishment of the State of Israel (1948), rapid agricultural and urban development took a heavy toll on nature, reducing open landscapes and modifying their nature. This anthropogenic impact resulted in the destruction and elimination of natural rain-pools to the extent that they were on the verge of extinction in certain parts of the country. Since the late 1970's, I made efforts to turn the attention of scientists, naturalists, and decision makers to the uniqueness of these freshwater habitats which are "hot spots" of freshwater biodiversity, hosting animals and plants that are exclusive to rain-pool habitats, some endemic to Israel. Gradually, efforts to restore rain-pools started, and energy was devoted also to replace lost pools by reconstruction of new ones. The success of the later effort was evident by the increasing request by local communities to reconstruct rain pools near and within their settlement, including urban areas. With time, communities, and municipal and regional councils realized the utility of constructing community natural parks in which rain pools are a central attraction and the landscape around it is restored by planting local, native vegetation. To facilitate rain-pool reconstruction I prepared a guide, particularly usable for landscape architects who are involved in parks' planning, detailing the landscape and environmental conditions that are required, how to create the rain-pool basin, and how to support and follow the establishment of rain-pool communities. A student of mine (Liav Shalem) with an academic background in landscape architecture and in ecology (conducted his Master thesis on rain-pool reconstruction and landscape restoration) is expanding this knowledge and experience, helping local communities and regional councils to carry it on "from theory to practice". Aside from supporting biodiversity, reconstructed rain-pools are effective educational tool for students of all grades, and for the public. Moreover, they bring nature closer to people, which is particularly important in urban landscape where the public is less exposed to nature than in rural areas, and rain-pool parks fulfil an important service of "bringing nature home".

Yes, tiny things are relevant: the use of zooplankton community in Mediterranean temporary wetland assessment and management

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Mediterranean temporary wetlands possess intrinsic characteristics that make them perfect natural laboratories to study the effect of global change. These wetlands are adapted to bear many environmental stresses, including desiccation for years, but they also are affected by many anthropogenic impacts. The knowledge of the structural and functional features is crucial for the decision makers and for the implementation of management policies. Many studies defend the use of plants, vertebrates, and macroinvertebrates to assess wetlands status. However, most of them forget about the zooplankton community, one of the groups that make the ecosystem bloom after a desiccation event. These components of the cryptic biodiversity, too tiny and temporally absent, allow the system to restart after unsuitable environmental conditions, being relevant for its resilience, thanks to the propagule or egg bank. We propose that zooplankton should be taken into consideration in the management of temporary wetlands. The zooplankton community assemblage responds to changes in catchment land use and can be used as a cost-effective management tool. Moreover, the aggressive intensive agriculture practices lead to detrimental effects on egg banks reducing the emergence rates and consequently in the ecosystem resilience.

Debris piles as hotspots of nutrients, microbial activity and ground-dwelling arthropod biodiversity in ephemeral rivers

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The Namib Desert's ephemeral rivers are amongst the most hydrologically variable fluvial systems yet described. The extreme climatic conditions of this area determine that significant landscape production is linked to fluvial systems, despite their highly fluctuating flow regime. Occasional flood events transport organic matter which is accumulated in river beds and floodplains in form of debris piles, contributing to the retention of both the organic and inorganic loads. In addition, the presence of shallow dry pools, as depressed and depositional areas of silt and clay, are also frequent along the dry riverbeds. The two types of geomorphological structures, debris piles and dry pools, could provide higher humidity and organic matter to potentially enhance primary and secondary production in Namib ephemeral rivers. We examined the effect of debris piles and dry pools on nutrient concentration, microbial activity and ground-dwelling arthropod community. For this purpose, we sampled in sandy channel, debris piles and pools and adjacent terrestrial habitats in Ugab river during the dry phase. In summary, a spatial domain of influence of debris piles and pools on organic matter, nutrient content and sediment microbial activity in approximately four meters to the center of geomorphic structures, with higher values in debris piles than dry pools and sandy channels. The terrestrial arthropod composition significantly differed between the five habitats, with Formicidae, Blattoidea and Coleoptera explained most of the differences found. Debris piles, apart from riparian zone, emerged as important habitats harboring the highest number of morphospecies. Our results emphasize the importance of debris piles along dry riverbeds as hotspots of nutrients, microbial activity and ground-dwelling arthropod biodiversity in ephemeral rivers.

Effects of agro-industrial pollution on biota and ecosystem functioning in an intermittent river (Evrotas, Greece)

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Climate variability and overexploitation of water resources by humans lead to a severe runoff reduction in Mediterranean rivers. An additional stressor in the olive oil producing Mediterranean countries is agro-industrial pollution from olive mill (OM) wastewaters, that can cause severe degradation to receiving waterways. Field experiments were conducted in the Evrotas River (Greece) to assess the combined effects of OM wastewaters and water scarcity on the structure and functioning of small Mediterranean stream ecosystems. Four river sections along an intermittency gradient were sampled for abiotic parameters in sediments and water, as well as for biotic groups (diatoms and macroinvertebrates), before, during and after the OM operation. Ecosystem functioning was measured as algal accrual on artificial substrata, particulate organic matter decomposition using wooden sticks, gross nutrient uptake using pulse additions and nutrient retention by the biofilm, using artificial substrata. The severity of the OM impact was assessed by comparing “control” (upstream from OM effluent) and “impacted” (downstream from OM effluent) reaches along the intermittency gradient, to detect any possible interactions between the two stress factors. First results indicate that OM pollution could be better detected in sediments than in water, with phenol concentration being the most appropriate indicator. Phenol concentration increased as a consequence of OM operation, especially in the most intermittent reach. This reach also presented high total organic carbon and total nitrogen in its impacted site, suggesting a cumulative effect of OM pollution in sediments at low water levels. Intermittency, rather than OM pollution, was the stressor that affected biotic communities, having a negative effect on macroinvertebrate richness and a positive effect on diatom richness. While organic matter decomposition and gross nutrient uptake indicators were inconclusive, nutrient retention increased during OM operation, but decreased with intermittency in both control and impacted sites. Our results suggest that intermittency could be a stronger stressor than pollution from OM effluents in driving stream community structure and ecosystem function, depending however on the scale of OM production.

Drought effects on the macroinvertebrate community in Northern Italy

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Intermittent rivers have emerged as an important part of the river network. This is particularly true in Southern Europe due to both the actual dry climate and the water abstraction for urban, industrial and agricultural use. In this context, an improvement of the knowledge about the effects of intermittence on river biota is needed in order to propose reliable strategies for the management and conservation of freshwater ecosystems. The aim of this work was to assess the effects of drought on macroinvertebrate diversity and abundance in intermittent streams of the Northern Apennines (Italy). To this purpose, 24 third-order streams, half of which were intermittent, were selected and sampled during May-June 2017. Temperature data-loggers were placed in both riffle and pool habitats of each site in order to assess if watercourses completely dried up or if water persisted during summer. Conductivity, pH and temperature were measured *in situ* with a multiparametric probe and water samples were collected for determining nutrients and major anions and cations. Macroinvertebrates were quantitatively collected with a Surber net and identified to the lowest practical taxonomic level. Replicates within site were kept separated from each other, and for each one water velocity, depth, grain size and quantity of coarse particulate organic matter (CPOM) were measured. Data were analysed within a linear mixed effect framework considering streams as random effects, while variation in community composition was explored by means of non-metric multidimensional scaling. Intermittent and perennial streams had similar nutrient contents, water velocity, substrate and depth. On the contrary, macroinvertebrate richness resulted lower in intermittent compared to perennial rivers, while abundance was not affected by flow regime. Flow velocity and CPOM significantly affected taxonomic richness and abundance in both intermittent and perennial streams. Surprisingly, multivariate analysis did not show any pattern related to flow intermittency. Our results represent a first step towards the knowledge of the effects of drought on the macroinvertebrate community in streams of the Northern Apennines, where the lack of information and the predicted increase of drought in the next years represent a serious threat for biodiversity conservation. This work is part of the NOACQUA project funded by the Italian Ministry of Education, Universities and Research.

Zooplankton taxonomic and functional diversity in tropical temporary ponds

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For biodiversity conservation, it is important to understand patterns of biota variations associated with natural and anthropic variations. Here we measured taxonomic and functional zooplankton diversity in temporary waters. Temporary waters are of great evolutionary and ecological importance, with communities physiologically adapted to dry conditions and effective and diversified mechanisms for dispersion. Despite their importance and vulnerability there is little information about temporary waters in tropical regions. The objective of this study was to analyze taxonomic and functional diversity of zooplankton community of eight temporary ponds of Minas Gerais State, Brazil. Samples of organisms and environmental variables were carried out in January and February 2017. Both taxonomic and functional diversity were relatively low, suggesting that the most important processes related to the community structure are due to the action of environmental filters on the species, leading to a convergence of the functional characteristics. Taxonomically, 26 taxa were found: 2 Anostraca; 7 Cladocera; 3 Copepoda Cyclopoida; 11 Rotifera and 3 Protozoa. Zooplankton community was divided in seven functional groups. The most significant functional attributes of the species were habitat, trophic group and food habit. Functional groups were close to the taxonomic ones, except for the Anostraca and bigger pelagic Cladocera that composed a same functional group. The presence of large Branchiopoda (*Dendrocephalus*) seems to have influenced the composition of the zooplankton community, particularly the Cladocera, possibly due to the overlap of niches. The use of different diversity indexes together may be an alternative for understanding ecological patterns between communities and ecosystems, aiming to improve management practices and sustainability.

Extreme drought may homogenize freshwater assemblages in semi-arid reservoirs

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Predicted climate changes will significantly impact biodiversity and ecological functions of semi-arid freshwater ecosystems in Brazil. The expected increase in evapotranspiration rates together with rainfall reduction will enhance the water deficit of the region. Decreasing net-precipitation leads to lower water levels in lakes and reservoirs and accordingly an increase in concentration of nutrients with severe implications for productivity, environmental heterogeneity and community structure. We hypothesize that decreasing rainfall may intensify reservoirs eutrophication leading to low water quality, biodiversity loss, and homogenization of freshwater communities. To test this, we used a comparative analysis of ecosystems in a space-for-time substitution approach to predict the consequences of rainfall reduction on water quality variables, and alpha (local richness) and beta diversity (measure of compositional heterogeneity) of phytoplankton, zooplankton, macroinvertebrates and fish. We compared these variables between two groups of reservoirs (n=16) inserted in two sub-basins with contrasting levels of precipitation in the Brazilian semi-arid region. Eight reservoirs were sampled in each sub-basin: one group located in the Seridó River Sub-Basin (SB) and another in the Piancó River Sub-Basin (PB), with annual mean precipitation around 500 and 700 mm, respectively. We compared the groups of reservoirs in a dry and in an extremely dry period to assess the response of the limnological and biological diversity variables to an extreme climatic event. The results showed that rainfall reduction increases water conductivity, total concentrations of chlorophyll-a, phosphorus and nitrogen, whereas the reverse pattern is observed for water transparency and reservoirs water level. The alpha diversity of phytoplankton, macroinvertebrates and fish was not affected by rainfall reduction, whereas for zooplankton it decreased. The beta diversity of phytoplankton and macroinvertebrates did not change, while for zooplankton and fish assemblages it decreased. We therefore conclude that extreme drought events will enhance Brazilian semi-arid reservoirs susceptibility to eutrophication homogenizing zooplankton and fish assemblages. Increased homogeneity of these key assemblages may result in stability loss due to a reduction of the biological complexity decreasing ecosystem resilience to potential future disturbances in semi-arid freshwaters.

The use of diatoms (Bacillariophyta) as indicators of water quality in an intermittent, urban and highly polluted river in Bolivia

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The Rocha River is born at the foot of the Eastern Andes (2685 m asl) and discharges into the Caine River (2527 m asl), after 70 km of crossing the city of Cochabamba and semi-rural surrounding areas. Its basin is inhabited by ca. 1.3 million people dedicated to agriculture, plastic, paper, tannery/leather, poultry industries. The discharge peak is reached in the rainy season (November-March, ca. 3 m³s⁻¹) while during the dry season (April-October) it is only ca. 0.5 m³s⁻¹. The river is contaminated by agricultural, factory and domestic waste. Especially during the dry season, it turns dark green and emits strong sewage odors. The present study intends to provide a monitoring tool for this river, useful for recovery and management practices. Sampling took place during the dry (2 dates) and rainy (1 date) seasons in 2008 at 6 stations in an agricultural/semiurban zone and 3 in urbanized areas. Epilithic samples were obtained by brushing rocks and oxidized in the laboratory with nitric acid to produce permanent slides using Naphrax mounting medium. Microscope identifications at 1000X were made using specialized literature. Water chemistry was measured *in situ* and in the laboratory. The Shannon diversity index and the Specific Polluosensitivity Index (IPS) were calculated and both species counts and IPS values were analyzed using CCA (Canonical Correspondence Analysis). The diatom community along the river was composed of 276 species and varieties. The most specious genera were Nitzschia, Gomphonema, Navicula, Ulnaria, Pinnularia and Fragilaria, which together comprise 77% of the total diatom community. Species composition varied at each of the 9 stations along the three sampling dates. There is no underlying river or land use typology, but localities associated with agriculture had higher species numbers, while sites associated with urban development had a lower number of taxa. 41% of the taxa were unknown, hindering the calculation of the IPS, which nevertheless shows a low (agricultural sites) and the lowest (urban sites) quality for both dry and rainy seasons. Despite the lower number of taxa used in the index calculation, the categorization correlates well with water chemistry (R² adjusted=0.45), being temperature, BOD₅ and orthophosphates the variables showing the highest correlations with taxa and index values. Thus, diatoms are a useful tool for monitoring the Rocha River and could be applied to other rivers in the semiarid region of the Bolivian Andes.

Adaptive Management Approach to Climate Change in Temporal Saline Wetlands in the Mediterranean Region

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Temporal saline shallow wetlands are characteristic systems of the center of the Iberian Peninsula, where climate patterns and specific geomorphological features allow to settle down these lagoons in some specific areas. Their outstanding importance is determined by the ecosystem services they provide, as well as their ecological peculiarity associated to the fluctuating behaviour and a huge level of well-adapted biodiversity to the fluctuating conditions. The hydroperiod is governed by rainfall and evapotranspiration, and saline levels are associated to the water volume. However, severe effects of climate change in the Mediterranean region, like longer droughts and temperature average increases, together with threats and impacts from human practices, have modified their structure and reduced their adaptive capacity to environmental changes. Therefore, a new management approach based on the adaptation reinforcement was developed in order to preserve wetland resilience and ecosystem services, thus ensuring their particular ecological processes. Management measures were designed for the saline lagoons of the "La Mancha Húmeda" Biosphere Reserve, inland the Iberian Peninsula, as testing sites. Some actions were based on the withdraw of external disturbances and main alteration causes, by promoting more sustainable agricultural practices compatible with the conservation of natural values of wetlands in their influential area. For the specific wet areas, measures were focused on the restoration of their natural ecological patterns and structure. Reintroduction of native adapted vegetation communities and watershed management were contemplated in order to protect the area from droughts and desertification, ensure water supply, and enhance wetlands sink effect by increasing carbon fixation and reducing natural greenhouse gas emissions. The measures enhanced the role of reducing water requirements for agriculture in an increasingly dry context, and strengthened the role of wetlands in climate change mitigation and regulation. Other ecosystem services like sediment and nutrient retention, water purification, shoreline stabilisation and reservoirs of biodiversity could also be improved with the implementation of this new management approach, though some other values could be weakened, so a strategical focus should consider the different services and uses wetlands offer.

A new approach to assess ecological status in intermittent rivers and ephemeral streams in a Mediterranean river basin district (Catalonia, NE Spain)

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Most of river networks in Mediterranean areas are composed of Intermittent Rivers and Ephemeral Streams (IRES), which are expanding in response to climate change and increasing water demands. According to the European Water Framework Directive, ecological status should be assessed by using quality standard procedures and biological indices. However, indices have been mainly focused on perennial rivers and managers need to find new ways and useful tools for IRES. A total of 95 river water bodies out of 248 (38%) are currently classified as IRES in the Catalan River Basin District (NE Iberic Peninsula), 65 of them are considered highly seasonal (26%, 864 km), 25 intermittent (10%, 406 km), and 5 ephemeral (2%, 66 km). Ecological status of IRES was not assessed in the Catalan River Basin Management Plan because methods used for perennial rivers were not adequate. In this context, the LIFE TRivers project (www.lifetrivers.eu) attempts to implement the WFD in IRES by providing a new tool (TREHS software). TREHS software classify the flow regime of water bodies according to the temporal patterns of three aquatic phases (flow, disconnected pools and dry river bed) that describe the hydrological conditions controlling the occurrence of different mesohabitats and the organisms associated to them. Hydrological and mesohabitat data are operationally collected from samplings, gauging stations, aerial photographs, satellite images or even surveys. Afterwards, sites or water bodies can be classified according to their temporality and the predictability of flow conditions, and results can be compared to reference conditions without human pressures to assess the hydrological status. According to the flow regime classification, different protocols may be applied in order to assess ecological status. Current and intercalibrated biological indices are being tested in perennial and quasi-perennial water bodies whereas in highly seasonal and intermittent ones (i.e. those that maintain disconnected pools) an adapted macroinvertebrate biological quality index (IMMi-T) is used. In intermittent water bodies that dry completely, a specific biological quality index based on Odonata, Coleoptera and Heteroptera is being tested to be potentially applied. Finally, only hydromorphological characteristics are used to classify ecological status in ephemeral water bodies. Several hydromorphological indices have been applied in order to analyse to analyse its adjustment to ephemeral streams.

Short term influence of sediment drying and organic matter enrichment on benthic metabolism, nitrogen and phosphorus recycling

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The littoral zone of lakes provides several ecological functions and services and is a key component of aquatic ecosystems. Here, the water-sediment interface is a biogeochemical hotspot, where nutrients are transformed, buried and recycled to the water column. Yet several anthropic pressures affect littoral zones of lakes which may influence benthic metabolism with possible implications for N and P biogeochemistry. Human exploitation of water resources and extreme hydrological events affect the magnitude and timing of water-level fluctuations inducing repeated drying-rewetting cycles of the sediment surface, while excessive growth and decay of primary producers, increase sediment organic matter (OM) enrichment. The main purpose of this work is to analyze the effect of short-term sediment desiccation and rewetting and OM enrichment on sediment features and benthic metabolism. The main focus is on biogeochemical processes: sediment capacity to accumulate and sequester reactive N and P, organic matter mineralization rates and the balance between benthic net autotrophy and heterotrophy, net N₂ and N₂O fluxes, dissolved inorganic N and P exchanges across the water-sediment interface and their stoichiometry. The effect of drying/rewetting cycles was simulated under laboratory conditions, by incubating reconstructed sediment microcosms under different desiccation and OM enrichment levels. The results indicate that exposure to air significantly influences the recycling of inorganic nutrients at the water-sediment interface. Exchange rates and fluxes depend on the extent of exposure and on the organic matter enrichment. Negligible or non-significant differences were measured between control and wet sediments. Desiccation affects exchangeable P and N pools within the sediment and increases their release after rewetting along with N₂ and N₂O production. The effect is transitory and about the 80% of dissolved inorganic nitrogen and phosphorous are released within one hour after rewetting.

Effects of water intermittency on diatom (Bacillariophyta) and invertebrate (aquatic and terrestrial) communities in streams of southern Portugal

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Macroinvertebrate and diatom communities were sampled in intermittent streams (i.e. no superficial flow for more than 3 months) of southern Portugal, in spring and end summer 2017 (when carabids were also sampled). The ecological classification of the 18 sampling sites ranged from Moderate to High in spring (flow conditions), according to the Water Framework Directive. During summer, high hydrologic variability was observed and the sites have been classified in three intermittency classes: "low flow" (2 sites), "scattered pools" (11 sites) and "dry" (5 sites). In "low flow" sites, macroinvertebrate and diatoms were collected following standard protocols; in "scattered pools" sites, macroinvertebrates were sampled from pools and two benthic diatom samples were collected from hard substrates in pools and dry riverbed; and in "dry" sites, only dry biofilm on hard substrate was collected. Carabids were sampled using pitfalls placed in the margins and channels in "scattered pools" and "dry" sites, and only along margins in "low flow" sites. First results show changes in diatom communities according to intermittency, with small differences between spring and summer samples collected from "low flow" sites; whilst spring differed from summer (independently of being collected from pools or as dry biofilm). Sites classified as Good or High in spring were more affected by intermittency, with significant reduction in macroinvertebrate species richness, diversity and evenness, whilst these differences were not so evident in Moderate sites. In "scattered pools" situation, a decrease in relative abundance of Trichoptera, Plecoptera and Ephemeroptera was detected, whilst Diptera, Heteroptera and Oligochaeta (more adapted to lentic conditions) increased in relative abundance. During the dry period, 14 carabid species were identified, both in the channel and margins. Among them, few species are typical from riverine systems and the majority occurs in agricultural areas, cork-oak forests and shrublands. This study increases our knowledge about the distribution and habitats of *Pheropsophus hispanicus*, a carabid species poorly known in Portugal. Our preliminary findings have also highlighted the importance of improving the assessment of intermittent streams considering the whole hydrological cycle (including the period with no flow), and integrating complementary biological indicators of their ecological status, as carabids and dry biofilm.

Nitrogen stable isotopes ($\delta^{15}\text{N}$) in halophytes as a proxy for anthropogenic nitrogen pollution in intermittent Mediterranean wetlands

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Nitrogen (N) loading from anthropogenic activities is concerning major human impact contributing to the eutrophication and degradation of wetlands worldwide. This is the case in the iconic Doñana wetlands in southwestern Spain, which have been exposed to increasing N inputs from intensive agriculture and urban wastewaters over recent decades. The uneven distribution of human impacts across the watershed and the inherent hydrodynamic complexity of the system require monitoring tools that go beyond conventional water-quality parameters to facilitate adequate, effective management measures to control and reduce N pollution. Natural abundance of N stable isotopes ($\delta^{15}\text{N}$) in aquatic plants allows tracing and monitoring of the spatial distribution of different nitrogen (N) sources. The variable nature of N sources is reflected in distinct isotopic ratios ($^{15}\text{N}/^{14}\text{N}$). Human wastewaters and animal waste N are enriched in $\delta^{15}\text{N}$ (10–20‰) while synthetic inorganic fertilizers have lower values (–3 to 3‰) because they are derived from industrial atmospheric nitrogen fixation ($\delta^{15}\text{N}$ -values close to zero). We investigated the spatial variability of different N inputs across the Doñana marsh and entry streams using the $\delta^{15}\text{N}$ values measured in two representative halophytes species (*Bolboschoenus maritimus* and *Typha domingensis*). We hypothesized that those areas most impacted by isotopically enriched wastewaters and/or organic fertilizers will result in enhanced N concentration and enriched $\delta^{15}\text{N}$ values. We collected fresh plant leaves in spring and surface water samples during the rainy period (Oct.–May) over two consecutive years (2015/16) from a network of points across the Doñana marsh and two tributary streams (La Rocina and El Partido). We found higher average values of $\delta^{15}\text{N}$ in the plant tissues collected in the streams than in the marsh. The stream most affected by urban wastewaters (El Partido) showed the highest isotopic values and N concentrations. Linear regression models revealed that isotopic values in plants were in general positively related to the N concentrations in surface waters. Our results provide the first information about the variability of $\delta^{15}\text{N}$ across the Doñana watershed-marsh system.

Intraspecific variability as a persistence mechanism of fishes in intermittent streams

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In the last decade, studies investigating interactions among individuals have answered questions about how the intraspecific variability acts within populations. Quantitative analyses taking into account ecological traits of each individual have promoted the rise of new approaches to study the theme. This has instigated new discussions about the relationships among intraspecific variability, individual specialization and niche expansion. Based on the theoretical knowledge that supports these discussions, the main objective these research is to verify the occurrence of intraspecific variation in fishes under the influence of the niche variation hypothesis and natural selection. To test the main objectives, I use intermittent river systems that are excellent models for investigating patterns of variation between individuals and populations. These systems work as natural filters for organisms affected by the variations between dry and rainy seasons. In the dry season, river bed fragments into pools where populations are trapped, and this process selects individuals with the most adapted traits to survive in these in extremes conditions of high water temperature, low oxygen concentration and high populational density. The result of this process is observed in the reproductive characteristics of the guppy *Poecilia vivipara* and morphological traits associated to the trophic characteristics of Characidae fish. The fluctuations of populations and individual variability may help us explain the persistence of fish populations in intermittent environments.

Metacommunity dynamics of ground-dwelling arthropods in intermittent streams over the drying phase

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Riverine ecosystems in Mediterranean climates are characterized by high levels of spatial and temporal environmental variation. This is particularly true in intermittent streams, where time-varying levels of resource availability, physical heterogeneity, and disturbance could influence biological assemblages in the riverine habitat and beyond. However, very little is known about how biotas across lateral gradients (i.e., in channel, riparian, and upland habitats) may respond to fluctuations in water and resources over time. This is unfortunate because makes the implicit assumption that metacommunities—or sets of communities potentially linked by dispersal—are static rather than temporally dynamic. Here we asked how river drying may affect the spatial and temporal arrangement of ground-dwelling arthropod assemblages (spiders, beetles, and ants) along the lateral habitat gradient of rivers. To this end, we monitored two permanent-intermittent reach pairs (in the Fuirosos and Rogativa streams, NE and SE Iberian Peninsula respectively) throughout the dry phase (29 days). We analyzed spatial and temporal variation in arthropod composition and structure, measuring alpha diversity, beta diversity and its components (richness and replacement), and local contributions to beta diversity over time. Intermittent reaches presented relatively higher alpha diversities (for the three taxonomic groups combined) and stronger upland-to-channel increasing gradients. Alpha diversity peaked in channel and riparian habitats after 10 days of surface water drying, coinciding with an alpha-diversity decline in the upland habitats. In contrast, no clear trend existed in the perennial reaches. Beta diversity was as well relatively higher in intermittent streams, with these higher values being associated with richness (rather than replacement) composition gradients. Finally, temporal fluctuations in local contributions to beta diversity identified habitats and moments that control the source-sink dynamics—that is, the process that allows these spatially-structured communities to persist in the face of drying disturbance. Our results contribute to the notion that drying may not only increase temporal but also spatial (lateral) heterogeneity in river ecosystems. Additionally, we contend that measuring variation in composition over space and time may be necessary to understand the dynamics of intermittent river metacommunities, and to identify 'keystone' habitats that may disproportionately contribute to their conservation.

Biological traits reveal contrasting aquatic invertebrate dispersal strategies in perennial and intermittent rivers

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Dispersal is a key process in community assembly that depends on endogenous (an organism's biological capacity) and exogenous (connectivity of habitats) factors. However, little is known about the relative roles of exogenous and endogenous dispersal factors in shaping communities. Contrary to perennial rivers, intermittent rivers experience loss of hydrological connectivity, which is likely to affect dispersal processes. We created a database compiling nine dispersal-related traits for 420 aquatic invertebrate genera from Europe and used it to assess the effect of flow intermittence on community dispersal capacity. While traits related to weak dispersal abilities were dominant in intermittent rivers, perennial rivers were colonized by organisms with large wings and long life span, indicating contrasting dispersal strategies between the two river types. Our results suggest that exogenous factors such as wind direction or topography may affect dispersal more strongly in intermittent than perennial rivers. Therefore, intermittent river communities could be particularly sensitive to spatial isolation. Further exploration of the effects of endogenous and exogenous dispersal on community assembly is needed to better predict community responses to environmental changes.

Quantifying spatial and temporal patterns of flow intermittency using spatially contiguous runoff data

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River channel drying caused by intermittent stream flow is a widely-recognized factor shaping stream ecosystems. There is a strong need to quantify the distribution of intermittent streams across catchments to inform management. However, observational gauge networks provide only point estimates of streamflow variation. Increasingly, this limitation is being overcome through the use of spatially contiguous estimates of the terrestrial water-balance, which can also assist in estimating runoff and streamflow at large-spatial scales. Here we proposed an approach to quantifying spatial and temporal variation in monthly flow intermittency throughout river networks in eastern Australia. We aggregated gridded monthly water-balance data with a hierarchically nested catchment dataset to simulate catchment runoff accumulation throughout river networks from 1900-2016. We also predicted zero flow duration for the entire river network by developing a robust predictive model relating measured zero flow duration (%months) to environmental predictor variables. We then combined these datasets by using the predicted zero flow duration from the regression model to determine appropriate 'zero' flow thresholds for the modelled discharge data, which varied spatially across the catchments examined. Finally, based on modelled discharge data and identified actual zero flow thresholds, we derived summary metrics describing flow intermittency across the catchment (mean flow duration and coefficient-of-variation in flow permanence from 1900-2016). We also classified the relative degree of flow intermittency annually to characterise temporal variation in flow intermittency. Results showed that the degree of flow intermittency varied substantially across streams in eastern Australia, ranging from perennial streams flowing permanently (11-12 months) to strongly intermittent streams flowing 4 months or less of year. Results also showed that the temporal extent of flow intermittency varied dramatically inter-annually from 1900-2016, with the proportion of intermittent (weakly and strongly intermittent) streams ranging in length from 3% to nearly 100% of the river network, but there was no evidence of an increasing trend towards flow intermittency over this period. Our approach to generating spatially explicit and catchment-wide estimates of streamflow intermittency can facilitate improved ecological understanding and management of intermittent streams in Australia and around the world.

In situ observations of temporary rivers dry sediments: chemical quality and microbial properties

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Temporary rivers are widespread in arid and semiarid climatic regions where they represent a direct source of water for human purposes. These systems are characterised by drastic changes of hydrological conditions where the duration of the dry phase is expected to increase under climate change. The hydrological regime regulates the deposition and re-suspension of the streambed benthic detritus as well as the biogeochemical processes. Sediments play an important role in these processes representing the element of continuity between flowing and dry period. In temporary rivers drying period is the most crucial as the suspended materials settle on the sediment (including pollutants) and the aquatic biota must pass through a "bottle neck" until the first flow arrives. Heterotrophic microbial communities play an important role in the food web channelling the C-flux from dissolved organic matter to biomass. Benthic microbial communities can adopt specific strategies to survive the drought, affecting organic matter quality and bioavailability with the potential to change the water quality when flow resumes. Drying imposes such physiological constraints that microbial communities from different temporary rivers may adopt similar functional strategies to survive i.e. the conservation of key processes useful for carbon and nutrient uptake. The first objective of this experimental work was to provide a cross view of hydrological regime together with chemical and microbial properties of dry sediments. To achieve this objective, sediments from five temporary rivers (Candelaro River basin, southern Italy) were analysed at the end of the dry period (early autumn) before flow resumption. Sediments were analysed for physical-chemical parameters (temperature, texture, water content, pH, conductivity, mineral composition, ash free dry weight, total organic carbon and nitrogen, pesticides and heavy metals concentrations) and microbial descriptors (prokaryotic biomass, DAPI stain; fungi biomass, ergosterol; total live biomass, ATP, luminescence; four extracellular enzyme activities, fluorescence technique; community respiration rates ETS; Biolog™ analyses). The second objective was to predict the impact of microbial processes onto carbon and nutrient fluxes at given dry conditions by analysing microbial properties of collected and historical data. This could help in elucidating biogeochemical processes active under these extreme conditions and their potential implications for the aquatic environment.

SE9.

**Hydrology, water
resources and
ecology of mountain
headwaters**

Multiannual monitoring in streams from the Picos de Europa National Park (northern Spain)

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River ecosystems from mountain areas are strongly affected by current global changes (change in climatic conditions, land uses or socio-economical activities). However, a high proportion of mountain headwater streams are generally excluded from current monitoring programs, as the Water Framework Directive only considers river catchments larger than 10 km². Moreover, mountain rivers and streams are often not represented in the official river typologies and they do not count with a defined set of biological metrics and thresholds (i.e. reference conditions). To determine how global change affects mountain aquatic ecosystems, a continuous monitoring network has been implemented in the rivers and streams of the Picos de Europa National Park. This network is composed of 8 non-intrusive gauging stations and 2 terrestrial stations that take pictures of the riparian area and measure the atmospheric conditions. In addition, an ecological monitoring was established at 13 sites selected following a Control/Impact design (6 Control and 7 Impacted; 4 by effluents and 2 by run-off processes at catchment scale, increasing the entrance of sediment in river channels). At each site, since 2012, water quality (ion concentration, suspended solids, conductivity, etc.), river metabolism (gross primary production, ecosystem respiration, etc.) and organic matter were measured, and invertebrate and fish communities were sampled every year. Biotic indices based on community structure and composition and river metabolism estimates were calculated. Both, environmental and ecological data, are uploaded on a free access web (picoseuropa.ihcantabria.com) in real time and every year, respectively. This monitoring network allowed to differentiate the effects of anthropogenic alterations from climatic changes. Our results show that invertebrate metrics (METI, IASPT, EPT) increased in impacted sites during wet years, but decreased in control sites. River metabolism and fish communities also responded differently to the variability in flow regime between Control and Impacted sites. Finally, this monitoring program allowed supporting decision for the management of the National Park, and was also a beneficial tool for environmental education, tourism and other activities linked to water ecosystems (fishing, canoeing, etc.).

Mountain freshwater metacommunity response to multiscale flow alteration

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Mountain watersheds exhibit particularly complex hydrographic networks characterized by both a high spatial and temporal environmental heterogeneity linked to the dynamic of the different water source contributions (glacier and snow meltwater, groundwater, rain). Mountain freshwater ecosystems shelter a singular biodiversity characterized by rare species, often endemic, and display a high spatial variability in aquatic community composition linked to this high level of habitats availability. However, these ecosystems are threatened by the ongoing climate change and associated flow alterations linked to both the accelerated glacier shrinkage and the modification in snow cover. In addition, although mountain regions were historically assimilated to water towers of the surrounding low lands with unlimited water resources; these regions are on the contrary facing unprecedented anthropogenic pressures on the resource, especially due to the current boom in hydropower projects but also the growing water needs of ski resorts for drinking water and artificial snow particularly during low-water periods. These flow alterations induce changes in the hydrological regime at the local scale; but also affect, at the catchment scale, the environmental heterogeneity in habitats and the connectivity of the stream network. These multi-scale alterations might have considerable effects on both the structure and functioning of mountain aquatic ecosystems. In this study, we examined the spatial distribution of aquatic invertebrate communities in two mountain glacierized catchments, with low (3%) and high (30%) glacial influence located respectively in the Andes and the Alps. We sampled benthic invertebrate communities and characterized geographical, physico-chemical and food resource conditions in 51 and 29 stream sites in the Andean and Alpine catchment, respectively. Using both distance decay relationship and variation partitioning analyses, we evaluated the relative contribution of local environmental conditions and spatial processes in structuring the aquatic metacommunity. This study allowed a better understanding of the mechanisms driving the spatial organization of the aquatic communities. This knowledge would permit to develop multi-scale environmental flows in mountains watersheds and management tools to mitigate the impacts of flow alteration and maintain these mountain freshwater ecosystems and their resulting ecosystems services.

Climate change increases vertical and seasonal water temperature differences, and inter-annual variability in a mountain lake

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Lakes around the world are warming, but rates for different water layers are different and in some cases are even cooling. Most studies, however, have focused on summer lake water surface temperatures or analyzed short-time series. Here, we analyzed using dynamic linear models and temporal trend decomposition, a 44-year-long time-series of water temperature from nine depths in a mountain lake. While we observed a significant long-term warming trend, this occurred only from August to December in all water layers. The lake warmed ca. twice as fast (0.23°C per decade) as the air, but warming of the epilimnion slowed down remarkably (from 0.65°C to 0.10°C per decade) after 1993. Deeper water layers cooled thereafter, pointing to a stronger isolation from surface layers, which were still warming over the whole study period. This differential warming of the lake was accompanied by significant shifts of lake freezing and thawing dates and lead to shorter ice cover periods (~5 days per decade). On the long run, also thermal Schmidt stability of the water column became stronger, but also temperature variance in the epilimnion increased significantly, probably because of increasing heatwave frequency and intensity over Europe. Our results show a significant autumn/winter warming effect of lake water together with an increasing intensity of temperature fluctuations, especially in seasonally ice-covered small mountain lakes, suggesting that current broad scale estimates of climate change impacts on lakes, based on summer temperature measurements and surface layers, do not fully reflect the impact of climate change.

When the going gets toughs get going: the enigma of feeding strategies in harsh environments

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Glacier retreat provides striking evidence of environmental change in alpine environments, leading to significant changes in physico-chemical characteristics and biological communities in glacier-fed rivers. The aquatic larvae of the Chironomidae, or nonbiting midges, are the first invertebrates colonizing alpine headwaters, and the first consumers in these harsh environments. Species composition in the two subfamilies, Diamesinae and Orthocladiinae, is diverse and strongly affected by the changing habitat - conditions upon glacier retreat. The overall effects of the environment on chironomid community structure are largely understood, but its influence on functional strategies such as feeding habits of same species are not. Here we show that Diamesinae have extremely flexible feeding strategies that explain their abundance, high body-mass, and predominance in glacier-fed streams. Along a multifactorial ecological gradient from benign to harsh, Diamesinae expanded their trophic niche area and covered more trophic levels when conditions harshened. In contrast, niche areas of Orthocladiinae remained small and were unrelated to water temperature, sediment transport and degree of glacial influence. In Diamesinae mean body-mass increased with harsher environmental conditions, but no such effects were found in Orthocladiinae. As facultative predators and able to feed on diverse food sources, Diamesinae have evolved survival mechanisms that allow them to thrive and successfully reproduce in glacier-fed streams, which likely explains their predominance in these habitats. Climate change-induced glacier retreat affects global water balance, with many downstream effects, including on irrigation and domestic use, and our study deepens our understanding of its effects on animals that depend on glacier-melt.

Efectos de las hidropuntas de una central hidroeléctrica sobre la movilidad de los sedimentos fluviales

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Se han estudiado los efectos de las puntas de caudal (hidropuntas) asociadas a la cobertura de la demanda de energía eléctrica, sobre la movilidad de los sedimentos del cauce fluvial en la cabecera del río Noguera Pallaresa (NE España, cuenca del Segre). Con esta finalidad se han analizado tanto las características morfosedimentarias como los patrones de movilidad de las partículas de este río de montaña con el objetivo de determinar los efectos de las hidropuntas en el comportamiento hidrosedimentario del río. La metodología se compone de levantamientos topográficos del cauce mediante RTK-GPS, la cuantificación y caracterización de la granulometría de los materiales del lecho a través de transectos lineales, métodos volumétricos, la monitorización de variables hidráulicas con sensores de nivel, el control de la movilidad de los sedimentos mediante cantos pintados y radiotransmisores pasivos tipo RFID®, y la modelización hidráulica de escenarios de caudal mediante Hec-Ras®. Los procesos observados se resumen en dos modelos de movilidad: i) un modelo dependiente del tamaño de los sedimentos en el cual la longitud del desplazamiento de las partículas es inversamente proporcional a su tamaño. Este modelo se asocia a crecidas naturales de baja magnitud y al conjunto de las hidropuntas, y determina la cantidad y la textura de los parches de material fino el lecho; y ii) un modelo hidráulico-dependiente en el que la magnitud del desplazamiento no está relacionada con el tamaño de las partículas movilizadas. Este patrón se asocia a crecidas de gran magnitud y controla la disponibilidad de sedimentos en todo el tramo de río afectado por las hidropuntas. La combinación de estos modelos de movilidad genera ciclos de histéresis de sentido anti-horario en la disponibilidad de sedimentos más finos en relación con el tiempo transcurrido desde la última crecida competente. Comprender estos ciclos es de gran interés para el diseño e implementación de medidas de restauración de ríos bajo régimen de hidropuntas ya que controla la disponibilidad de hábitat físico y su variabilidad espacial y temporal.

Efectos de las hidropuntas de una central hidroeléctrica sobre la estructura de la población de trucha (*Salmo trutta*)

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Se han estudiado los efectos de las puntas de caudal (hidropuntas) asociadas a la cobertura de la demanda de energía eléctrica, sobre la población de trucha en la cabecera del río Noguera Pallaresa (NE España, cuenca del Segre; Lleida). Se ha realizado una caracterización del mesohábitat y de la población de trucha (*Salmo trutta*) en sendos tramos de 500 m de longitud, uno de referencia aguas arriba y el otro aguas abajo de la Central Hidroeléctrica de Esterri-Unarre (957 m snm; Endesa Generación, S.A.) en base a 2 campañas de muestreo estivales. Esta central hidroeléctrica genera hidropuntas de hasta unos 18 m³/s sobre un caudal base inferior a los 2 m³/s. En cada uno de los 2 tramos de río se ha analizado la distribución espacial de las unidades hidromorfológicas que componen el mesohábitat de la trucha y su secuenciación longitudinal con el fin de comprobar el grado de similitud que, en términos de disponibilidad de hábitat físico para la trucha, presentan para un mismo caudal circulante. En el tramo de abajo de la central hidroeléctrica se ha cuantificado además la variación del Hábitat Potencial Útil (HPU) de la trucha en función del caudal circulante, para sus distintos estadios de desarrollo: freza, alevín, juvenil y adulto. Mediante censos con pesca eléctrica se ha determinado la densidad, la biomasa y la estructura de tallas de la población de trucha en cuatro puntos: 2 situados en el tramo de referencia, a unos 50 y 500 m aguas arriba de la central hidroeléctrica, y 2 puntos más en el tramo con hidropuntas a unos 100 y 500 m aguas abajo del canal de salida de dicha central. Se han encontrado cambios en la densidad y estructura de la población de trucha en el tramo con hidropuntas, con respecto al tramo de referencia y también se han observado diferencias significativas entre la población de trucha para los dos años estudiados. Todo parece indicar que la adaptación de la población de trucha al régimen de hidropuntas se manifiesta en una disminución de su densidad y en un aumento de la talla media que cabe asociarla a las variaciones que experimenta el mesohábitat durante las hidropuntas, medibles a través de los cambios de disponibilidad de HPÚI. Por otro lado, la variabilidad interanual en la densidad y estructura de la población de trucha, tanto o más importante que la debida a las hidropuntas, resulta ser muy dependiente de los caudales primaverales circulantes y se manifiesta de forma distinta en el tramo de referencia y en el de hidropuntas.

Índices biológicos en un espacio protegido de alta montaña (Sierra de Guadarrama). ¿Son realmente de utilidad?

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La Sierra de Guadarrama alberga una amplia red hidrográfica. En el Parque Nacional, se han inventariado 337 kms lineales de cursos fluviales. En general, la mayor parte de éstos son arroyos de mediana y pequeña entidad caracterizados como R-T11 ríos de montaña mediterránea silíceo. Los índices biológicos estandarizados están diseñados para ríos de mayor entidad, obviando los pequeños arroyos montanos y altimontanos. Por ello, nuestro objetivo es evaluar si los índices biológicos estandarizados son de aplicabilidad para estos cursos fluviales. Durante 13 años (2005-2017) se han aplicado índices biológicos en los cursos fluviales del Parque Nacional de la Sierra de Guadarrama y su Zona Periférica de Protección, con el fin de evaluar su estado de conservación. La metodología para su evaluación está adaptada a la Directiva Marco del Agua, aplicando los protocolos e índices establecidos en la legislación española. Los índices evaluados han sido IBMWP, IASPT, QBR, EPT, IHF, además de índices de diversidad. Los resultados se han evaluado en un total de 26 estaciones de muestreo en la cara sur del Parque Nacional (Comunidad de Madrid). Se han realizado dos muestreos anuales, primavera y verano. Los resultados muestran que los índices utilizados sí son aplicables en arroyos permanentes de menor entidad, al menos para los de orden 2. Además, se ha observado que a partir de una cota altitudinal, la diversidad, y por ello, los índices biológicos disminuyen. Otra conclusión es que son útiles para detectar ciertos impactos, como los de la actividad del baño, áreas recreativas ligadas al agua, y en ocasiones la ganadería. En cuanto a los cursos fluviales de carácter temporal, bastante numerosos en la Sierra de Guadarrama, no se ajustan a los baremos del índice IBMWP, aunque sí al índice IASPT. Otras expresiones como el ratio EPT y número total de taxones pueden ser buenos indicadores del estado de conservación. Por ello se sugiere este índice como una alternativa al índice IBMWP, aplicable al seguimiento de arroyos temporales de la Sierra de Guadarrama, basado en la propia experiencia del Parque Nacional.

A “riverscape” study: effects of alpine land covers on assemblages and functional traits of stream benthic macroinvertebrates

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The term “riverscape” refers to a riverine landscape that can be studied at different scales, from the single habitat patch to the catchment level. This definition stems from the observation that streams and rivers are characterised by the interaction and the reciprocal influence of different habitats located both in and outside the water bodies. While several studies have previously assessed the effects of land cover conversion on the aquatic environment in different parts of the world, very few studies examined these effects in the European alpine region. Using GIS analysis of the whole Italian alpine province of South Tyrol (Central Eastern Alps), we selected 15 riverine sites grouped by land cover typology (rocks, grasslands, forests, pastures) and comparable regarding discharge, altitude, catchment dimension and mean slope. We sampled stream benthic macroinvertebrates in three occasions during spring and summer 2017 at the selected sites. At the same time, we measured a set of water parameters (pH, ORP, EC, nitrate, turbidity, temperature). The typology of land covers in the surroundings of the sampled streams proved to be a crucial driver for the benthic macroinvertebrate communities, being a statistically significant factor in explaining the variation of the samples both in terms of structure and of functional diversity. This result may represent an important finding considering the land use intensification and abandonment currently experiencing by the alpine region due to different socioeconomic processes. Finally, in addition to climate change effects in mountainous regions, this phenomenon may constitute an additional indirect factor influencing structures and functions of aquatic riverine ecosystems in the region.

SE10.

**Ecohydraulics in
the global context of
river flow alterations
and impacts for
freshwater fish**

Impact of flow regulation on the composition and functional structure of fish assemblages

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Habitat change resulting from dam construction is an increasing worldwide problem. Particularly, dams built to generate electricity bring a different set of alterations as their typical operation mode (i.e. hydropeaking) causes high amplitude and sudden changes in flow and habitat available for fishes. Knowledge about the relationship between flow, habitat and fish assemblages is currently limited, and a holistic understanding of such patterns in non-regulated and regulated rivers, together with the assessment of the influence of streamflow and habitat components, is essential for the definition of suitable management actions. The main objective of this study was to contribute for a better understanding of these relationships by: i) comparing the composition and functional structure of fish assemblages inhabiting non-regulated and regulated rivers; and ii) assess the relationship between those ecological parameters and streamflow-habitat variability. Work was conducted in three rivers from Central Portugal, rivers Alva and Mondego, regulated for water storage and hydroelectric purposes, respectively, and river Vouga, with non-regulated flow. Fishes were collected and habitat characterized on two occasions, namely summer (August) and winter (February), on two consecutive hydrological years, 2012/2013 and 2013/2014, to account for inter and intra-annual variability. Multivariate analyses identified significant differences in fish assemblage composition and functional structure between the studied hydrologic scenarios. Particularly, a higher abundance of non-indigenous and limnophilic fish species was observed in the non-regulated river, while generalist species were more abundant in the river regulated for hydroelectricity production. DistLM models identified significant effects of a set of meso and micro-habitat (e.g. shade, substrate, depth) and streamflow predictors (e.g. Flow Rises) on the species composition (Best solution AICc=218.6) and functional structure (AICc=186.9) of sampled assemblages, but the latter set of predictors, related with streamflow components, explained a higher proportion of variance within the obtained ecological results (ca. 64% of variance explained) than habitat components (ca. 10%). These results will contribute to the definition of suitable management guidelines to promote the protection and conservation of river basins constrained by streamflow regulation.

Transferability of environmental flows: a case-study in a Mediterranean river

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Human impairment in aquatic ecosystems has increased in the last few decades severely affecting their natural physical characteristics and biological dynamics, consequently undermining their productivity and resilience. Nowadays, almost no stream or river worldwide has been left in its natural state as a result of an increasing demand for irrigation, consumptive water use and hydropower production. Over the years, the need to sustain and maintain the sustainability of aquatic ecosystems has been widely recognized and embraced by river managers, environmental policies and legislation. In particular, environmental flow regimes have been implemented all over the world. Setting an environmental flow regime involves identifying the quantity, timing, and variability of flow required to maintain desired levels of aquatic and riparian populations biomass and biotic diversity over time and space for a particular river segment. Achieving such level of detail can be resource demanding because surveys are expensive and time-consuming, especially if the species abundance nowadays is rare or occurs in remote locations. Thus, endangering the ability to gain knowledge on aquatic and riparian habitat requirements and assess environmental flow needs for each specific river. Transferring the flow-ecology relationships could be a successful measure to assist regional-scale environmental flow assessments. Nonetheless, little is known on the spatial transferability of flow-ecological relationships. The best way to judge it could be to maintain or recreate the hydrological, hydraulic and morphological river conditions under which fish communities had existed prior to disturbance, in order to meet their ecological needs. The habitat availability for the target species in the natural, non-regulated stream, will act as the reference condition (guiding image) for comparing the degree to which an environmental flow scenario deviates from the natural flow regime. The closer the environmental flow scenario is from the reference condition the “healthier” that flow scenario is judged to be. Conversely, the further from the reference condition, the less healthy it will be. In this study, we assess the viability to transfer the pre-defined environmental flow regime – set according to the reference habitat availability - from an upstream to a downstream river segment, which preserves similar morphodynamic conditions and flow-ecological relationships. A two-dimensional modeling approach was applied to predict the habitat availability for native cyprinid and riparian species in Mediterranean river and, thus, setting the environmental flow regime. This study is crucial not only for an improved understanding of transferability of flow-ecological relationships, but also for setting environmental flow recommendations at a regional-scale.

Biogeomorphic effects of the renaturalization of an urban river: the Manzanares River in the city of Madrid (Spain)

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Along the 20th century, the Manzanares River section that flows through the city of Madrid (Spain), was channelized with rip-rap and stone walls to allow for intensive urban development. Furthermore, two large dams were built upstream from the city for water supply and flood control, and nine small control dams were located in the urban section with the sole objective of creating an artificial view of a deep large river. At the ecological level, margins were disconnected from the channel by artificial structures, and the longitudinal connection of flows, sediments and species between upper and lower sections virtually disappeared. As part of the Renaturalization initiative by the Madrid City Council, the urban dam gates were opened at the beginning of 2016, with the following effects: (i) water depths have lowered, on average, from 4 m to 0.3 m, (ii) water flow presents different velocities within the channel, (iii) sands are being deposited in the channelized section in the form of bars and islands, and (iv) vegetation and fauna is colonizing the new habitats. The present study aims at evaluating this initial natural dynamics recovery through biogeomorphic metrics that allow for the association of better natural habitat conditions with the recovery of natural in-channel vegetation and fish fauna. Results show that there has been a remarkable increase in number, area and shoreline length of islands and bars straight after the gate opening (spring 2016) and a few months later (autumn 2016). The rapid creation of bars and islands entails an increase in natural zones of terrestrial/aquatic transition (shoreline length) that can be temporarily colonized by different types of animals and plants. In this regard, surveys on fish fauna have shown an increase in the number and biomass of autochthonous species (mainly barbel), at the expense of allochthonous species (especially catfish). This case study of the Manzanares River shows how an urban river can evolve with a non-intensive intervention focused on self-forming dynamics recovery.

Measuring flow complexity from fish perspective: Challenges and opportunities to impact assessment

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Fish have evolved in water and unlike terrestrial species have developed an external sensory system which responds to the water's hydrodynamic characteristics. This crucial physiological adaptation is called the mechanosensory lateral line (octavolateralis afferent system). The lateral line provides critical sensory input which drives many common behaviors in fish, such as prey and predator detection, obstacle avoidance, rheotaxis and schooling among others. Specifically, the lateral line encodes spatial flow stimuli, gathering data from the environment and translates it via the peripheral nervous system into useful information. Currently, the in-situ analysis of fish preferences is usually based in point measurements of the physical environment (e.g. time average velocity, water depth, substrate type and underwater vegetation presence). We believe that this discretization may lead to a grave oversimplification of the hydrodynamic characteristics of the aquatic environment, primarily because these metrics ignore the physical interactions between variables and fundamentally lack the temporal rate at which fish experience, and react to hydrodynamic stimuli. To try to address this complex problem, we have developed a new measuring device based in the sensing principles of fish: the artificial lateral line probe. Artificial lateral line probes provide a new technology for understanding aquatic ecosystems, and are fundamentally based on the fluid-body interaction between the sensor and the flow. Thus, they provide a new type of bio-inspired sensing device for ecohydraulic flow measurement and classification. This is achieved by using a time-synchronized array of rapid pressure sensors installed over a probe body. The benefits of this sensing system are multiple. For instance, in contrast to point measurements devices (e.g. acoustic Doppler velocimeter or propellers), the lateral line probe provides a source of simultaneous data in both space and time. This approach provides ecohydraulics researchers and managers with new sources of flow information as 1) the fluid-body interactions are considered, and 2) the sampling rate is higher than any other field tool (tested and validated up to 200 Hz), bringing the potential of measuring closer to the "fish's perspective". In this work, we summarize and analyze the results from over five years of continuous development and application, beginning with the fundamental working principles and concluding with a critical evaluation of our latest results in data-driven fish preference assessment. We discuss the opportunities of the technology for the in-situ and objective assessment and classification of the environments as well as the challenges to be faced in next years. Considering our results, artificial lateral line probes can become a multipurpose tool with the ability of monitoring the complex aquatic ecosystem experienced by fish.

Response of Fish Communities to Hydropeaking along a Morphological Gradient

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High-head hydropower plants are an important renewable energy source as they allow a quick response to short-term changes in the electricity market. However, their operation mode – the release of pulsed flow – affects downstream river ecosystems and has been identified as a critical threat to fish populations. The majority of hydropeaking studies so far restricted their investigations to single river case studies or experimental flumes. Here we utilized an extensive Austrian-wide database containing biological (fish population surveys), hydrological (natural flow and hydropeaking) and morphological data (variability screening). We analyzed the response of fish communities to hydropeaking (magnitude, frequency, timing, ramping rate) in Austrian rivers. Therefore, we dissected the multimetric Fish Index Austria into its associated metrics (e.g., guilds, population structure) and analyzed juvenile fish metrics to quantify river sites of varying degrees of pulsed flow along a morphological gradient. We present initial results from the database analysis and discuss potential options to mitigate the adverse impact of pulsed flow operations on fish populations.

Efeitos de barreira comportamental seletiva com estímulos acústicos, luz e bolhas, no salmónideo: *S. trutta* e ciprinídeos: *P. duriense* e *L. Bocagei*

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Resumo: O desenvolvimento de barreiras comportamentais seletivas e adaptadas às espécies piscícolas autóctones dulçaquícolas constitui uma importante ferramenta na salvaguarda dos fluxos migratórios das espécies potamódromas ameaçadas pela regularização dos cursos de água. Estes sistemas comportamentais podem fornecer condições específicas de orientação dos peixes para zonas de desova ou habitats de substituição, ou exercer efeito repulsivo no seu afastamento das armadilhas hidráulicas impostas por aproveitamentos hidroelétricos. A resposta das espécies dulçaquícolas selecionadas ao estímulo acústico (Sweep-up 2000Hz), estímulos luminosos (Strobe Light – 600 flashes/minuto) e cortina de bolhas, foram testadas em condições de laboratório, quer de forma isolada, quer de forma combinada: acústica/luz/bolhas. Apesar da diferenciação de sensibilidades registadas entre a espécie salmónicola testada: *Salmo trutta* e as espécies ciprinícolas testadas: *Pseudochondrostoma duriense* e *Luciobarbus bocagei*, em relação aos ensaios isolados com estímulos acústicos (maior sensibilidade repulsiva nas espécies ciprinícolas), assim como em relação aos ensaios isolados com estímulos luminosos (maior sensibilidade repulsiva na espécie salmónicola), quando utilizados de forma combinada apresentam sensibilidades repulsivas semelhantes e elevadas. A cortina de bolhas de forma isolada evidenciou sensibilidade repulsiva muito baixa para todas as espécies testadas. Os resultados demonstram o elevado potencial das barreiras comportamentais seletivas para peixes com base em sistemas combinados acústica/luz/bolhas, principalmente em cursos de água *Salmo* – ciprinícolas.

The consequences of pulsed flows to freshwater fish: challenges and solutions

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Hydropower provides energy that is efficient, rapid in responding to peak demands and with minimal carbon emissions. The consequent rapid flow fluctuations, i.e. hydropeaking, affect river abiotic and biological processes. The impacts of hydropeaking for fish may range from organism-level to life-cycle changes. However, there is still a lot of uncertainty on how to design effective mitigation measures based on those changes. In

this study, the effects of hydropeaking were investigated for the Iberian barbel (*Luciobarbus bocagei*) in an indoor flume. To mimic natural refuges that fish may find in the river, potential refuges were installed in the false bottom of the flume. In the first and second experimental campaigns, two lateral deflector configurations were tested for different flow events. In the third, two instream structures (open triangles and solid pyramids) were tested for the same flow events. The flow events differed in flow magnitude, ratio and rate of change. Physiological responses (blood glucose and lactate) and movement behaviour (refuge and flume activity) were quantified. A detailed characterization of the hydraulic conditions was also performed, measuring the flow field and the fluid-body interactions with the objective to better interpret fish responses. The flow events and refuge configurations induced physiological changes. More evident glucose changes occurred in fish subjected to hydropeaking with lateral refuges, whereas lactate changes were only evident in the presence of instream refuges. The use of potential refuges and swimming activity increased under hydropeaking conditions, particularly individual use and sprints respectively. Individual behaviour was more pronounced in the peak events with refuges whereas group behaviour increased in base flow and in hydropeaking conditions without refuges. The hydraulic characterization revealed that lateral deflectors and open triangles provided low velocity areas that can potentially mitigate the severity of peak flows. However, for the highest flow, the flow complexity created by the presence of refuges represented an additional constraint for fish, hindering their ability to find refuge behind the structures. This study provided novel insight on the effects of pulsed flows for Iberian barbel. The use of this integrated approach strengthened the interpretation of fish responses, minimizing misleading conclusions, and may contribute to future design of more effective mitigation measures.

Hydropeaking thresholds: Current status and outlook

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Hydropeaking is a phenomenon during which the base flow is disrupted by intense and short-duration discharge fluctuations resulting from high-head hydropower production. However, this operation scheme affects downstream river ecosystems. Among others, rapid flow increase, i.e., upramping, can induce macroinvertebrate drift, as well as fish downstream displacement. Furthermore, abrupt water reduction, i.e., downramping, can cause fish stranding and the dewatering of spawning grounds. Consequently, there has been an increasing global awareness and a corresponding growth in hydropeaking research, not only to mitigate the impacts but also to establish hydrological thresholds for different hydropeaking parameters. Therefore, the goal of this study was to analyze the so-far established hydropeaking thresholds in the scientific literature, as well as in the national guidelines or environmental regulations. Here, we provide an overview of the current knowledge and review of the established mitigation thresholds regarding, e.g., downramping rate or flow ratio. By analyzing fish according to life-cycle stages, more detailed threshold values may be derived for different hydropower operation periods and hydrological regimes. Thus, our study allows a comprehensive assessment of the current status of hydropeaking mitigation thresholds, providing an outlook for future management and operative hydropower measures.

Linking fish-based biological indicators with hydrological dynamics in a Mediterranean river: relevance for environmental flow regimes

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The relationship between flow dynamics and biological communities becomes especially relevant in Mediterranean rivers. Given their natural variability and growing anthropogenic pressures, their low sections are subjected to multiple impacts. The definition of ecohydrological relationships in this sort of rivers may constitute a useful management tool. Fishes were the first group used to assess community-level ecological quality, and different indices and metrics have been proposed. However, many of these indicators have showed up to date to be insensitive to hydrological alteration. There is therefore a need to deepen into the ecohydrological relationships between such indicators and flow regimes in Mediterranean rivers. This study presents an analysis of the relationship between interannual flow regimes in the lower section of the Ebro River, defined using a set of daily and hourly hydrologic indices, and ecological quality based on fish community, assessed through the indices IBICAT2010, IBICAT2b and EFI+. Hydrologic indices were computed using time periods of different amplitude and ecological quality was obtained in different transects along the river section in order to identify spatiotemporal patterns. Our results showed that the IBICAT2010 responded better to hydrologic indices, followed by the IBICAT2b and the EFI+. Both temporal and spatial patterns were observed, with a correlation between some hydrological and biologic indices. On one hand, daily hydrological indices did not show relationship with changes in ecological quality when they were computed using less than 9 months or more than 36 months of flow records (previous to the sampling date) whereas subdaily indices responded better using between 3 and 9 months. On the other hand, some sampling transects showed clearer relationships than others, even within the same water unit or mass, which indicates the importance of factors such as the distance to the gauging station and the hydromorphologic variability of the studied transects.

Efectos de las hidropuntas de una central hidroeléctrica sobre la organización y estructura de la comunidad de macroinvertebrados bentónicos

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Se han estudiado los efectos de las puntas de caudal (hidropuntas) asociadas a la cobertura de la demanda de energía eléctrica, sobre la comunidad de macroinvertebrados bentónicos en la cabecera del río Noguera Pallaresa (NE España, cuenca del Segre; Lleida). Se ha realizado el seguimiento de 3 puntos de muestreo situados aguas abajo de la Central Hidroeléctrica de Esterrí-Unarre (957 m snm; Endesa Generación, S.A.) a lo largo de un ciclo anual, en base a 7 campañas de muestreo, comparando los resultados con un cuarto punto de referencia situado aguas arriba de dicha central. Las hidropuntas consideradas presentan una amplitud variable, según la época del año, desde un caudal base inferior a 2 m³/s hasta los 18 m³/s. En cada punto y campaña de muestreo se ha medido, entre otros parámetros, la composición del macrobentos, la densidad, la similaridad entre inventarios, la función trófica según la forma de alimentación de las unidades sistemáticas presentes y los desfases en el ciclo biológico entre el punto de referencia y el tramo afectado por las hidropuntas. Se han llevado a cabo determinaciones sobre la calidad físico-química de las aguas y la estructura del sustrato en todos los puntos de muestreo. Los datos se analizan temporal y espacialmente (en el sentido longitudinal de la corriente de agua). Los resultados obtenidos indican que las hidropuntas de caudal de la central hidroeléctrica determinan cambios significativos sobre la organización y estructura del macrobentos, especialmente en términos de densidad, composición y ciclo biológico. Estos cambios, no obstante, se van atenuando río abajo hasta una situación comparable a la de referencia, a una distancia de unos 1.800 m que puede considerarse un indicador de la magnitud y alcance de la afectación. Todo parece indicar que las características hidráulicas y geomorfológicas (gradiente granulométrico del sustrato a lo largo del tramo de estudio sujeto a hidropuntas) explican una parte de los cambios identificados. Las variaciones en la temperatura del agua, entre la que circula por el cauce desde aguas arriba (punto de referencia) y la que se registra aguas abajo de la central hidroeléctrica, dan lugar a condiciones de "termopeaking" asociadas a las hidropuntas, con capacidad para explicar otra parte de los cambios. No se ha abordado ni la deriva del macrobentos ni su distribución transversal diferencial en el cauce, aspectos ambos importantes en un escenario de hidropuntas.

SE11.

Homenaje a la

Dra. Julia Toja:

Conservación y

gestión de embalses

y otros ambientes

acuáticos

Dos factores de gran valor estratégico para el desarrollo de la Limnología en España: Ramón Margalef y un amplio y diverso patrimonio de embalses

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España, un país sin apenas lagos, pasó a contar en el año 1970 con más de 700 embalses. Éstos constituyen en su mayoría masas de agua de gran volumen que fueron apareciendo en relativamente poco tiempo por las cuencas hidrográficas del país y de las que, desde el punto de vista de la calidad del agua y de sus posibles incidencias medioambientales, se desconocía prácticamente todo. Por aquella época, el Dr. Ramón Margalef, de reconocido prestigio internacional, que había consagrado su vida científica al estudio de la Limnología de las masas de agua generalmente modestas que naturalmente había en el país, y a la oceanografía, se encontró con la oportunidad de estudiar los enigmáticos embalses dispersos por un amplio territorio caracterizado por una gran diversidad hidrológica, litológica y climática; el marco ideal para el desarrollo de una Limnología de gran alcance que constituiría el inicio de una ciencia que ha tenido una gran repercusión en España. Las investigaciones se iniciaron gracias a un contrato con la Dirección General de Obras Hidráulicas en 1973 que permitió la adquisición de los equipos necesarios y la constitución de un equipo de científicos que, dirigidos por el Dr. Margalef, constituyeron el germen de la Limnología en España, una ciencia que se aplica como tal en numerosos proyectos tanto privados como gubernamentales, que se imparte en la mayor parte de las Universidades de nuestro país y que es justamente reconocida internacionalmente.

Lecciones desde la biología pesquera: Evolución hacia el estudio de los embalses

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El estudio de las comunidades de peces de los embalses en España se sustenta en un trípode que ha sido una constante en su desarrollo y evolución desde que en los años 70 se llevase a cabo el primero de ellos: la gestión, la ecología y las ciencias pesqueras. No podemos obviar que los embalses son cuerpos de agua explotados por el hombre con fines muy diversos, por lo que los efectos derivados de su uso están detrás en gran parte de la variabilidad que se genera en ellos, la cual afectará a su vez a los diversos factores tanto abióticos como bióticos que conforman a éstos como ecosistemas. El estudio integral de las poblaciones y asociaciones de peces de los embalses, tanto en lo relativo a sus parámetros biológicos como a su estructura y función, requiere por tanto de una aproximación desde la ecología. Sólo desde el conocimiento profundo del funcionamiento limnológico de este tipo de ecosistemas se puede dar respuesta a las necesidades de manejo de los mismos en el marco de una gestión sostenible, garantizando así su conservación. A los conocimientos procedentes de las ciencias pesqueras, con años de bagaje en la gestión de las poblaciones de peces, se debe el soporte logístico de los estudios, especialmente en relación a las metodologías de muestreo y a los modelos de análisis de los stocks piscícolas. En este aspecto, las lecciones que desde la biología pesquera se incorporaron en los albores del nacimiento de un grupo de investigación con formación eminentemente ecológica y limnológica, el Grupo de Investigación de Ecología de Peces de la Universidad de Sevilla, permitieron abordar el estudio de los peces en los embalses, evolucionando a lo largo de los años, sistematizándolo, y haciendo del grupo un referente nacional de los mismos.

Dinámica del zooplancton en algunos embalses andaluces

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El objetivo principal del estudio fue conocer la evolución temporal y espacial del zooplancton en cuatro embalses andaluces (Charco Redondo, Concepción, Limonero y Guadalcaén) con particularidades muy contrastadas (cuenca, edad, forma y tamaño). Cada embalse se caracteriza por una serie de factores físico-químicos y morfológicos que pueden dar lugar a variaciones en la composición, abundancia y diversidad de sus comunidades, entre ellas, la del zooplancton. En cada embalse se tomaron muestras de zooplancton de superficie en tres estaciones con respecto al eje longitudinal del embalse (presa-cola) y durante el periodo de estratificación y mezcla del mismo. Los grupos dominantes en estos embalses fueron los copépodos y los cladóceros (más del 40 % respectivamente en los cuatro embalses), siendo el género más abundante entre los copépodos, *Acanthocyclops* y, entre los cladóceros, *Bosmina* y *Ceriodaphnia*. Las principales características morfológicas y físicas de los embalses no influyeron ni en la abundancia ni en la diversidad del zooplancton. La abundancia del zooplancton varía significativamente a lo largo del eje longitudinal de cada embalse, siendo siempre mucho mayor en la zona de la cola que en la zona de la presa. La diversidad del zooplancton varía significativamente a lo largo del tiempo, mostrando siempre el periodo de estratificación una mayor riqueza que en el periodo de mezcla.

Julia Toja Santillana: de la Limnología a la empresa

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En la actualidad la Limnología es ampliamente utilizada por las administraciones públicas y por empresas de carácter privado, como base científica para la gestión de muchos de los servicios que proveen los ecosistemas acuáticos continentales. Desde la producción de energía hidroeléctrica, el abastecimiento de agua potable e industrial, la regulación climática, la regulación de las perturbaciones naturales, el control de especies exóticas invasoras, hasta los servicios culturales en general, están beneficiándose de los conocimientos que los investigadores en el ámbito de la ecología acuática están poniendo a disposición de la ciudadanía. En este sentido, la Profesora Julia Toja en su dilatada carrera profesional ha conseguido acercar el conocimiento científico a las necesidades que en todo momento demandaba la sociedad. Y parte de su éxito en aplicar la Limnología a la gestión está determinado por dos factores, su elevado nivel académico y científico, forjado desde su inicio por el Profesor Ramón Margalef, y el hecho de haber trabajado en el día a día en la Empresa Metropolitana de Abastecimiento y Saneamiento de Aguas de Sevilla. En esos más de 11 años en EMASESA, consolidó en la gestión empresarial la importancia del conocimiento del funcionamiento de los ecosistemas acuáticos, tanto de los embalses adscritos al abastecimiento a Sevilla y su área metropolitana, como el del propio río Guadalquivir. Su actividad en la empresa no sólo estuvo enfocada en el agua en origen, sino en todo el Ciclo Integral, lo que le permitió una aplicación eficiente de sus conocimientos científicos en el campo de la Limnología. En la presente comunicación se plantean algunos ejemplos que muestran la continuidad de su labor y su utilidad para nuestra Empresa.

Patrones y determinantes de diversidad y abundancia de zooplancton en la red de embalses del consorcio de aguas Bilbao Bizkaia

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Los embalses en España tienen gran relevancia como ecosistema acuático, al ser un país sin apenas grandes lagos naturales y que a su vez es uno de los países del mundo con mayor número de embalses por área. La importancia de estudios sobre estos ecosistemas artificiales ha aumentado en los últimos años cuando, además de ser mayor la presión antrópica sobre los recursos acuáticos, los estudios de cambio global predicen mayores problemas relacionados con el agua y una escasez cada vez más pronunciada de este recurso. En este contexto se ha estudiado la comunidad zooplanctónica de 10 embalses y 3 balsas pertenecientes a la red de seguimiento de embalses del Consorcio de Aguas Bilbao Bizkaia por la UTE Anbiotek-AGQ, en 5 campañas durante el año 2017. Además, se tomaron medidas de las condiciones del agua, concentraciones de nutrientes, producción primaria y otras variables físico-químicas, morfométricas y geográficas, siguiendo las indicaciones de la directiva europea marco del agua. El objetivo de este estudio es encontrar patrones de riqueza, diversidad y abundancia del zooplancton (y sus grupos funcionales) en relación con sus principales factores determinantes. También se quiso estudiar a la influencia de los ciclos de abundancia de larvas de *Dreissena polymorpha* sobre la comunidad zooplanctónica. Se calcularon diferentes métricas del zooplancton (riqueza, diversidad, densidad y proporción de grupos funcionales) y se analizó su relación con las variables ambientales mediante análisis de ordenación y correlaciones múltiples. Se encontraron un total de 54 especies, 37 de rotíferos, 10 de cladóceros y 6 de copépodos. La riqueza por embalse estuvo entre 17-30 especies, y la densidad entre 1-957 ind/l, mínimos y máximos, respectivamente. De acuerdo con nuestros resultados, la composición y abundancia de zooplancton se relacionan principalmente con variables asociadas al estado trófico acuático (concentración de nutrientes y productores primarios).

Are Large Dams responsible for Riparian Vegetation Encroachment in Mediterranean rivers?

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The Riparian Vegetation Encroachment (RVE) is a widespread phenomenon in most of the Mediterranean rivers. The causes of this process have been linked to changes in the use of land, to decrease of extensive livestock, to a great demand for water for irrigation, and at present, climate change is reinforcing it. These drivers have led to a stabilization of river channels, reducing their size and dynamism, and at the same time have favoured the growth of the woody vegetation in the river banks whose development has been a positive feedback. The aim of this work is to quantify the annual vegetation encroachment ratio and to develop a model to understand its controlling factors, such as: land use, floodplain and channel traits; flow regulation intensity; type of regulation; present vegetation canopy; distance to the dam; and time since dam started functioning. Our results show a generalized natural vegetation encroachment process. Only two exceptions were found associated with farming and poplar plantation that occupied riparian soils. Average Annual RVE ratio is 12 Ha per km of river length, but fluctuates from 1 to 55 Ha/km. highest values are found in lowest reaches far from the dam. Also, in these highest values were reached in the years following to beginning dams to operate. However, in other reaches there was a delay of several years in the encroaching process associated to scarcity or absence of initial woody vegetation at the time when dam started working. The process associated with RVE is a hysteresis phenomenon, which represents a problem to river managers due to the reduction of the native biodiversity. Therefore is a problem difficult to be solved. Few Counter-measures may be suggested. Preventing RVE by directly avoiding new recruitment or eliminating saplings with controlling flows may be a simple task. However, once the vegetation has been established and grown, especially if it is in dense spots, the flushing flows or peaks flows needed to uproot the plants are often unattainable. Biological control of vegetation encroachment may be an option but it has also secondary effects. Increasing grazing by ungulates may effectively limit the vegetation recruitment and prevent height growth.

Fishes and reservoirs

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Freshwater fishes can be defined as “potential victims of their own success” in that the factors that promote diversity among them and account for their evolutionary success at the same time increase the likelihood of their possible extinction by human and other alterations of their environment. These threats have made freshwater fishes the most threatened group of vertebrates. Many species are now classified as threatened or endangered. Damming is one of the primary source of threats for world biodiversity fishes; they have in many cases led to significant and irreversible loss of species (migration and dispersal). Major threats caused by dams included habitat fragmentation and modification longitudinal connectivity. Global data sets are essential in macroecological studies. Although information is available for freshwater fishes at the global scale, such data are only accessible at the ecoregional or river basin scale. We integrated more than 5,800 geographical coordinates for reservoirs in the FRWater data set in ModestR (<http://www.ipez.es/ModestR>). A comprehensive collection of geospatial rasters was assembled, one for each of the reservoir with area in Km² occupied presented in cells of 5 arc-minute resolution. We used a data set of 1,173,449 geographical records of the 16,734 species of freshwater fishes recognized as valid by systematists at 2017 (GBIF and FISHBASE). The aims were to test whether the relative contribution of abiotic factors that set the geographical range of freshwater fish species may vary spatially by damming. We assemble and utilize a large and updated percentage of the readily available data on world freshwater fishes to estimate the main factors able to account for the global pattern. At the same time, we also detail the world distribution of geographical rarity for freshwater fishes, examining the relationship between species richness to shed some light on the kind of processes involved in the current configuration of biodiversity patterns. Lastly, we assess the relative contributions of different environmental factors on the obtained geographical variation of freshwater fishes. We also discuss the consequences of the changes.

Caracterización de la red de embalses del consorcio de aguas Bilbao Bizkaia

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Durante el año 2017 la unión temporal de empresas UTE Anbiotek-AGQ realizó en concesión el seguimiento de la red de embalses del consorcio de aguas Bilbao Bizkaia. Durante este año se muestreó en 5 campañas (Febrero, Mayo, Julio, Septiembre y Noviembre) un total de 13 sistemas, 3 Balsas (Aceña, Gartxeta y Zulueta) y 10 embalses (Lekubaso, Zollo, Nocedal, Artiba, Undurraga, Oiola, Albina, Ordunte, Santa Engracia y Ullibarri-Gamboa). Durante este seguimiento se implementaron los protocolos de muestreo, análisis y cálculo de métricas de fitoplancton en lagos y embalses establecidos por el MAGRAMA mediante el RD: 817/2015 adaptado a la directiva europea marco del agua (DMA). El objetivo de esta propuesta es ajustar el marco metodológico en el seguimiento de estos sistemas, aportar el potencial ecológico de los embalses con entidad de masa de agua (Albina, Ordunte, Sta. Engracia y Ullibarri-Gamboa; incluidos dentro de la tipología E-T07) y poner a disposición de la sociedad y en concreto de la comunidad científica datos relevantes sobre el estado trófico y presencia de contaminantes. Así mismo, se pretende constituir la referencia principal para otras dos comunicaciones coordinadas y presentadas a este congreso que buscan focalizar más detalladamente los compartimentos del fitoplancton y del zooplancton en estos sistemas. En nuestro caso, damos prioridad a su descripción y clasificación en base a las variables abióticas. Se valora el efecto de las variables diagnósticas del estado trófico, la presencia y concentración de nutrientes y contaminantes potenciales establecidos en la norma de calidad ambiental (NCA) detallada en el RD:817/2015 así como aquellas variables ambientales en relación con las características morfométricas de los sistemas.

Tendencias en el desarrollo de comunidades fitoplanctónicas en la red de embalses del consorcio de aguas Bilbao Bizkaia

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El estudio de los embalses españoles ha sido objeto de numerosos trabajos en limnología, puesto que, debido a la escasez de lagos, estos sistemas artificiales han constituido, desde mediados del siglo XX, un porcentaje importante de las masas de agua españolas. El estudio holístico de estos ecosistemas ha pasado a tener una gran importancia con el fin de facilitar la información necesaria para su adecuada gestión por parte de las administraciones. Según la Directiva Marco del Agua (DMA) los embalses se consideran masas de agua muy modificadas y en su caracterización son de relevante importancia las comunidades fitoplanctónicas que se desarrollan en ellos. Durante el año 2017 se ha llevado a cabo el seguimiento de la red de embalses del Consorcio de Aguas Bilbao Bizkaia por la UTE Anbiotek-AGQ siguiendo las directrices del MAPAMA y la DMA, por lo que se dispone de datos físico-químicos, nutrientes, fitoplancton y zooplancton de 5 campañas de 10 embalses y 3 balsas. El objetivo de este estudio es detectar patrones o tendencias en el desarrollo de comunidades fitoplanctónicas en relación a las variables ambientales. Se han calculado las métricas requeridas por la DMA: Biovolumen total (Bvt), Índice de Grupos Algales (IGA) y % cianobacterias (%CIANO) además de la diversidad y la riqueza específica. Se han analizado mediante análisis de correlaciones múltiples y de ordenación las relaciones entre las métricas de composición y abundancia de las comunidades de fitoplancton y las variables ambientales. Se han agrupado las localidades según las comunidades de fitoplancton y se han detectado las especies diagnósticas para cada grupo. Han sido identificados un total de 312 taxones de los cuales el 43,6% son clorofíceas, el 13,5% son diatomeas, el 12,2% cianobacterias, el 9% dinoflageladas, el 8,3% crisofíceas, el 6,1% euglenófitas, el 4,2% criptofíceas y el 3,2% xantofíceas. En cuanto a los valores de Bvt el rango obtenido oscila entre 36,609-0,022 mm³/L, los de IGA entre 46,96-0,01 y entre 65,48-0,00% en %CIANO.

Actividades científico- académicas de la Dra. Julia Toja Santillana en el cono sur de América

Rodrigues Capítulo AR

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La Dra. Julia Toja realizó una intensa actividad académico- científica en varias Universidades e Institutos de Investigación de Limnología de Latinoamérica basados en conferencias y cursos en sus múltiples viajes a esta región y en particular a la Argentina, que merecen un comentario especial por las enseñanzas y recuerdos allí dejados. Las primeras aproximaciones de la Dra. Toja con integrantes de Sudamérica datan de la década del 80 vinculadas a la dirección de tesis Doctorales y estudios posdoctorales de becarios del CONICET y Universidad Nacional de La Plata de Argentina durante sus estancias en Sevilla. Estas estuvieron relacionadas con el tema de los Embalses de la cuenca del Guadalquivir y estudios del metabolismo bentónico en ambientes lagunares. A partir de esta actividad desarrolló una serie de intercambios académicos por varios países latinoamericanos entre ellos Colombia, Brasil y Argentina, que le permitieron visitar varias Universidades Nacionales, como las de La Plata, Luján, Tucumán, Litoral, Sao Carlos (SP), entre otras, así como varios Institutos de investigación en Limnología (ILPLA- La Plata, INALI-Santa Fe, Tucumán, INEDES-Luján). Dictó durante estos viajes una serie de cursos de Grado y Posgrado relacionados con su especialidad en la gestión de embalses abriendo una perspectiva diferente que se evidenció en el interés de los jóvenes participantes. Cabe destacar que la Dra. Toja fue una entusiasta y promotora de las reuniones para desarrollar el intercambio entre la Limnología de Latinoamérica y la Península Ibérica desde su participación en el Primer Encuentro de Limnólogos Iberoamericanos realizado en Sevilla en 1992, que derivó en un Segundo Encuentro en Brasil en 1995 durante el desarrollo del Congreso Internacional de Limnología (SIL), y que continúa actualmente a través de la integración de las Asociaciones Iberoamericanas de esta ciencia. Recientemente y en el marco del IX Congreso de Ecología y Manejo de Ecosistemas Acuáticos Pampeanos (EMEAP, La Plata 11- 2017), ofreció una conferencia sobre "La restauración de ecosistemas. Integración de los factores de presión ecológicos y socioeconómicos en los modelos conceptuales para una gestión adaptativa". Asimismo en esta estadía dictó otros cursos y puso en evidencia una vez más la continuación de su vocación por la Limnología y su entusiasmo desinteresado, aun después de haber dejado la actividad académica para disfrutar de su merecida jubilación.

Estima de la calidad en masas de agua oligotróficas mediante imágenes de Sentinel-2

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Los lagos oligotróficos pirenaicos son masas de agua aisladas de pequeño tamaño con una gran dificultad en el acceso para trabajos de toma de datos de campo. En este sentido, la teledetección es una óptima herramienta para el seguimiento continuo del estado de la masa de agua a través de variables ópticamente activas como la transparencia o la concentración de clorofila *a* y así conocer mejor su dinámica espacial y temporal. Por ello, dentro de los estudios de aplicación de los nuevos sensores remotos, se pretende demostrar la validez de un algoritmo para las imágenes de Sentinel-2, el nuevo satélite de observación de la tierra de la agencia espacial europea, con una resolución espacial (10 m) y una frecuencia temporal (5 días) impensables hasta ahora en imágenes de acceso libre. El estudio se realizó con tres imágenes de la zona pirenaica del verano de 2017 recogidas en julio, agosto y septiembre. Se descargaron ya procesadas con la corrección geométrica y atmosférica a nivel 2A desde el hub de la ESA Copernicus. Se procesaron con el programa SNAP 5 para la extracción de los datos de reflectividad para estimar la concentración de clorofila *a* de cada embalse mediante aplicación de los algoritmos Tribanda de Dall'Olmo, modelo de cuatro bandas (ND4) de Sentinel-2, la regresión lineal múltiple de cinco bandas (RLM5) y el algoritmo semianalítico de tres bandas de Gilerson. Los datos estimados se validaron con muestras de campo, a partir de dieciocho muestreos en embalses de la cuenca del Ebro de la zona pirenaica principalmente. Además, para una mejor interpretación de los resultados se tomaron datos de profundidad del disco de Secchi, sólidos suspendidos y turbidez. Los resultados de la validación fueron muy buenos, puesto que la correlación lineal entre datos de campo y estimados fueron significativas para algunos de los modelos como el ND4 y la RLM5. La interpretación de los modelos nos muestra su utilidad como indicadores de pérdida de calidad en las masas de agua, de forma que se pueden supervisar remotamente sus condiciones.

La satisfacción que da la experiencia de hacer ciencia y aplicarla

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Pocas veces, cuando empecé mi andadura en el campo de la Limnología, se presentaba a un biólogo la posibilidad de aplicar directamente la ciencia que iba construyendo en la gestión diaria de un abastecimiento de aguas y, posteriormente, de la depuración de las aguas residuales de una ciudad. Varias circunstancias se conjugaron para permitir que yo fuera una de las primeras personas agraciadas. El estudio de los embalses españoles, liderado por mi maestro el Dr. Margalef, coincidió con el interés del gerente de la empresa de aguas de Sevilla (EMASESA) en contratar a un limnólogo (aunque no tuviera muy claro para que podía servir), fue el desencadenante. El integrarme en el Departamento de Sevilla, dirigido por el Dr. González Bernáldez, me enriqueció con una visión más amplia de la Ecología. El creciente conocimiento del funcionamiento de los embalses que íbamos adquiriendo, sus características diferenciales con los lagos e, incluso, con embalses de zonas de climas más regulares que el mediterráneo, me llevó a comprender el papel de la tasa de renovación del agua en el grado de eutrofia y el poder controlarlo extrayendo el agua de la profundidad más adecuada, sin gasto económico alguno. Este fue el inicio de una trayectoria en la que he intentado hacer comprender a los gestores del agua la utilidad de aprovechar el funcionamiento del sistema. Mi otro interés ha sido intentar preparar a mis alumnos para el ejercicio de la profesión fuera de la Universidad, donde la mayoría de ellos han tenido que desarrollar su trabajo. A todos mis colaboradores en mayor o menor medida (más de cien) y a todos mis alumnos les agradezco su ayuda porque de todos y cada uno de ellos he aprendido algo.

Evolución del estado trófico en embalses de la cuenca del Ebro: veinticinco años de estudios

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Tras veinticinco años de realización de los trabajos de seguimiento de la calidad ecológica de los embalses de la Demarcación Hidrográfica del Ebro, haciéndose en los últimos once años de acuerdo con los protocolos definidos por la Directiva Marco del Agua y su implementación en España por la Orden de Planificación Hidrológica ARM 2656 de 2008 y la modificación posterior, se han obtenido una serie de datos suficientemente larga que permite observar cuáles son las tendencias en el estado ecológico de estas masas de agua. A partir del estudio de los resultados de las variables consideradas (transparencia del agua, oxígeno disuelto, concentración de fósforo total, clorofila a, densidad y biomasa planctónica), se ha podido calcular por una parte el estado trófico de los embalses basado en los indicadores fisicoquímicos clásicos, y por otra parte la determinación del potencial ecológico según la normativa establecida, así como comparar estos resultados con una aproximación al cálculo del potencial ecológico de forma experimental, basado también en indicadores biológicos, pero utilizando tanto los resultados obtenidos a partir del fitoplancton como también del zooplancton. De los 65 embalses estudiados, a partir de los indicadores de estado trófico considerados, tan sólo 3 de ellos se encuentran en estado eutrófico y 31 en estado mesotrófico, los restantes corresponden a estado oligotrófico y ultraoligotrófico. La mejora en la calidad de los embalses durante los años transcurridos es significativa si consideramos su estado antes del año 2000 y el actual. Sin embargo, todavía quedan pendientes de mejorar esas 34 masas de agua que no se encuentran en buen estado, si se quiere alcanzar el objetivo de calidad de la DMA para el horizonte 2021.

AGRHYDROM

AGRHYDROM. A timely look at effects of agriculture on fluvial DOM: the role of hydrology

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Collaborative Projects among young researchers with the double aim of funding original research and promoting networking among the young researchers. Here, we present the preliminary results of the awarded project: AGRHYDROM. A timely look at effects of agriculture on fluvial dissolved organic matter (DOM): the role of hydrology. Owing to the current scenario of global change, which predicts an increase in both flow intermittency and agricultural practices, in the AGRHYDROM project, we examined the combined effect of seasonal hydrological fluctuations and agriculture on nutrient concentration and DOM quantity and composition. A team of 66 researchers from more than 20 institutions was involved. We analysed the concentration of dissolved organic carbon (DOC) and nutrients (nitrogen and phosphorous), and the DOM composition by fluorescence and absorbance metrics, in 24 agricultural streams and 24 forested streams across the Iberian Peninsula and Europe (Spain, Portugal, Switzerland and Germany). Moreover, to understand how flow variations modulated the influence of land use on nutrients and DOM properties, the selected streams were sampled in three phases of the hydrological cycle: base flow, contraction and expansion phases. We hypothesize a strong interaction between hydrological variations and land use that will modulate the influence of agriculture on fluvial nutrients, DOC and DOM properties through two possible mechanisms: through changes in the buffering capacity of streams, or through the alteration of the connectivity between the streams and their catchments. The results of this project will significantly contribute to a better understanding of the effects of agricultural practices, especially on highly fluctuating small rivers, and will help to design more specific management strategies aimed to avoid the impact of agriculture on streams at times of high sensitivity.

During the last years, various projects as 1000 Intermittent Rivers Project, Dryflux, EuroRun or DOMIPEX, have demonstrated how collaborative experiments based on simple and inexpensive methodologies can successfully answer ecological questions that require a broad spatial coverage. In this context, in 2016, the Iberian Association of Limnology (AIL) launched its second call for

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