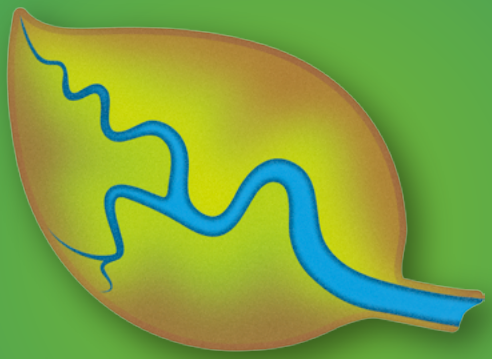

# Limnología 2020

## XX Congress of the Iberian Association of Limnology (AIL-2020)

## III Iberoamerican Congress of Limnology (CIL-2020)

ONLINE CONGRESS

**26-29 October**

Murcia (Spain)

## XX Congress of the Iberian Association of Limnology (AIL-2020)

## III Iberoamerican Congress of Limnology (CIL-2020)

# Limnology in a changing world

Between 26nd and 29th of October 2020 and honouring the theme of the congress, "Limnology in a changing world", we will celebrate in a virtual form from Murcia (Southeast of Spain) the XX Congress of the Iberian Association of Limnology (AIL-2020). We highlight that the congress is the result of a fruitful coordination between the Iberian Association of Limnology (AIL) and the Iberoamerican Associations of Limnology. Thus, this congress is will be also the III Iberoamerican Congress of Limnology (CIL-2020). This event will provide a valuable opportunity, although in a virtual way, for the exchange of knowledge and experiences among Iberian and Ibero-American limnologists.

One of the main aims of this meeting is to discuss the new scientific knowledge that will be useful to improve the management and conservation of inland aquatic ecosystems (from lakes to deltas and estuaries, through rivers and wetlands). This information will be discussed under a global change scenario and considering new models of man-nature cooperation. Under the slogan "Limnology in a changing world", the congress aims to discuss key issues to manage these ecosystems that despite being of high importance for humans, are subjected to increasing human pressures and impacts.

The Iberian Southeast is one of the most arid regions in Europe. Inland aquatic ecosystems in this area acquire a great importance for their uniqueness at European scale. Arid environments offer a wide variety of aquatic ecosystems, hosting an extraordinary biodiversity. The functioning of such ecosystems is determined by extreme biophysic conditions, especially at the terrestrial-aquatic interface. Despite its conservation value, the aquatic ecosystems of this region are highly threatened by the high degree of anthropic alteration and global change.

We invite you to participate in this unique event to share experiences, to coordinate works and advance in the knowledge of aquatic ecology, thus contributing to a more sustainable inland aquatic ecosystem management. In this sense, we feel that the involvement of water managers and interested technicians and consultants is essential as a bridge between scientific knowledge and society. For this reason, our invitation is extended to this collective.

The Congress logo is an original idea from Antonio José García Cano.

# Partners & Sponsors

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**Toni Camacho**
UNIVERSIDAD DE VALENCIA

# Invited Speakers

Nancy B. Grimm

Arizona State University,
Tempe, Arizona, USA

## The need for positive thinking in times of crisis: co-producing sustainable future scenarios and nature-based solutions for cities

We are in a time of accelerating global crises, and nowhere is this more evident than in cities. Because they concentrate people and infrastructure and are often found along coasts and rivers or in arid areas, cities are particularly vulnerable to the impacts of extreme, weather-related events. Population aggregation provides many benefits to society, including enhanced collective creativity and economies of scale, but among the detriments is rampant spread of disease, as illustrated by the current coronavirus pandemic. Facing this reality, building resilience for our cities requires diverse strategies that integrate social (S), ecological (E), and technological/built (T) components in a systems (S) approach. It also requires outside-the-box thinking and an emphasis on positive futures. I will present a conceptual framework for SETS integration and an approach for co-creating positive future visions (scenarios) developed and applied in nine North and Latin American cities. Examples from the scenario development process will highlight diverse strategies that address unique challenges across the cities. Closer examination of strategies for flooding will show common approaches across diverse cities. And finally, emergent themes, goals, and strategies will be examined in the context of the pandemic, asking how social, ecological, and technological systems respond and fare under this very different type of threat.

Mariana Meerhoff

Departamento de Ecología
y Gestión Ambiental.
Universidad de la Republica. Uruguay.

## Climate warming decreases ecosystem resilience against eutrophication; what about the other way round?

Climate change affects a myriad of processes that affect water quality and ecosystem functioning, from the watershed to the organism scale. Climate change interacts with other anthropogenic stressors, in often in a synergistic way, leading to a decrease in ecosystem resistance and resilience to external perturbations. In particular, there is a growing consensus on the idea that warming, in particular, enhances both eutrophication and its symptoms, promoting cyanobacterial blooms among others.

It has been hypothesized that eutrophication can also enhance climate warming, although the partial evidence is incipient and often contradictory due to the different processes involved.

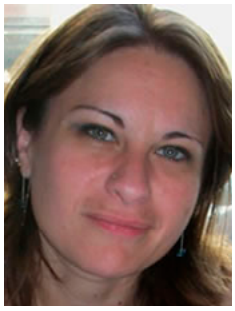
In this presentation, I will review the main processes that are affected by climate change that lead to a weakening of ecosystem resistance and resilience against nutrient enrichment, and the growing evidence on the interaction between eutrophication and its symptoms on the carbon cycle and the climate system.

Raquel Mendonça

Federal University of Juiz de Fora.
Brasil.

## Carbon footprint of reservoirs – lessons learned from tropical systems

Reservoirs play key social and economic roles as source of water and hydropower. There are currently about 38,000 dams around the world and many new ones are planned especially in the tropics, affecting landscape-scale greenhouse gas emissions and the carbon cycle. Particularly methane emission is of major concern, since the transformation of previously fixed atmospheric carbon dioxide to methane implies a 34-fold amplification in global warming potential. However, reservoirs also trap large amounts of fluvial sediments containing organic carbon in a burial-prone environment, thereby enhancing basin-scale organic carbon sequestration. In my talk, I will discuss some of the latest advances towards quantifying the carbon footprint of reservoirs, showing the research that my group has developed over the past years. We have demonstrated, for example, that reservoirs sequester terrestrial organic carbon with higher efficiency than other depositional environments. We also confirmed that methane emission through bubbles, an emission pathway largely overlooked, can account for most of a reservoir greenhouse gas emission. It is clear that the ultimate carbon footprint of a reservoir is strongly dependent on the characteristics of its project and on the properties of its catchment. Based on this, I will also discuss ideas of how strategic dam planning can reduce greenhouse gas emission.



Luisa Orsini

School of Biosciences,University of Birmingham. UK.

## Back to the future with the evolutionary time machine

Human-driven environmental change has been associated with loss of biodiversity and ecosystem services. Yet, we struggle to mitigate this loss and to regulate pollution. This is because the links between abiotic environmental change and biodiversity are dynamic and complex. Because of this complexity, it is challenging to convince regulators, politicians and the public of the causal correlation between our own activities and their consequences on biodiversity. Moreover, we know remarkably little about the mechanisms of resilience to future changes.

'Space-for-time' substitution and cross-generational studies in species with short generation time have provided important insights into evolutionary mechanisms of resilience. However, they have the main limitation of quantifying changes against an already shifted baseline and across a short time frame. A comprehensive understanding of past changes in biodiversity, and the causal correlations to environmental change can be achieved through the study of biological archives, which have the unique advantage of preserving temporal biological and environmental signals, allowing the reconstruction of multidecadal dynamics across space. The use of sedimentary archives enables time traveling into the past to pristine environmental conditions, providing a reference baseline to quantify changes in biodiversity caused by major shifts in abiotic environmental change. These long-term data are essential in predicting the future of biodiversity and ecosystem services because they enable us to account for species evolutionary response and for eco-evolutionary feedbacks. These mechanisms are currently ignored in model forecasts, which leads to overestimation of species survival under future global change scenarios.

Cayetano Gutiérrez Cánovas

Departament de Biologia Evolutiva, Ecologia i Ciències Ambientales. Universitat de Barcelona. España.

## Multiple stressor impacts on freshwater ecosystems: biodiversity responses and functional consequences

Freshwaters ecosystems are exposed to multiple drivers of change and stress, which threaten their biodiversity and their vital contribution to people's welfare and global biogeochemical cycles. As a consequence, to improve and adapt biomonitoring, management and conservation actions, a large body of research have started to identify and quantify combined of co-stressors on freshwaters. Multi-stressor combined effects can include the dominance of individual stressors, additive effects (sum of individual effects) or ecological interactions (joint effect is lower or higher than the sum of individual effects). Recent meta-analyses have shown a variable picture in the prevalence of such combined effects. Dominant and additive effects tend to be more frequent in observational studies, while interactive effects are common in experimental studies. Furthermore, multi-stressor effects can vary across organisms and ecosystem types. For example, lakes tend to be affected by nutrients as dominant stressor, while rivers showed a context-specific response where additive effects and interactions gained importance. However, despite these huge advances in multi-stressor research, our capacity to anticipate global change impacts is yet to be improved. There are three promising lines of research that can enable a better understanding of the biological and ecological mechanisms mediating multi-stressor responses. First, there is a lack of mechanistic understanding on how multi-stressors drive biodiversity changes. Mechanistic approaches, such as those combining eco-physiology, functional traits and food web relationships, can help to predict and generalize biodiversity responses in response to multiple stressors. Second, natural stressors and disturbances, such as flow intermittence, fire disturbance, water salinity or elevation, are widespread and can alter the way in which anthropogenic pressures impact freshwaters. A better understanding of how natural stressors interact with those of anthropogenic origin can improve our predictive capacity. Third, to anticipate the functional consequences of global change on freshwaters, there is an urgent need to explore how multiple stressors affect freshwater biodiversity - ecosystem functioning relationships.

Nicolás Vicente Parra

Department of Biosciences. Univeristy of Oslo. Norway.

## Saline lakes as barriers against pollution: the case of Pétrola Lake

Saline lakes are diverse ecosystems mostly located in arid and semi-arid regions associated with endorheic basins. These lakes are vulnerable to numerous environmental impacts closely related to human activities, including pollution. The low precipitation and high evaporation rates typical of arid regions lead to the accumulation and biomagnification of pollutants. Pollution is frequently associated to inputs from agricultural wastewaters, resulting in an increase in nutrients and subsequent eutrophication of the ecosystem. Aquatic interfaces are critical sites for nutrient turnover and biodiversity. Here, microbially mediated redox processes exert an important control on water quality.

Pétrola Lake, in Castilla-La Mancha region (central Spain), is a good example of a saline lake heavily disturbed by agricultural activities and urban wastewater discharges. Such practices led to the declaration of this wetland as vulnerable to nitrate pollution in 1998. In this regard, Pétrola lake-aquifer system has an important potential for removing pollutants, including nitrate. Its attenuation potential is not only associated to the sediment-water interface, but also to the freshwater-saltwater interface, where the density driven flow associated to saline lakes plays a key role. In order to unravel these mechanisms, a multidisciplinary approach involving hydrochemical, multi-isotopic, geophysical, and molecular techniques was addressed. These findings have significant implications for the understanding of how saline lakes act as reactive zones pollution.

Narcís Prat

Departament de Biologia Evolutiva,
Ecologia i Ciències Ambientales..
Universitat de Barcelona. España.

# Danzando con quironómidos: Una mirada retrospectiva a la investigación y gestión del agua en España.

Sin duda alguna la Limnología ha cambiado mucho desde 1981 cuando se creó la AIL (AEL en aquel momento) de la cual fui el segundo presidente y durante 12 años. En aquellos momentos los que enseñábamos Limnología podíamos tener todavía una visión global de toda la ciencia, que se reflejó en el libro del profesor Margalef en 1983. En el homenaje que le rendimos en 1992 en el Congreso de la SIL de Barcelona, presenté un trabajo sobre ríos (que era resultado de un curso de doctorado) que fue mi última intentona de intentar compilar lo que se sabía de ríos en aquel momento. Se puede decir que la Limnología como tal ha explosionado al mismo tiempo que se ha desvanecido, un poco ocultada por el término "Ecología de las Aguas", quizá más entre los que cultivan la Ecología de ríos que los que trabajan en lagos. Hoy en día sabemos un mucho de un poco y poco de Limnología. Todavía hay cursos de Limnología en España pero probablemente cuentan cosas muy diferentes. Este atomización se ha producido en todas las ciencias y las visiones globales de la Limnología pasan hoy por revisiones a nivel global donde muchas veces se utilizan los datos de otros, estas revisiones van al alza y cada año aparecen dos o tres (véase por ejemplo lo que ha pasado en los ríos temporales –ahora dichos intermitentes). Será por mi desconocimiento, pero me parece que muchos han visto los ríos o los lagos sólo en su ordenador.

Respecto a la gestión del agua, uno tiene bastante que contar, muchas decepciones y el sentir constante de que pasados unos años la gente se olvida de todo lo que habíamos aprendido. La gestión no parece seguir los criterios científicos, a pesar de la DMA, y o así se deduce de algunos planes de cuenca de los Distritos Hidrográficos en España, que ahora no se atreven a proponer transvases, pero que siguen olvidando el cambio climático y defendiendo actuaciones que solo pueden redundar en disminución de caudales en los ríos y aumento de la contaminación (por ejemplo más regadío). Cierto que después de miles de depuradoras construidas y miles de millones de euros gastados ahora la contaminación no es tan evidente (el agua ya no huele a podrido), pero es más silenciosa y complicada de combatir (microcontaminantes…). La legislación y la concienciación van por detrás de conocimiento, cuando este no se olvida por motivos incomprensibles (o no tanto).

¿Y por qué danzando con los quironómidos?. Los quironómidos (y los macroinvertebrados acuáticos en general) han sido el nexo de unión de toda mi vida de investigador y profesor y me han servido para mi tarea de difusión y de activista. Ellos me han mantenido "danzando" todo este tiempo, como si participara de sus elegantes nubes y todavía me apasionan como el primer día como presunto investigador en Limnología (fines de 1972). Mi director de tesis me dio un libro de 1921 y me dijo "A vd. le toca estudiar los quironómidos de los embalses españoles". Y todavía sigo.

# Sessions & Calendar

## Ordinary Sessions

| | |
|---|---|
| **RS1** | Microbial ecology |
| **RS2** | Population and community ecology |
| **RS3** | Biodiversity and conservation of aquatic ecosystems |
| **RS5** | Ecosystem processes and functioning |
| **RS7** | Stressed aquatic ecosystems |
| **RS8** | Wetlands, lakes and estuarine ecology |
| **RS9** | Monitoring, management and restoration of aquatic ecosystems |
| **RS10** | Alien and invasive species |
| **RS11** | Urban aquatic ecosystems |
| **RS12** | Global change and aquatic ecosystems |
| **RS13** | Ecosystem services |

## Special Sessions

| | |
|---|---|
| **SS1** | New challenges in management water and aquatic ecosystems in a changing world |
| **SS2** | The nitrogen cycle in inland waters: natural and human-driven processes |
| **SS3** | Water quality of reservoirs: monitoring tools and challenges for the future |
| **SS4** | Effects of contaminants on aquatic systems: from cells to ecosystems |
| **SS5** | DNA barcoding, (e)DNA metabarcoding and metagenomics to address ecological and evolutionary questions in aquatic ecosystems |
| **SS6** | Biogeochemistry of the carbon cycle |
| **SS7** | Beyond the natural sciences tool-box: what social sciences and humanities can teach us about freshwater ecosystems |
| **SS8** | Metacommunity ecology in aquatic ecosystems: applications, innovations and challenges |
| **SS9** | The tech revolution: Improving aquatic biogeochemical knowledge through new approaches and methodologies |
| **SS10** | Tropical limnology in the Americas: current status and future perspectives |
| **SS11** | EU Projects Workshop: exchanging experience in IAS management and awareness |

## 26th October 2020

| | ROOM 1 | ROOM 2 | ROOM 3 | ROOM 4 | ROOM 5 | ROOM 6 |
|---|---|---|---|---|---|---|
| 16:00 | **Opening Ceremony**<br>16:00-16:30 | | | | | |
| BREAK | | | | | | |
| 16:35 | **Margalef Conference**<br>16:35-17:35<br>Nancy Grimm | | | | | |
| BREAK | | | | | | |
| 17:45 | **RS12**<br>Global change and aquatic ecosystems<br>17:45-18:30 | **SS10**<br>Tropical limnology in the Americas: current status and future perspectives<br>17:45-18:30 | **RS5**<br>Ecosystem processes and functioning<br>17:45-18:30 | **RS8**<br>Wetlands, lakes and estuarine ecology<br>17:45-18:30 | **RS1**<br>Microbial ecology<br>17:45-18:30 | **RS11**<br>Urban aquatic ecosystems<br>17:45-18:30 |
| BREAK | | | | | | |
| 18:40 | **Plenary Conference**<br>18:40-19:40<br>Mariana Meerhoff | | | | | |
| BREAK | | | | | | |
| 19:45 | **Meeting Iberoamerican Associations**<br>19:45-20:45 | **SS11**<br>EU Projects Workshop: exchanging experience in IAS management and awareness<br>19:45-20:45 | | | | |

Times are expressed in Spanish local time (CEST Central European Summer Time)

## 27th October 2020

| | ROOM 1 | ROOM 2 | ROOM 3 | ROOM 4 | ROOM 5 | ROOM 6 |
|---|---|---|---|---|---|---|
| 16:00 | **Plenary Conference**<br>16:00-17:00<br>Raquel Mendoça | | | | | |
| BREAK | | | | | | |
| 17:10 | **SS6**<br>Biogeoche-mistry of the carbon cycle<br>17:10-17:55 | **RS2**<br>Population and community ecology<br>17:10-17:55 | **SS1**<br>New challenges in management water and aquatic ecosystems in a changing world<br>17:10-17:55 | **RS10**<br>Alien and Invasive species<br>17:10-17:55 | **RS13**<br>Ecosystem services<br>17:10-17:55 | |
| 17:55 | **SS2**<br>The nitrogen cycle in inland waters: natural and human-dri-ven processes<br>17:55-18:40 | **SS8**<br>Metacommunity ecology in aquatic ecosystems: applications, innovations and challenges<br>17:55-18:40 | **RS9**<br>Monitoring, management and restoration of aquatic ecosystems<br>17:55-18:40 | **SS4**<br>Effects of contaminants on aquatic systems: from cells to ecosystems<br>17:55-18:40 | **SS7**<br>Beyond the natural sciences tool-box: what social sciences and humanities can teach us about freshwater ecosystems<br>17:55-18:40 | **RS3**<br>Biodiversity and conservation of aquatic ecosystems<br>17:55-18:40 |
| 18:40 | **Round Table: Management Based on Science**<br>18:40-19:40 | | | | | |
| BREAK | | | | | | |
| 19:45 | **Plenary Conference**<br>19:45-20:45<br>Luisa Orsini | | | | | |

Times are expressed in Spanish local time (CEST Central European Summer Time)

## 28th October 2020

| | ROOM 1 | ROOM 2 | ROOM 3 | ROOM 4 | ROOM 5 | ROOM 6 |
|---|---|---|---|---|---|---|
| 16:00 | **Plenary Conference**<br>16:00-17:00<br>Cayetano Gutiérrez Cánovas | | | | | |
| BREAK | | | | | | |
| 17:10 | **RS7**<br>Stressed aquatic ecosystems<br>17:10-17:55 | **SS9**<br>The tech revolution: Improving aquatic biogeochemical knowledge through new approaches and methodologies<br>17:10-17:55 | **SS5**<br>DNA barcoding, (e)DNA metabarcoding and metagenomics to address ecological and evolutionary questions in aquatic ecosystems<br>17:10-17:55 | **SS3**<br>Water quality of reservoirs: monitoring tools and challenges for the future<br>17:10-17:55 | **Workshop**<br>Ecosystems and environmental responsibility during COVID 2019<br>17:10-17:55 | |
| BREAK | | | | | | |
| 18:05 | **Best Thesis Award Conference**<br>18:05-19:05<br>Nicolás Valiente Parra | | | | | |
| BREAK | | | | | | |
| 19:15 | **AIL-Young Assembly**<br>19:15-20:15 | | | | | |
| BREAK | | | | | | |
| 20:30 | **Cine-Forum**<br>Versión Original del Segura: reservas naturales fluviales de la cuenca del río Segura<br>20:30-21:35 | | | | | |

Times are expressed in Spanish local time (CEST Central European Summer Time)

## 29th October 2020

| | ROOM 1 | ROOM 2 | ROOM 3 | ROOM 4 | ROOM 5 | ROOM 6 |
|---|---|---|---|---|---|---|
| 16:00 | **Lifetime Achievement Award Conference**<br><br>16:00-17:00<br>Narcís Prat i Fornells | | | | | |
| BREAK | | | | | | |
| 17:10 | **Gender & Science Session**<br><br>17:10-18:10 | | | | | |
| BREAK | | | | | | |
| 18:20 | **AIL Assembly**<br><br>18:20-19:20 | | | | | |
| BREAK | | | | | | |
| 19:30 | **Awards and Closing Ceremony**<br><br>19:30-21:10 | | | | | |

Times are expressed in Spanish local time (CEST Central European Summer Time)

# The obscure part of science

**Dr. Andrea García Bravo**

Friday, October 23rd
16:00h Spanish / 17:00h Portuguese time

**Workshop**
**online format**

In the framework of the 2020 Limnology congress (Murcia), the J-AIL has organized this free workshop to discuss the difficulties that they may encounter along their scientific career and come up with strategies to overcome failures and unsuccessfulness.

The workshop will be a sharing platform, where everyone will be able to intervene, and the ultimate goal is for young researchers to leave more motivated to face a research career.

URBIFUN

# Urbanization effects on the relationship between microbial biodiversity and ecosystem functioning

Winning project in the 3rd call for the Collaborative Research Projects for young AIL-members

**Míriam Colls & Ferran Romero**
INSTITUT CATALÀ DE RECERCA DE L'AIGUA (ICRA).

## Project

More than a half of the global current population lives in urban areas, and this figure is expected to increase in the near future. Urban areas are largely recognized as a source of stress for surrounding water bodies, such as rivers and streams, upon which they exert negative effects including habitat and biodiversity alteration, and decreased water quality. Despite the recognized impact of urbanization in water bodies (the so-called urban stream syndrome), a knowledge gap is still to be filled concerning its effects on biodiversity-ecosystem functioning relationships and its impact on ecosystem services. While river ecosystem functions, (i.e. community respiration (R) and primary production (P)) are well recognized as regulators of key energy and matter fluxes, it is still unknown the effects of urban areas on P:R balances. Also, microbial organisms play a crucial role on energy and matter fluxes (e.g. nutrient spiralling and pollutant transformation), but methodological constraints have driven scientific community's attention towards the study of other organisms, including invertebrates and macrophytes. We here aim at studying the effects of an urbanization gradient by means of ecosystem functioning (i.e. P-R ratios) and microbial biodiversity measures (i.e. high-throughput sequencing). To that purpose, 77 young researchers (i.e. Ph.D. students and early Postdocs) assembled within >15 teams and located in Spain, Portugal and beyond will simultaneously participate in a sampling campaign scheduled for 2021 in which 60 urban rivers will be sampled. We hypothesize that the degree of urbanization will condition microbial biodiversity, and that this will translate into reduced P:R ratios across the gradient.

Jóvenes AIL Jovens AIL

# Awards for best poster and oral presentations by students

## Best Oral Communication (Transmitting Science Award)

The winner will obtain a free course inscription (https://www.transmittingscience.org/) and a prize of 125 euros sponsored by the Iberian Association of Ecology (SIBECOL)

## Best Poster Communication (Quercus Award)

The winner will obtain a free one year journal subscription (https://www.revistaquercus.es/) and a prize of 125 euros sponsored by the Iberian Association of Ecology (SIBECOL)

The second and third place for both modalities will be recognized with a distinctive diploma.

Students who wish to compete for these awards must expressly indicate it when they submit their communications.

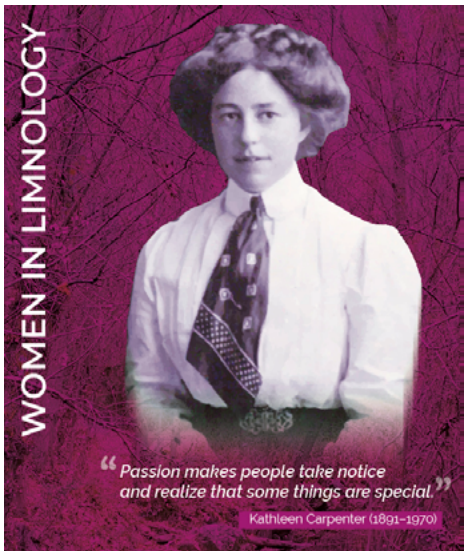
## Sibecol award to the best interdisciplinary talk

Real world problems rarely regard disciplinary boundaries. To promote interdisciplinarity, this award will be allocated to the best talk illustrating research that reflects the integrated nature of ecological issues and thus that combine disciplines and/or methods in order to provide responses to a key scientific question.

Each oral communica¬tion will be evaluated by a commission of researchers from SIBECOL who will score, style, content and originality, but mostly the interdisciplinarity. The talk should reveal that the research integrates several disciplines within the limnology. For example, the combination of different techniques or approaches to demonstrate a hypothesis will be a key point in the evaluation. Also, studies considering interactions or comparisons between freshwater and terrestrial or marine systems will also evaluated positively

This award is addressed to early career researchers: Be a master, doctoral and postdoctoral researchers with less 6 years of post-doctoral experience (since the PhD defense).

The prize is 200 euros sponsored by the Iberian Association of Ecology (SIBECOL)




# Gender & Science AIL Session

**Thursday, October 29th**
17:10h Spanish local time (CEST)

This session is organized by **Xavier Benito**, **Nuria Catalán**, **Anna Lupon**, **Ada Pastor**, **Pablo Rodriguez-Lozano** and **María Mar Sánchez-Montoya** (members of Gender and Science group of AIL).

This group was launched in 2014 with the aim of acting as an external observer of gender biases within the AIL, fostering women's visibility within the scientific community and proposing recommendations for improving gender equality in institutions related with limnology.

The group is constituted by AIL members and external collaborators that on a temporary or permanent basis to some of our projects. Since 2014, the group has conducted different projects, such as a study assessing the situation of women in Limnology "Women in Limnology in the Iberian Peninsula: Biases, Barriers and Recommendations" and the exhibition"Women in Limnology", inaugurated in Coimbra in 2018.

The female presence in Limnology has become more noticeable nowadays. However, the female presence decreases at higher stages of their career, as in other scientific fields. Conferences provide researchers the opportunity to disseminate their project results and build networks. However, these chances are rarely distributed equally between women and men.

This session will analyze and debate the involvement and visibility of women in scientific conferences. We will show the first results of a study carried out during the first meeting of the Iberian Ecological Society (SIBECOL) in 2019, which analyzed demographics, the questing-asking behavior, and the attendants' perception from a gender perspective. Besides, based on results we will elaborate guidelines to reduce gender barriers during meetings, and in particular in AIL congresses.

In this session, four introductory videos available online will be presented, to later address the following aspects in a live session:

1. To analyze Science from a feminist and anti-colonial perspectives that takes into account not only gender as an aspect typical of people but also as a encoded in cultural and knowledge systems, thanks to the presentation by researcher Irene Iniesta-Arandia (Universitat Autònoma de Barcelona).

2. To know current activities carried out by the AIL Gender and Science group (see presentation "Projects and Activities Gender & Science AIL").

3. To delve into the exhibition "Women in Limnology", knowing its journey during the last two years.

4. To analyze and debate on the participation and visibility of women during scientific conferences. The results obtained in the study carried out during the first congress of the Iberian Society of Ecology (SIBECOL) in 2019 will be presented, in which the gender statistics of the attendees are analyzed, as well as their participation and perception of gender barriers ( see presentation "Towards gender inclusive conferences: Insights from the first SIBECOL meeting"). In addition, recommendations and proposals to reduce gender barriers will be noted during scientific congresses and in particular for events organized by the AIL.

Gender & Science AIL group encourage all AIL2020 attendees to participate, sharing their experience and opinions with us using the hashtag #GenderScienceAIL2020. It is the responsibility of all of us to promote our association, promoting inclusive meetings where all have equal opportunities.

# Cultural activities

**OPENING CEREMONY**

**October 26;** 16:00h Spanish local time

## Performance by the Cuadrilla de Tallante y Las Palas.

This association is a traditional music group from Tallante and Las Palas villages (Cartagena, Murcia). Their typical landscape, such as Cañar and Valdelentisco streams (ramblas), were important commercial and resource supply areas for these towns, in which these traditional music groups keep visiting and revitalising with their music.

Traditionally their instruments are guitars, lutes, bandurrias, violins and different autochthonous varieties of chordophones (such as the guitar), accompanied by the rhythmic percussion of cymbals and tambourines, with some simpler ones such as bottle, mortar or castanet. The main piece of performance is the Christmas box to which the Tallante crew exclusively dedicates itself.

The malagueña and the jota complete the dance repertoire of the group. The Cuadrilla de Las Palas plays the “pascua palera”, the “jota of Fuente Álamo”, “malagueña por arriba” and “malagueña por abajo”, “sones de misa” (instrumental) and various popular pieces such as “La Ferroviaria” and “Clavelitos”.

Cuadrilla de Tallante

**October 28;** 20:30h Spanish local time

JAVIER MURCIA

## Cine-Forum: "Versión Original del Segura: reservas naturales fluviales de la cuenca del río Segura"

This documentary (34 minutes) aims at showing different aspects of the river ecosystems together with the causes that threaten their biological integrity by means of an explanatory tour of the Rivers Segura, Zumeta, Tus and Chícamo. This was made by COLUMBARES Association, in collaboration with others, which is a non-governmental organization that develops projects whose objective is to help groups in a situation of inequality as well as the conservation of the environment.

Guest speakers for the debate, are:

**Paz Parrondo Celdrán**: biologist and coordinator of nature conservation and environmental protection projects at the Colombares Association.

**David Verdiell Cubedo**: doctor in biology, specialist in animal diversity associated with mediterranean aquatic ecosystems. He is a research collaborator at the Institute of Aquatic Ecology at the University of Girona.

**Javier Murcia Requena**: underwater photographer and naturalist. He is the author of several books and numerous articles on aquatic biodiversity.

Asociación Columbares

**CLOSING CEREMONY**

**October 29;** 20:00h Spanish local time.


## Live stream concert by Sara Zamora & Juan Tae (Murcia, Spain)

Sara Zamora has just released her latest album entitled "Do It", with ten own songs, a big band and string section. You can listen to it on all social networks, Spotify or www.sarazamorajazz.com.

For this occasion, she brings us an acoustic show in which they will play one of the songs from her album. The rest of the repertoire will be a walk through the hits of divas and artists of soul, jazz and classics and contemporary standards. She will be accompanied by the guitar of the musician and producer Juan Tae (El Niño de Mula). He has played with artists such as Funambulista, El Kanka and currently he is the bass guitarist of the group Varry Brava.

www.sarazamorajazz.com

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# RS1

# Microbial ecology

## Changes in periphyton communities with land use in tropical mountain streams from Loja (Ecuador)

**Cartuche A**, Manoylov K, Ibelings BW & Venail P

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Tropical high-altitude lakes are vital freshwater reservoirs in the Andean regions. They are heavily threatened by human activities that may alter their functioning and hamper the provisioning of key ecosystem services such as water supply. Despite their ecological and social relevance, we know little about these waterbodies, especially regarding the factors influencing their functioning. Here, we explored the links between several environmental variables and phytoplankton productivity, measured as chlorophyll-a concentration and total phytoplankton biovolume. For this, we sampled twenty-four tropical high-altitude lakes located over three-thousand meters above sea level in Southern Ecuador. We found that four abiotic factors combined explained 76% of the variation in chlorophyll-a concentration amongst lakes. Contrary to what studies from temperate regions suggest, taxa richness was not related to either chlorophyll-a concentrations or total phytoplankton biovolume. Moreover, phytoplankton biovolume diversity was negatively correlated to both chlorophyll-a concentrations and total phytoplankton biovolume. This was due to a very uneven distribution of productivity amongst taxa in the more productive lakes. To the best of our knowledge, this is the first attempt to explore the determinants of phytoplankton functioning in tropical high-altitude lakes. We hope that this study will help to establish a baseline for evaluating the consequences of human activities in the ecology and functioning of this vital but fragile ecosystem. Our results suggest that by modifying the abiotic and biotic parameters of tropical high-altitude lakes, human activities can indirectly impact their functioning and their capacity to provide vital ecosystem services.

## Changes in aquatic and sediment prokaryotic communities along environmental gradients in Spanish saline lakes as revealed by 16S rRNA gene amplicon Illumina NGS

**Miralles-Lorenzo J**[1], Picazo A[1], Rochera C[1], Morant D[1], Casamayor EO[2], Menéndez-Serra M[2] & Camacho A[1]

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In this study, we analysed the prokaryotic communities inhabiting the water and sediment of 15 lakes along a salinity gradient, as well as their seasonal changes, by 16S rRNA gene amplicon sequencing. We selected different typologies of saline lakes, from lower salinity bicarbonate-sodium lakes to hypersaline lakes. The analysis of the sequences provided over 10000 Zero-Radius Operational Taxonomic Units (ZOTUs) (i.e. 100% similarity). Water and sediment showed different patterns. Water bacterial communities were less diverse and showed high variations along seasons, while sediment bacterial communities were temporally more stable and presented a higher richness. On the other hand, water bacterial communities were mainly influenced by the salinity gradient, but sediment bacterial communities were also affected by factors other than salinity, especially by avian and human impacts. Archaeal sediment assemblages were also affected by salinity, showing a lower abundance of methanogens as salinity increased. Also, the relatively high abundances of sulphate-reducing bacteria in these saline lakes suggested a strong competition with methanogens for the anaerobic degradation of organic matter. Our study shows the different adaptive responses of bacterial and archaeal communities to salinity and provides useful information on the potential shifts in the microbial communities and its carbon metabolism due to climate change in saline ecosystems.

## Metagenomic freshwater picocyanobacterial variability and metabolic adaptations to environmental factors. Light and salinity gradients.

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Studies on metagenomics of freshwater picocyanobacteria are scarce and only few freshwater strains have been thoroughly studied. To partially counteract this gap, we have obtained the metagenome assembled genomes from seven abundant picocyanobacteria from different freshwater ecosystems from Spain and Mexico. Most of them have a worldwide distribution and are affiliated inside new clades, comprising marine, brackish, euryhaline and freshwater species. Genomes varied significantly in size depending on the trophic status. Moreover, specific genes associated with niche adaptations occurred in all the strains. So far, we have found genes related with photosynthetic pigments biosynthetic pathways for light adaptation, specific sulfate transporters, nitrate/nitrite reductases, nitrogenase nif genes, or phage defense systems. In these strains there is a genomic pool mainly related with the adaptation to environmental gradients of salinity and light, thus allowing these strains to occupy different ecological niches. To better describe this hypothesis of a high ecological versatility in freshwater picocyanobacteria, we performed a cross-factorial experiment carried out with the seven strains, consisting on three levels of light (low, medium and high) and ten levels of salinity, from freshwater (0.6 g/l) to hypersalinity (50 g/l). For each strain we monitored growth rates, activity, phase of cell cycle, and the fluorimetric concentration of main photosynthetic pigments such as chlorophyll, phycocyanin and phycoerythrin. The results show how the genetic variability of freshwater picocyanobacteria provides the different strains a metabolic versatility that allows them to adapt to different ecological niches defined by the environmental gradients of light and salinity.

## Antimicrobial resistance in aeromonads isolated from a tributary of River Douro (Portugal)

**Saavedra MJ**[1,2,3], Fernandes C[4], Gomes S[2], Monteiro SM[2], Cabecinha E[2], Teixeira A[4] & Varandas S[2]

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The inappropriate use of antibiotics, one of the causes for high incidence of antimicrobial resistant bacteria isolated from aquatic environments, represents a danger for aquatic organisms and human health. Humans acquire the Gram-negative bacilli (*Aeromonas* genus), inhabitants of aquatic environments, from a wide range of food, water sources as well as during aquatic recreational activities. This study aimed to determine the antimicrobial resistance rates among riverine *Aeromonas* spp., taken as representative of the autochthonous flora, in order to evaluate the level of antibacterial resistance in Tua River (Douro basin), and the potential risk that it represents. The prevalence and degree of antibiotic resistance was examined using motile aeromonads as indicator bacteria. Samples were collected in the middle sector of the river, the most impacted by human activities. Four water samples were collected and plated on an *aeromonas*-selective agar with and without antibiotics. From each plate, one colony was screened for presumptive motile aeromonads and tested for antibiotic susceptibility. The activity of 19 antibiotics was studied against 30 strains of *Aeromonas* spp. using the standard agar dilution susceptibility test. Antibiotic resistance frequencies were: nalidixic acid 60%, tetracycline 13%, fosfomycin 83%, tobramycin 27% and cotrimoxazole 27%, cefotaxime 40%, chloramphenicol 17%, gentamicin 27%. Some of the nalidixic acid-resistant strains were susceptible to fluoroquinolones. Multiple resistance was also observed. Aquatic environments may provide an ideal setting for the acquisition and dissemination of antibiotic resistance because they are frequently impacted by anthropogenic activities. The potential risk for resistant bacteria to spread/transmit infection to humans and animals should be considered.

## Drying intensity and duration regulate river sediment microbial structure and function

**Schreckinger J**[1], Mutz M[1], Mendoza-Lera C[1,2] & Frossard A[3]

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[3] Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), Birmensdorf, Switzerland

Extreme and prolonged summer droughts, such as in 2018 in central Europe, can cause perennial reaches to become temporary. As consequences of climate change and anthropogenic water withdrawal, climate projections expect this phenomenon to be more frequent, extended, and covering larger areas in the future. To understand the impact of drought on sediment microbial community structure and functions, we applied various drying scenarios to sandy sediments from a temperate river (Spree river, Germany). Sediment with high and low organic matter content were exposed to 90 days under: i) severe (no artificial rain and no shade) , ii) intermediate (artificial rain but no shade) or iii) mild (artificial rain and shade) drying conditions in outdoor mesocosms. The dynamics of seven extracellular enzyme activities and the bacterial and fungal composition were followed throughout the experiment. Enzyme activities showed different patterns with drying duration and intensity; for instance, the activity of the leucine-aminopeptidase declined with drying duration, whereas the one of β-xylosidase showed a strong increase after 90 days of drying. Both drying intensity and duration as well as sediment organic matter content affected sediment bacterial and fungal community structure, beta-diversity and abundance. Interestingly, OTUs from the bacterial class Bacilli, not present in submerged sediments, were dominant after 90 days of drying. Our findings revealed a strong impacts of drought on stream sediment microbial structure and functions, with potential large consequences on biogeochemical dynamics of recent non-perennial temperate rivers.

POSTER

## Hydrological variations shape genomic and diversity responses of streambed microbes

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Microbiota inhabiting the intermittent streambeds mediates several in-stream processes that are essential for ecosystem function. Reduced stream discharge caused by the strengthened intermittency and increased duration of the dry phase is a spreading global response to changes in climate. Here, the impacts of a 5-month desiccation, one-week rewetting and punctual storms, which interrupted the dry period, were examined. The genomic composition of total (DNA) and active (RNA) diversity, and the community level physiological profiles (CLPP) were considered as proxies for functional diversity to describe both prokaryotes and eukaryotes inhabiting the surface and hyporheic streambeds. RNA expression showed the strongest relationship with the environmental conditions and resource acquisition, being more responsive to changing conditions compared to DNA diversity, especially in the case of prokaryotes. The DNA results reflected the legacy of the treatments because inactive, dormant, or dead cells were included, suggesting a slow microbial biomass turnover of responses of the microbial communities to changes mainly through physiological acclimation. The data highlight the need to improve the functional assessment of stream ecosystem with the application of complementary metrics to describe the streambed microbial dynamics under dry-wet stress.

# RS2

# Population and community ecology

## Evaluation of the diversity of aquatic invertebrates in temporary ponds: comparison between the active community and the egg bank

**Bisquert-Ribes M**[1], Martínez A[2], Castillo-Escrivà A[2], Gálvez Á[2], Iepure S[2], de Manuel B[2], Marinho M[3], Martins F[3], Olmo C[2], Armengol X[2] & Mesquita-Joanes F[2]

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Temporary ponds are aquatic ecosystems characterized by an alternation between a period with water and a period of drought. Many aquatic invertebrates have a state of dormancy during the unfavorable period. They produce resting stages that remain in the sediment of the pond and build up the egg bank. When the favorable season returns, these resting stages hatch and the community is restored. This study tries to evaluate the diversity (alpha, beta and gamma) of these ecosystems by comparing the invertebrate (rotifer and crustacean) community of the water column (active), sampled once, with the egg bank of the sediment, of 32 Mediterranean temporary ponds by carrying out a hatching experiment. We also want to determine the similarity between both communities. The results show a certain overlap between both datasets, although some taxa were observed in only one of them. A PERMANOVA analysis shows that the two metacommunities are statistically different, and according to SIMPER analysis, 10 taxa explain almost 50% of the differences between both. Beta diversity (Sorensen index=0.86±0.10) indicates high differences between ponds in the active and the egg bank communities. Alfa diversity is lower in the active (S=8.69±6.10) compared to the egg bank community (S=10.55±5.70), and the gamma diversity Chao2 index also shows a higher value estimated for the egg bank (Chao2=156.1±26.5) than for the active community (Chao2=111.7±11.3), maybe related to temporal accumulation of species in the experiment. This study shows the potential of temporary ponds to maintain a high biodiversity and of hatching experiments to uncover it.

## Dinámica temporal y espacial de los grupos funcionales del fitoplancton establecidos mediante el sistema de Reynolds et al. (2002) en un embalse tropical colombiano

Gil-Guarín IC, **Villabona-González SL** & Ríos-Pulgarín MI

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Se determinó la variación temporal y espacial (horizontal y vertical) de biomasa de los grupos funcionales propuestos por Reynolds *et al.* (2002) y su relación con variables físicas y químicas en el embalse El Peñol-Guatapé. Entre agosto y diciembre de 2014 se realizaron muestreos quincenales de variables físicas y químicas y fitoplancton en subsuperficie y al 1% de extinción de luz en cinco sitios de muestreo. Mediante análisis univariados se estableció significancia estadística de las diferencias entre campañas, sitios y profundidades y mediante multivariados se analizó la relación biomasa fitoplancton y variables abióticas. Se determinaron siete grupos funcionales: F (*Botryococcus braunni*, *Oocystis* cf. *lacustris*), Lm (*Ceratium furcoides* y *Microcystis wesenbergii*), Lo (*Chroococcus minutus*, *Peridinium gatunense* y un organismo perteneciente al Orden Peridiniales), P (*Staurastrum rotula*) S1 (*Oscillatoria limosa*), Y (*Cryptomonas* sp) y "Sin" (diatomea Central). Dichos grupos respondieron al periodo hídrológico por su influencia en el nivel del embalse, y porque la disminución del tiempo de residencia influyò significativamente en la transparencia, la permanencia de nutrientes en la columna de agua, la estratificación térmica y los procesos de mezcla. La mayoría de grupos funcionales no se restringieron a una zona particular del embalse debido a que pueden tolerar un amplio rango de condiciones ambientales y sus respuestas frente a las características del embalse son muy efectivas. Debido a que los grupos presentan estrategias para desplazarse en la columna de agua, su distribución no se asoció a ninguno de los estratos analizados.

## Interactive effects of water diversion and pollution on stream biological communities

**de Guzman I**[1], Blanco M[2], González JM[3], Larrañaga A[1], Pérez-Calpe AV[1], von Schiller D[3] & Elosegi A[1]

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Water diversion for hydropower alters stream hydrology, reduces the area of benthic habitats and affects both stream communities and ecosystem functioning. Pollution, another common stressor, can interact with water diversion thus affecting stream ecosystems. We assessed the effects of water diversion, pollution and their interaction on stream biological communities. We selected 4 streams with a different level of contamination and affected by water diversion, and compared their by-passed reaches with control reaches above diversion weirs. Macroinvertebrate density and richness decreased with water diversion at the most polluted stream but not at the least polluted ones, where the values remained similar above and below the weirs, thus showing a synergistic interaction between diversion and pollution. Fish density showed patterns opposite to invertebrate density, suggesting a strong top-down control. Our results indicate that diversion schemes should consider the pollution status to allocate environmental flows.

## Interacción trófica entre las comunidades Bentónicas y la ictiofauna y su relación con la variabilidad ambiental en ríos de los Andes centrales colombianos

Henao-Lopera V, Henao-Henao MA, Cardoso-Gaviria A & **Ríos-Pulgarín MI**

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La variabilidad en la estructura de las comunidades acuáticas se atribuye frecuentemente a cambios ambientales, no obstante, la oferta de ficoperifiton como fuente directa de energía para macroinvertebrados e indirecta para peces, podría ser un factor clave en esta variabilidad. Se analizaron datos ambientales y biológicos recolectados en muestreos trimestrales realizados entre 2014-2018 en tres ríos de los Andes centrales (Antioquía - Colombia), con el objetivo de determinar el efecto de los cambios ambientales sobre las comunidades ficoperifiticas y su relación con los cambios en las comunidades de macroinvertebrados y peces. Mediante análisis de regresión múltiple con particionamiento jerárquico se estableció el efecto de las diferentes variables fisicoquímicas sobre las comunidades biológícas. Se encontró que las algas son influenciadas positivamente por la temperatura y negativamente por los nitratos, pero es la presencia de organismos ETP (Ephemeroptera, Trichoptera y Plecoptera), quien tiene mayor influencia sobre la densidad perifítica y viceversa, mientras que la densidad de peces no tiene un efecto reconocible ($p<0.01548$, $r^2= 0.8108$). Respecto a la abundancia íctica, se encontró que SST y OD son las variables de mayor efecto sobre la comunidad ($p<0.02613$, $r^2=0.7857$). Sin embargo, su diversidad obedece tanto a los SST y el pH, como a la abundancia de macroinvertebrados ($p<0.002985$, $r^2=0.9246$). Los cambios en la abundancia y diversidad de estas comunidades acuáticas en los ríos analizados no siempre corresponden a variaciones en las propiedades físicas y químicas del agua, sino que en muchos casos inicialmente obedecen a la oferta de recursos tróficos del sistema.

## Paleoecological changes in thecamoebian populations coupled to the evolution of the Doniños coastal lake (NW Iberian Peninsula)

**Pontevedra-Pombal X**[1], Carballeira R[2], Guinarte R[1], Castro D[1], Souto M[3], Hernández A[4], Raposeiro PM[3], Sáez A[5] & Bao R[2]

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The camoebians are ubiquitous microorganisms in aquatic ecosystems with a characteristic theca that is very resistant to physicochemical degradation; thus, they are incorporated into paleoecological records, providing valuable information. The Doniños freshwater lake (43° 29.50'' N, 8° 18.70'' W) (4 m a.s.l.) is a coastal back-barrier perched lake with a maximum depth of 11 m, isolated from the sea by a wide sandy barrier. We used a UWITEC® gravity corer to recover the 53-cm long core DON12-3G. A 1 $cm^3$ sample per cm of muddy sediment was extracted to analyze thecamoebians, which were isolated, identified, and quantified. A total of 20 thecamoebian taxa were identified, all of them characteristic of acidic water lakes with pH <6.2 and enriched in organic matter. The fluctuations in thecamoebian abundance and composition defined three phases of paleoecological changes in the evolution of the lake (ZCT) in the last 2000 years: ZCT1, dominated by *Difflugia elegans*, *Netzelia oviformis*, and *Trinema enchelys*; ZCT2, dominated by *Arcella areanaria*, *Centropyxis aculeata*, and *Centropyxis elongata*; and ZCT3, dominated by *Difflugia oblonga* and *Trinema enchelys*. In the first phase, in ZCT1, Doniños was a freshwater body with thecamoebian communities linked to terrigenous particulate sediment. Later, a catastrophic process permeated the dune barrier, allowing for marine intrusion, and freshwater thecamoebians suffered a strong impact, marked in ZCT2 by the predominance of eurioic and tolerant species. Subsequently, in ZCT3, thecamoebian communities indicate a restoration of the lake's freshwater conditions, although with a greater dominance of species associated with aquatic plants.

## Alternancias en la especie dominante del zooplancton en marismas ¿Siguen el modelo de los estados estables alternativos?

**Quintana XD**, Antón-Pardo M, Bas-Silvestre M, Boix D, Compte J, Cunilllera-Montcusí D, Gascón S, Tornero I & Sala J

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El zooplancton en las lagunas costeras confinadas de las marismas de La Pletera (humedales de Baix Ter, Girona) están dominados por dos especies, un copépodo calanoide (*Eurytemora velox*) y un rotífero (*Brachionus plicatilis*). Ambas se alternan como especies dominantes (más del 80% de la biomasa total de zooplancton), siendo la primera dominante en invierno y la segunda en verano. Aunque el cambio entre *Eurytemora* y *Brachionus* parece estar correlacionado con la temperatura, otros factores también relacionados con la temperatura, como el estado trófico o la producción primaria y la respiración pueden desempeñar un papel importante. A partir de mediciones de sensores de oxígeno de alta frecuencia instalados *in situ* analizamos si los cambios en la composición del zooplancton están determinados por un umbral en las variables ambientales o, por el contrario, existe cierta inercia al cambio entre estados estables tal como predice la hipótesis de los estados estables alternativos. Nuestros resultados muestran que los cambios entre las especies dominantes de zooplancton en las marismas de La Pletera parecen ser asimétricos. El cambio a una situación de *Eurytemora* se debe principalmente a una disminución de la temperatura del agua, con un umbral de 19ºC de temperatura media diaria. La disminución de la temperatura suele estar acompañada de una menor oscilación de la concentración de oxígeno, con valores siempre cercanos al 100% de saturación. Por el contrario, parece darse cierta resistencia al cambio a una situación de *Brachionus* aunque se superen los mencionados valores umbrales.

# The importance of basic biological studies to define good ecological and physiological status of freshwater bivalves

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Due to their sensitivity and dramatic declines, freshwater mussels are prime targets for conservation. Species recently described or recognized as valid are of particular concern due to the basic knowledge. An example is the recently recognized and Near Threatened freshwater mussel *Unio delphinus* Spengler, 1793, endemic from western Iberian Peninsula, has suffered marked population declines. To overcome information gaps for *U. delphinus*, a holistic biologic study was carried out across species range, aiming to: i) estimating the occupancy area (AOO) and occurrence extent (EOO) based on literature and recent surveys; ii) estimate growth patterns from biometrical measurements; iii) estimating sex ratios from gonad biopsies; iv) estimating gametogenesis and sex ratio through histological examination of gonad/gill tissues (from a single population); and v) to determine host species from infestation trials of glochidia with co-occurring fish species. The estimates (EOO of 706 $km^2$ and AOO of 61 $km^2$), together with data on declines assigns the species to the Endangered category using IUCN criteria. *U. delphinus* was found to grow faster and to be shorter-lived than other European freshwater mussels. Growth and life span are similar across the range in lotic habitats, but different in lentic habitats. The larvae of *U. delphinus* may attach to most co-occurring fish species, but only native species were effective hosts. The information provided contributes to a better conservation status assessment, selection of conservation and rehabilitation areas, guidance for the establishment of propagation programs and the better timing for specimens manipulation including monitoring and possible translocations.

## Estructura de comunidades planctónicas y su relación con la calidad de agua en embalses andinos colombianos

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En seis embalses de la zona andina colombiana con diferente estado trófico (Amaní, Guatapé, Porce ll, Porce lll, Punchiná y San Lorenzo) se realizó un estudio para evaluar la estructura de las comunidades planctónicas y su relación con la calidad de agua, utilizando información secundaria levantada entre los años 2010 a 2015. Se calcularon los índices de diversidad verdadera de especies, se emplearon análisis de varianza y de Kruskal y Wallis para evaluar diferencias en espacio y tiempo de la estructura planctónica y se corrieron análisis de discriminantes para evaluar la relación de la densidad planctónica con la calidad del agua. La riqueza total del fitoplancton fue de 15 clases pertenecientes a las divisiones Bacillariophyta, Charophyta, Chlorophyta, Cryptophyta, Cyanobacteria, Euglenophyta, Miozoa y Ochrophyta. Se encontraron 47 géneros del zooplancton distribuidos en cladóceros, copépodos, ostrácodos, protozoarios y rotíferos. La composición planctónica fue diferente entre los embalses analizados y la densidad total de ambas comunidades fue significativamente mayor en los embalses de mayor estado trófico. La densidad de las clases y géneros de zooplancton de acuerdo con sus rangos de tolerancia mostraron una respuesta diferencial asociada principalmente al estado trófico, la conductividad eléctrica y la concentración de nutrientes. En general, las comunidades planctónicas respondieron más a variaciones en la calidad del agua entre los embalses que a las establecidas en las temporadas climáticas, probablemente porque en sistemas embalsados prima la variación temporal generada por el control hidráulico de la generación.

POSTER

## Study of the dynamics of recolonization of Mediterranean temporary ponds from the egg bank

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The invertebrate organisms that live in temporary ponds are strongly affected by hydroperiod, especially by drought stress during the dry season. Many of these organisms present diapausing stages in their life cycles to overcome this period, usually as drought-resistant eggs that are stored in the sediment, building the egg bank. These resting stages hatch when the favorable period returns, and the community gets restored. We carried out a hatching experiment using sediment from 32 Mediterranean temporary ponds to study the hatching dynamics of invertebrate (rotifer and crustacean) diapausing eggs in order to better understand how the community reassembles after dry periods. We analyze the emergency patterns for each of the 86 species that make up the egg bank of this pond metacommunity, and calculate the index for timing of hatching (ITH), showing general emergency patterns for the large groups. The first group to hatch is the Anostraca (approx. 5 days after the beginning of the experiment). Planktonic groups (rotifers and crustaceans) vary between 12 and 15 days to hatch, while littoral or benthic species usually appear later on (approx. 20 days after the beginning of the experiment). This may be related to the fast-initial exploitation of planktonic resources by some species, which in this way avoid predation by slower-growing taxa, while other species' strategies consist in using the delayed growth of submerged vegetation for protection from predators in the littoral habitat.

POSTER

## An unusual infestation of *Cybister larvae* (Coleoptera) by *Hydrachna* water mite larvae

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Water mites (Acari: Hydrachnidia) are the third more biodiverse group of freshwater invertebrates. In their life cycle, they have three active stages, of which the larvae of many species are known to be ectoparasites of freshwater insects: Plecoptera, Odonata, Hemiptera, Trichoptera, Coleoptera and Diptera. *Hydrachna* water mite is a genus inhabiting lentic water bodies that frequently parasites aquatic Hemiptera and Coleoptera.

In this work, we report the unusual heavy infestation of *Cybister* Coleoptera larvae by *Hydrachna* larvae in Doñana, SW Spain. Between 6 and 73 individual larvae were found in ten specimens of *Cybister*. This is not usual, as *Hydrachna* larvae usually parasitize adult Coleoptera, especially below the elytra. Consistently with this, the ecto-parasites impose significant fitness and immunological costs to aquatic insects and besides their action often damages external host appearance.

Identification of the early life cycle stages of these organisms is problematic using only morphological characters, and we have complemented morphological data with mtDNA sequences (so called 'molecular barcodes") for the *Cybister* and *Hydrachna* larvae.

The goals of this study is to describe this unusual infestation as first evidence and report this new host parasite association besides evaluate the potential role of immune function (measured as phenoloxidase activity) to understand the effects of parasitism on larvae diving beetles.

POSTER

## Experimental evaluation of biodiversity response to dispersal barriers and patch productivity in Mediterranean streams

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Diversity at the local scale is determined by different, and often interacting, factors. One factor that is suggested to be important in determining community structure is productivity, which has several relationships with diversity. Moreover, the concept of metacommunity considers the importance in the way in which several communities are linked through dispersion. Here, we experimentally assess, creating at reach scale a study system that resembles a metacommunity, how productivity (measured as algae biomass) and dispersal barriers drive diversity at local scale in Mediterranean stream. We found that higher productivity promotes a saturating relationship with taxa richness, density of individuals and diversity. However, we did not detect an effect of the dispersal barriers on the responses. Thus, our results show that, at the local scale, patch productivity plays a more important role in determining the structure of the community and the colonization process than dispersal barriers. In the framework of metacommunity theory, our study system can be explained by combining assumptions of the "Mass-Effects" and the "Species-Sorting" archetypes, supporting a non-exclusive view of these hypotheses.

POSTER

## Diversidad de invertebrados asociados a macrófitas sumergidas en relación con la dimensión fractal de las plantas

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Estudiamos la relación entre la arquitectura de macrófitas sumergidas y la estructura de las comunidades de invertebrados asociados a ellas en un arroyo de llanura. Se tomaron muestras de las macrofitas *Ceratophyllum demersum*, *Potamogeton striatus* y *Egeria densa* utilizando redes de cierre corredizo con malla de 180 µm; extrayendo todos los invertebrados, separándolos y fraccionándolos con tamices de 10, 5, 2, 1, 0,5 y 0,2 mm de lado. Para cada fracción registramos número de individuos y peso seco total e identificamos y contamos los invertebrados a nivel de especie. La arquitectura de las plantas se caracterizó mediante su dimensión fractal medida sobre fotografías desde diferentes ángulos usando el método de "conteo de cuadrículas" con grillas desde 1 mm a 1 cm de lado. Las dimensiones fractales medias de las plantas fueron 1,59 (*P. striatus*), 1,75 (*E. densa*) y 1,83 para (*C. demersum*). El tamaño mínimo de la fracción de invertebrados (tamiz) y su biomasa acumulada muestran una relación potencial. Los exponentes que relacionan tamaño y abundancia se correlacionan con las dimensiones fractales de las plantas de forma no lineal. La diversidad de los invertebrados (*H'*) se correlaciona linealmente en forma directa con la dimensión fractal de las plantas ($R^2$ = 0,995). Concluimos que la complejidad de las macrófitas sumergidas determina la diversidad de los invertebrados asociados y su espectro de tamaños y abundancias; en este último caso, los patrones de son influenciados por los efectos de costo metabólico y riesgo de depredación relacionados con el tamaño corporal.

POSTER

## The arrival order may influence on macrophyte competition and distribution in a tropical estuary (Southeastern Brazil)

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The sequence of species colonization and priority effect may drive the plant communities' organization along environmental gradients. We aimed to evaluate whether the arrival order influences on competition between early-colonizing and later-arriving individuals of the emergent macrophytes *Spartina alterniflora* (Poaceae) and *Crinum americanum* (Amaryllidaceae) to understand their distribution in an estuary in southeastern Brazil. We expected that (i) the later-arriving species growth would be limited by the early-colonizing species and (ii) the later-arriving species would not influence on the early-colonizing species growth regardless of sediment type due to the priority effect. We conducted a two factors laboratory experiment (4 arrival orders x 2 sediment types x 5 replicates) lasting 230 days and evaluated the species growth. We used natural sediments with different salinity and nutrient contents. We cultivated adult individuals (>50cm, initial=10) of the two species in monospecific treatments for 123 days. After that, we introduced five young individuals (<50cm) into heterospecific cultures forming mixed cultures and kept monospecific cultures as controls. The plants' growth in the different treatments was compared through the gain of biomass and two-way ANOVA application. The results corroborated our expectations since in both sediment types the later-arriving young individuals of *S. alterniflora* and *C. americanum* did not grow and establish in the cultures of early-colonizing adult individuals. Furthermore, the early-colonizing species growth was not influenced by the presence of the later-arriving young individuals. These results indicate that the arrival order and priority effect may influence on macrophyte assemblages' organization and species distribution in tropical estuaries.

POSTER

# Distribución espacio-temporal de macroinvertebrados bentónicos en un río tropical de alta montaña. Caso de estudio: Microcuenca del río Blanco

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La presente investigación evalúa la distribución espacio-temporal y composición de macroinvertebrados bentónicos en un tramo del río Blanco, Provincia de Tungurahua, Ecuador. La campaña de muestreo se ejecutó en un rango altitudinal comprendido entre los 1.579 hasta los 2.014 m.s.n.m, en 3 temporalidades distintas: agosto (estiaje) y noviembre (precipitación baja) de 2017, y enero de 2018 (precipitación intensa). Se realizó la medición de parámetros fisicoquímicos e hidráulicos en franjas litorales y limnéticas del río. Los parámetros analizados fueron: oxígeno disuelto (OD), % de oxígeno de saturación (ODS), conductividad (S), temperatura (T), pH, turbidez (TU), velocidad de corriente (V), calado (D) y tipo de sustrato (Kv). Se registraron 3 clases distribuidas en 9 órdenes y 27 familias donde, los taxones Helicopsychidae y Perlidae, presentaron las mayores abundancias relativas en concentraciones superiores a 8,0 mg/L (AR>50%). Además, se correlacionó las abundancias relativas de cada familia con las características hidráulicas y parámetros de calidad del agua relevantes de la zona de estudio: oxígeno disuelto, porcentaje de saturación de oxígeno disuelto, conductividad, temperatura, turbidez, pH, velocidad de la corriente, calado y tipo de sustrato. Respecto a los parámetros analizados, se presentó una relación lineal moderada, con una significancia elevada ($\rho<0,05$), con familias como Hydropsychidae [ODS(-), S(+)], Baetidae [T(+), S(-)], Helicopsychidae [V(-)], Leptoceridae [T(-), TU(+)], Chironomidae [S(+)] y Leptophlebiidae [V(-), T(+), OD(-), TU(+)], estableciendo una relación grupo taxa y sus requerimientos físicoquímicos e hidráulicos.

# RS3

# Biodiversity and conservation of aquatic ecosystems

## Bentonic macroinvertebrates and the state of environmental quality of streams of the middle basin of the Nanay River, Loreto, Perú

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Benthic macroinvertebrates are excellent bioindicators of the state of environmental quality of aquatic ecosystems. With the objective of assessing the environmental quality of lotic environments in the Peruvian Amazon, benthic macroinvertebrates were collected from 10 streams distributed in two sampling zones (ZM) in the middle basin of the Nanay River, Loreto, Peru: ZM 1: access road Nanay river (San Pedro, Santa Cruz, Tambishi, Agua Negra and Llanchama), and ZM 2: highway access road (Habanillo, Lindero, Pintuyacu, Tocón and Paujil), between the months of June (high-water season) and September (low-water season) of 2019. A total of 5,183 individuals (2,538 in high-water season and 2,645 in low-water season) were reported, distributed in 5 phylla, 13 classes, 22 orders and 68 families. The ZM 2, presented the greatest abundance of families in both seasons, represented by the Pintuyacu and Llanchama streams. The two sampling areas showed a high dominance of families; Chironomidae being the most dominant family in the streams of the ZM 2, representing 60.83%; while Leptophlebiidae, it was for ZM 1 with 18.62%. The pH, temperature, dissolved oxygen, electrical conductivity, total hardness, chlorine, CO2 and alkalinity showed relatively high values during the low-water period, while nitrite and ammonium showed high presence in the high-water period. According to the biotic index analysis: IBF (Biotic Family Index) and EFA (Efemeroptera, Plecoptera, Trichoptera); streams evaluated are in a state of relatively poor or moderately impacted environmental quality.

## Ecological effects of the largest dam decommissioning so far carried out in the Iberian Peninsula: Enobieta Dam (Artikutza, Navarre)

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As they become obsolete, useless or problematic, more and more dams are being decommissioned worldwide. Taking out weirs or small dams usually benefits river ecosystems, but there is less information on the ecological effects of the decommissioning of large dams. Here we report the effects of the decommissioning of Enobieta Dam (Artikutza, Navarre), a 42-m tall, 70-y old dam creating a 1.6 $Hm^3$ reservoir in a valley otherwise in excellent conservation status. When operating, the dam retained sediments, produced downstream armouring of the streambed, released high concentrations of dissolved metals, emitted large amounts of methane to the atmosphere, impacted downstream invertebrate communities and created a strong barrier effect for fish and for the Pyrenean desman. The dam was emptied slowly for over 1 y to reduce mobilization of the sediments stored and to avoid sedimentation of the Añarbe reservoir, further downstream. Fine sediments were only mobilised in the final phase of reservoir drawdown, and afterwards, when a small, previously submerged weir was demolished. Overall, emptying Enobieta Dam had almost no detrimental effects on the biological communities or ecosystem processes. We observed no fish kill, no changes in invertebrate communities, but biofilm metabolism decreased as a consequence of siltation. The newly formed river channels previously within the reservoir are being colonized swiftly by riverine invertebrates and the emerged sediments show a fast natural re-vegetation. Our results point out that careful management can reduce most of the potential ecological impacts of dam decommissioning and promote fast improvement of conservation status.

## Biogeography and conservation of terrestrial and aquatic molluscs in a semiarid Mediterranean region

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The aquatic ecosystems of Mediterranean regions present high values of biodiversity. However, these environments have been seriously altered by the surrounding land use intensification, the high water demand for irrigated crops or the introduction of exotic species, etc. One key task of ecology and conservation biology is to assign conservation priorities, i.e. to identify those sites that have high biodiversity values and are threatened. To this aim, it is essential to study the distribution patterns of such biodiversity and to evaluate the role of protected areas in its conservation. Here, we compiled a database including all the available bibliographic information, own sampling and data from public and private collections on the presence of continental molluscs (one of the most conspicuous and interesting groups of invertebrates) in the Region of Murcia. On this basis, we aim i) to explore and map the patterns of species richness of both terrestrial and aquatic molluscs; ii) to test the congruence between them especially in the location of the species richest areas, and iii) to assess to what extent the Natura 2000 network is effective in representing these areas. We found 2363 records (805 aquatic and 1558 terrestrial) of 35 species of aquatic and 84 of terrestrial molluscs. We found a positive correlation between the richness of terrestrial and aquatic molluscs, and we identified priority areas for the conservation of both aquatic and terrestrial molluscs, with five coincident areas. In addition, we identified some conservation gaps, i.e. areas that are of crucial concern for the conservation of malacological fauna in the study area that are outside or marginally covered by the Natura 2000 network. This information must be considered to develop management measures addressed to the conservation of the Iberian southeast biodiversity.

## Epibiosis in aquatic macroinvertebrates: preference for basibiont and habitat types

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Epibiosis is a type of interspecific relationship in which a sessile species (epibiont) is fixed to another one that provides support (basibiont). Despite being frequent and well studied in marine ecosystems, epibiosis is poorly known in continental waters. Here, we analysed the relationship between protozoa (epibionts) and aquatic macroinvertebrates (basibionts) to identify the characteristics of both basibionts and habitats that are more favourable for epibionts colonization. We explored the presence and abundance of epibionts in thirty representative samples of macroinvertebrates from different types of habitats and from different areas of the Iberian Peninsula. Epibionts were only detected in crustaceans and insects, being the aquatic beetles the main hosts. The data obtained for this order were statistically tested to determine differences in the presence and abundance of epibionts depending on the family they belong, their size, feeding and locomotion strategies, as well as habitat characteristics (lotic/lenitic, freshwater/saline, natural/altered), respectively. Our results did not show significant differences between families nor in the locomotion and feeding strategies of the basibionts. However, significant differences were found in size, having the larger individuals a greater number of epibionts. Epibionts preferred freshwater rather than saline and well-preserved habitats, regardless of their lotic or lenitic character. This work represents an important advance in the knowledge of epibiosis in continental aquatic ecosystems.

## Evidencias genómicas de los patrones de la evolución adaptativa en copépodos calanoides lacustres

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Presentamos un estudio de genómica poblacional de cuatro poblaciones del copépodo calanoideo *Leptodiaptomus* grupo *sicilis* que habitan lagos ecológicamente contrastantes, El Carmen, somero, temporal y salinidad variable (1-35 g/L), Quechulac, La Preciosa y Atexcac que son profundos, permanentes y salinidad constante (0.4 1.1 y 6.5 g/L, respectivamente). Estas poblaciones están en distintas fases de especiación ecológica, producto de adaptación local a su salinidad, con flujo génico poco probable debido a la inviabilidad de los migrantes y con barreras post-cigóticas entre al menos dos poblaciones. Utilizamos una representación reducida del genoma (genotyping by sequencing; GBS) para evaluar: 1) el grado de divergencia genética intra e interpoblacional, y 2) relacionarla con las diferencias ecológicas entre lagos; 3) el nivel de flujo génico, y 4) reconstruir la historia de colonización. Se filtraron 7,485 SNPs neutrales y 205 atípicos. El índice de diferenciación poblacional ($F_{st}$) fluctuó entre 0.07-0.22 con todos los SNPs, mientras en los SNPs atípicos fue de 0.27-0.54. Se identificaron cuatro grupos genéticamente bien diferenciados, con una probabilidad de migración prácticamente nula. La evidencia total indica que los tres lagos profundos fueron colonizados independientemente desde El Carmen, con ausencia de flujo génico posterior. Nuestros resultados sugieren que la adaptación local a la salinidad en los lagos profundos evolucionó independientemente a partir de un linaje generalista, y que, aunque la salinidad es una barrera efectiva contra el flujo génico, es probable que otros factores ecológicos asociados a la profundidad y permanencia del hábitat hayan contribuido a la alta diferenciación genética de las poblaciones.

## Contribution of different types of artificial ponds to regional biodiversity

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People continuously create artificial ponds for several purposes worldwide. In addition to the services provided for human activities, artificial ponds can provide habitats for supporting freshwater biodiversity. However, the contribution of artificial ponds to regional diversity has been scarcely explored. Here, we evaluated in selected regions of Western Europe (Spain, France, and Switzerland), the relative contribution of five types of artificial ponds to the regional biodiversity of amphibians, water beetles and freshwater snails. Additionally, we compared data between artificial and natural ponds in order to explore whether artificial ponds can buffer the biodiversity decline linked to the vanishing of natural ponds. Our results highlight the key role of artificial ponds to support a part of the biodiversity of the three animal groups at regional scale. Nevertheless, this part of the biodiversity remains moderate, attaining only half of the regional biodiversity. Amphibians benefited more than invertebrates from artificial ponds. Artificial ponds always supported a lower species richness than natural ponds, especially for freshwater snails. Our results will inform management strategies in order to maximize the potential of artificial ponds for supporting freshwater biodiversity in anthropised landscapes, as well as ensuring the conservation of the remaining natural ponds.

POSTER

# Construyendo una cartografía de las lagunas temporales mediterráneas en la España peninsular

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Las lagunas temporales mediterráneas son ecosistemas singulares reconocidos como hábitats prioritarios en la Unión Europea. Son ecosistemas muy sensibles y vulnerables frente a las perturbaciones externas, por lo que requieren una protección adecuada y medidas urgentes de conservación. Las especies de flora y fauna que habitan las lagunas temporales están adaptadas a los ciclos recurrentes de inundación y desecación que las caracterizan. Estas lagunas cobran especial interés en España, ya que es el país que tiene una mayor representación de estos hábitats prioritarios a nivel europeo. Entre los datos básicos que requiere la gestión de su conservación, se echa en falta una cartografía exhaustiva de estos humedales asociada a una base de datos georreferenciados. La escasa información actualmente existente no las contempla de manera exclusiva, sino que incluye una información sin actualizar que debe ser contrastada y completada. Para ello, queremos revisar y unificar la información existente con la ayuda de expertos. La construcción de esta cartografía nos permitirá elaborar una base de datos detallada que recopile los inventarios de las especies de invertebrados acuáticos (macro- y microinvertebrados), anfibios y macrófitos acuáticos, y de las variables físico-químicas disponibles para las mismas. Estos datos nos permitirán caracterizar las lagunas más vulnerables, bien por su alta diversidad, o bien porque careciendo de información de las mismas, resulten hábitats potenciales para especies acuáticas emblemáticas, favoreciendo así la gestión de la conservación de todo el sistema de lagunas temporales en la España peninsular.

POSTER

## Distribution of Trichoptera in the hydrographic network of El Harrach wadi (North-central Algeria)

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Trichoptera is a very diverse group of macroinvertebrates occupying a wide variety of environmental conditions. We studied the distribution of Trichoptera species along 5 stations in the upper part of the El Harrach wadi (north-central Algeria), and their relation to physicochemical variables between 2018 and 2019. We collected 546 individuals corresponding to 6 species which are unevenly distributed between 2 families and 3 genera: *Hydropsyche, Cheumatopsyche* and *Rhyacophila.*

Upstream stations were mainly characterized by high organic matter and high average temperature. At these stations, *Hydropsyche maroccana* was present with an abundance comparable to other stations, together with *H. lobata, H. pellucidula* and *Cheumatopsyche atlantis,* the latter is present only in stations 1 and 2.

The stations 3 and 5 were characterized by a rapid current velocity, a substrate dominated by pebbles, large pebbles and blocks, and a low altitude compared to the other stations. These stations were dominated by *H. resmineda.* At station 5, we also found *Rhyacophila munda,* where the waters have a rapid current velocity. The results of this study show that the most relevant changes in the distribution of Trichoptera along the El Harrach wadi were the quality of the water, the speed of the current velocity, and substrate.

POSTER

## Diversity and spatio-temporal distribution of chironimids (Insecta, Diptera) in Rhumel Wadi (north-east Algeria).

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A survey of Rhumel wadi (North-Eastern Algeria) between July 2016 and April 2017 was conducted in 5 sampling sites located on the main river.. The aim of this study was to analyze the spatio-temporal distribution of Chironomids (Diptera, Chironomidae) and determine their diversity along the stream. Three subfamilies of Chironomidae have been reported; Chironominae (Chironomini) representing the highest abundance with 69,24%. Indeed, they constitute 99.96% of all Chironominae sampled. The presence and abundance of Chironomini in the Rhumel wadi can be explained by the fact that it is particularly rich in organic matter. The latter is essential for the survival of Chironomini. Then, comes the subfamily Orthocladiinae with 30,75%. From 7398 collected larvae, 20 taxa were identified. Assessment of their relationships with several environmental parameters was performed using the Canonical Correspondence Analysis (CCA). Fortunately, the improved conditions observed in spring allowed the presence of a more diversified fauna. In winter, we observed a remarkable decrease in diversity. The highest evenness and diversity of Chironomids larvae were reported in Rh3 (an industrial place named "Zone industrielle 2"), with higher concentrations of organic and/or inorganic pollutants. The majority of taxa found included cosmopolitan species widely distributed along the sampling sites as: *Cricotopus annulator* and *Rheocricotopus* sp. *Chironomus riparius, Polypedilum nubifer* and *Tanytarsus* sp were abundant in the most polluted sites. These three species could be considered as tolerant species since they have the ability to survive in extreme environmental conditions with low dissolved oxygen and high concentrations of pollutants.

POSTER

## Anthropic impact on the distribution of Chironomidae larvae (Diptera: Insecta) in Rhumel wadi (North-East Algeria)

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A study of the composition and abundance of Chironomids and their relationship with physicochemical parameters was conducted on the Rhumel wadi. It is known for its extreme pollution and it is located in urban areas, few kilometres far from the city of Constantine. The objective of the study was to highlight the impact of human activities on the distribution of Chironomidae larvae (Diptera: Insecta) and water quality.. Five localities were seasonally sampled between July 2016 and April 2017. From 7398 collected larvae, 20 Chironomids taxa were identified using Epler's identification keys. The species richness of the Rhumel wadi varies from 6 to 12 depending of the natural condition of the localities sampled. The richness increased when decreased anthropogenic impacts. Assessment of their relationships with several environmental parameters was performed using the Canonical Correspondence Analysis (CCA). *Eukieferiella claripennis* and *Cricotopus sylvestris*, both belonging to the family Orthocladiinae are more abundant in such localities.. They were the species that seemed to support the highest pollution.

POSTER

## Fluvial ecology of a weir and metal-impacted river in the Pyrenees

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A two years' study has been performed in a small river of the Pyrenees that, despite it's great conservation status, has two main alterations: a small hydroelectric weir and an old mine leaking heavy metals. With the objective of analyzing the impact of both disturbances on the structure of the fluvial ecosystem, we sampled biofilms, macroinvertebrates and fishes, plus the physicochemical parameters and the metal concentrations, on both sides of the weir. The results didn't show statistical significantly differences on structural parameters analyzed for neither biofilms, nor for macroinvertebrates and fishes. Despite this, we detected an important intra-annual variability, with the higher primary and secondary production on Winter, due to the dominance of the algae *Hydrurus foetidus* in the stream in cold months, that becomes refugee and a food source for macroinvertebrates and higher trophic levels. Considering that due to climate change water scarcity and higher temperatures will affect the Pyrenees, the reduction of flow caused by the weir, and the dispersion barrier that it supposes, can severely impact this ecosystem, and thus we propose its removal.

POSTER

## Prioritising areas for water beetles conservation in central Spain

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In a context of limited resources for biodiversity conservation, setting conservation priorities is a key issue. This study aims to prioritise the most interesting areas for the conservation of the aquatic biodiversity in Castilla-La Mancha (CLM) using water beetles as biodiversity indicators, and to evaluate to which extent these areas are represented by the Natura 2000 network (N2000). Firstly, a compilation of all the bibliographic records of water beetles in CLM (at 10x10km grids) was conducted, which was completed with own surveys. A total of 303 species were registered, which represent 60% of the Iberian species and belong to 12 families. Most of these species are geographically widespread (150 trans-Iberian species). However, we found 52 Iberian endemisms (above 40% of the total endemisms). Subsequently, a prioritisation of areas was performed based on four criteria associated with richness, rarity and endemicity values. A total of 32 priority areas for conservation (APC) of aquatic beetles were identified, which are located mainly in the mountainous region of south of Albacete, or other disperse zones such as "Montes de Toledo" and "Alto Tajo". Finally, those APC, which are outside or have little overlap with N2000 were identified as conservation gaps. These areas were mainly located close to "Ojos de Villaverde" lagoon, "Saladares de Cordovilla y Agramón", Alboraj lagoon, and some rivers of the middle Guadiana basin. Considering the high conservation value and current lack of protection of these aquatic ecosystems, we propose/recommend their inclusion in the RN2000 or their designation as entomological micro-reserves for water beetles.

POSTER

## The invasive red swamp crayfish *(Procambarus clarkii)* increases infection of the amphibian chytrid fungus *(Batrachochytrium dendrobatidis)*

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Emerging infectious diseases are increasingly recognized as a severe threat to wildlife. Chytridiomycosis, caused by *Batrachochytrium dendrobatidis*, is considered one of the most important causes for the decline of amphibian populations worldwide. Identifying potential biological reservoirs is essential from a scientific point of view and relevant from an applied perspective (e.g. disease control strategies), especially when worldwide distributed invasive species are involved. We aimed (1) to analyse the prevalence and infection intensity of Bd in the invasive red swamp crayfish (*Procambarus clarkii*) across the western Andalusian region, Spain; and (2) to assess whether the presence of crayfish affects the prevalence and infection intensity of Bd in amphibians of Doñana Natural Space, a localized, highly protected area within the Andalusian region. First, we found that infection prevalence in crayfish guts was 1.5% regionally (four out of 267 crayfish were qPCR positive to Bd, all of them belonging to the same Andalusian population); qPCR positives were histologically confirmed by finding zoosporangia of Bd in gastrointestinal walls of the red swamp crayfish. Second, we found a higher prevalence of Bd infection in DNS (19% for crayfish and 28% for amphibians on average), a place with great diversity and abundance of amphibians. Therefore, the prevalence of Bd in amphibians could be related to the presence of the red swamp crayfish. These results suggest that the red swamp crayfish might be a possible reservoir for Bd, representing an additional indirect impact on amphibians, a role that had not been previously recognised in its invasive range.

POSTER

## Are estimates of the fundamental and relised niche congruent? A case study exploring desiccation resistance in water beetles

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In research on species' vulnerability to climate change, much attention has been set on the effects of changing temperatures, but little is known about the impact of aridification on species persistence and distribution. Predictions of distributional shifts using species distribution models (SDM) are frequently based only on estimates of the species realised niche (i.e. the environmental conditions within which the species are present, obtained from occurrence records). However, these data are not always congruent with the environmental tolerance ranges obtained experimentally (i.e. fundamental niche estimates). Therefore, such approach might represent unaccurately the range of climatic variation that species actually tolerate. This study explores the congruence between estimates of the fundamental and realised niche in relation to desiccation tolerance across eight species of aquatic beetles (***Enochrus***, Hydrophilidae). Data on desiccation resistance obtained by laboratory experiments were compared with compiled data on the distribution and climatic conditions (aridity index) of the sites where the species have been recorded, using phylogenetically generalized least squares regressions. We found no significant relationships between the physiological proxy for desiccation resistance (water loss rate) and the values obtained by the application of the habitat aridity index, showing incongruences between measurements of the fundamental and realised niches. Multiple factors, such as the phenotypic plasticity and intraspecific variation of desiccation resistance, or its interplay with other stressors (e.g. salinity), might influence this complex relationship. Nevertheless, these results provide valuable information for determining which species and populations could be more threatened in a climate change scenario.

POSTER

## Los macroinvertebrados de un sistema de lagunas de desborde fluvial salobre relevante para la conservación en la ecorregión Pampa de Sudamérica

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El sistema lagunar está ubicado en el tramo medio de la cuenca del río Salado en la provincia de Buenos Aires, con una superficie en aguas altas de 90 km$^2$. Lo conforman las lagunas Las Flores Grande y Las Flores Chica, ambas vinculadas al cauce fluvial. Se encuentra en la confluencia de dos subcuencas, A° Las Flores y A° Saladillo-Vallimanca. La cuenca del río Salado (150000 km$^2$), que desemboca en el estuario del Río de la Plata, es una de las principales zonas agrícolo-ganaderas de Argentina. Dentro del área de estudio se reconocen sitios AICA (Áreas Importantes para Conservación de Aves) y aguas abajo se encuentra un sitio Ramsar. La cuenca del río Salado en las últimas décadas se halla impactada por obras hidráulicas de drenaje que amenazan su estado de conservación. El objetivo de este estudio fue analizar las características físico-químicas conjuntamente con los macroinvertebrados, que constituyen un recurso alimentario para los niveles tróficos superiores. Las aguas exhiben conductividades que superan los 5000 µS, elevada turbidez (TSD: 3.5-5.5 g l$^{-1}$) y pH alcalino (7.9-9.1). El lecho y márgenes están conformados por loess y arcillas compactadas con concreciones calcáreas, careciendo de vegetación acuática en su cauce. Las márgenes están dominadas por *Oxybasis macrosperma* (Chenopodiaceae), praderas de *Salicornia ambigua* (Amaranthaceae) y pajonales halófilos. La riqueza taxonómica de invertebrados es baja representada principalmente por Nematoda, Trichoptera Hydroptilidae e Hydropsychidae, Simuliidae, Chironomidae, Oligochaeta y Amphipoda, que responden a un sistema moderadamente rico en nutrientes y materia orgánica, adaptado a fluctuaciones en el contenido de sales.

POSTER

## Assessing the role of aquatic Natura 2000 network to preserve hotspots of protected and threatened freshwater species

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European Natura 2000 network of protected areas (N2000) stands out as the main conservation strategy in the European Union to preserve biodiversity. As the management of N2000 sites is mainly focused on protecting the biological elements (habitat and/or Species of Community Interest, SCI) for which the site was designated, it seems urgent to discriminate which sites are really providing effective protection for aquatic biodiversity. On the other hand, although the main objective of N2000 is to protect species listed in the Birds and Habitats Directives (i.e., SCI), the conservation status of threatened species (TS, included in the European Red List of the IUCN) must be also a concern for the European Union. Focusing on Central Spain as a case study, we aimed to evaluate how far the "aquatic N2000", i.e., the part of N2000 declared by the occurrence of freshwater elements, is effective in the protection of the most important sites (hotspots) for both freshwater SCI and TS. Most of the N2000 from the study area was declared using aquatic elements, which means that the network could theoretically provide appropriate mechanisms to preserve aquatic biodiversity. However, N2000 provided a low coverage to most of the hotspots of both TS and SCI. Surprisingly, hotspots for TS are, in general, similar or even better protected by the N2000 than hotspots for SCI. These results could be useful to guide future revisions of the design of reserve networks, providing a framework to address deficiencies in N2000 for adequately protect European freshwater ecosystems.

POSTER

## Influência da radiação luminosa no crescimento de duas espécies de macrófitas aquáticas submersas

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*Egeria densa* Planch. e *Cabomba furcata* Schult. & Schult. são duas espécies nativas do sudeste do Brasil e ocorrem abundantemente em rios costeiros do estado de São Paulo. A distribuição e abundância das duas espécies varia em curtos espaços de tempo (< 3 meses) em um trecho da bacia do rio Itanhaém. Uma variável que pode determinar a distribuição, abundância e crescimento destas espécies é a radiação luminosa devido à variação de turbidez da água. Assim, nós realizamos um experimento em laboratório (4 tratamentos x 10 replicas) para cada espécie, com o objetivo de avaliar o ganho de massa em diferentes intensidades de radiação fotossinteticamente ativa. O experimento teve duração de 30 dias e os tratamentos foram: sem sombreamento e 30, 50 e 70 % de sombreamento. Aos valores de ganho de massa dos rametes aplicamos uma ANOVA one way para identificar diferenças significativas. Para *E. densa* nós observamos maior ganho de massa (1,7 vezes) no tratamento sem sombreamento em relação aos com sombreamento. Para *C. furcata* os maiores ganhos de massa (2,5 e 2,2 vezes) ocorreram nos tratamentos com maior sombreamento (50 e 70%, respectivamente) em relação ao sem sombreamento. Os resultados indicam que a variação da radiação pode explicar a variação de abundância das espécies no trecho de rio com maiores radiações favorecendo *E. densa* e menores favorecendo *C. furcata*.

POSTER

## Cartografía de los macrófitos litorales sumergidos y helófitos del Lago de Sanabria.

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En el marco de los trabajos del "Programa de control limnológico bianual intensivo del lago de Sanabria" (2015-2018) se ha realizado una cartografía de macrófitos litorales sumergidos, como base para la elaboración de una futura cartografía de hábitats. El muestreo se realizó por buceo mediante apnea con el apoyo de una embarcación, técnica que permite obtener resultados más exactos por observarse la vegetación *in situ*.

En total se realizaron 87 transectos paralelos a la costa, registrándose datos (siempre georeferenciados) de especies, cobertura, profundidad, tipo de sustrato y pendiente. Se tomaron igualmente datos de presencia de Helófitos en una banda de la orilla (1 m aprox.).

En 3 transectos no se observaron macrófitos acuáticos sumergidos. En los 84 restantes se han determinado 14 taxones diferentes, predominando *Ranunculus sp. y Myriophyllum sp.* En los helófitos de la orilla se han diferenciado 16 taxones, con una gran abundancia de *Lysimachia sp.* y *Carum sp.*

La información recogida se ha analizado mediante un Sistema de Información Geográfica (SIG), representándose mediante polígonos la distribución de los diferentes taxones en el lago, añadiéndose la variable profundidad en el caso de los macrófitos sumergidos.

La cartografía elaborada representa una contribución inédita y singular para este ecosistema único en la Península Ibérica, y supone además una valiosa herramienta de gestión para el estudio de los efectos de presiones sobre el litoral y la distribución de las especies.

POSTER

## Small ponds are big oases for terrestrial bird communities in a Mediterranean semiarid region

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Small waterbodies, such as ponds, are considered among the planet´s most endangered freshwater ecosystems, due mainly to several anthropogenic pressures such as water depletion, pollution, habitat degradation and biological invasions. In order to make management strategies effective, greater knowledge of pond biodiversity is urgently required. However, most studies of pond biodiversity are focused on obligate or facultative aquatic groups, such as freshwater invertebrates, amphibians or macrophytes. Only a few studies have evaluated the role of ponds for terrestrial biodiversity conservation, despite of the several services offered by these small aquatic habitats to terrestrial fauna. Here, we report the structural and taxonomic diversity of terrestrial bird communities linked to 39 ponds belonging to three different types (13 drinking troughs, 14 artificial pools and 12 cattle ponds) in a semiarid region. The relations among bird richness, pond typology and local conditions (average annual rainfall and habitat heterogeneity) were explored. A total of 80 breeding bird species were observed using the study ponds, which represents two thirds of the terrestrial breeding bird community in the study area. Drinking troughs supported a significantly greater diversity than other pond types. Bird richness showed a significant positive relation with habitat complexity, but no clear relation was observed with annual rainfall. These results highlight the key role of small ponds for terrestrial bird communities in semiarid regions and they should be considered in management programs, ensuring therefore effective pond conservation by accounting to all biotic groups associated to ponds.

# RS5

# Ecosystem processes and functioning

## Decline of periphyton biomass facilitates macrophyte recovery in a temperate shallow lake

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Many temperate shallow lakes have lost their submerged macrophytes during the 20th century as a consequence of eutrophication and have shifted to a turbid phytoplankton-dominated state. Much effort has been put into their restoration, especially on the reduction of their nutrient loading; however, the recovery of submerged macrophytes is usually strongly delayed even if water clarity is increasing. The mechanisms underlying this delay are still under debate. Increasing shading by periphyton plays a key role during macrophyte decline and top-down control, potentially driven by fish predation reducing macroinvertebrate grazing on periphyton, has been detected as a major driver. We hypothesize that declining periphyton is needed for the recolonization of macrophytes. Using the data collected over a twenty year period in a temperate shallow eutrophic lake subject to reduced external nutrient loading, we found a significant decline of periphyton biomass in spring (end of May and beginning of June). Further, increases in maximum colonization depth and in biomass of submerged macrophytes were inversely correlated with periphyton biomass in June. Using multilinear regression analysis, phosphorus and nitrogen concentrations, water temperature and earlier onset of net loss of periphyton by grazing were identified as drivers of periphyton biomass decline in June. We conclude that declining periphyton biomass in spring facilitates submerged macrophyte recovery in shallow lakes during nutrient loading reduction. Changes in both, bottom-up and top-down control factors were playing a significant role in periphyton dynamics and hence in facilitating macrophyte recovery.

## Phytoplankton Diversity Relates Negatively with Productivity in Tropical High-Altitude Lakes from Southern Ecuador

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Tropical high-altitude lakes are vital freshwater reservoirs in the Andean regions. They are heavily threatened by human activities that may alter their functioning and hamper the provisioning of key ecosystem services such as water supply. Despite their ecological and social relevance, we know little about these waterbodies, especially regarding the factors influencing their functioning. Here, we explored the links between several environmental variables and phytoplankton productivity, measured as chlorophyll-a concentration and total phytoplankton biovolume. For this, we sampled twenty-four tropical high-altitude lakes located over three-thousand meters above sea level in Southern Ecuador. We found that four abiotic factors combined explained 76% of the variation in chlorophyll-a concentration amongst lakes. Contrary to what studies from temperate regions suggest, taxa richness was not related to either chlorophyll-a concentrations or total phytoplankton biovolume. Moreover, phytoplankton biovolume diversity was negatively correlated to both chlorophyll-a concentrations and total phytoplankton biovolume. This was due to a very uneven distribution of productivity amongst taxa in the more productive lakes. To the best of our knowledge, this is the first attempt to explore the determinants of phytoplankton functioning in tropical high-altitude lakes. We hope that this study will help to establish a baseline for evaluating the consequences of human activities in the ecology and functioning of this vital but fragile ecosystem. Our results suggest that by modifying the abiotic and biotic parameters of tropical high-altitude lakes, human activities can indirectly impact their functioning and their capacity to provide vital ecosystem services.

## Implications of leaf litter and shredder diversity for decomposition in river networks

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The topology of dendritically structured river networks and features of their terrestrial matrix such as land use shape the spatial distribution of leaf litter and shredder species by different mechanisms. As a result, mismatches between the traits of leaf litter and those of the shredder community can arise across river networks; in other words: the decomposition of leaf litter may be locally inefficient when suitable shredders are not available. Specifically leaf litter of higher diversity, such as in leaf packs composed of multiple litter species, may need a higher functional diversity of shredders to be efficiently decomposed. Here, we investigate the consequences of experimentally increasing the diversity of leaf litter for its decomposition across multiple river networks. Specifically, we hypothesize the decomposition rate of leaf mixtures relative to the average of single species to be affected by shredder species diversity. We incubated coarse litterbags containing 4 individual leaf litter species plus a mixture of all of them across three fluvial networks in Austria and Switzerland, and measured litter decomposition rates and the density and diversity of invertebrates colonizing the litterbags. Based on these data we (i) analyse how spatial and environmental factors affect the distribution of shredder communities across the three river networks, and (b) assess the implications of natural diversity gradients of shredders for litter decomposition. The results of this study contribute to an increased understanding of the links between diversity and ecosystem functioning at the scale of river networks.

## Abundance-body mass relationships structuring aquatic food webs across biogeographical gradients

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Most of the biological rates (growth, metabolic, reproduction) are greatly associated with body mass. Trophic interactions are also highly dependent on body mass due to feeding constraints. Scaling of body mass with abundance, known as size spectrum, provides information on community structure, energy flow, and ecosystem functioning. However, not many studies have incorporated individual body mass-abundance scaling of several trophic levels across biogeographical gradients. In our study, we measured abundance-body mass relationships in multitrophic food webs in the Iberian Pond network. This experimental facility comprises six locations (Murcia, Toledo, Évora, Porto, Jaca, and Madrid) in the Iberian Peninsula, covering a variety of climates ranging from arid to alpine. We collected samples of phytoplankton, zooplankton, and macroinvertebrates from 2016-2018 during the growing season. We quantified the abundances and individual body sizes to construct the multitrophic size spectrum for each location. Results revealed a consistent pattern in size spectrum across different biogeographical regions - a higher abundance of smaller individuals observed across all trophic levels, thus supporting theoretical predictions. Despite substantial differences in environmental conditions across space (e.g. arid, temperate and alpine regions) and time (multiple years), no consistent differences were found in multitrophic size spectra. Overall, these preliminary findings suggest that the role of body mass and abundances in shaping food web and community structure may be generalized across environmental and biogeographical gradients.

## Interactive effects of fine sediments and water diversion on biofilm functioning

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Water diversion for hydropower generation is affecting streams worldwide. Diversion reduces water flow in the by-passed stream sections, which promotes deposition of suspended fine sediments (siltation) and can affect stream biota and ecosystem functioning. The benthic biofilm is potentially the stream biotic component most affected by siltation. We assessed the effect of fine sediments and water diversion on biofilm functioning in artificial indoor channels, in a factorial split-plot experiment design with two factors: fine sediment (no sediment or 1100 mg/L) and water flow (0.17 L/s, 0.14 L/s, 0.06 L/s, 0.04 L/s and 0.02 L/s). Limestone tiles were incubated for 25 days in an unpolluted stream to allow biofilm colonization, and then placed into channels for acclimation for 18 days. Subsequently, we manipulated water flow and fine sediment and, after 17 days, we measured benthic chlorophyll-a (Chl-a) concentration and biofilm metabolism. In absence of fine sediment, water flow reduction produced a decrease in water velocity (from 3.0±0.05 to 0.5±0.14 cm/s) and fostered Chl-a concentration (from 0.54 ± 0.2 to 0.77 ± 0.5 µg/cm$^2$). However, in the sediment treatment water flow reduction reduced siltation (0.17 to 0.05 g/cm$^2$), resulting in no effect on Chl-a accrual. Fine sediments promoted benthic metabolism increasing GPP and CR (from 0.14 ± 0.002 to 0.31 ± 0.003 mg$O_2$/h and from 0.04 ± 0.002 to 0.06 ± 0.003 mg$O_2$/h, respectively). Our results show that diversion can have contrasting effects on biofilm depending on suspended sediment loads and degree of siltation.

## Food web, taxonomy and functional level community response to large-scale biogeographical gradient

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Food webs are being increasingly used to predict ecosystem stability. The ultimate food web properties already account for the abiotic (environment) and biotic interactions (i.e. predator-prey interactions). While the importance of abiotic environment on a single taxonomical or functional diversity is being recognized, the role of environment in structuring trophic interactions is less explored. Additionally, food web complexity can often be difficult to interpret or link with specific predictors (i.e. increasing temperature). To fill this knowledge gap we studied trophic structure of freshwater pond communities together with its taxonomical and functional (body size and feeding traits) attributes across biogeographic gradient that ranged from semi-arid to alpine environments. We aimed to understand if taxonomical, functional and community trophic structure are uniformly driven by the biogeographical gradient of abiotic variables. We used stable isotopes and calculated isotopic metrics of trophic structure that can be easily comparable among sites and communities. The highest isotopic richness and nitrogen range was at the temperate climate sites and one mountainous. This pattern was also corroborated by the highest biomass of predators and omnivores at these sites. The simplest food webs were found at the arid climates where community was dominated by zooplankton and small herbivores that constituted the majority of the biomass. Regardless this obvious pattern, trophic metrics were highly variable within sites preventing to obtain clear signals with abiotic variables. Abiotic variables related to biogeographic gradient were more evident to shape taxonomical and functional community structure whereas food webs were rather reflecting smaller scale variability associated to pond characteristics.

POSTER

## The influence of waterbirds guano on the trophic state of the Guadalhorce river mouth wetland (Malaga, South Spain)

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Wetlands are relevant ecosystems for waterbirds. The Mediterranean coastal lagoons located at the Guadalhorce river mouth (Málaga) refuge important waterfowl colonies, both residents and migrants. These waterbirds colonies can import enough nutrients to cause shifts in the trophic status of wetlands by deposition of guano. This process is called guanotrophication. The effect of guanotrophication on the biogeochemistry and plankton dynamics has never been studied in this protected wetland. In this study, nitrogen (N) and phosphorus (P) loadings by droppings of waterbirds to the lagoons have been estimated through an empirical model using field data covering a period of 14 years. Nutrients loadings by guanotrophication were a function of the total amount of excrements produced per day and its nutrient concentration. The mass of waterbirds guano produced per day was derived using a well-known allometric relationship for body mass dependent daily energy requirement, the gross energy content of food and its apparent metabolizable energy coefficient, assuming a fixed ratio between food intake and excretion. The results show that guanotrophication represents an important input of nutrients into the ecosystem. A direct and statistically significant relationship has been found between the waterbirds phosphorus and nitrogen loadings and the trophic state of these eutrophic lagoons. In an average year, diving and dabbling ducks contribute the most to the guanotrophication process. Cormorants wintering in the wetland also play an important role in the guanotrophication process during winter. During summer period, nitrogen and phosphorus loadings by gulls increase due to the increment of the population of these species.

POSTER

## Testing the effect of flow alteration on stream community structure and functions

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Over the centuries, human's dependency on surface waters has resulted in management and infrastructures, which modify and regulate rivers and streams worldwide. Many rivers are affected by channelization, damming, hydropower and/or water abstraction. These alterations often translate to highly modified river flows. In this study, we investigate the effects of different flow alterations on stream biodiversity and functioning. Based on a mesocosm approach at the EcoLaboratory Facilities at University of Birmingham, we used 12m long semi-recirculating flumes to research the effects of damming, drought and irrigation on headwater streams. In October 2018, 16 flumes were set up and left running to insure homogenized colonization and similarity of the communities. Flumes were groundwater feed and consisted of three riffle-pool habitat sequences. After 8 months, four yearly hydrographs treatments were applied. Those mimicking: a natural flow treatment -reduced flows in summer and progressive increase towards autumn and winter-; a drought treatment -yearly low flows and summer dewatering events-; a flow homogenization treatment -constant yearly flow-; and a flow reversal treatment -high flows in summer for irrigation and reduced flows in winter for water storage. Seasonal samplings were carried for a year aiming to unravel effects of flow management on litter and wood decomposition, Dissolved Organic Carbon (DOC), biofilm productivity and structural and functional characterization, macroinvertebrates community biodiversity and functionality, macrophytes characterization and biomass, water quality and ecosystem metabolism. Initial results suggested that flow alterations affected ecological components by shaping community structure and total biomass. On drought treatments, connectivity loss and constriction of wetted area during dewatering events might be driving significant changes on water quality parameters, as well as reduction of macrophytes growth. On the contrary, flow homogenization seemed to promote macrophytes growth and dissipate differences between riffle and pool habitats. Further results of ongoing samplings would allow us to clarify the drivers and the effects of flow alterations on stream ecosystems structure and functioning in different seasons.

# RS7

# Stressed aquatic ecosystems

## *In-situ* bioassays to assess the impacts of wildfires in aquatic ecosystems

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In Portugal, wildfires constitute an environmental problem, occurring with high frequency and affecting large areas. The role of wildfire on water quality has increasingly attracted the attention of the research community, particularly to the input of polycyclic aromatic hydrocarbons (PAHs) and metals associated to ashes. Hence, the main goal of this study was the assessment of post-fire contamination on freshwater organisms through the use of *in-situ* bioassays. Bioassays took place after the first post-fire major rain events on two riverine systems: two in the main river (Alfusqueiro; RU-river-upstream and RD-River-downstream the burnt area) and two in tributary streams (SU-Stream-upstream and SD-stream-downstream). The freshwater shrimp *Atyaephyra desmaresti* (water column organism), the amphipod *Echinogammarus meridionalis* (water-sediment interface organism) and the benthic insect *Chironomus riparius* larvae were exposed in all sites. After two exposure days, the mortality and post-exposure feeding inhibition were evaluated. The results showed negligible mortality for all the species and sites, and lethality was not sensitive to discern impacts among the assessed sites. Conversely, the sub-lethal post-exposure feeding inhibition, revealed a decrease in feeding rate of organisms from the impacted sites (RD and SD). The sites outside the burnt area (RU and SU), showed no adverse effects in this endpoint. Results of this study underline the impacts of post-fire contamination, which can sub-lethally impair the aquatic and benthic organisms in water bodies located downstream the burnt area. Moreover, the ***in-situ*** bioassays revealed to be a suitable tool to assess the risks of wildfire to aquatic species.

## Are all intermittent streams the same? Multiple hydrological components driving invertebrate community changes

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During the last years, there has been a growing interest in the study of intermittent streams as they represent a great part of the global river network and have a key contribution to biogeochemical cycles. However, to date, despite flow intermittency is a complex phenomenon, it has been characterized based solely on the number of non-flow days, ignoring other crucial hydrological aspects. For example, streams with a similar number of non-flow days can have a different number of flowing days before sampling, different number of non-flow periods, or varying durations of the last non-flow period. All this could lead to different biological communities and become even more relevant in a context of climate change where flow intermittency is expected to increase globally. In this line, and sampling 33 streams across Catalonia along an intermittence gradient, we identified which temporal hydrological component shaped different aspects of invertebrate biodiversity. To do so, we deeply characterized hydrology during one year before sampling. We also collected samples of the invertebrate community on each stream to analyze taxonomic and functional (response and effect traits) diversity. Our results suggested that total non-flow days seems to be a powerful metric to explain and predict the patterns of aquatic communities' assemblage. However, on multiple occasions there are alternative metrics that can replace or complement it to better predict community dynamics and global change impacts. Indeed, the patterns of biodiversity differ substantially depending of which hydrological metric are disturbing it.

## Microbial activity in a hypersaline lagoon sediment: day/night and depth variations

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La Playa lagoon in *Saladas de Sástago-Bujaraloz* system (NE Iberian Peninsula) is an example of an extreme environment due to its high salinity, extreme temperatures and long drought periods. This study aims to a greater understanding of this system's ecology dynamics through the microbial functioning linked to dissolved organic matter (DOM) and its possible differences between day and night in two different depths of the sediment (surface and subsurface). Therefore a sampling was performed determining the main physicochemical characteristics and DOM optical properties of the surface and interstitial waters. For the sediment, the aerobic respiration and three extracellular enzyme activities (β-glucosidase, leucine-aminopeptidase, and phosphatase) were determined in situ, and also a biological characterisation (bacterial density and viability, pigment content, extracellular polymeric substances content, and organic matter) was made. Differences were detected between day and night microbial activities and also between surface and subsurface biofilm microbial activities, without interaction between the two studied factors. The obtained results of EPS content and bacterial viability suggest that microbial communities suffer from stress in this environment. Detected variations in microbial activities were attributed to bacterial density and primary production in the surface, detected through changes in the physico-chemistry and DOM quality. The effect of temperature in the microbial activities was detected but was lower than expected, probably due to the higher depth variation of other parameters dependant to primary production.

## Lower immune capacity in saline vs freshwater beetles

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Some water beetle species living in inland hypersaline waters have very waterproof cuticles and plastic cuticular hydrocarbon compositions (characterized by lots of long chain and complex methyl alkanes) to cope with the desiccation and salinity stress they experience in nature. Such cuticular properties also provide an effective physical and biochemical barrier against the entry of parasites and infectious agents, meaning that other defence mechanisms, such as the basal immune response, may be less developed in such taxa. We tested the hypothesis that hypersaline species have a lower immune capacity than related freshwater taxa, measuring three key components of immune function (phenoloxidase activity, encapsulation response and antimicrobial peptide activity) in freshwater/hypersaline species pairs of *Nebrioporus* and *Enochrus*, which differ in their cuticular properties. As predicted, the two hypersaline species studied (*N. ceresyi* and *E. jesusarribasi*) showed significantly lower phenoloxidase and encapsulation activity than their freshwater relatives (*N. clarkii* and *E. salomonis*). In addition, positive antimicrobial peptide responses were only detected in freshwater beetles. These results suggest that adaptation to saline environments may have entailed a trade-off between the physiological mechanisms to cope with osmotic stress and investment in immune defences, both of which involve energetically costly processes.

## Are microplastics a macroproblem to freshwater benthic macroinvertebrates?

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Microplastics (polymers with 0.001-5 mm in size) are ubiquitous and persistent in natural environments. However, knowledge regarding the ecological impact of such particles in freshwater benthic biota remain scarce. The "comPET" research project is investigating the potential ecotoxicological effects of microplastics on freshwater benthic and epi-benthic macroinvertebrates, addressing responses at different levels of biological organization (from genes to communities and ecosystems). Results obtained so far indicate that collectors (dipteran larvae and lumbriculids) are more prompt to ingest and accumulate microplastics than shredders (trichopteran larvae) and epi-benthic predators (flatworms). In addition, dipteran larva revealed to be the most sensitive group of benthic organisms to microplastics, with impairments on life-history traits (growth, bimodal emergence), and on physiological and biochemical response mechanisms that are crucial to organisms homeostasis (e.g., antioxidant and detoxification mechanisms, lipids integrity, neurotransmission, metabolic costs). Dipteran larvae are well represented in freshwaters where they are qualified as "ecosystem engineers", with an active role on the organic matter processing and freshwater food-webs. Thus, the potential negative impact of microplastics on dipteran populations may lead to adverse effect at the community and ecosystem levels.

## Uranium in contaminated streams affects macroinvertebrate communities, but it is not biodispersed from streams to land by insect emergence.

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Mining is an important economic activity worldwide. After exhausting the ore, mines are frequently abandoned leaving a legacy of environmental problems. Here we investigated the effects of uranium contamination to macroinvertebrate communities and uranium mobility along aquatic food webs and its potential biodispersion to land via insect emergence. We sampled water, sediments, biofilm, macrophytes, invertebrates in water (juveniles) and land (adults), and spiders in the riparian zone across sites with a gradient of uranium concentrations in stream water (from 2.1 to 4.7 µg/L) and sediments (from 10.4 to 41.8 µg/g). Macroinvertebrate assemblages differed among sites with higher diversity and predominance of Nemouridae and Baetidae at the reference site. Sites with the highest uranium concentration had low diversity and predominance of Chironomidae. Uranium concentrations in organisms increased with its concentration in the water and sediment. The highest accumulation occurred in leaf litter (83.8 ± 5.4 µg/g) and macrophytes (47.6 ± 6.9 µg/g). Among consumers, uranium was highest in scrapers (14.3 ± 1.0 µg/g) and shredders (13.0 ± 0.8 µg/g) followed by engulfer predators (7.0 ± 1.3 µg/g). In the riparian zone, uranium in adult aquatic insects ranged from 0.3 to 2.9 µg/g and in spiders it ranged from 1.0 to 1.7 µg/g, with no differences among sites. δ15N and uranium content in biota was negatively related, suggesting no biomagnification. We concluded that uranium accumulated by producers and consumers is not biomagnified nor dispersed to land with the emergence of aquatic insects.

## Coexistence pattern of congeneric beetle species from supralittoral rockpools is mediated by salinity tolerance

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In supralittoral rockpools, at the interface between land and sea, salinity is one of the main factors limiting aquatic communities, reaching supersaturation values as the pools are close to dry. This ecosystem has a poor but really interesting fauna, capable to survive in very high stress conditions of temperature, salinity and desiccation associated to cyclical phases of rising and falling sea levels, waves, winds, precipitation and strong sunlight exposure. Two congeneric water beetles species belonging to the genus *Ochthebius* (Family Hydraenidae), *O. quadricollis* and *O. lejolisii*, frequently cohabit in the south-Iberian Mediterranean rockpools, although some spatial segregation has been observed. The main objective of this work was to analyze the coexistence pattern of both species studying experimentally the salinity tolerance (fundamental niche) in all stages of their life cycles (adults, larvae and eggs) and the salinity range in the field where the species occurs (realized niche). Both species showed a high saline tolerance, although adults and larvae of *O. quadricollis* tolerated higher salinity concentrations than *O. lejolisii*. Nevertheless, *O. lejolisii* eggs had a higher hatching success than *O. quadricollis* eggs at high saline concentrations, being probably the resistant form when the pool dry. This differential salinity tolerance between life cycle phases and species point out distinctive life strategies that could explain the coexistence of both species across a wide range of salinities, but the dominance of *O. quadricollis* in the nearest rockpools to the sea.

## Insect communities in saline waters consist of realized but not fundamental niche specialists

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Considering how organisms adapt to stress is essential if we are to anticipate biological responses to global change in ecosystems. Communities in stressful environments can potentially be assembled by specialists (i.e. species that only occur in a limited range of environmental conditions) and/or generalist species with wider environmental tolerances. Here we address this question using aquatic insects and salinity stress as a model system. We review the existing literature on the salinity tolerance of aquatic insects previously identified as saline specialists because they were exclusively found in saline habitats, and explore if these saline realized niche specialists (abiotic conditions where an species occurs in natural systems) are also specialists in their fundamental niches (tolerated abiotic conditions in absence of biological interactions or dispersal limitations) or on the contrary are fundamental niche generalist species confined to the highest salinities they can tolerate. The results suggest that species inhabiting saline waters are generalists in their fundamental niches, with a predominant pattern of high survival in freshwater-low salinity conditions, where their fitness tends to be similar or even higher than in saline waters. Additionally, their performance in freshwater tends to be similar to related strictly freshwater species, so no apparent trade-off of generalization is shown. These results are discussed in the framework of the ecological and evolutionary processes driving community assembly across the osmotic stress gradient, and their potential implications for predicting impacts from saline dilution and freshwater salinization.

## Dry-phase quality indicators for the assessment of ecological health of rivers

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Intermittent rivers and ephemeral streams are subject to high levels of environmental variation, shifting between aquatic and terrestrial states. These ecosystems are widespread, abundant and increasing in extent, but a proper biomonitoring program to determine their ecological quality is still lacking and challenging to develop. When rivers are dry, traditional indicators of river health cannot be measured, however indicators during the dry phase are barely starting to be developed. Here, we examined terrestrial invertebrate communities present in dry channels to evaluate the potential of this group to act as biological quality indicator of river health. Moreover, we studied dry riverbed sediments and co-occurring riparian soils as potential indicators of physico-chemical quality elements during the dry phase of rivers. To this end, we monitored 48 intermittent and ephemeral streams located at Segura River Basin (SE Spain) during their dry phase. We analyzed the sensitivity of the proposed dry river health indicators metrics and parameters to a multiple stressor gradient which reflected the main pressures present in the study area. Richness and abundance of terrestrial invertebrates as well as salinity and nutrient concentrations in sediments of channel were studied as quality elements of river health. Main findings of this study support the incorporation of dry riverbeds into ecosystem monitoring and assessment works through government policy and legislation and call for the need to integrate the dry phase of intermittent and ephemeral streams into monitoring and conservation programs.

## Assessing behavioral and biometric effects of the insecticide methomyl in *Caenorhabditis elegans*

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*Caenorhabditis elegans* is a very versatile model organism with standard protocols both for aquatic and soil toxicity testing. In this study, the first larval stage (L1) of *C. elegans* was exposed to methomyl, aiming to address if acute exposures to sub-lethal concentrations of methomyl could result in irreversible behavioral and biometric effects. While the estimated $LC_{50}$ value of more than 2 g $L^{-1}$ pointed out to low lethal toxicity of the insecticide in this nematode species, a 1-h exposure to sub-lethal doses of methomyl (lower than 0.320 g $L^{-1}$) triggered significant changes in motor behaviors and suggested developmental impairment. In fact, not only the type of movement, but also some biometric parameters significantly changed in exposed worms. This was characterized by worms moving backwards to a greater extent and being idle than moving forward, as well as lesser body area, length and wavelength when compared with the controls. These effects were dose-dependent. Interestingly, after a 48-h recovery period in clean medium, the type of movement of the previously exposed worms was analogous to controls, while a dose-dependent reversion of the biometric changes was recorded. These results suggest that short-exposures to sub-lethal concentrations of methomyl likely does not compromise this nematode species, since the effects seem to reverse after a short recovery time. However, long-term exposure to methomyl at effective doses should be a concern, taking into account that this insecticide is still widely used worldwide and that the concentration of spray preparations to be applied in the field can bear active ingredient concentrations around 0.8 g $L^{-1}$.

## Efectos de la regulación hidrológica sobre las comunidades acuáticas de ríos andinos regulados por múltiples embalses

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El control del caudal genera alteraciones biológicas en los ríos; sin embargo, los efectos son poco conocidos cuando se trata de procesos de múltiple regulación asociada a complejos de embalses y trasvases. Con el objetivo de establecer la relación entre esta múltiple regulación y los patrones de variabilidad espacial y temporal de las comunidades acuáticas de ríos andinos, se muestrearon 5 ríos asociados al sistema de embalses y trasvases Punchiná-San Lorenzo (Antioquía, Colombia) entre 2010 y 2018. Se obtuvieron muestras estandarizadas de variables fisicoquímicas y biológicas (ficoperifiton, macroinvertebrados y peces), provenientes de 27 muestreos (3 por año) que contemplaron el ciclo hidrológico. Como variables biológicas se usaron la abundancia o densidad total, abundancia de indicadores de calidad ambiental y diversidad efectiva Q. Para establecer los efectos de los factores año, periodo hidrológico, fenómenos ENSO/EL NIÑO y sitio de muestreo sobre las variables ambientales y biológicas se usó el modelo lineal generalizado (GLM). Análisis discriminantes canónicos, PCA, regresiones multiples y otros multivariados fueron usados para evidenciar los patrones de variabilidad y relación entre las variables ambientales y biológicas. Los organismos bentónicos fueron predominantemente generalistas, con adaptaciones para hacer frente a la variabilidad de los caudales y el arrastre. Todos los grupos mostraron escasa variabilidad temporal y atenuación de los efectos del ciclo hidrológico y del ENSO debido a la regulación. Espacialmente, se evidenció un importante efecto sobre la abundancia de especies, principalmente para los macroinvertebrados, así como un incremento de importancia de las interacciones entre estos y el ficoperifiton.

## Effects of salinity changes on aquatic organisms in a multiple stressor context

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Under global change, the ion concentration of aquatic ecosystems is changing worldwide. Many freshwater ecosystems are being salinized by anthropogenic salt inputs, whereas many naturally saline ones are being diluted by agricultural drainages. This occurs concomitantly with changes in other stressors, which can result in additive, antagonistic or synergistic effects on organisms. We reviewed experimental studies that manipulated salinity and other abiotic stressors, on inland and transitional aquatic habitats, to (i) synthesize their main effects on organisms' performance, (ii) quantify the frequency of joint effect types across studies and (iii) determine the overall individual and joint effects and their variation among salinity–stressor pairs and organism groups using meta-analyses. Additive effects were slightly more frequent (54%) than non-additive ones (46%) across all the studies (n = 105 responses). However, antagonistic effects were dominant for the stressor pair salinity and toxicants (44%, n = 43), transitional habitats (48%, n = 31) and vertebrates (71%, n = 21). Meta-analyses showed detrimental additive joint effects of salinity and other stressors on organism performance and a greater individual impact of salinity than the other stressors. These results were consistent across stressor pairs and organism types. These findings suggest that strategies to mitigate multiple stressor impacts on aquatic ecosystems should prioritize restoring natural salinity concentrations.

## Identificación de cianobacterias en piscinas de cultivo de camarón *(Penaeus vannamei)* en un sector del estuario del río Chone y río Jama

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Las cianobacterias también conocidas como cianofíceas, algas verde-azuladas o cianoprocariotas, es el grupo de procariotas fotosintéticos más relevante en diversidad y biomasa. La presencia de cianobacterias en piscinas camaroneras es un problema común en Ecuador, los blooms de cianofitas generan problemas como: concentraciones muy bajas de oxígeno en la madrugada, altos niveles de amonio, y desarrollo de sabores indeseables en los camarones. Con el fin de identificar cianobacterias en piscinas de cultivo de camarón (*Penaeus vannamei*), estuario, río y canales de suministro de agua; en un sector del estuario del río Chone y río Jama se colectaron muestras procedentes de las dos áreas de estudio, en estaciones de muestreo de los diferentes lugares mencionados, durante noviembre de 2017 a noviembre de 2018. Se realizó la identificación y cuantificación de las cianobacterias, así como determinación de parámetros ambientales del agua, tales como: temperatura, pH, salinidad, oxígeno disuelto, conductividad eléctrica y sólidos disueltos totales. Se identificaron 5 especies de cianobacterias para ambos ecosistemas: *Cylindrospermopsis raciborskii***,** *Dolichospermum sp.***,** *Phormidium sp., Leptolyngbya sp.* y *Pseudoanabaena sp.;* siendo *Leptolyngbya sp.* la especie más abundante en las dos zonas. Los valores del índice de diversidad de Shannon-Wiener en los sitios del estuario y río fueron menores a 1,5 (1,11 y 0,98), indicando una baja diversidad respectivamente. Los parámetros ambientales del agua fueron similares durante los meses de estudio, excepto la temperatura donde existió diferencia significativa. Los resultados de este estudio aportan nuevo conocimiento sobre este grupo en los dos ecosistemas monitoreados.

## Response of periphytic communities to five contaminants: a rapid toxicity approach

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This work is focused on using the benthic microalgae (namely diatoms) communities one ecotoxicological testing. Benthic microalgae communities, are key elements in riverine ecosystems, constituting the basis of the food web. In fact, they are a biological element in ecological quality assessment for compliance with the Water Framework Directive. Despite their importance, no standardized ecotoxicological test exists with benthic microalgae for the environmental risk assessment of chemicals. Few studies were published on the single-species sensitivity of benthic diatoms to different chemicals, but community responses have been left largely unattended in this context. A methodology for a short-term toxic test with experimental freshly collected diatom communities was already proposed but validation with different communities and a wider array of chemicals is still to be done. This motivated the present work, where three periphytic communities classified as denoting good ecological status were tested against five environmentally-relevant contaminants (herbicide, insecticide, detergent, fungicide, metal). Exposure in the laboratory lasted for 48 h and a fast-microscopic evaluation of the relative diatom gender sensitivity to three contaminant concentrations was carried out. Results show that the periphytic communities respond differently depending on the contaminant tested, and the origin of tested communities. Given that the three different periphytic communities (all indicating good ecological status) responded differently to the tested contaminants, this interesting, cost-effective and low-demanding new methodology would constitute a valuable tool as a relevant ecotoxicological test focusing benthic communities, but only to be used in higher tiers of retrospective Environmental Risk Assessment of contaminated rivers.

## Defining DRY RIVERS as an unique ecosystem type of non-perennial rivers

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During last decades hydrologists, ecologists and geomorphologists have generated many terminologies to classify the wide universe of non-perennial rivers. Due to the lack of standard criteria among the proposed typologies, scientific evidences about the ecology of non-perennial rivers may be confusing since not all structural and biogeochemical attributes can be generalized. We define Dry Rivers as those fluvial ecosystems where surface water is only present during short time (few weeks, days or hours) primarily after heavy rainfall events, which generate flash-floods, therefore with dry riverbeds became the dominant habitat in the river length along space and time. This paper aims to show that Dry rivers are ecosystems in their own right given their distinct structural and functional characteristic compared to other non-perennial rivers (Intermittent rivers) in which the wet phase and aquatic habitats (flowing channels and isolated pools) have a greater prevalence. We achieve this aim by applying an integrative approach that incorporates the terrestrial view to the limnological perspective needed for a better understanding of Dry Rivers ecosystems where connections with the terrestrial landscape are tight. We firstly review the variety of definitions used to refer to non-perennial rivers with a clear dominance of the dry phase to contextualize Dry Rivers type. Secondly, we analyze the existing knowledge on: i) geophysical and hydrological characteristics, ii) biodiversity and iii) biogeochemical attributes in Dry Rivers that distinguish them from other non-perennial river type. In addition, we explore the capacity of dry rivers to provide ecosystem services and finally we conclude with a synthesis where we identify main knowledge gaps and avenues for future research in Dry Rivers. (Project CGL2017-84625-C2-2-R (MINECO/AEI/FEDER, UE).

## Assessing the effects of post-fire contamination in the benthic diatom *Navicula libonensis* (Schoeman 1970) exposed to surface water samples from Zêzere and Unhais rivers

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The increase in frequency, extent and severity of wildfires in many parts of the world raise increased concerns regarding the management and protection of critical natural resources that can be directly or indirectly affected. Rivers are sinks of ash input transported by rain events down the hillslopes. Specifically, the periphytic community assemblages in rivers have been shown to shift into the dominance of smaller and adnate *taxa* as a result of ash input. The objective of this work was to assess the impacts of river water samples contaminated by ash inflows through a 7-month post-fire period in freshwater periphyton communities. For the purpose, an optimized ecotoxicological test with the benthic diatom *Navicula libonensis* was used to compare among water samples collected in river Zêzere (ZU and ZD, both within burnt areas) and river Unhais (UU – unburnt area, UB – burnt area). The benthic diatoms were exposed to increasing dilutions of the samples plus a control (Chu medium) for 6 days. Median effect concentrations ($EC_{50}$) were estimated for each river water sample, which allowed ordering the toxicity of sites as follows: ZU>ZD>UB. The reference status of UU was confirmed by the absence of toxicity. Metal concentrations present in the water were quantified and agree with the toxicity results observed in UB and ZU, namely for Fe and Ni.

## Características físicas e diversidade de habitats em riachos impactados pelo cultivo de cana-de-açúcar e em florestas nativas

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As atividades antrópicas têm afetado ecossistemas aquáticos, com destaque para a urbanização, industrialização e agricultura, na qual crescem acentuadamente, causando efeitos negativos diretos e indiretos em riachos. O crescente aumento de monoculturas de cana-de-açúcar no Estado de São Paulo vem causando degradação da vegetação nativa e alterando as características físicas e diversidade de habitats aquáticos. O objetivo do estudo foi analisar as diferenças das características físicas e diversidade de habitats em riachos que drenam microbacias ocupadas por cultivo de cana-de-açúcar em comparação com riachos que drenam microbacias cobertas por florestas nativas. Para isso, foi realizada a descrição de parâmetros físicos e diversidade de habitats aquáticos a partir da aplicação de dois protocolos de avaliação visual. Os resultados do estudo indicam que os riachos em áreas de cana-de-açúcar apresentam atributos que desestruturam fatores físicos e diversidade de habitats, baixa estabilidade e/ou instabilidade das margens, sedimentos arenosos e/ou lamoso, canal altamente alterado, baixa à moderada disponibilidade de substrato, alta à moderada alteração do sedimento, alta erosão e/ou assoreamento nas margens e moderada transparência da água. Nos riachos com microbacias florestadas os fatores em destaque foram a mata ciliar conservada, alta estabilidade das margens, maior cobertura vegetal no leito e na zona ripária, alta disponibilidade de substrato, baixa alteração do canal, maior presença de plantas aquáticas e baixo soterramento do substrato. Os riachos próximos de cana-de-açúcar possuem estrutura física e de habitats inferior em comparação com riachos cobertos por florestas nativas, por conta das alterações negativas causadas nos fatores avaliados. Nesse sentido, a restauração de riachos impactados pelo cultivo de cana-de-açúcar deve ser aplicada, visando garantir a sustentabilidade dos recursos hídricos.

## Community recovery in intermittent stream after the non-flow period: recolonization vs resistant forms

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The aquatic communities in intermittent streams are adapted to the non-flow periods, and they have the capacity to recover when flow returns. To date, it is known that some species can present resistant forms to persist ***in situ*** the non-flow period (e.g. dormancy eggs), while others recolonize the habitat from perennial sites (***ex situ***). However, it is unknown which is the main strategy of aquatic communities and when they used it. Here, we study the recovery of macroinvertebrate community in Algars River (Northeast of Iberian Peninsula). For this, hydrology was monitoring during a year and we quantify seasonal changes in macroinvertebrates assemblies. In addition, we collected river sediments in August 2019 in two streams of Algars basin, Algars and Els Estrets. We choose two sites (one permanent and one intermittent in non-flow period) of each stream. The sediments of intermittent sites were rehydrated immediately, whereas the sediments of permanent sites were subjected to same non-flow period of intermittent sites before rehydration. The results showed that macroinvertebrates recovery in Algars basin depends of colonization of perennial sites. Maybe the intensity of droughts plays an important role to determine how recover biodiversity after perturbation, and it is very important in the current context of global change because increase of droughts was expected.

## Nutrient loads from land-based fish farms in Chilean streams

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Chile is the second largest producer of salmon worldwide (about 800.000 tons/year). Part of the production process (about 5% of total production) occurs in land-based fish farms which are located in Southern Chile. There, mostly pristine low order streams receive wastewater from aquaculture facilities mostly as dissolved organic and inorganic matter. Treatment systems remove particles by settlement or/ and rotating drum filters. Some facilities also possess recirculation systems (RAS) reducing wastewater discharge by 95%. However, up to now there is little information available to assess the actual loads of nitrogen and phosphorous and to evaluate its impact in streams and lakes. This lack of information is mainly related to the fact that the actual Chilean wastewater framework permits high N and P loads and therefore laboratories executing the monitoring of wastewater discharges often use analytical methods with high detection levels. Therefore, this study aims to provide information on the N and P loads of several fish farms with different treatment systems and different fish production located in geographical zones in Southern Chile. Results reveal that the 1) loads of N and P can be much higher as the natural loads of these nutrients, but often are diluted well within some kilometers downstream the effluent, 2) the dissolved fraction of N and P prevail, 3) about 50-65% of P and N in food are found in the effluent. More, some fish farms discharge wastewater to effluents of oligotrophic lakes which potentially enhances eutrophication processes in these lakes. Therefore, higher legal standards are necessary to reduce and to control wastewater discharge of land-based aquaculture facilities.

POSTER

## Effects of post-fire contamination in aquatic systems: biomarker responses of *Gambusia holbrooki* exposed *in-situ*

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In Portugal, wildfires have had devastating effects occurring with high frequency and affect large areas. During the first rain events, the post-fire runoffs containing polycyclic aromatic compounds and metal-rich ashes can be mobilized from burnt areas to aquatic systems. These xenobiotics are persistent, toxic, mutagenic and carcinogenic and tend to bioaccumulate along food webs. Besides that, they can accumulate in body tissues interacting with target molecules and causing damage. In environmental assessment, the use of biochemical biomarkers may provide information on molecular responses of toxicity as an early indication of potential effects on higher levels of biological organization. The present study, using *in-situ* bioassays and a battery of subcellular biomarkers, aimed to evaluate the impacts of post-fire contamination on *Gambusia holbrooki*. Thus, in a recently burnt area, fish were exposed for 96 h ***in-situ*** at four sites: two in a river, upstream and downstream the burnt area (RUS, RDS) and two in tributary streams within the burnt area ($BS_1$, $BS_2$). Gills and liver tissues, as metabolically active tissues which tend to accumulate high levels of toxicants, were chosen for analysis. Glutathione S-transferase (GST), enzymatic antioxidants (GPX, GR), a non-enzymatic antioxidant (glutathione-GSH), the extent of lipoperoxidative damage (TBARS) and DNA damage (erythrocyte nuclear abnormality), were measured. These biomarkers revealed distinct responses between sites impacted and non-impacted by the wildfire, allowing their differentiation. Our results support the usefulness of *in-situ* assays and biomarkers to assess exposure and the effects of post-fire contamination on aquatic species such as fish.

POSTER

## Waterborne more than food-mediated effects determine the response of shredders to stream salinization

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Freshwater salt-contamination is a serious environmental threat all over the word that decreases water quality and negatively affects aquatic biota. Here, we assess the effects of waterborne and food-mediated salt contamination on the ecology of the shredder *Sericostoma vittatum*. In a microcosm approach, we examined consumption, respiration, growth and survival of this species maintained in media with or without added salt (NaCl; 3g/L). Invertebrates were fed with leaves of distinct quality - oak and chestnut- previously conditioned in both media. A fully factorial design was used. Consumption rates were negatively affected by the presence of salt in the medium; oak was more consumed than chestnut, independently of colonization conditions. Consistently, respiration rates were also depressed by salt amendment to the medium and also by food conditioned in the presence of salt. No significant differences were found on larval growth across treatments but more than half of the invertebrates, exposed to media added with NaCl, died after one month, independently of the supplied leaf material. Results suggest an important negative waterborne, more than food-mediated, impact of salt on invertebrates' physiology and ecology. Nonetheless, a high resilience of fungal communities to salt-contamination seem to be able to provide a high-quality food supply to more resistant invertebrate species Further investigation is essential to better understand the mechanisms of toxicity of salt on invertebrates to provide insights into possible mitigation measures in stream ecosystems.

POSTER

## Evaluation and management of an intermittent river: study of ecosystem services and water quality

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Rivers and intermittent streams are aquatic ecosystems that lose hydrological connectivity during drought periods. Anthropogenic pressures, such as changes in land and water use, combined with climate changes, accelerate the spatial and temporal intermittency of these ecosystems, promoting alterations of their ecology and the services they provide. Ribeira de Silveirinhos, located in the municipality of Gondomar (north of Portugal), is the intermittent watercourse under study. The aim of this study is to assess the ecological status of Ribeira de Silveirinhos. Moreover, we intend to describe the land occupation in the surrounding area and evaluate the ecosystem services provided. For this purpose, water physical and chemical parameters were measured, and benthic macroinvertebrates communities were evaluated in five sampling sites. Additionally, a photographic survey of the surrounding area was performed to characterize the ecosystems services. The sampling was made in two periods, spring and autumn, but in the latter, some of the points were dry. Physical and chemical parameters show high concentrations of phosphate in the downstream sites, in spring and autumn. Low values of abundance and richness of the macroinvertebrate community were recorded, and ecosystem services reveal a high potential for improvement, mainly due to the monoculture of eucalyptus. Intermittent water courses are under-valued, consequently their protection is in risk. Thus, it is important to consider the specific ecological functioning of this ecosystems and adjust the planning and management models in order to guarantee ecological quality and conservation processes.

POSTER

## Reservoirs under stress conditions: influence of land use on these ecosystems

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Harmful (toxic, food web altering, hypoxia generating) cyanobacterial algal blooms are proliferating world-wide due to anthropogenic nutrient enrichment, and they represent a threat to the use of our freshwater resources. Galicia (Northwestern Spain) reports these blooms problems every year. Land uses have been studied based on the Land Use Information System in 2006 (SIOSE in Spanish). Anthropogenic contamination severely affects the two reservoirs (A Baxe and Salas reservoirs). In the case of A Baxe, the main land uses are agriculture and livestock, while the Salas reservoir meets the entire surface around it burned. Samples water from two reservoirs were cultivated in the laboratory under control conditions, with the sediments of its own reservoir and with the sediment of the other reservoir. Cyanobacterial algae modify the pH. Consequently, pH changes during microalgae culture have been analyzed. Hight values of correlation were obtaining for pH and cellular growth ($R^2 \geq 95\%$). The samples of the sediments studied in this case were rich in biotites, that can induce phosphate to be a limiting factor for phytoplankton, due to the formation and sedimentation of insoluble salts of ferric phosphate. Therefore, in the crops cultivated with sediments from the Salas reservoir, actinobacteria have been developed, inhibition microalgal growth. The origin of these actinobacteria, *Streptomyces exfoliatus*, is the barley straw presents in the reservoir of the Salas, used to treat runoff caused by the fire basin.

POSTER

## Influence of river regulation and instream habitat on invertebrate communities' structure and function

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In regulated rivers, dams modify geomorphology, water quantity, quality and timing of stream flows and consequently the flow of Ecosystem Services. Aquatic biota faces disturbed functioning in such modified ecosystems that can be reflected in Fluvial Ecological Integrity. In this study, as part of the RIVEAL project, we assessed structural and functional macroinvertebrate alterations in two Portuguese rivers impaired by flow regulation derived of damming. Specifically, we evaluate macroinvertebrate community and their biological traits abundance in river sites located downstream the dam (i.e. regulated) and upstream (i.e. control) assessing different instream habitats (i.e. riffle, run and pool). We found distinct taxonomic composition and abundance of macroinvertebrate communities between regulated and control sites, but also between instream habitats. The same pattern was found for biological traits, although differences were more striking between instream habitats. Biological traits describing locomotion were strongly related with habitat conditions showing a trend for higher presence of organisms with flight and temporary attachment modes in riffles, swimmers and animals with permanent attachment in runs, and epibenthic and endobenthic locomotion modes in pools. Differences between flow regime conditions were better reflected in feeding habitat traits, with deposit feeders and shredders more represented in control flow, whereas regulated flow showed a trend to be represented by filter-feeders, piercers and parasites. Biological traits describing reproduction, resistance forms and body size were also highly correlated to the functional differences found between regulated/control conditions, as well as among instream habitats.

POSTER

# Natural disturbances can produce misleading bioassessment results: Identifying metrics to detect anthropogenic impacts in intermittent rivers

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Ecosystems experience natural disturbances and anthropogenic impacts that affect biological communities and ecological processes. When natural disturbance modifies anthropogenic impacts, current widely used bioassessment metrics can prevent accurate assessment of biological quality. Our aim was to assess the ability of biomonitoring metrics to detect anthropogenic impacts at both perennial and intermittent sites, and in the latter including both flowing and disconnected pool aquatic phases. Specifically, aquatic macroinvertebrates from 20 Mediterranean-climate rivers were sampled along gradients of natural flow intermittence (natural disturbance) and anthropogenic impacts to investigate their combined effects on widely used river biomonitoring metrics (i.e. taxonomic richness and standard biological indices) and novel functional metrics, including functional redundancy (i.e. the number of taxa contributing similarly to an ecosystem function, here a trophic function) and response diversity (i.e. how functionally similar taxa respond to natural disturbance and anthropogenic impacts). Our results show that natural flow intermittence can confound river bioassessment, and that a set of new functional metrics could be used as effective alternatives to standard metrics in naturally disturbed intermittent rivers. Only the widely used IBMWP index (Iberian Biological Monitoring Working Party) was able to detect anthropogenic impacts in intermittent rivers when used during flowing phases. Several functional metrics also detected anthropogenic impacts regardless of flow intermittence. Besides, functional redundancy of the entire community remained effective even in disconnected pools. Therefore, our findings suggest that water managers should incorporate alternative functional metrics in the routine biomonitoring of naturally.

POSTER

## DryHarshSal Project: Effects of drying in harsh saline aquatic ecosystem

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The arid and semiarid regions of the Iberian Peninsula are home to the largest number of intermittent saline bodies of inland waters in Europe including saline lagoons and streams. Salinity and flow intermittence are natural stressors that shape biodiversity and essential biogeochemical processes. However, little is known about the effect of both stressors on the structure and functioning of lagoons and streams. In addition, intermittent aquatic ecosystems are highly dynamics experiencing significant shifts between aquatic and terrestrial states with potential effects on trophic food webs. In this context, DryHarshSal is a coordinated project focus on changes in microbial benthic biofilm structure, composition and function, its interaction with both the biogeochemical environment and invertebrate communities and resulting food webs and the ecosystem processes in intermittent natural saline shallow lagoons and streams. We also will explore the possibility of halophilic benthic biota as source of enzymes and metabolites of interest for green-bio industry. To do this, two saladas (Lagunas de la Muerte y Piñol; Monegros, NE Spain) and two saline streams (Ramblas de Los Serrano y La Parra, SE Spain) are being studied during wet, contraction and dry phases. Our findings will generate the understanding of: i) the structural and functional adaptive responses of halophilic benthic communities in such semiarid regions and ii) the links between responses at different scales (from microbes-biogeochemistry to the food web and ecosystem processes) in these ecosystems under the threat of increasing of drying in the global change context. This Project is financed by Spanish National Project RTI2018-097950-B-C22.

POSTER

## Knowing the invertebrate community in a Mediterranean intermittent stream. Preliminary results

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Mediterranean rivers are characterized by an annual and interannual variability in terms of rainfall and temperature. According to this variation, flow regime plays an important role as an evolutionary pressure that constraints macroinvertebrate community and their biological traits. In this study, environmental and biological characterization was carried out in the Algars basin (NE of Iberian Peninsula), with the aim to understand how benthic macroinvertebrates were related to the environmental factors. We analysed flow intermittency, land use and habitat features, as well as the taxonomic and functional composition of the invertebrate community. Environmental characterization divided the basin in two major landscapes, forest and herbaceous vegetation that dominated headwaters, were substituted by agricultural lands downstream. Otherwise, biological characterization reveals a quite homogenous community. Slight differences in abundance, richness and Shannon diversity were found, more related to the spatial component than to the hydrology. Beta- diversity analysis confirmed that most of the variability remains between headwaters and downstream reaches. As a response to a loss of habitat quality, it was found an increase in the total abundance, and a decrease in the diversity and EPT (Ephemera, Plecoptera, Trichoptera) abundance when increasing agricultural use. There were no significant differences in the biological traits between permanent and intermittent sites. Despite that, frequent traits in intermittent sites were small-sized, short-life cycle and low presence of adult aquatic forms.

POSTER

## Trends in the use and ecological effects assessment of fungicides in aquatic ecosystems

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The interest in the effects of fungicides on non-target aquatic species considerably increased in the last decade. The continuous use of fungicides in agriculture is a matter of great concern and exerts enormous pressure on aquatic ecosystems, which are the final recipient of these agrochemicals. European authorities (e.g., the European Commission or the European Food Safety Autority - EFSA) and legislation (e.g., Directive 2009/128/EC) are increasing the pressure towards a more sustainable use of pesticides; consequently, the list of authorized pesticides and their maximum residue levels are under continuous scrutiny. In this work, we review and present some data on pesticides sales from official authorities. Fungicides and bactericides represent the main group in pesticide sales, contributing with 34-40 percent to the total of sales in Europe over the last decade. The same pattern can be observed in Portugal, where around 4200 tons of fungicides are sold per year, representing about 50% of the total pesticide sales. Excluding the inorganic fungicides (copper and sulfur formulations), carbamates/dithiocarbamates and azole fungicides are the most used fungicide families in Europe. However, a considerable number of other fungicide families are still currently in use. We aimed to understand if the investigation on fungicide active substances accompanies the trend of sales of fungicide formulation. We reviewed data from the literature on how scientists have evaluated the ecological impacts of fungicides on non-target aquatic organisms, and we present some data about the studied families of compounds and the targeted groups of test organisms (particularly aquatic fungi).

POSTER

## A cost-effective methodology for microplastics separation in aquatic systems based on zinc chloride reuse

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Multiple pressures that can arise from natural or anthropogenic pollution influence aquatic systems. Currently, microplastics (particles with < 5 mm; MPs), due to their ubiquity, high persistence and toxicity, are considered one of the most emerging aquatic pollutants. Despite the increasing concern, there is still not a unified methodology for MPs separation/quantification in aquatic systems resulting in inaccuracy data that is not comparable between studies. Hence, this work aims to establish the most cost-effective method based on a multi-criteria approach: the efficiency of density separation (particles' recovering; D.S.) and organic matter degradation (O.M.D.), the cost of each procedure, the time required by each method, the easy handling of each method, the quality of recovered polymers and the potential to reuse the product. For that, artificial samples containing eleven plastics belonging to the most common types of polymers (i.e. PE, PP, PS, PVC and PET) were prepared and subjected to four methodologies (D.S.: sugar, zinc chloride; O.M.D.: wet peroxide oxidation and enzymatic digestion). Moreover, they were previously sieved, and after application of the methodologies, they were inspected and identified in its polymer composition. Based on D.S. results, the potential of zinc chloride to be reused was also tested, to compensate its high cost and toxicity. Results of the present study showed that zinc chloride is the most cost-effective method maintaining an efficiency above 95% using new and/or reused product (at least five times). Moreover, the use of hydrogen peroxide to degrade organic matter is also recommended with caution.

# RS8

# Wetlands, lakes and estuarine ecology

## The influence of water turnover rate on ecosystem metabolism in coastal lagoons

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Ecosystem metabolism is an important tool to assess the ecological status and habitat functioning. Daily net ecosystem production (NEP) can be estimated as the balance between gross primary production (GPP) and ecosystem respiration (ER). In the last years, an increasing number of studies on metabolism in different aquatic habitats have been performed, but factors influencing metabolism in coastal lagoons are still unknown. In these ecosystems, the water turnover rate could determine the concentration of nutrients and organic matter, water level, salinity or the aquatic community structure, producing at the same time variations in their metabolism. To study the influence of water turnover rate on ecosystem metabolism in coastal lagoons, four habitats at Baix Ter wetlands (Girona, Spain) showing a gradient in water turnover were selected. GPP, ER and NEP were estimated through high frequency monitoring (every 10 minutes) of oxygen concentration and other variables. In addition, nutrient concentration and organic matter were monthly monitored. The results show the high productivity of Mediterranean coastal lagoons, which present differences in their metabolic rates depending on their turnover rate.

## Determinantes de la diversidad zooplanctónica en un lago tropical de alta montaña en Suramérica

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Los lagos de alta montaña del norte de Suramérica están amenazados por la intervención antrópica. En Colombia, más del 70% de la población habita la zona andina. Estos lagos son pequeños y naturalmente oligotróficos; sin embargo, las actividades humanas los están deteriorando aceleradamente. Este trabajo es una contribución el estudio de la estructura del zooplancton de estos lagos y de los variables ambientales que la determinan. El estudio se realizó en dos épocas climáticas, en un pequeño lago somero, Laguna Verde, ubicado en la zona más alta de una montaña, a más de 3000 msnm, en la cordillera Oriental de Colombia. La riqueza zooplanctónica del lago es de 17 tazones: 12 branchiopoda, un calanoideo, tres ciclopoideos y un harpacticoideo. La diversidad gama total de orden $q$=0 estimada fue igual a la riqueza total observada; esto indica que el inventario de crustáceos zooplanctónicos del lago alcanza cerca del 100% de las especies presentes. Existe diferencia en la estructura, principalmente de abundancias de las especies de crustáceos planctónicos, entra la zona litoral y limnética. En la zona litoral abundan quidoridos, bosmínidos, Macrothricidae y *Tropociclops prasinus*. En la zona limnética predominan los copepodos *Colombodiaptomus brandorffí*, *Macrocyclops albidus* y *Eusecyclops serrulatus*. La variabilidad espacial del zooplancton está relacionada con las variables ambientales. *Bosmina Longirostris*, y la mayoría de especies de copépodos, prosperan mejor en época de mayor productividad primaria; los Chydoridae se relacionan con alta concentración de fósforo. Los harpacticoideo, al parecer, aumentan en la época de mayor conductividad.

## Surface exchange flows in lake-wetland interfaces may modulate the horizontal migration of zooplankton

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Exchange flows established in lake-wetland interfaces driven by temperature horizontal gradients and wind, directly affect lakes ecology. The modulation of horizontal migration patterns of freshwater zooplankters by these flows was hypothesized and a 48-h field campaign in a shallow lake (Lake Vela, Quiaios, Portugal) was carried out for investigation. Horizontal surface exchange flows were assessed by integrating data continuously collected by four water temperature probes, a current meter acquiring on 3D velocity fields, a meteorological station acquiring wind velocity and direction. In parallel, zooplankton samples were collected at the sub-surface in the lake-wetland interface (*Typha latifolia* stand) and the pelagic zone for further stereoscopic counting, through two diurnal cycles, every four hours. Total zooplankton abundance does not significantly differ between the interface and the pelagic zone neither during the day nor the night. Group-specific analysis revealed the same for Daphnidae, Chydoridae, Bosminidae, with Copepoda exhibiting significantly higher abundance in the interface during the day. Copepods are the best "swimmers" among the studied groups, thus theoretically those better able to keep predator-driven horizontal migration (the presence of several zooplanktivorous fish was confirmed), possibly against flows. During the day, lower temperatures due to shadowing in the wetland should drive a warmer (lighter) fluid into the interface, at the surface. However, wind-driven currents may disrupt this pattern generating currents into or out the interface against the thermal currents. This is consistent with the difficulties in identifying a typical migration pattern for the zooplankters, although further experimental work is planned for confirmation.

POSTER

## Composición de las comunidades de macroinvertebrados y factores determinantes en lagunas del sureste de la Península Ibérica

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Se estudiaron componentes abióticos y bióticos de ocho lagunas de las provincias de Granada y Málaga con el fin de identificar las variables que influyen en la composición de las comunidades de macroinvertebrados que las habitan. Para el muestreo de las comunidades se utilizó una metodología semi-cuantitativa y se midieron diferentes variables físico–químicas del agua (pH, oxígeno disuelto, temperatura, conductividad, turbidez y clorofila). Se encontraron diferencias tanto en la composición de las comunidades de macroinvertebrados acuáticos como en los factores físico–químicos de las lagunas. Los resultados de los análisis de ordenación (PCA y CCA) mostraron que los efemerópteros se encontraron en las lagunas con mayor concentración de oxígeno disuelto, mientras que los moluscos y oligoquetos se relacionaron con lagunas más eutrofizadas y cálidas. Por el contrario, dípteros y heterópteros dominaron en lagunas con bajas concentraciones de oxígeno. Aguas muy mineralizadas explicaron la presencia de la familia Chironomidae y el género *Micronecta* sp.

POSTER

# Ecotoxicological effects of oxyfluorfen on marine planktonic species under different temperature scenarios

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Fertilizers and pesticides are increasing in agriculture practices to suppress the food production needs. The excessive use of these compounds can comport deleterious effects to the ecosystems and damage to the public health. Herbicides are highly used and have the ability to bioaccumulate on primary producers with proliferation along the trophic chain. Oxyfluorfen is a fluorine-based herbicide that acts by inhibition of protoporphyrinogen oxidase, with an increase application. Since nowadays, this non-selective herbicide is an alternative to control the glyphosate resistant weeds. The evaluation of the oxyfluorfen effects on a set of species is scarce in literature. Thus, this work aims to evaluate the effects of oxyfluorfen under a set of temperatures on the sensitiveness of the marine diatom Thalassiosira weissflogii and the marine brine shrimp Artemia franciscana. Both species were exposed to the herbicide during 48h and 96h, respectively, to different temperatures (15ºC, 20ºC and 25ºC). The organisms were exposed to a range of 8 concentrations plus a negative and a solvent control. Lethal concentrations were determined to both species and to different temperatures (T. weissflogii: LC50(15ºC)=2.31(1.44-3.17) µg/L; LC50(20ºC)=3.22 (2.60-3.84) µg/L; LC50(25ºC)=8.74 (7.98-9.49) µg/L; A. franciscana: LC50(15ºC)=1.107 (0.942-1.383) mg/L; LC50(20ºC)=1.019 (0.708-1.939) mg/L; LC50(25ºC)=0.853 (0.548-1.832) mg/L). The diatoms showed an increase on the tolerance to oxyfluorfen with the increase of temperatures, whereas A. franciscana presented an opposite trend. This tendency highlights the tolerance of the marine diatom and the sensitiveness of the marine brine shrimp to the herbicide Oxyfluorfen with the increase of temperature. Further studies should be conducted with species from different trophic levels to determine the potential effects along the trophic chain and to the aquatic ecosystem and thus, to water quality.

POSTER

# Treatment of agricultural drainage water in a created wetland pilot plant

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The drainage of agricultural soils and the use of irrigation water with a high nitrate concentration are some of the main non-point sources water pollution that produces the eutrophication in aquatic ecosystems worldwide. Therefore, the use of sustainable technologies for the control and treatment of agricultural drainage waters is a pivotal issue for water quality management. In this sense, created wetlands, that recreate the appropriate biogeochemical conditions for retention, transformation and elimination of nutrients and water pollutants, are widespread useful tool. Efficiency of created wetlands depend among other factors, on the type of substrate with noticeable implications in the biomass and development of the microbial community. The treatment of agricultural drainage waters characterized by a high nitrate content but low concentration of dissolved organic carbon is a challenge. In this study, we report preliminary results from a multi-stage pilot plant of created wetlands that combine horizontal subsurface flow with surface flow wetlands. In addition, three different substrate have been tested: gravel, gravel with soil (30%), and gravel and biochar (10%). We present the main results regarding a) to the efficiency in the removal of nutrients and contaminants of the different type of substrates and b) their relationship with the biomass and activity of microorganisms in the wetland beds.

POSTER

## ¿Son diferentes los humedales naturales y artificiales? Efecto sobre la comunidad de macroinvertebrados y microcrustaceos.

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En paisajes altamente humanizados donde la conservación de la biodiversidad entra en conflicto con la agricultura intensiva, la construcción de humedales artificiales es una práctica que puede reconciliar el desarrollo económico y la protección ambiental. Este es el caso del Delta del Ebro donde tanto el cultivo del arroz como la conservación de la biodiversidad son objetivos prioritarios. En 2014 entraron en funcionamiento dos humedales artificiales de flujo superficial para depurar los vertidos de los arrozales. El objetivo de este estudio es analizar cómo ha evolucionado la composición de la comunidad de macroinvertebrados y microcrustaceos en los dos humedales construidos y compararla con la existente en dos humedales naturales y un agroecosistema, el arrozal. Se han muestreado tanto los humedales artificiales (2017-19) como los naturales (2018-19) en tres ocasiones, antes del cultivo del arroz, durante el periodo del cultivo y al final del mismo. Se han detectado en total 75 taxones en los humedales construidos y 46 y 17 en los humedales naturales y el arrozal respectivamente. La riqueza de macroinvertebrados es más alta en abril antes de que llegue el agua de los arrozales en los humedales naturales que en los artificiales. En los humedales construidos la riqueza taxonómica es más variable a conductividades bajas, a conductividades más elevadas la riqueza es menor y más constante en el tiempo. La construcción de humedales artificiales para la depuración de vertidos agrícolas contribuye tanto a la mejora de la calidad del agua como al aumento de la biodiversidad a escala regional.

POSTER

## Modeling surface water and groundwater dependence in the restored lagoons of the Pletera salt marshes

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Coastal wetlands are some of the most productive and dynamic ecosystems in the world, and their hydrology is conditioned by irregular meteorological disturbances, which in turn conditions ecological functioning and nutrient dynamics within aquatic communities. However, growing pressure from human activities may change their water regime and hydrochemical characteristics, causing degradation of the overall ecological functioning. The highly valued Pletera marshes, in the municipality of Torroella de Montgrí, represents these Mediterranean ecosystems under pressure from anthropological activity, and highlight the importance of restoration efforts to both improve the biodiversity and the adaptation of these aquatic communities to global change scenarios. Thanks to the LIFE restoration projects, three new lagoons were created in 2016, in already existing lagoon systems, and samples were regularly taken between 2016 and 2019 to measure hydrochemical parameters and environmental isotopes of the lagoons. Using the one dimensional General Lake Model (GLM), water inflows, outflows and evaporation fluxes were evaluated to establish the water balance of the lagoons and to determine the effects of hydrology and hydrogeology on the functioning of the aquifer-lagoon system of the Pletera marshes. We compare the hydrogeological dynamics of the newly established lagoons with already existing ones to analyze the effects of restoration and how lagoon morphology and their connectivity to the aquifer contribute to water salinity. These results may contribute to highlight the importance of groundwater in maintaining these ecosystems and their ecological functioning.

POSTER

## Formación de oxiclina estacional, anoxia y dinámica de nutrientes en una pequeña laguna kárstica del SE ibérico (Laguna de Alboraj, Albacete)

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La Laguna de Alboraj, localizada en el SE de España (Albacete) es una microreserva natural protegida incluida en la Red Natura 2000. En las últimas décadas viene sufriendo impactos antrópicos provocados principalmente por el descenso del nivel freático del acuífero que la sustentaba, resultando en una disminución acusada del volumen de agua de la laguna y un sensible aumento de la salinidad. Actualmente alcanza una profundidad máxima de 5m y una salinidad en torno a los 12 mS/cm. Con el fin de analizar los impactos de estas presiones, se han realizado perfiles mensuales de la columna de agua durante el período 2017-2019, incluyendo parámetros fisico-químicos (T, pH, conductividad eléctrica, potencial redox, profundidad disco de Secchi), análisis de nutrientes (nitrato, amonio, Nt y Pt), alcalinidad total y concentración de clorofila a. El análisis de los datos indica una dinámica estacional de estratificación de la columna de agua que responde a cambios biogeoquímicos ligados a la producción primaria y a los procesos de degradación de materia orgánica en la interfase agua-sedimento. Destaca la existencia de una estratificación química (oxiclina) en invierno y primavera, seguida de una estratificación térmica (termoclina) y completa anoxia de la columna de agua en verano, mientras que en otoño se produce una mezcla con ruptura de la termoclina y oxigenación completa. Se discute la influencia de las presiones antrópicas, principalmente la agricultura y el cambio climático, en los procesos hidrológicos, biogeoquímicos y ecológicos detectados en las últimas décadas en este humedal salino.

POSTER

## Origen de la materia orgánica y evolución de la productividad en el Lago de Sanabria durante el último siglo.

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El Lago de Sanabria es el lago de montaña más grande de la Península Ibérica. A pesar de la presión turística, los resultados del seguimiento histórico realizado por el Laboratorio de Limnología del Parque Natural del Lago de Sanabria, así como de otros estudios limnológicos o sedimentológicos, evidencian un estado actual oligotrófico del lago. Mediante dos testigos de sedimentos extraídos de la subcuenca oriental (SAN17-D2-2 y SAN18-D2-1), donde el lago presenta la profundidad máxima (51 m), se realiza el análisis de diferentes parámetros biogeoquímicos: isótopos estables del carbono (δ13C), del nitrógeno (δ15N), concentraciones de Carbono, Nitrógeno, Fósforo, clorofila ***a*** y feofitina ***a*** para determinar el origen de la materia orgánica sedimentaria y la evolución temporal de la productividad durante el último siglo. Los testigos son laminados con una alta resolución, 0,2 cm. y datados radiométricamente con $^{210}$Pb. Los sondeos permiten diferenciar tres intervalos: basal, anterior a 1959 en el que los diferentes parámetros muestran poca variabilidad, intermedio, correspondiente al evento de la rotura de la presa en 1959, y superior, hasta la actualidad en el cual se producen tendencias al descenso para los valores de δ13C y δ15N y aumento de las concentraciones de los elementos biogeoquímicos. La relación C/N indica que la materia orgánica es propia de una mezcla entre materia orgánica autóctona y alóctona, y sus valores permanecen bastante constantes a lo largo de todo el perfil con una ligera disminución en los centímetros superiores. El conjunto de estos indicadores apunta hacia un incremento progresivo de la bioproductividad.

POSTER

## Efecto de peces, nutrientes y macrófitos sobre el bucle microbiano en un experimento con limnocorrales en la laguna de Sentiz, León, España

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El conocimiento del bucle microbiano (BM) y sus factores de control en lagos someros mediterráneos es aún muy escaso. Aquí se presenta un estudio llevado a cabo en la laguna de Sentiz, León, España en el que se realizó un experimento en mesocosmos (36 limnocorrales, 3 réplicas), manipulando la abundancia de peces (3 densidades), de nutrientes (4 dosis) y de cobertura vegetal (corte de macrófitos, semana 7 de 11 del experimento). Se estimaron la abundancia y biomasa de la comunidad bacteriana y de ciliados, las cuales se analizaron junto con datos publicados sobre las de fitoplancton, zooplancton y peces, y las variables físicas y químicas del agua.

El efecto de los peces y los nutrientes sobre las bacterias depende de la cobertura de macrófitos y muestra el mismo patrón que para el fitoplancton: con baja cobertura, la mayor abundancia de peces se asocia a un incremento del bacterioplancton. No se ha hallado efecto de la adición de nutrientes sobre la abundancia de bacterias. El peso relativo del Bucle Microbiano (bacterias) respecto a la vía clásica (clorofila a) es mayor en condiciones de oligotrofia. Antes del corte de macrófitos la acción de los peces favorece la abundancia de ciliados. Tras la eliminación de la vegetación, las poblaciones de ciliados declinan, lo cual puede estar asociado al efecto tóxico del amonio liberado tras la eliminación de la vegetación; o a la depredación de los ciliados de menor tamaño por otros grupos.

POSTER

## El bucle microbiano en 18 lagunas subtropicales de Uruguay: organismos y factores de control

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El conocimiento sobre la ecología de los lagos subtropicales se ha incrementado notablemente en la última década, particularmente en relación a la vía trófica clásica. Se han estudiado 18 lagos someros del SE de Uruguay, estimando las abundancias de bacterias, ciliados, las cuales se analizaron junto con datos publicados sobre las de fitoplancton, zooplancton y peces, y las variables físicas y químicas del agua.

La mayor presencia de organismos del bucle microbiano se da en lagos de aguas claras de pequeño tamaño, en los cuales son también abundantes los organismos fitoplanctónicos y los peces planctívoros y piscívoros. No se ha hallado una relación significativa entre bacterias y organismos fitoplanctónicos que indique transferencia de recursos desde este grupo a las bacterias. La relación hallada entre abundancia de bacterias y de sólidos en disolución permite identificar a éstos como fuente de energía de la vía microbiana. Las relaciones encontradas entre bacterias (de todos los tamaños) y diversos grupos zooplanctónicos revelan una transferencia de energía desde el bucle microbiano a niveles tróficos superiores, de manera que éste no sería un sumidero sino un enlace. Los rotíferos (microzooplancton) juegan un papel muy importante en esta transferencia. La presencia de macrófitos se relaciona significativamente con la abundancia de ciliados, favorecida al relajarse la presión zooplanctónica sobre ellos.

# RS9

# Monitoring, management and restoration of aquatic ecosystems

## Impacto del uso recreativo en Las Presillas del río Lozoya (Madrid, Parque Nacional Sierra de Guadarrama)

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Las implicaciones ecológicas de los usos recreativos sobre los ríos del Parque Nacional Sierra de Guadarrama (PNSG) han sido escasamente estudiadas. Para evaluar el impacto de estos usos, se ha realizado un seguimiento de las variables fisicoquímicas, seston orgánico y biológicas (coliformes y estreptococos fecales, y macroinvertebrados acuáticos) durante el periodo de uso recreativo y fuera de él (julio, septiembre y octubre), en Las Presillas y el río Lozoya. Para el primer muestreo, también se aplicaron índices de calidad del bosque de ribera (QBR) e hidromorfología (IHF). Las variaciones observadas en los parámetros físico-químicos, se asociaron a la influencia otoñal durante el tercer muestreo. Sin embargo, en Las Presillas se encontraron evidencias de un comportamiento estructural y funcional diferente al resto de puntos, a través del aumento de la concentración de seston orgánico, de los niveles de contaminación fecal humana (que no alcanzaron niveles peligrosos) y a la respuesta de las comunidades de macroinvertebrados, que se tradujo en un claro descenso del índice IBMWP y otras métricas de calidad, durante el periodo de aprovechamiento recreativo (verano). Estas manifestaciones apuntan a que el efecto combinado de los represamientos y las propias actividades recreativas en Las Presillas, generan unas dinámicas funcionales en verano que alteran su hábitat. La identificación y estudio de estos impactos, mediante la aplicación de índices y clases de calidad innovadores que integren y contextualicen Las Presillas en la red de seguimiento del PNSG, se ha identificado como cuestión clave de cara a la gestión y a la conservación.

## Decision support systems in the prioritization of Douro river basin dam removal

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Although dams have many benefits, such as water supply, flood protection and hydropower generation, they represent also a huge threat to native species, altering the natural flow regime and degrading aquatic and riparian habitats. Given this concern, we built a probabilistic model and a multi-criteria analysis model (MCA) for dam removal or mitigation of the critical structures. The objective is to improve the structural connectivity and the movement of potadromous fish species along the stream network as well to define exclusion areas for additional obstacles. This work was developed in the Portuguese side of the Douro river basin, where 1201 barriers (dams and weirs) were georeferenced and where a subsample of 152 barriers were considered for field permeability assessment. For the remaining barrier, it was made an extrapolation of the values obtained in the field-validated barriers. The connectivity model calculates a habitat connector index (dPC), and a link improvement index used to prioritize dam removal based on structural connectivity criteria. Therefore, it has been possible through the dPC connector (that explains how much the node or the river segments contributes to the overall network connectivity) and the link improvement (that identify which barriers should be chosen to be removed in order to improve the connectivity of the river network) to identify 37 priority barriers to remove. Further, it was applied a MCA for dam removal or mitigation, considering different alternatives for the most critical structures (or to define exclusion areas), where is specially considered the potential spread of invasive species.

## Comunidad de macroinvertebrados bentónicos de ríos afectados por minería abandonada de mercurio (Concejo de Lena, Asturias)

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Evaluamos el grado de perturbación de la minería abandonada de Hg en Asturias (N de España, Concejo de Lena) sobre unos arroyos (≈ 300-400 m snm) de la Cuenca del Nalón (Confederación Hidrográfica del Cantábrico Occidental). Esta Cuenca Carbonífera Central presenta mineralizaciones de cinabrio y rejalgar, que fueron explotadas para obtener Hg y As, desde 1844 hasta su abandono en 1974. Infraestructuras, estériles, escorias y escombreras quedaron expuestos a la intemperie, liberando durante años, entre otros, los muy tóxicos Hg y As, y movilizándolos hacia ecosistemas acuáticos. El territorio tiene litología de pizarras, calizas y areniscas y clima atlántico (1000-1500 L $m^{-2}$ $año^{-1}$ y 4-20 ºC). Evaluamos (años 2008-2013) la perturbación producida por tres de esas explotaciones (Soterraña, Maramuñiz y Brañalamosa) que drenan hacia el río Muñón, mediante la taxocenosis de macroinvertebrados bentónicos (nivel de familia) y la calidad de esos ecosistemas acuáticos. En 2018 y 2019, con motivo de las actuaciones del proyecto *Life SUBproducts4LIFE* para recuperar el entorno minero, se realizaron nuevos muestreos. Caracterizamos el hábitat (velocidad del agua y caudal) y la fisicoquímica del agua *in situ* (temperatura, oxígeno disuelto, pH y conductividad eléctrica) y en laboratorio ($NO_3^-$, $PO_4^{3-}$, $SO_4^{2-}$ y As). Con muestreadores tipo *Surber*, determinamos la estructura de la taxocenosis (abundancia, riqueza, diversidad, equitatividad) y con red tipo D, realizamos vigilancia biológica *(IBMWP, IASPT)*; ambos con redes de 500 *µm* de luz. Los resultados preliminares no indican cambios temporales, muestran diferencias entre controles y ríos afectados y manifiestan diferentes grados de perturbación sobre la comunidad estudiada.

## Aquatic Humic Substances, a possibility to decrease trace metals concentration in aquatic environments.

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Aquatic Humic Substances (AHS) are reactive organic matter able to form complexes with trace metals. Transition metals present in aquatic systems may be essential and/or toxic to life, therefore, it is relevant to keep their concentrations at safe levels for the biota. The study of the toxicity of trace metals is of utmost importance to understand processes in aquatic environments. The bioaccessibility and bioavailability of the metal ion depend on its speciation,that is directly related to physicochemical parameters such as pH, temperature, and redox potential.This study presents the occurrence of reactions between Aquatic Humic Substances and metals that can be applied as a possible remediation method for metal pollution of aquatic systems. We investigated complexation reactions including evaluation of the competition between trace metals as copper, manganese, lead and zinc, towards AHS. These elements are related to mining or industrial activities and are considered among the main pollutants in freshwater bodies and groundwater. The experiments showed that trace elements have a large affinity towards Aquatic Humic Substances and demonstrate that reactions between AHS and metals may be employed to regulate the concentration of pollutants of inorganic origin. The metals-AHS compounds isolated show low solubility in water, leading to precipitation of the complexes, however, they can be reincorporated to the water column by either a turbulent flux or a change in physicochemical parameters by natural phenomena or anthropogenic activities.

## Limnological changes in two tropical, high-mountain lakes along an 18-years interval

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High-mountain lakes (HML) are placed above the timberline (3,500-4,800 m a.s.l in tropical regions) in remote and undisturbed areas of the planet. Their environmental conditions (acidic waters, low alkalinity and low concentration of dissolved inorganic and organic matter) turn them vulnerable to acid rain, airborne pollutants, and climate change. This "susceptibility" makes them "natural sentinels" of global change. To be useful as sentinel of global or regional change, it is indispensable to know the natural limnological variability (i.e., annual cycle) to distinguish it from anthropic changes. We recorded the limnological dynamics of the tropical HML El Sol and La Luna in three annual cycles in an 18-year period (2000-2001, 2006-2007 and 2017-2018). We measured physical and chemical variables (temperature, DO, pH, conductivity, nutrients) as well as phytoplankton biomass (chlorophyll a concentration). La Luna showed a significant decrease only in $N\text{-}NO_3$ (206.2 ± 33 µg $L^{-1}$; r = -0.83) and N-NID (226.9 ± 50 µg $L^{-1}$; r = -0.82), the rest of the variables did not show changes among sampling periods. El Sol sowed a significant increase in pH (2.5 ± 0.9 U; r = 0.85) and conductivity (32.5 ± 3.4 µS $cm^{-1}$; r = 0.85), and a significant decrease in $N\text{-}NO_3$ (59.5 ± 39.7 µg $L^{-1}$; r = -0.58) and N-NID (84.7 ± 42 µg $L^{-1}$; r = -0.61), the rest of the variables did not show significant changes among sampling periods.

## Puesta en marcha de un protocolo de muestreo de microplásticos en aguas continentales y muestreo extensivo asociado.

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Se presenta el protocolo LIBERA de muestreo y análisis de microplásticos en ríos y otras aguas continentales desarrollado por la Asociación Hombre y Territorio dentro del Proyecto LIBERA durante 2019 como una herramienta escalable a las necesidades, recursos y objetivos de diferentes sectores sociales. De forma complementaria se presentan los resultados del primer muestreo de microplásticos de alcance extensivo en España en Lugares de Importancia para las Aves y la Biodiversidad (IBAs), que se ha llevado a cabo en 2019 y 2020 en cerca de 150 localizaciones de toda España.

Cerca del 70 % de las muestras analizadas presentan microplásticos, siendo las fibras y los fragmentos los dos elementos más comunes y numerosos, aunque aparecen también esferas, esponjas, gomas y lacas de protección de diferentes materiales. La metodología se está contrastando con la de diferentes grupos nacionales e internacionales y se está presentando en reuniones técnicas y científicas para tratar de complementar las acciones desarrolladas desde las Administraciones para el seguimiento y el control de microplásticos en aguas continentales. Asimismo, se están aportando datos y aspectos metodológicos para su inclusión en las propuestas nacionales de la Directiva Marco de Aguas para este contaminante.

Esta iniciativa destaca por tratarse de un proyecto coordinado por una entidad del tercer sector en colaboración con una empresa dedicada a la retirada y reciclaje de envases, y cuyos avances están permitiendo la colaboración con diferentes Administraciones en el plano de la gestión.

## Using Unmanned aerial vehicles (UAV) for lake management: ecological status, lake state shifts and biogeochemical processes in a small Mediterranean lake

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High-resolution remote sensing by unmanned aerial vehicles (UAV) are useful tools for reducing the costs of measuring biological and hydromorphological quality elements for lake ecological status, but also to detect ecological and biogeochemical processes relevant to lake management. Eight UAV flights took place during an annual vegetative cycle (July 2016 to July 2017) in a small karstic lake located in southeast Spain (Laguna de Alboraj, Albacete). Limnological surveys were simultaneously carried out to correctly interpret UAV images. For each flight, an orthomosaic of georeferenced RGB images was produced, and the areas of the different elements of interest were delimited. UAV images recorded the beginning of a catastrophic shift from a clear water macrophyte-dominated state to a turbid phytoplankton-dominated state. The shift was promoted by the overgrowth of cyanobacterial mats, which caused the burial and collapse of Charophyte meadows. Additionally, biogeochemical processes taking place in the hypolimnion related to anoxia and sulphur bacteria blooms were also captured by UAV images. We conclude that, by avoiding the inherent limitations of climatological and strategic conditions, UAV methodologies can be fast profitable tools to contribute to the environmental management of lakes, including both ecological status assessment and to detect relevant ecological and biogeochemical processes.

## Recent changes in phytoplankton biomass and composition in Lake Sanabria (Spain)

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A study was performed on the phytoplankton of Lake Sanabria (LS) from October 2015 to September 2017, in order to monitor the dynamics of algal biomass and community species composition, with particular attention to *Tabellaria* (Bacillariophyta), which had a significant *bloom* in 2013. Monthly samplings were carried out in each of the two sub-basins of LS. Additional samples from the river inlet (River Tera) were used to analyse the composition of phytoplankton input. *Tabellaria* biovolume was low throughout the study (average of $Z_{eu}$ ≤0.004 $mm^3L^{-1}$). Based on biomass and species composition, two clear periods could be established, but not statistically significant differences were detected between sub-basins. From Oct-15 to Dec-16, total biovolume was low and cryptophytes, chrysophytes, chlorophytes and small chroococcales (Cyanophyta) co-dominated, a community described in earlier studies of LS. In 2017 total biovolume increased sharply to a maximum in April of >1.2 $mm^3L^{-1}$, due to *Asterionella*, an uncommon diatom genus in all lakes of the region. No clear relationships were observed between *Asterionella* abundance and the measured physical and chemical variables, although the increase of this species, together with *Tabellaria* flourishment in 2013, evidences recent exceptional changes in phytoplankton structure of LS compared to last decades. It is noteworthy that a parallel *Asterionella* increase was observed in the river inlet, indicating a growth of this diatom also in the reservoirs of River Tera. Therefore these results suggest that this unusual *Asterionella* event is a consequence of processes that occurred at local and regional scales (e.g. lake catchment area).

## Responses of Riparian Vegetation NDVI to changes in water availability in heterogenous ecosystems

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Riparian areas include a diverse array of plant and animal species ensuring several ecosystem services (e.g. storing and purifying water, preventing erosion, providing habitat). However, these areas have been deteriorating their health condition as a result of anthropogenic alterations and increasing frequencies and intensities of climate extremes, such as drought. In this study, we combined historical climate data (precipitation and temperature) with time series (from 2016 to 2019) of Normalised Difference Vegetation Index (Sentinel 2 - NDVI) to investigate seasonal and phenological responses of riparian vegetation during periods of droughts and across naturally and managed vegetation types: Coniferous, Broadleaved forest and Grassland. Our study area was the Cávado river basin (NE Portugal). We analysed the attributes of the NDVI seasonal dynamics (e.g. annual mean, relative range, coefficient of variation, and their inter-annual variabilities) in 20 squared plots (of 1 ha per plot) randomly selected in each vegetation type. Results suggest that the use of NDVI represents a promising method to obtain spatial distribution data for evergreen and deciduous trees, to estimate species diversity, based on the spectral variation hypothesis, and to investigate their relationship with climatic variables. Our findings show the importance of remote sensing data in providing useful cost-effective estimates of diversity and distribution patterns over space and time. From an ecological and operational point of view, the approach presented herein could improve our ability to map vulnerable areas within the river basin and to implement more efficient conservation practices.

## Promoting public participation on river monitoring to create a closer link between citizens and rivers

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Rivers have witnessed a long history of human pressure and it is believed that when they are truly and consciously regarded as a common good, there will be a greater vigilance and care in the way they are exploited. With a multidisciplinary approach aimed to recover the emotional connection between river and citizens, a study case was conducted in Ave river, the main watercourse of Guimarães, located in the Northwest region of Portugal. The target groups were the inhabitants of 14 Guimarães' parishes crossed by Ave river, particularly students of 24 schools, the "green volunteers" of each parish and parish council presidents. Ecological quality of river was assessed, encouraging participatory citizenship practices. Physico-chemical, hydromorphological and biological (benthic macroinvertebrates, macrophytes and diatoms) parameters were monitored at 11 sites located in different parishes during one year. Identification and georeferencing possible sources of contamination and river obstacles and qualitative methodologies as environmental history research were also included. Parallelly, 120 theoretical and practical environmental education sessions, on different themes (e.g. pollution, land use changes, biodiversity), were carried out to empower students with tools for a critical analysis of river health's indicators in order to act accordingly. Sessions targeted to volunteers and parish councils included discussions among citizens, researchers, local authorities and governmental entities about citizens' concerns. Results showed that all sites presented ecological status below 'good'. Citizens' engagement on river monitoring fostered good environmental practices for improving the river ecological quality and it enhanced informed, transparent and accountable environmental decision-making.

## Caracterización de las masas de agua de la tipología "Ríos Mediterráneos muy mineralizados (R-T13)" en la demarcación hidrográfica del Guadalquivir

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La aparición de una serie de arroyos muy mineralizados, localizados en el Sur de la Península Ibérica, se encuentra ligada a una litología específica formada por sustratos calcáreos y afloramientos evaporíticos, como consecuencia de un proceso de introgresión marina que ocurrió hace unos 200 millones de años, durante el período Triásico tardío y a procesos evaporíticos posteriores del Mesiniense. Este trabajo pretende identificar y clasificar los ríos según su grado de mineralización dentro de las tipologías establecidas por el Real Decreto 817/2015. Concretamente se pretende establecer cuántos de ellos pertenecen a las dos tipologías con las que se ha relacionado dicha litología, en la cuenca del Guadalquivir: tipo R-T07 (*Ríos mineralizados mediterráneos de baja altitud*) y tipo R-T13 (*Ríos mediterráneos muy mineralizados*). Debido a la elevada temporalidad de este tipo de ríos y a los grandes cambios de caudal, que provocan una gran variabilidad en los datos de conductividad medida, se establece como criterio de clasificación un valor umbral de conductividad eléctrica > 4100 µS/cm. De un total de 39 puntos de muestreo, se descartan 5 por su bajo valor de conductividad. De los resultados obtenidos, se determina que para 11 de estos puntos se proponga un cambio de tipología, mientras que 14 necesitarían de un mayor número análisis para poder confirmar su tipología. De esta forma, se incrementa el número de masas de agua con elevada mineralización en la demarcación hidrográfica del Guadalquivir (5 masas más en el tipo R-T13 y 6 masas más en el tipo R-T07).

## Heavy metals in eels from the Segura River and irrigation channels from the Huerta de Murcia.

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The European eel (*Anguilla anguilla*) is an endangered species in critical preservation state. It is subject of management and recovery programs, among which we can also achieve the improvement of its fluvial habitat. In the Segura River, the *'Anguila'* project (Eel Project) pursues these objectives along the basins of the irrigation network of the Murcia Orchard. In this study we analyzed the presence and concentration of some of the most threatening pollutants in eels tissue (such as lead –Pb– and cadmium –Cd–). Pb was detected in blood and liver in all the specimens analyzed, while Cd was detected in the 50% and 95% of the eels (blood and liver, respectively). In muscle, were found in the 85% and 10% (Pb and Cd, respectively) of the animals sampled. Other elements like Co, Cr, Cu, Fe, Ni, Mn and Zn were also a matter of interest in our study, analyzing the tissue concentration of all these elements in captured eels from the three study habitats: Segura river bed, and both types of irrigation channels (*azarbes* and *acequias*).

POSTER

## Critical review of environmental impacts of water transfer throughout the world (1951-2017)

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The aim of this study is to identify the effects of water transfer projects planned and done on the structure and function of the affected river basins and their associated socio-ecosystems through a systematic literature review. Published literature between 1951-2017 on the effects of the water transfers and diversions worldwide was gathered and classified according to geographic area, affected watersheds, impact type, negative or positive nature, and affected river connectivity dimension (longitudinal, lateral, vertical or wider-external). The broad [2]Alcorlo P; [2]Mata, C.; [3]Malo, J.E nature of our goal and the different metrics and approaches used in the reviewed studies precluded a meta-analytical approach, and we thus summarized the information through a systematic review. Literature was searched with a combination of terms and keywords that delivered a total of 281 WoS-indexed papers to review. Impacts on the natural environment and on socio-ecosystems were categorized according mainly to receiving factors into 20 categories and for each paper we recorded the presence or absence of each impact category and assigned them a final impact score as the sum of the marked impacts. Our results show an increase of papers focused on North America and Eastern Asia during the last 20 years, and a progressively wider attention to impacts to rivers in order to include the surrounding ecosystems. Remarkably, the reviewed papers reflect the increased use of water transfers as management tools with conservation or restorations purposes, and the impacts described by them challenge a broad use of such practices without a critical evaluation.

POSTER

## Eficiencia de diferentes agentes de retención de fósforo y floculación de cianobacterias

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La eutrofización se ha convertido en uno de los principales problemas de calidad de agua de la mayoría de los ecosistemas de agua dulce a nivel mundial, lo que ha llevado al desarrollo de diversas investigaciones durante los últimas cuatro o cinco décadas. No ajeno al contexto mundial, en Uruguay gran parte de los cuerpos de agua continentales presentan niveles altos de eutrofización, situación que se ha agravado en los últimos 10-15 años debido a la expansión de la agricultura intensiva. Con el fin de evaluar la eficiencia de diferentes metodologías de inhibición, coagulación-floculación de fósforo y cianobacterias, se diseñaron experimentos a escala de laboratorio, donde se expuso muestras concentradas de agua superficial con presencia de las cianobacterias *Cylindrospermopsis raciborskii, Dolichospermum circinale* y *Microscystis* sp a un gradiente de dosis de distintos agentes (i.e. Quitosano, PAC, Phoslock, bentonita modificada con hierro, entre otros). En cada muestra se determinó la concentración de clorofila-a, clorofitas, cianobacterias, criptofitas, diatomeas y dinoflagelados y su actividad fotosintética, mediante el analizador AlgaeOnlineAnalyser II– bbe Moldaenke, y adicionalmente se registraron valores de pH y conductividad. Para los compuestos precipitantes de fósforo se determinó la concentración de ortofosfato remanente en agua. Estas variables se analizaron en superficie y fondo de cada muestra luego de 24 horas de exposición a cada compuesto. Los resultados preliminares muestran que a ciertas concentraciones, el Chitosan, PAC y Phoslock generan efectos prometedores en cuanto a reducción de fósforo en la columna de agua.

POSTER

## Benthic diatom assemblages as indicators of eutrophication in the Mar Menor hypersaline coastal lagoon (Murcia, SE Spain)

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Southeastern Mar Menor lagoon (El Beal wadi) has been exposed to heavy metals derived from old mining activity. The lagoon has been historically considered oligotrophic but recently its status changed to eutrophic. Diatoms respond to interactive effects of metal and nutrients, but these aspects are still poorly understood. Toxicants can benefit more tolerant species and favor the elimination of sensitive taxa through a toxicant-induced succession (TIS). The main aims of this study were to assess the seasonal responses of benthic diatom assemblages to interactive effects of metal and nutrients and search for potential indicator species, through an experimental field approach. Assemblages' differences were investigated using PERMANOVA, SIMPER and biological indices. Significant seasonal differences were observed in assemblages' structure and before and after the eutrophication episode, with greater species richness in summer. Structural taxa decreased (*Fragilaria* sp, *Grammatophora marina*, *Opephora marina* and *Toxarium undulatum*, in winter, and *Amphora cingulata*, *Chamaepinnularia clamans* and *Castoridens striata* in summer) and an increase of low abundance taxa and new incomers was observed (*Cyclotella choctawhatcheeana*, *Licmophora colosalis*, *Pteroncola inane*, *Tabularia* aff. *ktenoeides*, in winter; and *Navicula salinicola*, *Nitzschia frustulum* and *Halamphora subsalina* in summer). The proliferation of motile species and tube dwellers may explain the increase in species richness and a succession to more tolerant assemblages.

POSTER

## *Vaucheria litorea* C. Agardh (Xantophyceae, Heterokontophyta) a new incomer or an unnoticed species in Mar Menor coastal lagoon (Murcia, SE Spain)?

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In the framework of a project focused on the effects of eutrophication on sediments and epipelic communities in Mar Menor coastal lagoon an extensive sampling was implemented throughout the shallow littoral areas. Epipelic communities were composed mainly of diatoms, together with some cyanophyta, but the presence of several species of *Vaucheria* was observed. *Vaucheria litorea* seemed to predominate in some places but *V. dichotoma* was also common, especially in the western part of the lagoon. Both species are fairly common and have been collected in marshes worldwide however it had not been reported previously for Spain. The preference for soft substrata, the usually short life cycle and the vernal development may explain why these species have remained unnoticed until now in the lagoon and elsewhere. The phenology and the different steps of development of both species have been studied, as well as their distribution and their relations with environmental conditions, especially salinity and nutrient concentrations.

POSTER

## Revisão do plano de gestão da pesca na ZPR do rio Olo

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A revisão do Plano de Gestão da Pesca na Zona de Pesca Reservada (ZPR) do rio Olo foi recentemente publicada. Teve como objetivo avaliar se o modelo de gestão instituído requereria, após dez anos de funcionamento, de eventuais ajustamentos para melhorar a sustentabilidade dos recursos explorados.

Foram efetuadas 36 amostragens da ictiofauna (pesca elétrica efetuada nas doze estações RHS definidas em 2008). A análise dos dados respeitantes à idade, crescimento e condição física da espécie principal — a truta (*Salmo trutta*) — mereceu novo estudo. Esta, prossegue presente em 11 das 12 estações de amostragem. O escalo-do-norte (*Squalius carolitertii*) continua a ocorrer na totalidade dessas áreas e, com a truta, continuam sendo as espécies piscícolas que apresentam mais ampla distribuição espacial. A *Gobio lozanoi*, apesar de mais espalhada, foi inventariada na $T_7$ (Volta da Lousa), mas em quantitativos muito mais reduzidos.

As atividades de sensibilização desenvolvidas junto dos pescadores, populações ribeirinhas e demais agentes de desenvolvimento local e regional, têm igualmente sido práticas regulares. A promoção da pesca à pluma, sem morte, muito tem contribuído para a sustentabilidade dos recursos aquícolas autóctones.

A importância socioeconómica da pesca sem morte neste curso de água contribuiu decisivamente para que fosse realizado o XXIII Campeonato Europeu de Pesca à Pluma (2017), na zona de Ermelo (Mondim de Basto), onde a pesca à truta, com morte, está culturalmente muito enraizada e onde se continua a trabalhar afincadamente para a mudança de mentalidades.

POSTER

## Construção de estradas e a metacomunidade de macroinvertebrados bentônicos

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Empreendimentos rodoviários podem causar alterações nos ecossistemas aquáticos e os macroinvertebrados bentônicos são utilizados para aumentar a eficiência de detecção. O presente trabalho visou analisar o impacto da construção de uma rodovia na estruturação das metacomunidades da macrofauna bentônica nos rios Carinhanha, Cocos e Itaguari (Bahia). As amostras foram coletadas semestralmente (dez./2016-jul./2019), totalizando 6 campanhas amostrais, através da metodologia *kick-sampling* (malha 0.5 cm), em triplicatas, com duração de quatro dias por ponto amostral (100m a montante e 100m a jusante da ponte). Para cada campanha foram calculados índices ecológicos e comparados por meio de modelos estatísticos lineares. A composição das metacomunidades também foi comparada e foi testada a hipótese de que o empreendimento causa homogeneização biótica no trecho a jusante. Por fim, os organismos foram classificados em grupos funcionais de alimentação (GFA). Foram identificados 117 táxons, que englobam cinco GFA. Os índices diferiram para os pontos em algumas campanhas, sendo o rio Carinhanha o que apresentou maior diferença. A composição da metacomunidade se apresentou diferente em todas as campanhas, exceto na segunda e a possibilidade de homogeneização biótica foi refutada. A proporção dos GFA diferiu entre os pontos amostrais. Os resultados mostram que há uma variação nas metacomunidades da macrofauna bentônica e que os padrões não são constantes temporalmente. Essa variação é mais evidente dependendo do rio e da faceta da diversidade biológica analisada. Isso mostra a complexidade da detecção dos impactos das obras na dinâmica natural das metacomunidades.

POSTER

## Environmental quality assessment of the Paiva river basin: the macrobenthic community as bioindicator

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Although water quality assessment is mainly focused on physicochemical data analysis, biological evaluations of aquatic ecosystems may improve the understanding of anthropogenic impacts in freshwater ecology. The present work aims to evaluate the environmental quality of the Paiva river basin (ALICE EAPA_261/2016), based on abiotic (physical-chemical) and biotic (macroinvertebrate communities) parameters. Twenty sites with 3 different river typologies and distributed along the main watercourse and tributaries, were sampled during the fall of 2018. The physicochemical parameters were classified according to the Water Framework Directive. The biological quality was evaluated using the Portuguese Northern Invertebrate Index ($IPtI_N$). Some metrics based on macroinvertebrate communities were evaluated to better characterize the communities within the basin. Among the macroinvertebrate communities, Ephemeroptera, Trichoptera, Coleoptera and Plecoptera, were the main orders, with values ranging from 41.18% to 87.09% within most locations. The trophic structure of the invertebrate community revealed the predominance of individuals from the "filter collector" group (50% sampling sites). In the remaining sites, the groups "scrapers" and "deposit collectors" dominated. However, it was not possible to establish a trend in increasing or decreasing terms, in a longitudinal analysis, nor in terms of typologies for the various evaluated metrics and $IPtI_N$ index. No patterns were also observed considering the binomial main watercourse versus tributaries. $IPtI_N$ results and physicochemical quality confirmed that all sites meet at least GOOD environmental status. The information obtained in this study is crucial to elucidate about the current conservation status of the River Paiva watershed, and as a reference for future changes, including climate change.

POSTER

## Artificial floating islands as a tool for the ecological improvement of fishponds

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In the present study, the eco-technology of artificial floating islands (AFIs) have been tested as a tool for the ecological improvement of fishponds. The experiment was done in two semi-intensive production systems during the grow-out period of tilapia, comprising one production cycle. It was completely randomized with two treatments (with and without AFIs) and three repetitions. The water temperature, dissolved oxygen (DO), electrical conductivity, pH, turbidity (turb), total suspended solids (TSS) and Secchi and concentrations of chlorophyll *a* (CL *a*), total nitrogen (TN), ammonium nitrogen (N-NH4), total phosphorus (TP) and orthophosphate (P-PO4) were analyzed fortnightly in the fishpond. Two groups ordered based on environmental characteristics were formed by applying PCA (67.78% explicability). Fishponds with AFIs were assigned higher values of Secchi and lower values of pH, turbidity and TSS and of the concentrations of CL *a*, TN, N-NH4, TP, P-PO4. In the fishponds without AFIs the highest values of these variables were assigned, except for Secchi. In 30 days, fishponds with AFIs showed the lowest concentrations of TP and P-PO4, and for CL *a*, TN and N-NH4, the differences were recorded after 90 days ($p < .05$). The use of AFIs has demonstrated a high potential to conserve water quality in fishponds, notably for biologically assimilable elements (orthophosphate and ammonium nitrogen) and for those directly related to eutrophication (total phosphorus and nitrogen). In addition, recommended the associating the use of AFIs with polyculture production systems would ensure better use of the feed offered, increasing the production per productive area.

POSTER

## DNA methylation biomarkers: new tools for the human health and environmental risk assessment of chemicals

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Epigenetic mechanisms have gained relevance in the fields of human and environmental health, due to their pivotal role in disease, gene-environment interactions and adaptation to environmental change and/or contamination. Epigenetic mechanisms are highly responsive to external stimuli and a wide range of chemicals has been shown to determine specific epigenetic patterns in several organisms. Furthermore, the mitotic/meiotic inheritance of such epigenetic marks as well as their corresponding changes in gene expression and cell/organismal phenotypes has now been demonstrated. Therefore, epigenetic signatures are very interesting candidates to link environmental exposures to disease as well as they can inform on relevant past exposures to stressors. Accordingly, well developed epigenetic biomarkers can be useful tools in both prospective and retrospective environmental risk assessment (ERA) but their actual application in this context is still not effective due to several data gaps that exist.

Here we show that the incorporation of epigenetic biomarkers in the prospective ERA of chemicals can allow a better characterization of hazard potential (exposure and effects), by providing a comprehensive view on the corresponding mode of action or mechanism of toxicity and eventually elucidating on exposure routes, globally contributing to the establishment of Adverse Outcome Pathways. Epigenetic biomarkers can also have an important role in retrospective assessment by allowing to better distinguish fluctuating or historical exposure, as well as providing insights on the resilience of natural populations. By bringing together the epigenetics field and ERA as a comprehensive framework to tackle contamination challenges, promising avenues are open for scientists and regulators.

POSTER

## The occurrence of microbranchiospines in cichlids *Oreochromis* sp. and *Geophagus brasiliensis*: evidences of cyanobacteria control

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Fishes are exposed to contaminants and adjustments are needed for obtaining oxygen, occurring changes in water flow and blood, as well as remodeling of the gill morphology. Evaluation the morphological changes of the gills contribute to the understanding of the deleterious effects occurred in specimens exposed to contaminated environments as pesticides, medications or cyanotoxin. Cyanobacteria blooms represent a serious problem for the water quality of lakes and reservoirs because of the toxins production. The colonies formation prevents predation by zooplankton, but on the other hand, increases the vulnerability of cyanobacteria to herbivorous pressure by omnivores filtrating fishes. In the literature we can found a description of the presence of a structure called as microbranchiospines which would function to retain particulate matter in suspension such as phytoplankton. This study analyzed the gills of *Oreochromis* sp. and *Geophagus brasiliensis* seeking to characterize the gill morphology of these cichlids through scanning electron microscopy. Exemplary of cichlid were evaluated for intake/filtration of cyanobacteria *Microcystis aeruginosa* and *Cylindrospermopsis raciborskii*. The analyses were carried out in a scanning electron microscope with the *Noran System SIX* software 1.8 according to the protocol of the Electron Microscopy Center (CME) of UFRGS. Were analyzed the length of the gill filament (mm), intrafilamentar space (mm), the presence or absence of gill microbranchiospine, as well as, the area of gill microbranchiospine (mm). Both cichlids analyzed showed microbranchiospines gill, which enables the retention of organic microparticles such as cyanobacteria, allowing them to act as a biological control in episodes of cyanobacterial bloom.

POSTER

## Uso de *Typha domingensis* na fitorremediação de efluentes contaminados com metais: uma alternativa à sustentabilidade ambiental

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Métodos tradicionais para tratamento de efluentes contaminados com metais apresentam limitações devido ao seu alto custo e à necessidade de utilização de produtos químicos para o tratamento. Deste modo, o uso de macrófitas aquáticas como fitorremediadoras é bastante promissor, pois sua utilização apresenta benefícios em relação a outros métodos de remoção de metais. Entre eles está a abundância da espécie de macrófitas no ambiente, tornando-as recursos renováveis de fácil acesso. O presente estudo avaliou a capacidade da macrófita emergente *Typha domingensis* (Taboa) em acumular metais presentes no efluente da ERQA (Estação de Recuperação da Qualidade Ambiental), situada no Campus do Vale da UFRGS, bem como analisar a concentração desses metais na raiz e na parte aérea das plantas. O efluente da ERQA recebe contribuição dos laboratórios, banheiros e restaurantes do Campus Universitário. A partir da realização de experimentos em mesocosmos, foram coletadas macrófitas que estavam mergulhadas em efluente contendo metais por 27 dias. Ao todo 6 plantas foram coletadas e separadas em raiz, base e ápice, totalizando 18 amostras. Após secagem em estufa, as plantas foram trituradas, pesadas e diluídas em ácido nítrico para a realização das análises da concentração de metais, através do método de espectrometria de absorção atômica em chama de ar/acetileno. Os metais analisados foram cádmio, cromo, cobre, chumbo e zinco. Os resultados indicaram concentrações de cobre e zinco nas amostras analisadas, sendo que as maiores concentrações foram encontradas nas raízes das plantas, com médias de 16,67 µg/g (±3,29) para cobre e 116,54 µg/g (±33,18) para zinco.

POSTER

## Creación de un banco de huevos de *Triops cancriformis* en la Comunitat Valenciana

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Los *Triops* ("tortuguetas") son crustáceos típicos de charcas temporales de lluvia. Ambientes efímeros, pequeños y aislados de difícil seguimiento. Su desarrollo rápido y dependiente de condiciones climáticas dificulta su localización. Por otra parte es una especie de gran interés científico y biogeográfico, por sus especiales adaptaciones y su antigüedad. Todo ello nos ha llevado a realizar prospecciones específicas en la Comunitat Valenciana como ejemplo de especie singular característica de ambientes poco apreciados.

Desde 2017 se han realizado campañas fundamentalmente basadas en referencias bibliográficas, dando como resultado la detección de 7 poblaciones en buen estado, 3 de ellas desconocidas hasta el momento. Se encuentran en la zona interior mientras que en la zona costera no se han detectado poblaciones activas en ninguna de las zonas con referencias.

Paralelamente se han llevado a cabo trabajos de conservación *ex situ*, con los que se ha creado un banco de huevos de resistencia viables de estas 7 poblaciones. Esta será la primera especie de fauna que se conservará en el banco de germoplasma de referencia del CIEF-GVA, creado para especies de flora protegida. Este banco servirá tanto para reforzar poblaciones conocidas como para creación de nuevos hábitats, revalorizando estos ambientes. La investigación y la educación ambiental también son objeto de actuaciones en este campo. El éxito de este banco abre camino para la conservación de otras especies temporales de escasa representación (anostráceos, concostráceos).

POSTER

# A conceptual optimization of the ecological evaluation in rivers

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Preserving the integrity of freshwaters and its biodiversity is imperative. Freshwater ecosystems are often negatively impacted by human activities and climate change has been potentiating the effects of these impacts. The EU Water Framework Directive (WFD) assessment scheme was adopted in a joint effort to effectively evaluate the ecological status of all European water bodies integrating multiple lines of evidence (LoE) and obtaining comparable information among countries. The implementation of the WFD brought many positive changes in the ecological evaluation, including a new paradigm of ecological status, but the assessment scheme also presents some constraints. In fact, it is now urgent to explore the possibility of improving its efficiency as an ecological evaluation tool, namely learning from Ecological Risk Assessment (ERA) and/or including the use of complementary metrics proposed by the scientific community (e.g., functional traits, ecotox tools, environmental DNA). Following this line of thought, a conceptual scheme for an improved evaluation strategy was developed. This scheme is not intended to substitute the WFD assessment scheme; instead, it aims at a fusion between the bioassessment tools of the WFD with the ERA philosophy in a tiered approach of increasing complexity and spatial resolution, with the inclusion of expert judgement in specific decision stages. Our proposal offers the true integration of chemical, ecological and ecotoxicological LoE, thus constituting a comprehensive framework to evaluate ecological status in freshwaters. Our goal is to open way for the scientific discussion towards the improvement of aquatic ecosystem health evaluation, 20 years after the WFD implementation.

# RS10

# Alien and invasive species

## Importance of the invasive species *Trichocorixa verticalis* and ectoparasites in Corixidae communities in south-west Spain

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The oral communication tackles the interactions between native and alien species in aquatic ecosystems and the role of biotic and abiotic factors involved in an invasion. The focus is on aquatic insects of the family Corixidae in south-west Spain, including the alien species *Trichocorixa verticalis*. This species, native to North America, is the only strictly aquatic insect categorised as an invader in Europe, considering that dipterans are only aquatic in their larval phase. *Trichocorixa verticalis* was detected for the first time in the Iberian Peninsula in 1997, and since then it has spread through the south and west of the Peninsula as well as northern Morocco. It is the dominant corixid in permanent saline waters, such as the salt ponds of Marismas del Odiel and Cádiz Bay Natural Parks, and the fish ponds of Doñana Natural Park, but is also recorded in less saline waterbodies within Doñana National Park as well as protected shallow lakes elsewhere in Andalusia.

*Trichocorixa verticalis* is a poorly known species in the introduced range, therefore our first study was of its life cycle, essential to understand its biological traits and how it gains an advantage over native species. Other aspects analysed were the predator-prey (*Artemia parthenogenetica–T. verticalis*) interactions to determine the possible impacts of the invasive species on native prey. In addition, we analysed the immune response of native and invasive corixid species to mite ectoparasitism, and consider the implications of parasites for the invasion process and the success of *T. verticalis*.

## Uso del cangrejo rojo *(Procambarus clarkii)* para la obtención de un suplemento dietario en concentrados y como mecanismo de control de una especie invasora en Colombia.

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El Cangrejo rojo (*Procambarus clarkii*) especie nativa de Norteamérica, fue introducido a Colombia en el año 1985. 27 años luego de su introducción, esta especie se ha expandido por varias regiones del país, representando una amenaza para la biodiversidad acuática, por lo cual, es necesario buscar métodos de control. Por ello, el objetivo de este trabajo fue evaluar el rendimiento de biomasa de los cangrejos para la obtención de un suplemento dietario para concentrados y como mecanismo del control poblacional. Para esto, se desarrollaron capturas por anzuelo en transectos de banda de 8 $m^2$ en un lago. Se encontró en promedio, 10,75 individuos/$m^2$, de los cuales 41% fueron hembras y 59% machos. El lago representa un total de 60 hectáreas con una población aproximada de 6,4 millones de individuos. Las características fisicoquímicas fueron baja transparencia, temperatura de 27°C; conductividad de 350 µS/cm; pH de 6,7 y una saturación de oxigeno de 19%. Respecto al rendimiento del cangrejo, se obtuvo que para generar 1 kg de harina con un 3% de humedad, se requieren 4,6 kg de biomasa viva; donde solo el 21% de los organismos se convierten en harina y el 78% restante está compuesto por aceites y agua. La generación de la harina a base de cangrejo como un suplemento dietario puede ser un método efectivo en el control de la población, ya que los volúmenes de captura son muy altos. Es necesario hacer capturas frecuentes y masivas para poder reducir las poblaciones de este cangrejo invasor.

## How does the invasive *Dikerogammarus haemobaphes* (Eichwald, 1841) affect biomonitoring metrics and functional diversity in rivers?

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There is limited understanding of how biological communities are influenced by new invasive species and in particular their effect focusing on routine bioassessment tools and biological indices. This study aims to examine the effects, implications and consequences of an aquatic invasive species *Dikerogammarus haemobaphes* (Eichwald, 1841) (Crustacea: Gammaridae) on river biomonitoring tools and functional features of macroinvertebrate communities using a long-term dataset (20-years) for England (UK). The research sought to determine if the performance of four biomonitoring tools used during routinely river assessments (WHPT, WHPT_ASPT, LIFE, PSI) and two functional indices (functional richness and redundancy) were affected following the invasion of demon shrimp (pre- and post-invasion). A total of 5,988 samples comprising more than 8 million macroinvertebrate taxa were analysed from 259 lotic sites. Taxonomic and functional indices data were analyzed using a Before–After Control–Impact (BACI) approach and linear mixed models. All of the indices demonstrated significant changes following invasion by *D. haemobaphes* when the entire dataset was considered. Specifically, WHPT index and functional measures displayed significantly different changes at invaded sites compared to control sites. Temporal patterns for individual seasons (spring and autumn) were similar to the overall dataset. The wider implications of the ongoing project examining implications of *Dikerogammarus haemobaphes* on UK rivers are also considered

## Assesment on the diet of several exotic fish species in "El tancat de la Pipa", L'Albufera Natural Park (Valencia).

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Exotic fish are among the most important invader species in Spanish aquatic systems, some species were introduced many years ago and are considered as naturalized species, some others were more recently introduced. Among the main advantages of exotic invaders over native fauna, the amplitude of their diet has been commonly indicated. Our study has been developed in "El tancat de la Pipa", a reserve area inside the Natural Park of "L'Albufera de València", and aims to describe the diet (studying the gut content) of common exotic fish on this area, compared with the main available resources. The work has two main parts: in the first one, we have examined the gut content of several individuals of three exotic fish species (*Lepomis gibbosus, Carassius auratus* and *Cyprinus carpio*) captured with eel nets in December 2017; the second part includes the study of the gut content of these species together with another invader fish, *Gambusia affinis*, but in this case compared with the trophic resources (zooplankton and macroinvertebrates) existing on this area. For this second part, samples of fish with fish nets and smaller eel nets and, on the same day, also samples of zooplankton and macroinvertebrates will be taken. The preliminary results show that the main items consumed by the fish belong to 5 taxa: copepods, ostracods, decapods, insects, cladocerans, fish and vegetal remains. An Additional interesting issue was the presence of microplastic fragments and fibbers of various sizes.

## Historical, human and environmental drivers of genetic diversity in the red swamp crayfish *(Procambarus clarkii)* invading the Iberian Peninsula

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Patterns of genetic diversity in invasive populations can be modulated by a variety of factors acting at different stages of the invasion process, including the genetic composition of the source population(s), the introduction history (e.g. propagule pressure), the environmental suitability of recipient areas and the features of secondary introductions. The invasive red swamp crayfish, *Procambarus clarkii*, is one of the most widely introduced freshwater species worldwide. Legally introduced in Southern Spain in the 1970s, rapidly colonized almost the entire Iberian Peninsula. We used nuclear microsatellites to describe the genetic structure and diversity of 28 introduced populations in the Iberian Peninsula and to reconstruct its invasion process. Additionally, we analysed the relationship between environmental suitability and genetic diversity of the studied populations. A clear spatial genetic structure was found in red swamp crayfish populations of the Iberian Peninsula, probably determined by the two independent introduction events in the 1970s, which have produced two main clusters separated spatially, one of which is dominant in Portugal and the other in Spain. The human-mediated dispersal process seemed to have involved invasion hubs, hosting genetically diverse populations and acting as sources for subsequent introductions. Genetic diversity also tended to be higher in more suitable environments across the Iberian Peninsula. Therefore, our results show that the complex and human-mediated expansion of the red swamp crayfish in the Iberian Peninsula has involved several long- and short-distance movements and that both ecological and anthropogenic factors have shaped the genetic diversity patterns resulting from this invasion process.

## Trans-National Horizon Scanning for Aquatic Invasive Alien Species in the Iberian Peninsula: a preliminary Action of INVASAQUA

**Oliva-Paterna FJ**[1], Ribeiro F[1], Anastacio PA[1], García-Murillo P[1], Gallardo B[1], García-Berthou E[1], Boix D[1], Cobo F[1], Morcillo F[1], Almeida D[2], Arias A[2], Banha F[2], Barca S[2], Biurrum I[2], Cabezas MP[2], Calero S[2], Capdevila L[2], Capinha C[2], Campos JA[2], Casals F[2], Clavero M[2], Cuesta JA[2], Encarnazao JP[2], Fernández-Delgado C[2], Franco J[2], Guareschi S[2], Guillén A[2], Hermoso V[2], Machordom A[2], Martelo J[2], Medina L[2], Mellado A[2], Miranda R[2], Oficialdegui FJ[2], Olivo del Amo R[2], Oscoz J[2], Rodríguez-Merino A[2], Ros M[2], Perdices AI[2], Pou-Rovira Q[2], Sánchez E[2], Sánchez MI[2], Sánchez-Fernández D[2], Sánchez-González JR[2], Teodósio MA[2], Torralva M[2] & Vieira R[2]

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An important goal of LIFE INVASQUA project is to develop tools that will improve management and will be more efficient the Early Warning and Rapid Response (EWRR) framework for Invasive Alien Species in the Iberian Peninsula. Horizon scanning for high-risk IAS is basic in implementing measures to reduce new invasions and to focus effort in the species already established. We developed a trans-national horizon scanning exercise focused on inland waters of Spain and Portugal in order to provide a prioritised lists of aquatic IAS that may pose a threat to aquatic ecosystems and socio-economic sectors in the future. We followed a step approach of existing information about IAS (Plants, Freshwater Invertebrates, Estuarine Invertebrates and Vertebrates; 128 established – Black list; 88 non-established – Alert list) combining with an expert scoring of prioritized taxa. IAS established in the Iberian aquatic system consistently highlighted as the worst included *Azolla filiculoides, Eichhornia crassipes, Ficopomatus enigmaticus, Callinectes sapidus, Procambarus clarkii, Dreissena polymorpha, Corbicula fluminea, Gambusia holbrooki, Cyprinus carpio,* etc. Amongst taxa not yet established (Alert list), expert pointed to *Perna viridis, Hydroides dirampha, Dreissena bugensis, Procambarus fallax f. virginallis, Perccottus glenii, Branta canadiensis*, with higher risk of invasion, ecological and socioeconomic impacts. Over 20.6% of the taxa in the black list received no votes (no prioritization) by experts, 17.8% in the alert list. This work received funds from the LIFE Programme (LIFE17 GIE/ES/000515).

POSTER

## The exotic snail *Potamopyrgus antipodarum* (Gray, 1843) in southern Spain: spatio-temporal distribution and ecological preferences

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The gastropod *Potamopyrgus antipodarum* is a worldwide distributed species native to New Zealand. The first records of this species in Spain date back to 1977 and later only a few studies have been focused on this species. Recently *P. antipodarum* has been declared as invasive alien species by the Spanish law, which makes necessary the monitoring and the study of its current distribution. The present study has compiled all available information of the occurrence of *P. antipodarum* in several rivers and streams of southeast Spain in a period of 40 years. In addition, environmental information of these watercourses has been also provided. Our results suggest that the occurrence of this snail do not depends of site altitude but is related to physicochemical conditions, as temperature, pH, ammonium concentration, and water conductivity. Although in the Sierra Nevada Mountain range has not been a notable advance in the last 40 years, the projected increase of water temperature due to the global change, together with stretches of rivers running through calcareous areas, which favor the presence of this snail, are risk factors towards colonization by *P. antipodarum*. Thus, due the importance of this area for harboring ecosystems in risk for global change and being refuge of many endemics species it results necessary to develop management measures appropriate in the monitoring of this exotic species in this Nature Area.

POSTER

## Invasion biology of the American Boatman *Trichocorixa verticalis verticalis* (Fieber, 1851) in Western Europe: The role of ecophysiology and biological interactions

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The boatman (Corixidae) *Trichocorixa verticalis verticalis* (Fieber, 1851) originates from North America is the only aquatic hemipteran alien to Europe, where it is concentrated on the coastal areas in the southwest of the Iberian Peninsula. Recent studies of its ecophysiology, ecology and interactions with native corixids are reviewed. The main questions addressed are its potential non-native range in the world and its physiological performance and biological interactions, conditioning its invasive range and effects on native communities. We show that *T. verticalis* has the potential to disperse across a high proportion of the coastal lowlands across a wide range of latitudes. The most important factors determining its invasion success in permanent, saline wetlands seem to be its high plasticity in response to temperature and salinity, very high fecundity, and ability to reproduce throughout the year. Moreover, although its eggs are not resistant to drought, epizoochory of eggs by waterbirds may contribute to the expansion of this alien species. *T. verticalis* is an important predator in its introduced range, and is likely to reduce the abundance of native zooplankton. It has been proved this species is able to live and reproduce in freshwater, so its rarity in fresher wetlands may be explained by its greater susceptibility to parasitism, together with a higher predation rate by Odonata larvae compared to native corixids. The presence of *T. verticalis* has been shown to modify the distribution and co-occurrence patterns of native corixids, niche differentiation being the main mechanism enabling coexistence and resource partitioning.

POSTER

## Desiccation tolerance of the invasive bivalve *Corbicula fluminea* at varying temperatures

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Given its wide geographical distribution over 6 continents and documented effects on aquatic ecosystems, there is considerable interest in the behaviour, propagation and control of Asian clam (*C. fluminea*). We conducted a series of laboratory experiments to assess the effects of complete desiccation (aerial exposure) on a UK population of *C. fluminea* for: (i) different environmental temperatures (6 scenarios: winter through to summer heatwave thermal conditions); and (ii) two size classes (adult and juvenile). The greatest differences were recorded between lower and upper experimental temperatures. At 30 ºC 100% mortality was observed after two days. In contrast, some individuals were alive following ten days desiccation at 4 ºC. Both size classes displayed similar responses to desiccation. An extended period of desiccation of at least 5-6 days was necessary to obtain a 90% mortality at an air temperature of 15 °C for the population studied. *C. fluminea* is more desiccation tolerant when low temperature and high humidity conditions coincided, suggesting they could persist in regions not currently forming part of its ecogeographical range. The results may be of direct interest for regulatory authorities as a potential means of managing and preventing the further spread of this species

POSTER

## Reference lists of Aquatic Invasive Alien Species in the Iberian Peninsula: preliminar result of LIFE INVASAQUA

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LIFE INVASAQUA aims to reduce the introduction and spread of aquatic invasive alien species (IAS) by increasing public and stakeholder awareness, and by developing tools that will improve the management and Early Warning and Rapid Response (EWRR) framework for new IAS in freshwater and estuarine habitats in the Iberian Peninsula. Here, we have updated the established list (262 taxa) and alert list (244 potential taxa) of aquatic IAS of the Iberian Peninsula as part of an action coordinated by INVASAQUA with the collaboration of approximately 59 experts, most of them external to the project staff. The type of lists presented here are a tool that will improve the Iberian framework for management and EWRR of invasive species. Moreover, they could be primary tools for raising awareness on biological invasions. This work receives funds from the LIFE Programme (LIFE17 GIE/ES/000515).

# RS11

# Urban aquatic ecosystems

## A year on the rehabilitation of the Tinto river (Portugal): effects on some ecological quality parameters.

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The Tinto river is a small watercourse of the Douro river basin (Portugal) that over the years has been subject to various types of environmental disturbance, which has led to a great degradation of its ecological status. Between 2013 and 2017, numerous studies were carried out in order to characterize and monitor some of the parameters related to their ecological status and to detect the main sources of environmental disturbance. The results obtained in these studies led to the realization between 2017 and 2018/19 of a set of actions and projects to eliminate the main sources of environmental disturbance and to promote the rehabilitation of the river and its riverside areas. In the present study we compared the results of some parameters related to the ecological state (naturalness of the channel and banks, some physicochemical parameters and benthic macroinvertebrate community) of the Tinto river determined before the interventions and after one year of them in some of the sectors of the river that were targeted by the interventions. Given a previous analysis of the results obtained, it is possible to verify some improvement of at least some of the evaluated parameters, even considering the short time elapsed from the interventions and the adverse hydrological conditions of the current year (a very dry summer and a autumn with some flood episodes)

## An industrial byproduct as alternative labile carbon source enhances nitrogen removal in freshwaters receiving wastewater treatment plant inputs

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Wastewater treatment plant (WWTP) effluents are relevant sources of nutrients and dissolved organic matter (DOM) that may cause eutrophication in freshwater ecosystems. As a consequence of WWTP operations, DOM bioavailability in the WWTP effluents is usually low, which can limit nitrate ($NO_3^-$) removal in the receiving streams. Here, we assessed the effect of a by-product rich in sugars (i.e., labile DOM) from the beer brewing process on the $NO_3^-$ removal along flumes filled with gravels fed by a WWTP effluent. Experimental treatments included unvegetated and *Iris pseudacorus* flumes. We quantified the main biogeochemical pathways driving $NO_3^-$ removal (i.e., assimilation, denitrification and dissimilatory nitrate reduction to ammonium (DNRA)) using $^{15}NO_3^-$ additions under unamended conditions and during labile DOM fertilizations. Under unamended experimental conditions, $NO_3^-$ removal was mainly driven by assimilation (up to 98.0% of total uptake). Under labile DOM fertilizations, $NO_3^-$ removal increased by one order of magnitude compared to unamended conditions, and denitrification contributed up to 45% of total $NO_3^-$ uptake. Labile DOM also enhanced the contribution of DNRA to total $NO_3^-$ uptake from <1% to 12.2%. There were no differences between unvegetated and vegetated treatments. Overall, these results suggest that natural $NO_3^-$ removal in receiving urban streams may be limited by the low bioavailability of the remaining DOM present in WWTP effluents and that the use of alternative labile DOM in tertiary treatments may alleviate this limitation and promote permament $NO_3^-$ removal.

## Avaliação da qualidade de microbacia por meio de análises físico-química e ecotoxicológica da água e sedimento do rio Toledo.

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A água e o sedimento do rio são importantes na avaliação da qualidade da bacia hidrográfica. Conforme a metodologia utilizada, o grau de qualidade pode apresentar níveis diferentes. Este estudo teve como objetivo avaliar a microbacia do rio Toledo no Paraná Brasil por meio de métodos físico-químicos e ecotoxicológico. As amostragens foram realizadas bimestralmente no período de julho 2015 e maio 2016 em cinco locais denominados P1 a P5. Avaliaram-se os compostos nitrogenados, fosfatados, pH, oxigênio dissolvidos, demanda bioquímica de oxigênio e coliformes além dos metais pesados (Cu, Zn, Cd, Pb, Cr, Mn, Fe e Al). Os testes ecotoxicológicos foram feitos nos diferentes compartimentos com *D. magna* conforme a ABNT NBR 12713 pois a bacia hidrográfica ao longo de um ano sofre uma sucessão de cultura como soja, milho, trigo e aveia com uso excessivo de defensivos agrícolas e fertilizantes. Como resultados, a água apresentou valores de condutividade e pH em P4 e P5 maior que 60 mg/l e 5,5 respectivamente. O Índice de qualidade de água (IQA) variou entre 30 e 85. Os metais pesados apresentarem valores alarmantes em P1, P2 e P3. Em relação aos nutrientes observou-se maiores concentrações em P4 e P5. As análises ecotoxicológica não apresentaram efeito agudo nos organismos na água, entretanto nos sedimentos os resultados indicaram riscos uma vez que os testes crônicos afetaram a reprodução. O estudo evidenciou que o grau de qualidade difere, conforme o método utilizado sendo a ecotoxicologia do sedimento mais apropriada para avaliação da bacia.

POSTER

## Estudio de las comunidades algales implicadas en el biodeterioro de la Noria Grande de Abarán, patrimonio hidráulico del SE de la Península Ibérica

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Los paisajes culturales agrícolas del sureste de la Península Ibérica incluyen un importante patrimonio hidráulico, a menudo, en mal estado. De madera y con doce metros de diámetro, la Noria Grande de Abarán es la de mayor diámetro de Europa que sigue funcionando y también una de las más antiguas (origen 1805). La presencia de agua unido a la intensa radiación y a las elevadas temperaturas de la zona, además de su falta de mantenimiento, propician la aparición de un rico ecosistema de comunidades algales, que deterioran los elementos estructurales de la Noria. Signos claros de biodeterioro son la formación de biopelículas de distinta coloración dominadas por cianobacterias. En el estudio de la flora algal se han identificado un total de dieciséis taxones, ocho especies incluidas en la División Cyanophyta, una en la División Rhodophyta, una especie en la División Chlorophyta y seis en la División Heterokontophyta. *Scytonema crispum, Gloeocapsa compacta, Gloeocapsa rupestris* y *Gloeocapsa violacea* son las especies dominantes en las muestras estudiadas. La presencia de *S. crispum, Chroococcopsis gigantea, Geitlerinema amphibium* y *Bangia atropurpurea,* es la primera vez que se registra en trabajos de biodeterioro. Estos resultados contribuirán de forma importante a la búsqueda de tratamientos adecuados para la conservación de nuestro patrimonio rural.

# RS12

# Global change and aquatic ecosystems

## Effects of climate change on the distribution of Iberian endemic water beetles

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Ongoing climate change is arguably the greatest emerging threat to global biodiversity. Adapting to this threat will require accurate predictions of how species will respond to future climate, which will play an important role in alerting scientists and decision makers to potential future risks. In the Iberian Peninsula, a region already vulnerable to climate variability, global warming is projected to be especially severe. Climate change will alter the suitability of habitats for a species' establishment, growth, and reproduction, causing species distributions to change. Consequently, the vulnerability of species to global warming will depend on the availability of suitable habitat in the future, but also on their capacity to reach these suitable future environments. This study aims to assess the effects of climate change on the distribution of endemic species of water beetles in the Iberian Peninsula using species distribution models. We modelled the potential distribution of over 80 species under current climatic conditions and in the year 2070 considering two different IPCC warming scenarios and seventeen general circulation models. Vulnerability to climate change was assessed by measuring different parameters of range change in order to account for the degree to which species depend on dispersal capacity to shift their distributions under global warming. Overall, the results show a notable reduction in the potential distribution of the studied species under all the studied scenarios, particularly so for mountain species, and highlight that endemic water beetles can be highly vulnerable to a warming climate.

## Warming effects on freshwater consumer-resource dynamics

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Anthropogenic climate change is likely to rise mean surface temperature up to 4.8ºC over this century. Warming is amongst the major threats to biodiversity across all ecosystems. Ectotherms inhabiting aquatic systems are expected to largely suffer this temperature increase because their body temperature and physiological responses highly depend on the environment. Warming is also expected to have large impacts beyond individual responses, altering consumer-resource interactions. Differences in thermal sensitivities (i.e., energy mismatches) of different energy flow parameters (e.g. photosynthesis, respiration and ingestion) can impact community dynamics and ecosystem functioning. I will present our research on the effects of increasing temperatures on consumer-resource dynamics using populations of *Daphnia pulex* as consumer, and two algal species as resources isolated from warm and ambient mesocosms from a long-term (13 years) experiment. I experimentally tested acute thermal dependencies of different biological rates related to energy flow on single populations and on pairwise consumer-resource interactions using thermal performance curves. We investigated the extent of thermal adaptations of these biological rates on both resource and consumer populations and on their interaction. Our work sheds new light on the consequences of potential mismatches in thermal sensitivities of physiological rates of consumers and resources for community dynamics in an increasingly warmer world.

## Is the Metabolic Theory of Ecology hold under fluctuating temperature and different nutrient conditions?

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The Metabolic Theory of Ecology (MTE) predicts that the temperature increase stimulates the metabolic rates and organisms' growth, this being greater for a heterotrophic than for an autotrophic metabolism. However, no available studies within the framework of MTE have focused on organisms' response to fluctuation at increased temperature or to this factor in interaction with others, such as nutrient availability. In this experiment, we assess how nutrients alter the impact of increased temperature or fluctuation at high temperature on metabolism and species composition of a simplified community composed of a strict autotrophic species (*Monoraphidium minutum*) and a mixotrophic species (*Chromulina* sp.). Our hypothesis is that increased and fluctuating temperature will have a greater positive effect on heterotrophic metabolism and the mixotrophic species abundance, while interaction with nutrients will boost photosynthetic activity and the abundance of strict autotrophic species. Our results showed that increased and fluctuating temperature stimulated all the metabolic variables, but only fluctuating temperature treatment stimulated the respiration (R) rate and *Chromulina* sp. abundance, in agreement with the MTE. When nutrients were added, the interaction with increased or fluctuating temperature stimulated the primary production (PP) and autotrophic species abundance against the heterotrophic metabolism and mixotrophic species abundance, contrarily to the MTE. Moreover, the responses observed demonstrated lower susceptibility of protists to global change and extreme events when nutrient concentrations increased. Our results indicate that a straight application of the MTE to protists does not hold under high nutrient conditions.

## Human enhancement of high-mountain lake productivity throughout history: the case of the ultraoligotrophic Lake Redon (Pyrenees)

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Even seemingly pristine, lakes in the high mountains have been subject to human influence throughout history, changing with technological and social development. A constant of the influence has been a fertilizing effect of the ecosystem by increasing the catchment nutrient load with soil erosion, the modification of the trophic network with fish stocking and the atmospheric deposition. The study of photosynthetic pigments, cladocerans remains, and stable isotopes of carbon and nitrogen in the sedimentary record of the ultraoligotrophic Lake Redon (Pyrenees) revealed these phases over the last 3500 years. Before 2500 years ago, the lake was extremely unproductive and the cladocerans community was restricted to mostly littoral chydorids of broad distribution in the Pyrenean lakes (*Chydurus sphaericus, Alona affinis*). After that, in a few years, the lake productivity markedly increased and the cladocerans community was progressively enriched with littoral and planktonic species (e.g., *Daphnia pulicaria, Eurycercus lamellatus*). At the end of the 15$^{th}$ century, the density of the largest chydorid, *E. lamellatus,* largely declined. Recently, during the last decades, productivity has further increased, and also the *Daphnia* remains. During the historical progressive increase in productivity, the $\delta^{15}N$ was declining from initial values around 4‰ to 2.5‰ during the preindustrial time; however, it markedly shifted to 0.9‰ during the last decades. Ancillary information indicates that the observed major shifts in the lake productivity correspond respectively to the beginning of occasional visits of sheep flocks to the catchment, trout stocking and atmospheric nutrient loading during the current global change.

## Cross-ecosystem effects of the infection of riparian trees by invasive pathogens on leaf litter decomposition in streams

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Invasive pathogens are widespread threats to forests worldwide, but the cross-ecosystem effects they may have on streams are less studied. In this work, the effects of infection of *Castanea sativa* (chestnut) trees by *Phytophthora cinnamomi*, *Alnus glutinosa* (alder) trees by *Phytophtora alni* and *Ulmus minor* (elm) trees by *Ophiostoma novo-ulmi* on leaf litter characteristics and microbial-driven litter decomposition were assessed by incubating senescent leaves from healthy, symptomatic and highly symptomatic trees in stream-simulating microcosms. Tree infection significantly affected litter characteristics and decomposition, although not in a consistent manner across the three tree species. Highly symptomatic chestnut trees had slower litter decomposition than the other health statuses, lower microbial respiration than healthy trees and lower fungal biomass than symptomatic trees, likely as a result of higher litter toughness. Highly symptomatic alder trees had faster litter decomposition and fungal biomass than the other health statuses, higher microbial respiration rates than healthy trees and higher sporulation rates by aquatic hyphomycetes than symptomatic trees, likely as a response to higher litter phosphorus concentration. Finally, highly symptomatic elm trees had faster litter decomposition than the other health statuses and higher microbial respiration rates, fungal biomass and sporulation rates than healthy trees, likely as a response to higher litter nitrogen concentration. Tree infection alters the nutritional quality of leaves, potentially affecting the functioning of aquatic ecosystems strongly dependent on riparian litter inputs. To better characterize the impact of invasive pathogenic species on stream ecosystem functioning further collaboration between forest pathologists and stream ecologists is recommended.

## Heat wave effects on the swimming behaviour of a Mediterranean freshwater fish, the Iberian barbel *Luciobarbus bocagei*

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Heat waves are expected to become more frequent under the ongoing climate change, with freshwater organisms being particularly vulnerable to high temperature fluctuations. In Mediterranean-climate areas, depending on the extent of summer droughts and loss of longitudinal connectivity, river segments may become isolated from upstream or downstream ones, maintaining fish populations confined in series of disconnected pools, with no possibility to move to thermal refuges and thus becoming more prone to stress. In this study, we evaluated the swimming behaviour of an Iberian endemic potamodromous fish, the Iberian barbel *Luciobarbus bocagei*, under experimental mesocosm conditions, following a 6-day exposure to a heat wave, defined as a temperature increase of 5ºC in relation to control temperature (30ºC and 25ºC, respectively). Behavioural parameters such as fish activity, boldness and shoal cohesion were continuously measured at a constant flow velocity of 18 cm/s. Overall, results show that the behaviour of juvenile Iberian barbel is likely to be affected by heat waves, with fish displaying lower activity and boldness, while no clear differences were observed in shoal cohesion. Potential consequences include changes in fish movement patterns and microhabitat use. This study highlights the importance of managing thermal refugia in intermittent rivers. Future studies should focus on the interaction of heat waves with other stressors (such as oxygen depletion), for a broader understanding of the perturbation affecting freshwater fishes.

## Functional connectivity network between anthropogenic and aquatic habitats by a waterbird: implications for contaminant transportation

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Highly mobile waterbirds can act as biological connectors (e.g. transport of heavy metals, nutrients, or pathogens) between habitat patches providing functional connectivity. Here we used GPS data of the Lesser black-backed gull (*Larus fuscus*), to create an inter-habitat connectivity network among anthropogenic terrestrial environments and freshwater habitats within the wintering area of Andalusia, Spain. We acquired data for 42 tagged individuals, and identified 5,676 direct flights that connected 37 nodes, classified into seven habitat types. Overall, 90% of all direct flights were connected to rubbish dumps, thereby connecting anthropogenic and different aquatic habitats, such as lakes, ricefields, marshlands and reservoirs. Connectivity decreased with distance between nodes and was concentrated within 10 independent functional units, in which gulls normally feed in a rubbish dump and roost in one or several aquatic environments. Within a functional unit, gulls are more likely to transport biotic and abiotic materials between particular wetlands and rubbish dumps. We provide a detailed example of heavy metal internal transportation from rubbish dumps to a particular lake, Fuente de Piedra (Malaga).

## Charophytes: freshwater key players under global change

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Charophytes (submerged macrophytes) form dense meadows playing crucial roles for the structure and functioning of freshwater ecosystems. These roles involve all the system's components from the underlying sediment with the microbial community to the planktonic and benthic communities living within the meadows or on their surface, respectively. The current global change is affecting this complex multi-interaction network, especially in the small and shallow waterbodies of the Mediterranean region. By means of experimentation, at both microcosm and mesocosm scale, we have tackled two important questions: (i) how will charophytes respond to concomitant environmental variations related to global change? and (ii) how will the structure of the freshwater multi-interaction network be affected by these changes? The expected temperature increase accompanied by higher evaporation and the consequent increases in salinity, nutrients, and UV radiation doses produce a sort of antagonistic and synergistic effects on the vulnerable charophytes. In general, higher temperature mitigates the harmful effects of other factors and the responses are species- and population-specific. Moreover, we highlight i) the role of the structural tandem "charophyte-large zooplanktonic herbivorous" bringing together the global multi-interaction network and ii) the influencing role of the periphytic community attached to charophytes on the other elements, mainly through indirect interactions. These and other important relationships of the multi-interaction network have resulted sensitive to foreseeable environmental changes. Our results are relevant to place the biodiversity-function relationship in freshwater ecosystems within the framework of the current global change and will be of direct applicability in the restoration and conservation of wetlands.

# Evidence of early settlement of the Azores archipelago using a high-resolution paleolimnological approach

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The discovery and settlement of the Azores archipelago is generally attributed to the Portuguese during the XV$^{th}$ century, but recent insights have raised questions about whether the islands were discovered earlier. Paleolimnological data from São Miguel suggest that the island was settled 150 years before the official Portuguese arrival date. To pinpoint the date of first human arrival in the archipelago, we performed multiproxy characterizations (e.g. pollen, diatoms, chironomids, XRF geochemistry, faecal related organic compound) using long continuous sequences of natural lacustrine sedimentary archives to reconstruct past environmental changes for the last millennium across four of the nine islands of the Azores archipelago. We have found evidence of livestock introduction (incl. spores of coprophilous fungi, sterols), extractive forestry, and cereal cultivation around 1150 CE in two islands of the archipelago. After this first human impact period an extensive deforestation and the large-scale introduction of exotic species have reshaped the lake and island ecosystems and sedimentary dynamics to present-day status. Hence, our results suggest that the human impact in the Azores archipelago started approximately three centuries prior to the official occupation of the archipelago.

## The drastic loss of Laurisilva forest after human arrival: A case study from Corvo Island

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Humans are a well-known threat to island biodiversity; however, the magnitude and dimension of flora loss is often not well understood. On Corvo island, in the Azores Archipelago and one of the most remote islands of the North Atlantic Ocean human land-use changes had a strong impact on the structure and function on its ecosystems. For instance, people removed the natural Laurisilva forest that dominated the island, resulting in the expansion of *Sphagnum*-dominated environments. In this study we obtained a 2000-year long plant macrofossil record from a sedimentary core in Lagoa do Caldeirão (400 m a.s.l.). We reconstructed the Laurisilva phytocenosis that surrounded the lake: *Juniperus brevifolia* and a rich epiphyte community of bryophytes and pteridophytes dominated a dense Laurisilva forest until the mid-12$^{th}$ century. A significant increase in the fragmented wood remains and charcoal particles between the mid-12th and 15th centuries signifies the onset of deforestation. In the second half of the 16th century, abrupt changes in vegetation occurred with the disappearance of the laurel forest. From the 17th century to the present day, pressure from livestock on the island led to a progressive increase in the abundance of *Sphagnum* and associated grassland species. The non-natural conditions of the present-day *Sphagnum*-dominated habitat illustrates a prime example of why the Habitats Directive of the EU requires a long-term perspective.

POSTER

## Study of the influence of land use changes on hydrological flows in the River Guadiamar basin (SW, Spain).

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The hydrological cycle is threatened by the changes of land use which are promoting an increase of water scarcity in the socio-ecosystem of Doñana, even enhanced by the effects of climate change. Land uses are related with the distribution of rainfall into different types of flows, the green water (evapotranspiration) and blue water (runoff and recharge) flows. This study assesses the influence of these land uses on the provision of hydrological flows in the River Guadiamar basin, which represents a large part of the Doñana´s socio-ecosystem. The hydrological model BalanceMED is used to quantify the hydrological functioning of this catchment through a georeferenced database. The results of the model are then weighted, taking into account the quantification of the land use changes occurred from 1956 to 2007. The results show by the one hand that land use and vegetation cover determine both types of hydrological flows, especially the magnitude of the green water flow. On the other hand, over the years, there has been an increase of the surface dedicated to irrigation, resulting in an extra supply of blue water flow that is not sustainable in the long-term. In contrast, the traditional rainfed agriculture has solely depended on the green water flow. This study highlights the importance of paying greater attention to the green water flow when managing water resources in the region, focusing on a more efficient agriculture in terms of water consumption to conserve the natural ecosystems. Ultimately, the idea of an integrated management of land and water uses is reinforced.

POSTER

## Ecophysiological responses of aquatic hyphomycetes to climate change related stressors

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Climate change may lead to an increase in water temperature, in drought events and in the concentration of dissolved nutrients. Aquatic hyphomycetes are the major microbial decomposers of plant litter in streams and play a key role in carbon and nutrient cycling. Therefore, it is important to ascertain how aquatic fungi cope with climate change stressors. We selected 24 fungal strains (isolated from streams with different ecological state, based on their co-occurrence in streams and their phylogenetic relatedness) and measured the growth rate at different temperature (5ºC, 10ºC, 15ºC, 20ºC, 25ºC, 30ºC and 35ºC), drought (0%, 20%, 30%, 40%, 50% and 60% dehydration) and nutrient enrichment (N-NO3/P-PO4: 0/0, 50/3, 200/12, 500/30, 2000/120 and 5000/300 µg/L). We determined the thermal performance curves for fungal growth and their cardinal temperatures: 5ºC was the Tmin for 3 strains; optimal temperature ranged between 15 and 25ºC; and Tmax varied between 30 (8 strains) and 35ºC (15 strains). Under drought conditions, we observed a 4.4 to 51% growth inhibition (9 strains), 5.6 to 23% growth stimulation (11 strains) and 6 strains were not affected. Concerning nutrient enrichment, 11 strains decreased their growth between 5.7 and 44.5% at higher N/P concentrations, 4 strains increased their growth by 4-11.5% and 8 strains were not affected. Interestingly, the strains collected from streams with good ecological state were the most affected by nutrient enrichment. Phylogenetic relatedness did not always translate into similar responses to the stressors.

POSTER

## Anticipated effects of acacia invasion of riparian areas on streams – a conceptual model

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Biological invasions are major threats to ecosystems worldwide, leading to changes in community structure, which can result in biodiversity loss and impair ecosystem functioning. The invasion of riparian forests by exotic woody species can affect stream ecosystems given their large aquatic–terrestrial interface and strong dependency on the riparian vegetation. Invasion by alien nitrogen-fixing woody species can be particularly troublesome but studies on their effects on stream ecosystems are scarce. I present a conceptual model to predict the effects of the invasion of riparian forests by alien nitrogen-fixing woody species on stream ecosystems, focusing on the invasion of temperate deciduous forests, with reduced representation of native nitrogen-fixing species, by *Acacia* species. Predicted effects include increased water nitrogen concentration due to nitrogen-rich soil leachates and decomposition of nitrogen-rich litter and lower water availability due to higher water consumption by dense stands of fast-growing, evergreen acacia trees. The characteristics of litter inputs to streams will also change, with, e.g., less diverse inputs entering streams in acacia stands, probably more evenly distributed throughout the year. Consequently, aquatic communities and ecosystem processes (e.g. litter decomposition) will likely be affected. The magnitude and direction of the effects will depend on the extent and duration of the invasion, with stronger effects when streams flow through pure acacia stands that have been establish for long. Effects will also depend on acacia species and composition of native forests, with stronger effects when traits of the acacia species are underrepresented or absent in the native vegetation.

POSTER

## Surveillance of mosquitoes communities (Diptera: Culicidae) as a preventive measure to face global change and the possible arrival of invasive vector species in Galicia (NW Spain) (ReGaViVec)

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The foreseen climate change scenarios indicate an increase in average temperatures and a decrease in rainfall, which is, simultaneously, associated with increased adverse weather conditions such as torrential rains and floods. These latter stimulate the emergence of breeding sites for species that directly depend on water to complete their life cycle, such as mosquitoes (Diptera: Culicidae), which are capable of invading practically any reservoir of stagnant freshwater. On the other hand, high temperatures not only enhance a greater abundance of these insects but also their vector competence, which is especially worrying in those species capable of transmitting serious diseases such as dengue and chikungunya. In this context, the tiger mosquito (*Aedes albopictus*) is the main cause of concern because of its high invasive capacity. As a result of global climate change, it is estimated that certain areas of the Iberian Peninsula such as Galicia (NW Spain) will become ideal climatic spaces for the development of culicid species coming from subtropical environments, like the tiger mosquito. Due to this, in 2017 the "Xunta de Galicia" established the surveillance network "Rede Galega de Vixilancia de Vectores (ReGaViVec)" as a preventive measure to monitor populations of mosquitoes in the region by setting and collecting specific traps at strategic points. The results not only allowed to detect the presence and distribution of a large number of vector mosquitoes in the Galician territory, but also showed a general enlargement of their active period probably linked to climate change effects.

POSTER

## Integrating physiology into assessments of the vulnerability of aquatic insects to global change

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Knowledge of the physiological capacity of aquatic organisms to deal with changing environmental conditions is essential for evaluating their vulnerability to climate change. Thermal performance curves (TPC) describe the effects of temperature on organismal performance, and can be incorporated into mechanistically based models of responses of species to climate change. However, this is a challenging issue given the difficulty in capturing the complexity of physiological responses through experimental studies, especially considering the great diversity of physiological parameters, their plasticity and the importance of multiple stressors in aquatic ecosystems. In this study, we are conducting an integrative assessment of vulnerability to global change of water beetle species from freshwater and saline aquatic habitats, combining distributional and climatic data with experimental measurements of TPCs for metabolic rates and locomotory performance. Such traits are evaluated considering the specific multiple stressor context of each system, by acclimating individuals at different combinations of the main abiotic stressors of their habitats (e.g. desiccation, salinity and different thermal regimes for saline species). The results of this study will provide important insights into how aquatic insects deal with climate change. As macroinvertebrates are a fundamental part of the aquatic biodiversity and are early response indicators of global environmental changes, such information will be also pivotal for defining management and conservation strategies to mitigate the negative effects of climate change on aquatic communities.

POSTER

# Non-pollen palynomorphs preserved in sedimentary archives of Lake Caldeirão, Azores: Fungal and algal remains as paleoecological indicators

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Non-Pollen Palynomorphs (NPPs) are sub-fossil remains from a wide range of organisms that can be sensitive to various ecological and/or anthropogenic factors. These microfossils include the remains of fungi, algae and invertebrates. Here we describe NPPs from the sedimentary record of Lake Caldeirão (Corvo Island, 400m a.s.l.), which spans the last two millennia. There are three successional NPP assemblages that track changes from a pristine ecosystem to an area severely altered by human activities. 1) The first assemblage includes diverse fungi wood saprophytes and mycorrhizae, indicating a pristine forest, and a set of aquatic fungal species associated with littoral plant communities. 2) This is followed by an increase in hyphomycetes conidia from decaying wood, and ascospores from the forest pathogen *Kretzschmaria deusta.* This assemblage also includes Glomeraceae, which is derived from a forested landscape that is disturbed by soil erosion and herbivores. The NPP assemblage points to the major transformation of the landscape from a forest to open grass and wetlands. 3) The most recent assemblage is dominated by ascospores of the coprophilous fungi (*Podospora* spp. and Sordariaceae) found in the faeces of pasture-livestock. This interpretation is supported by the presence of *Lacunastrum* and *Desmodesmus*, planktonic algae, which are associated with nutrient enrichment. The use of NPPs will improve palaeoenvironmental reconstructions from the Azores, although further studies of modern analogues are required to get a better understanding of the specific habitats associated with particular NPPs.

POSTER

# Monitoring the response of Maltese microalgae to climate variability

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Research into the effects of global climate variability (GCV) on microalgae is generally lacking, with bloom-forming cyanobacteria being the exception. This study aimed to assess morphological and biochemical changes in different strains of Maltese microalgae by replicating climate change parameters within a laboratory setting. These included increases in temperature (T), exposure to ultraviolet radiation (UV) and carbon dioxide ($CO_2$) concentration. These set parameters were based on the 2014 IPCC predictions, which estimate a $CO_2$ concentration of 800 ppm and a 4 °C increase in temperature by the year 2100. A six-month study has been conducted on the freshwater filamentous cyanobacterium *Nostoc* sp. AD0303 and the coccal chlorophyte *Jenufa* sp. AD0402. Increased UVR had the most pronounced effect on the morphology of cells. In fact, *Nostoc* sp. AD0303 presented as aggregated filaments, whereas *Jenufa* sp. AD0402 exhibited thicker cell walls. Such morphological adaptations protected against elevated UVR and allowed both strains to accumulate biomass at a significantly higher rate than the control. An elevated $CO_2$ concentration resulted in an inhibition of growth in *Jenufa* sp. AD0402 and bleaching of filaments in *Nostoc* sp. AD0303, both leading to culture death. An increase in T stimulated growth and biomass accumulation of *Nostoc* AD0303, whereas growth of *Jenufa* AD0402 was partially inhibited. The study is ongoing with two halotolerant strains; the cyanobacterium *Calothrix* sp. SLM02-11and the chlorophyte *Coelastrella* sp. SLM05-03. So far, our findings indicate that the effects imposed by GCV are strain-specific, making changes at an ecosystem level difficult to predict.

# RS13

# Ecosystem services

## How management scenarios affect the provision of ecosystem services from soils and sediments in a Mediterranean catchment

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Both "grey" (e.g. check-dams), and "green" infrastructures or "nature-based solutions" (e.g. reforestation, buffer lines) are widely applied to regulate river fluxes of water and sediments. All these interventions have impacts on the soils of the catchments and on the geomorphological and ecological dynamics of rivers, and thus on the ecosystem services provided by them (e.g. soil condition, climate regulation, moderation of extreme events, water provisioning). We present an assessment of the provision of ecosystem services under different management scenarios related to land use change, hydrological control works and reforestation for a medium-sized catchment (~300 km$^2$) in Southeast Spain. The area represents many of the main land use changes and management interventions of Mediterranean catchments in the last century. The work combined field and modelling data collected over the last decade, value and multi-criteria analyses, including the perspective of different management plans affecting the catchment. The results show that 'green' solutions, respecting landscape and ecological dynamics, are more sustainable and cost-effective in the medium and long term than scenarios based on "grey infrastructures", although the latter could have more immediate short-term impacts. The value analysis reflects how there are some concepts, such as ecosystem services, that could easily be deeper incorporated into several environmental management plans. When choosing a management scenario, this needs to be adapted to the local environmental conditions and to the specific objectives of the restoration works. Tailor-made management scenarios taking into account local conditions and specific management objectives can optimize resources and achieve medium to long-term sustainability.

## Engaging communities into ecosystem services - Innovating with nature towards an integrated landscapes management

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The alterations on Ecosystems composition, structure and dynamic produced by anthropogenic and natural factors can be described as part of the global change process. These threats can cause losses of biodiversity and Ecosystem Services (ES) supply. The implementation of Blue and Green Infrastructures (BGINs) have been studied as a landscape planning instrument to optimize the spatial arrangement of ecosystems to promote nature conservation, while delivering ES to populations. BGINs reduce vulnerability and exposure to climate variability, improve human health, social and economic wellbeing, environmental quality, and livelihoods. The implementation of BGINs will depend primarily on the needs and potentialities of each territory, acting accordingly the stakeholders' interests. ALICE is a project with eleven partners from Portugal, Spain, France, Northern Ireland and United Kingdom which aims to promote sustainable investments in BGINs through identification of the benefits of ES delivered at the terrestrial-aquatic and land-sea interface in the Atlantic Region. To assess the major environmental issues in Paiva River (Portuguese case study), a participatory process involving national to local stakeholders was developed. Through a process of collaborative mapping, the identification and prioritization of the Paiva catchment major problems and ES delivery, were structured towards the aim of the project. This approach also involved the development of participatory scenarios to identify the barriers and benefits of the BGINs implementation to promote ES and biodiversity. Overall, this study aimed to develop participatory learning approaches to engage local stakeholders for valuing BGINs in Atlantic landscapes towards a smart, sustainable and inclusive management.

## Nutritional quality indices for freshwater resources at La Plata Basin for human health as an ecosystem value concept

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The aim of this work was to study some freshwater aquatic animals (crustaceans and fishes) of La Plata Basin as good quality nutritional resources and compare them with marine species. Protein and lipid contents, and fatty acids and aminoacids profiles were evaluated in the muscle of freshwater crustaceans (*Macrobrachium amazonicum*, *M. borellii*, *M. rosembergii*) and fishes (*Leporinus friderici*, *L. obtusidens, Luciopimelodus pati, Prochilodus lineatus, Pseudoplatystoma corruscans*), and then it was compared with marine species (crustacean: *Penaeus monodon*; fishes: *Merluccius merluccius, Thunnus obtesus, T. albacares*). Fatty acids and aminoacids compositions were used to investigate the nutritional quality through indicators such as atherogenicity index (AI), thrombogenicity index (TI), hypocholesterolemic/ hypercholesterolemic ratio (h/H), n3/n6 ratio, essential amino acids/total amino acids (EAA/TAA), functional amino acids/total amino acids (FAA/TAA) and Arg/Lys ratio. Lipids content was higher in fishes (0.5-2.4 %w/w) than prawns (0.4-1.4%w/w), being similar between freshwater and marine species. The AI and TI values were low in freshwater species and like marine species; the lowest values correspond to *Leporinus* (Boga), and then *Pseudoplastystoma* (Surubi) and *Luciopimelodidus* (Pati). The higher values of h/H ratio correspond to Boga and Surubi, while marine species had a higher n3/n6 ratio. Freshwater species are rich sources of protein like marine animals, having crustaceans the highest values. Approximately, 50% correspond to EAA. FAA was higher to 60% of the total AA and the relation between Arg and Lys was near to 1. Thus, the freshwater species of La Plata Basin provide, as ecosystem service, good resources nutritional for human health.

## The certification of salt as a producto, process and landscape: a tool to value one of the NCPs of saline wetlands

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Wetlands are one of the major ecosystems that provide nature's contributions to people (NCP). They are also among the best studied ecosystems, because of their interest, complexity and vulnerability. Nor have the NCPs (or, for that matter, the ecosystem services) of solar evaporation ***salinas***, a subtype of saline wetland of major importance in the Mediterranean region, been considered with enough attention. In this contribution, special attention is given to salt as one of these contributions from solar evaporation ***salinas*** located in Natura 2000 sites in Spain and Portugal. By designing a salt certification system, the aim is to highlight not only the product itself and its quality, but also the process of obtaining it, using techniques that respect the natural values of the site. Therefore, the landscape as a whole is also preserved. There are many certification mechanisms, quality seals, organic production certificates, etc., but so far none has been designed to encompass aspects related to the product, the process and the landscape with the same emphasis. This work, which forms part of the Life SALINAS project, is being developed in four pilot solar evaporation ***salinas*** in Spain and Portugal, but it is intended to be used in any other ***salina***, regardless of their location, size or scale of production.

## Contributions of dry rivers to human well-being: a global review

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Over the past three decades, many perennial rivers have been assessed in terms of ecosystem services (ES), unlike non-perennial rivers. These last ones, both intermittent and dry rivers, are the most widespread rivers in the world. In addition, according to the climate change scenarios, the number of non-perennial rivers will increase in the future. The social undervaluation and the scientific-technical difficulties to study these rivers have led to a lack of knowledge. Nevertheless, several publications have emerged recently claiming ES and human well-being that these rivers provide. The objective of this study is to analyze the state of the art of research on ES in dry rivers. Here, we define dry rivers as channels where surface water is only present during short time (few weeks, days or hours) after heavy rainfalls. In order to achieve the objective, we performed an exhaustive search of scientific literature. Initially, 607 articles were found, but only 86 were selected to analyze their bibliometric variables (e.g. number of publications, affiliation country, etc.) and their thematic contents (ES, indicators, etc.). The first ones were assessed by bibliometric analysis and the contents were assessed by clustering and statistical and descriptive analysis. The ES that appear most frequently linked to dry rivers are food, freshwater, habitat maintenance and recreational activities, while the most prominent drivers of change are climate, land use, demography and sociopolitical changes. Many gaps of knowledge and challenges are highlighted. These gaps must be investigated in the future for a sustainable management of these ecosystems.

## Assessment of microbiological quality parameters as regulation services' indicators in Urdaibai's Biosphere Reserve, Basque Country, Spain

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Aquatic ecosystems provide several regulation services that are closely related to their quality. The Water Framework Directive proposed a series of indicators to assess the quality status of water bodies around Europe. Nevertheless, in all cases microbiological quality has been assessed through physicochemical proxies (i.e. BOD). Indeed, microbiological indicators that are important for public health, like total and faecal coliforms (i.e. *E. coli* and/or *Enterococcus*) are monitored regularly, but the ecological quality is established without considering them. The microbiological composition of water bodies could be a better indicator of contamination by municipal wastewater and of quality of the ecosystems than the parameters actually in use and might be potentially a more useful proxy for water regulation ecosystem services assessment (i.e. self-purification). We evaluated several microbiological parameters in Urdaibai's Biosphere Reserve, obtained from the surveillance networks from the Basque Water Agency and estimate their correlation with the physicochemical parameters. Finally, an indicator that integrates such information is proposed, showing the actual water self-purification capacity in the Urdaibai's Biosphere Reserve.

POSTER

# Diversidad funcional y flujo de servicios hidrológicos en cuencas de altura en pastizales naturales y forestadas con pináceas exóticas

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La forestación de cuencas en pastizales modifica el hábitat fluvial afectando la composición de especies, el funcionamiento del sistema y la provisión de servicios ecosistémicos. En este trabajo se analiza: i) el flujo de servicios en microcuencas en pastizales naturales y forestadas con pináceas exóticas de las sierras de Córdoba, Argentina; ii) la relación entre la diversidad funcional (DF) de las comunidades acuáticas con la provisión de servicios. En 3 cuencas en pastizales y 3 forestadas se estimaron 4 servicios de regulación (biodiversidad acuática, descomposición de materia orgánica, secuestro de carbono, purificación del agua) y 1 de abastecimiento (cantidad de agua) mediante 6 variables proxy: riqueza algal y de macroinvertebrados, tasa de descomposición de materia orgánica, desarrollo del biofilm, concentración de nutrientes y rendimiento hídrico. La DF de la comunidad algal y de macroinvertebrados fue calculada como Entropía Cuadrática de Rao y Divergencia Funcional mediante la asignación de rasgos funcionales. El flujo de servicios fue diferente entre las cuencas. En pastizales se registró mayor biodiversidad y mayores caudales mientras que las cuencas forestadas presentaron mayor tasa de degradación de materia orgánica (eje 1, Análisis Componentes Principales, ACP). La DF algal se correlacionó con el eje 1 del ACP (r Pearson = 0,53; $p < 0,01$) mientras que la DF de macroinvertebrados no mostró asociación con este eje (r Pearson = - 0,19; $p = 0,38$). Los resultados sugieren una modificación en el flujo de servicios en las cuencas forestadas, que podría evaluarse analizando la diversidad funcional de la comunidad algal.

# SS1

# New challenges in management water and aquatic ecosystems in a changing world

## New Challenges towards an integrated watershed management improving biodiversity conservation and ecosystem services

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Ecosystems composition, structure and dynamic are changing across the globe as a response to different pressures. Consequently, the overexploitation of ecosystems, introduction of invasive species, alteration of biogeochemical cycles and climate and land use/cover changes, are real threats to the natural environment and populations as well. The impact of these factors can cause losses of biodiversity and Ecosystem Services (ES) supply. The long-term functioning of the biosphere and human well-being rely mostly on the good status and resilience of natural and semi-natural ecosystems. The implementation of Blue and Green Infrastructures (BGINs) have been studied as a landscape planning instrument to optimize the spatial arrangement of ecosystems, habitats and practices to promote nature conservation, while delivering ES to communities. The implementation of BGINs will depend on the needs and potentialities of each territory, acting accordingly to stakeholders' interests. Therefore, the premise of ALICE project **https://project-alice.com/** is to demonstrate the benefits of implementing BGINs within the EU Atlantic Region, to enhance the delivery of ES and biodiversity. This project is focused on a catchment scale approach to identify the benefits delivered by the introduction of potential BGINs under different future scenarios for each of the ALICE Case Studies (Northern Ireland/ Republic of Ireland, France, Spain and Portugal). Here we will focus on the Portuguese CS. The key objective is to develop a full-package of new methods and tools to assist with riverine and inland landscape management, based on participative learning and modelling processes, accounting for stakeholders' interests, incorporating socioeconomic and climate change scenarios.

## Gestão ambiental de rodovias: um caminho para a conservação de invertebrados aquáticos

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Este trabalho tem como objetivo demonstrar como a gestão ambiental de obras de infraestruturas rodoviárias pode contribuir para a minimização dos impactos nas comunidades de invertebrados aquáticos e assim contribuir para a sua conservação. O Instituto Tecnológico de Transportes e Infraestrutura, da Universidade Federal do Paraná, executa programas ambientais durante a implantação e manutenção de empreendimentos rodoviários desde 2008 em diversos estados do Brasil, onde já foram desenvolvidos 26 projetos, dos quais, 16 englobam ecossistemas aquáticos. Em três desses projetos foi realizado o monitoramento da fauna aquática, de acordo com a Instrução Normativa Nº 13 de Julho de 2013 do Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) que estabelece procedimentos padronizados de amostragens, exigidos para o licenciamento ambiental de rodovias e ferrovias. Essa determinação ampliou o monitoramento nos recursos hídricos e da biota aquática, contribui na orientação de empreendedores para utilização de práticas ambientalmente adequadas, propiciou a formação de um banco de dados sobre diversidade de invertebrados aquáticos em diferentes regiões do país e possibilitou o aumento do conhecimento sobre a ocorrência e ecologia das espécies. O material biológico é depositado em instituições que se comprometem a disponibiliza-lo para atividades de ensino e pesquisa. Desta forma, busca-se aliar o desenvolvimento econômico e social com a preservação da qualidade ambiental. Os desafios para a eficácia na aplicação da Instrução Normativa concentram-se principalmente na falta de profissionais capacitados para a identificação taxonômica e o tratamento dos dados, incluindo métricas específicas para regiões com características hidrogeológicas distintas.

## Performance of a surface constructed wetland designed as a polishing and naturalizing final step of a sewage treatment plant effluent

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Polishing constructed wetlands are designed to improve the quality of effluents of wastewater treatment plants (WWTP). They may serve to further assimilate the water features to those of the receiving environments, thereby resulting helpful for Mediterranean basins where these discharges usually constitute an important hydric contribution. Such wetland type operates experimentally as a tertiary-treatment of a part of the effluent of the WWTP of Quart-Benàger (Valencia, Spain). This is a narrow stream of nearly 400 $m^2$ surface and a maximum depth ~1 m. Routine monitoring demonstrated an efficient settling of solids and removal of organic loads and nitrogen, regulated by inlet loads, temperature and water flow. Shifts in the optical characteristics of the dissolved organic matter indicates changes in its nature and degradability, as well as an enhancement of bacterial activity with increased hydraulic retention. To assess parallel changes in the prokaryotic community structure of water samples we performed a MiSeq-Illumina sequencing. The dominance of Proteobacteria, Bacteroidetes, Firmicutes and Actinobacteria, as well as the recently identified candidate phyla group Patescibacteria, remained after passing the wetland, although proportions varied. In this sense, microbial guilds typical from wastewater, as sulfur-oxidizers and denitrifiers, decreased in favor of aerobic heterotrophs and autotrophs. Our findings in this pilot scale system will help to define operational settings that improve both the removal of chemical pollutants and the establishment of microbial communities more suited for the receiving riverine environments.

POSTER

## Possible effect of microplastics in water and sediments on the aquatic macroinvertebrates communities in Pontevedra rivers (NW Spain)

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Microplastics are defined as plastic particles with <5 mm size, which can be found in both terrestrial and aquatic ecosystems (Horton *et al.*, 2017). Their abundance and distribution in marine ecosystems has been wide studied in the last decade as an important element of ecological impact; nevertheless there are not many studies based on the impact of these pollutants presence in freshwater ecosystems. Despite this, a huge range of microplastics has been identified in different concentrations in water and sediment samples from lakes, rivers and estuaries around the world. Different types of microplastics are consumed by organisms from multiple trophic levels and feeding guilds (e.g. zooplankton, macroinvertebrates, fish and marine mammals) and can be transferred from prey to predators. Because of these reasons we have delimitated three main objectives to assess the microplastics effect on macroinvertebrates in Galician rivers (NW Spain): building a sampling design to detect and analyze microplastics associated to water, biota and sediment of the river (i); carrying out two samplings during 2020 (spring and summer) in order to know the biological communities and the environmental conditions (ii); and assessing the diversity and abundance of the biological communities according to the microplastics presence in water, biota and sediments (iii).

POSTER

# Corrective measures to improve the conservation status of the Minho River international basin

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The international basin of the Minho River is one of the most important natural areas in the northwest of the Iberian Peninsula. A clear example is the high surface area included in Natura 2000, with 3 SPAs (Special Protection Areas) and 8 SCIs (Sites of Community Importance). In the last few years, within the cooperation framework between Galicia and North Portugal, environmental monitoring and surveillance programs have been intensified. Thus, since 2017, the University of Vigo is part of the Interreg Project VISIT RIO MINHO (POCTEP), whose main objective is to guarantee the preservation and enhancement of the natural resources of the basin. Among several actions, during this time the ecological status of the main freshwater bodies inside the basin has been monitored (i) and an inventory was made of the different species and types of habitats found in the Minho basin (ii). Moreover, part of the effort focused on detecting the main ecological threats that may endanger the international basin of the Minho River. Therefore, this communication will show several corrective suggestions to improve the conservation status of the basin.

POSTER

# Conservation and management of freshwater pearl mussel *Margaritifera margaritifera* and its host (Brown trout - *Salmo trutta fario*) in Portugal

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Freshwater bivalves are among the most endangered faunistic groups worldwide. These mollusks perform important functions like water filtration and nutrient recycling in sediments, contributing to the ecological integrity of aquatic ecosystems. The conservation and management of *Margaritifera margaritifera* populations in Portugal, a Critically Endangered (CR) species, depends on the knowledge of their distribution, population structure, reproductive success, threats and also on the host fish species, the brown trout, *Salmo trutta*. This project presents the conservation and management actions that are being developed in rivers of northern and central Portugal, namely A) in situ: (i) determination of the extent, detailed distribution and conservation status of the target species; (ii) assessment of the biological and ecological quality of salmonid rivers; (iii) analysis of vulnerability to climate change, introduction of invasive alien species and other regression factors; (iv) implementation of habitat rehabilitation; (v) development of management and legislation measures and (vi) monitoring the river restocking of *M. margaritifera* and *S. trutta*; B) ex situ: (i) captive breeding of *M. margaritifera*; (ii) captive breeding of *S. trutta*; (iii) genetic characterization of wild *S. trutta* populations, including the selected stocks for captive breeding.

# SS2

# The nitrogen cycle in inland waters: natural and human-driven processes

## High rates of $N_2O$ production by comammox nitrification and denitrification in the water column of reservoirs

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Human activities can promote $N_2O$ production due to nitrogen inputs in inland waters associated with urban and arable land use. Both nitrification and denitrification produce $N_2O$ depending on oxygen availability. $N_2O$ production in inland waters have mainly focused on rivers or lake sediments, and the water column has received less attention. Here we quantified the production of $N_2O$ by nitrification and denitrification using $^{15}N\text{-}NH_4^+$ and $^{15}N\text{-}NO_3^-$ at different depths in a shallow (i.e. Cubillas) and a deep reservoir (i.e. Iznájar) with nitrogen inputs from the watershed. We performed the incubations at the beginning and the end of the stratification period to explore the effect of oxygen availability on $N_2O$ production. We detected high nitrification (i.e., $NH_4^+$ to $NO_3^-$) rates in both reservoirs, reaching up to 13000 nM $day^{-1}$ in Cubillas reservoir, and up to 9300 nM $day^{-1}$ in Iznájar reservoir. We did not detect significant ammonia oxidation to nitrite. Therefore, we think nitrification through the complete ammonia oxidation to nitrate (i.e., comammox) may be occurring in these reservoirs. The $N_2O$ production by nitrification reached up to 35 nM $day^{-1}$ in Cubillas and 69 nM $day^{-1}$ in Iznájar. The production of $N_2O$ by denitrification was higher than the production by nitrification, with the maximum values located at the bottom of Cubillas reservoir (134 nM $day^{-1}$) and in the hypolimnion of Iznájar reservoir (125 nM $day^{-1}$). These results suggest that water columns of reservoirs are important sites for $N_2O$ production by both comammox nitrification and denitrification.

## Bringing carbon bioavailability into the nitrogen cycling in urban streams

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In this talk we aim to stress the relevance of the biogeochemical interactions among different key bioreactive elements to better understand nutrient cycling in fluvial ecosystems. In particular, we will conceptually argue that removal, retention and transformation of dissolved inorganic nitrogen (DIN) in streams can be influenced by the bioavailability of dissolved organic matter (DOM). DOM is a source of carbon that fuels in-stream metabolism; and as such, it can determine the fate of DIN in streams by mediating interactions between assimilatory (heterotrophic uptake) and dissimilatory (e.g., nitrification end denitrification) pathways of N cycling. Low concentration of labile DOM may confer an advantage to nitrification. Conversely, high concentration of labile DOM may confer an advantage to heterotrophic uptake and denitrification, thereby increasing the fraction of DIN that is retained. We will provide empirical support to these conceptual ideas based on studies conducted in urban streams receiving inputs from wastewater treatment plant (WWTP) effluents. These streams provide key scenarios to test our working hypothesis since inputs from WWTP not only increase the concentration of key bioreactive elements, but they shift their relative availability. We will experimentally show that these conditions can induce limitation of rates for some N cycling processes, such as net N removal; and thus, providing biogeochemical understanding on how we can increase N removal in urban streams subjected to high N loads. Finally, we will also discuss how these trends may vary in streams under more pristine conditions.

## Agricultural and urban delivered nitrate pollution input to Mediterranean temporary freshwaters

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Nitrate dual stable isotopes ($\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$) is a powerful technique to trace nitrate sources and transformations in freshwater systems worldwide. However, most studies have focused on perennial systems, and less is known about intermittent ones. The impacts of agriculture and wastewaters in Doñana (SW Spain), an iconic Mediterranean temporary wetland protected as a UNESCO World Heritage Site, were quantified using stable isotope mixing models in a Bayesian framework under different denitrification scenarios. We aimed to identify the main nitrate sources and transformation processes in surface waters of interconnected temporary streams, ponds and marshes, and link them with the main human pressures in the watershed (e.g. intensive fruticulture, urban wastewaters). We measured nitrate ($NO_3^-$) concentrations and stable isotopes ($\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$) in water samples collected during different periods over two years (2015-2016). Most sites showed coupled increases of nitrate isotopic values ($\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$), which were higher than reference values of any possible sources (e.g. synthetic/organic fertilizers and wastewaters). The main nitrate sources to the watershed were linked to agricultural practices and the use of synthetic fertilizers, but further investigations in other transformation processes that occur simultaneously should be evaluated. High isotopic fractionation (ε) was observed in most samples, which is typical during denitrification (ε= -5 to -40‰) but not during other processes. The highest fractionation values were observed in those sites predominantly surrounded by agricultural land. These results highlight an important nitrate removal capacity (i.e. denitrification) of the system which may positively contribute to natural resilience against eutrophication.

## Nitrogen terrestrial sources and biofilm growth in Arctic aquatic ecosystems

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The Arctic is warming at over six times the rate of the global average, causing permafrost thaw through the gradual deepening of the active layer and increasing soil mass wasting processes. These climate-driven changes will affect the hydrological and hydrochemical fluxes reaching aquatic ecosystems. However, it is unclear how nitrogen sources and the ecological consequences will change in high-latitude running waters. In this talk, we will (i) assess the biogeochemical role of high-Arctic riparian soils as sources of nitrogen, and (ii) evaluate how stream nitrogen concentrations influence biofilm accrual. We sampled two riparian areas and six stream reaches subjected to a gradient of vegetation coverage, soil physical perturbation and geomorphological units in NE Greenland (74ºN). Our results showed that riparian soils had low nitrate concentrations in the valley, associated to negligible net nitrification rates and negative net nitrogen mineralization rates, thus indicating efficient soil microbial nitrogen uptake. Low soil $NO_3^-$ content is consistent with low $NO_3^-$ concentrations found in most streams. However, upstream reaches with high channel instability and erosion in the watershed had $NO_3^-$ concentrations 10 times higher than downstream sites and had the highest autotrophic biofilm growth. Overall, we showed that low soil $NO_3^-$ availability could limit hydrological transport, thus influencing stream autotrophic production in high-Arctic region. Our study further suggest that terrestrial-aquatic nitrogen export and ecological effects depend on the geomorphological features, vegetation and erosion in the watershed, which are extremely vulnerable to climate change.

## Can oxygen and light modify diversity of nitrogen-recycling bacteria in eutrophic saline lakes?

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The global nitrogen (N) cycle consists of processes that transform and transfer N among the reservoirs. These processes are predominantly controlled by microorganisms through enzymatic mechanisms. When $O_2$ is limited or unavailable (e.g. suboxic-anoxic aquatic environments), and C/N ratio is high, microorganisms perform dissimilatory nitrate reduction to ammonium (DNRA) rather than denitrification to obtain energy. Ammonium ($NH_4^+$) supplementation may promote anammox activity. Likewise, light can also impact on coupled DNRA-anammox by enhancing primary production and $O_2$ production. Pétrola Lake is a highly saline, shallow and eutrophic wetland located in SE Spain. Excess of nutrients in the system is mainly derived from inorganic synthetic fertilizers and wastewater spills. While denitrification, DNRA, and anammox coexist as nitrogen removal pathways in Pétrola Lake, previous studies showed the predominant role of coupled DNRA-anammox under the absence of oxygen and light in the water column.

A mesocosm experiment was performed to study the influence of oxygen and light on microbial diversity from the Pétrola Lake, focusing on nitrogen-recycling bacteria. Recent organic-rich sediments were incubated in mesocosm devices for 120h. Nitrate was added to promote N turnover under different conditions of light and oxygen in the water column. Samples from water column were collected for DNA extraction and for further metagenomic analysis at both, beginning and end of the incubations. Sequencing of the V3–V4 region of the 16S rRNA gene was used to map diversity. Our results provided insight on how light and oxygen conditions affect microbial diversity responsible for nitrogen cycling in aquatic ecosystems.

POSTER

## From theory to practice: sizing nitrification/denitrification units for urban wastewater treatment

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Wastewater treatment plants (WWTPs) are designed to remove the main pollutants from wastewater: total suspended solids (TSS) and dissolved organic compounds (BOD/COD). However, following the application of more restrictive laws (91/271/EEC,98/15/EC), the imposition of more stringent treatments was incorporated: nitrogen and phosphorous would also have to be removed in vulnerable areas. For this reason, the WWTPs that had to apply these treatments began to install new treatment units. The removal of phosphorus is carried out by chemical precipitation but in order to reduce the percentage of nitrogen, a biological treatment is required. The most common process to remove nitrogen is nitrification-denitrification (N-D) process, by which $NH_4^+$ is oxidized to $NO_3^-$ until it converts to molecular nitrogen ($N_2$-gas). There are different manuals (Metcalf Eddy, 1995; Hernández-Lehmann, 1997; Ribau, 1989) in which different configurations of N-D reactors are proposed: pre-connected denitrification, post-connected, discontinuous sequential operation or simultaneous N-D in an active sludge of low load carousel type. However, when operating a N-D reactor it is important to take into account both physical-chemical considerations (reactor volume, cell retention time or agitation) and biological considerations (bacterial metabolism, BOD/NT ratio or oxygen concentration). Therefore, for the optimum operation of an N-D reactor, it is necessary to have a broad knowledge of all the parameters to ensure that the biological reactor manages to simultaneously eliminate dissolved organic matter and nitrogen and thus achieve a discharge with a lower environmental impact.

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# SS3

# Water quality of reservoirs: monitoring tools and challenges for the future

## Estudio multitemporal de la eutrofización del Mar Menor con los satélites Sentinel-2 y Sentinel-3

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Los nuevos satélites Sentinel-2 (S2) y Sentinel-3 (S3) del programa europeo Copernicus, proporcionan imágenes gratuitas muy útiles para hacer el seguimiento temporal del estado ecológico de aguas continentales y costeras. S2 tiene una resolución espacial de 10 m y proporciona imágenes cada 5 días, mientras S3, con 300 m de tamaño de pixel, proporciona imágenes diarias con una configuración de bandas optimizada para estudios de los cuerpos de agua. El Mar Menor es la mayor albufera de agua salada en España, situada junto al Mediterráneo en la región de Murcia. Con importantes problemas de eutrofización, en octubre de 2019 aparecieron toneladas de peces muertos en el Mar Menor, lo que se atribuyó a las lluvias torrenciales ocurridas en septiembre. En este trabajo se han calibrado y validado distintos índices para el estudio de la turbidez y la concentración de clorofila en el Mar Menor. Para ello se han utilizado datos obtenidos en distintos puntos del lago a lo largo de los años 2017, 18 y 19, en los que se midió la clorofila y la turbidez en fechas coincidentes con imágenes de Sentinel-2, con lo que se ha obtenido una metodología válida para el estudio multitemporal del Mar Menor con imágenes de S2 y S3. Además, se han comparado los resultados con el producto de clorofila que proporciona el programa SNAP de la ESA. Se muestra la variación temporal de clorofila y turbidez a lo largo de 2019 evidenciando el gran aumento producido después de las inundaciones.

## Can bacterioplankton be a relevant bioindicator in the assessment of water quality of reservoirs?

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Water Framework Directive 2000/60/EC (WFD) is a European water legislation with the aim of standardizing the forms of monitoring and managing of the water. Reservoirs are artificial water bodies in rivers, created by human activities, which break the connectivity of the lotic ecosystem. These changes modify the ecological processes upstream of the dam, like the nutrient cycle and organic matter accumulation, changing the structure of biological communities and the functioning of the initial lotic ecosystem. In order to assess the ecological potential of reservoirs, the WFD is based in specific physical, chemical, biological (phytoplankton) and hydromorphological parameters. However, the base of the trophic levels is not included as a bioindicator of reservoir water quality. In this study, we aimed to assess the potential importance of the bacterioplankton community as an indicator of water quality. A culture independent assay (denaturing gradient gel electrophoresis, DGGE) as well as an ecotoxicological (cell viability assay) approaches were conducted. Four water bodies (Miranda, Pocinho, Aguieira and Alqueva reservoirs) were analysed in three sampling periods (Autumn 2018 and Spring, Autumn 2019). No water toxicity was observed in the cell viability assays performed with the planctomycete *Rhodopirellula rubra* as model bacterium. Microbial communities' richness, diversity, and similarity indices will be compared between the water bodies. Specific Operational Taxonomic Units (OTUs) could be allocated to different reservoirs and corresponding gel-excised DGGE bands will be sequenced to clarify if reservoir-specific bacterial species can be assigned. The importance of bacterioplanckton in the assessment of reservoirs water quality will be discussed.

## El zooplancton como indicador del potencial ecológico: Una aproximación experimental en los embalses de la Cuenca Hidrográfica del río Ebro.

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El objetivo de las políticas europeas en la gestión del agua es alcanzar un buen estado en sus diferentes masas de agua. A través de La Directiva Marco del Agua (DMA) se definieron diferentes elementos a evaluar para determinar el estado-potencial ecológico, como lo son las variables físicas y químicas, así como las biológicas. Para esta última, el único componente tomado en cuenta es el fitoplancton, dejando fuera al zooplancton, sin embargo, este grupo tiene un papel importante en las redes tróficas ya que transfiere la energía a niveles superiores, puede controlar la comunidad fitoplanctónica y por su alta sensibilidad puede ser utilizado como bioindicador de calidad. En el presente estudio se realizaron muestreos durante el verano en diferentes embalses de la cuenca hidrográfica del Ebro, la cual es la segunda de mayor extensión en la península ibérica. En cada uno se midieron las variables fisicoquímicas y el fitoplancton según la DMA para establecer el potencial ecológico, también se obtuvieron muestras de zooplancton de los tres principales grupos: copépodos, cladóceros y rotíferos. Por medio del análisis de correspondencias canónicas (ACC) se analizó el uso de las especies como posibles indicadores de los diferentes niveles del potencial ecológico (optimo, bueno, moderado, deficiente y malo). Tanto algunas especies y géneros de copépodos ciclopidos y calanoides, como de cladóceros (*Bosmina longirostris*, *Daphnia* spp., *Diaphanosoma* spp.) y rotíferos (*Asplanchna* spp., *Keratella* spp., *Polyarthra* spp.) fueron relacionadas al potencial ecológico además de ser representativas de la comunidad zooplanctónica presente en la cuenca del Ebro.

## Crustacean zooplankton dynamics from Portuguese reservoirs and its relation with abiotic and biotic variables

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The Water Framework Directive (WFD) was a major leap for European waterbody conservation and water quality evaluation by combining physical, chemical and hydromorphological variables with biological elements. Reservoirs are artificial ecosystems subject to heavy anthropogenic pressure, so the appraisal of ecological status is difficult. Crustacean zooplankton has been shown to be a valuable tool in characterizing water quality of reservoirs; however, it is absent from the WFD bioassessment scheme. With all of this in mind, our objective was to assess the community composition and seasonal changes of the crustacean zooplankton in reservoirs and how it responds to abiotic and biotic drivers. The crustacean communities of four reservoirs (Miranda, Pocinho, Aguieira and Alqueva) were sampled at three different periods (autumn 2018, spring and autumn 2019), along with several environmental variables. Results show that cyclopoids were more abundant in sites (such as Miranda and Pocinho reservoirs) with higher phosphate concentrations, in contrast with calanoids. The crustacean community of Aguieira reservoir was mostly influenced by chlorophyll ***a*** concentration, temperature and turbidity. The more productive spring season of Aguieira was characterized by high abundances of *Daphnia longispina*, while in the warm autumn season of 2018, *Diaphanosoma branchyurum* or *Ceriodaphnia quadrangula* dominated. A trait-based functional analysis of the zooplankton community brought additional insight on seasonal, spatial and inter-reservoir variation. Our results suggest that crustacean zooplankton is sensible to trophic state, pollutants and changes in phytoplankton and fish fauna, and as such would provide a great additional tool to the evaluation of reservoir water quality.

## Can biochemical and physiological endpoints improve the sensitivity of assays with standard species for water quality evaluation?

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The Water Framework Directive (WFD) was adopted in 2000 and is a common framework for water management and protection in Europe. The Directive's methodologies assess some metrics (physical, chemical, biological and hydromorphological parameters), however they ignore indicators of ecosystem functioning and sub-individual performance. Reservoirs are influenced by anthropogenic activities that promote their imbalance, which may result in a loss of biodiversity and/or impaired ecosystem functioning. Bioassays and biomarkers are particularly useful tools to link the chemical and ecological assessments in water quality monitoring. These approaches can be complementary to WFD methodologies, allowing the detection of impacts on the ecosystem at different time scales and biological levels. However, bioassays cannot reflect the complex toxicity of water for organisms. Thus, subcellular and cellular biomarkers as biochemical parameters, involving different metabolic pathways, must be evaluated. We aimed to obtain *Daphnia magna* ecotoxicological information and to evaluate if biochemical parameters can improve the identification of the ecological potential of reservoirs. Four reservoirs (Aguieira, Miranda, Pocinho and Alqueva) were analysed in three sampling periods (Autumn 2018 and Spring, Autumn 2019), for three distinct water conditions (Unfiltered – NF, filtered with 1.2 µm pore – F1, and filtered with 0.22 µm pore – F2). *D. magna* feeding rate assays were performed during 24h and oxidative stress and lipid peroxidation biomarkers were evaluated in the exposed organisms. In general, feeding rate assays showed sensitivity to water conditions. Biomarkers suggest that these results could improve the sensitivity of bioassays, since they demonstrated significant changes in water conditions between sites and reservoirs.

## Nuevos algoritmos para la cartografía dinámica de grupos funcionales del fitoplancton en aguas continentales

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La nueva generación de satélites hiperespectrales de observación de la Tierra, y en especial el próximo satélite FLEX (Fluorescence Explorer) de la Agencia Espacial Europea, abre nuevas posibilidades en el estudio de la dinámica del fitoplancton en aguas continentales. La hipótesis de partida del presente trabajo es que, en imágenes de alta resolución espectral y radiométrica como las de FLEX, es posible identificar y cuantificar la absorción de pigmentos con valor taxonómico en los espectros de luz solar reflejada por una masa de agua. Partiendo de esa hipótesis, el objetivo principal es el desarrollo de algoritmos para estimar la concentración de pigmentos (fotosintéticos y fotoprotectores), que a su vez permitan generar mapas de la biomasa del fitoplancton en lagos y embalses, a partir de imágenes hiperespectrales.

Para el desarrollo de los algoritmos se ha partido de una base de datos de espectros de reflectividad, simulados mediante un modelo de transferencia radiativa (Hydrolight), que recoge la variabilidad esperada en masas de agua de la Península Ibérica. Se han aplicado técnicas de deconvolución y funciones de ajuste y se han obtenido índices espectrales para diferentes pigmentos con valor taxonómico. Los índices se han validado con una base de datos ***in situ*** de más de 60 lagos y embalses. Para la estimación de la biomasa de los principales grupos del fitoplancton se han ajustado modelos empíricos multivariantes. Se presentan los resultados obtenidos y las posibles mejoras de los algoritmos propuestos.

## Uso combinado de los satélites Sentinel-2 y Sentinel-3 para el seguimiento de la materia orgánica disuelta y la biomasa del fitoplancton en aguas continentales

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Dentro del programa europeo Copernicus de Observación de la Tierra hay dos constelaciones de satélites de especial interés para la limnología: Sentinel-2 (S2), con imágenes multiespectrales (13 bandas) de alta resolución espacial (10 m) y Sentinel-3 (S3) con 21 bandas espectrales y resolución espacial media (300 m). El sensor OLCI, a bordo de S3, es un sensor específicamente diseñado para el estudio de la calidad del agua y capta imágenes diarias sobre la Península Ibérica, mientras que S2, diseñado para aplicaciones terrestres, toma imágenes cada 5 días mediante el sensor MSI. Su mayor resolución espacial permite el estudio de la mayoría de masas de agua continentales, con una resolución espectral y radiométrica suficiente para el mapeo de variables indicadoras del estado ecológico. En el presente estudio se han calibrado algoritmos basados en índices espectrales de las bandas de S2 y S3 para determinar variables clave como CDOM (Materia Orgánica Disuelta Coloreada), clorofila-***a***, ficocianina y transparencia mediante el disco de Secchi. Los algoritmos se han validado utilizando una base de datos limnológicos y radiométricos medidos ***in situ*** en lagos y embalses de la Península Ibérica. Finalmente, los algoritmos se han aplicado a imágenes de S2 y S3, superponiéndose los mapas temáticos obtenidos y analizando su correlación espacial. El uso combinado de ambos sensores permite el seguimiento continuo de la variación espacial y temporal de variables clave del estado ecológico en masas de agua continentales.

## New bio-optical tools for detection and prevention of cyanobacterial blooms based on espectro-fluorometry and multitemporal remote sensing images from Sentinel-2 satellites

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Cyanobacteria blooms seriously affect water quality and thus it has an impact on its use and adverse effects from an environmental point of view. Because these blooms are an increasing problem due to water eutrophication and climate change, extended monitoring of cyanobacteria presence and growth is crucial in avoiding the toxicity problems associated with these blooms. A continuous control of cyanobacteria concentration could be carried out by ***in situ*** measuring instruments or using remote sensors, which would serve as warning systems previous to sampling and determine their specific composition by microscopic observation, developing works linking instrumental methods using phycocyanin as indicator (spectro-fluorometry and remote sensing), with direct sample counting of cyanobacteria. A submersible calibrated fluorometer was used for *in situ* phycocyanin measurements, *synchronized in time* with remote sensing images from Sentinel 2, corrected atmospherically with the C2RCC method, adjusting the algorithm, previously set-up, to assess phycocyanin concentrations in eutrophic water bodies with the phycocyanin data measured *in vivo* at the lakes and reservoirs of this study. Spectral band ratio 740/665 nm has given the best correlation between remote sensing signal and logarithmically normalized values of phycocyanin ($R^2$=0.9594, p<0.001, RMSE 17.21 mg/$m^3$). The use of satellite remote sensing images would function as an early warning system for the presence of cyanobacteria, which, if positive, might enable us to evaluate its potential toxicity, enlarging significantly both in time and space the information available.

POSTER

## New water quality index considering toxicology: the case study of three reservoirs in Spain

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Cyanobacterial Harmful Algae Blooms (Cyano-HABs) are reported every year in Galicia (Northwestern Spain). This involves changes in the water quality. Cyano-HABS are consequence of the agriculture, livestock and climate change. Samples from two reservoirs (As Conchas and A Baxe) with eutrophication problems have been studied, as well as a third sample from a reservoir (Salas) with no previously problems detected. In this study, the quality status of the reservoirs has been analyzed through the application of water quality indexes and with the assessment of toxicology. Values of very good quality were reached in As Conchas and A Baxe reservoirs and medium quality in Salas reservoir. While only a good quality rating was reached in "As Conchas upstream" and A Baxe reservoir with the General Quality Index. This fact contrasts with the data obtained by the application of the Total Nutrient Status Index, with a moderately eutrophic condition for the three reservoirs, and hypereutrophic value for As Conchas. On the other hand, when the toxicity was analyzed, values of 1.12±0.06 µg/l MC-LR, 0.64±0.04 µg/l MC-LR, 1.24±0.05 µg/l MC-LR for As Conchas, Salas and A Baxe reservoirs respectively. Finally, adapting these quality indices to consider the presence of cyanotoxins in water column will be a useful tool for water managers. General Quality Index has been adapted to the presence of cyanotoxins in water column. Considering the value toxic, establish for the WHO of the 1µg/l MC-LR. The new index obtained a value to regular for the three samples.

POSTER

## Evaluation of the water quality in some Portuguese reservoirs according to the Water Framework Directive

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The Water Framework Directive 2000/60/EC (WFD) indicates different parameters, (physical, chemical, biological and hydromorphological) for monitoring and managing European artificial waterbodies. The water quality of these is evaluated through the calculation of its ecological potential (EP). The present study aims to evaluate the ecological potential (EP) of four Portuguese reservoirs: Miranda, Pocinho, Aguieira and Alqueva. Each reservoir was studied in three sampling periods: Autumn of 2018; Spring and Autumn of 2019. General water physical and chemical parameters were measured ***in situ***, and additional water samples were collected for further chemical analysis in laboratory. Water samples for the analysis of the phytoplankton community were also collected. Miranda and Pocinho reservoirs presented almost always a good EP, whilst Aguieira reservoir tended to present low EP (poor or moderate EP) concomitant with the occurrence of Cyanobacteria blooms. Alqueva reservoir showed a decrease in water quality along the studied period (from the good to poor EP), with the worst ecological potential recorded in the autumn of 2019. Large reservoirs (Alqueva and Aguieira) attained their worst classification in the upstream sampling sites. In conclusion, the metrics of WFD applied in these reservoirs were sensitive to spatial and temporal alterations. Nevertheless, it is important to understand which factors influence the water quality and the ecological status of the reservoirs, in order to define specific management programs.

POSTER

## Validación de productos de clorofila y sólidos en suspensión generados por el procesador C2RCC con los satélites Sentinel-2 y Sentinel-3 en aguas continentales

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El C2RCC (Case-2 Regional Coast Colour) es un procesador de corrección atmosférica desarrollado específicamente para la estimación de los constituyentes del agua o sus propiedades ópticas, a partir de la inversión de una base de datos de simulaciones de transferencia radiativa y redes neuronales, que puede ser aplicado a una diversa cantidad de sensores. Esta herramienta, disponible en el software libre SNAP, desarrollado por la Agencia Espacial Europea (ESA), genera automáticamente dos productos sobre aguas correspondientes a las concentraciones de clorofila [Chl-a] y sólidos en suspensión (TSM), los cuales son calculados a través de factores de conversión aritméticos a partir de los IOPs (propiedades ópticas inherentes del agua). El C2RCC es capaz de procesar los datos provenientes de los sensores MSI de Sentinel-2 (S2) y OLCI de Sentinel-3 (S3), pertenecientes al programa europeo Copernicus de la ESA, de especial interés por su utilidad para hacer el seguimiento ecológico de masas de aguas continentales, debido a las características de cada uno: S2-MSI posee 13 bandas de alta resolución espacial (10 m) tomando imágenes cada 5 días; mientras que S3-OLCI posee 21 bandas de alta resolución espectral con resolución espacial media (300 m) y resolución temporal diaria. Las imágenes están disponibles de forma gratuita en el servidor de la ESA. A partir de datos S2-MSI y S3-OLCI, en este trabajo se han validado los productos automáticos generados por C2RCC usando una base de datos limnológicos y radiométricos medidos *in situ* en embalses de la Comunidad Valenciana entre los años 2017 y 2019.

POSTER

## Bio-optical modelling of reservoirs: a solution for a rapid water quality assessment?

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Reservoirs are subject to anthropogenic stressors, becoming increasingly degraded. However, this ecosystem provides habitats to a large amount of species as well as critical ecosystem services, making it important evaluate changes within reservoirs and understand their magnitude and implications towards the ecosystem. In this study we intend to validate the utility of remote sensing techniques to assess the ecological potential of Portuguese reservoirs, established by the Water Framework Directive (WFD). WFD defines several metrics to assess water quality requiring field work followed by laboratory analyses, making a process slow and expensive. However, Remote Sensing techniques provide a complementary, cost effective and practical solution that has a broad coverage and can be frequently executed with expressive results. Thus, this study aims to determine the relationship between certain Water Quality Parameters (WQP) - chlorophyll-*a*, phycocyanin and turbidity - and digital data from the Sentinel-2 satellite to estimate and map these WQP. Sentinel-2 Level-1C satellite images dating from January 2017 to December 2018 were used as inputs regarding water quality via image processing chain based on the "waterquality" R package, in order to analyse spatial and temporal differences between reservoirs. Indeed, after validation with *in situ* data, these estimates can help to predict future evolutions of water quality in reservoirs, as well as understand the significance of anthropogenic stressors and environmental pressures in the water bodies. Therefore, with global climate changes in mind, this digital tool is undeniably needed for the evolution of limnetic knowledge and its integration with other fields of research.

POSTER

## Estudio analítico de las especies del fitoplancton para determinar el estado ecológico del agua en los embalses de la Cuenca Hidrográfica del Ebro.

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La Directiva Marco del Agua propone el uso combinado de métodos fisicoquímicos y biológicos para el seguimiento del estado ecológico de las masas de agua y hacer una gestión con la visión global de todas las variables y componentes del agua. Entre las variables biológicas se encuentra el estudio analítico de las especies del fitoplancton presentes en los embalses, su composición taxonómica, abundancia y biomasa. El papel del fitoplancton como productor primario indica su importancia dentro de los ecosistemas acuáticos. Es un indicador de alteraciones a corto plazo, para el que un cambio en las condiciones ambientales puede desencadenar un crecimiento excesivo o cambios en las proporciones de los distintos grupos de la población, debido a la baja tolerancia que presentan determinadas especies ante ciertos cambios ambientales. Ello puede provocar desde que el cambio quede como un indicador de eutrofización hasta alcanzar efectos tan negativos como la producción de distintos tipos de toxinas que limiten el uso posterior de dichas aguas. De ahí la importancia de su estudio analítico, la observación y seguimiento de los posibles cambios tanto en la composición como en las proporciones de los distintos grupos algales. En los embalses estudiados del río Ebro se han identificado un total de 274 especies pertenecientes a distintos grupos algales: diatomeas, crisofíceas, sinurofíceas, xantofíceas, clorofíceas, zignematofíceas, dinofíceas, criptofíceas, euglenofíceas y cianobacterias. Los porcentajes y presencia de dichos grupos variaron tanto entre embalses como entre años, en consonancia con las variaciones de las variables fisicoquímicas y por ende del estado ecológico

POSTER

## Nuevos algoritmos para la cartografía dinámica de grupos funcionales del fitoplancton en aguas continentales

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La nueva generación de satélites hiperespectrales de observación de la Tierra, y en especial el próximo satélite FLEX (Fluorescence Explorer) de la Agencia Espacial Europea, abre nuevas posibilidades en el estudio de la dinámica del fitoplancton en aguas continentales. La hipótesis de partida del presente trabajo es que, en imágenes de alta resolución espectral y radiométrica como las de FLEX, es posible identificar y cuantificar la absorción de pigmentos con valor taxonómico en los espectros de luz solar reflejada por una masa de agua. Partiendo de esa hipótesis, el objetivo principal es el desarrollo de algoritmos para estimar la concentración de pigmentos (fotosintéticos y fotoprotectores), que a su vez permitan generar mapas de la biomasa del fitoplancton en lagos y embalses, a partir de imágenes hiperespectrales. Para el desarrollo de los algoritmos se ha partido de una base de datos de espectros de reflectividad, simulados mediante un modelo de transferencia radiativa (Hydrolight), que recoge la variabilidad esperada en masas de agua de la Península Ibérica. Se han aplicado técnicas de deconvolución y funciones de ajuste y se han obtenido índices espectrales para diferentes pigmentos con valor taxonómico. Los índices se han validado con una base de datos *in situ* de más de 60 lagos y embalses. Para la estimación de la biomasa de los principales grupos del fitoplancton se han ajustado modelos empíricos multivariantes. Se presentan los resultados obtenidos y las posibles mejoras de los algoritmos propuestos.

POSTER

# Treinta años de estudios del estado trófico en embalses de la cuenca del Ebro

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Desde la década de 1990 se realizan los trabajos de seguimiento de la calidad ecológica de los Embalses de la Demarcación Hidrográfica del Ebro y desde 2006 de acuerdo con los protocolos definidos por la Directiva Marco del Água. Partiendo de los estudios realizados antes del año 2000 en 35 embalses, se ha 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 indicadores fisicoquímicos clásicos y por otra parte la determinación del potencial ecológico según la normativa establecida, basándose especialmente en indicadores biológicos, utilizando también los resultados obtenidos a partir del fitoplancton. De los 65 embalses estudiados, a partir de los indicadores de estado trófico considerados, tan sólo cuatro 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 en los embalses durante los años transcurridos es significativa considerando que antes del año 2000 sólo el 12 % de los embalses estaba en buen estado. Sin embargo, todavía quedan pendientes de mejorar esas 35 masas de agua que no se encuentran en buen estado, para alcanzar los objetivos de calidad marcados en el horizonte de la DMA.

# SS4

# Effects of contaminants on aquatic systems: from cells to ecosystems

## Unravelling the interaction between fungicide pollution and fungi-mediated processes in freshwaters: results from project FunG-Eye

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Pesticide use in agriculture is still away from being sustainable, and aquatic ecosystems (water, sediments and biota) remain the final recipient of these agrochemicals. European authorities recognize the undesirable pressure of pesticides on non-target aquatic organisms (see Directive 2009/128/EC), and many researchers have pointed out the need for refinement of fungicide risk assessment. Indeed, fungicides have received less attention in comparison to herbicides and insecticides, and their impacts on aquatic fungi have been overlooked, despite their pivotal role as decomposers, symbionts or parasites. Project FunG-Eye looks at this environmental problem "through the eye" of fungi, transcending the available ecotoxicological toolbox and feeding a functional approach to the risk assessment of fungicides. Using different fungi models as experimental systems, one of the goals of the project is to generate ecologically relevant information on the impacts of fungicides on aquatic fungi and the processes where they intervene (e.g., decomposition and disease spread). Here, we present some of our results on a host-parasite model (the crustacean *Daphnia sp.* and the microparasitic yeast *Metschnikowia bicuspidata*) and a detrital food web model (decomposer fungi and detritivorous insect larvae). Some fungicides (e.g., azoles) revealed the potential to interfere with disease spread in aquatic ecosystems by suppressing or decreasing sporulation, affecting the production of parasite transmission stages at environmentally realistic concentrations. In parallel, higher concentrations altered the community composition and sporulation of aquatic hyphomycetes, without affecting decomposition rates. Altogether, project FunG-Eye is contributing with novel knowledge for managers and risk assessors, whilst informing authorities and regulators.

## Neurogenesis and DNA methyltransferases related genes expression in zebrafish (*Danio rerio*) early life stages co-exposed to microplastics and copper

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Microplastics (MPs) pollution have gained recognition globally as an emerging environmental problem in aquatic ecosystems. Besides, MPs can also serve as carriers for toxic chemicals, such as heavy metals. Recently, several studies have reported the adverse effects of MPs in aquatic organisms. However, little is known about their toxicity, and its interaction with heavy metals, in the DNA methylation mechanisms and in the nervous system, particularly in early life stages of aquatic vertebrates.

In this study, the combined effects of MPs and copper (Cu) were assessed in zebrafish (*Danio rerio*) embryos and larvae. Zebrafish were exposed from 2 hours post-fertilization (hpf) until 14 days post-fertilization (dpf), to control, MPs (2 mg/L), two concentrations of Cu (60 and 125 µg/L) and to their mixtures (Mix1, MPs+60 µg Cu/L; Mix2, MPs+125 µg Cu/L). At 48, 144 hpf and 14 dpf, gene expression of *pcna, sox2, islet1, islet2a, islet2b* and of DNA methyltransferases genes (*dnmt1, dnmt3, dnmt4, dnmt5, dnmt6, dnmt7* and *dnmt8*) was assessed.

Survival and larvae length were reduced ($p<0.05$) after 14 days in the exposed groups. The expression of *pcna, sox2* and *islet* genes were downregulated ($p<0.05$) in the Cu and MPs groups, mainly at 144 hpf. Considering the DNA methyltransferases genes, most of these were significantly downregulated in MPs and mixtures groups.

Overall, both MPs and Cu exposure were stressful and resulted in negative developmental effects on zebrafish. The findings reported suggest negative impacts of MPs on zebrafish neurogenesis and in the establishment of DNA methylation patterns.

## Can rotifer populations recover from anti-cancer drug contamination in freshwaters?

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Preservation of water quality is one of the biggest challenges in the 21st century. With increasing urbanization and human population, a large variety of chemical contaminants will arrive into freshwaters mainly through landscape contamination, atmospheric sources and direct discharges of wastewaters. Emerging Chemical Contaminants (ECCs) are neither commonly monitored nor suspected to have adverse effects on ecosystem and human health. Anti-cancer drugs are a class of ECCs currently raising concerns due to increasing cancer rates and use of related chemotherapy. In this study we determined the impacts of two anti-cancer drugs, a cytotoxic antibiotic (doxorubicin) and an anti-neoplastic drug (5-fluorouracil), to freshwater rotifer *Brachionus calyciflorus* by assessing lethal and sublethal effects in short- and long-term exposure at the generational level. At short term, 5-fluorouracil showed no lethal effect on rotifer populations at the tested concentrations but showed stronger level of inhibition in population growth rate than doxorubicin (5-FU $EC_{50}$=0.011 mg $L^{-1}$ vs DOX $EC_{50}$=5.91 mg $L^{-1}$). Increasing levels of oxidative stress were observed through epifluorescence microscopy for both anticancer drugs. When exposed through several generations to the $EC_{50}$ concentrations of 5-fluorouracil, rotifers were able to recover their population growth rate at F2 generation. Surprisingly, when exposed to the $EC_{50}$ concentration of doxorubicin, the population growth rate kept decreasing until extinction at F2 generation. Long-term transgenerational studies showed to be crucial for proper assessment of environmental risk of anti-cancer drugs as the short-term standard tests may underestimate or overestimate their impacts on aquatic systems.

## Toxicant effects on trophic interactions of fluvial invertebrates

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Chemical pollution has been identified as one of the planetary boundaries for which continued impacts could erode the resilience of ecosystems. Sources of chemical pollution in fluvial systems gives rise to a mixture of toxicants that makes it difficult to attribute effects to any particular toxicant. In addition, rivers are suffering other natural and anthropogenic stressors affecting biological communities and ecosystem functioning, which can ultimately affect goods and services derived from them.

The effects of toxicants can be measured at different level (e.g. individual, population, community level) but the assessment of combined effects of stressors and implication for ecosystem functioning are still unclear. Trophic interactions determine energy transfer in the system. The analysis of the effects of pollution on resource-consumer response variables contributes to better elucidate effects at ecosystem level.

We present several experiments analyzing the direct and indirect effects of different toxicant compounds, acting alone or in combination, on feeding rates of different freshwater key species. Fungicides and antidepressants reduced the leaf litter consumption by shredders and changed how they researched the food. Herbicide and fungicide effects were tested on shredders and grazers detecting effects on leaf litter and biofilm consumption likely relevant elsewhere in the food chain and through the entire ecosystem. Relevant effects to the trophic network were also observed in a field experiment. Wastewater pollution (mainly nutrients and pharmaceuticals) in Mediterranean streams reduced energy efficiency transfer along the food web reducing predator richness and food web resilience.

## Poblaciones silvestres vs poblaciones de laboratorio: La importancia del origen de las poblaciones en ecotoxicología

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Los estudios en ecotoxicología emplean individuos procedentes tanto del medio natural -que posteriormente son aclimatados en laboratorio- como de poblaciones cultivadas en laboratorio. Las condiciones a las que están expuestas estas especies a lo largo de sus generaciones son diferentes y, en consecuencia, esto podría causar diferencias en las sensibilidades a los tóxicos para una misma especie entre poblaciones procedentes del medio natural y de cultivos. Sin embargo, hay pocos estudios que hayan analizado esta cuestión. Este trabajo intenta determinar si la fuente de procedencia de los organismos empleados es una variable influyente en la tolerancia a los tóxicos. Para comparar las sensibilidades a diferentes tóxicos entre poblaciones de especies acuáticas procedentes del medio natural y de cultivos se empleó la base de datos ECOTOX (US EPA). Se seleccionaron aquellas entradas que analizaban la sensibilidad ecotoxicológica para una misma especie o diferentes especies de un mismo género, para un mismo tóxico, un tiempo de exposición equivalente y un mismo parámetro ecotoxicológico. Se realizó un test pareado para comparar las concentraciones estandarizadas de las especies procedentes del medio natural y de cultivos. Este estudio puede ayudar a entender si el uso de poblaciones con diferente origen puede afectar a los resultados de sensibilidad a los tóxicos en los estudios ecotoxicológicos.

## Microplastics and silver nanoparticles can affect microbially-driven plant litter decomposition in streams

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Aquatic ecosystems are being subjected to extensive pollution by plastics and microplastics (MPs) because of the increasing use of these materials. Also, silver nanoparticles (Ag-NPs) that have been incorporated in textiles, detergents, personal health care products and in several medical care products are of major concern. The probability of these two emerging contaminants co-occurring is therefore very high, making it relevant to assess their impacts alone and in mixtures. Freshwaters constitute a link between the land-based wastes and marine ecosystems. In freshwater streams, plant-litter decomposition is a key ecosystem process driven by microbial decomposers, predominantly fungi, and invertebrate detritivores. Here, we used plant-litter decomposition to assess the impacts of MPs and Ag-NPs on the diversity and activity of stream-dwelling microbial decomposers. Microbially colonized leaves were exposed in microcosms to MPs (100 µg L-1; 1 mg L-1; 5 mg L-1; 100 mg L-1 and 1 g L-1) alone or in mixtures with Ag-NPs (0.1 mg L-1 and 1 mg L-1).

Microbial decomposition of plant-litter was reduced in a dose dependent-manner by MPs individually or in mixtures with Ag-NPs particularly at higher concentrations with greater impacts in mixtures scenario (<40% decomposition). This was also supported by a decrease in the activity of the extracellular enzymes fungal β-glucosidase and phenol oxidase. Overall results show that microplastics are a threat to microbial decomposers with potential impacts to freshwater detrital based foodwebs. Moreover, the interactions of MPs with Ag-NPs suggested a higher impact when compared with the individual MPs impact.

POSTER

## Azoxystrobin effects on non-target aquatic organisms: impacts on a host-parasite relationship and disease spread potential

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Fungicides are widely used in agriculture because diseases caused by fungi and oomycetes are a major cause of crop losses worldwide. The intensive use of fungicides can lead to negative consequences in aquatic ecosystems, because these agrochemicals have the potential to affect non-target organisms. However, fungicides have received less attention when compared to herbicides and insecticides. As such, our aim was to evaluate the effects of azoxystrobin (a strobilurin fungicide) in an aquatic host-parasite model (*Daphnia magna* × *Metschnikowia bicuspidata*), in order to understand if the contaminant affects this relationship, and how this may reflect on the prevalence and spread of disease. To do so, we conducted a chronic 21-day life history experiment, exposing the host to eight azoxystrobin concentrations ranging from 6.25 to 200 µg/L (plus a negative and a solvent control), in the presence or absence of the microparasitic yeast. Both stressors (fungicide and parasite) in isolation impacted the host life history, with the parasite causing a drastic effect in adult mortality. Although azoxystrobin did not substantially affect parasite prevalence or parasite-induced host mortality, an anti-parasitic action of the fungicide was visible from 100 µg/L upwards in the form of a delay of the infection. Additionally, parasite sporulation was also affected by azoxystrobin, with the number of immature spores increasing from 25 µg/L upwards, which was translated in a significant reduction of spore load at 200 µg/L. These results show that azoxystrobin can affect the fitness of a non-target fungus and alter the potential for disease spread.

POSTER

## Exposure to triazole fungicides affects disease spread in aquatic ecosystems: different paths to the same outcome?

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Aquatic ecosystems are the final recipients of numerous chemical substances used in agriculture, which may impact non-target aquatic organisms. Considering the pivotal role of fungi as decomposers, symbionts or parasites in freshwaters, there have been recent pleas towards the refinement of fungicide risk assessment, with many researchers recognizing that the effects of these agrochemicals on aquatic fungi have been overlooked. Previous research from our team has demonstrated that triazole fungicides, namely tebuconazole and myclobutanil, can suppress infection signs and decrease sporulation in a microparasitic yeast (*Metschnikowia bicuspidata*) that infects *Daphnia*. The goal of this work was to further explore the impacts of both triazoles on parasite fitness, especially in the production of parasite transmission stages (sporulation). To do so, we tested a concentration gradient of both compounds under two exposure scenarios defined according to the predicted stage of disease. Both toxicants were overall ineffective in suppressing infection signs when applied in an early stage of the disease. When applied in a later phase (coincident with sporulation), results for both fungicides were contradictory, despite their common mode of action. Tebuconazole did not greatly affect parasite prevalence (proportion of infected hosts), but significantly decreased spore production; myclobutanil caused a small reduction of prevalence but a tendency to increase spore production. Both compounds affected spore maturation and myclobutanil, in particular, seemed to delay the infection (time of death of the host). Our research shows that anthropogenic chemicals can interfere in the yeast's ability to produce mature spores (transmission stages), thus conditioning disease spread.

POSTER

## Behavioural responses of zebrafish larvae following embryonic exposure to a glyphosate commercial formulation

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The use of herbicides with glyphosate as an active ingredient (a.i.) has been increasing in recent years, with its residues being often found in water. This causes some concerns about its harmful side effects to aquatic ecosystems. Toxicant-induced behavioral impairments are often used to surveil the underlying physiological disorders, in order to evaluate the ecological risk posed by a stressor. Therefore, the objective of this work was to assess the effects of a commercial formulation of glyphosate (Roundup® Ultra Max), at environmentally relevant concentrations, on zebrafish embryos through a set of behavioral tests. Embryos were collected after fertilization and exposed during 72 h to 0, 1, 2 and 5 µg a.i. $mL^{-1}$ concentrations of the glyphosate formulation. After exposure, larvae were washed and maintained in system water until 144 hpf. At this point, the general exploratory motility, escape-like responses, anxiety-related behaviors and social interactions were evaluated. Overall, no significant changes were observed in the exploratory motility nor in anxiety-related behaviors. In addition, no social interference was observed following exposure to these glyphosate concentrations. On the other hand, the larvae exposed to 5 µg a.i. $mL^{-1}$ failed to respond to aversive stimuli, supporting the existence of glyphosate-induced changes in the sensory-motor coordination during development. In general, the results suggest that this glyphosate-based formulation may induce neurotoxic effects, that should be further evaluated. Moreover, the concentrations used here, already described in aquatic matrices could impose a risk for ecologically relevant species that should not be neglected.

POSTER

## Evaluation of the effects of the environmental estrogenic contaminant 17α-ethinyl estradiol in aquatic species: *Raphidocelis subcapitata* and *Daphnia magna*

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17α-Ethinylestradiol (EE2) is a synthetic hormone derived from natural hormone estradiol, that is one of the most commonly used medications for humans, but also for livestock and aquaculture practices. This pharmaceutical is continuously released into the aquatic environment by discharging domestic sewage, untreated industrial effluents or improper disposal. Moreover, this compound is resistant to biodegradation representing a potential environmental concern, mainly for non-target organisms, with their bioaccumulation increase. *Raphidocelis subcapitata* and *Dapnhia magna* are standard species commonly used in ecotoxicological studies. The main objective of this study was to evaluate the impacts of EE2 on the growth rate of algae *R. subcapitata* (exposure: 72 hours; 0.01 – 1000 µg/L EE2) and on the survival, reproductive, biochemical/physiological parameters of the cladoceran *D. magna* (exposure: 21 days; 0.1 – 100 µg/L EE2). Algal inhibition growth rate appears to be dose dependent; however, only significantly differences were observed, at the highest concentrations tested. For *D. magna* exposed to EE2, results revealed significant changes in life history parameters, namely a decrease in age at first reproduction and somatic growth rate. The results of biochemical and physiological biomarkers indicated that the exposure to EE2 induced alterations on the cellular redox status (catalase, glutathione-S-transferases), lipid peroxidation (TBARS), glycogen content and DNA damage. According to previous results the contraceptive EE2 represents a potential chemical pollutant, since significant effects were recorded for levels already reported in the wild. This work reinforces the need for further research on the ecological consequences of these class of pharmaceutical products namely on non-target organisms.

# SS5

# DNA barcoding, (e)DNA metabarcoding and metagenomics to address ecological and evolutionary questions in aquatic ecosystems

## DNA knowledge gaps and biodiversity analysis in reference databases about European freshwater macroinvertebrates

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Gaining quick understanding on the impact of global change on freshwater communities is pivotal in the midst of an unprecedent biodiversity crisis. Unfortunately, most performed attempts rely on morphological species identification: a time-consuming process, requiring a high level of expertise and training, partially subjective and often overlooking actual diversity. As DNA sequencing becomes cheaper, molecular-based identification has raised as a promising bypass to these limitations. However, since they rely on the comparison of DNA fragments to reference databases, its usefulness depends on the availability, taxonomic coverage, and the quality of such databases.

We here assessed the completeness and quality of the genetic information curated in GenBank and BOLD databases on European freshwater macroinvertebrates. We merged three European sources of macroinvertebrates data (freshwaterecology.info, MacroMED, Weigand et al., 2019) into one checklist including 26 groups (8820 taxa) and used it to download all available sequences of a 500 and 300 base pairs fragment barcoding region of COI. For each group, we then mapped and aligned the sequences, discarding those containing gaps, stop codons and missing data.

Then, we checked the consistency between specific identity and attributed names through neighbor-joining cluster analysis. Finally, we built our taxonomic operational units using ABGD and GMYC, two widely used methods in DNA taxonomy. Preliminary analyses showed that genetic taxonomic coverage varies greatly across geographical regions and taxonomic groups, often revealing a surprising incongruence between taxonomical and genetic information, potentially leading to coarse identification errors.

## Are we ready to monitor non-indigenous species in aquatic ecosystems through DNA metabarcoding?

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In aquatic ecosystems, non-indigenous species (NIS) are recognized as a major threat to biological biodiversity, ecosystem functioning and socio-economic activities. Here we present a systematic review on the use of metabarcoding for NIS surveillance in aquatic coastal ecosystems, through the analysis of 33 publications. Metabarcoding has been applied to DNA extracted from bulk organismal samples or to eDNA, namely from water. DNA extraction kits have been widely used (31 publications) and the 18S rRNA and the COI genes the most employed markers (26 and 16 studies, respectively). The Illumina MiSeq platform has been used in more than half of the publications. Current weaknesses of metabarcoding include the lack of universal primers and the incompleteness of reference libraries, which can restrict the resolution and detection capacity of NIS at the taxonomic assignment step. A gap of ca. 44% still exists in genetic databases for NIS occurring in European coastal waters. Furthermore, the possibility of the occurrence of false negatives is particularly concerning in the case of NIS. Until these weaknesses are resolved, NIS metabarcoding is ought to be supported by complementary approaches. Even so, metabarcoding has already proved to be a very sensitive and effective tool to: i) detect smaller organisms or undifferentiated life stages, which are hardly noticeable through morphology; ii) describe the composition and distribution of NIS assemblages across a wide taxonomic range, and iii) improve the spatial and temporal resolution of NIS surveillance, representing an alternative or a complementary approach for comprehensive surveys of NIS in aquatic ecosystems.

## Machine-learning models based on molecular data to assess streams' quality with diatoms

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The application of official indices used to assess rivers' quality with diatoms requires the identification of individuals under a microscope. This is a highly specialized and time-consuming task, often susceptible of disagreements among analysts. In alternative, DNA metabarcoding combined with High-Throughput Sequencing (HTS) produces sequences obtained from environmental DNA, that are usually clustered into Operational Taxonomic Units (OTUs) which can be assigned to a taxon, using reference databases, and from there calculate biotic indices. However, this approach has also drawbacks, especially due to the incompleteness of reference libraries. Alternatively, we tested an innovative taxonomic-free approach to assess rivers: a combination of three machine learning techniques is used to build models that predict diatom OTUs expected in test sites under reference conditions, from environmental data. The Observed/Expected (O/E) OTUs ratio indicates the deviation from reference condition and is converted into a quality class. To evaluate its efficiency, we built one model based on OTUs lists (HYDGEN) and compared it to one based on taxa lists from morphological identification (HYDMORPH) and a biotic index (IPS). The models were trained and tested with data from 81 sites from central Portugal. Both models were accurate (linear regression O/E richness: $R^2 \approx 0.7$, interception ≈ 0.8) and sensitive to global anthropogenic disturbance ($R^2 > 0.30$ $p < 0.006$ for global disturbance). Yet, the HYDGEN model was sensitive to more types of pressures (such as, changes in land use and habitat quality), which gives promising insights to its use for bioassessment of rivers.

## Combining eDNA metabarcoding and morphological-based approaches to increase resolution of biodiversity assessments

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Environmental DNA (eDNA) metabarcoding has the potential to improve aquatic biodiversity assessments by improving detection capability, taxonomic resolution and cost-effectiveness when compared to morphological-based approaches. Advances have been made in the field of metabarcoding, but challenges remain, including sensitivity of results to DNA extraction method and marker choice, and its dependency on often-incomplete reference databases. Also, it does not easily provide quantitative estimates for surveyed species, whereas abundance and biomass data are often required. Here, we present a framework to combine datasets from eDNA metabarcoding- and morphological-based approaches in an attempt to address some of these limitations. Biodiversity surveys were conducted over time and space across the Iberian Pond Network, covering a biogeographic gradient, from semi-arid to alpine environments. Different markers were used to amplify DNA from different trophic levels (from bacteria to macroinvertebrates). Organisms were also collected with conventional methods, and were identified and enumerated under the microscope. Preliminary results showed that there were differences when comparing directly both datasets. However, both approaches identified similar environmental gradients, with regions exposed to greater environmental filters, e.g., higher temperatures in southern regions or colder temperatures in mountain tops, having fewer numbers of species than temperate regions. Combining eDNA metabarcoding- and morphological-based datasets improved the recovery of different taxa. These results indicate that eDNA-based assessments may not always directly replace morphological-based identification and biomass quantification, but might certainly complement and enhance current approaches when combined, especially for those groups that are perceived as difficult to identify, allowing more consistent and faster identifications.

## Mapping the distribution of two endangered aquatic species (*Unio mancus* and *Austropotamobius pallipes*) using environmental DNA

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Environmental DNA (eDNA) offers a broad set of possibilities for detecting aquatic species. However, different techniques present different resolution and accuracy. Species-specific markers were demonstrated to be more sensitive, faster and cheaper than universal metabarcoding markers. In this study, two endangered aquatic species (*Unio mancus* and *Austropotamobius pallipes*) were selected as model species to use eDNA as a tool for mapping its distribution in the rivers of Cantabria, North Spain. A review of previously developed markers for those species was done. There was not any previous specific marker for *U. mancus* then, a species-specific genetic marker was developed. Several markers were found for detecting *A. pallipes* and all were validated before used but none of the previously described markers passed the evaluation. Finally, a new species-specific marker was developed. The two new genetic markers were validated *in silico, in vitro* and *in vivo* and used in water samples of 10 rivers from Cantabria. A total of 93 water samples were analyzed and results were mapped with GIS software. Distribution of the two species, possible risk areas or isolated populations were identified using this methodology. This study pointed out that the selection of an accurate developed and validated species-specific marker is crucial for employing eDNA as a tool for conservation.

## Evaluation of DNA metabarcoding for diatom-based WFD bioassessment of Mediterranean rivers

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Benthic diatoms are widely used as bioindicators for biomonitoring programmes, including those for European rivers demanded by Water Framework Directive (WFD) due to, amongst other things, their rapid and specific responses to environmental changes. Ecological status is assessed by calculation of an index – commonly the Indice de Polluo-Sensibilité Spécifique (IPS) –from morphology-based counts at species level, which are time-consuming and require expert knowledge. DNA metabarcoding of environmental samples, is emerging as an alternative to light microscopical identifications due to its speed, reproducibility and cost effectiveness. Our study is the first to test the applicability of DNA metabarcoding (using Illumina sequencing of a 312-bp *rbcL* barcode) for a large set of Mediterranean river sites (164). A very good correspondence was shown between IPS values calculated by morphological and molecular methods and a high proportion of the samples analysed were assigned to the same WFD ecological status. However, there were some discrepancies and in a minority (6%) of sites, the WFD ecological status was downgraded from acceptable (High/Good) to unacceptable (Moderate/Poor/Bad) in the molecular assessment. IPS differences between morphological and molecular methods were investigated by performing a sensitivity analysis to determine the contribution of individual species to the IPS. This revealed that discrepancies were mainly due to the misidentification and overlooking in light microscopy of a few species that were better recovered by DNA metabarcoding, e.g. the pollution-tolerant *Fistulifera*, and to the differences in the *rbcL* copy number per cell that affected the abundance estimation of important species for WFD.

## Species sensitivity analysis as a tool for interpreting diatom metabarcoding for WFD bioassessment

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In our evaluation of DNA-based biomonitoring of river diatoms for the WFD in Catalonia (see presentation by Pérez-Burillo et al., this AIL congress) we found very good correspondence between ecological assessments by morphology (LM) and molecular (HTS) approaches. However, in 10 out of the 164 sites analysed the ecological status class was downgraded from "Good"/ "High" obtained by LM to "Moderate"/ "Poor"/ "Bad"by HTS. These "critical" sites are especially important, because the WFD requires remedial action by water managers for any river with Moderate or lower status. We investigated the contribution of each species to the IPS using a "leave-one-out" sensitivity analysis, paying special attention to these critical sites. Discrepancies in IPS between LM and HTS were mainly due to the misidentification and overlooking in LM of a few species, which were better recovered by HTS. This bias was particularly important in the case of *Fistulifera saprophila*, whose clear underrepresentation in LM was important for explaining 8 out of the 10 critical sites and probably reflected destruction of weakly-silicified frustules during sample preparation for LM. Differences between species in the *rbc*L copy number per cell affected the relative abundance obtained by HTS for *Nitzschia inconspicua* and *Ulnaria ulna*, which were also identified by the sensitivity analysis as important for the WFD. Only minor IPS discrepancies were attributed to the incompleteness of the reference library, as most of the abundant and influential species (to the IPS) were well represented there. Finally, we propose that leave-one-out analysis is a good method for identifying priority species for isolation and barcoding.

## Dealing with methodological drawnbacks of the use of DNA metabarcoding for freshwater biomonitoring using macroinvertebrates

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The validation and normalization of genomic tools for the identification of freshwater macroinvertebrates as an alternative to traditional methods, represents an important milestone in biomonitoring of freshwater ecosystems. For this task, as a part of the European project BIOWAT, different rivers situated in three biogeographic regions, Spain (Mediterranean), Germany (Continental) and Finland (Boreal), were selected and sampling was performed to set up a group of macroinvertebrate mock communities' representative of each region.

A main issue for metabarcoding studies is the selection of a proper genetic marker, so two commonly used mitochondrial genes were selected, the Cytochrome oxidase subunit I gene (COI) and the 16S rRNA gene to address the main methodological difficulties not yet well solved. For COI, two pairs of highly degenerated primers were selected. However, in the case of 16S primers, four new primer pairs were developed. After primer selection, mock communities were sequenced. In general, primers targeting the 16S region showed higher amplification success than COI primer sets. However, none of the tested primer pairs could amplify the complete set of different macroinvertebrate taxa present in the mock communities. Primer performance was particularly poor for annelids, platyhelminthes, and amphipods. Although 16S primers showed better results, public databases based on this mitochondrial gene are scarce compared to COI, and some taxa are missing, especially for important components of the benthic communities of Mediterranean rivers. To overcome this problem, we sequenced the concerned taxa of interest and registered their sequences into a local 16S database for the taxonomic assignment.

POSTER

## Evaluando procesos de configuración comunitaria en invertebrados bentónicos estuarinos

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Los hábitats sedimentarios cubren gran parte del fondo de los ecosistemas estuarinos, y albergan una alta diversidad de organismos que cumplen roles esenciales en estos ecosistemas. Por ejemplo, las comunidades bentónicas son parte importante de los ciclos de nutrientes y son fuente de alimento para muchas especies acuáticas. Sin embargo, se conoce poco de estas comunidades, especialmente por tratarse de organismos pequeños (50–1000 µm). Bajo este contexto, existe poco conocimiento sobre los procesos dinámicos que rigen la composición de las comunidades bentónicas tanto en el tiempo como en el espacio. Este trabajo presenta un estudio que pretende evaluar el rol del ambiente en la composición de la meiofauna bentónica en el Humedal del Rio Cruces (HRC), centro sur de Chile, usando una técnica de Metabarcoding y un diseño anidado a lo largo de un ecosistema ambientalmente bien caracterizado. Los resultados preliminares han confirmado una alta variabilidad y heterogeneidad ambiental al interior del humedal, diferencias de diversidad entre los sitios de estudio, así como una posible correlación entre la composición de las comunidades y algunas condiciones ambientales particulares. Finalmente se discute como una interpretación adecuada de estas condiciones podrían mejorar nuestra comprensión sobre los procesos que generan y mantienen la diversidad de las comunidades naturales, lo que en un contexto de cambio climático ayudaría a predecir y mitigar el efecto de las presiones antrópicas sobre ecosistemas de especial interés.

POSTER

## Environmental DNA to detect the invasive species *Mytilopsis leucophaeata* in reservoirs and inside the facilities of the water supply company of Seville, Spain.

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Biological invasions are a problem worldwide and currently one of the main threats to biodiversity. *Mytilopsis leucophaeata* is a significant biofouling pest in many countries, especially where it has been introduced in Europe. In Seville (South Spain), it invades the Guadalquivir River and causes ecological and economical problems therein. In this study, we have tested the detection of the species employing environmental DNA techniques in one irrigation pond, two water reservoirs in the province of Seville, the Guadalquivir River and different facilities of the local water supply company. Sediments and water samples were analyzed with species-specific markers to detect the invasive mussel (*Mytilopsis leucophaeata*). The species were detected in the irrigation pond, in the Guadalquivir River and inside the cooling water system of the water supply company. However, the invasive mussel was not detected in any sample of the two reservoirs. Since the reservoirs are located close to other already invaded areas, regular monitoring with eDNA as an early detection method of the species is recommended. In addition, this species is causing damages to the piping of the cooling system of the water company. Then, it is highly recommended to regularly check all the facilities where the species were detected to prevent future clogging problems. Finally, we recommend to other public and private companies with a piping system connected to the Guadalquivir River to analyze their facilities to avoid the expansion of this invasive mussel as well as possible economic problems.

# SS6

# Biogeochemistry of the carbon cycle

## Why healthy wetlands? Climate implications

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Following recent data showing global increases in greenhouse gases (GHG) emissions, and given the low ambition achieved in the last COP25, it seems that temperatures will continue to rise, with negative consequences for our environment and societies. Nature, however, has mechanisms to reduce or mitigate, to some extent, the anthropogenic climate change. Wetlands, for instance, are highly active ecosystems in the exchange of GHG with the atmosphere. Carbon sequestration and retention capacity has been demonstrated in many regions and ecosystems types, though not always wetlands can be considered as allies in the fight against climate change. Its conservation status plays a special relevance, since pressures and impacts have negative consequences on their structure and functioning, and thus, on its climate regulation capacity. Knowing that Mediterranean wetlands are one of the most threatened ecosystems, an analysis of these impacts on their carbon balance and the GHG emission, is essential to determine the climate implications. With the results obtained from observations, experimentation and modelling, a relationship between the conservation status and the wetland mitigating capacity can be quantified. Comparisons among wetlands with similar ecological characteristics but different degree of alteration, show how impacts such as eutrophication, hydromorphological modifications or changes in water physical-chemical features, have an impact on the metabolic rates associated with the carbon cycle, and methane emissions, one of the main GHG gases. These results can also be taken as the basis for an adaptive management to improve their condition as well as to increase their climate regulatory capacity.

## Adaptive management of Mediterranean wetlands to strengthen their climate change mitigating capacity

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Wetlands are among the most metabolically active ecosystems on Earth, playing an important role in carbon exchange with the atmosphere. Under well-preserved conditions, they are largely considered as carbon sinks, and provide the capacity for climate regulation as an ecosystem service. However, alterations and impacts on these systems can reduce this capacity, and increase greenhouse gas emissions, reversing the carbon balance. Currently multiple management measures can be performed that improve the wetland condition, while increasing their social perception. Some of these measures can also be essential in strengthening the mitigating role of wetlands on climate change. This work assesses the potential effect of different management practices and their effects on the capacity of carbon retention or release, and therefore the effects on the capacity of climate regulation in different types of Mediterranean wetlands. To carry out this assessment, different management conditions are projected on a carbon balance model, which studies the influence of each practice on the metabolic rates of carbon exchange. Preliminary results show which measures have the greatest influence, both positively and negatively, on the carbon sink capacity of the wetlands. Depending on the type of wetland considered, the management practices that better adapt to the mitigating capacity may vary, although generally, they tend to be measures that recover or maintain their natural ecological characteristics. They range from the maintenance of their natural hydroperiod, to the recovery of physical-chemical features attending the wetland class, or the reduction of the trophic level in sites undergoing eutrophication.

## Drivers of $CO_2$ emissions in open-canopy Pampean streams (Argentina)

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Carbon dioxide ($CO_2$) emission from fluvial systems represents a substantial flux in the global carbon cycle. However, variation in fluvial $CO_2$ fluxes as well as its drivers are poorly understood. Here, we estimated $CO_2$ concentration and fluxes in 14 open-canopy streams (Pampean region, Argentina) that cover a range of nutrient levels and agricultural land use in the basins. We analyzed drivers of $CO_2$ fluxes, including current velocity, stream nutrient concentration, fluvial metabolism and land use (cropland, cattle breeding, natural vegetation, and other uses). Mean $CO_2$ concentration in the streams was 3050 ppm, and all streams were net emitters of $CO_2$ to the atmosphere. However, the emissions varied considerably among streams. $CO_2$ fluxes were related positively with the gas exchange rate coefficient ($K_{600}$) and agricultural cover, and negatively with net ecosystem production. We also observed a high spatial heterogeneity in $CO_2$ fluxes within each stream reach, which was associated to flow variation and the presence of different macrophyte species and algae mats. Our results indicate that $CO_2$ fluxes in open-canopy Pampean streams are driven by hydraulics and aquatic metabolism.

## Interaction between calcite precipitation and planktonic metabolism and its effect on lake carbon fluxes

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The precipitation of calcium carbonate is a relevant process in the carbon cycle of lakes and reservoirs. It can imply a significant burial of carbon into lake sediments, as well as strongly determine $CO_2$ dynamics whereby interactions with the inorganic carbon equilibria have direct effects on the concentration of dissolved inorganic carbon (DIC) species, including $CO_2$. Recent evidence suggests that calcite precipitation could be a major source of $CO_2$ in lakes of high alkalinity, leading to $CO_2$ supersaturation. In lakes, calcification is tightly coupled to primary production, apparently due to a nucleation effect of picophytoplankton. This interaction can trigger peaks of calcification during the summer season, affecting carbon dynamics and the carbon budget of a lake. Using incubation experiments in combination with High Frequency Measurements data in several European lakes, we quantify the interaction between primary production and calcite precipitation and its potential effect on carbon fluxes.

## Impact of dam decommissioning on carbon greenhouse gas emissions in Enobieta Reservoir (Artikutza, Navarre)

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Many have estimated emissions from reservoirs, but for a comprehensive life cycle assessment of the reservoir, the dam decommissioning (DD) must be incorporated. We measured $CO_2$ and $CH_4$ emissions upstream and downstream, as well as in the surface water and emerged sediments before, during and after DD of the reservoir of Enobieta. $CO_2$ fluxes in the reservoir were always positive, except for one time at the beginning of the emptying process, and $CH_4$ was always emitted from the reservoir to the atmosphere. $CO_2$ emissions were greater in emerged sediments than in the inundated parts of the reservoir. For emerged sediments, highest $CO_2$ flux was (570 ± 250 [342-838] mmol $m^{-2}$ $d^{-1}$), at the beginning of the drawdown process, while the lowest (114 ± 130 mmol $m^{-2}$ $d^{-1}$) occurred when the reservoir had lost half of its water. $CH_4$ was partially emitted via ebullition, with the highest $CH_4$ ebullition flux (15.74 mmol $m^{-2}$ $d^{-1}$) recorded in the shallow zone at the beginning of the emptying process. For the total C ($CO_2$ + $CH_4$) there was emission to the atmosphere, but also C fixation at the beginning of the emptying process due to the photosynthetic activity of phytoplankton. This study shows that during DD, C fluxes peak in some places (hot spots) during different times (hot moments). Our results confirm that considering DD is essential to estimate reservoir contribution to current and future greenhouse gas emissions.

## Organic matter respiration in the hypolimnion of a Mediterranean reservoir

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Lakes and reservoirs play a significant role on global carbon (C) exchanges by regulating the transport of C from continents to oceans. In the Mediterranean region, these ecosystems remain thermally stratified during long periods, what usually leads to anoxia in the hipolimnion. The anoxic hypolimnion of stratified ecosystems constitutes a seasonally isolated environment, where organic matter mineralization is especially intense and only occur through anaerobic processes. While carbon dynamics related to aerobic metabolism has been widely studied in lakes and reservoirs, the relevance of the different anaerobic pathways of C degradation is still uncertain.

In this study we explored dissolved inorganic carbon (DIC) production in the anoxic hypolimnion of a Mediterranean reservoir (El Gergal, Spain) through the main organic matter respiration pathways (aerobic respiration, denitrification, sulphate-reduction and metals reduction) during two thermally stratified periods. Samplings were carried out twice a month. The concentration of $O_2$, $NO_3^-$, $SO_4^{2-}$, $Mn^{2+}$, and $Fe^{2+}$ was measured at three depths in the hypolimnion and temporal trends were used to estimate metabolic rates at an ecosystem scale. Results showed that until hypolimnetic anoxic conditions were reached, aerobic respiration was responsible of most of the DIC production. During anoxia, denitrification was active until late summer, when $NO_3^-$ was depleted. Thermal stratification persisted during fall, when sulphate-reduction and metals reduction were the main anaerobic respiration pathways. The contribution of metal reduction pathways to total DIC was comparatively small. Anaerobic pathways were less efficient producing DIC than aerobic respiration. This could suggests that longer stratification periods would reduce the amount of DIC generated in the reservoir.

## Consequences of climate change on the carbon balance of Mediterranean wetlands: modelling the response of metabolic carbon processes

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Attending to recent studies and scenarios, the Mediterranean region will be one of the most affected environments by climate change. Changes in the distribution and amount of rainfall and the increase in temperatures are already ongoing. Wetlands, water ecosystems of great importance in these semi-arid latitudes, are suffering the threats of climate change and modify their natural patterns and condition. Together with the anthropogenic impacts, increase in their vulnerability generates a loss of a sort of ecosystem functions and services. The study of the carbon cycle in wetlands is interesting to quantify the capacity of these systems to retain and store carbon, and to release carbon GHG, as a function of its capacity to regulate the climate. In this study, changes in wetland's environment and hydrology are modelled, and responses of main carbon metabolic processes to these changes are experimentally determined. Then, carbon cycle is modelled and connected to the environmental features to show the trend of the carbon balance in several future IPCC climatic scenarios. Preliminary results show how Mediterranean wetlands in good condition can increase their carbon retention capacity in different future scenarios, when temperatures are expected to rise. However, $CO_2$ emissions and, especially, $CH_4$ release, are forecasted to rise as well. Changes in hydrology are of major importance in temporary systems, where fluctuations would greatly modify the carbon balance. The general patterns for the different wetland types are shown by modelling, where the ecological type and conservation status are linked to the carbon balance and its variation.

## Calcite precipitation in lakes: is it a relevant component of lake carbon budgets at a global scale?

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The vast majority of studies addressing carbon cycling in lakes have focused on planktonic metabolism and allochthonous organic carbon inputs as major drivers of lake carbon fluxes. Calcite precipitation in lakes occurs within dense littoral vegetation but also in pelagic environments as a result of primary production due to a nucleation effect of picophytoplankton. This process can imply a net sink of inorganic carbon into lake sediments, buried as calcium carbonate. Also, calcite precipitation can be a source of $CO_2$ to the atmosphere due to the interaction with the dissolved inorganic carbon equilibria, as shown in marine environments for decades. However, calcite precipitation has been traditionally considered a minor component of lake carbon budgets, as it has been assumed to take place only in lakes of high alkalinity, non-representative of typical lake functioning. Here we show that pelagic calcification can occur in a non-negligible fraction of global lakes, and that it is clearly related to lake alkalinity. Despite the relevance of this process in lakes of alkalinity above 1 meq $L^{-1}$, our estimates of the $CO_2$ emissions due to calcite precipitation suggest a minor role of this carbon source in total emissions from lakes at a global scale. However, the magnitude of the burial of calcium carbonate in sediments is comparable to the global burial of organic carbon, what implies a potential major carbon sink that is neglected in current models of carbon biogeochemistry in lakes.

# SS7

# Beyond the natural sciences tool-box: what social sciences and humanities can teach us about freshwater ecosystems

## Citizen science, volunteer biomonitoring and expert biological assessment data on rivers: are they comparable?

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Citizen science tools and volunteer biomonitoring on rivers have a long tradition in Catalonia involving thousands of students, teachers, NGOs, and citizens. Many people have been introduced to freshwater ecology, biomonitoring and river management through these initiatives. One example is RiuNet (www.riunet.net), is a citizen science project, started in 2014, using an app for smartphones and tablets to assess the hydrological status and ecological quality of rivers. Another example is Projecte Rius (www.projecterius.cat), a volunteer biomonitoring program that started in 1997, which goal is to assess the ecological status of rivers and streams using a simplified methodology. Both initiatives have generated 3057 datasets on macroinvertebrates and simplified biological indices. Since the year 2000, official data gathered by experts of the water agencies are available following the requirements of the Water Framework Directive. The main question is whether non-expert assessments match the results of official ones. We used information on biological indices obtained from 269 water bodies in Catalonia where data was collected by non-experts (RiuNet and Projecte Rius) and experts (Catalan Water Agency and the Ebro Water Agency). Results show that non-expert assessments tend to underestimate the biological quality for the higher quality classes (very good and good) while for intermediate and low-quality classes (moderate, poor and bad) non-expert results and expert results mostly agreed. Therefore, non-expert data could be overall used to inform water managers about the need to investigate potential local quality problems in river reaches not officially assessed.

## Te mana o te Wai: Protecting, managing and restoring fresh waters in New Zealand

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Freshwater ecosystems are essential to people's economic, cultural and social wellbeing, yet are still one of the most seriously threatened ecosystems on the planet. Worldwide, this conflict is reflected in political regulations that ask to halt the loss of, restore and safeguard freshwaters, their biodiversity and the ecosystem services they provide. In New Zealand, the only recently implemented freshwater quality legislation is based on the concept of te Mana o te Wai, "the well-being of the water". It sets out limits for a handful of ecological quality indicators, which are the basis to develop freshwater management plans by 2025. In addition to the ecological quality indicators, the legislation mandates to collaborate with communities and include any ecological, cultural or socio-economic values they relate to the respective freshwater system to be managed. Ecological values have a long history of being used to assess the quality of freshwater systems, while cultural ones are fairly new. Conceptually, cultural values are important because they connect people with the environment. Hence, considering them in freshwater management is thought to lead to benefits for people and the environment. However, how to practically quantify and integrate cultural values with ecological and socio-economic ones is still a challenge and needs testing. In my talk, I will introduce my research project SABER CULTURAL, in which I use multi-criteria decision analysis theory to tackle the challenge of including the community's cultural values, besides ecological and socio-economic ones, in the development of a management plan for New Zealand's iconic Lake Wanaka.

## Perceptions and values around the non-perennial streams of the Balearic Islands

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Droughts and floods characterize non-perennial streams and, indeed, their flooding risk is the key of several conflicts around their management. The Balearic Islands are a singular case because all their streams are non-perennial. Within this social-ecological context, we carried out an online survey to the university community and to stakeholders aiming to understand the social perception about these systems. Results from over 2000 surveys showed that 70% of the respondents feel not at all or slightly informed about local streams, but only 15% think that these systems are not at all or slightly important for their personal wellbeing. Regarding flooding risk, most people (> 80%) agreed that: 1) floods will be more common in the near future due to climate change, 2) floods' effects on humans are caused by an inadequate urban planning, and 3) it is danger to be close to a creek during heavy rain events. However, 40% of respondents had never checked if they live in a flooding zone and there is a heterogeneous perception about if clearing the vegetation within the creeks or canalizing streams are useful management practices to reduce flooding risk. Finally, the survey showed that people value streams more because of their inherent values than because the benefits they provide to people, challenging the ecosystem services based approach. Our study illustrates how social sciences methodologies can be useful tools to understand public awareness and conflicts around freshwater ecosystems which can help guide future science communication and management practice.

## Los ciudadanos opinan sobre sus ríos: Beneficios de la participación pública

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Los ríos que cruzan entornos urbanos o periurbanos suelen estar sometidos a múltiples impactos (p.e. canalizaciones, destrucción de riberas, contaminación de sus aguas, etc). Las medidas que suelen tomar las administraciones públicas para paliar estos problemas rara vez incorporan la opinión de los ciudadanos. Sin embargo, y cada vez con más intensidad, la sociedad civil reclama tener mayor participación en las decisiones de actuación que se realizan con dinero público. En este trabajo se presentan los resultados de dos procesos participativos desarrollados en Murcia sobre el río Segura y su entorno cuyos objetivos fueron: i) conocer la opinión pública sobre los servicios ecosistémicos y problemas asociados e ii) identificar sus aspiraciones ambientales y sociales, sus preferencias sobre los paisajes ribereños, y el interés por su recuperación. Los resultados muestran que los habitantes de Murcia poseen un alto grado de comprensión sobre las relaciones entre el ecosistema fluvial y el urbano; aprecian la diversidad de especies silvestres de fauna y flora, de las razas y variedades de animales domésticos asociados a la huerta murciana y una gran preocupación por la escasez de agua en el cauce. En cuanto a las preferencias paisajísticas, los ciudadanos prefieren ríos con pendientes suaves y vegetación de ribera densa y diversa en sus márgenes. Su opinión sobre el estado actual del río es mala o muy mala debido a su falta de naturalidad y solicitan la recuperación de alamedas, eliminación de las cañas, accesos al río y recuperación de las zonas de baño.

POSTER

## Pescadors de Plàstic: Understanding the role of rivers in the transport of plastic pollution from land to sea through citizen science in schools

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Citizen science can play an outstanding role in school science education and it is especially appropriate for addressing socioecological problems. Citizen science in schools engages the students directly with these environmental problems at local level while gives them an understanding of the scientific process. Here, we report a citizen science project designed to engage students (10–12 years old) in a real research project to explore a relevant environmental problem: plastic pollution in freshwater ecosystems. Despite plastic pollution has been widely studied in marine ecosystems, only a few studies provide evidence for the presence of plastic litter in freshwater environments. This project uses standardized methods to study the presence of plastic litter in rivers and the role of these systems in their transport from land to sea. During the first edition of this project, around 800 students from 25 different schools have worked together with scientists, applying a scientific method to collect, document and analyse data on macroplastics and microplastics in 52 reaches within three contrasting watersheds (Fluvià, Tordera and Baix Ter; NE Spain). Results from this project not only provides evidences on the prevalence of plastic waste in rivers and its distribution along the studied watersheds, but also on the important role that citizen science in schools can play to increase environmental awareness and scientific literacy in society.

POSTER

## "El batec dels rius", an outreach project for stream lovers

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The stream flow regime determines the biological communities, functionality and ecosystem services of running waters. Similar to humans' heartbeat, the flow regime – including natural floods and droughts – is unique for each fluvial ecosystem and warrants its good health status. *"El Batec dels Rius"* is an outreach project that aims to increase the society's awareness on the ecological, biological, and cultural values of the stream flow regime. We installed informative boards nearby 14 streams with different flow regimes within the Besòs and Tordera catchments (Catalonia, Spain). The boards explain the *stream flow regime* concept and invite citizens to become fully aware of the dynamic nature of streams through their senses. Citizens are also encouraged to take pictures and record audios of the stream and to share them in the social media. All the shared media can be seen and listen in the website of the project and in Twitter. Moreover, the website includes several concepts, research, and news related to stream hydrology and ecology. Since September 2019, we have had over 1000 website visualizations and more than 100 followers in Twitter. The success of the project highlights that there is a social interest in learning about streams. Therefore, outreach projects like this one are essential to effectively transfer scientific knowledge to citizens and engage them into the resolution of key environmental problems such as water resource management.

POSTER

## Streams: knowledge and preservation of a common legacy

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Running waters are among the most threatened ecosystems on the planet. Understanding their functioning, their history, and the relationships established with humans are fundamental grounds for the protection and sustainable use of these life-supporting systems. LivingRiver is a European Project that includes universities and NGO's of Portugal, Romania, Spain and Turkey. The project aims to provide advanced training as well as pedagogical and scientific tools to be used by schools, and by the general community, to a better understanding of streams, their history, cultural legacy and ecology. As in streams, this project is an open system: participants from different countries are invited to make and immerse mesh bags filled with alder leaves in selected forested stream reaches. Along with a physico-chemical characterization of the study sites, the participants follow the leaves' decomposition – a key stream ecosystem process - gaining insights on streams' ecology and functional integrity. In parallel, they collect and analyze sources of tangible and intangible heritage, which contribute to the knowledge of the history and valorization of cultural legacy of watercourses in close relation with the communities who live in their margins. Data resultant from this crossed ecological-social approach are discussed and registered online contributing to an international database. All activities of the LivingRiver project are disseminated to the general public in a multimedia and citizen science-based platform.

POSTER

## What do students know about rivers and their management? Analysis by educational stages and territories

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Understanding rivers from an ecosystem perspective is a necessary starting point to develop management strategies able to reverse the current deterioration of these socio-ecological systems. Current scientific knowledge related to rivers and their management should be present from primary school and increase in complexity according to educational levels. In this context, the main purpose of the present study was to evaluate the overall student knowledge about the ecosystem conception of rivers and their sustainable management. We designed and distributed a nine-question survey to students at three different education levels 6th of Primary Education, 3rd year of Secondary Education and 3rd year of the Bachelor in Primary Education- and from six different geographic territories, obtaining 3447 responses. Respondents showed a limited understanding of rivers, much simpler than the ecosystem conception, which was related to proposals of unsustainable management of these ecosystems. Although the results were analogous among territories and educational levels, undergraduate students had a more complex conception of rivers as well as more sustainable ideas regarding their management compared to primary and high school students. This study demonstrates the lack of knowledge transfer between science and students regarding river ecosystem models. Current educational programs should be adapted to address, even at early stages of education, the sustainability challenges around river ecosystems.

# SS8

# Metacommunity ecology in aquatic ecosystems: applications, innovations and challenges

## Wind directionality and strength affects wetland invertebrate metacommunities in Patagonia

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Wind has the potential to shape metacommunities by affecting organism dispersal strength and directionality. Here we evaluate the relative importance of wind in the assembly of wetland invertebrate metacommunities of active (i.e. flying adults) and passive (e.g. through birds) dispersers in Patagonia. This region experiences some of the strongest winds on Earth, with persistence of westerly winds. The study included invertebrate samples collected from 82 pristine wetlands across the Argentinian Patagonia. For each wetland we measured water quality, morphology and plant cover. These variables were used to calculate an environmental distance between sites (i.e. how each pair of sites was in terms of local habitat conditions). Then, we built two metric of landscape resistance to dispersal between sites: topographic (i.e. least cost path between sites taking into account topographic barriers) and wind (i.e. least cost path between sites taking into account wind speed). We built distance-decay relationships of macroinvertebrate community similarity for each distance. Wind had a much stronger effect than environmental conditions and topography on the metacommunity organization of passive dispersers. On the contrary, wind had a weak effect on the organization of active dispersers' metacommunities when compared with topography and environmental conditions. Our results suggest that metacommunity studies should account for the effects on external dispersal agents, with e.g. wind being a major determinant of community organization.

## Implementation of a metacommunity approach for river biomonitoring under water scarcity

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Rapid shifts in biotic communities due to environmental variability challenge the detection of anthropogenic impacts by current biomonitoring programs. Metacommunity ecology has the potential to inform such programs, because it combines dispersal processes with niche-based approaches and recognizes variability in community composition. Using intermittent rivers – prevalent and highly dynamic ecosystems that sometimes dry – we develop a conceptual model to illustrate how dispersal limitation and flow intermittence influence the performance of biological indices. We produce a methodological framework integrating physical- and organismal-based dispersal measurements into predictive modeling, to inform development of dynamic ecological quality assessments. We provide a case study of application using macroinvertebrate IRES metacommunities. Such metacommunity-based approaches could be extended to other ecosystems, and are required to underpin our capacity to monitor and protect ecosystems threatened under future environmental changes.

## Avances en ecología de metacomunidades en ríos intermitentes para la mejora de su conservación y gestión

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El estudio de los ríos intermitentes ha cobrado una gran importancia, ya que constituyen más de la mitad de los cursos fluviales en climas mediterráneos y se prevé que este porcentaje aumente como consecuencia del cambio climático y de la demanda creciente de agua a nivel global. La existencia de cauces secos en la red fluvial tiene un efecto directo sobre la dispersión de las especies y puede, por tanto, modificar las dinámicas de sus metapoblaciones y metacomunidades. El objetivo del proyecto MECODISPER, que presentamos aquí, es evaluar la influencia de la fragmentación del hábitat sobre organismos que tienen distintos medios de dispersión (algas, macroinvertebrados y peces). El proyecto se está llevando a cabo en diferentes arroyos del parque natural de Sant Llorenç del Munt i lObac. Los arroyos muestreados cubren una gran variabilidad estacional, dando lugar a distintos niveles de conectividad hidrológica debido a los periodos de sequía dominantes durante una parte considerable del ciclo hidrológico anual. El proyecto combina experimentos de colonización y resistencia a la sequía con recopilación de información genética y taxonómica. Además, se ha realizado una caracterización hidrológica detallada utilizando medidas en continuo de la temperatura del agua a través de sensores. Los datos obtenidos serán utilizados para analizar la dinámica y estructura de las metapoblaciones y metacomunidades respecto a cambios en las variables ambientales, de hábitat y de paisaje. Por último, se elaborarán herramientas de conservación e identificación de refugios de biodiversidad. Se presentarán los resultados obtenidos hasta el momento.

## Time also matters: a multi-taxon approach to the relative role of environment, space and time on the structure of a tropical temporary pond metacommunity

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Metacommunities are dynamic systems, but the influence of time independently of environmental change in their configuration has been rarely considered even though strong temporal effects are expected to influence metacommunity structure of some ecosystems. We surveyed 30 temporary ponds in western Costa Rica and Nicaragua at three different moments of their hydroperiod: after the infilling of the ponds, at the middle of the hydroperiod and before desiccation. We obtained data on 56 environmental variables, and used geographic coordinates to build spatial variables (Moran Eigenvector Maps). We collected biological samples and estimated the specific abundance of phytoplankton, zooplankton and macroinvertebrates. To estimate the relative role of environmental, spatial and temporal processes in metacommunity, we used variation partitioning analysis with distance-based redundancy analyses for each taxonomic group. We repeated the analyses for selected taxonomic groups, separately for each sampling season to check how the variance explained by spatial and environmental factors vary between sampling periods. We found strong environmental effects, but no clear patterns of spatial effects according to dispersal strategy (actively vs. passively dispersing groups), although passive dispersers were more strongly influenced by environmental processes than active ones. We obtained significant percentages of variance explained by pure temporal effects in almost every group, these being stronger for groups with longer generation times. In addition, when analyzing each sampling period separately, we found large differences in the relative role of environment and space at different sampling periods, showing that snapshot survey studies may not be representative of highly dynamic metacommunities.

# How far can EPTs fly? A comparison of empirical flying distances and existing dispersal metrics

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Most EPT species (Ephemeroptera, Plecoptera, Trichoptera) have an aerial dispersal phase, essential to maintain their metapopulation dynamics. However, empirical data on dispersal capacity is available for only 5-10% of the European EPT species. Alternatively, indices based on species traits are used to assess dispersal capacity, like relative body length, dispersal capacity metric DCM (Li et al., 2016) or species flying propensity SFP (Sarremejane et al., 2017). The aim of this study was (1) to create a database on empirical data on European EPT flying distances, and (2) to identify the invertebrate dispersion indices best fitting the empirical data. The database was created reviewing the literature from Sondermann (2017) and extracting the EPT flying distances. The scores of the dispersal indices mentioned above and modified versions of DCM (excluding aquatic mobility) and SFP (excluding voltinism) were calculated for every species. Ordered logistic regression models were used to test which indices were significantly related to the empirical distances. Because the database empirical sources used different methods, flying distances had to be transformed into distance classes (<0.8km, 0.8m–3km, 3–5km, >5km) and some species assigned to several classes. To account for this uncertainty, these species were randomly assigned to one single class, regression models calculated and results saved. Then, this process was repeated 10,000 times. SFP was the index best fitting the empirical data, as regression models were significant the highest number of repetitions. Nevertheless, less uncertain and comparable empirical data on EPT flying distances is needed to better understand aerial dispersal.

# SS9

# The tech revolution: Improving aquatic biogeochemical knowledge through new approaches and methodologies

## Improving river metabolism estimates: a promising modelling approach to solve light-associated misspecifications

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The recent development of a hierarchical state-space model has facilitated more accurate estimates of river metabolism. However, understanding how biological or physical processes might be misspecified in this model is an important step in identifying how to incorporate statistical process error (PE) and further improve our estimates. A significant part of this error can be associated to light because 1) characterizing light regimes at reach scales remains challenging, and 2) we do not know how ecosystem-scale GPP responds to light. These misspecifications can cause large errors in GPP estimates. Here we developed a new modeling approach that accounts for PE during the day (versus generic PE during both day and night) to allow a flexible means of addressing light saturation and to account for misspecified light inputs into metabolism models. We compared three models: 1) linear GPP-light relationship and generic PE; 2) saturating GPP-light relationship and generic PE; and 3) linear GPP-light relationship and daytime PE. We compared their performance by simulating $[O_2]$ data under different light scenarios (i.e., cloudiness, bank shading and light saturation) and evaluating each model's success in recovering the simulation parameter values. Results showed that, across all scenarios, daytime PE had the greatest accuracy and least bias of the three model variants, suggesting it is a promising approach to improve estimates of river metabolism and, therefore, to better quantify carbon fluxes and investigate drivers of aquatic activity.

## High resolution methods for the molecular analysis of natural dissolved organic matter: no pain, no gain?

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Freshwater ecosystems have a strong impact on the global carbon cycling, degrading inputs of terrestrial organic matter that are outgassed to the atmosphere, affecting the global carbon land sink. These inputs and their processing rates are altered by anthropogenic actions such as induced drought or land use changes.

The organic matter (OM) composition exerts a direct control on its degradation and consequently, on its fate in freshwater ecosystems. Here, we will present how the study of OM composition at a molecular level through different methods can help us to understand which compounds are present and preferentially lost in freshwater environments. On the one hand, to understand which terrestrial OM compounds are present and more reactive across different sub-catchments feeding a common estuary, we used high-resolution mass spectrometry (FT-ICR-MS) for the non-target analysis of dissolved organic matter. On the other hand, a target tool, pyrolysis-gas-chromatography-mass-spectrometry (Pyr-GC-MS), was applied to study the loss of a long-term carbon sink: lake sediments organic matter. We aim to discuss the information obtained from both target and non-target approaches on natural OM compounds in different environments and highlight the main gains of each method.

## Revealing the timescale dependence of biogeochemical signatures of high-mountain streams using time-frequency domain methodologies

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In high-mountain landscapes, elemental resources are limited and heterogeneously stored in poorly developed soils, snow, ground ice and glaciers. The melting of these cryospheric reservoirs guide the temporal patterns of solute mobilization to the recipient streams. These patterns, depending on the stream location within the catchment, vary from seasonal (e.g., snow melt in spring) to daily (e.g., ice melt in summer) scales. Also, because microbial communities mediating solute transformations are most of the year under suboptimal conditions (e.g., snow cover, low temperatures, physical disturbance), the contribution of in-stream processes remains bracketed in short time windows (days to minutes). While traditional monitoring fails on revealing these responses, capturing the variety and temporal richness of stream biogeochemical signals is now a reality with the advent of high-resolution sensors. Here we take profit of these advances to improve the understanding of the timing and magnitude of the processes regulating the transport and the cycling of solutes in high-mountain streams. To do so, we use synchrony (*S*) analysis on 4 years of high-frequency physicochemical data at 12 headwater streams in the Alps to examine whether patterns of biogeochemical signals persisted (or collapsed) across temporal scales in heterogeneous high-altitude landscapes. We expect that *S* between streams will be primarily determined by the similarity of catchment pairs, and secondarily by the biophysical reactivity of the solutes of interest. However, we predict that for cases of high pair similarity, *S* patterns will be more persistent across temporal scales. In contrast, frequency-dependent non-linearities will arise in cases of lower pair similarity. We conclude that elucidating most prominent time scales of stream physicochemical synchronicities is relevant given the hydrological alterations projected for high-mountain regions.

## Resazurin, a smart tracer for analyzing groundwater influences on stream metabolism

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The reactive tracer resazurin is frequently used to assess metabolic processes in aquatic systems because its transformation to resorufin depends on oxygen consumption in living cells. To date, this tracer technique has been mostly used for hydrologic or cytotoxic applications, but less so to answer ecological questions. However, the resazurin-resorufin system provides opportunities to improve our understanding of ecosystem functioning because it offers key advantages compared to traditional measurements of stream metabolism (e.g. it guarantees precise end-member information, compounds are not gaseous). In this study, we used resazurin in in-stream constant rate additions and laboratory incubations to investigate the influence of discrete inputs of shallow groundwater, potential sources of dissolved organic matter, on stream metabolism in a boreal headwater stream. Results from resazurin incubations showed that only the groundwater inputs with high concentration of labile dissolved organic matter could fuel stream metabolic activity. Moreover, constant rate additions of resazurin showed consistent increases in stream metabolic activity downstream of groundwater input zones, especially during periods of high terrestrial-aquatic connectivity. Together, these results suggest that discrete groundwater inputs may serve as ***control points*** of metabolic activity in boreal streams; and ultimately highlight the utility of the resazurin-resorufin tracer system for understanding patterns and controls of stream under different scales and hydrologic conditions.

## Analyzing dissolved organic matter from land-based fish farms in North Patagonian Streams (SALMO-DOM)

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Chile is the second largest producer of salmon worldwide. Land-based aquaculture facilities are in charge of producing the first stages of salmonids. These aquaculture facilities are located on pristine low order streams and introduce huge amounts of organic matter, mainly dissolved, since particles are retained by physical treatment systems. This input of highly labile and mainly dissolved organic matter has a high potential to disturb stream metabolism, deteriorating water quality and generating stress in fluvial ecosystems. However, the fate and effects of dissolved organic matter contribution with high carbon and nitrogen content generated by this productive activity in the north Patagonian region has been little studied. The present work presents results of different analytical approaches, such as analysis stable isotopic signatures (d13C & d15N), fluorescence spectroscopy and FT-ICRMS of dissolved organic matter obtained from aquatic matrices coming from fish farm effluents located in the North-Patagonian region. The results clearly show different isotopic signatures in the aquaculture effluents when compared to the isotopic ratio in the non-impacted stream water. This difference is supported by fluorescence spectroscopy, bacterial activity and FT-ICRMS spectra deciphering and enabling the estimation of SALMO-DOM load and fate in north Patagonian streams.

POSTER

## Monitoring of riparian zones using satellite images

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Riparian vegetation is highly modified in most parts of the world. Some important agents of perturbation in these systems are the changes caused by alien plants or environmental changes. Therefore, many restoration projects are underway. In these projects, the initial evaluation of this ecosystem is essential for the correct decision making. There are different indexes for the determination of riparian vegetation quality (Quality Riparian Forest, River Vegetation Index, River Habitat Index, Riparian Forest Evaluation, etc.), all of them help in choosing the best restoration action. But another kind of problem arises, it is necessary to take into account the technical, human and economic resources, which are essential for a correct evaluation. In addition to the time required for field work and the evaluation of the measurements made. This study aims to obtain these indexes through satellite images, obtained from the Copernicus platform (Sentinel II). Trying de data with Geographic Information System (GIS) programs, with their extensions in raster and hydrology among others, we get a scale which will adapt to the indexes. With the treatment of the images, and with the field data collected from each of the indices, the correlation between the two systems has been established in order to determine a specific index that has allowed us to evaluate the riverside vegetation. This leads to certain advances in future evaluations, reducing the efforts required to perform the in-situ analyzes.

POSTER

# Detección de blooms de algas en embalses a través del análisis geoespacial: Desarrollo de técnicas de teledetección.

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En los últimos años se ha comprobado que el nivel de eutrofización en el embalse de A Baxe (Galicia) ha empeorado, llegando a tener lugar proliferaciones de cianobacterias (cyanoHABs). Se realizó un estudio y análisis de las técnicas de teledetección de contaminación por floraciones de algas a través de imágenes satelitales obtenidas de la plataforma Copernicus. El satélite utilizado fue Sentinel II, del que se utilizó la resolución espacial de 10 m y las bandas 3, 4 y 8. Estas bandas fueron utilizadas para los cálculos de Índice de Vegetación de Diferencia Normalizada (NDVI) y el Índice de Clorofila, los cuales nos permiten identificar la contaminación en la masa de agua de forma remota. Además, se realizaron muestreos en dos puntos diferentes del embalse, dos veces al mes a lo largo de todo el año 2018. Las imágenes de satélite se trataron en el programa de software libre "Qgis" y los resultados fueron correlacionados con los datos tomados en campo. Finalmente, logramos usar imágenes satelitales para la detección temprana de la contaminación por cyanoHABs en los embalses. La aplicación de estas técnicas resultan ser herramientas útiles para la detección temprana. Por otro lado, resulta necesario continuar avanzando en esta tecnología para poder detectar si la presencia de esta contaminación es de fitoplancton, cianobacterias u otros tipos de organismos.

# SS10

# Tropical limnology in the Americas: current status and future perspectives

## Rotíferos de la familia lecanidae (clase monogononta - orden ploima) en humedales de la amazonia colombiana

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En la Amazonia colombiana las planicies inundables se llenan periódicamente tras el aumento de caudal del río Amazonas, este fenómeno mezcla diferentes tipos de agua presentes en esta zona y genera mayor heterogeneidad ambiental que, junto a la variedad de micro ecosistemas, permite el desarrollo de una gran diversidad de especies zooplanctónicas. En el presente estudio, se analizaron los Lecanide de los lagos Yahuarcaca, Mariyu, Tarapoto, El Correo, Chepetén, Cocha Larga, Socó Redondo y Garza Cocha, en los municipios de Leticia y Puerto Nariño, Amazonas, Colombia, durante los períodos de aguas bajas y aguas en ascenso, en las zonas litoral y limnética. Se registraron 49 especies del género Lecane en estos humedales, se analizó su distribución y se realizó una descripción de caracteres relevantes y una clave taxonómica. Se concluyó que este género presenta mayor riqueza en las zonas litorales en los periodos de aguas altas, como consecuencia del lavado de macrófitas y procesos de mezcla y arrastre de organismos y que la distribución de algunas especies se restringe exclusivamente a ecosistemas de aguas negras amazónicas.

## An ecological integrity index for páramo lagoons based on biological indicators and habitat: a case study of La Virginia lagoon, páramo Sumapaz, Colombia

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Ecological integrity shows ecosystem structure status and functioning in relation with pristine ecosystem reference conditions or ecosystems with high conservation status. There aren't ecological integrity index for lentic ecosystems of páramo. Páramos are high mountain biomes (elevation 2900-4700 m), characteristic of the Andes mountains of Colombia, Venezuela and Ecuador, with extensions in Costa Rica and Panama. Objective is to development and validation of an ecological integrity index for lentic ecosystem of páramo using three multitemporal ecological status indicators: Biological integrity, aquatic habitat integrity and habitat quality considering cover changes in lagoon landscape. Biological integrity assessment is made through formulation and implementing of a biological integrity composite index (BICI) based on macrophytes biological integrity, macroinvertebrates, and birds. Habitat integrity assessment is performed by formulating the aquatic habitat integrity index (AHII) considering water surface availability, types of substrates and physical-chemical factors. Habitat quality at landscape scale assessment is done by considering changes in landscape lagoon cover and using InVest quality model. BICI and AHII have a score 0.63 (good integrity) and 0.54 (acceptable integrity), respectively. At landscape level, habitat provision is good (89.7% – 90.3%) in the lagoon, but it decrease (9.7%) close to a rural road. Even though aquatic biodiversity is high, the habitat is subject to continual alterations, including effects of ENSO and climate variability, which compromises the ecosystem conservation and drinking water supplement, the most important ecosystem services of this páramo.

## Dinámica biogeoquímica del metano en un ecosistema epicontinental tropical hipertrófico y su contribución a las emisiones de gases efecto invernadero: Variación a diferentes escalas de tiempo

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El metano ($CH_4$) representa ~25% del total de emisiones de gases efecto invernadero a la atmosfera (Shindell et al., 2011). Los lagos y embalses, a pesar de solo cubrir el 3.7% de la superficie continental terrestre, son responsables de ~16% de las emisiones totales de $CH_4$ a la atmosfera (Bastviken et al., 2011). Caracterizar la dinámica biogeoquímica del $CH_4$ y sus variaciones, así como los principales factores que la afectan, es fundamental para entender y estimar el impacto de estos ecosistemas en el panorama del cambio climático. El embalse de Valle Bravo (VB) es un ecosistema tropical impactado antropicamnete y la principal fuente de agua para la Ciudad de México (Ramirez-Zierold et al., 2010), por lo que su estudio es de gran relevancia. La dinámica biogeoquímica del $CH_4$ se monitoreo en VB en fechas caracterizadas por regímenes de mezclado contrastantes (inicio de mezclado, mezclado y estratificación térmica), con el fin de conocer la variación estacional, además, en cada una de las fechas se monitoreo la dinámica biogeoquímica del $CH_4$ en tres momentos del día, con el fin de conocer la variación diurna-nocturna y el efecto del viento. Con respecto a las emisiones de $CH_4$, las variaciones a corto plazo fueron más grandes, siendo las rachas de viento características de este ecosistema el factor determinante, mientras que en la variación de concentración de CH4 en la columna de agua fue mayor a largo plazo, siendo la estratificación térmica y la acumulación de $CH_4$ en el hepilimnio el factor más importante.

## Methane emission dynamics from a large tropical American river

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Tropical aquatic ecosystems are considered along with boreal the main sources of greenhouse gases of biogenic origin to the atmosphere. However, there is considerable uncertainty about the estimated amounts. It is assumed that tropical rivers and streams produce, transport and emit significant amounts of methane but there is very little information available. The present study provides new information on seasonal and spatial differences in $CH_4$ concentrations and diffusive emissions to the atmosphere in the longest river in Central America, the Usumacinta River (Mexico-Guatemala). During dry and wet seasons of 2019, we measured fluxes of $CH_4$ using floating chambers, and dissolved $CH_4$ concentrations by the headspace technique combined with complementary data in the main river channel as well as in several tributaries along the Usumacinta River basin. $CH_4$ concentration ranged 0.04-0.48 µM, with higher values in the lower basin although differences between sampling stations along the river were not significant. Methane fluxes varied from 2.8 to 1,663 mg $CH_4$ $m^{-2}$ $d^{-1}$, with higher fluxes in the lower basin and with greater spatial variations during high water than during low water. No statistical difference among periods was observed. We estimate an annual methane emission of 5,634 t $CH_4$ $y^{-1}$ for the main river channel of the Usumacinta River, which contrasts with the high emissions released by the large wetland area of Pantanos de Centla (2,060 $km^2$; 0.32 Tg $y^{-1}$), located at the river mouth.

## Concentración y Flujo de carbono orgánico e inorgánico en un sistema fluvial tropical (Río Usumacinta, México) durante condiciones hidrológicas opuestas

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El río Usumacinta es el principal sistema fluvial de México y el décimo en Norteamérica. Al ser un río tropical, tiene una fuerte estacionalidad climática. El objetivo de este estudio fue evaluar la concentración y el flujo de C orgánico e inorgánico, disuelto (COD, CID) y particulado (COP, CIP) a lo largo del río Usumacinta (cuenca media y baja) en dos temporadas contrastantes (lluvias 2017-TL y secas 2018-TS). Las concentraciones de COD, COP, CID y CIP fluctuaron entre 0.88 a 7.11 mg $L^{-1}$, 0.21 a 3.78 mg $L^{-1}$, 15.59 a 48.27 mg $L^{-1}$ y 0.05 a 1.51 mg $L^{-1}$, respectivamente. El COD fue ~doble en la TL y mostró una tendencia de incremento longitudinal, probablemente por intercambio con los humedales y llanuras de inundación; además, fue la especie orgánica dominante (COD/COP>1). El COP y CIP mostraron una relación positiva con la concentración de sólidos suspendidos totales; mientras que, la proporción COP/Clor-a (1,465±2,605) sugiere que el COP se deriva principalmente de la erosión y la escorrentía de la cuenca, excepto en algunas estaciones cercanas a la desembocadura donde aumenta la productividad fitoplanctónica en secas. El CID se reporta como la concentración más alta medida para América tropical, no presentó una tendencia longitudinal y fue mayor en secas debido al balance precipitación ***vs.*** evapotranspiración. Finalmente, el flujo de exportación anual de C estimado para el río Usumacinta fue 3.06 Tg $año^{-1}$, de los cuales, el CID fue la mayor fracción transportada (85%), seguida del COD (10%), COP (4%) y CIP (<1%).

## Carbono total en 18 lagos kársticos tropicales a lo largo de un gradiente trófico en Chiapas, México

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En los lagos del Parque Nacional "Lagunas de Montebello" (PNLM), Chiapas, México, se reportaron cambios en la coloración del agua en algunos de los cuerpos acuáticos derivado del proceso de eutrofización. En el presente trabajo se estudió la concentración, variación temporal y espacial del carbono total particulado (CTP) y seston, así como la transparencia de la columna de agua ($Z_{EU}$) en dieciocho lagos del PNLM a lo largo de un gradiente trófico. Los muestreos se llevaron a cabo en dos épocas climáticas contrastantes, la temporada cálida/lluvias (estratificación) y la fría/secas (circulación). Se caracterizó el perfil vertical *in situ* de T, OD, $K_{25}$, pH y PAR y se determinó la concentración de CTP y seston en cada lago. Las concentraciones promedio de CTP variaron entre 0.5 y 3.0 mg $L^{-1}$ en la temporada cálida/lluvias y 0.5 y 7.9 mg $L^{-1}$ durante la temporada fría/secas. Las concentraciones promedio de seston se registraron entre 0.7 y 21.1 mg $L^{-1}$ en la temporada cálida/lluvias y entre 0.4 y 11.2 mg $L^{-1}$ durante la temporada fría/secas. Las características fisicoquímicas del agua permitieron clasificar a los lagos en dos grupos, prístinos (oligotróficos) e impactados (eutróficos) y estos presentaron diferencias significativas ($p < 0.05$) en la concentración y distribución vertical del CTP y seston. Los cambios acaecidos en los lagos ubicados en la zona NW del PNLM, clasificados como impactados, conllevan un incremento en la concentración de CTP y material particulado -seston- presente en los mismos, así como una distribución diferencial en el perfil vertical así como una disminución en la $Z_{EU}$.

POSTER

## Materia orgánica autotrófica y detritos en dos arroyos tropicales de primer orden con distinto estado de conservación

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La abundancia de los productores primarios en arroyos de primer orden fluctúa a escala temporal. El carbono, de origen autóctono (producción primaria) o alóctono (detritos), varía estacionalmente, en particular en regiones tropicales donde se asocia a los regímenes de precipitación. Se busca describir la dinámica anual de la materia orgánica autotrófica autóctona (MOAA) y de detritos (D), su relación con la estacionalidad climática y su efecto en el metabolismo ecosistémico, en dos arroyos tropicales de primer orden con distinto estado de conservación. Se realizaron muestreos bimestrales en tributarios del Río Lacantún, Chiapas, México. Se cuantificó el área de cobertura de la MOAA y los D en un segmento de 100 m en cada arroyo, las entradas de D por vías laterales, verticales y deriva. Se aplicó el método de oxígeno diario para cuantificar el metabolismo del ecosistema (PPN). Se encontraron diferencias entre las entradas de D ($p<0.001$) a lo largo del año, una correlación entre la cobertura de algas bentónicas con el valor de PPN ($p<0.1$) y con la precipitación ($p<0.05$) sólo en el arroyo conservado, de forma que los meses con menor precipitación tuvieron mayor cobertura de algas bentónicas y valores menos negativos de PPN. La PPN fue negativa durante todo el año indicando un metabolismo heterotrófico, sin embargo, aumentó (no estadísticamente) durante los meses con mayor abundancia de MOAA en ambos arroyos. La dinámica anual de la materia orgánica se relaciona con la precipitación e influye en el metabolismo del arroyo conservado, pero no en el arroyo no conservado.

POSTER

## Variación espacial y estacional de la $pCO_2$ y carbono disuelto en el río tropical Usumacinta, Tabasco/Chiapas

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Las estimaciones actuales de la evasión y $pCO_2$ de los sistemas fluviales tropicales son consideradas imprecisas debido, en parte, a la limitación de las mediciones afines a la dinámica temporal y espacial de los sistemas. Con la finalidad de estimar la $pCO_2$ y su variación espacial y estacional a nivel cuenca del río Usumacinta, el río tropical principal en Norteamérica por su tamaño y descarga, se midió la $pCO_2$ y concentración de carbono disuelto en el cauce principal del río y sus principales tributarios durante dos temporadas hidrológicas contrastantes (secas 2017 y lluvias 2018). Se encontró que todos los sitios se encontraron sobresaturados de $CO_2$ (483-999 ppm), con un promedio general de 909 ± 121 ppm, y se observó una diferencia entre temporadas, con menor saturación (729 ± 146 ppm) durante la TL y mayor variabilidad espacial (20% C.V.) con respecto a la TS (954 ± 53 ppm y 5%, respectivamente). No se encontró una tendencia significativa de disminución o aumento de la $pCO_2$ río abajo. La variabilidad de la $pCO_2$ se correlacionó significativamente con la concentración de COD en el río principal y sus tributarios sólo durante la TL ($P < 0.05$). Los datos de $pCO_2$ indican que desde la cuenca media hasta la desembocadura del río Usumacinta se emite $CO_2$ a la atmosfera; aunque, el promedio de $pCO_2$ es de dos a cinco veces menor que el promedio global de los ríos debido probablemente a la baja carga de COD en el río con respecto a otros ríos tropicales.

POSTER

# Grupos funcionales de diatomeas como indicadores de hábitat y características químicas de lagos de páramo de Colombia

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Las diatomeas del registro sedimentario de lagos son utilizadas como indicadoras de las condiciones ambientales pasadas. El desarrollo de modelos de indicadores se basa en el uso de las especies para reconstruir variables como el pH, el fósforo y en menor grado el hábitat. La aproximación de grupos funcionales morfológicos podría aportar información valiosa en ambientes en donde el conocimiento taxonómico aún tiene muchos vacíos. Para el caso de los lagos de páramo de los Andes tropicales, existen pocas herramientas que puedan usarse en la reconstrucción ambiental. El objetivo de este trabajo fue evaluar las relaciones ecológicas entre grupos funcionales de diatomeas y las características físicas, químicas y del hábitat, en 60 lagos de páramo de la Cordillera Oriental de Colombia. Para cada uno se realizó un muestreo durante el período seco de 2017, que incluyó toma de muestras para la determinación de características físicas y químicas del agua y una colecta de diatomeas (sedimento superficial del fondo). Los lagos muestreados presentaron un amplio rango de condiciones ambientales, desde aguas muy ácidas hasta alcalinas, con diferencias en el grado de influencia antrópica y en los tipos de coberturas. Se exploraron diferentes aproximaciones de grupos funcionales, usando características morfológicas cómo la presencia de rafe, simetría, presencia de poros en las zonas apicales, tamaño, hábito, longitud máxima, entre otras. Mediante análisis multivariados y modelos de regresión, se evaluó cuales variables ambientales explican los diferentes grupos funcionales y cuáles grupos podrían ser usados en la reconstrucción ambiental de los lagos de páramo.

# SS11

# EU Projects Workshop: exchanging experience in IAS management and awareness

## AQUAINVAD-ED: Early Detection Control and Management of Aquatic Invaders

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Project AQUAINVAD-DE. Swansea University.

The main research goal of AQUAINVAD-ED was to develop innovative methods of early detection, control and management of Aquatic Invasive Species (AIS). Because AIS negatively impact biodiversity, human health and ecosystem services (food, tourism and water provision), their control and management has become a priority. Management of AIS can be tackled by: (1) early detection, (2) identification of routes of introduction and pathways of dispersal, (3) identification of impacts on ecosystems and ecosystem services, and (4) development of efficient control measures and risk assessment. From these, early detection is the most crucial step and at which more efficient measures can be developed, but it is also the most challenging. Public awareness and stakeholder involvement are also critical for preventing new introductions and for mitigating the impact of existing ones. AQUAINVAD-ED combined the expertise of scientists and other professionals from different sectors (higher education institutions, government agencies and SMEs) working on fundamental and applied aspects of AIS in three different countries (UK, Spain and Italy). The main conclusions of the action were:

- Environmental DNA metabarcoding and Species Distribution Models (SDM) are effective methods for (a) early detection and monitoring of AIS, (b) identification of novel vectors of introduction and (c) assessment of the dispersal of native and non-native species.
- Anthropogenic factors and distance to the first introduction site are amongst the most important factors determining the expansion of AIS.
- The impacts and invasion success of AIS depend not only on the biology of a single species but also on synergies between different species.

## LIFE RIPISILVANATURA Strengthening associated biodiversity of habitat 92A0 and control of Invasive Alien Species in the Segura River

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LIFE+RIPISILVANATURA developed a fight against Alien Invasive Species (AIS) that colonize riverine ecosystems in the Segura River BASIN (SRB), both in the water itself and on its riverbanks, with three main approaches:

### 1. AIS removal

Action C4 tested a new Giant Reed Elimination technique consisting of initial trimming, native species plantation, and periodic trimming of Reed sprouting for two years.

Action C5 focused on tree AIS, that were cut down, unrooted and replaced with native species.

Action C8: capacity building in detection and removal of animal AIS.

### 2. AIS prevention and control tools

Action C3: creation of a mobile app "ExoticasMurcia, for ANDROID" allowing any citizen to directly report the presence of a possible AIS to the proper authorities, easily providing a picture of the suspect specimen, geolocalization and a list of possible species.

Action A2: development of relevant planning documents and strategic tools that will guide future management of AIS with regards to its prevention, control and possible eradication: a) List of priority AIS for the SRB & management handbook for those species, b) Strategy for AIS management in water habitats

### 3. Disseminating and awareness raising

Several communication actions were implemented in the project:

E1: Awareness raising and dissemination of the project by all partners.

E2: design and production of merchandising for dissemination

E3: Layman's Report

E4: Information panels at restoration sites

E5: Volunteer works to support the project implementation.

This work receives funds from the LIFE Programme (LIFE13 BIO/ES/1407).

## LIFE INVASAQUA: Awareness and Prevention of Aquatic Invasive Alien Species in the Iberian Peninsula

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The Iberian society has limited understanding about the threats posed by Invasive Alien Species (IAS) in aquatic ecosystems. This lack of knowledge and awareness about IAS problems hampers any management policy proposed by public administration and stakeholders, contributing to missing an IAS management strategy. We present the Environmental Governance and Information LIFE project – LIFE INVASAQUA – that will run between 2018 and 2023 in the Iberian Peninsula. The main goal of INVASQUA is to increase Iberian public and stakeholder's awareness for aquatic IAS problems and to develop tools that will improve an efficient Early Warning and Rapid Response (EWRR) framework for new IAS in freshwater and estuarine habitats in the Iberian Peninsula. We will focus on new challenges and outcomes of the project to explore some of the problems and solutions encountered in the project implementation. This work receives funds from the LIFE Programme (LIFE17 GIE/ES/000515).

## Lessons learnt from several recent experiences on direct management of alien aquatic fauna in Catalonia

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All along last 15 years I have been involved in several experiences attempting to solve or to mitigate local ecological effects of the presence of alien fauna species, mainly fish. Those experiences include from large and well-funded projects (e.g. 3 LIFE projects), to small or quick execution tasks. From high mountain lakes (>2000 MASL), to coastal lagoons, crossing through karstic lakes or urban ponds, these projects focused in species as *Phoxinus* sp, *Salmo trutta, Salvelinus fontinalis, Oncorhynchus mykiis, Micropterus salmoides, Lepomis gibbosus, Gambusia holbrooki, Cyprinus carpio, Carassius auratus, Neovison vison, Trachemys scripta, Paramisgurnus dabryanus, Procambraus clarkii, Pacifastacus leniusculus, Orconectes limosus, Corbicula* sp, or *Sinanodonta woodiana*, among others. From total successes to some discouraging results, all these experiences share their highly demonstrative value. A transversal presentation of a selection of 12 of these projects will be done, highlining their main objectives and results achieved.

# LIFE Fluvial: Results after three years of alluvial forest restauration in the Eo River (NW of Iberian Peninsula)

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Alien and invasive plants are one of the mayor threats for the alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (priority habitat 91E0*) of NW of the Iberian Peninsula river corridors. A correct management is required to improve the actual conservation status of this riparian habitat. The aim of LIFE Fluvial project is to increase the quality of this habitat in several Atlantic river corridors, included in the Natura 2000 Network sites from Spain and Portugal. To achieve this objective the project LIFE Fluvial proposes a sustainable management of habitat 91E0* by restoring its composition, structure and functionality, improving connectivity and reducing fragmentation. During these first three years of LIFE Fluvial project; we have conducted different actions oriented to improve the riparian habitat (51.1 ha), such as a detailed study of the vegetation of each action area, the detection of fragmented areas, the plantation of native tree species and the control of alien and invasive plants. Across the 28 ha of action areas in the Eo River, we detected around 50 alien species growing in natural, semi-natural or degraded habitat conditions. In this work, we explain the methods used for the detection and control of alien plant species that grow in the Eo river corridor and our preliminary results. No herbicides were used for the control of alien species, but only manual or mechanical methods. We also conducted experiments about alternative methods for the control of alien species.

# Adenda

POSTER

## RS9
## Bioremediation of cyanobacterial blooms using the Asian clam, Corbicula fluminea – the history of the bad against the villian

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Cyanobacteria can cause ecological, economic and human health problems. Several studies suggesting that climate change will give them advantage over other phytoplanktonic groups, thus increasing likelihood and/or severity of deleterious effects of this nuisance in the foreseeable future. There are currently several management strategies to deal with the presence of cyanobacteria in freshwaters, however many are not effective due to the possibility of cell lysis and toxin release. A case of special concern is their removal in the drinking water production industry where cyanotoxin release due to lysis is a threat to public health. The present study explores the suitability of the use of the invasive and widespread bivalve *Corbicula fluminea*, a species with high filtration rates and low food particle selectivity, for cyanobacterial biomass control. The capacity of clams to filter and ingest cyanobacteria was evaluated using a set of bloom-forming strains comprising different morphological features potentially affecting edibility and palatability. Results generally showed limited filtration of the majority of cyanobacteria, compared to green microalgae used as the reference for optimal filtration, except for Pseudanabaena and Anabaena. However, the analysis of the binomen filtration-ingestion showed that this filtration often relates to the deposit of cyanobacteria as pseudofaeces, rather than reflecting assimilation through effective ingestion. This behavior opens the possibility of using *Corbicula fluminea* to mimic the effects of synthetic flocculants for cyanobacterial (villain) removal in settings where a natural treatment alternative using an (bad) invasive bivalve could be suitable yet controlled to avoid side ecosystem effects.

POSTER

## RS10
## Study of the gut content of the non-indigenous fish Gambusia holbrooki compared with the potential trophic resources in restored coastal lagoons of La Pletera (Girona)

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Fish populations have an important structuring role in aquatic habitats, which is particularly important in warm temperate shallow lakes, ecosystems that face serious threats due to climate warming and eutrophication. In the restored lagoons of La Pletera (Girona, Eastern Spain), the presence of the endangered and native Iberian toothcarp (*Aphanius iberus*) is negatively affected by the abundance of mosquitofish (*Gambusia holbrooki*), an invasive species commonly found in coastal wetlands along the Iberian Mediterranean littoral. In order to study the diet of the mosquitofish, at two dates (April and June) fyke nets were placed in several lagoons (C, D and E), and left during approximately 24 hours. After this period, retained mosquitofish were collected and fixed with 96% ethanol. At the same day, zooplankton and macroinvertebrate samples were taken in the ponds, and they were fixed with 4% formaline. Around 150 individuals were inspected to study their diet: they were measured and weighted, the gut was extracted, opened, rinsed and their inner content examined under a microscope at 100X-400X magnification. Gut content showed high variability among individuals and frequently included vegetal and microplastic fragments and fibers. Among the invertebrate remains, undetermined crustaceans and insect, corixids, copepods and rotifers were relatively abundant compared with ostracods, cladocerans and mollusks, which were found at lower proportion. Zooplankton samples included, in order of abundance: rotifers, copepods, ostracods and larval stages of polychaetes, insects and gastropods.

## SS1
## The "bright side" of cyanobacteria – a water management perspective

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Water quality degradation can be caused by the presence of harmful algal blooms (HAB). Cyanobacteria, are one of the major constituents of HAB, and have a 'dark side' that can cause ecological, economic and human health problems. Climate change favours these organisms so it is important to improve HAB-related management strategies to ensure water quality. An innovative perspective that can constitute an asset for cyanobacteria management is the exploitation of their "bright side". Several exploitable products produced by cyanobacteria (e.g. pigments, lipids and bioactive compounds) present high market value. In this way, we propose the use of cyanobacterial biomass removed from natural blooms as a feedstock for future valuation. Due to the seasonal nature of cyanoHABs, the sustainability of the biotechnological investment requires parallel production under controlled conditions. Knowledge on which species to produce and the conditions to meet the desired yield is essential to support their parallel cultivation. Here we explored this conceptual framework by addressing the production of valuable products (i.e. the pigments phycocyanin (PC) and chlorophyll (Chl)) by three cyanobacterial species, *Nostoc* sp., *Anabaena cylindrica*, and *Spirulina platensis* under long-term controlled culturing. Growth curves and pigment production were evaluated for more than 100 days. Although *Spirulina* is one of the most produced species at the industrial level, our results showed that *Nostoc* sp. was the best producer of both PC and Chl. This shows that prior to cultivation at the industrial scale, laboratory characterization and species selection is a critical to ensure the sustainability of the process.

## SS4
## Effects of metal mining effluents from abandoned mines on freshwater ecosystems. Frongoch mine as a case study

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Effluents from abandoned mines represent a source of chronic uncontrolled pollution because of the lack of any regulation about these wastewaters treatment. The specific hazards posed by chemical stressors harboured in mine effluents to the aquatic environment have been barely investigated. Biofilms are complex microbial communities with a relevant role in aquatic ecosystem functioning that are considered as effective bioindicator of ecological impacts and are recognized as necessary target within the Water Framework Directive. This study aims to evaluate the ecological impact in freshwaters of a metal effluent from an abandoned mine (Frongoch) in Wales, United Kingdom. For that, aquatic biofilms have been used as biological indicators. Specifically we compared the behavior of biofilms in a pristine stream (Nant cell) with the mining effluent (SITE 1) and different impacted reaches (SITE 2 to 6) along the Frongoch river, downstream the abandoned mine. Mining effluent significanlty affected river biofilms by reducing its photosynthetic efficiency and changing its phototrophic community composition, which shifted from diatom to green-algae dominated community. In addition, diatoms found in the most impacted site presented deformities and a loss of biodiversity. By constrast, as distance to the mining area increased, the ecological impact decreased. Sites located more downstream presented a gradual dilution of the metal concentration in water and both, the phtosynthetic efficiency and the phototrophic community composition of the biofilm, were recovered. The main conclusions are: i) the mining effluent severely affect the biofilm communities with potential consequences at ecosystem level, ii) the sampling points downstream are affected by the metal content in water and iii) along the river, with the dilution factor, the river are able to recover the biofilm community composition but with a loss and deformities in the diatom species.

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