ABSTRACT BOOK

SETAC EUROPE 33RD ANNUAL MEETING

30 APRIL–4 MAY 2023 | DUBLIN, IRELAND + ONLINE

"DATA-DRIVEN ENVIRONMENTAL DECISION-MAKING"

Abstract Book

SETAC Europe 33rd Annual Meeting

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This book compiles the abstracts from the 33rd annual meeting of the Society of Environmental Toxicology and Chemistry – Europe (SETAC Europe), conducted from 30 April–4 May 2023 in Dublin, Ireland, and online.

The abstracts are reproduced as submitted by the author and accepted by the scientific Committee. They appear in order of abstract code and alphabetical order per presentation type. The poster spotlight abstracts are included in the list of poster abstracts. The presenting author of each abstract is highlighted in bold.

The information in this abstract book reflects the status of the abstracts as was on 14 April.

PRINT ISSN 2309-8031 - ONLINE ISSN 2310-3043 © 2023

Society of Environmental Toxicology and Chemistry Europe (SETAC Europe)

About SETAC

In the 1970s, no forum existed for interdisciplinary communication among environmental scientists, biologists, chemists, toxicologists, managers, engineers or others interested in environmental issues. The Society of Environmental Toxicology and Chemistry (SETAC) was founded in North America in 1979 to fill the void and quickly saw dynamic growth in the Society's membership, meeting attendance and publications.

A unique strength of SETAC is its commitment to balance the scientific interests of government, academia and business. The Society by-laws mandate equal representation from these three sectors for officers of the World Council and Geographic Unit Boards of Directors and Councils, and in the composition of committees and other society activities. The proportion of members from each of the three sectors has remained nearly equal over the years.

The Society is concerned about global environmental issues. Its members are committed to Environmental Quality Through Science®, timely and effective communication of research, and interactions among professionals so that enhanced knowledge and increased personal exchanges occur. Therefore, SETAC publishes two globally esteemed scientific journals and convenes annual meetings around the world, showcasing cutting-edge science in poster and platform presentations. Because of its multidisciplinary approach, the scope of the science of SETAC is broader in concept and application than that of many other societies.

SETAC's growth is reflected in the founding of Geographic Units around the world. SETAC Europe was established in 1989 as an independent organisation, followed by SETAC Asia-Pacific in 1997 and SETAC Latin America in 1999. In 2002, the four existing organisations joined together under the governance of the SETAC World Council. SETAC Africa is the most recent Geographic Unit, which was adopted in 2012. As evidence of international acceptance of the SETAC model and of the great interest at the local level, regional chapters and branches have emerged in a number of countries.

SETAC publishes two journals, *Environmental Toxicology and Chemistry* (ET&C) and *Integrated Environmental Assessment and Management* (IEAM). ET&C is dedicated to furthering scientific knowledge and disseminating information on environmental toxicology and chemistry, including the application of these sciences to risk assessment. Integrated Environmental Assessment and Management focuses on the application of science in environmental decision-making, regulation and management, including aspects of policy and law, and the development of scientifically sound approaches to environmental problem solving. Together, these journals provide a forum for professionals in academia, business, government and other segments of society involved in the use, protection and management of the environment for the enhancement of ecological health and human welfare.

SETAC books provide timely in-depth reviews and critical appraisals on scientific subjects relevant to understanding a wide range of contemporary topics pertaining to the environment. These include any aspect of environmental chemistry, toxicology, risk assessment, risk management or environmental policy.

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toxicants can vary across different clonal lines, test guidelines do not specify a *D. magna* strain/genotype. We used *D. magna* lines resurrected from the sedimentary archive of a lake with documented changes in chemical pollution over time and exposed 20 of these lines to cadmium chloride. The observed EC50 varied significantly among lines up to two orders of magnitude. The genetic variation among clonal lines, as well as historical environmental stress, may contribute to significant variation in reported EC50 values for chemicals. This study shows that extrapolating EC50 levels from a single strain may lead to under- or overestimation of toxicity. It potentially points to the limited power of EC50 estimates for environmental risk assessment.

1.04.P-Mo030 Effect of Historic Pesticide Exposure Upon Response to DDT in *Daphnia*
***Niamh Eastwood**, William A. Stubbings, Mohamed Abou-Elwafa Abdallah and Luisa Orsini, University of Birmingham, United Kingdom*
Daphnia are a keystone species in freshwater communities, and their response to environmental stress can be used to infer wider community response in small-scale laboratory settings. Changes in their reproduction and transcription are often used to understand the effect of environmental toxicants such as pesticides. The insecticide DDT was widely used until the second half of the 20th century when it was banned in many areas of the world, in part due to its nature as a persistent organic pollutant and its possible adverse effects on human health. However, it is still used today in parts of Africa and East Asia for effective control of disease-bearing insects.

In this study, we utilise *Daphnia* resurrected from a sedimentary archive with known historical presence of DDT to assess how historical exposure to chemical stress may affect naive and experienced Daphnia genotypes to DDT exposure. Using liquid chromatography-mass spectrometry (LC-MS), we measured DDT in the sediment of the lake from which the *Daphnia* originated.

We study fitness-linked life history traits and biomolecular responses of *Daphnia* to environmentally relevant concentrations of DDT, and identify evolutionary mechanisms underpinning response to recurrent and novel stress.

The potential impact of novel chemical stress on the keystone grazer *Daphnia* has important implications for aquatic food webs, given its central role in lentic freshwater environments worldwide.

1.04.P-Mo031 Chronic Exposure of *Daphnia magna* to Insecticides: Unconventional Effect on Reproduction and Sensitivity of Behaviour as Biomarker
***Floriane Tisserand**[1], Christophe Reis[2], Federica Gilardi[3], Aurélien Thomas[3] and Nathalie Chèvre[2], (1)IDYST, Ecotoxicology, Faculty of Geoscience and Environment, University of Lausanne, Lausanne, Switzerland, (2)Faculty of Geoscience and Environment, University of Lausanne, Lausanne, Switzerland, (3)Unit of Toxicology, CURML, University of Lausanne, Switzerland*
Aquatic organisms are chronically exposed to a multitude of pollutants over several generations. Chronic exposures at low concentrations can induce physiological changes and thus have direct adverse effects on populations. Nowadays, classical endpoints measured during chronic exposure focus on reproductive endpoints. However, other parameters may be impacted by long-term exposure and could be interesting to study regarding the ecological relevance of the test results. The behaviour is one of those parameters. Indeed, change in the behaviour can affect the population survival. For example, the organisms may no more be able to escape predation or to feed. In my study, I aimed in highlighting the physiological changes in *Daphnia magna* (reproduction, mortality, and size) through a parental exposure of 21 days to concentrations of 0.1 to 300ng/L to the insecticide diazinon. I also evaluated the effect of the pollutant on the swimming behaviour of organisms. Indeed, diazinon, as an acetylcholinesterase inhibitor, is expected to affect the behaviour of the daphnids. The first results show a significant decrease of the cumulative reproduction over 21 days from the lowest concentration at 0.1ng/L with an increase of this phenomenon up to 33ng/L before decreasing to the normal level from 100 to 300ng/L. On the other hand, the size of the organisms after 21 days does not show any significant difference. The effects on swimming behaviour are currently being processed.

1.04.P-Mo032 Differential Susceptibility to Arsenic in Glutathione S-Transferase Omega 2 (GST-O2)-Targeted Freshwater Water Flea *Daphnia Magna* Mutants
*Eunjin Byeon, Haksoo Jeong and **Jae-Seong Lee**, Department of Biological Sciences, Sungkyunkwan University, Korea, Republic of (South)*
To examine the role of glutathione *S*-transferase omega class (*GST-O2*) genes in the biotransformation and detoxification in *Daphnia magna*, various responses such as *in vivo* endpoints, arsenic speciation, enzymatic activities, and gene expression pathways related to arsenic metabolism were investigated in wild-type (WT) and *GST-O2*–targeted mutant (MT) fleas produced by CRISPR/Cas9. Sensitivity to arsenic in MT fleas was higher than in WT fleas. Also, the reduction rate of arsenate (As^{V}) to arsenite (As^{III}) in the MT group was significantly lower and led to accumulation of higher arsenic concentrations, resulting in decreased protection against arsenic toxicity. Relative mRNA expression of other *GST* genes in the *GST-O2*–targeted MT group generally increased but the enzymatic activity of GST decreased compared with the WT group. Oxidative stress on arsenic exposure was more strongly induced in the MT group compared with the WT group, resulting in a decrease in the ability to defend against toxicity in *GST-O2*–targeted mutant *D. magna*. Our results suggest that *GST-O2* plays an important role in arsenic biotransformation and detoxification functions in *D. magna*.

1.04.P-Mo033 Toxicity of Atmospheric Particulate Matter from a Brazilian Industrial Area on *Daphnia magna*
***María del Pilar Gonzalez Muñoz**[1], Andrea Cordero[1], David Salvatierra[1], Marisa Narciso Fernandes[2], Cristiano Araújo[1] and*

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Mining, iron, and steel industries are a continuous source of air pollution due to the amount of atmospheric particulate matter (PM) they release. This PM is a complex mixture formed by metallic nanoparticles and metals, which can reach aquatic ecosystems and may have significant ecological consequences. The aim of this study is to evaluate the toxicity of the PM, collected in a Brazilian region (State of Espírito Santo, Southeast Brazil) influenced by the steel and iron mining industry, and to know the possible impact it may have on aquatic organisms. For this purpose, the crustacean *Daphnia magna* was exposed to different environmentally relevant concentrations (0.01, 0.1, 1, 5, 10 g/L). The endpoints studied were: avoidance throughout 24 h in a nonforced exposure system, reproduction (number of neonates per female after 21 days of exposure), acetylcholinesterase activity (AChE) after 48 h, and finally, feeding rates in a short-time exposure (48 h) and in a long-time exposure (21 day + 48 h). As results, there was a negative effect of this material on the organisms, with the exception of reproduction, which was increased as from 1 g/L and the first brood occurred earlier as from 5 g/L. The avoidance was concentration-dependent and represented 88% and 100% at the two highest concentrations. The AChE activity was significantly inhibited in 5 and 10 g/L. The postexposure feeding rates were lower in long-term exposure at the highest concentration. According to our results, the concentrations with statistically significant differences were 5 and 10 g/L. In addition, in order to explain this material's toxicity, a chemical analysis was performed to characterize the metals present in this compound, but no direct relationship was observed. This study highlights the need to understand the toxic effects generated by metal mixture present in MP coming from anthropogenic activities on aquatic organisms, to perform adequate safety regulations, because of their toxicity, persistence in the environment, and potential bioaccumulation in living organisms.

1.04.P-Mo034 Establishing the Effects of Aquatic Pharma-Pollution on Female *Daphnia magna* Strauss 1820 Biological Organization

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Contaminants may cause adverse effects at all levels of biological organization, manifested from molecule to ecosystem levels. Illuminating the cause-and-effect linkage between stressors and responses across the levels of biological organisation affords advances in environmental risk assessment. We investigate the effect of emerging contaminants detected in surface waters on the aquatic ecosystem.

To improve our understanding of anthropogenic pharmaceutical pollution within aquatic environments, we investigated aquatic pharma-pollutants within the well-characterized *Daphnia magna* model. Bioaccumulation of contaminants within the tissues of adult female *Daphnia magna* Strauss 1820 acutely exposed to environmentally relevant venlafaxine concentrations as a single compound as well as a mixture containing 11 emerging contaminants categorised as Watchlist compounds by The Water Framework Directive (metformin, gemfibrozil, sulfamethoxazole, trimethoprim, venlafaxine, carbamazepine, diclofenac, erythromycin, clarithromycin, azithromycin, and gabapentin) were quantified using liquid chromatography-mass spectrometry (LC-MS) analysis. Initial monitoring results for Watchlist chemicals identified that venlafaxine is the most predominantly observed analyte in surface waters. Therefore, this analyte has been chosen in this study of biological effects.

The chronic effects of the pharmaceutical were then established by observing transgenerational effects on organism survival, reproduction, morphology, organ function, and epigenetic alterations. Preliminary results have shown the bioaccumulation of contaminants within *Daphnia Magna* Strauss 1820 tissues. Analysis of reproduction studies on individuals chronically exposed to environmentally relevant concentrations of venlafaxine shows a decrease in offspring numbers with an increase in heart rate. The study aims to further correlate transcriptomic alterations investigated by RNAseq analysis to population effects including body length and width of first-generation females (F0) and first filial (F1) individuals.

1.04.P-Mo035 Acute Toxicity, Oxidative Stress, and Apoptosis due to Short-Term Triclosan Exposure and the Multi- and Transgenerational Effects in the Freshwater Water Flea *Daphnia magna*

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In this study, the median lethal concentrations of triclosan (TCS) were determined as 184.689 and 349.511 μg/L in neonate and adult stages of the freshwater water flea *Daphnia magna*, respectively, based on the acute toxicity assessment. Furthermore, 50 and 100 μg/L TCS have induced oxidative stress and the changes of reactive oxygen species (ROS) content and antioxidant enzymatic activities in *D. magna* have been analyzed. However, several apoptosis-mediated proteins showed TCS-induced oxidative stress damage in response to 25 μg/L TCS, indicating that apoptotic proteins were the most sensitive mediators. Also, the multi- and transgenerational effects of TCS were evaluated in *D. magna* over three generations on various *in vivo* endpoints, DNA damage responses, and biochemical reactions. The transgenerational group exposed to TCS showed more negative impacts on antioxidant responses, DNA fragmentation status, and biological endpoints than the multigenerational exposure group, leading to decreased reproduction and higher ROS content. The transcriptional expression levels of glutathione *S*-transferase genes in the transgenerational exposure group were upregulated compared to those in the multigenerational group, but they were fully recovered in the F2 offspring group. Our findings provide an in-depth understanding of the adaptive effects of multigenerational TCS exposure groups.

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The freshwater amphipod *Gammarus pulex* Linnaeus, 1758 occurs in both pristine and anthropogenically polluted sections of European rivers. Applying population genetics approaches, we addressed the question, whether *G. pulex* is impacted by a selective effect of ecotoxicologically relevant anthropogenic organic micropollutants (AOM) in polluted field sites. We performed a regional scale study with *G. pulex* sampled at differently polluted sites at six rivers in central Germany. The *G. pulex* genetic population structure was analyzed by genotyping 16 microsatellite markers and by comparisons of individual DNA sequences of a segment of the mitochondrial cytochrome oxidase I (COI) gene. In parallel, AOM contamination levels and their toxicity potentials at the sampling sites were determined by measuring an array of AOM in water and amphipod tissue samples. Genetic data indicated intact gene flow within the rivers; a separation of genetically differently adapted *G. pulex* subpopulations by chemical water contaminants was not indicated. However, there was a clear trend of reduced genetic diversity of *G. pulex* from sites with higher AOM levels. Tissue levels of AOM in *G. pulex* were found to depend on AOM levels at the respective sampling sites, with higher AOM tissue levels and accordingly higher chemical toxicity potentials in individuals from the more polluted sites. As indicated by a lab experiment with the model toxicant imidacloprid toxic susceptibility of *G. pulex* for adverse chemical effects was higher when individuals were from a sampling site with increased AOM water and tissue levels. Although *G. pulex* can be abundant in river stretches with high AOM levels our studies, comprising population genetics, chemical analysis and toxicological approaches, show that *G. pulex* is affected by AOM: 1) Continuous exposure to certain AOM levels in the species' habitat leads to an increase of its toxicological sensitivity on the individual scale; 2) AOM caused reduced genetic diversity on the population scale. Reduced genetic diversity and increased sensitivity may lead to a reduction of species resilience to further stressors in its habitat.

2.01.P-Th103 Effects of Artificial Light at Night on Two Freshwater Invertebrates
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Light pollution is one of the emerging environmental concerns. ALAN has been expanding worldwide, and it is expected to increase continuously, in the upcoming years, according to IUCN. Artificial light at night (ALAN) leads to changes in natural light timing, intensity, and spectrum. Consequently, human health and biodiversity have been threatened since the day/night light cycle plays a crucial role in living organisms' behavioural and physiological processes. In fact, ALAN, namely from white LEDs that emit a wavelength peak in the blue range, is associated with the suppression of nocturnal melatonin production. Melatonin, the time-keeping hormone, regulates biological rhythms and an array of physiological processes and has been appointed as a key sensitive response to ALAN in many organisms. We present work aimed to assess the effects of ALAN on the life history traits of two freshwater invertebrates: the insect *Chironomus riparius* and the planarian *Girardia tigrina*. This work also aimed to understand the potential role of the hormone melatonin as mediator of light pollution effects.
For that, *C. riparius* were exposed for 28 d to three light regimes (control, i.e., dark nights) and two relevant levels of ALAN (1, 10 lux during the night period), in the absence and presence of exogenous melatonin (1 µM). Larval growth, development time, and imagoes body weight were analysed. *G. tigrina* were exposed for 10 days to the same treatments. After exposure, behavioural endpoints (feeding and locomotion) and cephalic regeneration after decapitation (blastema length, photoreceptors, and auricle formation) were evaluated.

Results show that exposure to ALAN led to delayed emergence of *C. riparius* (significantly for females) and altered males imagoes size. Concerning *G. tigrina,* exposure to ALAN caused a delay in head regeneration, with no clear effects in behaviour. Results also indicate that exogenous melatonin could help mitigate the ALAN-elicited effects suggesting that ALAN might affect its production in aquatic invertebrates. However, further studies are needed to clarify this and ongoing experimental work is evaluating biochemical responses (e.g., energy metabolism and oxidative stress/damage). Results suggest that low, environmentally relevant intensities of ALAN could affect the life history traits of freshwater invertebrates, potentially leading to adverse population-level effects.

2.01.P-Th104 Broadening the Perspective of Environmental Stress in Aquatic Ecosystems due to Contamination: An Approach using the Habitat Selection Response Based on a Cost-Benefits Balance
María del Pilar Gonzalez Muñoz[1]*, Andrea Cordero*[2]*, David Salvatierra*[2]*, Mohammed Islam*[2,3]*, Helmut Stremmel*[4]*, Lucía Herrera*[5]*, Eloisa Ramos-Rodriguez*[6]*, Gema Parra*[7] *and Cristiano Araújo*[2]*, (1)Instituto de Ciencias Marinas de Andalucía, Spain, (2)Institute of Marine Sciences of Andalusia (CSIC), Spain, (3)Faculty of Fisheries, Sylhet Agricultural University, Bangladesh, (4)Ruhr University Bochum, Germany, (5)Environmental and Food Safety Research Group of the University of Valencia (SAMA-UV), Spain, (6)University of Granada, Spain, (7)University of Jaén, Spain*
If it is assumed that mobile organisms move to look for food, a safe habitat, to mate or to avoid predators, why is the same not expected to occur when they are confronted by contamination? What would happen if we looked at the effects of contamination from another perspective, by broadening the way that toxicity is assessed? From a wider conceptual perspective, some particularities that can condition the responses of organisms to contamination should be considered: (i) are organisms able to escape from contaminants thus avoiding their toxic effects? (ii) what is the role of contamination in organisms' habitat selection processes? The aim of this work is to show, firstly, evidences of the role of contaminants in the organisms' decision to stay in or avoid an ecosystem and, secondly, how a nonforced approach could be integrated to the forced exposure approach to understand the balance of cost-benefits performed by organisms when a contaminated habitat is selected. In addition, we will show the different nonforced multicompartmented exposure systems that have been developed at different spatial scales (mini- and

mesocosms) to simulate spatially connected heterogeneous contamination scenarios (methodological advance). Our recent data show that contamination by the agrochemicals chlopyrifos and terbuthylazine at 10 µg/L was not very aversive to *Daphnia magna*; however, in mixture they considerably prevented the colonization response (even at 0.01 µg/L). In a cost-benefits study, copper showed to be aversive to the freshwater shrimp *Atyaephyra desmarestii*, but when simultaneously confronted to contamination, risk of predation, and presence of shelters, shrimps made an environmental analysis moving toward moderately contaminated area with shelter and lower risk of predation, instead of selecting clean areas with predation risk. Finally, we observed the attraction exerted by fluoxetine on *D. magna* (organisms moved to 800 µg/L) even at lethal concentrations (LC50 was 365 µg/L), disturbing the cost-benefits balance. This approach represents an effort to broaden the ecology component within ecotoxicology, where contaminants are integrated as an ecological element (Stress Ecology), providing a tool that could be used complementarily with the traditional forced exposure approach. Finally, the nonforced exposure approach allows to include ecological concepts as habitat selection and colonization (conceptual advance) to Ecotoxicology.

2.01.P-Th105 Application of a Feeding Inhibition Test with the Mayfly *Cloeon dipterum*

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In recent years, the interest of testing nonstandard species for environmental risk assessment of pesticides has increased. Particularly, interest in mayflies increased due to their relevance in aquatic ecosystems and sensitive response to exposure to certain pesticides.

In this context, we developed a semistatic test system to investigate the food uptake and thus the potential feeding inhibition on the mayfly *Cloeon dipterum*, exposed to different concentrations and exposure scenarios of two insecticides. The exposure scenarios differed in the duration of the preexposure to the test substance (48 h, 24 h, 8 h) which allows the quantification of onset of effects. During the feeding period, the larvae were provided with laboratory grown periphyton. For the periphyton culture, a natural inoculum collected in field was used and the periphyton was grown on unglazed tiles under controlled conditions. The quantity of the periphyton was measured fluorometrically as chlorophyll-*a* concentration at the start and the end of the 96 h feeding period. The experiments consisted of 20 replicates for each of the six concentrations and the control. Each replicate contained one single medium-sized larvae of *C. dipterum* grazing on one tile covered with a predefined periphyton layer. Additionally, five replicates were prepared for each concentration and the control to determine the growth of the periphyton in the absence of larval feeding. The food uptake was calculated as amount of periphyton consumed by a larva over the feeding period corrected by the growth of periphyton without grazing. Despite considerable variability, the results revealed a concentration- and time-dependent decrease in food uptake: effects in lower concentrations tend to increase with the exposure duration also in the absence of signs of immobilization. Nevertheless, further development regarding the standardization and culture of food is needed to particularly reduce variability as observed for the measured endpoints.

2.01.P-Th106 All the Way up? – Does Contaminated Biofilm Affect its Grazer *Cloeon dipterum*?

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Ecosystems are multibranched and multilevelled networks. Aquatic ecosystems are based on multiple connections within and among trophic levels supporting ecosystem integrity. Chemical stress can disrupt these interactions and lead to shifts in structure and function. Direct effects of chemicals have been widely studied, but studies of potential indirect effects are scarcer. Against this background, aquatic biofilms acting both as primary producers and food source for primary consumers were offered as food to the mayfly larvae *Cloeon dipterum* after exposure to chemical stress. To do so, we collected biofilm from a small river in a natural reserve in Rhineland-Palatinate (Germany) serving as inoculum colonising ceramic tiles in the Landau Laboratory Stream Microcosms. After a four-week period of precolonisation, biofilms were chronically (14 days) exposed to 1) 10 µg/L of the herbicide propyzamide, 2) 10 µg/L of the antibiotic ciprofloxacin and 3) to the mixture of both. Subsequently, we fed the biofilm to field collected *Cloeon dipterum* larvae (larval stage 1-3) under controlled conditions for 21 days. Grazers were analysed regarding growth, physiological condition (fatty acid composition), and feeding activity, while the biofilm was analysed in terms of biomass using ash free dry weight data, chlorophyll content, and fatty acid composition. The data are currently being analysed supporting a coherent interpretation of potential bottom-up effects among trophic levels.

2.01.P-Th107 The Use of *Potamopyrgus antipodarum* Feeding Rates as a Sensitive Ecotoxicological Endpoint: Effect of Salinity and Niclosamide

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Potamopyrgus antipodarum is a detritivore freshwater snail species native to New Zealand that has become a successful invader in a variety of freshwater environment. Characteristics such as its worldwide distribution and a wide tolerance to a range of environmental factors led this species to be proposed as a potential model species in ecotoxicology. Additionally, its exclusively parthenogenic reproduction outside its native distribution allows for the easy isolation of clonal lineages. A standard protocol has already been developed for the use of *P. antipodarum* reproductive output (OECD guideline no. 242) as an endpoint to assess potential effects of contaminants exposure.

quantified to evaluate potential effects at the functional and structural levels. In absence of fungicides, beech, as the species with the least beneficial leaf traits, showed a 50% lower decomposition rate than alder and maple. On the contrary, fungal biomass did not follow this pattern of leaf litter decomposition observed for the three leaf species, suggesting a decoupling of biomass and functional trait composition in fungal communities. In the presence of high fungicide concentrations (300-3000 µg/L), beech showed a concentration-related decrease not only for microbial leaf litter decomposition but also for fungal biomass. This suggests that beneficial traits of leaf litter (as for alder and maple) enable leaf-associated microorganisms to acquire leaf-bound energy more easily to endure potential effects induced by fungicide exposure. Our results point to the need to deepen our understanding on how leaf species' traits relate with the impact of chemical stressors on the leaf decomposition activity of microbial communities. This step seems relevant for a more complete understanding of anthropogenic effects on carbon and nutrient cycling in streams.

2.07.T-02 Chemical Stress Increases Methane Production in Freshwater Sediments: Role of Temperature Feedbacks, Adaptation, and Resistance

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The increasing emissions of atmospheric greenhouse gases are the main driver of climate change and a serious concern for human health and the environment. Microbial methane (CH_4) production in anaerobic freshwater sediments is the largest and most unresolved source of atmospheric CH_4. Given the rising CH_4 emissions, researchers have been investigating environmental controls and climate change feedbacks for decades. Despite their omnipresence, the impact of anthropogenic chemical stressors (e.g., antibiotics) on methanogenesis in freshwater systems is still largely unknown. Against this background, we first incubated natural pond sediment at four levels of a five-component antibiotic mixture. Second, three temperatures (i.e., 10, 15, and 20 °C) were employed as additional factor to assess interactions on the toxicokinetics and -dynamics of antibiotics. Third, the adaptability of a pristine and a preexposed microbial community was investigated. Both communities were treated with antibiotics for three weeks and consecutively incubated at three concentrations of the same antibiotic mixture. In every experiment, the effect of antibiotics was decisive with the CH_4 production rates almost doubling at the highest treatment concentration (i.e., 5000 µg L^{-1}). Furthermore, higher temperatures resulted in increasing effects of antibiotics indicating a potential feedback-loop. Both the pristine and the exposed community showed effects of antibiotics on methanogenesis with effects increasing in the former and decreasing in the latter after the first treatment phase. Compound-specific isotope signatures indicated that the same synthesis pathways (i.e., mainly acetate and H_2/CO_2 as substrates) were utilized and metabarcoding of the 16S rRNA gene suggests changes in the community composition of microorganisms relevant to methanogenesis.

2.07.T-03 Seasonal Fluctuation of Metabolomic and Photosynthetic Yield Response of *in situ* Freshwater Biofilms Exposed to a Model Herbicide

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With increasing aquatic chemical pollution, the study of microbial communities (e.i periphytic biofilms) improves the ecological dimension of biomonitoring. Despite a growing knowledge, there is a paucity of information about the seasonal fluctuation of their sensitivity to chemical stress. If classical endpoints often lack sensitivity and focus only on one component of the biofilm, untargeted metabolomics can provide a comprehensive and sensitive picture of the molecular response prior physiological. The present study aims to characterize the changes of sensitivity of freshwater periphyton to the model herbicide terbuthylazine over months through the combined measurement of the photosynthetic yield (ΦPSII) and the metabolomics response based on high-resolution mass spectrometry. To do so, periphytic biofilms were sampled on a pilot site and exposed during 4 h in controlled conditions to a range of six concentrations of herbicide. The sensitivity of periphyton to chemical was assessed through the determination of Benchmark Doses with a standard deviation of 1% compared to the control (BMD) and their cumulative distribution for metabolomics data. The results indicate a change in the sensitivity over the months for both endpoints. Indeed, BMD of ΦPSII vary from 5.5 to 13.8 µg/L. Multivariate analyses on metabolomics data showed a response at 0.3 µg/L of terbuthylazine; our results highlighted that the metabolomics response is more sensitive than the photosynthesis since almost 50% of the metabolome have reacted at the BMD *ΦPSII*. Metabolite identification found significant pathway modification under exposure. This study shows that sensitivity of periphyton to chemical stress fluctuates along the year, highlighting the need to consider it for field studies. In addition, this work confirms the higher sensitivity of metabolomics against photosynthetic response in the form of their BMD responses. The metabolite annotation highlighted similar pathway response effect but different regulation. The continuation of these investigations along the year will provide additional insight on the influence of environmental parameters on the sensitivity of periphyton to chemical stress. Especially, metabarcoding analyses should highlight the natural taxonomic shift according to environmental conditions and hone the identification of which metabolites and pathways are sensitive to environmental conditions against those specifically impaired by the chemical stress.

2.07.T-04 Contamination on Ecosystems and Habitat Selection – The Role of Ecological Interactions on the Behavioural Responses

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The reason by which ecotoxicity tests are reductionist regarding to ecosystems complexity is due to the fact that the environmental variables can be more easily controlled by the experimenter. In this sense, two important scenarios have not been usually integrated to ecotoxicology: i) the chemicals are not always homogeneously distributed in the ecosystems and ii) the effect of the ecological interactions (such as predation, competition, etc.) can exert on how organisms respond to toxicity. The aim of the present study was to assess how contamination can affect the spatial distribution of organisms in a chemically heterogeneous landscape and how the habitat selection in a contaminated environment is influenced by the interactions that organisms have with other ecological factors. To that end, three study cases were analyzed where contamination was evaluated along to stressors/attractors simultaneously in two nonforced free-choice multicompartmented assay systems: the linear and the Heterogeneous Multi-Habitat Assay System (HeMHAS). For the tilapia fry case, the organism avoided the contaminant, but when confronted to food the fish intermittently moved to the most contaminated compartment. For the freshwater shrimp case, the organisms avoided the contamination but this response was density-dependent inversely-proportional, so the higher density the lower avoidance, and conversely. For the estuarine shrimp case, it avoided the contaminant as well, but when confronted to predation risk, the response shifted. In addition, when organisms were faced to the attraction of food along to both stressors, the foraging behavior was impaired in the presence of contamination. As conclusion, the nonforced exposure systems (e.g., HeMHAS) showed to be suitabile to simulate chemically heterogeneous environments to assess how contaminants disturb the habitat selection by organisms. In addition, it was evidenced how the contamination affects the organism's response to other ecological variables performing a cost-benefits analysis to reduce exposure to contamination and obtain more benefits. This novel methodology (nonforced exposure) and the integration of ecological interactions provide, respectively, new practical and conceptual approaches to assess the contamination effects from a landscape perspective. This could provide a little more of ecology to ecotoxicology studies.

2.07.T-05 Single and Combined Effects of Pesticides and Metabolites in Microbial Litter Decomposition in Streams
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The combined effects of pesticide parent compounds and their corresponding transformation products (metabolites) are often omitted in aquatic ecotoxicology studies. This gap of information is surprising given the large amount of pesticide molecules with relatively low half- life times and a plethora of metabolites found in aquatic environments. In the present study, we aim to compare the effect of tebuconazole and its metabolite hydroxy-tebuconazole on microbial litter decomposition, and to determine whether the presence of other pesticides and metabolites frequently found in surface waters (i.e., glyphosate and AMPA) increase the toxicity of the hydroxy-tebuconazole toward microbial litter decomposition. We conducted a microcosm experiment to address the research questions described above. A total of 15 glass aquariums of 15 L were filled with dechlorinated tap water supplemented with N and P and spiked with the different contaminants (i) tebuconazole (10 µg/L), ii) hydroxy-tebuconazole (10 µg/L), iii) glyphosate (0.1 µg/L) + aminomethylphosphonic acid (AMPA) (0.3 µg/L), and iv) the combination of hydroxy-tebuconazole (10 µg/L) + glyphosate (0.1 µg/L) + AMPA (0.3 µg/L)) or without (v) control. Each aquarium contained precolonized black alder leaves enclosed in fine-mesh bags (0.5 mm mesh size) to assess microbial decomposition. The results show that tebuconazole and its metabolite hydroxy-tebuconazole had similar effects in reducing microbial decomposition of leaf litter and the diversity of aquatic hyphomycete communities, even if tebuconazole effects tended to be stronger than those of hydroxy-tebuconazole. Glyphosate and AMPA did not enhance the toxicity of hydroxy-tebuconazole on leaf-associated microbial communities, except when combining hydroxy-tebuconazole, glyphosate, and AMPA which consistently impaired the diversity of the aquatic hyphomycete communities.

2.07.P Ecosystems Responses Under a Multiple Stressors Scenario in a Rapidly Changing Climate (Part II: Microcosms, Mesocosms, Factorial Design, Community-Level)

2.07.P-Mo119 Aquatic Macroinvertebrates Under Multiple Stress: Insights from a Mesocosm Experiment
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Freshwaters are frequently subject to a complex mixture of stressors like pollution and climate change. Moreover, wastewater effluents are one of the main sources of chemical pollutants in freshwater ecosystems. Multiple stressor impact on these ecosystems directly acts at the level of biodiversity-ecosystem functioning relationships. Studies on multiplicative effect of climate change, e.g., changing water temperature and chemical pollutants on freshwater biodiversity and implications thereof are limited. Accordingly, the aim of the current study was to investigate single and combined effects of wastewater effluent and elevated water temperature on aquatic macroinvertebrates. A mesocosm experiment was conducted with a simplified freshwater food web containing nonvascular macrophytes (moss) and Ephemeroptera, Plecoptera, Trichoptera, and Amphipoda, feeding as shredders and grazers. Samples were collected at the beginning and end of the experiment, whereas emerging animals were collected daily. Analyses enabling assessment of the response of nonmodel aquatic macroinvertebrates to selected stressors are ongoing, such as total protein and lipid content, and metabolome and lipidome profiling. Preliminary results show species-specific