Alternative approaches to animal testing for ecotoxicity assessments

Adam Lillicrap, Mark Lampi, Teresa J Norberg-King

Tuesday May 24, 10:50 AM - 12:50 PM, Auditorium 800

Within this session, new and novel approaches to the use of vertebrate species (e.g. fish amphibians and birds) for the assessment of ecotoxicity will be explored with a focus on understanding the role that animal alternatives have in supporting environmental hazard and risk assessments. Numerous technical and regulatory challenges need to be considered during future integration of the 3Rs (reduction, refinement, and replacement of animal tests) in environmental science. The need for alternative approaches has been primarily driven by legislation, including the EU Animal Protection Directive, the UK Animal Protection Act, the 7th Amendment to the EU Cosmetics Directive, selected legislation in Germany and the adopted European chemical legislation REACh which is fast approaching the 2018 registration deadline. The number of substances to be registered under the 2018 deadline is expected to be considerably higher than the 2013 deadline and the use of alternative methods is expected to see a tremendous rise. Since the primary goal of the REACh legislation is the protection of humans and the environment, it is imperative that only highly accurate, reliable predictions or robust alternative in vitro/in vivo approaches will gain regulatory acceptance. This session will explore new approaches towards developing and adopting efficient chemical (including effluents) assessments related to both acute and chronic ecotoxicity endpoints. Enhanced predictive models (e.g. QSARs) and new developments for in vitro and in vivo models to support environmental risk assessments will also be a focus. Additionally, progress relating to the generation of new bioaccumulation data using alternative approaches, particularly for PBT assessments, are also encouraged. Furthermore, it is recommended that abstracts have a focus on how any new approach could be accepted into a regulatory framework or integrated test strategy. This session is sponsored by the SETAC Animal Alternatives in Environmental Science Advisory Group (AAAG), a group that continues to explore the state of the science in method and strategy development.

Behavior Revised: Examining Behavioral Effects of Contaminants and Other Stressors in Aquatic Animals

Gregory G. Pyle, Bryan W. Brooks, Alex Ford

Monday May 23, 8:15 AM - 10:15 AM, Salle 300

Animal behavior integrates multiple levels of biological organization. Contaminant effects that occur at the molecular or physiological level can manifest at much higher levels of organization, often times leading to population, community, or even ecosystem level effects. Understanding such adverse outcomes is further challenged as the chemical "universe" continues to change through time as older compounds are phased out and newer substances enter commerce. Contaminant effects on behavior can be maladaptive to aquatic animals exposed to traditional contaminants (e.g., metals, pesticides) and those inhabiting municipal wastewater treatment receiving environments, where new and emerging contaminants of concern, such as pharmaceuticals and personal care products (PPCP) result in continued exposure scenarios. Of particular relevance to behavior, many of therapeutics are designed target specific neural receptors that result in modified behaviors (e.g., anti-anxiety drugs). In the aquatic environment, these drugs can accumulate in resident biota to concentrations that are equivalent to a human therapeutic dose, often with undesirable effects on behavior, which can potentially alter the normal functioning of the ecosystem. With other PPCPs and industrial chemicals, much less is known about their fate and/or potential to induce an adverse outcome in a natural receiving environment.

This session proposes to attract a wide range of researchers interested in understanding the potential for environmental contaminants and other stressors to modify aquatic animal behaviors and the resulting influence these behavioral modifications have on the structure and normal functioning of ecosystems. Links will be established between uptake pathways and target receptors as they relate to behavioral modifications. Expertise will be sought to ensure a broad coverage of aquatic animal behaviors representing multiple trophic levels among vertebrate and invertebrate species. The ultimate objective of the session is to consolidate the current state of knowledge on behavioral effects of environmental contaminants and other stressors to effectively inform future environmental assessment management in natural aquatic systems.

Cost effective and ecological relevant approaches in environmental toxicology using invertebrate species

Bruno Campos, Susana Loureiro, Magnus Breitholtz, Carlos Barata

Monday May 23, 2:00 PM - 4:00 PM, Salle R0-B

Invertebrate species are commonly used in ecotoxicity testing to investigate the impact of chemicals on the environment. A range of regulatory guidelines (OECD, ISO, EPA) are available, combining different invertebrate species and toxicological endpoints. However these guidelines and studies are limited to relatively few species, while invertebrates offer far greater range of interest for research, spanning from toxicological characterization to basic developmental biology, from endocrinology to immunology. The small size, ease of maintenance and short life cycles of invertebrate species commonly used in ecotoxicology make them also very suitable for several approaches at different levels of organization. From automated high throughput screening applications to guild related traits, and transposing to ecosystem functions make them good models for assessing toxic effects in the laboratory and the field using micro, mesocosms and transplant experiments. Emerging molecular-based technologies are allowing ever more complex research involving genome studies and tools such as gene editing, gene knockout and recombinant DNA, which are greatly facilitating our understanding of the molecular mechanisms of toxicology and its phenotypic translation. Omic technologies combined with system biology approaches offer the possibility to assess effects from the transcriptome, metabolome, organ or individual as well as the linkage to higher ecological levels, e.g. such as population level. Within this session we intend to show the latest breakthroughs and new directions in toxicological research using invertebrates, focusing on novel systems, endpoints, assays and testing strategies. We invite presentations focusing on lab and field studies addressing impacts across several levels of biological organization considering molecular, life-history, demographic and/or behavioural endpoints; studies focused on a mechanistic understanding of toxic effects and/or on risk assessment of chemical pollutants with, both human and environmental health importance. We also invite engineers and industry to show latest high throughput approaches using invertebrate species. The session is intended to be interdisciplinary and bring together researchers across a wide range of study areas with the ultimate goal of enhance our understanding of different approaches in ecotoxicity testing.

Ecological traps for wildlife driven by pollutants

Rafael Mateo, Clémentine Fritsch, Richard Shore

Wednesday May 25, 8:15 AM - 10:15 AM, Salle G+H

Animals can select habitat according to cues of the environment that correlate with better survival and reproductive success after an evolutionary process. In rapidly changing environments, these natural preferences can become harmful decisions if the selected cues correlate with adverse environmental factors that affect individual fitness. These scenarios are known as ecological traps. Although these traps have been present in nature in an evolutionary context, it is in the fast changing world after human action, when multiple scenarios of ecological traps can occur and result in local or even massive extinction of diversity. Pollutants can be one of the important drivers of ecological traps nowadays because: (1) contaminants can accumulate in highly productive habitats attractive to animals (e.g. aquatic environments), (2) some pollutants can produce an attractive cue to the animals, facilitating their exposure (e.g. pesticides/rodenticides or other chemicals that impair survival or behaviour in prey such that become easier to to catch), or (3) many other scenarios in which the preferred habitat or resource is intimately associated with the presence of a toxic chemical. The way chemicals exert adverse effects can also hinder the negative cues of polluted environments; for instance, if compounds are present in concentrations that are acutely lethal, individuals are less likely to develop avoidance behaviours. The mechanisms by which wildlife can adapt to polluted environments, through behavioural or physiological changes, can be another factor to consider in the study of ecotoxicological traps. The outcomes of potential ecological traps driven by pollutants at local or global scales, and how these affect the evolution of the species, offer a new viewpoint within the field of ecotoxicology.

Fate, Effects and Risk Assessment of Chemicals in Aquatic and Terrestrial plants

Stefania Loutseti, Noel Diepens, Carola Schriever

Monday May 23, 8:15 AM - 12:50 PM, Salle R0-B

This session presents scientific contributions that highlight topics within the fields of uptake and behaviour of chemicals in plants as well as aquatic and terrestrial plant ecology, ecotoxicology and risk assessment for algae, periphyton and aquatic and terrestrial vascular plants.

In recent years, the uptake of pesticides into plants received increasing attention as this process is considered in exposure simulations and reduces the mass available for leaching. However, an approved protocol for a standardized test design for measuring plant uptake is not yet available from official bodies such as the OECD.

Plants on the other hand, are a diverse group of organisms with variability in growth forms and life histories, and they develop and grow over multiple compartments in the environment that include sediment/soil - pore water - water - air. As a result, they are key components in aquatic and terrestrial ecosystems with important structural and functional roles and perform essential ecosystem services. Plants may play a role in the environmental fate of a broad range of chemicals in these different compartments and by transforming them through metabolism or redistributing them within the plant by translocation. This has triggered the development of additional OECD tests with rooted aquatic plants (Myriophyllum spicatum; Glyceria maxima in development), but guidance for performing higher tier testing is still lacking, especially for terrestrial plants.

Overall, a better fundamental understanding of fate, behaviour and effects of chemicals in plants is needed to support especially higher tier risk assessments.

Abstracts in this session cover the topics of

1. Testing the fate and behaviour of chemicals in plants;
2. Plant uptake testing of chemicals in the context of environmental exposure simulations;
3. Lower tier (EPA, OECD) testing with focus on selecting species, endpoints and methods;
4. Sediment exposure and effects on rooted, (aquatic) plants;
5. Higher tier testing: Species Sensitivity Distributions, micro-/mesocosm and field tests;
6. Ecological modelling approaches as a higher tier tool in the risk assessment for plants;
7. Using recovery in plant testing and risk assessment;
8. Plant risk assessment schemes under different regulations (PPPs, WFD, REACH, Biocides);
9. Invasive species: Constraints for lower and higher tier testing and risk assessment related to chemical stressors;
10. Plant ecology and trait-based approaches for the risk assessment of chemicals.

Fish model species in environmental toxicology

Jessica Legradi, Ioanna Katsiadaki

Wednesday May 25, 2:00 PM - 4:00 PM, Salle 300

Fish models are used commonly in ecotoxicity testing to investigate the impact of chemicals on the aquatic environment. A range of OECD guidelines are available, which use different fish species and target different toxicological endpoints. These studies however are limited to relatively few species, but fish offer far greater utility for research, spanning basic developmental biology, neurobiology, endocrinology to immunology. The small size of some available fish species including the zebrafish (Danio rerio) or medaka (Oryzias latipes) and their robust nature makes them ideally suited for application in automated high throughput screens. Furthermore, early life stages of these species offer all the key attributes of a complex in vivo system (e.g. including metabolism), as well as attributes of in vitro assays, as tests can be carried out in multiwell plates formats with small sample volumes and run in comparatively short periods of time. These attributes make them well suited for ecotox testing of environmental extracts and in effect directed analysis (EDA) to detect unknown contaminants in environmental samples. Research on fish over the last decade has been greatly facilitated by the availability of sequenced genomes, which are available for over twelve species with more pending. This facility together with advances in genetic and epigenetic studies, including gene knockout and transgenesis technologies, is greatly facilitating understanding of the molecular mechanisms of toxicology. Thereby helping to study and define adverse outcome pathways (AOPs). Within this session we intend to show recent developments in toxicological research using a variety of different fish model species, focusing on novel systems, endpoints, assays and testing strategies especially as applied to ecotoxicology. We will focus on molecular approaches that could lead to new AOPs. Results of toxicity studies of single compounds as well as complex environmental samples are of interest. Effects on individual fish, multigenerational exposure effects, and population level impacts will be considered. We especially welcome presentations highlighting new analytical methods and techniques for contaminants or their metabolites in exposure media or fish. The session will be interdisciplinary and bring together researchers across a wide range of research areas with the view to enhance approaches in ecotoxicity testing.

Interpreting Biological Effects of Metals and Their Mixtures

Eric J. Van Genderen, Nicolas Bury

Tuesday May 24, 8:15 AM - 10:15 AM, Salle 200

A mechanistic understanding of the physiological processes affected by pollutants provides robust scientific evidence that aids regulators in making informed environmental risk assessment. This scientific understanding will be essential to identify and prioritize those populations and environments that require protection in a multi-stressed world. The effects of metals and their mixtures has been well studied over the last 20 to 30 years and this research has contributed to the development of the biotic ligand models that are now incorporated into single metal risk assessments. There are, however, many challenges facing future metal risk assessments that will benefit from a better understanding of the physiological processes underpinning toxicity. For example, how to best regulate metals in the context of mixtures (with other metals and in combination with other pollutants), environmental change (changes in ocean pH and rising temperature, climatic fluctuations), long-term chronic exposure to via the water and diet, and adaptation. In addition, the field of metals research has advanced to the point where the principles of bioavailability can be applied to "real world" risk assessment scenarios where metal mixtures commonly occur. This session aims to provide a platform to present our current understanding for interpreting the mechanisms of metal toxicity that may aid future metal risk assessment.

Metals in the Environment: Fate, Speciation and Bioavailability in Water, Soil and Sediment

Erik E.T. Smolders, Rute F. Domingos, Karel A.C. De Schamphelaere, Yann Sivry

Monday May 23, 8:15 AM - 04:00 PM, Salle 200

The knowledge about metal transport, distribution, speciation and bioavailability has considerably increased over the past two decades. Whereas this knowledge has begun to find its way into environmental regulation of metals, environmental science keeps progressing and novel scientific and regulatory questions arise. For instance, established equilibrium models are now accepted for risk assessment, however the equilibrium assumption is not always clearly related with the biouptake processes. The role of both metals dynamic speciation and colloidal fractions under natural conditions can be be crucial on metal risk assessment. However, both aspects largely remains to be qualitatively and quantitatively described. The risk assessment of poorly soluble metal compounds in the environment needs pragmatic models to address the regulatory requirements for testing the myriad of products under natural conditions.

This session will welcome all novel contributions covering metal fate, speciation and bioavailability in water, soil and sediments. The contributions can address:

i) Chemical speciation and bioavailability of cationic metals, organometals or toxic oxyanions in the environment;

ii) Development/improvement of analytical tools or models;

iii) Fate modelling and observations;

iv) Bioavailability of metals across different species and exposure routes.

Polar ecotoxicology: hot issues in cold climates!

Katrine Borga, Nico van den Brink

Thursday May 26, 10:50 AM - 12:50 PM, Salle 150

Assessment of environmental risks of chemicals and contaminants in Polar Regions has gained increased interest in recent years. In the Arctic region this is due to potential increase of human activities like oil and gas exploitation and shipping related to the fact that larger areas will become free of ice over summer as a consequence of climate change. In the Antarctic new and unexpected contaminants are emerging, related to long-range transport. In addition the Polar Regions are act as early warning of how climate change will affect the distribution, uptake and effects of contaminants, as the environmental response to climate change will occur here fastest and with highest amplitude. A major factor affecting the environmental fate and hazards of contaminants in Polar Regions is the extreme seasonality of environmental conditions due to the high latitude, and the ecosystem adaptation to these conditions. Sea ice dynamics govern the biological cycles, and as such impact both the fate of chemicals as well as their potential effects. This makes Polar Regions different from temperate and tropical regions, hampering the extrapolation of concepts and results between regions and studies. For instance, the adaptation of Polar organisms to seasonal food availability results in build up of energy reserves (lipids) during the summer seasons that may make them vulnerable to chemical exposure and selected time windows of enhanced stress when contaminants are re-mobilised from the lipids. Hence the ecological constraints of Polar ecosystems and organismal adaptation to high seasonality may limit their resilience towards chemicals stress. To justify the need for specific risk assessment procedures and threshold levels, effects of different Polar specific factors on the vulnerability of local species to chemicals stress need to be quantified.

In this session we solicit for papers that assess environmental hazard en fate of chemicals with specific focus on factors that modulate Polar specific impacts. This may include exposure and accumulation studies as well as effect assessments. The aim of the session is to increase the knowledge of such factors, in order to increase the relevance of site specific ERA for Polar regions, but also to assess the potential risks of emerging chemicals to Polar environments even before their marketing.

Soil and water contaminants: evaluation, biomonitoring and bioindicators for effective management

Beatrice Opeolu, Matt Dodd, Annette de Vaufleury, Benjamin Pauget

Thursday May 26, 8:15 AM - 12:50 PM, Salle 300

Poverty, corruption diseases, political and sectarian violence, natural disasters are some of the challenges of the 21st century world. Impacts of these are greater in the developing economies such as Africa and Asia. Population explosion also contributes to greater demands for goods and services. Consequently, needs for industrialization, urbanization, improved quality of life commensurate to population density continue to exert pressure on natural resources. Several studies have reported pollution of ecosystems with organic and inorganic contaminants including heavy metals, phenols, phthalates, PAHs, and emerging ones such as pharmaceuticals, perfluorooctane sulfonate (PFOS), perfluorooctane acid (PFOA) and microplastics as a result of industrial, transportation, domestic and agricultural activities in association with urbanization and industrialization. These contaminants impacts negatively on soil and water resources thereby limiting their usefulness for intended purposes. The high lipophilicity and persistence of most of these environmental contaminants also results in their bioaccumulation and transport through the food chain predisposing humans to their potential negative impacts.

Developing countries are the worst hit by the impacts of soil and water pollution due to unavailability of measurement, monitoring and remediation technologies coupled with ineffective policy enforcement. Such challenges usually, cannot be solved by a single event but by continuous processes that will ensure that pollution levels are assessed and controlled. Over-utilization of Asian and Africa's soil and water resources necessitates continuous studies on monitoring of use, pollutants levels and cheaper remediation technologies for sustainability. If 'balancing economic growth opportunities with environmental sustainability' is to be achieved, efforts should be made by researchers to provide adequate data for policy decisions. This session therefore aims at inviting papers on soil and water contaminants' assessment, monitoring and remediation innovations including biomonitoring, bioindicators and bioassay. It is hoped that the session will attract researchers from the African continent and beyond sharing their experiences in the field leading to methodologies that could be adapted for developing economies as well as of data for policy framework. The session is also expected to generate a network of researchers that may possibly collaborate on regional surveys.

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Wildlife ecotoxicology: from food chain exposure to population effects

Renaud R Scheifler, John E. Elliott, Kim J. Fernie

Wedneday May 25, 10:50 AM - 12:50 PM, Salle G+H

Populations of many terrestrial vertebrates are exposed to plethora of environmental contaminants. Exposure to contaminants already released in the environment such as legacy persistent organic pollutants tends to be low level and chronic in nature. Such exposure is normally direct from diet and related to accumulation of a persistent chemical through a food chain. Wild animals also can be exposed to greater concentrations of compounds that are recently and purposely released in the environment, including plant protection products, insecticides or fungicides, or mammalian pest control products such as rodenticides. Effects of low level, chronic exposure to compounds may be very elusive and difficult to separate from effects of other stressors. Recent advances in molecular biology have, however, improved the ability to detect such subtle perturbations. Generally, exposure does not result in direct mortality, but animals exhibit reduced fitness, which can be compounded by other environmental stress factors such as the often inter-related factors of food supply and weather. In contrast, effects of acute toxicity may be relatively obvious, including mortality, although affected animals may be difficult to find in the field, as they seek shelter to recover. Linking subtle molecular or 'biomarker' effects to individual health can be challenging, linking effects detected at the individual level, even mortality, to impacts at the population level is even more challenging. For both regulatory purposes and risk assessment it is essential to obtain information on risks from both acute and chronic exposure scenarios, and to establish links between measurable biomarkers and implications for populations. In this session we are soliciting presentations that provide insight into effects at both molecular, population and even community levels, and in particular studies that make credible connections. This could include assessments that employ an adverse outcome (AOP) framework.