Amphipods as models to investigate toxicology of environmental contaminants at the land-sea interface

Gisela Umbuzeiro, Alex Ford, Theodore Henry

Tuesday May 24, 2:00 PM - 4:00 PM, Salle G+H

Amphipods frequently live in aquatic ecosystems that are vulnerable to contamination by toxic substances and occupy niches that link benthic habitats with higher trophic levels. Among these critical ecosystems are estuarine environments that combine complexity of the land sea-interface with fresh-estuarine-marine waters. Those ecosystems provide important services that include transport and transformation of toxic substances released from human activity, but the presence of these toxicants can negatively affect organisms in these environments. Despite the importance of estuarine environments and their vulnerability to environmental toxicants, there are relatively few organisms that have been developed for ecotoxicity testing. Amphipods are emerging as particularly good models for ecotoxicology and there have been substantial advancements made in understanding amphipod genomics, physiology and toxicology that will enhance the ability to establish them as standardized models. Being ubiquitous and hugely important to a variety of ecosystems and trophic interactions this diverse group has an added advantage of an enormous depth of ecological literature to assist connecting biomarkers to population level effects. Because they live in benthic habitats they become particularly interesting in nanotoxicology. This session aims to 1) explore recent developments of amphipods as models for ecotoxicology; 2) introduce new species with unique attributes that enhance ability to assess toxicology in critical habitats; 3) describe standardized methods for conducting ecotoxicity testing with amphipods including analysis of biomarkers.

Biomonitoring of contaminants in the marine environment: integration of biological and chemical approaches

Kari K. Lehtonen, Lucia Guilhermino, Ketil Hylland, Larraitz Garmendia

Tuesday May 24, 10:50 AM - 12:50 PM, Salle R0-B

The development of integrated biological-chemical monitoring and assessment of chemical pollution has been ongoing in European coastal and offshore areas for close to two decades. An integrated approach is widely seen as the most reliable way to get a holistic picture of the status of our seas with regard to contaminants. Despite the significant technological advances and a wealth of data currently available, however, the implementation of the methodologies in national and international monitoring has been limited to some countries and programmes. Some of the issues raised relate to the perceived lack of ecological relevance of the measured biological parameters, others to the high cost of some methods (e.g., -omics), while it is also conceptually challenging to combine the data in an easily interpretable form. In addition, different areas and habitats require amendments to general strategies: one size does not fit all.

The use of biological effects methods such as biomarkers can clearly contribute towards detecting and quantifying environmental impacts caused by chemical pollution, but there is still a need to develop links to population effects. Adverse outcome pathways (AOP) have recently been identified as a tool to link chemical properties of toxicants to specific molecular damage and responses at higher biological levels. Such contextual or probabilistic approaches based on known mechanisms of toxicity can provide useful modeling tools for the interpretation of the risk levels indicated by biomarker data and the levels of different chemicals measured in the environment.

Mixture toxicity and the effects of non-chemical factors (such as temperature, salinity, hypoxia and acidity) will in the future produce a matrix of interacting factors where realistic estimates of how any one factor affects the functioning of organisms and conceivably the ecosystem can only be reached by holistic assessment of the health of the individuals through applying a well-designed set of biological effect parameters.

The current session proposal invites researchers to present new data related to biological-chemical monitoring with respect to (1) new methodologies and parameter combinations, (2) application of integration methods on datasets, (3) tailoring of monitoring strategies for different types of needs, (4) modeling of linkages between observed concentrations of contaminants through damage on biomolecules and further up the biological level hierarchy, and, finally, (5) new approaches and strategies on how to implement the integrated methodologies in monitoring programmes on political and practical levels.

Development and application of oxidative stress biomarkers and models in ecotoxicology and environmental monitoring

Johan Lundqvist

Tuesday May 24, 8:10 AM - 6:30 PM, Exhibition Hall (Poster only session)

Oxidative stress is involved in a wide range of toxicological end-points (e.g. tissue toxicity, genotoxicity, mutagenicity, carcinogenicity and teratogenicity). The nuclear factor erythroid 2-related factor 2 (Nrf2) is a regulator in the cellular defense against oxidants and a key event in the oxidative stress pathway is the release of Nrf2. In an investigation of the effects of more than 300 pesticides on nuclear receptors and transcription factors, the Nrf2 pathway was one of the most commonly affected target and activated by the largest number of chemicals (Martin et al., 2010). Further, the Nrf2 activity was highly correlated with classical toxicological endpoints.

A key mission in the strategy of using in vitro bioassay in ecotoxicology and environmental monitoring is the establishment and selection of suitable bioassays. The bioassay development has been focused on finding molecular events that are important for a wide range of toxicological end-points and that is triggered by a large number of the known hazardous substances. Based on the findings described above, oxidative stress in general and Nrf2 activity in particular has been highlighted as very promising molecular events for bioassay establishments.

Environmental samples are often highly complex mixtures of known and unknown chemical compounds. Effect-driven fractionation and chemical analysis is a promising strategy where in vitro toxicity assays leads the way in the identification of toxic compounds. Furthermore, in vitro toxicity testing can be a valuable tool to asses the total toxicity exerted by mixtures of chemical compounds.

During the last years, a wide range of methods to study oxidative stress response and Nrf2 activity has been presented; e.g. gene expression studies of Nrf2, gene expression studies of downstream genes in the oxidative stress pathway (HO-1, NQO1, SOD etcetera), Nrf2 responsive luciferase reporter assay systems and Nrf2 responsive green fluorescent protein transgenic zebra fishes. Some, but not all, of these assays has also been used in ecotoxicology or environmental monitoring settings.

The aim of this session is to present and discuss biomarkers for oxidative stress, their correlation to toxicity endpoints in various organisms and their application in effect-driven identification of novel hazardous compounds in the environment.

Toxicity Testing in Sediments - Bioassays As Link Between Chemistry and Complex Benthic Community Testing for Sediment Quality Assessment

Sebastian Höss, Ute Feiler

Monday May 23, 10:50 AM - 12:50 PM, Salle 300

Sediments represent both, a major sink and a potential source of persistent toxic substances in the aquatic environment. At the same time, sediments play a key role for the ecological status of aquatic ecosystems, as they are a habitat of diverse communities and a compartment of important biochemical transformations. Therefore, sediment studies are very suitable for highlighting the extent, the history and the trend of water pollution. Among others, toxicity criteria are used to decide on the acceptability of dredged material relocation within the waters or the need for other disposal options, which may be considerably higher in their costs. Therefore, thorough sediment characterization is essential.

At present, weight-of-evidence approaches, such as the sediment quality triad, are widely accepted to assess the ecological risk of sediment-bound contaminants. Besides chemical analysis and in-situ benthic community assessment, toxicity testing with single species represents one line of evidence (LoE), which allows to assess cause-effect relationships. Whole-sediment exposure protocols representing realistic scenarios simulating in situ exposure conditions as well as aquatic bioassays for testing aqueous extracts or pore water that were obtained from the sediments are currently part of the international guidelines for the assessment of sediment and dredged material. Other LoEs, linking chemical and ecological status of benthic habitats, are effect-based sediment quality guidelines (SQG) that are derived from toxicity and biotic data, as well as pollution sensitive biotic indices (e.g. SPEAR[%] index; NemaSPEAR[%]-index).

In this session we would like to get an overview on the pros and cons of the different approaches and the benefits of WoE approaches using various LoEs for assessing sediment toxicity. Abstracts relating sediment toxicity testing with other LoEs for sediment quality assessment are welcome.