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Physical, chemical and biological determinants of ecological functioning

BIOLOGICAL DETERMINANTS OF ECOSYSTEM FUNCTIONING

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Type: *Keynote*

Status: *Accepted for oral*

Ecosystem functioning depends on interactions between physical and chemical determinants, and biological determinants. Indeed, ecosystem processes (productivity and nutrient cycling) result directly from the diversity of functional traits in the biotic communities, which is itself determined by the species composition and diversity. This species diversity results from biotic introductions and from environmental constraints. Thus, changes in biodiversity under environmental selection pressures, are prone to have a direct impact on ecosystem processes.

This question on the relationships between biodiversity and ecosystem functioning is the focus of many research works since several years. From these works, it appears that ecosystem productivity for example, seems generally to be linked to biodiversity. But there is a large debate on the signification of this observation. On the one hand, biodiversity could enhance the probability that some key species with particularly functional traits are present, while in the other hand, biodiversity could allow the assortment of complementary species, which increases the performance of communities. These two hypothesized mechanisms are not exclusive.

In fluctuating environment, insurance hypothesis predicts that biodiversity insures ecosystem functioning firstly because the probability that species adapted to new environmental conditions is greater when initial species richness is high, and secondly because redundancy of functional traits in high species diversified communities "permits" the loss of some species.

Most of these works are based on experimental manipulations of plant species richness in grasslands and only a few studies concern aquatic ecosystems. The main reasons to explain this low number of studies on aquatic ecosystems are linked to the difficulty to manipulate these systems and to the fact that we need more information on the diversity of microbial organisms, which are responsible of most of the primary production. New molecular tools such as SSCP, DGGE and ARISA will allow, in the future, to better estimate the diversity of aquatic microbial communities and to understand the relationships between this diversity and the functioning of aquatic ecosystems.

Keywords: *biodiversity, microbial ecology, molecular biology*

**THE BIOGEOCHEMICAL FUNCTIONING OF HYDROSYSTEMS AS
DETERMINED BY HUMAN AND NATURAL PROCESSES IN THE
WATERSHED**

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Type: *Keynote*

Status: *Accepted for oral*

During the last twenty years, considerable progress has been achieved in the study of large river systems, which are now considered as a whole as continuums or networks of aquatic ecosystems. Conceptual and operational models are available to link the overall biogeochemical functioning of these hydrosystems to the basic processes occurring at the scale of the land plot in the watershed or of the microorganism in the water body. These models allows to predict the changes in water quality and biogeochemical functioning of large drainage network caused by changes in land use and urban wastewater management in the watershed.

From a biogeochemical point of view, two important characteristics of the functioning of river systems are the balance between autotrophy and heterotrophy in the different sectors of the drainage network, and the ratio in the N, P and Si fluxes they deliver to the coastal zone. We will discuss how the historical and future development of agricultural, domestic and industrial activity have modified and will further modify these characteristics in European river systems.

Keywords:

THE INVASION OF EXOTIC SPECIES: A GLOBAL THREAT TO THE INTEGRITY OF FOOD WEBS AND FISHERIES OF THE NORTH AMERICAN GREAT LAKES

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Type: *Keynote*

Status: *Accepted for oral*

For the past several decades, the North American Great Lakes have suffered from eutrophication. The deteriorating state of the Great Lakes alarmed both the governments of Canada and The United States resulting in revisions to the Great Lakes Water Quality Agreement (GLWQA), which has brought about substantial improvement in water quality. While phosphorus abatement resulted in a significant decrease in nutrients, the sudden invasions of exotic species posed a serious threat to the Great Lakes food webs. *Dreissena* spp. followed by other exotics infested Lakes Erie and Ontario in large numbers causing a drastic reduction in phytoplankton biomass and increasing water clarity. In this paper, we present an overview of the time line of transportation and spread of nuisance species via ship ballast from Europe to the North American continent. The expansion and growth of the exotics has been responsible for significant modifications of the structural and functional characteristics of food webs and fisheries of the Great Lakes leading to serious economic consequences.

This presentation will highlight the contributions of Dr. Jack Vallentyne to Great Lakes research especially the implementation of the "Ecosystem Approach" resulting in the revisions of the GLWQA and its implications to current Great Lakes research including the management of exotic species. The presentation will include case studies of Lakes Erie and Ontario comparing pre-mussel and post-mussel colonization. Another important biomodifications of the food web such as the disappearance of the amphipod *Diporeia* will also be discussed. Our Great Lakes experience demonstrates the significance of the impact of exotic invaders and the need to manage this serious problem on a global basis so that the integrity of food webs and fisheries of various regions of the world could be protected.

Keywords: *lake food-web, eutrophication, invasive-species*

WHAT KIND OF PHYSICAL HABITAT DESCRIPTION COULD IMPROVE THE ECOLOGICAL EVALUATION AND RESTORATION OF STREAMS AND RIVERS ?

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Type: *Keynote*

Status: *Accepted for oral*

It is now well accepted that the efforts to control the point sources of pollution and the use of effluent-based water quality standards are not sufficient to restore the ecological status of streams and rivers. Some argued that other types of pollutants, such as sediments, nutrients or diverse xenobiotics associated with non-point sources of pollution are responsible of that state. I developed here a complementary view, dealing with physical habitat, a fundamental compartment of the hydrosystems, which has been often ignored or under evaluated in previous investigations. The habitat is defined by the structural morphology of the rivers combined with dynamic pulses of the hydrology. The links between habitat and aquatic biota have been described in numerous local impact studies, but a common and synthetic view was lacking in the past. How can we describe the habitat complexity ? And how can we distinguish different goals and associated methodologies for an efficient habitat evaluation, linkable to the dynamic of biota ? Can we associate prediction of biota evolutions with changes in habitat, natural changes (i.e. climate change) or anthropogenic changes (i.e. channelization or rehabilitation) ?

For that purpose, I analysed the principal running methodologies and pointed out their strengths and weaknesses. Then, I described some recent results of habitat/biota relationships. And at the light of these results, I proposed what could be a core for habitat description and modelling to analyse the state and the possible trends of ecological status of streams and rivers. Some of the data could also be usefull to reanalyse some chemical parameters in different spatial and dynamic views.

Keywords:

ASSESSMENT OF THE IMPACTS OF HYDROLOGICAL EVENTS ON BACTERIAL COMMUNITIES IN FRESHWATER SEDIMENT

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Type: *Oral presentation*

Status: *Accepted for oral*

The predictable hydrologic events concerning continental hydrosystems and associated to climate changes, affect the rate of flow. They could be summarized by three variables : intensity, duration and frequency of flood (or of low water), including of course the water quality (in the dissolved or particulate phases). Freshwater sediments, which are an essential component in the ecological functioning of hydrosystems, are always associated to the main hydrological events. In a simplifying way, one can group their potential effects in 2 groups : 1/ the marked floods with large mechanical effects (important erosion of bed sediment, increased transfer of suspended solids with a down stream settling, in the rivers themselves or in flooded soils) and 2/ changes in wetting and drying processes affecting the rivers' banks or the flooding plains.

The whole benthic community will be strongly affected by such events. Just a few research works study this question, particularly towards microorganisms. This contribution will enlight some issues specific to bacterial communities: what are the known or predictable effects of hydrologic disturbances, especially in terms of oxygen level changes, on the bacterial diversity? How the bacterial community structure and their related functions react to these changes ?

Some examples issued from the literature and from original data precise these questions, which are still largely to be informed.

Keywords: *hydrological events, bacterial community, sediment, freshwater*

DIATOM COMMUNITIES NATURAL VARIABILITY AND ANTHROPOGENIC PRESSURE EFFECTS: THE INTEREST OF HYDRO-ECOREGIONS

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Type: *Oral presentation*

Status: *Accepted for oral*

Our poor ability to appreciate diatom communities natural variability often leads us to a wrong evaluation of aquatic ecosystem quality.

But if we succeed, for both altered and non altered conditions, in linking river types to diatom community types, it becomes possible to develop management tools integrating this variability. Classification is, thus, a critical step in many bio-assessment programs.

In France, a set of abiotic parameters (geology, climate, altitude,...) are used to divide the hydrographic network into different homogeneous "hydro-ecoregions" (Wasson et al., 2002). But to what extent can this typological classification account for diatoms natural variability ? How do these communities react to anthropogenic pressure ? Is it a predictable response ?

These are the questions we tried to answer. Then we gathered more than 800 diatom samples coming from the different hydro-ecoregions of France.

30% of these samples, situated in weakly impacted conditions, allowed us to define the importance of the diatom communities spatial fluctuations due to natural variability. The other stations illustrated the way those communities were modified by anthropogenic pressure.

This classification, linking the different environmental situations encountered in our basin (river type x alteration intensity) to the corresponding diatom community structure, should allow us to initiate a predictive approach. At the end of this second step, we hope we will be able to predict from environmental parameters what the diatom community should be like, and then to reveal possible ecosystem damage.

Classification was performed thanks to artificial neural networks (self-organizing maps). This research was carried out in support of the Water Framework Directive settlement.

Keywords: *diatom, reference conditions, hydro-ecoregions, anthropogenic pressure, artificial neural networks, bio-assessment*

DYNAMIC VARIATION OF GLUTATHIONE AND PHYTOCHELATINS IN PERIPHYTON AS A FUNCTION OF BIOACCUMULATED METALS

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Type: *Oral presentation*

Status: *Accepted for oral*

Algae produce intracellular metal-binding polypeptides when exposed to high metal concentrations to reduce their toxicity. Phytochelatins (PCn) are such ligands which complex excess of accumulated metal and by this way, avoid non-specific binding with important biomolecules. Periphyton was shown to have variations of its intracellular Cu and Zn content depending on variations of metal concentrations in the Furtbach stream during rain events (Meylan 2003, in preparation). In this study, we have examined whether such variations of intracellular Cu and Zn influence glutathione (GSH) and phytochelatin (PCn) content in algal biofilms.

Periphyton was collected from colonized glass slides placed in the Furtbach stream (Switzerland) at a site located 1 km downstream from an important industrial area. The intracellular metal content was determined after washing cells with EDTA and was analysed by ICP/MS after acidic digestion. The thiol content, extracted from lyophilized periphyton, was measured by HPLC after a monobromobimane precolumn derivatization.

Cellular glutathione increased from 82 nmol/g dw to 137 nmol/g dw at its maximum. PC2, which was already observed at the lowest metal concentrations in water, was found to increase from 2.1 to 7.6 nmol/g dw. Other low molecular weight thiols than GSH and PC2 were also detected but at very low concentrations. The intracellular Cu and Zn concentrations were found to follow the same trend as GSH and PC2 with an increase from 0.22 to 0.69 $\mu\text{mol/g dw}$ (Cu) and from 2.10 to 3.50 $\mu\text{mol/g dw}$ (Zn). This observation suggests that, during this short-time event, the periphyton is able to quickly produce intracellular metal-binding polypeptides in response of its fast accumulation of metals. More experiments will be performed to confirm our results.

Keywords:

ECOTOXICOLOGICAL ASSESSMENT OF POLLUTANT FLUX RELEASED FROM MSWI BOTTOM ASH USED IN ROAD CONSTRUCTION : AN APPROACH BASED ON SINGLE-SPECIES TESTS AND MICROCOSM ASSAYS

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Type: *Oral presentation*

Status: *Accepted for oral*

This study deals with the impact on lentic ecosystems of municipal solid waste incineration (MSWI) bottom ash used as road embankment. One of the purpose is to propose a methodology of ecotoxicological assessment based on laboratory bioassays, and fitted to these ecosystems.

Two methodologies have been used to assess MSWI bottom ash percolates produced at a scale laboratory, in a lysimeter. Percolates are collected at three different mass-ratios (water mass/bottom ash mass) : 0.5 (P1), 1.0 (P2), 1.5 (P3). Their toxicity was tested with three single-species tests : microalgae (*Pseudokirchneriella subcapitata*), duckweeds (*Lemna minor*) and cladocerans (*Daphnia magna*). In the same time, the percolates were applied on freshwater/sediment microcosms. The 2-L microcosm contained a lacustrine sediment and a water column. Different species were introduced : microalgae, duckweeds, cladocerans, amphipods and chironomids. Survival, growth and reproduction of organisms were assessed on a duration of 30 days. Three concentrations were tested : 1.56, 4.0 and 8.0 %.

Single-species tests required pH adjustment of percolates. Initial pH ranged between 10 and 11 pH units, therefore it did not enable organisms survival. This pH adjustment was unnecessary in the microcosm because of the environment buffer capacity which was able to regulate this parameter. Metals, anions, cations and organic matter concentrations decreased during percolates production except for P3 metals concentrations. With both methodologies, when the mass-ratios raised, the percolates toxicity decreased. Nevertheless, *Daphnia magna* bioassays classified percolates as non acutely toxic. In microcosms, toxicity raised with percolate concentration. Results revealed disruptions for each population, including cladocerans. Species interactions, like those between algae and cladocerans, were modified.

Single-species tests could be classified according to the organisms sensitivity to MSWI bottom ash percolates, in decreasing order : algae > duckweeds > cladocerans. Ecosystems dynamic was approached with microcosm at higher spatial and temporal scales. The representativeness level is higher in those systems.

Keywords: *lentic ecosystem, MSWI bottom ash, single-species tests, microcosm*

INFLUENCE OF MATURATION ON RIVER BIOFILMS BACTERIAL COMPARTMENT (STRUCTURE AND FUNCTIONING)

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Type: *Oral presentation*

Status: *Accepted for oral*

As compared to free living bacteria, bacterial cells involved in aggregates are supposed to develop particular responses to environmental factors. Bacteria associated with river biofilms share common properties with all bacteria associated in biofilms or mats : to be integrated in a complex multidimensional structure and to develop particular responses in relation with the thickness of the structure. The specificity of the considered assemblage lies in the presence of algae structuring the assemblage.

Bacterial diversity, viability and activities were studied in epilithic biofilms collected in natural environments (Garonne and Célé Rivers) or in microcosms (laboratory flumes). Results were analysed in view of maturation and / or biofilms thickness.

Shannon diversity index, ranging from 0.032 to 0.050, remain constant during colonisation although dominant taxa richness, varying from 35 to 25 ribotypes and percentage of viable bacteria, decreasing from 70 to 49 % for biomass ranging from 4 to 30 g AFDM m⁻² did not.

On the other hand increase in biomass and thickness induces changes in environmental conditions within the aggregate (decrease in light, oxygen... diffusion to the deeper layers). This leads to changes in bacterial populations of the assemblage : between the 2nd and the 6th week of colonisation only 47% of initial populations are still detected.

Endly, the increase of senescence of internal layers (80 % of viable bacteria in external layers vs 50 % for the whole assemblage) with biomass accumulation leads to a modification of the assemblage functioning toward N-cycle with a shift from autotrophy (N-assimilation) to heterotrophy (Ammonification) for biomass higher than 32 g AFDM m⁻².

These results confirm the particularity of such assemblages where a control by global biomass (thickness) is predominant leading to a modification of physical and chemical parameters within the aggregate which influence the structure (diversity, viability) and the functioning of only a part of the communities present in these biofilms: bacterial community.

AFDM : Ash Free Dry Mass.

Keywords: *river biofilms, bacteria, diversity, community activity, viability*

INFLUENCE OF NUTRIENT ADDITION ON THE RESPONSE OF PERIPHYTON TO TOXIC EXPOSURE

Dr Helena Guasch

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Type: *Oral presentation*

Status: *Accepted for oral*

Nutrient availability for periphyton has motivated many investigations in recent decades. This research has demonstrated that nutrient availability is a main factor controlling the structure and function of periphyton communities in lotic systems. At the same time, a great deal of effort has been put into developing and implementing new tools for assessing the effect of toxic substances on periphyton communities. However, the interaction between nutrient availability and toxicity in these complex communities is still poorly understood. In this study, a set of experiments have been designed to investigate the interaction between nutrient addition and toxic exposure in natural periphyton communities that were presumably nutrient limited. We used two model compounds, copper and atrazine, in two separate experiments. In the first experiment, three weeks of nutrient addition increased atrazine sensitivity (measured as EC50 in acute toxicity tests), whereas similar nutrient additions reduced copper sensitivity in the second experiment. On the other hand, long term exposure to atrazine under conditions that were either nutrient-limited or not, had similar effects on algal biomass and the atrazine sensitivity of the community. In contrast, in the case of copper, nutrient addition was able to partially counterbalance the effect of copper on the photosynthetic activity of the community, which also showed a lower copper sensitivity at the end of the experiment. The physiological and community related factors involved in the influence of nutrient limitation on toxicity are discussed.

Keywords: *atrazine, copper, long-term toxicity, nutrients, periphyton, river*

IS THE GULF REALLY SUCH AS "COLDSPOT" OF BIODIVERSITY: SCALING EFFECTS AND COMPARISON WITH THE RED SEA

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Type: *Oral presentation*

Status: *Accepted for oral*

Preliminary analysis of echinoderm datasets for the Gulf and Red Sea region reveals consistently lower species richness in the Gulf at 4 different spatial scales: point, sample, large area and biogeographical. Levels of endemism are comparable at small and intermediate spatial scales, whereas at the biogeographic scale levels are slightly higher in the Gulf (12%) than the Red Sea region (10%). Endemism, even expressed as a percentage, is highly scale dependent as is species richness. Values of taxonomic distinctness, one of a suite of relatedness measures based on average properties, are very similar for the Gulf as the Red Sea region. Except at small (point) scales, observed values appear to be scale independent. This probably reflects the behaviour of taxonomic distinctness to 'saturate' much sooner than species richness, endemism and other 'species measures'. More generally, relatedness measures based on average properties, are influenced little by sampling thoroughness and taxonomic rigour. Our findings suggest the Gulf may not be the coldspot of biodiversity generally acclaimed, especially if a broad set of measures is utilised. Biodiversity is an important constituent of ecosystem health and criterion for determining where conservation attention should be targeted. Until the functional/ecological significance of taxonomic distinctness is better understood, management implications our study's findings remain unclear. We also stress that any conclusions drawn are tentative, pending compilation and analysis of more comprehensive datasets for both echinoderms and other groups.

Keywords: *biodiversity, Gulf, Red Sea, scaling effects*

LABILE AND BIOAVAILABLE TRACE METAL MONITORING OF THE SEINE RIVER (FRANCE) BY MEANS OF DGT : A TWO YEARS- EXPERIENCE.

Dr Marie-Hélène Tusseau-Vuillemin

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Type: Oral presentation

Status: Accepted for oral

It is now well documented that metals are not equally bioavailable under environmental conditions of different pH, hardness or DOM concentrations. The general consensus is that free hydrated ion concentrations in water is generally the key determinant for bioavailability. Most of the methods that allow to determine the metal speciation require however specific skills and materials that are difficult to use in situ or present a lack of sensitivity. These methods are not suited to the monitoring of rivers and urban or industrialized discharges that will be required by the WFD. The Diffusion Gradient in Thin Films (DGT) technique was proposed by Davison and Zhang as a robust way to measure free and labile metal species in aquatic environments. The device pre-concentrates the metal and the measurement is performed in an acidic eluate. Therefore, not only the quantification levels are lowered by increasing the deployment time, but also there are no matrix effects even when the DGT is deployed in natural waters. The potentialities of DGT for the estimation of bioavailable metals in presence of different kinds of organic matter were first studied in vitro by means of biotests coupled with chemical analysis .

We report here on our two years experience of monitoring labile and total dissolved trace metals in the Seine river basin with DGT. Three different sampling sites were investigated : upstream and downstream from Paris, plus a low order stream where the dominating DOM is of humic origin. The analysis were performed with ICP-MS, in order to get a comprehensive overview of the trace metals. Eight of them could be reliably measured with DGT and their quantification limits were lowered with a eight days deployment time. Total dissolved and labile concentrations were shown not to follow the same trends. The labile concentrations could be roughly related to a bioavailable fraction thanks to the characterization of the dissolved organic matter.

Keywords: bioavailable, copper, monitoring, DGT

PHOSPHORUS TRANSFERS AS INFLUENCED BY LANDSCAPE AND MANAGEMENT OF AGRO-ECOSYSTEM

Dr Aubert Michaud

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Type: *Oral presentation*

Status: *Accepted for oral*

Reduction of non-point source phosphorus (P) related to agricultural land use has been identified as a priority activity by a multi-stakeholder Management Conference on Lake Champlain, a 1124 km² surface area water body shared by the states of Vermont and New-York in U.S., as well as the Canadian province of Quebec. Objectives of a co-operative research effort initiated in 1997 within the Beaver experimental watershed (11 km²) were 1) to describe the non-point source P transfer to the aquatic ecosystem through landscape and agricultural production systems descriptors and 2) to evaluate the effectiveness of riparian zone and surface runoff management on P transfer. Spatial discrete water sampling and continuous flow gauging allowed a description of the temporal and spatial patterns in phosphorus exports from the watershed. Most of the annual P transfer was associated with flashy peak flow events in late winter and early spring period, when saturation-excess overland runoff developed over extended field surfaces. Monitoring data also suggest that subsurface flow inputs of P to the main channel as well as in-stream storage and release of highly bioavailable particulate P were important mechanisms of P transfer in the watershed. Analysis of covariance (ANCOVA) of water quality data using stream flow as a covariate highlighted a landscape-driven hydrologic control on the spatial pattern in P transfer, despite an opposing gradient in terrestrial soil P enrichment. Management of manure P sources was also shown to influence P transfer amongst sub-watersheds with comparable levels of hydrological activity. The ANCOVA model yearly trend in P concentration from the downstream station also indicates an improvement in water quality in response to the establishment of riparian buffers and catch basins along the stream main stem.

Keywords: *eutrophication, phosphorus, watershed, non-point source pollution, riparian buffer, runoff management*

SCALING IN ECOTOXICOLOGY: THEORY, EVIDENCE AND RESEARCH NEEDS

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Type: *Oral presentation*

Status: *Accepted for oral*

Issues of scale, particularly extrapolations across spatial or temporal scales, are of great importance in ecotoxicology. Scale is an ubiquitous and frequently overlooked constraint on the biological functioning of experimental and natural systems. A variety of approaches are available for addressing issues of scale, and for developing scaling relationships that allow for extrapolation across scales. These approaches range from theoretical to strongly empirical. To practically address this problem, a variety of models may be employed, including statistical models, simulation models, or physical models (such as microcosms and mesocosms). Specific approaches that appear promising include: (1) dimensional analysis, which focuses on the units associated with scaled quantities; (2) allometry, which employs empirical power laws to describe scale-dependent relationships; (3) fractal geometry, which may in some cases provide theoretical justification for power law relationships; and (4) microcosm/mesocosm experiments in which scale can be appropriately manipulated as a treatment variable. The scaling relationships thus derived can be applied for extrapolation of results from experimental systems to natural systems, or between different natural systems.

Keywords: *grain, extent, extrapolation, dimensional analysis, fractals, allometry, microcosm, mesocosm*

SHORT-TERM NUTRIENT ADDITIONS IN OLIGOTROPHIC STREAMS: DO THEY AFFECT THE STRUCTURE AND FUNCTIONING OF LIGHT-LIMITED ECOSYSTEMS?

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Type: *Oral presentation*

Status: *Accepted for oral*

Excess of nutrients may accelerate metabolic processes and cause shifts in the structural components of stream ecosystems. However, this effect is modulated by light availability, and it is unknown whether it affects selectively some of the components of the stream. In a field experiment, nutrient addition was performed in an oligotrophic, forested stream, with abundance of sand and rock substrata. Nitrogen (as nitrate and ammonia) and phosphorus (as reactive phosphate) were added continuously for 45 days. The effect of the fertilization in the benthic structure and metabolism was determined by comparing an upstream non-fertilized reach with a downstream fertilized reach by means of a BACI design. Nutrient caused the increase in chlorophyll density on rocks and sand, but only slightly enhanced the ¹⁴C incorporation in the rocky substrata. The heterotrophic activities (extracellular enzyme activities) increased differently depending on the substratum considered (sand, rocks, detritus), but phosphatase activity decreased at the fertilized reach due to the higher availability of inorganic phosphorus. The changes did not affect the structure of the macroinvertebrate community, except by an increase of snails (*Ancylus*) in the fertilized reach. Similar results of structural and functional descriptors were detailed throughout a colonization experiment performed simultaneously in the two reaches. It has been therefore determined other factors (e.g. benthic substrata) may be more relevant for the stream functioning than the drastic difference in the water nutrient content, at least in short-term additions.

Keywords: *nutrients, light, organic matter use, stream*

THE ACCUMULATION AND EFFECT OF INORGANIC ANTIMONY AND ARSENIC ON THE GROWTH OF SCENEDESMUS VACUOLATUS (CHLOROPHYCEAE).

Dr Renata Behra

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Type: *Oral presentation*

Status: *Accepted for oral*

Concentrations of antimony (Sb) in surface waters are typically very low. However, the use of antimony in commercial products has risen dramatically over the last 10 years, leading to increases in dissolved concentrations. The toxicity of Sb is thought to be similar to that of arsenic (As). Despite this, only few studies have examined the effects of Sb to aquatic organisms. The aim of this study was to evaluate the toxic potential of antimonate (Sb(V)) and antimonite (Sb(III)) to algae and to compare it to that of arsenate (As(V)) and arsenite (As(III)), for which more information is available. To this end we have examined the effects of inorganic Sb and As species on their accumulation and growth in the freshwater green alga *S. vacuolatus*. *S. vacuolatus* was cultured in a chemically defined culture medium with nutrients and micronutrients and buffered with EDTA. To investigate effects on growth, cultures were exposed to different concentrations of Sb(V), Sb(III), As(V) and As(III). Growth experiments were carried also under phosphate-limiting conditions with algae previously acclimatized to a low phosphate culture medium. Population growth was measured as the temporal change in optical density (OD) at 680 nm and by flow cytometric measurements. Accumulation of the Sb- and As- metalloids was examined by short-term uptake experiments. Metalloid content in culture medium and in algae was measured after acidic digestion by ICP-OES.

The growth of *S. subspicatus* was not susceptible to Sb (V), Sb(III) and As(III) at concentrations up to 100 μ M. However, As(V) showed inhibitory effects that were more severe under P-limited conditions. Accumulation of the Sb- and As-metalloids was not detectable. The absent toxicity of Sb(V) suggests its low availability to algae. The larger ionic radius and different structure of Sb(V) compared to that of As (V) may prevent uptake, or conversely, algae may dispose of efficient mechanisms of extrusion. The evaluation of the availability of As(V) however needs concomitant consideration of the phosphate availability.

Keywords: *antimonate, antimonite, arsenate, arsenite, algae, accumulation, toxicity*

THE TARGET PROJECT: INTEGRATED ASSESSMENT TOOLS TO GAUGE LOCAL FUNCTIONAL STATUS IN RIVER ECOSYSTEMS

Ms Diana Slijkerman

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Type: Oral presentation

Status: Accepted for oral

In the EC Water Framework Directive, ecological assessment of water quality is fundamental to the management of surface waters and the protection of aquatic ecosystems. However, biological monitoring and quality assessment of surface waters within EU member states is based on measures of community structure rather than on any functional aspect of systems being studied. The EC 5th Framework TARGET project involves four partners in the UK, the Netherlands and Portugal. The project provides a complementary approach to conventional measures of ecological quality within river ecosystems using simple tools to assess ecosystem function, in the context of the Water Framework Directive. TARGET tools aim to establish ecological standards for river water quality. The tools employ measures of resource processing rates (primary production, herbivory, detritivory) in the form of in situ bioassays with locally sourced organisms. The bioassays aim to gauge system performance in terms of supply and demand. The supply side bioassay is based on a technique that immobilises algae in alginate beads. Demand side performance is measured using invertebrate grazers (e.g. *Daphnia*). Similarly, in situ bioassays are used to assess detritus-detritivory processes. Shredder organisms (e.g. *Gammarus*) are used to measure detritivory and leaf packs give information on detritus breakdown rates in the system. The relative response of the assays have been tested in mesocosms using specific stressing agents; a fungicide, a metal, a herbicide and an insecticide. The bioassays are also deployed in river sites and in ditches of "good" and "poor" ecological quality across different European ecoregions. Results are incorporated into an online database, which will ultimately be accessible from the project website (www.target-eu.org). TARGET project outputs support the objectives of the EC Water Framework Directive by providing direct assessment techniques for "functional sustainability", which can be used to complement existing techniques applying structural ecological measures.

Keywords: river, functional assessment, bioassays, ecological quality indicators

THE TROPHIC REGIME OF FISHES OF A MAN-MADE LAKE IN IMO STATE, NIGERIA

Dr Afamdi Anene

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Type: *Oral presentation*

Status: *Accepted for oral*

The trophic regime of fishes within a man-made lake in Imo State, Nigeria is the subject of this paper. The stomach contents of fishes caught from the lake were studied macroscopically and microscopically by using qualitative methods.

Considering the breadth of food items in the stomach contents, 2 broad trophic regimes within the systems can be deciphered. The first category is fishes with euryphagic diet. Fishes in this category are the cichlids viz; *Chromidotilapia guntheri*, *Tilapia cabrae*, *T. mariae*, and *T. zilli*. The diet of this category of fishes included algae, zooplankton, macrophyte and mud/sand at various percentages (rations) of almost equal amounts.

The second category the non-cichlid fishes had a more restrictive on stenophagic diet. Fishes in the category included *Ophiocephalus obscura*, *Hepsetus odoe*, *Citharinus citharus*, *Distichodus rostratus* and *Labeo senegalensis*. *O. obscura* and *H. odoe* were predatory on other species of fish while the diet of *C. citharus* was dominated (85.2%) of mud/sand. *D. rostratus* fed exclusively on aquatic macrophytes (94.6%) while the diet of *L. senegalensis* was dominated by mud/sand.

Keywords: *trophic, fish*

AN INTEGRATED APPROACH TOWARDS A DECISION SUPPORT SYSTEM FOR AQUATIC ECOSYSTEM MANAGEMENT

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The current know-how about components, internal processes of aquatic ecosystem and interrelations with external (anthropic) process is supposed to contribute to better manage the ecosystem in a sustainable development framework. Scientists are currently turning towards sophisticated models to simulate interactions and potential states for these complex systems. However, these tools tend to produce information which cannot be directly used by field-based stakeholders for their own information and decision making. Stakeholders being institutions, elected representatives, citizen... On the other hand, the current decision making system is often based on an "institutional" point of view rather than on a "know-how based" one.

This communication gives a conceptual presentation of a global system oriented towards the aquatic ecosystem management. The objectives of such a system consist in informing and involving all potential stakeholders as well as supporting decision, management and evaluation of action / projects.

The concept is based on the integration of the following axes :

- The monitoring systems give data about the status of the ecosystem.
- The integration of multi-disciplinary expertise is necessary in order to define the way to transform data in comprehensive information for communication and decision making (indicators and their combination, integrated tools...).
- An adapted information system insures the data exchange and information availability between / to all type of actors.
- Regulation and political orientations are together taken in consideration for the interpretation of the information for decision making at local and global scale.
- The management process leads decision making and project management and evaluation. It also leads the global networking organisation which is necessary for making the entire system operational.

Keywords: *management, decision support system, integration, local, globa*

CHEMICAL TYPOLOGY AND FUNCTIONAL MICROBIAL TYPOLOGY IN 3 ALPINE WATER COURSES

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Status: *Accepted for poster*

Chemicals parameters are commonly used to discriminate ecological situations and to base many water quality criteria and associated assessment methods. Theoretically, in the aquatic environments, a balance exists between water quality and the microbial communities. Microorganisms, and especially bacteria, have a key role in the biochemical cycles and in organic matter processing in hydrosystems, thus controlling the water quality. Conversely, physicochemical parameters explain at least partially the diversity and the activity of microorganisms. If one can "easily" develop a chemical typology (for example : Quality Assessment Systems in France), it is more difficult to establish a "microbial typology".

The aim of this work was to try to establish such a microbial typology, based on several enzyme functions and allowing to constitute a functional profile of these microbial communities and, finally, discriminate the ecological quality of small rivers.

Three small water courses (Strahler order 1 and 2), in the same alpine small watershed, but rather contrasted (respectively a forested area, a pasture area and downstream a lagoon), were studied. In such low-order streams, microbial processes are mainly driven by the microbial benthic communities (e.g., periphyton, epipsammon...) and these microbial assemblages were considered. The studied functions were related to the organic matter processing and to the carbon and nitrogen cycles : extracellular enzymes (glucosidase, aminopeptidase, phosphatase), respiration, denitrification. Biomass measurements completed the assessment of microbial communities (viable bacteria, total biomass dry weight, chlorophyl A).

A one-year survey, with a weekly (chemical parameters) or monthly (biological parameters) sampling frequency was performed. Data were analysed by a PCA and discussed the seasonal variability, the site discrimination, the feasibility of such approach and its limits.

Keywords:

EFFECT OF COPPER ON OXIDATIVE STRESS BIOMARKERS IN THREE-SPINED STICKLEBACK (*GASTEROSTEUS ACULEATUS ACULEATUS* L.).

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Status: *Accepted for poster*

The three-spined stickleback is a both freshwater and marine fish species widely present throughout the Northern Hemisphere. It lives in both clean and polluted areas which renders it a good candidate as a bioindicator species to study biomarkers of pollution. The aim of this study was to characterise oxidative stress biomarker responses in sticklebacks exposed to copper, a widespread agricultural and industrial pollutant. For this purpose, male and female adult sticklebacks were exposed for 3 weeks in semi-static conditions to copper sulphate at 0, 25, 100 and 200 $\mu\text{g L}^{-1}$ as Cu. At days 4, 8, 12 and 21, we measured several parameters including somatic indexes (liver, gonad and spleen somatic index), hepatic biomarkers (catalase, superoxide dismutase, glutathione peroxidase, glutathione status, glutathione-S-transferase and 7-ethoxyresorufin-O-deethylase) and copper concentration in the liver. Water quality and actual copper concentration in the water were also monitored throughout the experiment. Significant copper accumulation in fish liver was observed after 8 days. Biomarker analyses showed rapid and transient responses of antioxidants to copper within the first week of exposure. At Cu concentrations of 25 and 100 $\mu\text{g L}^{-1}$, a significant increase of catalase and superoxide dismutase activities suggested a rapid adaptative response of the fish to the metal. At 200 $\mu\text{g L}^{-1}$, a significant increase of catalase and superoxide dismutase was also observed together with an increase of glutathione peroxidase and a decrease of total glutathione. This study shows that copper induced an oxidative stress in three-spined stickleback before significant metal accumulation in the liver could be detected. This fish species appears to be a sensitive model to study oxidative stress induced by metals.

Keywords: *biomarkers, oxidative stress, copper, three-spined stickleback*

EFFECTS OF DIURON ON PHYSIOLOGICAL ACTIVITY AND STRUCTURE OF NATURAL BACTERIA COMMUNITY DETERMINED BY FLUORESCENT IN SITU HYBRIDIZATION AND TTGE ANALYSIS IN EXPERIMENTAL STUDY.

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The direct and indirect effects of the phenylurea herbicide Diuron on a natural bacterial community sampled in Brouage Channel (Charente-Maritime, France) were studied during 15 days by a batch method in acute pollution conditions. This study is the first stage of a project aimed at estimating global effects of usually herbicides on natural aquatic microbial communities (phytoplankton and bacteria) by using in situ, experimental and prospective approaches.

Four freshwater microcosms (3 L) were established including two microcosms treated with Diuron (3.5 mg.L⁻¹) and two untreated controls. Dissolved oxygen, nitrate, nitrite, ammonium and phosphate concentrations were measured regularly in each microcosm. Physiological activity and structure of the bacterial community were analyzed using DAPI- and CTC-staining, fluorescent in situ hybridization (FISH) and temporal temperature gradient gel electrophoresis (TTGE) analysis of polymerase chain reaction (PCR)-amplified 16S rDNA fragments. Alpha-, beta-, gamma- classes of Proteobacteria and Cytophaga-Flavobacterium-Bacteroides species were targeted with specific fluorescent-oligonucleotide probes.

Diuron treatment did not modify dissolved oxygen and nutrients concentrations.

The herbicide effects noted on bacterial community essentially came from physiological and phylogenic modifications. Diuron introduction reduced bacterial respiring activity, relative abundance of alpha-Proteobacteria and Cytophaga-Flavobacterium-Bacteroides species but had no effect on total bacteria density because of the increasing number of non-targeted cells. TTGE method revealed the existence of persistent and sensitive microbial species and the emergence of novel bands during the experiment.

This work showed that molecular biology techniques (TTGE and FISH) are useful to estimate the effects of herbicide contaminant, as Diuron, on bacterial community in aquatic ecosystems.

Keywords: *bacterial community, experimental study, diuron, TTGE, fluorescent in situ hybridization*

PERIPHYTON FUNCTIONAL RESPONSE TO ROAD RUNOFF REGARDING EXPOSURE CONDITIONS IN ARTIFICIAL STREAMS

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Road runoff can enrich hydrosystems with mineral and organic matter, however there have been few studies on their effects on aquatic biota. We studied effects of road runoff on river biofilms (periphyton). To control the principal environmental parameters the study was carried out in two indoor artificial streams with frosted glass slides, used as a substrate for periphyton. We regulated the current velocity in the first channel at 12 cm s⁻¹ (slow) and the second at 50 cm.s⁻¹ (fast). The periphyton communities were periodically subjected to road runoff (three times per week for 20 to 30 days) which came from storage settling basins of a national road (average daily traffic from 34,300 vehicles to 53,900). Road runoff samples were collected during rainfall and then characterised by a series of physical and chemical analyses (pH, electrical conductivity, TSS, COD, NO₃⁻, SO₄²⁻, Cl⁻, TA, Pb, Zn, Cd, and Cu). We used two exposure times (1 hour and 4 hours) and two runoff dilutions (10% and 50%). The two laboratory experiments carried out during this study revealed that the biomass (DW, AFDW), chlorophyll-a and the metabolic activity (net primary production and respiration) of biofilms increased when they were subjected to transitory motorway runoff. However, the rise varied in function of the current velocity, runoff conditions (exposure time) and the amount of organic and mineral elements in the rainwater. The absence of inhibitory effects may be because our experiments were not carried out in the most extreme conditions (concentrations in pollutants, runoff dilution...).

Keywords: *road runoff, impact, artificial stream, periphyton, biomass, chlorophyll-a, net primary production, respiration*

POSSIBLE CAUSES AND CONSEQUENCES OF THE DISAPPEARING AMPHIPOD DIPOREIA SPP. TO THE FISHERIES

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The burrowing amphipod *Diporeia* spp. until recently dominated the benthic community in the hypolimnion of the Laurentian Great Lakes, forming 60 to 80 % of the benthic biomass. The amphipods consume settling algae especially diatoms, storing lipids to 40 % of their body weight. They are consumed by cold-water forage fish and juvenile trout and salmon, as well as supporting a large commercial fisheries for smelt (*Osmerus mordax*) and whitefish (*Coregonus* spp.) in the Great Lakes. The related amphipods *Monoporeia affinis* and *Pontoporeia femorata* fill a similar role in the Baltic and Beaufort seas and parts of the Gulf of St. Lawrence. Due to their sensitivity to eutrophication and local pollution they have been used as oligotrophic indicators. In the past decade the Great Lakes has been colonized by *Dreissena* spp. Concurrently *Diporeia* have undergone a progressive offshore disappearance at their depth of maximum abundance (30-60 m) in lakes Erie, Ontario, Michigan and Huron. Only in Lake Superior has abundance remained stable. Consequently this has effected the fisheries of the lakes, abundance of sculpins and alewives has declined, as well as body condition of commercially caught whitefish in lakes Ontario and Michigan. Investigations into possible causes of the amphipod decline (ecological, toxicology, exotics and unknown diseases) have been initiated. Toxicological assessment consisted of sediment and pseudofaeces assays. Results indicated that sediment with high mussel density reduced survival of *Diporeia*. Presence of pseudofaeces reduced survival slightly. In order to explore further the dilemma of the disappearance, physiological and pathological health of the amphipods also have to be examined. The study attempts to integrate possible factors which might have caused the demise of the *Diporeia*.

Keywords: *food-web, diporeia, fish, abundance, biomass, diagnosis*

PRESENCE OF BROMINATED FLAME RETARDANTS AND TRIAZINES IN FRENCH ESTUARINE ECOSYSTEMS.

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Ecosystems are environments at risk, permanently exposed to various contaminations. The ecosystems of interest in this study are the Loire and Seine estuaries (France) which are densely populated. Furthermore, they are exposed to two contamination types: mainly agricultural for the Loire and industrial for the Seine. The studied contaminants, brominated flame retardant (BFRs) and triazines, have different behaviours in the ecosystems. BFRs are omnipresent in our environment and are used to prevent any departure of fire in numerous materials. Recent studies have shown their presence in various aquatic compartments and even in the human milk. Triazines, considered for a long time as easily biodegradable, are found at long distances off the French Atlantic coast and, in spite of the ban on atrazine and simazine use, these products will unquestionably remain for numerous years in the aquatic environment. Their mobility and their persistence were demonstrated and the Seine Aval studies revealed a preservative behavior of the herbicides during their estuarine transport. These characteristics could thus be at the origin of an accumulation of these contaminants in various environmental compartments and for the BFRs, biomagnification in the estuarine trophic webs leading to human beings is highly probable.

Six BDEs congeners (BDEs 28, 47, 99, 100, 153, 154 and 209) and two triazines (atrazine and simazine) and one of their degradation products (desethyl atrazine) were studied in sediments and fish. The results showed the presence of some contaminants in samples from Loire and Seine. BDE-47 was found in all analysed samples.

The analytical method here-developed was based on microfocused wave extraction for sediments and Soxhlet warm extraction for fish, followed by separation using solid phase extraction (SPE) and analysis by gas chromatography - mass spectrometry operated in MS/MS mode.

Keywords: *Brominated flame retardants, triazines, estuaries, sediment, fish*

SAMPLES CONSERVATION FOR THE DETERMINATION OF EDTA SPECIATION AND TOTAL OF ALL EDTA SPECIES PRIOR TO ANALYSIS

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Type: *Poster*

Status: *Accepted for poster*

EDTA is an extremely powerful chelating agent, it has the potential to affect the behavior and availability of toxic heavy metals and radionuclides in the aquatic environment. The elimination of EDTA is very difficult. The World Health Organization recommends a maximal concentration of 0.68 mol/l of EDTA in drinking water and in the Switzerland the limit is 0.017 mol/l. The available methods of measure of EDTA are very precise (up to 0.005 mol/l Nirel et al., 1998). However the reliability of the measurements relies not only on the analytical method, and sampling collection but also on the conditions of conservation of the samples prior to the analysis. This issue is not extensively evoked in the literature. This led us to determine the optimal conditions for conservation of the samples for measuring total EDTA and its speciation. The knowledge of the optimal conditions for conservation of the samples is necessary to improve the accuracy of the results of EDTA monitoring on a global and on national level in Switzerland. It will be useful for the researchers to better evaluate their results in seeking a methods for EDTA degradation.

Therefore, in this study the effect of sample conservation upon the results of Fe(III)EDTA and total EDTA measurement is studied in order to figure the optimum sample treatment and conservation prior to analysis. The study is performed with two kind of samples: i) conditioned the day of sampling and ii) conditioned the day of analysis Ni for Fe(III)EDTA determination or nitric acid and Fe(III) for total EDTA determination, in compliance with the method of Nirel et al., (1998). After sampling, the both kind of samples are kept unfiltered and filtered (passed through a 0.45 m filter) in a refrigerator (+4°C) or in a freezer (-20°C). The statistical evaluation of the resultants is done by Shewhart control chart.

The study shows that the EDTA speciation must be determined immediately after the sampling, because the speciation changes very quickly with the time. The determination of total EDTA may be done: i) after at least 62 days in the case of samples, conditioned the day of sampling, and ii) after 4 days in the case of unfiltered samples, kept in a refrigerator and conditioned the day of analysis.

Nirel P., Pardo P-E., Landry J-C. and Revaclier R. (1998) Method for EDTA speciation: application to sewage treatment plant effluents. *Water research* 32 (12), 3615 - 3620.

Keywords: *EDTA, speciation, sample conservation*

**THE INTERACTION BETWEEN PHOSPHATE AND THE
ECOTOXICOLOGICAL RESPONSE OF PERIPHYTON IN AN
AGRICULTURAL WATERSHED**

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Type: *Poster*

Status: *Accepted for poster*

The increasing input of land-derived substances into freshwater ecosystems has generated much concern about their potential effects on the biota. Biofilms are the base of the local food chain in a fluvial ecosystem and their response to toxic substances entering the system will therefore be crucial. The main objective of this study is to explore the relationship between the input of inorganic nutrients into a river in an agricultural watershed and the sensitivity of the natural periphyton community to phytotoxic compounds. The toxicity of two model compounds, copper and atrazine, was tested using short-term tests, measuring the sensitivity of the periphyton as EC50 values. The significance of nutrient limitation versus eutrophication - measured in terms of phosphatase activity - on the ecotoxicological response of the periphyton communities growing in agricultural rivers of the Mediterranean region is discussed.

Keywords: *atrazine, copper, ecotoxicology, Mediterranean river, periphyton, phosphatase*

THE PLANT-CULICINE LARVA INTERACTIONS IN SUBALPINE MOSQUITO BREEDING SITES: FROM CHEMICAL ECOLOGY TO INTEGRATED CONTROL

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Type: *Poster*

Status: *Accepted for poster*

The vegetation surrounding subalpine temporary aquatic ecosystems is involved in ecological discrimination among culicine populations inhabiting those mosquito breeding sites. The decomposed leaf litter, used as a main food source, may exert against culicine detritivorous larvae a dietary toxicity comparable to that obtained after intoxication with the bacterio-insecticide *Bacillus thuringiensis*.

Phytochemical investigations controlled by standard larval bioassays showed that the toxicity of the decomposed leaf litter is associated to an extractible insoluble cell-wall fraction including lignin-polypeptidic complexes. Whereas the lignin fraction might be involved in the water-insolubility of the toxic complex, the peptidic component might constitute the binding site of the complex against membrane receptors of the larval midgut epithelium. Ecotoxicological and biochemical investigations indicated that the settling of leaf litter toxicity in natura, which requires a 10-month long decaying process, corresponds to the progressive maturation of the different components within the foliar material under multiple seasonal environmental factors.

Operational interest of leaf-litter toxic complexes as efficient larvicidal phytochemicals in sensitive aquatic media comes from their water-stability together with their dietary attractiveness for target larvae. These vegetable complexes may be used as an alternative dietary strategy in the integrated management of anthropophilic vector-competent mosquito species resistant to conventional insecticides (e.g., *Aedes* and *Culex* species in man-made breeding sites).

Keywords: *decomposed leaf litter, larvicidal activity, lignin-polypeptidic complexes, integrated mosquito control.*

TOWARDS A MOLECULAR SURVEY TO CHARACTERISE THE NITRIFYING BACTERIA DYNAMICS IN THE SEINE RIVER

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Type: *Poster*

Status: *Accepted for poster*

The wastewater treatment plant (WWTP) of Ach res (France) is one of the biggest in Europe and is known to discharge a high quantity of ammonium in the Seine River. This substrate concentration induces a nitrification process which is observed in the Seine estuary. This phenomenon causes a dramatic decrease of the oxygen concentration. The ecological consequence is a limitation of ichthyological life in the estuary. The microbial ecology of nitrification is not well known. Moreover, an increase of the nitrifying WWTP capacity in the parisian agglomeration is planned in the next few years. This should increase the abundance of nitrifying populations in the river. The objective of this project is to improve our knowledge of the nitrifying contribution of the three main existing WWTP treating the parisian wastewater (Ach res, Valenton, Colombes).

To this aim, a reactor approach was chosen to reproduce the microbial process involved in nitrification occurring in the Seine River. Each bacterial fraction of the three main effluents was alternatively mixed in a reactor with a sample of the Seine water. Comparison of the lag time before nitrification have shown different behaviours. The shorter lag time was observed when the bacterial fraction from the effluent of Valenton was added (nitrifying plant). On the other hand, the addition of the sole Seine's bacterial fraction in the reactor induces the longest lag time.

These results imply that nitrifying bacteria were present in all the WWTP effluents, even in the Ach res one (the less efficient nitrifying WWTP). In addition, nitrifying bacteria contained in the effluents are able to be activated and may contribute to nitrification process in the Seine River. Finally, the lag time before nitrification in the reactor depends on bacterial fraction origin. For these reasons, survey of ammonia-oxidizing bacteria concentration and diversity with molecular tools will be informative to understand microbial ecology mechanisms occurring in these reactors.

Keywords: *ammonia-oxidizing bacteria, nitrification, Seine river, wastewater treatment plant effluent, microbial ecology*

USE OF DGGE TO EXAMINE BACTERIAL COMMUNITY STRUCTURE IN PERIPHYTIC ASSEMBLAGES FROM INDOOR EXPERIMENTAL CHANNELS.

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Type: *Poster*

Status: *Accepted for poster*

Possible changes in species composition of eubacterial communities from periphytic assemblages were investigated in four indoor experimental channels exposed to an industrial salt effluent. Experiments were conducted in dechlorinated urban water enriched in Si, NO₃⁻ and PO₄³⁻. The laboratory streams were seeded with an equal volume of a dense and homogenized periphyton slurry obtained by brushing rocks in the Ain River. Then, 23 days were allowed for the colonization on artificial substrates (glass plates) before injecting the effluent. During this experiment, we tested three concentrations of effluent ranging from 10 to 50% and corresponding to a content in chloride of 3 g/l, 7.5 g/l and 15 g/l. One channel was kept as reference.

Periphyton samples were collected in each channel at regular intervals to compare bacterial community structure within different samples and to examine its temporal changes. For this, amplified DNA coding for the 16S rRNA were resolved by Denaturing Gradient Gel Electrophoresis (DGGE). Visual interpretations of the resulting fingerprinting patterns were carried out to observe the changes in the presence/absence and in the variation of intensity of each band. The data table was then analyzed by correspondence analysis to determine if the variations in species diversity observed between samples could be related to the tested effluent concentrations.

The results clearly showed differences in the bacterial structure evolution depending on the exposure level and the time. The more abrupt changes in community structure occurred with the highest effluent concentration. This suggests that the structural changes in the bacterial communities are a good bio-indicator of a chloride contamination. It also demonstrates that artificial channels associated with the DGGE technique are a powerful tool to examine the progressive changes in bacterial communities from periphytic assemblages under various environmental stresses. Thus, it could contribute to the understanding of ecological phenomena in streams.

Keywords: *indoor channels, DGGE, 16S rRNA, periphyton, diversity, salt pollution.*

UTILITY OF BENTHIC ORGANISMS AS INDICATORS OF RIVER HEALTH

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Type: *Poster*

Status: *Accepted for poster*

Physical and chemical parameters have been good indicators of environmental conditions, but sometimes those parameters do not reflect temporality effects. The life history of living organisms respond differently to contaminants reflecting, therefore, the environmental quality of the aquatic ecosystem. The objective of this study is to suggest biological indicators of a Mexican estuary. The study area, is influenced by the national petroleum industry as well as dredging activities. Nickel and vanadium levels has shown an accumulative tendency in the river sediments, as well as some PAHs.

In order to identify temporal and spatial variations, sediments were sampled, during four times, which corresponds to dry and wet seasons. Each sediment sample was divided into three fractions. The first was used for granulometric and physical and chemical analysis. The second fraction was passed through a 0.50 mm (1 ϕ) sieve and used for macrobenthic community analysis. The third fraction was used to measure metals and PAHs.

Sediment particles follow the typical deposition patterns of the outlet river systems: the marine (sandy), fluvial (clay-loamy) and marine-fluvial (loamy clay). Biological analysis showed that benthic polychaeta community was the dominant one, and the highest diversity, according to the Shannon and Weaver index, was found during the dry season, after the superficial sediment had been dredged. *Cossura brunnea* was associated with high organic matter concentration. The deeper fraction of the sediment showed an accumulative tendency of nickel, as well as phenanthrene and fluoranthene. Changes in frequency and abundance of *Nereis pelagica*, *Paraprionospio pinnata* and *Parandalia ocularis* could indicate better environmental conditions. Further work is needed to establish the range of conditions in which benthic community could be used as an indicator of sediment environmental quality.

Keywords: *polychaeta, bioindicator, metals*

Advanced (bioassay) techniques and their management application

PREDICTING EFFECTS ON BENTHIC POPULATIONS: A PROMISING WAY FOR DERIVING SEDIMENT QUALITY GUIDELINES? AT WHICH CONDITIONS?

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Type: *Keynote*

Status: *Accepted for oral*

Empirical Sediment Quality Guidelines (SQGs) are derived by matching sediment chemistry and biological effects such as biotests results from field sediments. Although these approaches have proven valuable in many cases, their ability to protect benthic populations, which should generally be their ultimate objective, may be questioned for several reasons. A major criticism pertains to the fact that biotests report effects (or no effects) on a few individuals and a limited array of endpoints. Therefore, the real consequences of these effects for populations are not well understood. Moreover, this limited understanding may be an important component of the uncertainty underlying the relationship between contaminant concentrations and biological effects, particularly in the transition zone between the range of concentrations where effects are rare, and that where effects essentially always occur. In order to step over this fence, two models were developed for the species *Chironomus riparius*: an exhaustive model, allowing to provide a complete description of the life-cycle of the species and of the effects of toxicants, and a simplified model using data from standard toxicity tests (*C. riparius* - 7 days survival and growth, 28 days survival and emergence) only. Both models were applied to an array of either uncontaminated, spiked or field sediments. A "no-effect" threshold was determined on the basis of the experiments with uncontaminated sediments; it is essentially defined as the upper bound of the natural variability of the chironomid populations exposed to uncontaminated sediments. Other effect levels may be calculated. This approach seems therefore promising for deriving ecologically relevant SQGs, provided several questions are addressed: (i) is it possible to develop similar models for other benthic species? How select the relevant ones? (ii) which approach should be used for checking the "predictive ability", and the ecological relevance, of such population-based empirical SQGs?

Keywords: *sediment-quality-guideline ; benthic populations ; chironomids ; model*

SCALING TOXICITY FROM BIOASSAYS TO THE ECOSYSTEM

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Type: *Keynote*

Status: *Accepted for oral*

The actual risk caused by contaminants present in polluted sediments is a function of the probability of exposure and the potential harm that can be done to ecological relevant targets. Different tools are available to make extrapolations from laboratory-based effect measurements to the situation in the field. A first approach is based on a model that calculates the fraction potentially affected species (PAF), using information on species-sensitivity distributions that can be found in the literature. The model calculations can be extended to predictions of population growth of key species. The extrapolation of laboratory observations of sediment toxicity can be accomplished using field exposure systems in which both classical endpoints and biomarkers may be combined.

For location-specific risk assessments, a biological effects-based assessment of sediment quality can be performed. Evidence for damage to the ecosystem can be based on a broad range of observations, from accumulation measurements, via analysis of the benthic community, via biomarker applications in species collected from the field, to observations on the fitness and reproductive output of wildlife in top positions in food chains. The assessment of damage to the ecosystem can be both prognostic and retrospective.

The assessment can also start with field observation, followed by the application of techniques in a diagnostic framework, in order to identify possible causes. Here also biomarkers and toxicity identification evaluation techniques are promising tools.

Keywords: *bioassays, biomarkers, field observations, modelling*

AQUATIC ECOSYSTEM MANAGEMENT : EARLY WARNING SYSTEMS AND BIOASSAYS FOR POLLUTION MONITORING

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Type: *Oral presentation*

Status: *Accepted for oral*

The protection of aquatic ecosystems requires "early warning systems"(EWS), such as biosensors, for on line and in situ pollution monitoring. These cheap and transportable tools can be used for global screenings to identify pollution sources. If a pollution is detected, the need for better statistical responses to evaluate the level of pollution, its space distribution and its effects on different aquatic organisms could be assessed using adequate bioassays. In this context we propose a methodology using these two systems to better control the environment quality. However in a first step, we have to confirm the possibility to detect pollutants using both biosensors and bioassays. In this study, Cd²⁺, Zn²⁺ and Pb²⁺ have been chosen.

Biosensors and bioassays for heavy metal detection

A novel micro-conductometric biosensor based on immobilised whole cell *Chlorella vulgaris* microalgae has been developed and tested for Alkaline Phosphatase Activity (APA) analysis (French patent # 02-13.439). It is based on the inhibition of APA in presence of heavy metals. The sensor is made of two interdigitated Pt electrodes on a Pyrex glass substrate. An active membrane containing algae was deposited on the sensitive area of the electrode to measure APA.

Laboratory bioassays used in this work were carried out in 96 well microplates using free algae cells for which APA was measured by a spectrofluorometer. Using these microplates, replicates can be easily and quickly obtained for a further statistical study.

Results

First measurements have shown that it is possible to monitor APA with both whole algae cell conductometric biosensors and bioassays

Toxicity assays for different heavy metals have been led for both biosensors and bioassays and their results have been compared. For Cd²⁺, inhibition rates with immobilised cells on biosensors seem to be higher than with free cells (bioassays) for different heavy metal concentrations and different exposure times as it appears in table 1. The same conclusions has been drawn for Zn²⁺ and Pb²⁺.

Contact with Cd bioassays conductimetric biosensors

10 ppb 100 ppb 10 ppb 100 ppb

1 hour - >70% 0%

2 hours 95% 90% 30-50% 0%

4 hours 80% 65% 0% 0%

Table 1 : Comparisons between bioassays and biosensors concerning APA rate for exposure times to cadmium

Conclusion

In environmental management conductometric biosensors can be considered as a competitive early warning systems for on line and in situ measurements since they are small and give quick answers. If necessary, laboratory bioassays will be carried out for a better knowledge of the state of the site since it has been shown that results could be considered similar.

Keywords: *conductometric biosensors, algae, heavy metals, alkaline phosphatase, early warning systems*

ARE PERCOLATES RELEASED FROM MSWI BOTTOM ASHES SAFE FOR LENTIC ECOSYSTEMS ? A LABORATORY ECOTOXICOLOGICAL APPROACH BASED ON 100-L INDOOR MICROCOSMS

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Type: *Oral presentation*

Status: *Accepted for oral*

In France municipal solid waste incineration (MSWI) bottom ashes are mainly used in road building. MSWI bottom ashes must display minimal contamination levels and must be used in conditions where aquatic ecosystems should not be concerned with chronic discharges of percolates released from these wastes. However, little is known on ecological impacts of these effluents, especially on lentic ecosystems which differ from running waters by their low turnover, a more stable sediment and particular conditions of functioning linked to chemical and thermal stratification. Ecotoxicological assessment of liquid wastes is classically based on single-species tests. Due to the well-known limitations of this approach, efforts of ecotoxicologists should focus on more relevant approaches such as microcosm testing. This communication will present the results of two microcosm assays on MSWI bottom ashes percolates using 100-L aquaria. This study is part of a whole approach based on single-species tests, small laboratory microcosms (volume : 2 L) and bigger laboratory microcosms (100 L). Results of single-species tests and 2-L microcosms are presented in another communication (Triffault-Bouchet et al.).

The 100-L microcosms are 0.70 m x 0.45 m x 0.42 m tanks filled with a lake sediment (12 kg) and synthetic water (100 L). After a period of stabilization allowing homogenisation and cross-inoculation of the systems, various organisms bred in the lab or collected in the field are introduced : rooted macrophytes, microalgae, duckweeds, daphnids, amphipods, chironomids, pond snails. In the bioassays on MSWI bottom ashes percolates, systems were allowed to grow during 2 or 3 weeks, then percolates were added so as to reach a concentration of 1% (v : v). Additional contamination were carried out depending on the response of the systems. In the first assay, only two systems were available, one system was used as a control whereas the other was contaminated. In the second assay, 6 systems were used, which provided 3 control systems and 3 contaminated systems. The systems were monitored during 2 months following contamination. Survival, growth and reproduction of organisms were assessed.

Keywords: *lentic ecosystem, MSWI bottom ash, microcosm, ecotoxicology*

ARE SEMI-PERMEABLE MEMBRANE DEVICES SUITABLE FOR IN SITU MEASUREMENTS OF BIOAVAILABLE HYDROPHOBIC CONTAMINANTS ?

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Status: *Accepted for oral*

River waters and wastewater treatment plant effluents contain persistent, bioaccumulative and toxic hydrophobic organic compounds (HOCs). The biological risk assessment of HOCs requires the estimation of their bioavailable fraction in addition to their total concentration in the media.

The bioavailability of HOCs is dependent on the aquatic environment characteristics. In particular, HOCs may be bounded by dissolved organic matter (DOM), which usually lead to a reduction of the HOCs bioavailability. The generally accepted assumption is that bound pollutants are too large and too polar to cross biological membranes.

A passive sampler (Semi-Permeable Membrane Device (SPMD)) has been developed to evaluate bioavailable fractions of HOCs. It is a long, flat polyethylene (PET) tube containing lipid (triolein). PET allows contaminants to pass through, in the same way as the membranes of animal cells and the triolein was chosen to be like lipids in biological tissues. The great advantage of SPMD is their relative simplicity for in situ estimation of HOCs.

We first successfully tested the ability of SPMD to sample HOCs in anthropic rivers as well as in wastewater effluents. Concentrations in SPMDs were related to total concentrations in waters. Then, we compared the ability for SPMD to sample bioavailable fractions of HOCs. In the laboratory, the bioavailable fraction of some Polycyclic Aromatic Hydrocarbons could be modified by the presence of DOM. Therefore, the bioaccumulation of PAHs to *Daphnia magna* and *Danio rerio* in the presence of various natural or commercial DOM (with different binding capacities) was compared to the fraction of PAHs accumulated in SPMD, showing that in most cases SPMD are good surrogates for living organisms.

Keywords: *bioavailability, persistent organic pollutants, SPMD*

ASSESSING WATER QUALITY IN A TROPICAL LAKE USING ZEBRAFISH EMBRYOS : EMBRYOTOXICITY AND PROTEOTOXICITY TESTS

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Status: *Accepted for oral*

A more realistic and substantial assessment of water quality depends not only on the comprehensive measurement of the physical and chemical parameters of the water itself, but even more so, on the impact of existing conditions on aquatic biota. This is possible with the use of biomarkers. Two of the most widely-used biomarker tools are developmental toxicity (96-hour embryotoxicity test) and induction of heat shock proteins (proteotoxicity test). To validate the efficacy of these biomarkers, eggs of zebrafish embryos were exposed to waters taken from 5 identified sites of varying levels of pollution from Laguna Lake, Philippines. Developmental parameters such as egg and embryo mortality, gastrulation, somite formation, movement and tail detachment, pigmentation, heart beat, and hatching success were noted and described within 48 and 96 hours of exposure. After the 96-hour exposure, the levels of stress proteins (hsp 70) were determined in embryos from all exposure groups. Preliminary results showed no significant differences in the normal development of embryos from all exposure groups at the end of 96 hours. Low mortality rates and high hatching success rates were observed in embryos from all exposure groups and the data did not differ significantly in all groups. There was a tendency for a slightly higher heart rates in embryos from the South Bay and Northern West Bay sites. Likewise, no significant malformations were noted among all developing embryos throughout the exposure period. However, the levels of heat shock proteins in the two sites (Northern West Bay and Central West Bay), located closest to Manila, the Philippine capital, showed a pronounced elevation relative to the control, indicating that these stress proteins protect the embryos from the detrimental effects of pollutants in the water. Based on the 96-hr early life stage (ELS) test, the water quality of the lake is good for fishery propagation despite the current levels of pollutants in the water. This finding is in accordance with the Class C status given to the lake by the local environmental agency. On the other hand, data on proteotoxicity showed that the fish are under stress from pollutants. This calls for a continuous monitoring and improvement of the lake water. The biomarker methods used proved to be very easy, practical, rapid and sensitive for assessing water quality in a tropical lake.

Keywords: *zebrafish, embryotoxicity, proteotoxicity, heat shock proteins, water quality*

COMBINING INDIVIDUAL AND DEMOGENETIC ENDPOINTS FOR ECOLOGICAL RISK ASSESSMENT: A STUDY IN THE FRESHWATER GASTROPOD *LYMNAEA STAGNALIS* EXPOSED TO TOXICANTS

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Population-level estimation of the effects of pesticides on non-target species is a main goal in ecotoxicology. Demographic approaches are currently developed, from the theoretical background of population dynamics. In such approaches, individual-level endpoints have to be selected for their potential sensitivity to toxicants as well as their power to reflect demographic processes. Moreover, toxicants may have genetic impacts on a population, through selection (adaptive responses) or by increasing environmental stochasticity, which may in turn amplify random genetic drift or the level of inbreeding. Microsatellites usually show high levels of presumably neutral variability and typically provide information on recent historical events (e.g. demographic bottlenecks) or fine-scale evolutionary factors. Microsatellite loci also allow to infer the genetic relatedness among individuals and can be used to obtain natural or ecologically realistic estimates of heritability for traits of interest (e.g. responses to a toxicant, life history traits). Such tools can be extremely informative for risk assessment of chemicals.

As an illustration, results in a self-fertile freshwater gastropod, *Lymnaea stagnalis* are presented. The investigations focussed on individual lineages or populations, and was applied under outdoor experimental conditions (lentic mesocosms). First, a significant within-population (family-level) heterogeneity for different biological variables was pointed out in toxicant-free environments. The results emphasized the need to control for this level of variation when estimating the toxic effect of a xenobiotic. Second, exposure to different type and intensity of stress (including exposure to a pesticide) significantly decreased life history performances. Yet, the effect was generally more pronounced under outcrossing than under selfing. Evolutionary consequences of such differences are expected in terms of effective population size variation as well as population inbreeding, genetic load and inbreeding depression.

The impact of genetic parameters on population extinction risk is discussed, and a practical approach based on experimental populations controlled for initial genetic composition is proposed.

Keywords:

CONTRIBUTION OF AN AUTECOLOGICAL APPROACH TO THE DEVELOPMENT OF A BENTHIC INVERTEBRATES TEST BATTERY BASED ON BIOLOGICAL AND ECOLOGICAL TRAITS OF AQUATIC ORGANISMS.

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Type: *Oral presentation*

Status: *Accepted for oral*

Considering the huge variability of sensitivity (up to 106) to a toxicant among species, the choice of the tested organism can dramatically affect toxicity evaluation. The variability of sensitivity among taxa has thus to be accounted for in risk assessment methods. To fulfil this need, between-taxa differences of sensitivity to toxicants have to be better understood.

We hypothesize that some biological and ecological traits can explain a large part of the between-taxa variability of sensitivity to a compound. On this hypothesis, 11 biological and 9 ecological traits that we believe to be directly involved either with the exposure level or with toxicity mechanisms at the individual scale have been selected.

Using multivariate analyses and classification methods, we clustered 109 benthic invertebrate species (previously selected for their habitat characteristics from faunal lists) in 6 functional groups according to their similarities in terms of combinations of the selected biological and ecological traits. The clustering of species into functional groups allows us (1) to consider the organisms within a group as relevant combinations of biological and ecological traits, permitting us to link sensitivity with these traits; (2) to set up a rational basis for species selection on a toxicity testing perspective.

The resulting taxa selection includes *Chironomus riparius*, *Branchiura sowerbyi*, *Vejdovskyella intermedia* and *Valvata piscinalis*. *Potamopyrgus antipodarum* and *Anabolia nervosa* may also be included. Testing protocols will be developed for the non standard testing species.

Keywords: *toxicant sensitivity, benthic macroinvertebrates, biological traits, ecological traits, risk assessment*

EFFECT OF COPPER ON ORGANIC MATTER DECOMPOSITION: A LOTIC MESOCOSM STUDY

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Status: *Accepted for oral*

Stream ecosystems are exposed to copper released by anthropic activity. Its impact on organic matter decomposition is poorly known but copper is suspected to be harmful due to its fungicide effect. An indirect effect of copper on organic matter decomposition might be the decrease of leaf palatability for detritivorous macroinvertebrates resulting from the direct toxic effect of copper on leaf-colonizing microorganisms.

Two litter bags experiments were carried out, using lotic mesocosms contaminated with various copper concentrations (0, 5, 25 and 75 $\mu\text{g/L}$) during 18 months (April 2002 - Oct. 2003). The first experiment (Feb. - June 2002) used a mixture of leaf species and dealt with the effect of litter bag location and substrate quality along the mesocosms. In the second experiment which is under way from Jan. 2003, we evaluated the effects of copper on leaf-associated microorganisms and detritivorous macroinvertebrates associated with alder leaves.

The first experiment showed that copper has a significant negative effect on macroinvertebrate number in litter bags placed in the upstream-pebbles sections of the mesocosms ($F=8.229$, $P<0.001$). However no significant effect was observed in the downstream-fine sediment sections. Leaf breakdown coefficients in the upstream sections were negatively ranked with copper concentrations, with a reduction of the breakdown coefficient by more than 50% at the highest concentration. This pattern was not found in the downstream section where breakdown coefficients were consistently lower.

First results of the second experiment showed a negative effect of copper (25 and 75 $\mu\text{g/L}$) on breakdown coefficients from both coarse and fine mesh bags, indicating that both detritivorous macroinvertebrates and microorganisms were affected. Determinations of fungal biomass and sporulation rate of aquatic hyphomycetes and numbers of leaf-associated bacteria and macroinvertebrates, which are in progress, will allow to characterize the direct and indirect effects of copper on the organisms involved in organic matter decomposition.

Keywords: *copper, mesocosm, aquatic hyphomycetes, detritivorous macroinvertebrates*

EVALUATION OF THE TROPHIC STATUS OF THE RIVERS WITH DOMINANT FIXED BIOMASS : CAN THE BIOFILM BE USED AS A BIOINDICATOR?

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Type: *Oral presentation*

Status: *Rejected*

In a concern of preserving the integrity of surface waters, the recent European Water Framework Directive constrains the member states : 1) to achieve an initial ecological state diagnosis of their hydrosystems, before 2) setting up best management practices which could be necessary to reach the correct ecological status at the term of 2015. Within this framework and concerning the high-energy and high-flow rivers, the phytoplankton production and the concentration of chlorophyll (chl.a) inside the water column are low and not representative of their real trophic status. Indeed, in these rivers, the algal and bacterial compartments are mostly developed as biofilm structure. Therefore, in order to search for trophic status indicators, the aim of this work is to identify a set of criteria relative to the biofilms and that are able to discriminate stations under different nutrient charges. The final objective is to propose an integrated calculation method able to illustrate the trophic status of fixed biomass rivers.

To respond to this need, we associated a field approach in river and hydrobiological experiments in laboratory conditions with controlled factors. Our study, which was carried out on the Garonne river (S.W. of France), aims at measuring the effects of anthropic disturbances caused by the sewage plant discharges of two major towns (Toulouse, Agen) located along its course. In laboratory experiments, the purpose is to clearly establish the relationship between nutrient fluxes (about PO₄) and phytocenosis reactions while all other environmental factors are constant. On the field, trophic conditions are studied through biofilm colonization on artificial substrates. The quantitative and qualitative development of the biofilm is evaluated through rate of biomass colonization on the substrates (dchl.a/dt) and by the observation of the diatom group and bacterial numerations.

The first results, which will be presented in this talk, show graded biomass development rates according to nutrient levels in both field approaches and lab experiments.

Keywords: *trophic level, biofilm, bioindicator, rate of colonization, European Water Framework Directive, river*

MEDICAL RISKS RELATED TO THE REJECTIONS OF WASTEWATER IN THE MARINE ENVIRONMENT OF RABAT AND TEMARA, MOROCCO

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Status: *Rejected*

Increase in the urban population and increase in individual drinking water consumption involve a significant increase in the volume of the wastewater rejections, the latter represent a true harmful effect for the receiving medium. Accordingly, our study related to a qualitative and quantitative study of the various parasites met in rough wastewater of the towns of Rabat and Temara and their to become in water of the Atlantic.

The parasitologic analyses enabled us to highlight existence only of two species of protozoa, *Entamoeba coli* which accounted for 32,06% of the protozoa and *Giardia intestinalis* which accounted for 67,93% of the protozoa, in the four stations sampling rough wastewater on the other hand we noted a reduction in half of the concentration in *Entamoeba* cysts and a complete abolition of species *Giardia intestinalis* in sea water.

The helminths eggs were characterized by a predominance of the *Ascaris* eggs which accounted for 70,35% of the helminths eggs detect in rough wastewater of the cities Rabat and Temara, with a maximum of concentration, in the rejection wastewater of Temara and 78,57% of the *ascaris* eggs met in sea water with a maximum in that of sea water of Riad, followed by *Entérobis* which accounted for 9,77% of the helminths detect in rough wastewater of the cities Rabat and Temara with a great quantity in wastewater of Temara and that of slaughter-house. While *Hymenolepis* accounted for 7,81%, *Trichuris* 8,79% and *Ankylostoma* 3,25% of the helminths eggs met in rough wastewater of the cities Rabat and Temara, are distributed between the rejections of Riad, Temara and Yacoub el Mansour. Consequently only the *ascaris* eggs and *ankylostoma* persist in sea water and which respectively accounted for 78,57% and 21,42% of the helminths eggs met in sea water.

In conclusion, hygienic measurements must be done on local, regional and global scale in order to meet the standards of rejections and to protect human and animal public health.

Keywords: *wastewater, marine environments, smedical risks*

METAL ACCUMULATION AND CONDITION OF TRANSPLANTED ZEBRA MUSSEL (DREISSENA POLYMORPHA) IN METAL POLLUTED RIVERS

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Type: *Oral presentation*

Status: *Accepted for oral*

Trace contaminants can be measured in the tissues of native organisms, eventually in combination with measurements of their condition. The feasibility of this so-called passive biological monitoring programs (PBM) depends on the presence of resident organisms of the same species at all sites in sufficient biomass or number of individuals. This problem can be overcome by using translocated organisms, called active biomonitoring (ABM). Instead of collecting indigenous organisms, animals can be collected at a clean reference site or cultured in the laboratory and subsequently exposed at the sampling sites in cages.

In this study zebra mussel (*Dreissena polymorpha*) originating from a drinking water basin were exposed in cages in four different metal polluted lowland rivers. In one river, cages were deployed along a pollution gradient. At each site three cages, containing 30 mussels each were exposed for 7 weeks. Mussels were collected after 10, 26 and 49 days. At each sampling moment from each cage 10 mussels were pooled and analysed on their metal content and their condition was assessed.

Metal levels increased in the soft tissues of the mussels. When relating condition of the mussels to the metal load in mussel tissue no significant relationship was found when all data were pooled. However, when this relationship was examined for the separate rivers or within the pollution gradient, highly significant relationships were found.

Keywords: *in situ bioassay, dreissena, metals*

METALLOTHIONEIN ISOFORMS AS BIOMARKER

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Type: *Oral presentation*

Status: *Accepted for oral*

Metallothionein (MTs) show an important induction in animals exposed to metals. Consequently MTs were proposed as biomarkers of metallic contamination. However this study revealed that an important induction of MTs appeared in liver of roach and carp exposed to two fungicides: procymidone and chitosan respectively. Additionally, roach caged in basins contaminated by copper, diuron, and procymidone presented important increase of their hepatic MT contents which were well correlated with the global contamination level of each basin. Moreover MTs contents seemed more influenced by the fluctuations of pesticide concentrations than by evolution of Cu concentrations.

MTs participate to metal homeostasis and detoxification. It had been recently demonstrated that MTs participate also to anti-oxidative defenses, cellular growth regulation or apoptosis. In most animals, MTs presented various isoforms regulated by the expression of different genes which indicated that they may participate to different functions. So MT isoforms analysis is essential to understand MTs induction by pesticide and uses them as biomarker. Results obtained in control carp liver confirmed that it possess two isoforms. An preferential repartition of Cu and Zn on each isoform was put in evidence and suggest distinct physiological roles. Induction of MTs in liver of carp exposed to Cu or chitosan was related to an increase of MT-I. Additionally the metal content of MT-I and MT-II was highly modified and different for carp exposed either to copper or to chitosan. These differences suggested that MT inductions were involved in different physiological functions and not presented the same biological significance when fish were exposed to a metal or a pesticide.

We can concluded that MTs are interesting unspecific biomarker to study fish contamination. MT isoforms analysis is important to try to understand the perturbations of MT contents observed.

Keywords: *metallothioneins, isoforms, Cu, Zn, pesticide, biomarkers, procymidone, chitosan*

REMEDICATION FOR HEALTH AQUAECOSYSTEMS FROM LOCAL TO CATCHMENT

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Type: *Oral presentation*

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The health aquaecosystems are essential for sustainable development of human society. The historical landscapes of waters with abundant balanced or increasing biodiversity of macro-organism are suitable for health human being. These kinds of aquaecosystems might be estimated as "health aquaecosystems". The aquaecosystems with obvious decreasing biodiversity of macro-organism in relation with climatic change and / or human activities might be estimated as "degradative aquaecosystems". The health aquaecosystems with local and temporal or potential degradative tendency of biodiversity of macro-organism might be estimated as "sub-health aquaecosystems". Increase of environmental pressure caused by increasing population and economic development is the main reason for degradation of aquaecosystems in China. The nutrients loading could not be reduced to the historical level in many regions in China. When the increased pollutants loading exceed the self-purification capacity, the surface water ecosystems near pollutant source degrade firstly, effect on the lower river/lake ecosystems. The aquaecosystems degrade from local to wider and wider areas. The health aquaecosystems could be remedied or reconstructed by enhanced self-purification capacity only in the limited, especially interested areas firstly with limited capital during limited period. Therefore, the Physical-Ecological Engineering-PEEN technology was developed since 1990. The main principles, key technologies, and experimental samples were summarized. The 5 Key technologies of PEEN are: 1) Soft wall and biophysical membrane technology; 2) Technology for Removing Algae Plume (TRAP) and Improving Transparency; 3) Mosaic technology and Macrobionics; 4) Technology of Immobilized Nitrogen Cycle Bacteria (INCB); and 5) Ecological floating island. The 5 M-key taches of remediation for the healthy aqua-ecosystems are: 1) Macrophyte; 2) Microorganism; 3) Mollusk; 4) Macrobionics; and 5) Management.

The PEEN technologies were tested for different natural conditions to remedy for health aquaecosystem in local surface waters in China. It is possible to disseminate the technologies from local to catchments in the meaning of scaling from local to global freshwaters.

Keywords: *remediation for health aquaecosystems, from local to catchment and to global freshwaters, Physical-Ecological Engineering-PEEN*

ALKALINE PHOSPHATASE ACTIVITY OF WHOLE-CELL ALGAE USED FOR MONITORING HEAVY METALS IN ENVIRONMENT

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Status: *Accepted for poster*

The ever-growing discharge of chemicals into nature leads to the requirement of early-warning systems to detect toxic compounds in low concentrations. Automatic devices allowing real time detection and on-line monitoring may find a successful in Alkaline Phosphatase Activity (APA) of whole-cells green algae using as an algal biosensor. *Chlorella vulgaris* cells are immobilised and placed in front of an optical fiber bundle for an optical biosensor. These system allows the cells to operate in their natural environment which favours long term stability and reflects the mechanism of toxic inhibition providing therefore a better ecological interest.

APA is strongly inhibited by heavy metals. This property has been used for the determination of those toxic compounds. The response of APA to heavy metals for immobilised cells are in agreement with the results obtained with a microplate reader for the optical biosensor. Heavy metals ions such as Cd^{2+} and Pb^{2+} are detected down to 1 ppb. This biosensor can be applied for monitoring municipal solid waste incinerator bottom ash leaching.

Keywords: *biosensor, whole-cells, chlorella vulgaris, alkaline phosphatase activity, heavy metals*

AN IN SITU BIOASSAY USING CHIRONOMUS RIPARIUS LARVAE TO INVESTIGATE THE EFFECTS OF A PYRETHROID INSECTICIDE IN FRESHWATER MESOCOSMS

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An experiment on the effect of connectivity between aquatic ecosystems on their recovery following an insecticide treatment has been designed in sixteen 9 m³ outdoor experimental ponds using deltamethrin as a model contaminant. Eight ponds were contaminated with deltamethrin, the remaining 8 ponds being used as controls. Immediately after contamination with deltamethrin, 4 contaminated and 4 untreated ponds were covered with a plastic net. To investigate early effects of deltamethrin on insects, an in situ bioassay was performed using *Chironomus riparius* larvae. Test chambers were made of a 8.5 cm-diameter plastic mesh cylinder with an outer cover of 1 mm mesh size and 1 m long, and an inner cover of 250 μ m mesh size and 45 cm long. Both covers were attached to a beaker containing 300 ml of a mixture of sand and cellulose (5:1), and topped by a transparent wasp trap. Water and third instar larvae were added to the beakers, and the test chambers were deployed in the mesocosms three days before the treatment. Deltamethrin was added to the ponds at a nominal concentration of 2 μ g/L, and the bioassay was conducted for 21 days. Traps were checked every day for emergence, but no imagos were found. At the end of the observation period, the test chambers were collected, and the larvae separated from sediment. Endpoints were survival, wet weight, instar and development of the imaginal discs. Mortality was high in all ponds, although cases of complete disappearance of the individuals were more frequent among the treated ones. By contrast, larvae of some control mesocosms remained as third instars, while in the treated ponds, the remaining larvae were mostly at the latest phases of development before pupation. The results are discussed in relation to the suitability of the test chambers for in situ bioassays in mesocosms.

Keywords:

ANTIOXIDANT ACTIVITY IN JUVENILE RAINBOW TROUT LIVER USING THE MODIFIED TROLOX EQUIVALENT ANTIOXIDANT CAPACITY (TEAC) ASSAY: DEVELOPMENT AND COMPARISON WITH OTHER BIOMARKERS OF OXIDATIVE STRESS.

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The purpose of this study was to develop the measurement of non-proteic antioxidant capacity using TEAC assay in fish liver samples and to assess its utility as a biomarker of oxidative stress. This assay, originally developed for human plasma samples, measures the ability of scavenger molecules contained in a biological sample to reduce free radical species. In the method development, the major modification included an acidic precipitation step of the total hepatic proteins in order to avoid their interference with the enzymatic reaction of the assay. This step did not modify the antioxidant capacity of the major scavengers found in the liver as verified by sample supplementation experiments using either reduced glutathione, ascorbate or alpha-tocopherol. The potential of hepatic TEAC measurement as a biomarker of pollution was assessed by exposing juvenile rainbow trout to oxidative chemical compounds (cadmium, zinc, PCB77, estradiol) during 21 days and by comparing the TEAC responses with biomarkers of oxidative stress (reduced and oxidised glutathione, GPx, CAT, SOD). Cadmium and PCB77 exposure increased the TEAC levels while estradiol treatment decreased the level. A high correlation between TEAC and glutathione responses was observed suggesting that glutathione is largely implied in the TEAC measurement and confirming its major role as a free radical scavenger in hepatic cells. This study shows that TEAC measurement provides relevant information on the non-enzymatic antioxidant status in fish livers and can be considered as a useful biomarker of oxidative stress within the framework of biomarker studies.

Keywords: *antioxidant capacity, biomarkers, fish, liver*

ASSESSING FRESHWATER STATUS USING AN IN SITU SHREDDER FEEDING TEST

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Type: *Poster*

Status: *Accepted for poster*

Two major types of community and ecosystem parameters may be distinguished and used as endpoints in ecotoxicological studies: structure and function. Current approaches to the establishment of ecological quality objectives are based almost entirely on structural rather than functional criteria. However, new techniques emerging in ecotoxicology and aquatic ecology offer the potential to derive functionally based water quality criteria. These techniques are based on the simple idea that ecosystem services are dependent not only on the biodiversity, but also on the energy transforming processes at the base of the aquatic food chains: primary production and detritus processing. To compare the measurement of these basic processes across systems we need to validate and standardize methods to be applied across different aquatic habitats. Here we compare an in situ shredder-feeding tool across different Portuguese rivers. The test organism selected was the shredder Trichoptera Calamoceras marsupus Brauer. Caged organisms were exposed at different river basins (3 reference and 1 contaminated sites per basin) in Autumn and Spring. Thirty individuals were deployed per site, each one being allowed to feed at 9 pre-weighted alder (*Alnus glutinosa*) sterilized leaf discs, during 6 days. Almost 100% survival was registered in all sites. Variability in response between reference sites was observed and could be explained by environmental factors. The feeding rates registered at the contaminated sites were lower than the ones registered at reference sites. The feeding inhibition response observed at contaminated sites suggests that feeding activity can be used as a test endpoint to assess and compare environmental status.

Keywords: *feeding response, in situ tests, shredder, Trichoptera*

ASSESSING STRUCTURAL AND FUNCTIONAL PLANKTON RESPONSES TO CARBENDAZIM TOXICITY

Ms Diana Slijkerman

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Type: *Poster*

Status: *Accepted for poster*

A mesocosm experiment was conducted to investigate the ability of an in situ *Daphnia magna* feeding bioassay to assess impairment of ecosystem function. Animals were deployed in mesocosms dosed with different concentrations of the fungicide carbendazim and effects on the post-exposure feeding rate of *D.magna* were compared with effects on zooplankton species richness (ecosystem structure) and development of phytoplankton biomass (ecosystem function).

In the medium-dosed systems (21 $\mu\text{g/l}$) a structural change was observed within the zooplankton community but no indirect effects on phytoplankton development were detected. It appears that at this treatment level functional redundancy was sufficient to prevent functional impairment despite species loss. The feeding assay did not show any response at this concentration. In the high-dosed systems (221 $\mu\text{g/l}$), structural changes in the zooplankton community resulted in an increase in the development of phytoplankton biomass. The feeding bioassay also showed a significant response at this concentration. At the high treatment level species loss resulted in functional impairment, indicating that at this level, functional redundancy could not compensate for loss of individuals. The *D.magna* feeding bioassay matched well with the functional response, i.e. the indirect effects on phytoplankton, in the dosed systems, but not with more subtle effects on zooplankton community structure. These results lend positive support to the use of in situ feeding bioassays in combination with structural indices such as species richness to assess the effects of stress on ecosystem functioning in a direct way, allowing a more balanced assessment of ecological risk.

Keywords: *daphnia, in situ, ecosystem functioning, structure*

**ASSESSMENT OF THE ECOTOXICOLOGICAL IMPACTS IN AQUATIC
MICROCOSMS OF DREDGED SEDIMENTS TREATED OR NON-TREATED
BY A PHYSICO-CHEMICAL TREATMENT.**

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Type: *Poster*

Status: *Accepted for poster*

Today environmental and socio-economic management of aquatic ecosystems implies more and more dredging operations. In the past, soil deposit has been used as the major way of storage for dredged sediments. The volumes and the nature of materials which are actually dredged in various hydrosystems necessitate alternatives. Aquatic disposal (offshore disposal, gravel pits) is one of these but the sediments contamination levels often represent a restriction for environmental disposal. Technologies development and socio-economic interests for this subject have conducted some economical actors to develop and propose physico-chemical treatments for dredged sediments. The efficiency of these methods could (or not) be a valuable argument for aquatic disposal and environmental valorization of dredged sediments. We propose to evaluate, on three natural and highly contaminated freshwater sediments, the chemical and biological efficiency of a physico-chemical treatment which associates incineration and chemical complexation of contaminants. In order to evaluate the impacts of aquatic disposal of treated sediments in lentic freshwater ecosystems, bioassays were carried out with 2-liter aquatic microcosms. The systems received non-treated, treated or artificial reference sediment to give an ecotoxicological assessment of "in place" sediments effects on aquatic ecosystems. Systems were filled with synthetic water and inoculated with five organisms (*Daphnia magna*, *Hyalella azteca*, *Chironomus riparius*, *Lemna minor*, *Pseudokirchneriella subcapitata*). Biological criteria (lethal, sublethal endpoints) and physico-chemical parameters were assessed over 28 days. Biological assessment of the sediment was coupled with complete physical and chemical analyses of treated and non-treated materials. Efficiency of the treatment was determined by removal of contaminants and evolution of biotic and abiotic data during bioassays for each of the three couples of treated/non-treated sediments.

Keywords: *dredged sediments, aquatic disposal, physico-chemical treatment, aquatic microcosms*

BIOACCUMULATION OF CU AND FE SPIKED IN NATURAL SEDIMENTS

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Type: *Poster*

Status: *Accepted for poster*

Diverse inorganic ions are considered essentials for living forms. That is the case of Cu and Fe, therefore its toxic at relative high concentrations. There is consistent evidence of competition between a numbers of metals, such as Cu-Fe. The antagonistic effect of Fe on Cu accumulation may result in homeostatic mechanisms. In animal cells, the concentrations of these metals are controlled by energy-dependent pumping mechanisms and those of the essential trace elements are buffered by storage or detoxification systems. In the other hand, metal concentrations in sediments are not only determined by metal inputs but also are affected by reactions at particle surfaces that influence the quantity of metal adsorbed, reduction/oxidation reactions. The objective of the present work was to determine the influence of the Fe in the uptake of Cu in *Limnodrilus hoffmeisteri* in spiked in natural sediments from a mexican dam. The intoxication system was constituted of sediment and water in a proportion of 1:4 and spiked with 0.1 mg/L of Cu and Fe (CLO obtained from a previous acute study). They were mixed during 4 hr until equilibrium was reached, and organisms were added (1 g of organism/100 mL of water) and exposed at 0 (control), 12, 24, 36, 48 and 72 hr. After exposure time, Cu and Fe concentration were measured by atomic absorption in sediments and worms, also the biconcentration factor was determined. The obtained results showed that the Cu uptake and bioconcentration factor had been modified by Fe. In conclusion, it is necessary evaluated both metals in each site of sampling to water body toxicity determined.

Keywords:

EFFECTS OF COPPER ON THE METABOLISM OF SUGARS AND LARVAL DEVELOPMENT IN CHIRONOMUS RIPARIUS LARVAE

Ms Maria-José Servia-Garcia

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Type: *Poster*

Status: *Accepted for poster*

Classical endpoints used in ecotoxicity tests with *Chironomus riparius* larvae such as survival, growth or emergence, may ultimately be reflecting changes in energy metabolism of the individuals. Therefore, the quantification of energy expenditure due to the response of individuals to toxicants will represent a valuable link between biochemical biomarkers and those life-cycle endpoints. In insects, energy storage and metabolism mainly occur in the fat body which is in intimate contact with the hemolymph, thus facilitating exchanges of metabolites. In the fat body, carbohydrates are stored as glycogen, while the main circulating sugar in the hemolymph is trehalose. Trehalose level in hemolymph is constant and in a dynamic equilibrium with glycogen stored in the fat body. In addition, the hemolymph contains also a significant concentration of glucose. Since sugars are an important ready-to-use source of energy when insects are exposed to toxicants, this work aims to investigate the effect of copper on sugar metabolism in *Chironomus riparius* larvae. Larvae were maintained in beakers and exposed to different concentrations of copper. As soon as fourth instar larvae in the controls reached their maximum weight and length (phases of development 6 to 8 sensu Wülker & Götz, 1968), all the larvae, including those exposed, were removed from the beakers. Individuals were sexed and aged depending on development of the imaginal discs. Males and females were dissected separately to obtain hemolymph and fat body. Concentrations of glycogen in the fat body and of trehalose and free glucose in the hemolymph were measured spectrophotometrically. In addition, developmental effects of copper were investigated using larval size and weight, by determining the developmental phase from the imaginal discs, and by identifying morphological abnormalities. Changes in glycogen, trehalose and glucose levels, which reflect the ability of the larvae to use energy to counteract the toxicity of copper, were compared to changes in larval development.

Keywords:

EFFECTS OF HEAVY METALS FROM MINING WASTES ON BIOTA IN THE MAR MENOR

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Type: *Poster*

Status: *Accepted for poster*

The Mar Menor is a large hypersaline lagoon in the SE of Spain and a very popular tourist place. However, the mine tailings of a former Pb-Zn mine are situated next to the southwest part of this Mediterranean lagoon. Although mining activities in the area have ceased, there was and still is a high input of metals due to drainage and sedimentation wastes through occasional watercourses. Lead, zinc and cadmium are the main contaminants of the mine tailings and therefore, these heavy metals can be found at very high concentrations in the sediment at the mouth of such watercourses in the Mar Menor.

Animals and plants were collected at those highly contaminated spots and their content of different heavy metals was determined. Furthermore, monitor organisms collected from non-contaminated environments were exposed to seawater and sediment from a metal contaminated spot at the Mar Menor. In addition, experiments about Pb-uptake from seawater were carried out under controlled laboratory conditions. The marine polychaete *Nereis diversicolor* collected from a clean environment was exposed to seawater spiked with different concentrations of lead and the lead concentrations in the different exposure groups were determined.

The different metal concentrations in contaminated and non-contaminated areas and the uptake and bioaccumulation of metals, in particular lead are compared; and a possible harm to human beings living in this area because of the high metal contamination is discussed.

Keywords:

EFFECTS OF SHORT-TERM CLIMATIC VARIATIONS ON FLUCTUATING ASYMMETRY LEVELS IN CHIRONOMUS RIPARIUS LARVAE AT A POLLUTED SITE

Ms Maria-José Servia-García

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Type: *Poster*

Status: *Accepted for poster*

In recent years considerable effort has been dedicated to the analysis of morphological alterations of individuals as bioindicator tools for detecting and assessing stress conditions. One approach that has become increasingly popular is the analysis of fluctuating asymmetry (i.e. minor, nondirectional deviations from bilateral symmetry). The number of studies related to this subject is enormous, but recently some authors have questioned its utility, in view of our poor current knowledge of different aspects of FA-stress relationships. Concerning morphological deformities, the discovery of frequent abnormalities in chironomid (Diptera, Chironomidae) larvae collected from contaminated sites has given rise to numerous studies on the relationships between deformities and pollution, and today it is generally accepted that severe pollution increases the frequency of deformities in larval populations. We examined FA levels in fourth-instar larvae of *Chironomus riparius* (Diptera, Chironomidae) collected monthly from a polluted site in Galicia (NW Spain) where pollutant inputs are known to be roughly constant throughout the year. However, despite this constancy, larval deformities were previously found to be more frequent and severe during cold periods and less frequent and severe during warm periods of the year, in accordance with the "time-of-exposure" hypothesis. This hypothesis predicts that short-term climatic variations occurring throughout the year influence the frequency and severity of larval deformities, by means of the control they exert on developmental time and, as a consequence, on the time larvae remain exposed to pollutants. We investigated whether FA levels were likewise in accordance with this hypothesis, but, contrary to our expectations, no significant differences in FA levels were detected either among months or among seasons, suggesting that FA is not influenced by normal climatic variations. However, climatic influences may be masked, and the observed constancy may be a consequence of the action of a mixture of stressors which compensate each other.

Keywords:

FEEDING POST-EXPOSURE OF HYDROPSYCHE PELLUCIDULA AS A RESPONSE TO DIFFERENT TEST SOLUTIONS

Ms Paula Silva

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Type: *Poster*

Status: *Accepted for poster*

Ecological integrity refers to system wholeness, including the presence of appropriate species, populations, and communities and the occurrence of ecological processes at appropriate rates and scales. Feeding is one of the most important physiological processes upon which depend the health and well-being, respiration, growth, fitness and survival of a species. Once stress conditions affect physiological and behavioural functions they may greatly reduce the foraging success and hence feeding rate of the affected species. With this study we intend to evaluate and compare the effect of different test solutions (Artificial Pond Water (APW) and APW contaminated with metals) in the post-exposure feeding rate of collector organisms. The test organism selected was the Trichoptera *Hydropsyche pellucidula*. To establish feeding duration, *Hydropsyche* were placed individually in flasks with 60 ml APW and 100 artemia nauplii. Feeding rates were calculated after two and three hours. In addition, organisms were exposed to different metals (Zn and As) concentrations during 24 hours, without food, and afterwards transferred to a 60 ml flask with APW where they were allowed to feed individually on 150 artemia nauplii, during two hours. Regarding the feeding duration, the average feeding rate registered was higher after two than after three hours. This can be explained by the reduction in artemia density affecting food capture success. Therefore, a feeding period of two hours was selected. In the second experiment we observed that the organisms feeding rate was affected by the quality of the test solution.

Keywords: *feeding response, collector, trichoptera, metals*

**HIGHER-TIER RISK ASSESSMENT OF FOMESAFEN AND
FOMESAFEN-NONYLPHENOL POLYETHOXYLATE ADJUVANT MIXTURE.
1. FATE AND EFFECTS ON PLANKTONIC COMMUNITIES**

Mr Thierry Caquet

UMR 985 INRA-ENSAR, Rennes, FRANCE

Author(s): Laurent Lagadic, Gérard Lacroix, Laurence Deydier-Stephan, Bertrand Le Rouzic, Jean-Pierre Cravedi, François Lescher-Moutoué, Didier Azam, Micheline Heydorff, Thierry Caquet

Type: *Poster*

Status: *Accepted for poster*

Adjuvant are used to enhance the effects of pesticides, especially herbicides, but the effects of the mixture of active ingredient and adjuvant are rarely assessed. The fate and ecotoxicological effects of a diphenyl ether herbicide, fomesafen, applied alone or in combination with Agral 90 (mixture of polyethoxylated derivatives of nonylphenol) were assessed in 18 m³ outdoor mesocosms during a 9 month study. Nominal concentrations of both compounds were 40 µg/L and 90 µg/L, respectively. Four mesocosms were contaminated with fomesafen only, four were treated with the mixture fomesafen-Agral 90 and four were kept as untreated controls. Five treatments were performed every three weeks from April 18, 2000. This series of posters describes effects of the tested compounds on various communities and at various level of biological organization.

Concentration of fomesafen in water was significantly higher in the ponds treated with fomesafen alone. At the end of the contamination period, herbicide concentrations in water at mid-depth were 60.33 ± 2.68 µg/L and 30.33 ± 14.91 µg/L in fomesafen- and mixture-treated mesocosms, respectively. Principal response curve (PRC) analysis of abundance data showed that fomesafen, either alone or in mixture with Agral 90, had a significant effect on phytoplankton ($p = 0.025$). It caused a decrease of the dominance of Chlorophyceae and an increase in the abundance of Cyanobacteria, Cryptophyceae and Dinophyceae. Phytoplankton diversity was greater in treated than in control ponds. Structure of zooplankton community was deeply altered in the mixture-contaminated mesocosms (PRC analysis, $p = 0.005$), presumably through a combination of both direct and indirect effects of Agral 90. Calanid copepods were negatively affected whereas the abundance of rotifers and Cyclopid copepods increased. These results demonstrate that adjuvants may greatly modify the fate of pesticide in water and that they may have themselves a significant ecotoxicological impact on aquatic organisms.

Keywords:

HIGHER-TIER RISK ASSESSMENT OF FOMESAFEN AND FOMESAFEN-NONYLPHENOL POLYETHOXYLATE ADJUVANT MIXTURE. 2. EFFECTS ON MACROINVERTEBRATE COMMUNITIES

Mr Thierry Caquet

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Type: *Poster*

Status: *Accepted for poster*

Adjuvants are frequently used to enhance the effects of pesticides, especially herbicides, but the effects of the mixture of active ingredient and adjuvant are rarely assessed. The fate and ecotoxicological effects of a diphenyl ether herbicide, fomesafen, applied alone or in combination with Agral 90 (mixture of polyethoxylated derivatives of nonylphenol) were assessed in 18 m³ outdoor mesocosms during 9 months. Nominal concentrations of both compounds were 40 µg/L and 90 µg/L, respectively. Four mesocosms were contaminated with fomesafen only, four were treated with the mixture fomesafen-Agral 90 and four were kept as untreated controls. Five treatments were performed every three weeks from April 18, 2000.

A stratified sampling strategy (benthic multiplate samplers, tubular substrates and emerging traps) was applied to study the macroinvertebrate communities in control and treated ponds. Organisms were enumerated and identified at the appropriate taxonomic level to evaluate both structural (i.e. abundance of the various taxonomic groups) and functional (i.e. relative abundance of functional feeding groups) characteristics of the communities. Each individual was attributed to a functional feeding group based upon literature data on food preference.

Principal response curve (PRC) analysis of abundance data showed that no overall significant effect of any treatment occurred on benthic macroinvertebrates ($p = 0.55$ and $p = 0.78$ for taxonomic and functional feeding groups data, respectively). However, two groups (Chironominae larvae and Chironomidae pupae) exhibited a high weight in the PRC, suggesting an effect of the mixture. A significant positive effect on the abundance of emerging Chironominae was observed in the first weeks following the end of the contamination period in the mixture-treated mesocosms only. These results may be due to an increase in food availability in the treated mesocosms through e.g. decaying plants or an increase of the biomass of the microorganisms involved in the biodegradation of Agral 90.

Keywords:

**HIGHER-TIER RISK ASSESSMENT OF FOMESAFEN AND
FOMESAFEN-NONYLPHENOL POLYETHOXYLATE ADJUVANT MIXTURE.
3. CHANGES IN INDIVIDUAL PERFORMANCES OF THE SNAIL LYMNAEA
STAGNALIS**

Mr Audrey Jumel

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Type: *Poster*

Status: *Accepted for poster*

The fate and ecotoxicological effects of a diphenyl ether herbicide, fomesafen, applied alone or in combination with Agral 90 (mixture of polyethoxylated derivatives of nonylphenol) were assessed in 18 m³ outdoor mesocosms during 9 months. Nominal concentrations of both compounds were 40 µg/L and 90 µg/L, respectively. Four mesocosms were contaminated with fomesafen only, four were treated with the mixture fomesafen-Agral 90 and four were kept as untreated controls. Five treatments were performed every three weeks from April 18, 2000. The influence of nonylphenol polyethoxylates (NPEO), formulated as the adjuvant Agral 90, on the effects of the diphenyl ether herbicide fomesafen in the pond snail was investigated, with particular attention to growth and reproduction, and underlying energetic and hormonal processes. At the concentrations used in the studies, NPEO were known as non-toxic in *L. stagnalis*. Multiple application of fomesafen, leading to maximal herbicide concentrations of 60.33 ± 2.68 µg/L in water, resulted in inhibited growth, reduced number of egg-masses and altered glycogen metabolism in contaminated snails. These changes, as well as affected steroid-like levels in fomesafen-exposed snails, support the hypothesis of impaired neuroendocrine functions. When Agral 90 was added to the herbicide, results obtained in mesocosms showed that the adjuvant softened the impact of fomesafen. In mesocosms treated with the fomesafen-Agral mixture, significantly lower herbicide levels were found in the water (30.33 ± 14.91 µg/L at the end of contamination period). Consequently, internal exposure of the snails to fomesafen was reduced when the herbicide was mixed with the adjuvant (48.67 ± 10.30 ng/g vs 80.00 ± 43.51 ng/g for the snails sampled in the ponds treated with the mixture and fomesafen alone, respectively). Mitigation of the effects of fomesafen by the adjuvant may therefore result from non-ionic surfactant activity of NPEO that prevented fomesafen from reaching the snails.

Keywords:

IMPACT OF SEDIMENT QUALITY ON THE TOXICITY OF PYRENE IN AQUATIC MICROCOSMS.

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Type: *Poster*

Status: *Accepted for poster*

Organic matter, measured through T.O.C (total organic carbon) is one of the main factors that can influence accumulation, persistence and toxicity of P.A.H bound to sediments. Although acute and chronique toxicity of some of these compounds were clearly demonstrated on isolated species, few studies have investigated the role of these factors in long term impacts of P.A.H on aquatic ecosystems. Aquatic microcosms can provide a good approach of ecotoxicologic perturbations induced by sediment contaminants. A variable number of biotic and abiotic parameters can be assessed simultaneously and can help to predict effects in natural environments. The aim of this study was to evaluate the influence of sediment quality on chronic toxicity of pyrene in artificial aquatic ecosystems. In order to evaluate the role of T.O.C in pyrene toxicity, two natural freshwater sediments were used in this study : one showed a high T.O.C content, the other was characterized by a very low T.O.C content. The two sediments were spiked with 50 $\mu\text{g/g}$ of pyrene. Aquatic microcosms used 5 test organisms which simulate three aquatic compartment potentially impaired by pyrene : *Daphnia magna* (zooplanktonic, water column), *Hyalella azteca* (epibenthic, water column/sediment interface), *Chironomus riparius* (benthic, sediment), *Lemna minor* (floating macrophyte, water column), and *Pseudokirchneriella subcapitata* (microalgae, water column and sediment). The effects were studied in 28-day chronic bioassays with biological and physico-chemical assessment of the systems. Results showed that survey and development of benthic and epibenthic organisms (*H. azteca*, *C. riparius*) can be seriously impaired by pyrene for the low T.O.C content's sediment. Reproduction of *D. magna* is punctually affected by pyrene bound to this sediment but no effect on survey was observed. *L. minor* and *P. subcapitata* were insensible to contamination for the two sediment. Survey and development of the organism weren't affected by pyrene in the high T.O.C content's sediment.

Keywords: *pyrene, aquatic microcosms, sediments quality*

LITTER BREAKDOWN AS A PROPOSED FUNCTIONAL ENDPOINT IN ECOTOXICOLOGICAL RISK ASSESSMENT

Mr Thierry Caquet

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Author(s): *Laurent Lagadic, Thierry Caquet, Marc Roucaute*

Type: *Poster*

Status: *Accepted for poster*

Measurement of structural and functional integrity is a basic issue in the assessment of aquatic ecosystem health. Leaf litter breakdown is the most frequently used parameter to evaluate the functional performances of benthic macroinvertebrate communities in streams. In the framework of higher-tier ecotoxicological risk assessment of pesticides, responses of aquatic ecosystems are usually assessed through structural endpoints (e.g. qualitative and quantitative composition of biological communities), especially for macroinvertebrates. However, since arthropod shredders (e.g. amphipod and isopod crustaceans, caddisfly larvae) usually play a key role in litter breakdown, it may be a sensitive functional measure of the effect of some toxicants such as insecticides.

In this study, the relevance of litter breakdown as a measurement of the functional performance of benthic macroinvertebrate communities was evaluated in 8 control and 8 deltamethrin-contaminated outdoor pond mesocosms. Three grams of air-dried alder (*Alnus glutinosa*) leaves collected at abscission were enclosed in coarse (5 mm) and fine (0.25 mm) mesh bags. Fifteen bags of each type were introduced three weeks before the contamination of the mesocosms. Bags were collected in triplicate at regular time intervals in each pond, and brought back to the laboratory. Their content was sorted and leaves-remains were oven-dried and weighed. Macroinvertebrates found in the bags were enumerated and identified. Change with time of the weight of remaining leaves was used to compute the rate of litter breakdown. The effects of deltamethrin contamination on this parameter are presented. Influence of the abundance and taxonomic composition of benthic macroinvertebrate community on litter breakdown process is also discussed.

Keywords:

LYSOSOMAL FRAGILITY OF HEMOCYTES AS A BIOMARKER IN THE FRESHWATER GASTROPOD LYMNAEA STAGNALIS EXPOSED TO PESTICIDES

Mr Jacqueline Russo

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Author(s): *Laurent Lagadic, Jacqueline Russo*

Type: *Poster*

Status: *Accepted for poster*

Hemocyte responses such as phagocytosis and oxidative burst have been shown to react to chemical stress in freshwater snails. Components of the internal defense system may therefore provide biomarkers to early detect exposure of the individual to toxicants. In order to better understand the functional role of such biomarkers, investigations have been performed in the freshwater snail *Lymnaea stagnalis*. After phagocytosis, vesicles combine with lysosomes inside the cell. Any change in membrane characteristics of lysosomes may affect this process, with possible consequences on cell activity. Short term effects of herbicides, namely atrazine and fomesafen, on hemocyte lysosomes have been studied in *L. stagnalis* maintained in laboratory test systems and in outdoor microcosms. The snail have been exposed to increasing concentrations of each compound. Fragility of lysosome membrane has been assessed using the neutral red retention time assay with hemocytes sampled 24 hours after treatment. In the laboratory, exposure to herbicides resulted in significantly reduced stability of lysosome membrane. Concentration response relationships were obtained for both compounds. The effects were maintained over the long term (3 week exposure). Outdoor microcosms have been used as a first validation step of such responses as biomarkers in *L. stagnalis* exposed to atrazine. Influence of environmental factors on stability of lysosome membrane, and consequences on the response of these organites to toxicants are discussed.

Keywords:

METALLOTHIONEINS INDUCTION, ANTIOXIDATIVE RESPONSE, GLYCOGEN AND GROWTH PERTURBATIONS AS BIOMARKERS IN TUBIFEX TUBIFEX (OLIGOCHAETE) EXPOSED TO THE FUNGICIDE, FENHEXAMIDE.

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Type: *Poster*

Status: *Accepted for poster*

Laboratory studies were conducted to determine the effects of different concentrations of fenhexamide (0.1, 1, 10 mg.l⁻¹) on growth, protein, oxidative stress, and metallothioneins content in Tubifex tubifex after an exposure of 2, 4, and 7 days. Residues of the fungicide were followed in water and in the worms. In water, fenhexamide concentration decreased slowly (maximum - $2 \pm 0.03\%$ after 2 days for 1 mg. l⁻¹). In the worms, it increased after 2 days and decreased thereafter. Control worms presented a positive growth rate. In presence of the fungicide, growth rate was negative (maximum effect - $12 \pm 4.5\%$ after 7 days with 10 mg.l⁻¹) demonstrating the toxic impact of the pesticides. This growth rate decrease was accompanied by a reduction in protein and glycogen contents. The activity of catalase (CAT), and glutathione reductase (GR) increased in response to the fungicide (maximum increase: $247 \pm 5\%$ and $210 \pm 6\%$ for CAT, and GR, respectively) demonstrating an oxidative stress in the worms. All the measured parameters appeared to be more sensitive than mortality, indeed LC50 values were $48 \pm 5 \pm 0.7$, and 16 ± 2 mg.l⁻¹ after 2, 4, and 7 days. Also the increased in metallothioneins (MTs) content was observed in all concentrations and time of exposure (maximum $169 \pm 78\%$ after 2 days for 10 mg.l⁻¹). Therefore, the biochemical changes and growth rate may be proposed as biomarkers of fungicide exposure.

Keywords: *fenhexamid residues, water, worms, MTs, protein content, glycogen, oxidative stress*

MULTI-TIERED ASSESSMENT OF THE EFFECTS OF CHEMICAL MOSQUITO CONTROL ON INVERTEBRATES IN COASTAL WETLANDS OF MORBIHAN (BRITTANY, FRANCE)

Mr Laurent Lagadic

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Type: *Poster*

Status: *Accepted for poster*

From 1998 to 2002, a pilot study was undertaken to evaluate the ecological impact of Abate 500e (a.i. temephos) and Vectobac 12AS (a.i. endotoxin of *Bacillus thuringiensis* var. israelensis, Bti) used against mosquito larvae in Morbihan coastal wetlands. Three study sites were chosen, and control and treated areas were defined in each site. The marine worm *Hediste diversicolor* and the midge *Chironomus salinarius* were used as sentinel species to assess individual and population effects. In both species, in situ exposure to larvicides was monitored using acetylcholinesterase (AChE), carboxylesterase (CbE) and Na⁺/K⁺-ATPase activities. Emergence rate of *C. salinarius* was also determined. Invertebrate communities were described using taxonomic richness, Shannon's diversity index and Simpson's dominance index. Taxonomic and functional feeding group similarities between control and treated areas were evaluated using Bray-Curtis' index. As compared to the controls, temephos-exposed *H. diversicolor* showed inhibited CbE activities whereas Bti had no effect on enzyme activities. In the midge larvae, enzyme activities were unchanged, but emergence was affected. Communities in control and treated areas were highly similar, and ecological indices showed that treatments did not affect invertebrate abundance. However, summer drying and variation of salinity in the sampling sites induced dramatic changes in species abundances. Changes observed in individuals indicated that non-target invertebrate species may be affected by Abate 500e used against mosquito larvae in Morbihan coastal wetlands. Propagation of effects to populations and communities was not observed, indicating that coastal wetlands communities are adapted to rapidly changing environment. Their dynamic is naturally chaotic and as r-strategists, most of them are able to maintain population levels in chronically stressed ecosystems. For marine species, recolonization by propagules coming from distant sites, especially during spring tides, might also have played a role in buffering the effects of pesticides at the population level.

Keywords:

PROPAGATION OF EFFECTS OF HEXACHLOROBENZENE BETWEEN LEVELS OF BIOLOGICAL ORGANIZATION IN OUTDOOR POND MESOCOSMS

Mr Laurent Lagadic

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Type: *Poster*

Status: *Accepted for poster*

The fate and effects of the organochlorine fungicide hexachlorobenzene (HCB) were assessed in freshwater outdoor pond mesocosms (12 m³). Three nominal concentrations of HCB were used (0.5, 1.25 and 5 µg/L, respectively ; one replicate per treatment) and three untreated mesocosms were kept as the controls. A unique contamination was performed on May 5, and the fate and effects of the compound were studied for 8 months. HCB rapidly disappeared from the water (estimated half-life : 24.5 h) and accumulated in the sediments and the organisms. Analysis of the data on the benthic macroinvertebrate community using Principal Response Curve (PRC) showed a positive effect of HCB on populations of the freshwater snail *Physella acuta* (Draparnaud) at the two highest nominal concentrations. The analysis of population abundance data confirmed that this species was more abundant in the mesocosms contaminated with the two highest nominal concentrations of HCB. Although an indirect positive effect of HCB through food availability cannot be excluded, studies at the individual and population levels on a related model snail species, *Lymnaea palustris* (Müller), showed that HCB may have a direct effect on the performances of freshwater gastropods. HCB caused a decrease of growth and glycogen content and an increase of the fecundity and polysaccharide hydrolytic activity in caged *L. palustris*. These observations were confirmed in laboratory studies. The effects of HCB could be related to an impact on the neuro-endocrine control of the balance between growth and reproduction in exposed snails. This study confirms that mesocosms are suitable devices to study the propagation of effects of toxicants between various levels of biological organization, ranging from subindividual to community level, and to identify putative mechanistic links between these effects.

Keywords:

RISK ASSESSMENT OF LAKE MAGGIORE (N.ITALY) SEDIMENTS BY CONSENSUS-BASED QUALITY GUIDELINES

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Type: *Poster*

Status: *Accepted for poster*

Lacustrine sediments are recognised sink for many micropollutants, including trace metals and xenobiotic compounds, whose persistence and potential for bioaccumulation seriously threaten natural ecosystems. Lake Maggiore, the second largest Italian lake (volume 37.5 km³, surface area 212.5 km², average depth 177 m) is located in a heavily industrialised and densely populated subalpine area. Its drainage basin covers 6599 km² and it receives inputs from anthropogenic point sources as well as from diffuse natural sources. In the present study lacustrine sediment cores were sampled in the Pallanza bay and along the main axes from Northern to Southern basin. The sediment cores were cut in 1-cm slices and analysed for the OCs (PCBs, DDTs, Lindane) and trace metal (Cr, Cu, Ni, Zn, Cd, Pb As and Hg) concentrations, the organic carbon content and the sedimentation rate. The consensus-based sediment guideline approach was applied in this study for risk assessment of lake sub-basins. The results revealed a marked contamination by DDTs and Hg in the Pallanza bay with concentration peaks related to flood events. Micropollutant decreasing trends from the River Toce mouth to the open lake as far to the Southern basin reflect their transport from local industrial wastes by allochthonous suspended material into the lake and their sedimentation/mobilization following lacustrine dynamics. Identification of major contaminants and sub basin area of potential concern by sediment quality assessment are examined and discussed together with point and diffuse sources of pollution and geochemical background.

Keywords:

SEDIMENT TOXICITY IN THE INTERTIDAL FLAT ZONE IN THE MIDDLE WESTERN COAST OF KOREA

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Type: *Poster*

Status: *Accepted for poster*

Sediments from tidal flats along the middle west coast of South Korea including Saemankeum coast where the wide-scaled reclamation project is in progress, were subject to bioassays to look for the regional distribution of sediment toxicity. For the bioassays, 3 crustacea (*Daphnia magna*, *Nitocra spines*, *Hyalabella azeca*) were used as test species to compare their sensitivity to sediment toxicity and evaluate their suitability as a monitoring tool for the assessment of tidal flat contamination..

Sediment samples were collected from tidal flats in Korea at the locations shown in Fig. 1. on October 30-31, 2000. The sampling sites were categorized into 3 groups (non polluted, potentially polluted by nutrients, potentially polluted by chemicals and nutrients), based on the contamination sources. Sediment samples were taken at a depth of 15-25cm at low tide.

Test organisms were exposed to 16% sediments (wet weight). Immobility (%) was checked as an endpoint after 24hr and 48hr exposure of *Daphnia magna* and after 96hr exposure of *Hyalabella azteca* and *Nitocra spines*. Among the three bioassays, the 48hr *Daphnia* bioassay showed the most distinct differential sensitivity related to sediment contamination. The *Nitocra* and the *Hyalabella* bioassays failed to show the differential sensitivity properly among the sites classified as polluted. Significantly different levels of immobility (%) were obtained between the sites classified as chemical/nutrient polluted and the sites classified as non-polluted in the *Daphnia* bioassays, but not in the *Nitocra* bioassay and the *Hyalabella* bioassay. Some differences of toxic response to the same sediments among bioassays were observed, suggesting that there may be a chemical specificity of response sensitivity to sediment toxicity, due to the different bioavailability of sediment toxicants among test species.

Keywords: *sediment bioassays, intertidal flat zone, crustaceans, differential sensitivity, sediment toxicity*

STUDY OF WELLS WATER QUALITY OF CASABLANCA CITY (MOROCCO)

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Type: *Poster*

Status: *Accepted for poster*

This work is integrated within the framework of the environmental studies undertaken in Wilaya of Casablanca. It consists, by bacteriological and physicochemical analyses, to evaluate the potability of water of wells of two prefectures (Ben M'Sick Sidi Othmane and Moulay Rachid) of this locality.

The researches are carried out during the months of April and May of the year 2003 and related to thirty and one wells dispersed through the two prefectures.

The bacteriological analyses are made on the basis of the technics and results standardized by AFNOR for the research and identification of the indicators of fecal contamination and the pathogenic germs. These analyses showed that, on the thirty and one samples, only two meet the standard. Indeed the contamination by the coliformes and the streptocoques fecal ones interests all the wells, whereas that by the ASR relates to half of these wells; we note the absence of *Samonella typhi* and *Staphylococcus aureus* but the presence of *Pseudomonas aeruginosa* (35% of the wells) among the pathogenic ones.

The physicochemical analyses are carried out according to Moroccan standards inspired of AFNOR and technics of Rodier and related to several parameters. These analyses revealed that only one well meets the standard. Indeed, the wells have a total hardness going until a maximum value of 35,6 meq/L, contents chlorides with a maximum value of 1232,35 mg/L. Moreover the subsoil waters of Wilaya of Casablanca are exceptional by their nitrate concentration: only one well on the 31 analyzed wells answers the Moroccan standard, and the found maximum value is worth 363 mg/L. However the presence of ammonium and nitrites is very negligible.

In summary, it thus appears that thirty wells out of thirty and one present a medical risk; what strongly pleads for setting-up of system monitoring in order to ensure to the populations a water of better quality.

Keywords:

THE USE OF CHITOBIASE ACTIVITY AS A RAPID TOXICANT SCREENING TOOL FOR AQUATIC INVERTEBRATES

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Status: *Accepted for poster*

Arthropods undergo predictable growth in size through the process of shedding their exoskeleton, known as moulting or ecdysis. In order to successfully moult, the old exoskeleton must be broken down and recycled, via the functioning of a number of enzymes. The exoskeleton of arthropods is composed mainly of chitin, a polysaccharide, which is acted upon by two enzymes, chitinase and chitobiase. Chitobiase is involved in the cleavage of N-acetyl- β -D-glucosamine (NAG) polymers to monomers, which are produced by chitinase hydrolyzing chitin to polymers of NAG. Chitobiase is released at basal levels during the intermoult period and activity increases drastically during the moulting phase. It is possible to measure the activity of chitobiase in the media surrounding invertebrates and estimate secondary production rates. Current methods were modified for screening toxicants to invertebrates (the midge *Chironomus riparius* and the cladoceran *Daphnia magna*) using a microplate system. Standard toxicity test methods can last from 48 hours to 60 days for these species and involve extensive cost and personnel. The new screening method based on the measurement of chitobiase activity assesses the ability of the animal to moult upon exposure to the toxicant of interest and requires only a few hours of incubation in a microplate. Measurement of chitobiase activity is performed via fluorometry. A number of toxicants were screened, including fluorinated surfactants and common insecticides. The results were then compared to standard acute and chronic assays for these organisms and will be discussed.

Keywords:

TOXICITY ASSESSMENT OF CONTAMINATED SEDIMENTS BY USING BACTERIAL AND MICROBIAL TESTS : SOME CONFLICTING RESULTS

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Status: *Accepted for poster*

Sediments often accumulate chemicals discharged in the environment. When they increase the risk of flooding or when they induced troubles to shipping, the dredging of these sediments becomes a necessity. However dredging could then cause harmful effects to the aquatic ecosystems due to the remobilization of sediment and to the dispersion of the associated contaminants. In the same way, according to the management and the deposit of the dredged sediment, a point source contamination could be created. The definition of a risk assessment method adapted to these questions is based on chemical criteria (chemicals characterization) and biological effects criteria (mainly based on laboratory bioassays). In the frame of such bioassays, microbial and bacterial tests are often considered as interesting and low-cost alternatives to bioassays using invertebrates or fishes. In fact, the biological informations are obviously not equivalent, but also the sensitivity of microorganisms to parameters other than contaminants (O₂, ammonium, OM, ...) could make the bioassays interpretation rather tricky.

This study discusses the effect on microorganisms of 5 contrasted sediments, dredged in ship canals highly, but differently, contaminated in trace metals and in PAH. The management scenario was a deposit in a pond and the assays were conducted on the sediments pore water. Two types of microbial parameters were used : 1/ enzymes activity of a sedimentary microbial community (natural assemblage sampled in an uncontaminated freshwater sediment), related to the carbon and nitrogen biochemical cycles, and 2/ two bacterial tests based on pure culture (Microtox and Metplate).

The results were highly contrasted with biological effects ranging from a marked stimulation to a strong inhibition. Nitrification was often stimulated by the pore water (4 cases out of 5) but conversely glucosidase activity and MetPlate bioassay (i.e. galactosidase activity) were always inhibited. Denitrification was intermediate with a stimulation at diluted pore water and inhibition at low dilution or at pure pore water. The chemistry of the pore waters, their nutrients and organic matter content should explain such discrepancies in the results, making difficult to conclude on the toxicity of the sediment.

Keywords: *sediment toxicity, microbial tests*

TRACE METAL AVAILABILITY AND MACROINVERTEBRATE COMMUNITY IN APENNINE RIVERS: AN INTEGRATED APPROACH

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Status: *Accepted for poster*

Trace metal uptake accumulation by macro invertebrates from the surrounding aquatic medium varies with invertebrate taxonomic group, trophic role, and the relative bioavailability of the metal in water, sediment and diet. Spatial and seasonal availability of sediment-bound trace metals to benthic macroinvertebrates was investigated in four rivers (Taro, Ceno, Trebbia, Nure) located in the northern Apennines (Italy). These rivers were included in the E.U. funded AQEM project aimed at developing and testing an integrated assessment system for the ecological quality using benthic macroinvertebrates. According to the WFD requirements for assessment systems and monitoring strategy, a broad gradient of environmental quality was covered by the selected sites, which included some "reference" (unpaired) sites. Half of sites investigated in the present research are reference ones and the other ones suffer for morphological alteration or light to moderate organic pollution. The collected macroinvertebrates were grouped following their feeding guilds: collectors/shredders (C), scrapers (S), filter-feeders (F) and predators (P) with the aim of studying relations between trace metal bioaccumulation and invertebrates trophic role. Besides, the association of bioaccumulation with ambient (water and sediment) bioavailability of trace metals and macroinvertebrate community structure was studied. Biological and abiotic samples were acid digested in microwave oven and assayed for As, Cd, Co, Cr, Cu, Ni, Pb and Zn by atomic absorption spectrometry. Hg was assayed on solid samples by atomic absorption spectrometry after thermal decomposition and trapping on gold amalgamator. Bioavailable fractions of trace metals in <math><250\mu\text{m}</math>-sediment samples were determined by SEM-AVS method. Data were analyzed by means of multivariate ordination techniques to identify the major factors influencing metals accumulation and partitioning. Results show that accumulation in benthic macroinvertebrates was dependent on functional feeding group and follows the decreasing order: $S>C>F>P$. The use of selected taxa belonging to the categories of collectors and scrapers as indicators of bioavailable sediment-bound trace metals can thus be suggested for the studied area. Some general notes on the possible use of widely distributed invertebrate taxa for assessing metal bioavailability, together with a first comparison with quantitative, habitat-based invertebrate data, are also reported.

Keywords:

USE OF DGT TECHNIQUE TO ASSESS METALS MOBILITY AND BIOAVAILABILITY IN SEDIMENTS

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Status: *Accepted for poster*

In aquatic systems, dissolved trace metals are distributed between ionic form ("free"), inorganic complexes and organic ones, and that speciation appears to strongly influence mobility and bioavailability of these elements. For example, it is recognized that biological effects are more related to the free-ion activity than the total dissolved concentration. The DGT technique (Diffusive Gradients in Thin films) accumulates labile metals on a chelex resin after their diffusive transport through a hydrogel. The DGT probe deployment in sediment creates a perturbation inducing metallic flux from porewater to the probe. In some cases, the desorption process from the particles may participate in the flux. Thus, DGT is an interesting technique for describing metal mobility in the sediments, but the challenge is to evaluate if the concentration of labile forms, determined by DGT, could be a relevant indicator of the bioavailability of the metal.

To assess this assumption we have performed microcosm experiments to measure the metals accumulated in benthic invertebrates as well as in DGT probes exposed to a metal contaminated sediment. 2-days-old *Chironomus riparius* larvae were exposed to the sediment, and Cd, Pb and Cu bioaccumulation were measured after 7 days of exposure. In addition to classical determinations of particulate and dissolved metal concentrations, DGT probes were deployed in the sediment and sampled at different time periods, allowing to calculate labile metal fluxes and concentrations on time (Cu, Cd, Pb).

The resupply of metals from particles to porewaters seemed to be very low during the experiment for this particular sediment. However, bioaccumulation was significant and it appeared that bioconcentration factor in chironomids ($BCF = \mu\text{g}/\text{kg organisms}/\mu\text{g}/\text{L porewater}$) was higher for Pb than for Cu and Cd. Calculating BCF with DGT porewater concentrations (24h deployment) gave comparable factors for Cu and Pb.

Keywords: *sediment, metals, speciation technique, bioavailability, microcosm experiments, benthic invertebrates*

USE OF MAYFLIES IN BIOMONITORING OF SEVERAL WEST SIBERIAN RIVERS: INTEGRATING OF FIELD AND EXPERIMENTAL STUDIES

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Type: *Poster*

Status: *Accepted for poster*

First macroinvertebrate biomonitoring studies were conducted on several rivers in Western Siberia. Macroinvertebrate communities was investigated with special interest on mayfly larvae. Also acute bioassays with *Daphnia magna* and chemical analyses of waters were done. The reference conditions were established. Positive correlations were found between water quality and such metrics as Shannon's diversity, Probability of Interspecific Encounters, Diversity Index, EPT and EPTO species numbers and Woodiwiss Biotic Index. These metrics were used for calculating of integral Index of Biotic Integrity (IBI). Conducted bioassays with *Daphnia magna* were not informative. Additional laboratory experiments (acute toxicity tests with mixture of ammonia, nitrite and nitrate) were conducted on larvae of six mayfly species: *Baetis fuscatus*, *Baetis vernus*, *Cloeon bifidum*, *Ephemerella lenoki*, *Potamanthus luteus* and *Heptagenia sulphurea*. Obtained for the Ephemeroptera taxa LC50s (96h) and field data from this study as well as European Saprobic Indexes tend to be correlated. Analysis have shown significant ($p < 0.05$) positive correlation for the LC50s, saprobic indexes and mean nitrogen concentrations of ammonia, nitrate and nitrite of waters where the mentioned species were found. Number of sites where the species occurred have significant correlation only with derived LC50s. Integrating of field and experimental research is usually a good method in cause inferring studies. Results of the present experiments showed that direct effect of the mentioned toxicants could be considered as a factor affected the distribution of the mayflies. Final conclusions are being addressed to the long term monitoring and experiments with more species.

Keywords: *biomonitoring, mayflies, cause inferring studies*

USING BIOASSAYS TO DEFINE A SEDIMENT MANAGEMENT STRATEGY

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Type: *Poster*

Status: *Accepted for poster*

This paper describes a program to define a sediment remediation zone in a wetland/pond area adjacent to a chemical disposal site in the northeastern U.S. Sediment remediation was necessary in an area where PCBs and lead posed potential ecological risks, but the exact area to be remediated needed to be determined. An ecological sampling program which involved laboratory toxicity and bioaccumulation bioassays was implemented. Based on previous analytical chemistry data, sediment samples were obtained from selected points throughout the impacted area to represent the range of PCB and lead concentrations detected. Toxicity tests were performed with *Hyalella* and *Chironomus*. Test data demonstrated a clear dose-response relationship between sediment lead concentrations and toxicity, and indicated a toxicity threshold for lead of greater than 1000 mg/kg. Bioaccumulation studies were performed with *Lumbriculus*, and results were compared to dietary toxicity benchmarks for selected higher trophic level receptor species. *Lumbriculus* tissue residues that exceeded the toxicity benchmarks were observed in sediment samples where lead concentrations were greater than 1000 mg/kg. These results were used to define a remediation zone that encompassed only those sediments that exhibited toxicity and/or potentially significant bioaccumulation, thereby excluding substantial areas of the wetland from active sediment remediation (excavation).

Keywords: *sediment, bioassays, lead*

Scientific inputs to environmental policies and management

A COMPLÉTER

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Type: *Keynote*

Status: *Rejected*

A compléter

Keywords:

A COMPLÉTER

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Type: *Keynote*

Status: *Rejected*

A compléter

Keywords:

THE WATER FRAMEWORK DIRECTIVE: A COMMON FIELD FOR SCIENTISTS AND DECISION MAKERS

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Type: *Keynote*

Status: *Accepted for oral*

The implementation of the water framework directive, by making the "good status" objective the ambitious aim of the public policies, will lead to a deep change in water bodies management. A close co-operation between scientists and decision makers is then imperative to achieve the objective.

From that point of view, 3 key points are to be highlighted:

- in spite of what some could think, the terms are close and we have to implement the directive in a short time: between the characterisation of the river basin district and the "practical" elaboration of the first management plan, less than 5 years are left. It is then essential that, certainly while developing new fields of knowledge, scientists give above all priority to an "operational valorisation and translation" of existing knowledge;

- the objectives defined in the management plan will become legally binding in 2015. So, it is necessary to go beyond the basic principle consisting in "going in the right way", and to consider that results are mandatory, which leads to optimise the technical and financial measures to be adopted. The scientific community must help that optimisation, by facilitating the diagnosis, but above all by offering "predictive tools" in order to be able to assess, in advance, the effects that can be expected from the actions;

- finally, a real "triangular dialog" must exist between i) scientists, ii) policy makers and iii) local stakeholders and decision makers, which implies:

* a true scientific competence actually existing and maintained "around" the policy making bodies and authorities,

* a helpful scientific approach so as to convince local stakeholders and decision makers that the suggested measures are relevant, from the technical, social and economical point of view: the involvement of human and social sciences, beside the "classical" technical fields, is indispensable to reach that goal.

On these 3 points, co-operation must be promoted at every territorial level: European, national, district and local.

Keywords:

EFFECT OF MUNICIPAL WASTEWATER ON

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Type: *Oral presentation*

Status: *Rejected*

Water is essential for the human beings and plants. The utilization of water for plants through irrigation is different for different soils. Hydraulic conductivity is the ability of the soil to transmit water through its pores subjected to difference in pressure head. The water movement through soil depends on the grain size distribution, porosity, shape and arrangement of pores, properties of the pore fluid and entrapped air or gas. Due to soluble or suspended solids & soluble compounds in the municipal water, which sealed the pore space of the soil, results the depletion of flow. In this study, the effect of municipal wastewater on the hydraulic conductivity of different types of soil has been experimented. It has been found that, hydraulic conductivity decreases with respect to time and after certain time, the water can not pass through the soil; because wastewater contains insoluble or suspended solids & soluble compounds in the water. As a result, water logging creates due to sealed of soil pore space.

Keywords: *Wastewater , irrigation, hydraulic conductivity*

RISK ASSESSMENT OF SINGLE HERBICIDES AND THEIR MIXTURE AT DIFFERENT SCALES, FROM SMALL STREAMS TO LAKES

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Type: *Oral presentation*

Status: *Rejected*

Monitoring programs throughout America and Europe have demonstrated the widespread presence of pesticides in surface water. Public concern is focused on possible environmental impact of such pollution. For this reason, European and American countries, and recently the European Union with the new EU Framework directives established "Environmental Quality Standards (EQSs)" for single pesticides in surface water. These EQSs are generally based on long-term ecotoxicity of pesticides and represent target limit values, which should be respected to protect aquatic ecosystems. Comparison of EQSs with environmental concentrations gives an indication on the pressure that each pesticide places on the aquatic system and allows identification of those that present a risk for aquatic life. In the first step of our study we assessed the risk of five commonly found herbicides at different scales, i.e. from small streams to a lake, comparing continuous measured field concentrations with EQSs. Our results show that the aquatic risk is high during and after the application period for most of these herbicides - i.e. when the concentrations increase in surface water. However, when the source of pesticide is not only agricultural but also urban, the pollution is more constant and the risk can be high during the whole year. Furthermore, the risk in small streams is much higher than in rivers and in lakes, as the concentrations in water can reach very high values during some hours. However, in the environment, aquatic organisms are not only exposed to single pesticides but typically to mixtures of these substances. This is especially the case in spring, when most of the pesticides are applied. In a second step, we therefore assessed the risk of the mixtures of the five herbicides for the aquatic life. Results show a large increase of risk when the mixture of components is taken into account, which strongly supports the introduction of quality standards not only for single substance, but also for mixtures.

Keywords: *risk assessment, herbicide, mixture, environmental quality standards*

TOWARDS A CANADIAN INTEGRATED NETWORK ON AQUATIC ECOSYSTEM HEALTH MONITORING

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Type: *Oral presentation*

Status: *Rejected*

At present, there is no established national water quality monitoring program in Canada. Current monitoring is temporally and spatially fragmented; monitoring of key issues and stressors is lacking; and there is inadequate use of data and information generated by monitoring activities. As a result, water quality managers are often unable to provide a comprehensive regional, watershed and national pictures of the status and trends of water quality and the state of ecosystem health in Canada.

To address this critical issue, the development and promotion of a Canadian Integrated Network on Water Quality Monitoring is proposed. The aim of this network would be to encourage strategic monitoring programs that are driven by current scientific and policy questions, and that provide a balance between the generation of data and the timely interpretation and reporting of this information to Canadians.

Partnerships and collaboration across public and private sectors is fundamental to building this network. The first step will be to bring together existing water quality monitoring programs, such as those conducted by various levels of government, industry, academia, and communities and non-governmental organizations, and determine what water quality monitoring is currently underway. A national steering body could be established to oversee an analysis of national monitoring priorities and gaps. This would be followed by an assessment of new monitoring activities needed to address key issues and stressors, such as microbial pathogens, pesticides, EDCs, as well as emerging issues (e.g., pharmaceuticals, GMOs).

The long-term goal is to achieve an integrated, national water quality monitoring network of networks that addresses relevant water quality and aquatic ecosystem health issues and provides Canadians and decision-makers with timely, integrated and comprehensive water quality information needed to make informed, responsible decisions.

Keywords: *monitoring, water quality, networks*

**UNDERSTANDING ECOLOGICAL RISK CONSTRUCTS: IMPLICATIONS
FOR AQUATIC ECOSYSTEM ASSESSMENT COMMUNICATION**

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Type: *Oral presentation*
Status: *Accepted for oral*

(to be completed)

Keywords: *risk attitude, risk communication, pycho-social construct, assessment*

USE AND NEED OF BIOLOGICAL INDICATORS IN ENVIRONMENTAL POLICIES OR MANAGEMENT : A QUESTION OF SCALE

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Type: *Oral presentation*

Status: *Accepted for oral*

With the rising impact of human activities on ecosystems, it is necessary to define and apply environmental policies to protect or restore ecosystems. The different implied actors should have strong abilities to define realistic environmental objectives, to establish relevant diagnostics and to recommend adapted remediation measures (including forecasting capacities). While recognizing that the needs of knowledge are beyond the only field of ecology (i.e. the socio-economy...), the biological indicators have a key position since they allow to justify measures and to assess the efficiency of the measures.

But the need of biological expertise is variable according to the different scales of management and the level of action. The biological supports can be used for different purposes, such as:

- the operational diagnostic : need of precision in the biological process analysis, need to pass judgement on a situation (generally a problematic situation),
- the monitoring of the ecological status : needs of standardisation and reliability of the protocols to provide ecological status assessments that are comparable through time and places,
- the knowledge improvement : fundamental research, looking for comprehension of the biological functioning, risk assessment.

In the same way, there are several scales for the environmental policies and management with specific needs and requirements :

- The international or national regulations (i.e. waterframework directive) require the definition of environmental objectives. The monitoring is then a strategic aspect to display the ecological status evolvments and to prove the objectives have been met. It does not necessarily require a detailed understanding of the biological functioning.
- The regional management programmes (i.e SDAGE, SAGE) need a more precise diagnostic likely to support the definition of management plans, although they have comparable basic requirements for classification purposes.
- The case studies aim to test hypothesis of management strategy. The diagnostic must be as precise as possible. A detailed understanding of the relationships between biology, natural perturbations and anthropogenic pressures become then strategic.
- The scientific works *stricto sensu* are the breeding ground for further water management actions. By progressing the knowledge, the scientists regularly point out environmental risks or disturbances which may have sociological or economical impacts.

These different scales are of course not strictly independant. They obviously may feed each other to support environmental policies. But it is not strategically profitable to systematically look for the most detailed analysis of the biological functioning. While working to day on scientific issues that may be relevant for the tomorrow water management, it is nevertheless important to look for the adequate level of information according to the level/scale of action: the managers cannot wait to know all about ecology before to act but have to use the best available knowledge to build action strategies.

Keywords:

A CASE STUDY OF ARTISANAL GOLD MINING IMPACTS ON AQUATIC ENVIRONMENTS IN GHANA

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Type: *Poster*

Status: *Accepted for poster*

Investigations on environmental impacts of mercury used by artisanal gold washers were led in two different areas in the Ankobra catchment (Ghana). Sediment and fish samples were collected in both places in dry season conditions, along with non aquatic samples, and total mercury was analysed. A few methyl-mercury analyses were also performed in sediment samples. In Dumasi area, gold is extracted from hard rock; the crushed ore is washed, gravity concentrated and then mercury is introduced in order to collect gold powder. In Gyapa area, gold is extracted from alluvium; amalgamation of the concentrate is done either directly on the spot or in the village. These two different extractive processes lead to quite different contamination pathways, and result in different contamination patterns. In Dumasi, sediment concentrations are comparable to those reported in other artisanal gold mining regions, such as Brazil; in Gyapa the contamination appears more diffuse and variable. Fish samples are more difficult to compare, as the species collected differ. Both case studies show that these environmental impacts should not be neglected; a broader surveillance should be set up at the basin scale. As the mercury contamination directly affect various common food resources, human health potential consequences should also be assessed.

Keywords: *artisanal gold mining; mercury; sediment; fish*

A WEB-BASED TOOL FOR MANAGING AND SHARING RELEVANT INFORMATION ON PHARMACEUTICALS

Mr Christophe Biasini

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Type: *Poster*

Status: *Accepted for poster*

Because they are designed for interacting with biological receptors and supposed to be more or less quickly released from the target organisms to water systems, human and veterinary pharmaceuticals should be given a particular attention. However, not all of them could have noxious effects on aquatic ecosystems. Consequently, there is a need for sorting out those more likely to exert effects on aquatic organisms, in order to select the substances which need to be studied in more details. Such a risk-based tiered approach primarily relies upon the management of various kinds of information: substances' physico-chemical characteristics and fate, amounts used, ecotoxicity. A Web-based application attempting to respond to these needs was therefore developed at the first step of the REMPHARMAWATER research project (Removal of Pharmaceuticals ...). It now includes data on 44 compounds. A module allowing to determine probable no effect concentrations (PNEC) and risk quotients according to various exposure conditions was added recently. The results of these determinations will also be stored in the database, if needed.

Keywords: *pharmaceuticals, database, risk-assessment, risk-quotient PNEC*

BIOAVAILABLE METALS IN WASTEWATERS: DGT AS A PROMISING MEASUREMENT TECHNIQUE

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Several heavy metals were recently pointed out in the European Water Framework Directive as toxic substances needing a monitoring in the environment. However, giving that the ecological state is at stake, bioavailable metals rather than total or dissolved metals need to be considered. Urban waters are a significant pathway for metals toward receiving waters. Although wastewater treatment plant (WWTP) significantly reduce total metal concentration, little is known about their efficiency in reducing bioavailable metal concentration. Therefore, simple tools are needed to follow the bioavailable metals in wastewaters for a regulation and management purpose.

Labile metals are believed to be a good indicator of bioavailable metals. However, in complex matrixes like wastewaters, the measurement of labile metals with standard electrochemical techniques raises many analytical problems. Therefore the suitability of the DGT technique, as a simple analytical tool, was studied in laboratory for the measurement of labile metals in raw and treated wastewaters. The *Daphnia magna* acute toxicity test was also used in order to study the relevance of labile metals compared to bioavailable metals in wastewaters. Two types of gels layers (open pore and restricted) were studied in this way.

It appears that the DGT is able to perform accurate measurements of labile metals in wastewaters. The biotest shows that DGT, especially with restricted gels, discriminates a part of the wastewater matrix effect on toxicity and helps for the assessment of bioavailable metals. The DGT was therefore used on WWTP samples to follow the behaviour of the labile metals. Preliminary results show that labile metals are always present in effluents but their removal from raw to treated wastewater is quite variable. Urban wastewaters are therefore a potential source of bioavailable metals for the environment and need to be quantified.

Keywords: *bioavailable metals, diffusive gradient in thin films, urban wastewaters, labile metals*

VIDEO MONITORING AS A RAPID ASSESSMENT METHOD FOR HEALTH ASSESSMENT OF CORAL COMMUNITIES IN THE GULF OF AQABA, RED SEA

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Status: *Rejected*

In order to assess the impact of the very rapid development of several parts of the Sinai coastline and diving tourism in the past 5-10 years and assist management decisions, Ras Mohammed National Park has set up since February 2001 the Gulf of Aqaba Monitoring Programme (GAMP) mainly based on video-monitoring and associated still digital photography of permanently marked stations to be surveyed on a yearly basis. The GAMP sites were selected according to different natural environments and human impacts and also for comparison with data collected during a 1996 survey using other techniques. This video-monitoring method has been adapted to collect and data at 3 depths along 1350m of reefs/station. At most stations genera diversity peaks at 16m depths, supporting the literature in the region with an increase in diversity down to 30m. Data from offshore stations display the highest cover of hard and soft corals. Community data based on proportional cover of each genera or category were compiled into a matrix and imported to PRIMER ecological statistics software package for multivariate analysis. A total of 6 clusters can be recognized in the MDS plot. It can be concluded that stations are mainly characterized by their natural topography and location. The GAMP programme has proven to provide a most valuable regional benchmark database on natural processes and recovery of coral populations, reef habitat structural complexity, and fish communities. It also helped to improve and develop monitoring capacities of National Parks Staff. It is presently replicated all along the Egyptian Red Sea coast.

Keywords: *coral reefs, videomonitoring, rapid health assessments, impact of development, diving tourism, marine protected area, resources management*

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