

Erasmus Mundus Master Course in Ecohydrology

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Erasmus Mundus Master Course in Ecohydrology – an opportunity for global water education challenges

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Abstract

Despite the Earth is the blue planet, only 3% of total Earth's water is freshwater, and only 0.03% is both accessible and suitable for human use. Human population and climate variability are posing the increasing pressure on water resources available for human consumption, agriculture and industry, as well as on aquatic ecosystems functioning and health. The development of EH is based on science, education and cooperation. In 2009, the Education, Audiovisual and Culture Executive Agency (EACEA), from European Commission, approved a five years Erasmus Mundus Master Course in Ecohydrology. High quality students from all regions of the world have been applying to and attending this course. This special volume brings together several papers developed by the students of the EMMC in Ecohydrology, resulting from their Master Thesis, or course assignments. The papers are covering different topics, including urban, freshwater and coastal ecohydrology, and bioengineering.

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Efficiency analysis of two sequential biofiltration systems in Poland and Ethiopia - the pilot study

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Abstract

The study presents the results of comparative analysis of sequential biofiltration systems (SBS) efficiency in Poland (SSBS) and Ethiopia (ASBS) constructed in order to purify urban storm- and waste water and mixed agricultural water, and treated sewage from a Water Treatment Plant, respectively. The efficiency of SSBS (Poland) has been tested in different hydrological conditions prevailing during three storm events. The obtained results showed that the SSBS reduction efficiency reaches 95% for MM, 86% for TP and OM and 81% for TN. The results also demonstrated the enhanced reduction of analysed compounds in the diluted stage of storm events. The obtained data showed also that the SSBS purification rate is increasing with the flow up to $0.04 \text{ m}^3 \text{ s}^{-1}$. Above this value the efficiency decreased and SSBS appears as the source of the analysed pollutants. For comparison, the effectiveness of ASBS (Ethiopia) which was examined when the sedimentation chamber was filled with sediments, showed the reduction of 8%, 78% and 65% for TP, OM and MM, respectively. Whereas TN was released from the system with a higher concentration in the ASBS outlet. The increased reduction in all the analysed compounds, amounted to 93% for TP, 73% for TN, 67% for MM and 36% for OM, was observed for samples collected after the sediment removal during proper maintenance of the system. The obtained results for both SBSs demonstrated the crucial role of monitoring and quantification of hydrological processes, especially transport of MM, OM and nutrients, for enhancement of the studied SBS efficiency.

Keywords: sequential biofiltration system, urban stormwater, agricultural water pollution, water pollution, pollutants removal efficiency, ecohydrology.

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Ecohydrology and good urban design for urban storm water-logging in Beijing, China

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Abstract

in Beijing, its effects and causes were analyzed. Among others, the causes include increasing impervious surfaces and climate change. Considering the limitations of current approaches, the need for a more sustainable approach – ecohydrology (EH) – was identified. Thus concepts of EH and good urban design (GUD) were introduced and a framework of systematic EH solution with GUD, utilizing best management practices (BMPs) and source control principle, was proposed. The idea of applying a combination of EH methods with GUD was explained. This approach was expected to eliminate USWL problems, harvest stormwater and create other benefits as well. In addition, several helpful tools, models and systems (TMS) were described.

Keywords: "7.21" disaster, stormwater utilization, best management practices, source control, runoff reduction, Living Water Garden.

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***In situ* effective clearance rate measurement
of mangrove oysters (*Crassostrea rhizophorae*)
in a tropical estuary in Brazil**

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Abstract

Anthropogenic nutrient enrichment in estuaries induces high phytoplankton production, contributing to coastal eutrophication. Abundant natural banks provide habitat for filter feeders, such as bivalves, in downstream areas. Bivalves can then consume phytoplankton, reducing the amount of biomass material subjected to microbial regeneration, and thereby reducing symptoms of eutrophication. The current concern is to what extent bivalves can control water quality and how environmental parameters can influence the filtration process and vice versa. In the present study *Crassostrea rhizophorae* (Guilding, 1818) grazing ability on suspended particles in their natural environment was determined *in situ*, using the biodeposition method and uniquely constructed sediment traps. Additionally the effect of body size on effective clearance rate (ECR) was examined using three different size groups. The experiment was conducted in the Piraquê-açu/Piraquê-mirim estuary system, (Aracruz, ES, Brazil) during the second week of June 2012 (dry season). Environmental parameters were measured together with total particulate matter (TPM, mg L⁻¹) and chlorophyll *a* analysis (CHL, µg L⁻¹) at the beginning and at the end of the experiment. Average values recorded for TPM and CHL were 5.79 mg L⁻¹ and 2.55 µg L⁻¹ respectively with very high organic seston fraction (80%). The reported effective clearance rate (ECR, in litres per hour) was 17.99 L h⁻¹g⁻¹ dry weight (DW), one of the highest reported in literature and can be associated with a high detritus content and different feeding strategies in comparison to bivalves residing in temperate environments. Weight and length (height) relationship were closely correlated (r=0.73) however, clearance rate (ECR) standardized to 1 g dry tissue weight did not vary significantly among different size classes. High ECR at high particulate organic matter (POM, %) supports the belief that bivalves can exhibit ECR flexibility according to food quality.

Key words: *Crassostrea*, effective clearance rate, natural seston, oyster size, tropical ecosystem.

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Fish habitats in a small, human-impacted Sibunag mangrove creek (Guimaras, Philippines): a basis for mangrove resource enhancement

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Abstract

The fish assemblage of a small, open access mangrove creek highly influenced by aquaculture farms, was studied for the first time in the Philippines as a baseline of such system as well as examining the degree of ecological disturbance among fish habitats, as basis for the necessity to rehabilitate mangrove resources aiming to balance human activities and mangrove functioning. In total, 475 fishes (total weight = 3875 g) were captured and 50 species representing 32 families were identified. Thirty two species were represented by small numbers (<5 individuals). Commercial species was considerably high (~23 species) but majority were low grade commercial species. Total species, species diversity and fish abundance consistently showed a decreasing pattern from outside creek to inner creek. Fish habitats exhibited substantial differences following a distinct spatial segregation of fish communities, a dominance of non-shared species and a minimal species overlapping inside the creek, which is attributable to the existing mangrove fragmentation associated with aquaculture ponds in the area. Increasing levels of disturbances were observed within the creek indicating 'stress' as a result of overutilization of mangroves by aquaculture farms. Our results confirmed the need to rehabilitate mangrove resources in this area. The development of mangrove resources through reforestation, coupled by strict regulation of fishing activities and aquaculture ponds will reduce ecological stress in the area and regain gradually a robust mangrove functioning that will improve fish diversity, fisheries and productivity of adjacent coastal systems by creating a suitable fish nursery, feeding ground and refuge habitat.

Key words: fish assemblage, small mangrove creek, disturbance, aquaculture pond, fragmented mangroves.

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Selection of coastal estuarine habitats by *Atherina boyeri* larvae in laboratory experiments

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Abstract:

Coastal wetlands are important nursery areas for many fish species as they provide food, refuge from predators and optimal hydrodynamic conditions. The impact of anthropogenic and environmental changes on ecological functions of these areas need to be identified as a basis for establishing adequate ecohydrological measures for the long-term sustainability of the ecosystem and its associated services. Patterns of habitat selection were examined in wild-caught larvae of *Atherina boyeri* (Risso, 1810), by means of microcosms experiments. We simulated three habitats representative of vertical marsh profile at Guadiana wetland (non-vegetated bottom (sand) and two vegetation types (*Spartina maritima* and *Sarcocornia* spp.)) in experimental units and monitored fish larvae spatial distribution by video-recording. We observed a strong avoidance of both vegetated habitats suggesting that habitat choice behavior may be dependent on external stimuli such as current velocity, predator effect and food availability. Similar experiments including external factors are required to unravel the behavioral responses of *A. boyeri* to different types of habitat.

Key words: wetlands; ecosystem functions; ecosystem services; nursery habitat; behavior; fish larvae.

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The effect of distinct hydrologic conditions on the zooplankton community in an estuary under Mediterranean climate influence

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Abstract

Several studies have documented effects of hydrological conditions influencing fish and benthonic communities in estuaries and coastal areas, but only few evidences of freshwater discharge on zooplankton assemblages are found. The major finding of our study in an estuary under climate variability with regulated flow by dams is that increased annual flow leads to an increase in abundance and diversity of zooplankton and decrease of jellyfish blooms. This offers suitable nursery conditions with positive consequences on the food-web functioning. The ecohydrological approach of dual regulation could be useful with controlling the timing, frequency and volume of freshwater inflow by altering dams' operational efficiency, leading to healthy functional environment and optimize adaptability to climatic changes.

Key words: ecohydrology, ecological indicators, dam, Northern Atlantic Oscillation, jellyfish, global climate change.

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An analysis of the impacts of climatic variability and hydrology on the coastal fisheries, *Engraulis encrasicolus* and *Sepia officinalis*, of Portugal

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Abstract

The notion that climate change may impact coastal fish production suggests a need to understand how climatic variables may influence fish catches at different time scales. Evidence suggests that the effect of climatic variability and fishing effort on landed catches (as proxy of fish abundance) may vary at the regional scale. This study aims to assess the sensibility of two commercial species with a short life cycle (*Engraulis encrasicolus* and *Sepia officinalis*) to climatic and fisheries effects across different regions of the coast of Portugal: northwestern, southwestern and southern Portugal. The effect of environmental explanatory variables, i.e. NAO index, sea surface temperature (SST), upwelling (UPW) index, river discharge, wind magnitude (WmaG), wind direction (Wdir), and fishing variables (fishing effort) on catch rates time series were studied between 1989 and 2009. The sensibility of the species studied to climatic variability differed among regions and were explained by different climatic variables. River discharge had a significant effect on catch rates of the two species, region independently. However, wind driven phenomenon and UPW were the variables that better explained the observed fishing trends across the three regions. Changes in catch rate trends among the studied regions, at a given time, were mostly associated with the reproduction periods of the species. Therefore, regional analyses will significantly contribute to a better understanding of the relationship between climate change and coastal fisheries, aiming to improve integrated coastal zone management.

Key words: climate variables, fishing trends, dynamic factor analysis, river discharge, fishing effort, wind driven phenomenon, integrated coastal management.

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