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Land-cover change dynamics and insights into ecosystem services in European stream riparian zones

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Abstract

Riparian zones, transitional environments between terrestrial and freshwater ecosystems, have been historically threatened in Europe by land reclamation and exploitation of their natural resources. These fragile environments deliver a large number of ecological and societal services, while simultaneously playing a key role in the maintenance of biodiversity in fragmented landscapes. At large scales, one of the clearest and most informative indicators of alteration of state and characteristics of ecological systems is land-cover change. A newly available European riparian zone distribution dataset and continental land-cover change information allowed us to obtain an unprecedented continental overview of riparian land conversion and associated drivers, as well as a broad indication of their loss of capacity to provide ecosystem services. The analysis shows that only 1.8% of riparian zones experienced land-cover changes in the period 2000–2006. The majority of riparian changes involved forest loss and forest regrowth due to forestry activities and, to a lesser extent, to fires. Approximately 9% of land-cover changes involved conversion to artificial and agricultural surface, with trajectories largely affecting their ecological integrity. Using land-cover proxy-based indicators we show that the loss of riparian zones' capacity to support ecological integrity and ecosystem services was overall significantly higher than the proportion of converted surface. The methodological approach can be used to support the assessment of environmental policy targets, and for regional planning and management of riparian zones.

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A framework for assessing river health in peri-urban landscapes

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Abstract

The definition and assessment of the health of river systems is a difficult and complex task. This is mainly because river systems are distributed over a large geographical space with unique biotic and abiotic characteristics attributed to a given catchment, the existence of competing perceptions of stakeholders and an inability to establish a clear rationale for a universal river health assessment methodology. Such complexity and uncertainty can be addressed through a river health assessment framework with step-by-step guidance to help river health management authorities develop site-specific tools suitable for their river systems by taking into account the local river ecohydrology, hydrobiology, water quality aspects and insights from river users. The present work proposes a river health assessment framework based on the key outcomes of a three year project and showcases the role of each step in the framework. The proposed framework consists of four steps: understand, identify, develop and apply. During the first step, a comprehensive understanding is obtained using historic and current water quality data. This information is supplemented with community understanding of the changing condition of river health. This knowledge is then used together with relevant multivariate stoical techniques to identify some key indicators for river health monitoring and assessment. Finally tools are developed to assess river health for community, environmental and management purposes. We developed two tools to assess the risk associated with river health for primary contact recreational activities and algal blooms using three key indicators.

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Nitrogen pollution removal from areas of intensive farming—comparison of various denitrification biotechnologies

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Abstract

In recent decades, dynamic demographic processes resulting in an increased intensity of agricultural food production have changed the natural flow of nitrogen (N_2). This modification of the nitrogen cycle has led to number of changes. As nitrate is the most mobile form of nitrogen in soil, it is the most dangerous polluter of waters, and causes many diseases, including methaemoglobinaemia. Nitrogen contributes to the eutrophication of freshwater and marine ecosystems, resulting in the intensive development of toxic algal blooms and, often, the exclusion of affected freshwater from drinking water resources.

A literature review indicates that applying various biotechnologies to the denitrification process reduces the nitrogen load on the catchment scale by up to one order of magnitude, and seems to be an inexpensive tool for the reduction of nitrate loads to surface waters. Various reports underline the role of abiotic factors dependent on the climate, geology and management of agricultural areas. Depending on the specificity of a nitrogen pollution source, different biotechnological solutions can be applied in the field. For example, in a catchment with intensive farming or pasturing, around a point source such as manure storage, or near the coastline, denitrification walls can be an appropriate solution.

Protection and restoration should employ methods used for gradually developing the properties of the ecosystem responsible for its resilience and ability to respond flexibly to human pressure. These treatments are designed to restore the biogeochemical cycles of evolution-shaped properties and increase the resilience of the environment to human pressure.

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Use of oligochaete communities for assessing the quality of sediments in watercourses of the Geneva area (Switzerland) and Artois-Picardie basin (France): proposition of heavy metal toxicity thresholds

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Abstract

The aim of the study was to validate biological tools based on the analysis of sediment-dwelling oligochaete assemblages for assessing the biological quality of sediments in watercourses. The study intended to establish and compare heavy metal toxicity thresholds in streams of two different ecoregions (Geneva area in Switzerland and Artois-Picardie basin in France). The metals Cr, Ni, Cu, Zn, Hg, Pb, Cd, As, Co, Fe and Mn were analyzed. The PEC-Q (Probable Effect Concentration-Quotient) and TEC-Q (Threshold Effect Concentration-Quotient) were used as metal contamination indices. The results showed a significant negative correlation between the oligochaete index of sediment bioindication IOBS and metal contamination indices. Moreover a significant positive correlation between the percentage of Tubificinae without hair setae and metal contamination indices was noticed. Toxicity thresholds of PEC-Q = 0.14–0.18 and TEC-Q = 0.4–0.6 were established. The toxicity thresholds established in the two different ecoregions were consistent. At some sites, the sediment biological quality evidenced by the oligochaete analysis was poor, yet moderate PEC-Q were observed. The effects of confounding factors such as the bioavailability of metals and the presence of other pollutants (PCBs, PAHs and organic pollution) are discussed. Other conflicting results seemed to be explained by a reduced bioavailability of metals due to organic matter and Mn/Fe oxides.

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Morphological–behavioral adaptations of two benthic invertebrate species to face strong bed hydrodynamic forces in a large South-American river

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Abstract

This scientific communication describes and discusses morphological–behavioral adaptations to flow of two benthic invertebrate species to survive in highly turbulent habitats of the large Paraguay River (Argentina – Paraguay). It is based on field and laboratory observations under microscope made during the performance of usual researches. In this sense, we found that *Djalmabatista* sp. 1 (Chironomidae, Tanypodinae) ballasts its body by ingestion of fine sediment grains which storage into a dorsal bulge, herein called "dorsal bag". This specie would have the ability to take or release these grains according to the surrounding hydrodynamic conditions. Otherwise, the juvenile stage of *Limnoperna fortunei* (Bivalvia, Mytilidae) also ballasts its body but attaching sand grains through the byssal threads.

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Patterns of the growth of soft-shell clam *Mya arenaria* L. (Bivalvia) in shallow water estuaries of the southern Baltic Sea

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Abstract

We explored the shell shape and growth performance of the soft-shell clam *Mya arenaria* L. in two shallow brackish water estuaries of the southern Baltic Sea – Darss-Zingst and Ruegen lagoons. Observed clams ranged from 2 to 50.1 mm in length with detected age up to 6 years old. The growth patterns of the clams were analyzed using the von Bertalanffy growth function (VBGF). An isometric relationship was found between shell length and shell height or shell thickness. Asymptotic length and weight were predicted according to von Bertalanffy equation as $L_\infty = 82.75$ mm and $W_\infty = 10.9$ g. The relationship of wet weight to length was allometric, with exponent $b = 3.09$. Observed shell lengths were close to values predicted by the model. Our study distinguished patterns of the molluscan growth in estuarine transitional environment of the southern Baltic Sea in comparison with other coastal habitats with pronounced spatial environmental heterogeneity.

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