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Original Research Article

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Editorial

Synthesis and conclusions to the International Symposium on Ecohydrology, Biotechnology and Engineering: Towards Harmony between the Biogeosphere and Society on the basis of Long-Term Ecosystem Research

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Ecohydrol. Hydrobiol. 14(1), 14–20, 2014
Research article

Ecohydrology, biotechnology and engineering for cost efficiency in reaching the sustainability of biogeosphere

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Abstract

The major challenge in attaining a sustainable future for humanity lies in accelerating development of well-integrated, problem solving, and policy-orientated environmental science. The recent global increase of environmental degradation has come from exploitative resource use and mismanagement, as well as the domination of economic activity in the management and funding of science. The problems have been further exacerbated by limited communication among professional disciplines and consequent lack of knowledge transfer. One ultimate effect has been lack of basic understanding of the great complexity of interactions between hydrological and ecological processes and their socioeconomic backgrounds. That is why we suffer from increasing costs of maintaining infrastructures and environmental management, and 'overengineering' of the environment. If 'business as usual' is maintained, we can expect that soon the biosphere will no longer support a declining global carrying capacity, threatening global conflicts. Major drivers of biogeosphere evolution and function have been the cycles of water and nutrients in a complex array of differing climates and catchment geomorphologies. In the face of global climate change and unequally distributed human populations, the principles of ecohydrology should be the bases for further integration of ecology, hydrology, engineering, biotechnology and other environmental sciences. Examples are introduced to show how the integration of these will not only increase efficiency of measures to harmonize ecosystem potentials with societal needs, but also significantly reduce the costs of sustainable environmental management.

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Ecohydrol. Hydrobiol. 14(1), 21–32, 2014
Discussion article

Models from ecohydrology and hydrobiology can inform our human future

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Abstract

Freshwater problems link a future 'perfect storm' of climate change, self-inflicted problems of health and economics in the developed world, poverty, overpopulation, and disease in the developing world, and, most fundamentally, conversion of most former land biomes to anthromes: human-dominated, agricultural and urban systems, with consequent diminution of regulatory ecosystem services. Biological processes regulate the compositions of the ocean and atmosphere, such that a band of equable temperatures has prevailed for millions of years. Biomes self-regulate through natural selection of their components; no comparable engineered system is tested so rigorously. Anthromes offer provisioning and cultural services but almost none of the fundamental regulatory services that biomes provide, and then only to the extent that biomes underpin them.

Engineering of biomes to multiple-use anthromes has steadily eroded their long-term value in favour of short-term wealth creation. When they have deteriorated, we have converted more biome to compensate. This can never be sustainable and the remaining area of biome is inadequate to provide sustained regulatory services. As well as our limiting carbon emissions severely to mitigate our problems, large areas of present anthromes will need to be restored to natural biomes, the human footprint confined to much smaller areas, and our engineering talents devoted to making human societies thrive in the latter. We are a clever species and can solve these problems, but only if the selfish interests of the rich and powerful in particular, and if the self-interest of our minds, itself paradoxically determined by natural selection, can be curbed.

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Ecohydrol. Hydrobiol. 14(1), 33–38, 2014
Research article

Balancing flood risk and development in the flood plain: the Lower Thames Flood Risk Management Strategy

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Abstract

Following the severe flooding experienced by mainland Europe in 2000, the UK Government, in 2005, published its policy document *Making Space for Water*, one of the aims of which is to deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles. To facilitate this holistic approach, the Environment Agency was given an overarching strategic overview across all flooding and coastal erosion risks.

The Environment Agency's Lower Thames Flood Risk Management Strategy covers one of the largest and most at risk developed but undefended flood plains in England, with 21,000 properties and approximately 50,000 people currently at a 0.5% annual exceedance probability (AEP) flood risk or higher. The consequences of flooding in the area would be severe, with floods lasting up to two weeks. Major flooding would cause severe disruption and likely traffic grid-lock to key highways, suspend several major drinking water abstractions supplying London and threaten up to 20 local electricity sub-stations. It is predicted that climate change impacts will double flood damages in a 0.5% AEP flood event from the current level of £850 million to some £2 billion by 2055, with the number of properties at flood risk reaching 35,000.

The key objective of the Lower Thames Strategy was to identify sustainable solutions to reduce flood risk to people and property whilst ensuring compliance under the EU Water Framework Directive (WFD) and Habitats Directive. This had to be achieved by minimising disruption to infrastructure and services, protecting and enhancing sites of nature conservation and biodiversity, and by maintaining biological quality and sediment regime of rivers.

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Ecohydrol. Hydrobiol. 14(1), 39–54, 2014
Research article

Systematic solutions and modeling on eco-water and its allocation applied to urban river restoration: case study in Beijing, China

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Abstract

Water and related environmental problems have become a key barrier to the sustainable development of China, where multiple uses of water and urban water management are two significant means to sustain urban development and the ecological restoration of rivers. A new assessment approach and water system model were developed to estimate eco-water or the volume of water essential for maintaining healthy and sustainable urban river ecosystems under various natural landscapes and water quality objectives. Moreover, multiple scenario analysis was adopted to explore the influences of water quality on eco-water management. The Yongding River in Beijing was selected as a case study. The results showed that the eco-water volume was 0.079, 0.073 and 0.067 billion m^3/a under high, medium and low objectives without water quality requirements, and 0.112, 0.107 and 0.101 billion m^3/a further considering water quality. The water residence times anticipated under each development scenario were 34.8, 37.5 and 41.5 d, which were 13.0%, 14.5% and 13.6% longer than those when water quality was considered. Better water quality could be achieved by implementing water diversions. The comprehensive implementation of water diversion projects could increase the rate of water discharge by 45.1%, decrease the permanganate concentration by 16.1%, and reduce the water residence time by 28.9% on average. This study is expected to provide scientific bases for good water governance, prepare healthy water systems for sustainable communities, and provide a reference case to achieve multiple uses of water for human uses and ecological river restoration in water short areas in developing countries.

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Research article

Future climate change impacts on the ecohydrology of Guishui River Basin, China

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Abstract

Quantifying the impacts of future climate change on the ecosystem and hydrology is very important to ecohydrology research. In this paper, the vegetation model BIOME BioGeochemicalCycles (BIOME-BGC) and the Hydrological Simulation Program-FORTRAN (HSPF) are combined to investigate the potential impact of climate change on the hydrology and ecosystems of the Guishui River Basin in Beijing China, under two emission scenarios A2 and B2 of the future period 2010–2099. The projected daily maximum and minimum air temperatures, precipitation and evapotranspiration (*ET*) of HadCM3 are downscaled on to local meteorological stations using the SDSM (Statistical Downscaling Model). The model calibration and validation results are in accord with observed data of surface runoff and Net Primary Productivity (NPP). Average climate projections based on two emission scenarios were used in simulations to assess future ecohydrological responses in the Guishui River basin. Also, the uncertainties in climate change impacts are discussed in detail. The predicted daily maximum and minimum air temperatures and evapotranspiration show a reasonable upward trend, while daily precipitation and surface runoff generally show a downward trend in the next 90 years. The changing rates of daily maximum and minimum temperatures, precipitation, evapotranspiration and surface runoff are 0.46 °C, 0.45 °C, −3.68 mm/year, 15.83 mm/year and −0.05 m^3/s (0.26 °C, 0.26 °C, −4.99 mm/year, 9.36 mm/year and −0.04 m^3/s) per decade under A2(B2) scenarios, respectively. The results also show that global warming impacts would decrease annual discharge and increase annual NPP (at the rate of 10–30%). These results present a serious challenge for water and land management in the basin and will provide support for regional water management.

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Research article

The sustainable restoration of lakes—towards the challenges of the Water Framework Directive

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Abstract

Most in-lake restoration projects use deeply intrusive methods. They include the removal of bottom sediments and the use of high doses of precipitants. They are very radical, causing extinction of many organisms, and are very expensive. Alternative methods described in this paper are inexpensive, easy to use, effective, and sustainable (energy-efficient, not destructive for most of the biota). They have been applied to three lakes located in Poznań and the surrounding area (Western Poland) and their effectiveness has been documented. They include: (i) use of biomanipulation to increase trophic influence of zooplankton on phytoplankton, and small doses of iron sulphate to reduce phosphorus content in the water column, used in Maltański Reservoir, (ii) delivering water rich in nitrates from small tributaries to the deepest part of the lake, thus increasing redox potential and limiting the release of phosphorus from bottom sediments, used in Uzarzewskie Lake, (iii) oxygenation of hypolimnetic waters using wind aerators, iron treatment with small doses of coagulant and biomanipulation, used in Durowskie Lake. Use of limited doses of an innovative solid phosphorus precipitant called Sinobent® is also possible. These methods, in accordance with the intermediate disturbance hypothesis, increased the diversity of flora and fauna in the lakes and contributed to improvements in water quality. Simultaneous application of several methods, which prevented feedback mechanisms, increased the efficiency of lake restoration.

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Research article

The effect of PCB-contaminated sewage sludge and sediment on metabolism of cucumber plants (*Cucumis sativus* L.)

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Abstract

Increasing amounts of sewage sludge are produced nowadays, which need to be disposed of in a safe and responsible manner. Likewise, bottom sediments from small urban water bodies undergo periodical dredging and need to be utilized. These deposits often contain Persistant Organic Pollutants (POPs) and other toxic substances. Plants can be used to reduce these pollutants during or before disposal to land (phytoremediation). Cucurbitaceae are known to accumulate high levels of POPs, including polychlorinated biphenyls (PCB), compared with other plant species but such accumulation may lead to secondary oxidative stress that may limit their value. This study examined the impact of sewage sludge and urban lake sediment on soil toxicity, measured as PCB concentration, and changes in the antioxidative system of cucumber plants grown in the soils.

There was an average reduction of PCB by 38.63% and 27.38% in soil amended with sewage sludge and sediment, respectively after 5 weeks of cucumber plant cultivation. In the case of plants grown with sewage sludge, guaiacol peroxidase (POx) activity significantly decreased to 49% of the control at the highest dose given, while that of glutathione S-transferase (GST) increased to 172% of the control value in the same treatment. α-Tocopherol concentration was higher in the plants grown in the sewage sludge amended soil.

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Research article

The management and development of constructed wetlands for treatment of petrochemical waste waters in Hungary: 35 years of experience

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Abstract

In Hungary, as elsewhere, an important problem is the adequate treatment of waste waters, and especially of petrochemical waste water. Properly functioning waste water treatment systems, including the constructed wetlands, should produce water quality that is very similar to that of the natural waters.

The paper surveys Hungarian constructed wetland types that have been established for waste water treatment in the last forty years, and provides a detailed analysis of the structure and functioning of those reed pond systems that have been constructed for the post-treatment of petrochemical waste waters, and with emergent and/or submerged macrophytic vegetation operate as free water surface systems.

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Ecohydrol. Hydrobiol. 14(1), 89–95, 2014
Research article

Long-term decrease of the vendace population in Lake Pluszne (Poland)—result of global warming, eutrophication or both?

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Abstract

Numbers of vendace (*Coregonus albula* L.) in Lake Pluszne were monitored twice a year from 1999 until 2013 by hydroacoustic methods and pelagic trawls. Since 2002, the numerical density of vendace has decreased continuously. Young-of-year fish were caught in large numbers only in 2001, when a strong year class was recruited, and very few in subsequent years, indicating that natural reproduction after 2001 was hampered. Observed changes in the vendace population were related to temperature and oxygen conditions and we suggest that mainly worsening hydrological conditions, associated with increased eutrophication, have been responsible for scarcity of coregonids.

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Research article

Structure and function of bacterioplankton in the rehabilitated Lake Trzesiecko

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Abstract

Changes in bacterioplankton in relation to the temperature and water chemistry in Lake Trzesiecko were studied from 2008 to 2013. The lake was highly eutrophic until 2005 when measures were begun to precipitate phosphate, to increase oxygen concentrations by re-aeration and to reduce algal crops through biomanipulation of the fish community. Some improvements were also made to reduce phosphorus levels in the inflows. Conductivity increased, redox potential remained largely unchanged, and pH decreased during the period. The abundance, biomass, and morphological structure of the bacterioplankton suggest Lake Trzesiecko remains eutrophic but bacterial numbers and biomass have declined since 2008. The decline was significantly related to decreases in concentration of nitrogen and phosphorus compounds. The bacterial community comprised mostly small cells (<0.05 μm^3), with a lower proportion of cells >0.1 μm^3. Most were cocci. A negative correlation between conductivity and bacterial numbers and biomass suggests that mineral salts from the phosphorus coagulant inhibited the bacterioplankton. Key nutrients (nitrogen and phosphorus) and DOC were positively related to bacterial biomass and numbers.

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