

Healthy Rivers and Sustainable Water Resource Management

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Ecohydrology – process oriented thinking for sustainability of river basins

Maciej Zalewski

European Regional Centre for Ecohydrology under the auspices of UNESCO, Tylna 3, 90-364 Łódź, Poland; Department of Applied Ecology

University of Lodz, Banacha 12/16, 90-237 Lodz, Poland

Abstract

The ecological and hydrological processes together with the observed global changes should be considered while formulating the strategy for sustainable development. The step forward is to increase carrying capacity of the ecosystems by enhancing the key ecohydrological processes acting in the biogeosphere. The integration of knowledge and information among disciplines is a prerequisite to generate wisdom followed by well-informed and well-planned actions. This was the rationale for the 2nd Conference on Healthy Rivers and Sustainable Water Resource Management that took place in Chongqing, China, in October 2011; and the papers selected for this issue follow the same idea. Short summaries of each of them is given at the end of this article.

Key words: transdisciplinary science, regulation, integration, management.

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Assessment of hydrological alterations from 1961 to 2000 in the Yarlung Zangbo River, Tibet

He Chen

State Key Laboratory of Water Environment Simulation, School of Environment, Beijing

Normal University, Beijing 100875, China, e-mail: chenhe@bnu.edu.cn

Abstract

Hydrological regime that is primarily described by combinations of its magnitude, duration, frequency, timing, and rate of change, is the main driving force in river ecosystems. The Yarlung Zangbo River is the largest river in Tibet and the highest river in the world. Data from 1961 to 2000 together with Range of Variability Approach (RVA) analysis were used to calculate hydrological regime characteristics. The hydrologic regime of the Yarlung Zangbo River has been altered over the studied period and the annual flow decreased more than 10% and even 30%. The extreme low flow duration increased more than 200%. The low pulse duration and the high pulse duration increased even more than 1000%. Extreme water conditions, including extreme low or high flow pulse, may cause severe habitat alterations and should be kept in an appropriate range.

Key words: range of variability approach; hydrological regime; flow pulse; flow duration.

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Concentration of nutrients in the soil in water-level-fluctuating zone of Three Gorges Reservoir

Bin Zhang^{1,2}, Jin-Song Guo^{1,*}, Fang Fang¹, Zhe Li¹, Chuan Fu³

¹ Faculty of Urban Construction and Environmental Engineering, Chongqing University, Chongqing 400045, China, e-mail: ZHANG Bin, zbqdhys@163.com

² Energy and Environment College of Xihua University, Chengdu 610039, China

³ Faculty of Chemistry and Environmental Engineering, Chongqing Three Gorges University, Chongqing 404000, China

*Corresponding author, e-mail: Guo0768@126.com

Abstract

Contents of nutrients in the surface soil in the water-level-fluctuating zone of Three Gorges Reservoir was investigated. Soil samples were collected at 57 sampling stations from Wushan County to Chongqing City in April 2010. The average organic matter concentration was 10.636 ± 4.401 mg g⁻¹ with a range of 1.097-19.947 mg g⁻¹, total nitrogen was 0.865 ± 0.423 mg g⁻¹ with a range of 0.127-1.903 mg g⁻¹, and total phosphorus was 0.595 ± 0.222 with a range of 0.205-1.365. Variability of organic matter and total nitrogen concentrations between sampling sites was high, whereas total phosphorus concentration was little diversified. Results of TOC/TN analysis showed that organic matter in surface soils was mainly derived from sedimentation of biomass. Nitrogen and phosphorus in soils of the water-level-fluctuating zone could become potential pollution sources. Therefore, more attention should be paid to the potential impact of nitrogen and phosphorus in soils of this zone on reservoir eutrophication. Single standard index of total nitrogen ranged from 0.72 to 2.12 and was generally above 1, indicating relatively serious nitrogen pollution. However, total phosphorus concentration was relatively low, with standard index values ranging from 0.83 to 1.40, indicating that the phosphorus pollution is not very serious.

Key words: Three Gorges Reservoir, water-level-fluctuating zone, organic matter, nitrogen, phosphorus.

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Challenges and solutions for assessing the impact of freshwater reservoirs on natural GHG emissions

Joel Avruch Goldenfum

IHA Central Office, Nine Sutton Court Road, Sutton, London, SM1 4SZ, UK, Professor at IPH/UFRGS (Institute of Hydraulic Research / Federal University of Rio Grande do Sul), Brazil, e-mail: j.goldenfum@gmail.com

Abstract

Results from twenty years of studies of greenhouse gas (GHG) emissions from reservoirs show the importance of GHG emissions from reservoirs at a global scale, as well as the difficulties in properly estimating their effects. Despite strong efforts to build consensus in assessing the GHG status of reservoirs, many uncertainties still remain due mainly to the lack of standard measurement techniques and standard tools for assessing net GHG exchanges from reservoirs, and limited reliable information from a sufficient variety of sources. International collaborative initiatives, such as the UNESCO/IHA GHG Research Project (GHG Status of Freshwater Reservoirs) and the IEA Hydro Annex XII Task 1 (Managing the Carbon Balance in Freshwater Reservoirs), came as responses to these challenges by aiming to improve understanding of the impact of reservoirs on natural GHG emissions through the proposal and use of standardized techniques for measuring emissions in the field and for assessing the global changes of GHG emissions resulting from the creation of reservoirs.

Key words: Net GHG assessment, impact of reservoirs, GHG emissions at a global scale, standardised field measuring techniques.

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Restoration of a seashore eroded due to dam operation through beach nourishment

Georgios K. Sylaios*, Sotiria Anastasiou, Vassilios A. Tsihrintzis

Laboratory of Ecological Engineering and Technology, Department of Environmental Engineering, School of Engineering Democritus University of Thrace;

* Corresponding author: Vas. Sofias 12, 67100 Xanthi, Greece, Tel: +30-25410-79398, e-mail: gsylaios@env.duth.gr

Abstract

Nestos River damming disrupted significantly the sedimentary equilibrium of Keramoti shoreline, intensifying the coastal erosion problem in the area. Coastal erosion, assessed through Landsat images, showed a net sediment deficit of 0.94 km² of land loss along this beach. An integrated study was undertaken aiming to detect submarine relict sand deposits available for beach nourishment, to estimate the total excavated and dry sediment volumes, to assess the post-nourishment longshore sand transport and to evaluate the related environmental implications. Results showed that available sediment volume extracted from the sandbank may range from 5×10^6 to 4.3×10^7 m³, increasing beach width from 52 to 450 m, respectively. Post-nourishment longshore sediment transport volumes could reach 1.34×10^6 m³ yr⁻¹ at the exposed eastern part of the beach, diminishing rapidly to 2.91×10^5 m³ yr⁻¹ at its sheltered part, implying that beach restoration could last up to 33 years before sand is completely lost.

Key words: river damming environmental impacts, coastal erosion, beach nourishment, side scan sonar, North Aegean Sea.

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An Ecohydrology approach to the Danube River, and the “enviroGRIDS” project

Ioan Jelev, Viorica Jelev

National Institute of Hydrology and Water Management, Spiru Haret University, Bucharest,
Romania, e-mail: ioan.jelev@hidro.ro

Abstract

The paper presents a review of research performed on the Danube River, Danube Delta and Black Sea area, carried out since 1990 by the National Institute of Hydrology and Water Management (NIHWM), Bucharest, and other institutes, and indicates how the main concepts and principles of Ecohydrology are being used and implemented. A closer view is given to the large scale research project entitled: “Building Capacity for a Black Sea Catchment Observation and Assessment System supporting sustainable Development”, known as “EnviroGRIDS”. Some of these ideas and principles of Ecohydrology were applied to the activities developed under the project. The paper gives an idea of a compatibility of the research and activities being undertaken with Ecohydrology theory and methods, and presents the way this can serve good management practices and sustainable river basin development.

Key words: principles of ecohydrology, water resources, hydrology, sustainable development, ecological reconstruction.

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Integrated planning for the resilience of urban riverine ecosystems: the Istanbul-Omerli Watershed case

Azime Tezer^{1*}, Omer Lutfi Sen², Ilke Aksehirli³, Nuket Ipek Cetin⁴,

Aliye Ceren Tan Onur⁴

¹ Urban and Regional Planning Department, Faculty of Architecture, Istanbul Technical University, Taskisla, Istanbul, Turkey

² Eurasia Institute of Earth Sciences, Istanbul Technical University, Maslak, Istanbul, Turkey

³ Landscape Architecture (PhD Candidate), Institute of Science and Technology, Istanbul Technical University, Maslak, Istanbul, Turkey

⁴ Urban and Regional Planning (PhD Candidate), Institute of Science and Technology, Istanbul Technical University, Maslak, Istanbul, Turkey

* Corresponding author: e-mail: tezera@itu.edu.tr

Abstract

Since urban areas display nonlinear and dynamic interactions within their growth patterns, a crucial question is how complex systems can be integrated into urban planning practices in relation to urban ecosystems. Natural threats and extreme weather conditions resulting from climate change will threaten social, environmental and economic assets in urban riverine ecosystems due to their cumulative vulnerabilities, especially in less developed regions. This paper will discuss an “ecosystem services based watershed management framework” to increase the resilience capacity of urban riverine systems using the case of the Omerli Watershed (Turkey), which is located in a metropolitan area characterized by rapid population growth and ecosystem change. Three research domains, i.e. ecosystem services (ESs), spatial planning and climate change (CC) mitigation, will be integrated in order to propose an analytical methodology for spatial planning of urban riverine systems. The adaptive mitigation approach is used to accommodate both mitigation and adaptation policies in its structure. The methodology used here is a part of an ongoing research effort. However, this assessment is aimed at clarifying the integration of the three research domains for use in policy development.

Key words: Climate change, ecosystem services, spatial planning, adaptive mitigation, Omerli Watershed, Istanbul.

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Application of molecular tools in Ecohydrology

Joanna Mankiewicz-Boczek

European Regional Centre of Ecohydrology u/a UNESCO, Polish Academy of Sciences,
3 Tylna, 90-364, Łódź, Poland; j.mankiewicz@erce.unesco.lodz.pl;

Department of Applied Ecology, Faculty of Biology and Environmental Protection,
University of Lodz, 12/16 Banacha, 90-237, Łódź, Poland

Abstract

This paper presents synthetic knowledge about the usefulness of molecular methods for implementation of the Ecohydrology principles as a framework for scientific investigation and problem solving associated with deteriorating quality of freshwater. Genetic markers are indispensable in the early monitoring of threats, precise analysis of the cause-effect relationships between biotic and abiotic components of environment and, consequently, in developing methods to improve water quality and enhancing ecosystem carrying capacity. All these elements provide the methodological background of Ecohydrology, and were described based on a study of the problem of water blooms dominated by toxic cyanobacteria.

Key words: gene, toxic genotype, cyanobacteria, microcystins, monitoring of threats, bacterial degradation.

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Water sustainability and the implementation of the Water Framework Directive – a European perspective

Richard Allan

Managing Director, Scottish Water Horizons, Enterprise House, Springkerse Business Park, Stirling, United Kingdom, FK7 7UF, e-mail: Richard.Allan@Scottishwater.co.uk

Abstract

Many resource demands are competing for available fresh water resources and have an impact on ecosystem sustainability. Within the European context the Water Framework Directive (WFD) is the main legislative instrument for water protection and requires member states to ensure water bodies (freshwater and coastal marine) achieve good ecological status by 2015. Member states must engage in a range of activities, including river basin management planning, to meet the aspirations of the WFD. These river basin management plans need to include objectives for each water body; reasons for not achieving the targets; and the programme of actions required to meet the goals that deliver good ecological status within a catchment. The multidisciplinary approach known as Ecohydrology supports this by promoting regulation of fundamental ecological processes. This paper illustrates how WFD and river basin management planning principles are applied using Scotland as the example.

Key words: Catchment management, sustainability, river basin management planning, Water Framework Directive.

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