

Why we need to know more about the relationships between flood regimes and the responses of nature and natural processes

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Abstract

This paper introduces the concept of combining a more spatial and natural way of coping with flooding incidents in and along the European river system with possibilities for restoring conservation values. The restoration of original floodplain functions could considerably increase flood control and thereby alleviate unwanted inundations of other areas within the same catchment basin. Restoration of biodiversity values lost over centuries of ever-increasing human land use and river control would seem an evident by-product. However, as this paper argues, since man restricted river dynamics to narrow, embanked winter beds, land use and landscape design have been intensified so much, that simple reversion of river access to former floodplains may not always be a key to successful ecological restoration, even when international EU laws are actually supporting such actions. Moreover, the presence of source populations of rare and relatively immobile species of plant and animal has often become so restricted that re-colonisation will be difficult or even impossible. In fact, it is argued that a sound restoration of original natural riverine processes and corresponding biodiversity on local, regional (catchment) and continental scale levels is only likely to be achieved through careful studies of the local particularities of each case and taking into account existing conservation values as well as potentials.

Keywords: Flooding, EU policies, water management, ecological rehabilitation, research needs

Plant communities response to floodwater conditions in Ławki Marsh in the River Biebrza Lower Basin, Poland

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Abstract

The aim of the study is to establish whether sites in the lower basin of the Biebrza valley are registering change in moisture content and whether the process is related to flood events. Analysis of water level readouts from the 50 years period from the water-level gauge at Burzyn did not indicate the reduction of river flooding. The vegetation change observed over the last 35 years suggests an increase in the amplitude of water level fluctuation with a tendency of the water level to drop lower during the dry period. The most probable cause of this phenomenon must be the reduction of amount of water feeding the central and marginal section of the valley.

Key words: floods, wetlands, fresh marsh vegetation

Influence of macrophytes on river water levels and flood dynamics in the Upper Eider river valley a riparian wetland in Northern Germany

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Abstract

In this study, the effect of macrophyte growth and management on water level and flood dynamics is quantified for a lowland riparian wetland in Northern Germany to improve knowledge on the restoration of a natural flow pattern. According to ten year water level data and one year discharge measurements, river water levels are controlled by an increasing hydraulic resistance of the macrophyte vegetation during summer and by the physical features of the river channel during winter season. Flooding of the wetland occurs under both conditions. Mowing of in-stream vegetation in summer leads to a decrease in the river water levels by 0.5 to 0.8 m within a few days. Ceasing macrophyte management is a low cost technique for restoring a natural flow pattern in lowland rivers. The effects of this method are limited temporally to the late summer months. Flood area calculations prove that ceasing macrophyte management will not raise the spatial extent of the flooded area above the water levels reached in winter. It can be concluded that ceasing macrophyte management reduces human control in riparian ecosystems, but the rewetting effects in the adjacent peatland are spatially limited by (human induced) physical changes of the river bed and wetland morphology.

Key words: connectivity, ecohydrology, hydraulic resistance, river restoration, *Sparganium emersum*

Recovery of alluvial meadows after an extreme summer flood: a case study

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Abstract

Recovery of alluvial meadows after one of the highest floods in history (1997) was studied for six years in the floodplain of the Morava River, in the southeastern part of the Czech Republic, central Europe. Above-ground vegetation did not survive the flood, but 23 species, i.e. 20% of all species (117) recorded during the study, regenerated from underground organs shortly after the flood. Other species established later from the seed bank. Various ruderal species were typical for the first 4 years, but, gradually, typical meadow species largely prevailed. The total number of species increased during the first 4 years, then decreased slightly as some ruderals disappeared from the recovering meadows. Recovery of the meadows seemed to be nearly completed after 6 years, especially in lower elevations, indicating rather good adaptation of the studied alluvial meadows to flooding. Both direct vegetative regeneration of resident species and secondary succession contributed to vegetation development.

Key words

Flooding, Secondary succession, Species number, Vegetation change, Vegetative regeneration

The use of reference areas in the conservation and restoration of riverine wetlands

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Abstract

Reference areas are relatively undisturbed areas where (near-)natural processes can be studied in the absence of significant human interventions. Comparison of reference areas with disturbed areas to be restored may be useful in conservation and restoration for a variety of reasons. A comparison may help to discover the relationship between natural key processes and ecosystem functioning; to estimate the degree of degradation of areas to be restored; to set targets for nature conservation; to define environmental conditions necessary for (re) establishment of target species and communities and to design restoration measures in restoration projects. There are, however, problems to overcome such as (in) compatibility in climate, geology, geomorphology, hydrology, ecosystems, species tolerances and the spatial scales of the landscape components. Knowledge from reference areas does not unambiguously tell the potential degree of recovery of disturbed and stressed ecosystems, since recovery does not necessarily follow the same path as deterioration and also the rate of recovery may differ. Re-establishment of the desired species or crucial species for ecosystem functioning may be hampered if they are absent from the actual species pool. In this paper the opportunities and constraints that arise from the use of knowledge obtained from reference areas in nature conservation and restoration is reviewed and critically discussed. Special emphasis is put on riverine wetlands.

Key words: Biebrza, degradation, ecosystems, natural processes, recovery, species, stress.

Competition and succession affecting vegetation structure in riparian environments: implications for nature management

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Abstract

Most of open riparian wetlands used to exist for centuries under a low-intensity mowing management. A decline of this management over several past decades is believed to be the main cause of a rapid vegetation succession observed in wetlands throughout Europe often leading to a decrease of biodiversity. We demonstrate the rate and extent of vegetation succession in case study areas in the Biebrza and Narew valleys (NE Poland) and discuss ecological mechanisms responsible for this process. Data from aerial photographs prove a high rate of scrub encroachment from the valley flanks and expansion of reed communities from the riverside. Particularly endangered by these processes are species-rich sedge-moss fens, which may also evolve towards tall sedge communities. We demonstrate how this phenomenon can be explained by community-level mechanisms, with special reference to results of competition studies in fens. We conclude that maintenance of traditional management is crucial for preserving natural values of riparian landscapes with semi-natural wetland communities. Referring to the idea of using riparian wetlands for ecological flood control, we suggest that vegetation management should become an integral part of such approach, not only to maintain the biodiversity but also to optimise the water retention capacity.

Key words: wetland management; floodplains; plant communities; spatial analysis.

Nutrient mobilisation and losses related to water conservation in peatlands

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Abstract

Nutrient concentrations of in groundwater samples at different groundwater level were analysed in peatlands of the Biebrza National Park and its vicinity. The relatively prompt lowering of groundwater level during summer time was accompanied by the increase of phosphate and ammonium concentrations, sometimes to the quantity seldom observed in these waters. The decrease of groundwater level was a prerequisite for the occurrence of higher concentrations of both compounds, though the low level of groundwater was not a sufficient condition. The mineralisation of peat organic matter stimulated by prompt lowering of groundwater level favours the production of ammonium at the cost of nitrate. Nevertheless, the elevated concentrations of phosphate and ammonium in groundwater occurred during the summer months, when the outflow of water from peatland was occasionally likely.

Keywords: phosphorus, ammonium, peat soil, groundwater, groundwater level, pollution

Phosphorus and Nitrogen cycling in fen vegetation along different trophic conditions in the Biebrza valley, Poland

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Abstract

The nutrient cycles between of three vegetation types along a trophic gradient were compared: a nutrient-poor fen fed by groundwater discharge (*Caricetum limoso-diandrae*), a transitional fen fed by rainwater (*Betulum humulis*), and a nutrient-rich fen in occasionally flooded area (*Caricetum cespitosae*). The calcium in groundwater plays a conditioning role by keeping phosphate availability low. Vegetation growth was limited by phosphorus in the nutrient-poor and transitional fen, while in the occasionally flooded areas, the *Caricetum cespitosae* vegetation was limited by nitrogen. Mean residence time (MRT) of phosphorus and phosphorus use efficiency were higher in *C. limoso-diandrae*. This could be a beneficial strategy to maintain high biodiversity in the low-phosphorus availability fen. In the occasionally flooded areas, *C. cespitosa* dominated the vegetation and showed higher rate nutrient cycling, both in above and below ground biomass.

The significance of the findings for vegetation management at the Biebrza is discussed as well as the usefulness of studying nutrient dynamics at the Biebrza as a reference for nature restoration.

Key words: Nutrient cycling, nutrient mean residence time, fens, flooding, eutrophication.

Response of riparian vegetation to the decrease of flooding: Narwiański National Park, Poland

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Abstract

The section of the upper Narew River valley protected as Narwiański National Park is known for a unique system of anastomosing riverbeds, which supports extensive area of wetlands. The frequency and duration of floods have changed in the last decade due to alteration of the hydrological regime. The distribution of plant communities and soils in 1970s and 2003 has been compared on the background of hydrological conditions monitored over 30 years.

A comparison of vegetation data showed that the area of tufted sedge communities *Caricetum elatae*, which used to be the dominant vegetation type in the park, decreased drastically. At the same time we observed an expansion of *Caricetum gracilis* and an invasion of *Phragmites australis*. The hydrological and soil investigations revealed a significant lowering of the groundwater level during the growing season in the last decade, which is mainly due to the decreased duration of floods. This resulted in the desiccation of peat soils. Our results show that even within the range of hydrological conditions supporting wetland communities, some changes can largely affect species composition and conservational values.

Key words: national park, plant communities, hydrogenic soils, groundwaters, floods.

Could ecological flood defences be used as functional stepping-stones along migration routes of wetland birds? A theoretical approach

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Abstract

Severe floods along European rivers over the last decade have caused the reduction of natural floodplains to be perceived as a risk for human land use. Over the past centuries, most river systems have become heavily modified in their natural course. Intensive land use and the protection against flooding have immensely reduced the original floodplain areas. Peak river discharges now lead to much higher water levels within the embankments, threatening their resistance and posing serious risks to human interests in former floodplain areas. Sustainable solutions are being sought in allowing once again seasonal flooding of former floodplains to take off the risks from more intensively used areas. For many migratory wetland bird species, the larger European river catchments traditionally mark their migration routes. During these migrations, birds rely on the presence of regular stopover sites to rest and refuel, before reassuming their trip. These flyways have been shaped evolutionally by changes in climate and landscape over the geological time scale. Man-induced changes upon the landscape (canalising river systems, reducing floodplains, reclaiming and cultivating wetlands) are, therefore, likely to influence these flyways as well. This paper focuses on the perspectives of rehabilitation of floodplains in also restoring the ecological coherence of wetland systems on a European scale, with respect to the relevant parameters for migratory wetland and water birds. It is argued that the existing network of wetlands throughout Europe could be enhanced significantly by ecological rehabilitation of floodplains. 'New' wetlands along the main migration routes would contribute to a broader choice of potential stopover sites for migratory wetland birds and thus enhance their survival chances.

Keywords: risk reduction, floodplain restoration, migratory flyways, wetland birds

The impact of flooding regime on ecosystems in a tidal freshwater area

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Abstract

The theory that flood events will affect ecological relations as a dominating pulse was tested in a tidal area in the lower parts of the river Rhine, where natural fluctuation in fresh water level shows an amplitude of one metre twice a day. A distinct zonation was found in the vegetation, explained by the different elevations of the plots according to the mean high tide level. This zonation was also shown by the soil fauna, but here further succession towards the development of an organic layer appeared to be a second dominating factor. Evaluation of the data reveals firstly, that the flooding zone harbours characteristic species while many common species are avoiding this zone, thus lowered potential competition is found. Secondly, that the specific natural values might be well-adapted to coping with regular periodic flooding as a dominating ecological factor. Thirdly, natural flooding periods will stimulate a tidal ecosystem with differential elevations, and will contribute significantly to the original biodiversity.

Key words: tidal freshwater ecosystem, vegetation, ground-dwelling fauna, flooding frequency