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Special Issue of *Hydrological Processes* Wetland Hydrology and Eco-Hydrology

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This special issue contains ten contributions that were originally presented† at the international symposium 'Changing Wetlands' held in Sheffield, UK, between 11 and 13 September 2001, and organized by the Sheffield Wetlands Research Centre (SWeRC) with sponsorship from the British Ecological Society and the Society of Wetland Scientists. The focus of the symposium as a whole was on environmental changes in wetland ecosystems and on opportunities for restoration of wetland systems in terms of their total area and of their floristic and faunal quality. It was clear from many of the papers given at the conference that hydrological processes represent a fundamental component of virtually all wetland ecosystems (the links between hydrology and ecology within wetlands have been discussed elsewhere, e.g. see Wheeler (1999)). Thus, it was thought appropriate to invite authors of some of the more interesting hydrological papers to submit their work for consideration for publication in a special issue of *Hydrological Processes*.

In the end, ten papers were accepted for publication following peer review. These have been grouped into four broad themes. The first three papers deal with losses of water from wetlands to the atmosphere. Atmospheric losses are often the largest component of water loss in the wetland water budget; yet, characterization of this key loss and elucidation of the effect of wetland vegetation on rates of loss remain problematic. The first paper, by Moro, Domingo and Lopez, describes the novel application of the stem heat-balance method for measuring sap flow, and, therefore, transpiration, from reeds (*Phragmites* spp.) in a semi-arid wetland. To the editors' knowledge this is the first time that such a method has been applied in a wetland. The research reveals the very high rates of transpiration that are possible in isolated wetlands in a semi-arid setting, where the advection of heat and dry air from surrounding dry land enhances rates of water loss. The papers by Gavin and Agnew and by Peacock and Hess consider how well-established methods of measuring and modelling evaporation and evapotranspiration can be applied to wetlands. Although the methods discussed have been applied widely in non-wetland environments, their use in wetlands has been less routine. The papers provide detailed information on how the Bowen ratio energy balance method and the Penman–Monteith and the Taylor–Priestley models can be applied to wet grasslands and reed beds.

Three papers look at groundwater flow in wetlands. The papers by Clymo and by Baird, Surridge and Money look at the measurement of hydraulic conductivity K of peat soils. Clymo finds that hydraulic properties of a raised bog in southwest Scotland contrast strongly with those reported for a raised bog in Minnesota (Chason and Siegel, 1986), and do not fit the assumptions of Ingram's (1982) widely used groundwater mound model of raised bog growth/shape. Clymo's work clearly suggests a need to consider how hydraulic properties vary between raised bogs in different climatic environments and also to re-evaluate Ingram's standard model. Baird, Surridge and Money use the Piezometer method to measure the K of fen rootmat/peat deposits. They find

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† Two papers not presented at the conference were also solicited and appear in the special issue (Clymo, and Price and Whitehead).

that the piezometer method is useful but that attention must be given to how the test is conducted and how the data from such tests are analysed. It is possible using so-called textbook procedures to obtain significant underestimates of the 'true' K of a medium. They also find that the K of rootmats can be very high (at the top end of the range for peat soils) and comment on the significance of such results for water exchange between wetland sediments and adjacent bodies of open water. Although it reports field data, the paper by Crowe, Shikaze and Ptacek has a modelling focus. The authors apply a finite-element groundwater and contaminant transport model to a barrier bar dividing Lake Erie from a wetland consisting of shallow ponds and stands of *Typha* spp. They demonstrate the usefulness of the modelling approach for applied research (one focus of their study involves modelling contaminant transport from septic systems to the wetland) and comment on its potential for 'pure' research such as considering the effect of climate change on the hydrological behaviour of a wetland.

The final four papers deal with various aspects of the restoration and management of wetlands. Price and Whitehead discuss the effect of past and present hydrological conditions on the establishment and spread of *Sphagnum* mosses on cutover raised mirc surfaces. They find that *Sphagnum* more readily colonises a peat surface when the capillary fringe extends to the surface for most of the growing season. In places where surface peat is covered in an ericaceous shrub litter, the capillary fringe is prevented from reaching the surface and *Sphagnum* colonisation is inhibited. Where *Sphagnum* does become established, it seems it can, in part, 'regulate' its own water supply. Peat beneath *Sphagnum* cushions was found to be wetter than that under nearby bare areas. This enhanced wetness may allow *Sphagnum* cushions to spread laterally. The paper by Barber, Leeds-Harrison, Lawson and Gowing looks at the relationship between water-table position and air-filled porosity in a drained fen that is now managed as a wet grassland. The rationale for the study is the concern of managers to maintain redox and aeration status in near-surface peat in a condition suitable for the establishment and growth of flowering plants 'typical' of traditionally managed wet meadows. The authors find that, while there are good relationships between air-filled porosity and water-table position, the relationship between redox potential and water-table position is less secure.

The final two papers deal with hydro-chemical management. White, Reddy and Moustafa use an experimental approach to investigate the effect of hydrological regime on the phosphorus removal capacity of constructed wetlands set up to mimic stormwater treatment areas (STAs) in the Florida (USA) Everglades. The STAs are used to remove phosphorus from water entering the Everglades area. The authors find that the amount of phosphorus removed by the constructed wetlands depends on hydrological regime. In wetlands which are permanently flooded, removal is more effective than in wetlands where drawdown is allowed to occur. The paper by Trepel and Kluge describes a novel approach to modelling water and nitrogen exchange in riparian peatlands. Their matrix model consists of two input vectors, two transformation matrices and three result vectors. Although the model is in the early stages of development, it offers a potentially simple and robust tool for assessing water and nitrogen exchange in riparian wetlands, both for wetland research and management.

We hope the papers in the special issue give a flavour of the breadth as well as the depth of current research in wetland hydrology, and that that they give a good indication of the important linkages between hydrological and ecological processes in wetlands. Clearly, many questions in wetland hydrology remain unanswered and we hope this contribution will encourage hydrologists from all disciplines to contribute to the ongoing study of these globally important ecosystems.

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