Quebec 2000: Millennium Wetland Event
Quebec, Canada
August 6-12, 2000

The effects of decreasing water levels on the hydrodynamics of shallow wetlands

C.E. Oldham, B. Hodges, and E. Gale
Centre for Water Research, University of Western Australia, Nedlands, Australia

Abstract

The current paradigm in wetland ecology is that shallow systems are fully mixed, at least vertically. However, detailed measurements of stratification in coloured wetlands show that they can be stratified for several days at a time. These timescales of stratification will in turn have a profound impact on the wetland ecology. This study aimed to test the ability of hydrodynamics models, originally developed for deep lakes, to predict the hydrodynamics of shallow systems. The stratification in a shallow wetland is strongly influenced by the effects of the margins; areas which have small impact on the overall hydrodynamics and stratification of lakes. Thus, the relatively coarse treatment of margins in existing models impedes their direct application to wetlands. The lake models, 3D-ELCOM and 1D-DYRESM, were transformed for use in wetlands, then used to investigate the effect of changing water levels on wetland stratification cycles and hydrodynamics. In particular, we investigated the interactions between water level and colour in determining those stratification timescales. We also found that we were able to predict the increase in the degree and duration of stratification as water colour intensified.

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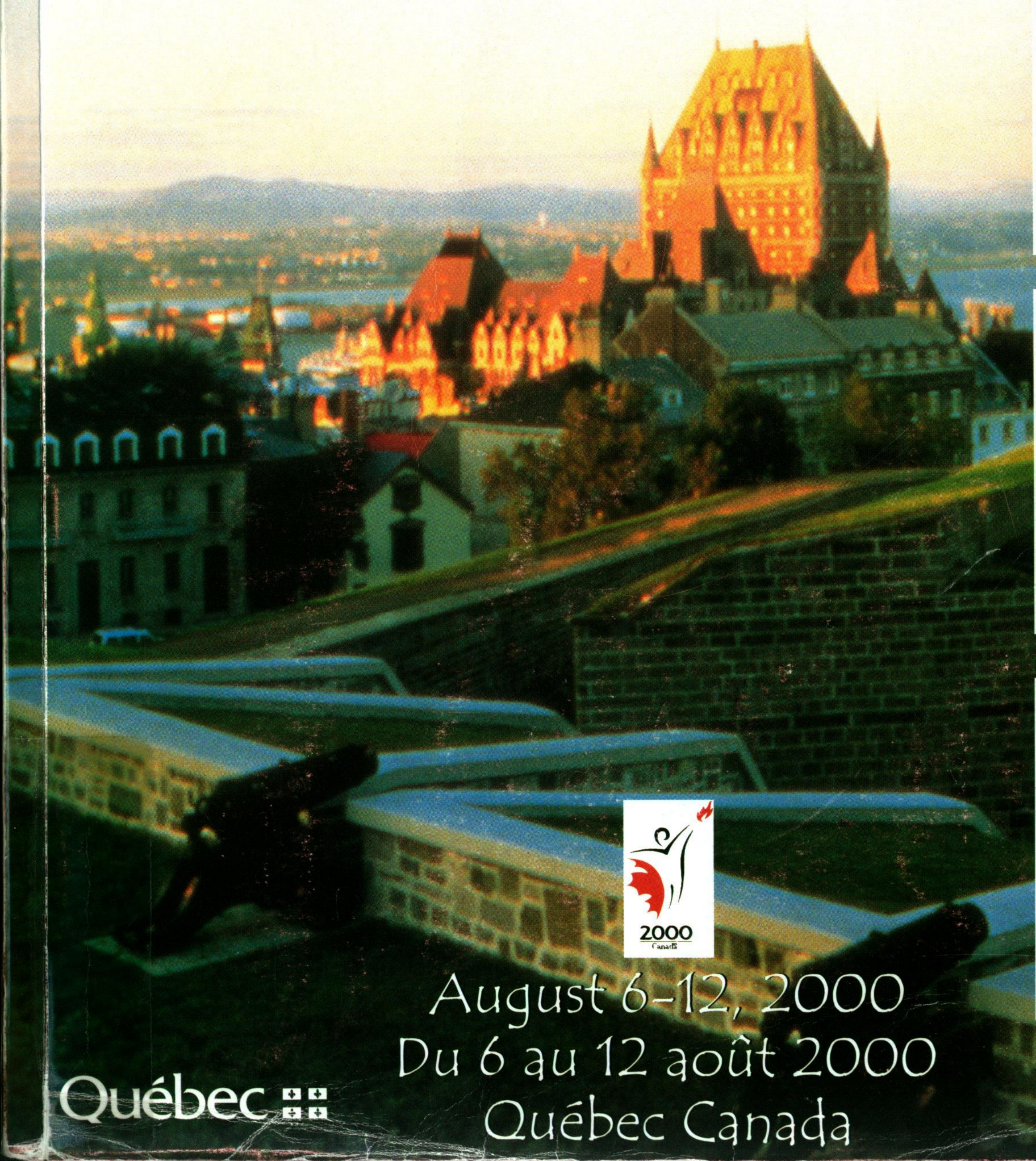

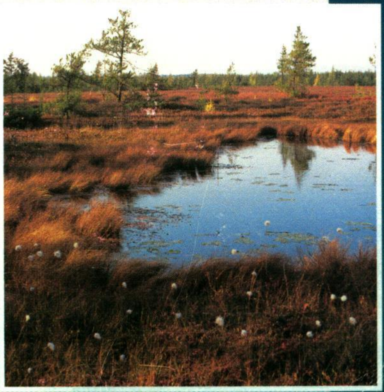

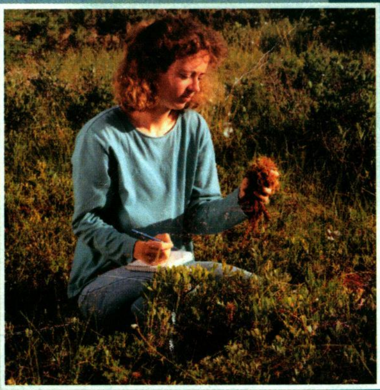

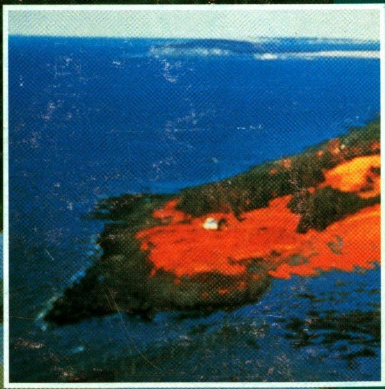

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August 6-12, 2000
Du 6 au 12 août 2000
Québec Canada

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Québec 2000: Millennium Wetland Event / Québec 2000 : Événement du millénaire sur les terres humides

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INTECOL INVITED PAPERS SYMPOSIUM 48 (PART 1)

Thursday August 10 **Room 206A**

Predicting Wetland Response to Changing Water Quantity and Quality

Chair : Dr. Carolyn Oldham
Lecturer in Contaminant Dynamics, Centre for Water Research, Department of Environmental Engineering, University of Western Australia 6907, Australia

8:30 The effects of wetland structure on water quality and water quality on wetland structure : experiments with freshwater marshes

W. Mitsch
School of Natural Resources, The Ohio State University, 2021 Coffey Road, Columbus, Ohio 43210, USA.

Experimental marshes at the Olentangy River Wetland Research Park are used for a whole-ecosystem (2-ha), long-term (20-yr) experiment to investigate theories of self-design and ecosystem development of open systems. Two identical 1-ha wetland basins were constructed in 1993-94. One wetland basin was planted with 2400 individuals representing 12 species of wetland plants while the other was not planted. Hypotheses on self-design and effects of ecosystem structure on water quality function and water quality effects on ecosystem structure are being tested by measuring 18 indicators of ecosystem function, 9 of which are related to water quality. Early results published after 3 years of experiment suggested a short period of functional divergence followed by functional convergence. New results after 6 growing seasons suggest that much more time is needed to determine the ultimate effect of planting in the first year on ecosystem structure and to investigate the role of structure on ecosystem function. As well, the water quality changes may be feeding back to influence wetland structure.

9:00 Predicting coastal wetland processes : hydrologic processes and soils

E. Turner
Coastal Ecology Institute, Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, Louisiana 70803, USA.

Salt marsh stability and change can be constructively viewed from the bottom-up as the result of an interactive and chaotic system of above- and below-ground dynamics. The friction from the rooted aboveground canopy creates physical conditions allowing for higher particle settling rates. The vegetative surface also results in temporary, but significant, surficial accumulations during flooding, and detrital residues may accumulate if turnover is sufficiently reduced. The resulting net soil accretion may compensate for the relative change in water level arising from global sea level rise, soil compaction and shrinkage, and from organic oxidation belowground. However, the inorganic accumulations on the soil surface are hardly as significant as the under-appreciated belowground accumulations that build and sustain salt marshes below ground. Salt marsh soil bulk density is strictly defined by inorganic density, but soil accretion in is well-defined by the organic accumulations of roots and rhizomes extending up to 1 m below ground. These results imply that we might view the horizontal distribution of salt marshes as a consequence of physical restrictions at the seaward margins, and of plant competition landward. The ecological conditions allowing for salt marsh maintenance should, therefore, be distinguished from conditions prevalent during their creation. Wetland hydrologists working with botanists and soil ecologists may provide the answers to key questions about wetland stability, whose resolution is necessary to move beyond the presently empirically-defined hit-or-miss restoration efforts and mitigation evaluations.

9:30 Managing wetland responses to environmental change : the role of conceptual models

P. Horwitz[1], J. Davis[2], A. McComb[2] and R. Froend[1]
[1]Centre for Ecosystem Management, Edith Cowan University, 100 Joondalup Drive, Joondalup, Western Australia, 6027. [2]School of Environmental Science, Murdoch University, South Street, Murdoch, Western Australia, 6027.

Environmental change affects wetland water balance and trophic relations. Management agencies aim to manage effects of change across a range of wetland types in different climatic zones and geological settings. How might an agency cope when there may be few quantitative data, and no numerical models to guide management? One possibility is to develop conceptual models for selected wetland types of high management priority and use these models to highlight key processes. Scenario setting and sensitivity analyses can then define wetland responses and help set targets for management intervention. This approach will be discussed using the wetlands of Western Australia as a 'case study'. This vast, single political unit of 2.5 million square km sprawls over 21 degrees of latitude, has a climate from tropical in the north to Mediterranean in the south west, is dominated by a large area of low rainfall, and has a corresponding diversity of wetlands. Conceptual models have been developed for a salt lake, a sedge-dominated fen, a tropical lagoon, and an urban wetland. Reasons are given for their selection, and conceptual models for wetland response presented to demonstrate potential points of management intervention and the role of such models in decision-making.

10:30 The effects of decreasing water levels on the hydrodynamics of shallow wetlands

C.E. Oldham[1], B. Hodges[1] and E. Gale[1]
[1]Centre for Water Research, University of Western Australia, Nedlands, Western Australia, Australia, 6907.

The current paradigm in wetland ecology is that shallow systems are fully mixed, at least vertically. However detailed measurements of stratification in coloured wetlands show that they can be stratified for several days at a time. These timescales of stratification will in turn have a profound impact on the wetland ecology. This study aimed to test the ability of hydrodynamic models, originally developed for deep lakes, to predict the hydrodynamics of shallow systems. The stratification in a shallow wetland is strongly influenced by the effects of the margins; areas which have small impact on the overall hydrodynamics and stratification of lakes. Thus, the relatively coarse treatment of margins in existing models impedes their direct application to wetlands. The lake

models, 3D-ELCOM and 1D-DYRESM, were transformed for use in wetlands, then used to investigate the effect of changing water levels on wetland stratification cycles and hydrodynamics. In particular, we investigated the interactions between water level and colour in determining those stratification timescales. We also found that we were able to predict the increase in the degree and duration of stratification as water colour intensified.

11:00 Deep lakes and shallow wetlands : commonalities and differences in aquatic ecological models

B.J. Robson[1], D.P. Hamilton[1], J.A. Davis[1], R.H. Froend[1], P. Horowitz[1] and C.E. Oldham[1]
[1]Centre for Water Research, University of Western Australia, Nedlands, Western Australia 6907, Australia.

In this paper, the effect of lake depth on key system behaviours, including the timing and magnitude of algal blooms, is characterised. In light of this, requirements for ecological models for deep and shallow lakes are compared. A detailed three-dimensional ecological model, ELCOM-CAEDYM, is applied to idealised lakes of four different depths under otherwise identical conditions. Sensitivity of the model to key parameters is found to vary with lake depth, reflecting differences in the significance of certain processes in deep and shallow lakes. The results are used to determine which parameters and processes may be expected to be more important in modelling wetlands in each category, allowing monitoring and calibration effort to be focussed appropriately.

11:30 Discussion

SWS INVITED PAPERS SYMPOSIUM 49

Thursday August 10 **Room 2000C**

Neotropical Wetlands : Building Links Among Wetland Scientists / Humedales Neotropicales: estableciendo lazos entre los científicos de humedales

Chair : Dr. Eduardo M. da Silva
Instituto de Biologia da UFBA, Campus de Ondina, 40210-170 Salvador – BA, Brazil.

Co-chair : Dr. Johan F. Gottgens
Department of Biology, College of Arts Sciences, University of Toledo, Toledo, Ohio 43606-3390, USA.

Co-chair : Dr. Ronald Fortney
Department of Bioscience, 223 W. Main Street, Salem-Teikyo University, Salen, West Virginia 26426, USA.

8:30 Pantanal wetland : features and conservation

A. Pott[1] and V.J. Pott[1]
[1]Embrapa Pantanal, Caixa postal 109, Corumbá, MS 79320-900, Brazil.

The Pantanal is one of the largest wetlands, 140,000 km^2, in Central West Brazil. It is a sedimentary floodplain influenced by 280,000 km^2 of higher watershed. Annual rainfall is 1,000-1,400 mm, very seasonal. There are two main types of mosaic landscapes, according to flood origin : 1) river flood (1-5 m), on clayey eutrophic soils, vegetation being gallery forests, pioneer forests and scrub, *Tabebuia* and *Copernicia* parks, seasonal swamps and oxbow lakes; 2) rain flood (10-80 cm), mainly on dystrophic sandy soils (72%) with savanna ("cerrado") grasslands and woodlands, with or without ponds (a few are brackish). Grazing during 200 years of cattle ranching apparently did not cause major changes in the vegetation, except turning tall grass into short swards, as the domestic herd found a nearly empty niche, by scarcity of large native herbivores. However, severe threats originate outside, mainly on the sandy highlands, due to erosion, causing river siltation and consequently changes in hydrology (wet-and-dry to wet), fauna and flora, e.g., killing riparian forest.

9:00 Status of knowledge, ongoing research, and research needs in Amazonian floodplains

W.J. Junk
Max-Planck-Institute for Limnology, Tropical Ecology, P.O. Box 165, 24302 Plön, Germany.

Since the discovery of the Amazon River the vast floodplains called for attention to scientists. However, only after the second world war detailed limnological studies began. In the beginning, centers of research were Belém and Manaus. In recent times, Santarém and Tefé became increasingly important. Since the seventees, studies were stimulated by various bilateral and multilateral cooperation projects. The establishment of post-graduate courses at several local universities improved the teaching and increased the number of local scientists. Today, research concentrates on general limnology, fish and fishery, aquatic mammals and reptiles, terrestrial invertebrates, herbaceous plants and floodplain forests, agriculture and socio-economic aspects of the rural population. There is an increasing need in studies related to sustainable use of renewable resources and environmental protection. This requires a better understanding of structure and function of the river-floodplain ecosystem, its role in the biogeochemical cycle of the whole catchment area, mechanisms to create and maintain biodiversity, the dynamic of human impact, and management alternatives. Application of remote sensing techniques is needed for upscaling local studies about the impact of the flood regime, vegetation cover, human activities, and their changes in time to model scenarios for future development.

9:30 Instruments and alternative approaches in the monitoring and management of Neotropical wetlands

S. Loiselle[1] and C. Rossi[1]
[1]Department of Chemical and Biosystems Sciences, University of Siena, Pian dei Mantellini 44, 53100 Siena, Italy.

The management of the utilisation of natural resources from wetland ecosystems is a multiobjective task. Often times, management approaches are dominated by a single discipline and the local context is not fully considered. This is particularly true in neotropical wetlands, often found in remote underdeveloped areas. The creation of innovative decision making tools for à sustainable wetland resouces utilisation is an important challenge for the future. This is crucial in the light of the growing shortages for high quality