PREFACE

Ecology is the study of the interrelationships between organisms and their environment, including the biotic and abiotic components. There are at least six kinds of ecology: ecosystem, physiological, behavioral, population, and community. Specific topics include: Acid Deposition, Acid Rain Revisited, Biodiversity, Biocomplexity, Carbon Sequestration in Soils, Coral Reefs, Ecosystem Services, Environmental Justice, Fire Ecology, Floods, Global Climate Change, Hypoxia, and Invasion. This new book presents new research on ecology from around the world.

From the beginning of the 20th century to the 1970s water management in Portugal was essentially regarded as a non-integrated activity. Various hydraulics projects were undertaken whose main objective was to make an inventory of works that were required to develop specific economic sectors. In that context, the energy and agricultural sectors were considered the most relevant. Schemes were developed within a water policy that set hydraulic works above environmental concerns; this is just one of the things discussed in Chapter 1.

Chapter 2 aims to give a synthesized yet comprehensive account of the main trends and approaches on monitoring ecological indicators for river research and management, and to show the importance of the links between society's values and environmental water quality. Human pressure on freshwater ecosystems has increased along with a greater awareness of environmental quality concepts like river health and ecosystem integrity. Several industrialized countries have already integrated these concepts in recent water quality guidelines, giving more emphasis on studying and regenerating biotic communities. Such is the case of the European Water Framework Directive or the Environmental Monitoring and Assessment Program of the U.S. Environmental Protection Agency

In response to a perceived decline in the quality of aquatic resources and associated changes in public policy, a great deal of recent ecological research has investigated the feasibility of restoring aquatic ecosystems. In 1992, the National Research Council (NRC) on Aquatic Ecosystem Restoration called for a more systematic and holistic approach to aquatic restoration that addresses not only structural aspects of morphology and hydrology but also attributes of ecosystem function. In this chapter the authors review the status of lake, river, and wetland restoration since the NRC recommendations. In particular, the authors focus on the restoration of trophic functionality in these three ecosystems and the degree to which it has been achieved by structural modification and by biomanipulation. Trophic restoration of lakes, while typically featuring the reduction of external and internal nutrient loads, has successfully incorporated biomanipulation of fish populations to manage phytoplankton

through trophic cascade. River and wetland restoration efforts have included trophic function to a lesser degree. In these ecosystems, hydrologic regime and landscape connectivity have necessarily been given far more attention according to Chapter 3.

A described in Chapter 4, developed catchments riparian wetlands can intercept runoff and potentially act as buffer zones protecting downstream waterways from excess N enrichment. However, understanding of the processes involved in N transformation and the sustainability of the N removal function are far from complete. Due to its low natural abundance the stable isotope of nitrogen (^{15}N) can be used as a tracer to investigate N transformation processes in ecological systems. In separate laboratory experiments the authors investigated the fate of $^{15}NH_4^+$ in lake-edge wetland microcosms inhabited by *Salix cinerea* (grey willow) and *Typha orientalis* (raupo) plants and the fate of $^{15}NO_3^-$ in stream-side wetland microcosms inhabited by *Glyceria declinata* (glaucous sweetgrass) relative to unplanted microcosms. The authors found that *Salix* and *Typha* plants readily assimilated NH_4^+ (9-11% of applied $^{15}NH_4^+$), enhanced the natural diffusion of $^{15}NH_4^+$ up through organic soil into the overlying water (by 7 to 18-fold) and, via litterfall, provided a flocculent substrate for sequential mineralisation-nitrification-dentrification processes in the overlying water layer.

Long-term changes in net ecosystem metabolism (NEM) and net denitrification (ND) in the Ohta River estuary of northern Hiroshima Bay were analyzed based on the phosphorus (P) and nitrogen (N) budgets, using the method recommended by the Land-Ocean Interaction in the Coastal Zone (LOICZ) Working Group. From 1987 to 1997, data were collected as part of several monitoring programs conducted by governmental organizations. The NEM of the estuary was calculated to be 0.52 g C m^{-2} day^{-1} on average, with a positive average value in the upper layer (0.71 g C m^{-2} day^{-1}) and a negative average value in the lower layer (-0.20 g C m^{-2} day^{-1}), thus indicating production in the upper layer and active decomposition in the lower layer. The ND was calculated to be -90 and 72 mg N m^{-2} day^{-1} for the upper layer and lower layer, respectively, suggesting that nitrogen fixation was occurring in the upper layer while denitrification dominated the lower layer, perhaps in the surficial sediments as discussed in Chapter 5.

The objective of chapter 6 is to review current knowledge of the design of horizontal subsurface flow constructed wetlands planted with common reed when constructed to reach secondary treatment. Observations included in that paper are based on our own previous studies and those to be found in the literature. TSS removal in these systems is usually high and effluents have concentrations lower than 35 mg/L. To avoid clogging and ensure effluent quality the surface TSS loading rate should be lower than 20 g TSS/m^2.d. BOD_5 removal is highly dependent on the surface organic loading rate, which should be lower than 4-6 g BOD_5/m^2.d to reliably obtain effluents with a concentration of less than 25-30 mg/L. Nutrient removal is not significant (10 to 40%) when the systems are designed for secondary treatment. Microbial removal ranges from 2 to 4 log-units for faecal bacteria and 1 to 3 for faecal viruses. Further discussed in Chapter 6 are the improvements to both nutrient and microbial removal require additional steps beyond those provided by an unique horizontal subsurface flow constructed wetlands.

In Spain, very little interest has been shown in gaining knowledge of the purifying potential of aquatic macrophytes and testing their adequacy and viability as opposed to the conventional systems of urban sewage treatment. This has not been the case in the United States and various European countries, where this issue has received special attention since

over ten years. According to Chapter 7 the treatment pilot systems are located in the Experimental Low Cost Wastewater Treatment Station of León (NW Spain).

In Chapter 8 the two principal forms of logic that can be used as a basis for spatial modelling are Boolean and fuzzy logic. This paper documents research investigating the use of fuzzy logic modelling to predict the distribution of dryland secondary salinity. In considering the modelling of salinity, classical set theory would demand that all areas be classified as being saline or non-saline. Fuzzy logic allows for this unrealistic division to be removed, modelling the uncertainty of the boundary between these regions and the measurements on which they are based by allowing degrees of membership to classes, that better reflect the natural variation of soil properties. To this end, an existing approach for predicting the distribution of salinity, Fuzzy Landscape Analysis GIS (FLAG), developed by Roberts *et al.* (1997) is implemented. An attempt is made to optimize the predictive power of FLAG through the inclusion of geological and remote sensing data. FLAG models salinity distribution within the framework of fuzzy logic. Results from this investigation are compared with the outputs of a predictive model of salinity based on probability theory and Boolean logic.