

Preface

Water underpins all life on Earth, and in particular, hydrology and water chemistry play a signature role in maintaining the structure and function of freshwater ecosystems. Despite the manifest importance of freshwater, and the human dependence on healthy freshwater ecosystems, wetlands have continued to be degraded, polluted, and drained, and freshwater species have declined at an alarming rate—for example, the well-documented decline of global amphibians. This book aims to provide a comprehensive and concise synthesis of the vast literature on the techniques used in freshwater ecology and conservation that is currently dispersed globally in manuals, toolkits, journals, handbooks, 'grey' literature, and websites. It should be regarded as a 'book of books', and it is on this basis that the late Brian Moss encouraged me to carry out the project. The book is intended to provide a thorough understanding of different approaches and techniques needed for successful research, management, and conservation of freshwater ecosystems. Freshwater conservationists and practitioners often need to understand hydrochemical storages and fluxes in wetlands, the physical processes influencing freshwaters at the catchment and landscape scale, and the hydrochemical processes that maintain species assemblages and their dynamics. Conservation builds on a sound ecological framework, in which each species must be examined at the individual, community, and catchment level of interaction, and in which human interactions with freshwaters are a critical part. The survey approaches and techniques used, and the subsequent analytical methods, directly affect the interpretation of results, and it is essential to understand their limitations or biases in order to make informed decisions on conservation and management. This book cannot list all techniques used to survey or sample freshwaters—that is an impossible task; rather, it presents some of the practical approaches that are used in freshwater ecological research and surveys, and, using examples from international studies, synthesises why certain methods are used in preference to others for particular types of freshwater habitat or particular types of organism, or for measuring, documenting, and evaluating the dynamics and management of the ecosystem. Central to all freshwater surveys is the identification of organisms to the species level. This book does not attempt to cover identification and taxonomy although passing reference is made to new methods in species identification in some chapters.

The book is divided into three parts. The first part is an overview, presenting an outline of the diversity of freshwater ecosystems; the importance of hydrology and water chemistry in driving ecosystem processes; the different approaches required to answer questions in freshwater ecology and provide effective solutions to conservation problems, including the essential nexus between scientists, social scientists, and stakeholder participation; and an overview of sampling strategies and protocols used in freshwater investigations. The second part describes the techniques needed to quantify the individual physical and biological components of the ecosystem, including, for

example, water quantity, water chemistry, aquatic plants, aquatic animals, and algae. This section summarises the huge array of approaches and techniques used for surveying and measuring the multitude of organisms to be found in freshwaters and their physical environment, and that are needed to answer questions on—for example—species richness and abundance, species hydrochemical preferences and tolerances, or the impacts of human populations on freshwater ecosystems. The final part deals with the bigger picture in conservation and management and the approaches needed to answer complex questions involving different stakeholders. It brings together the different approaches and techniques needed to understand interactions between the physical and biological components of freshwater ecosystems, changes over time and ecosystem dynamics, human dependency on and interactions with freshwaters, and the conservation, management, and evaluation of these ecosystems. Individual chapters synthesise approaches and methods drawn from science, economics, landscape management, and engineering; for example, evaluating the restoration of eutrophic waters, monitoring the spread and control of non-native invasive species, and quantifying ecosystem services.

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