METHODS IN AQUATIC ECOLOGY

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In
Aquatic Ecology

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Dedicated
to
our respected teacher
"PROF. V.S. DURVE"
who laid the foundation
of
Limnological Studies in Rajasthan

Foreword

Despite a small share to global water budget, surface waters such as lakes, reservoirs, rivers and streams have a significant place in our biosphere. This fraction of less than 1 per cent of total global water supports great biodiversity of plant and animal species. The aquatic ecosystems and freshwater ecosystems in particular depict a fascinating world of biota ranging from microscopic algae to vertebrates such as fishes, reptiles and birds. Being an important source of livelihood for fisherfolks these water bodies are also useful to mankind for various needs and thus indeed are life support systems. These are also important as reservoirs of gene banks for conserving biological treasures.

Of late, human interferences of different kinds and magnitude have adversely affected these aquatic systems. Thus, freshwater bodies are increasingly affected by waste disposal which disrupts ecological balance ultimately leading to extinction of valuable species of biota. Under such environmental stresses, regular surveillance, monitoring and status survey of aquatic ecosystems are becoming important for their scientific management.

This book is therefore a timely step in the field of practical aquatic ecology as it cover a wide range of topics related to biotic and abiotic factors of freshwater aquatic ecosystems. It encompasses practical methods as well as brief theoretical description for various ecological parameters, which is desirable. The book is an outcome of painstaking efforts by Dr. L.L. Sharma and Dr. V.P. Saini, that would prove a useful tool for teaching and research in water quality, limnology, hydrobiology and allied fields. I am sure this will be an invaluable addition to libraries and research establishments.

(Dr. S. Ayyappam)
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Preface

In the modern era of science and technology the activities of man is increasingly posing threat to regional, national and global environments. Pollution in different forms and variable quantities in grossly influencing the physico-chemical and biological properties of major ecosystems. The aquatic ecosystems being directly exposed to human activities are not exceptional to this. Considering the increasing level of pollution and other environmental problems associated with aquatic ecosystems and freshwater standing ecosystems in particular, the need for management of these ecosystems has been felt at various national and international fora. For sustainable use of aquatic ecosystems for various purposes appropriate strategies are to be evolved. In this context, therefore for the efficient environmental monitoring, surveillance and studies appropriate methods are needed. Considering this, the present book has been presented to cover a wide range of methods usually required in freshwater ecology, limnology and hydrobiological investigations. Through this book an attempt has been made to give simple methods for water quality analysis with brief theoretical background for the ecological parameters. While narrating a particular water quality parameter efforts has been made to give its relevance with public health, fisheries and such other purposes. Besides including several physico-chemical water quality parameters normally used in water quality studies, biological methods (plankton, periphyton, benthos and macrophytes) have also been presented in a justifiable manner. Similarly, a section pertaining to aquatic microbiology is also included in this manuscript. Besides these, at the end some useful information comprising of water quality standards, water classification, water distribution and brief glossary of common terms related to aquatic ecology have been attached to this book.

This book has been written in a simplified manual style with necessary illustrations to further elaborate the subject. It is hoped that this publication will be useful to a wide range of researchers engaged in water quality studies.

For the preparation of this manuscript the encouragement and moral support received from Prof. G.S. Sharma (Dean, RCA, MPUA&T, Udaipur), Prof. Pratap Singh (Director Research, MPUA&T, Udaipur) and Prof. V.S. Durve (Ex Prof. & Head Dept. of Limnology and Fisheries, MPUA&T, Udaipur) is gratefully acknowledged. We are highly thankful to Dr. P.K. Dashora (Assoc. Prof. Statistics, MPUA&T, Udaipur) for the useful suggestions on biometrics section of this manuscript.

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Contents

		Page No.
	Foreword	
	Preface	
1.	Introduction	9
2.	Morphometry of inland water bodies	12
3.	Sampling devices	18
4.	Physico-chemical analysis of water (Water temperature - Odour - Taste - Turbidity - pH - EC - Dissolved oxygen - CO_2 - BOD - COD - Acidity - Alkalinity - Hardness - TDS - Chloride - Chlorine - Maganese - Sodium - Sulfate - Fluoride - Iron - Silica - Nitrogen - Phosphorus - Organic carbon)	30
5.	Aquatic Biology : Plankton, Periphyton, Benthos and Macrophytes	113
6.	Aquatic Biology : Bacteriological examination of water and waste water (i) Standard plate count (SPC), (ii) Test for total and faecal colifoms (MPN & Millipore filter technique) (iii) Examination of pathogenic and pollution indicating bacteria (Faecal streptococci, *E. coli*, Clostridium, Salmonella, iron bacteria ; sulphur bacteria) and (iv) Staining of bacteria.	141
7.	Primary productivity	173
8.	Bio-statistics	179
9.	Glossary	206
10.	References	220
11.	Appendices	223

1

INTRODUCTION

Two things make water a unique natural resource. One is that water is essential for human survival. The other is that, unlike other natural resources, the total amount of water in the world is constant and it can neither be increased or diminished. The total volume of water on earth is about 1,400 million cubic kilometres - some 10^{18} tonnes. But more than 97% of this is sea water. Of the rest 22 per cent is ground water and 77 per cent is ice, locked away in glaciers and the polar ice caps. This leaves less than 1 per cent of supply of freshwater to take part in the hydrological cycle ; about half of this is found in rivers, lakes and swamps. Despite this, on a global scale, there is more than enough freshwater to meet demand, both now and in the foreseeable future. But it tends to be available in the wrong place, at the wrong time, or with the wrong quality.

Agriculture is by far the greatest user of freshwater, mostly in the form of irrigation. If carefully planned and managed, irrigation can bring about dramatic increases in production. All too often, however, 70-80 per cent of water used never reaches the crops or so much of water is poured onto cropland that the soil eventually become water-logged and salinized.

In much of the developing world the hydrological cycle is being disturbed by deforestation as upland areas are cleared for agricultural use. Although industry uses much less water than agriculture, it pollutes it selectively more. Water shortage are causing more and more nations to utilize their supplies of ground water, which is some 3000 times more abundant than surface water. However, groundwater - unlike

surface water - is neither renewable nor self cleaning. In some areas, ground water is now being mined, just like coal; and its extraction leads to ground subsidence. Even pollution, particularly from agriculture chemicals, such as nitrates is beginning to trickle down to ground water reserves. Man's biological need for water is modest; only a few litres per day are needed to support life. Furthermore, since much of this usually supplied by food, often a litre or two of drinking water is adequate. Man's desire for water, however, vastly exceeds his need. Though only 6 per cent of all the water used by man is consumed domestically, this is not nearly sufficient to meet demand. In the developing countries, about 75 per cent of the population lacks adequate sanitary facilities. Most waste is simply dumped into the nearest body of flowing water. These are what make untreated human waste the world's most dangerous environmental pollutant: four out of every five common diseases in developing countries are caused either by dirty water or lack of sanitation and water-borne diseases cause an average of about 25,000 deaths a day in the third world.

Scarcity of supply and heavy pollution have led to a situation in which at least one fifth of the third world's city dwellers and three quarters of its rural people lack access to reasonably safe supplies of water. It is widely recognized that water is going to be one of the major issues confronting humanity at the turn of the century and beyond.

The universal way of obtaining freshwater is from rain. River systems are the results of the excess water that falls on dry land in the form of rain. On the one hand, rain water penetrates the permeable soils, saturates them and accumulates to form ground water reservoirs, and aquifers, which can come to the surface in the form of springs. On the other hand, the water is absorbed by vegetation, which uses it for pumping minerals and then evaporates it by transpiration. Excess water finally flows over saturated soils, shaping the complex systems of the watersheds or river basins. Water

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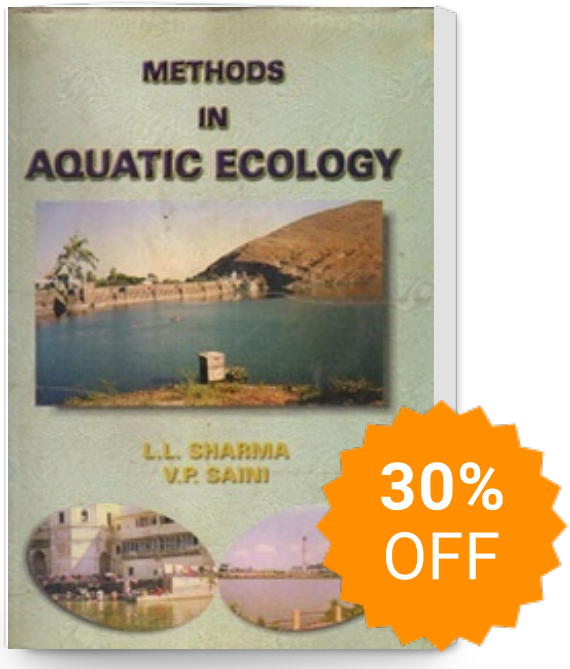

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