# GUIDELINES of LAKE MANAGEMENT

Volume 7

# Biomanipulation in Lakes and Reservoirs Management

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# FOREWORD

*Tatuo Kira*

Lake ecosystems and island ecosystems seem to be homologous with respect to their intolerance to the invasion of alien species of plants and animals, probably because both ecosystems consist of the limited biota which could migrate by chance across the surrounding barriers of land or water and may therefore be less firmly organized as compared with those in the ocean or on the continent.

Due to the ever-increasing inter-continental communication and transportation, more and more alien species are being introduced either intentionally or by chance to a number of lakes, where they often propagate explosively, resulting in severe damage to native species. In certain extreme cases, the introduction of a single fish species may completely alter the structure of a whole lake ecosystem. This is a serious threat to the biodiversity of certain geologically old lakes in which many indigenous taxa were born through hundreds of thousands of years.

On the other hand, such variability of lake ecosystems may also indicate the possibility of effectively controlling their structure and thereby changing aquatic environments by artificial intervention in the biological processes within lakes - the so-called biomanipulation. Its practice is not new; people have long been trying to introduce various new organisms into their home lakes in order to increase fishery production, to remove unfavourable plants and animal species, etc.. However, systematic studies on biomanipulation have started rather recently. A lot of papers dealing with the subject are appearing in scientific journals, but it is still difficult for non-specialists to understand what has so far been achieved by those studies and how their results can be applied in the practical management of lake resources and environments.

This volume of the ILEC/UNEP guideline book series is expected to fill the need by offering a general introduction to the role of biomanipulation in lake management with emphasis on the control of excessive algal growth in lakes suffering from eutrophication. We hope that this new approach may give stimulative suggestions to lake environment managers worldwide.

The ILEC Foundation would like to sincerely thank the editors Dr. R. de Bernardi and Dr. Giussani and the other contributors for their efforts in preparing this useful and unprecedented book. The continued support to the serial publication by the United Nations Environment Programme is also heartily acknowledged.

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# FOREWORD

*Jorge Illueca*

Eutrophication is surely the most important process affecting lakes and reservoirs worldwide. An important consequence of this process is the general reduction of the possibilities for water use, so that the importance of lakes and reservoirs as primary resources for socio-economic development can be seriously compromised. On the other hand, biological processes in eutrophic environments increase productivity, including fish yield and this process can be regarded positively as a source of protein in developing countries. It is well-known that eutrophication involves increasing nutrient inputs resulting from human activities. Historically, the way to prevent this process from eroding the quality of the environment and to rehabilitate freshwater environments once eutrophied, was engineering for the control and reduction of nutrient inputs. This costly process is unquestionably necessary in many cases, but it does not necessarily produce the expected improvement in a reasonable time, due to the resistance of the ecosystem itself.

For this reason several in-lake ecotechnologies have been proposed, developed and tested on a natural scale. These ecotechnologies have to be considered as an alternative to the engineer's reduction of nutrient loads. Among them, one of the most promising is the biomanipulation of the aquatic food chains.

Biomanipulation began in the late fifties as an approach to the study of ecosystem function. Since then many real scale experiments have proved that biomanipulation can ameliorate eutrophic water bodies. It is now clear that the principles of biomanipulation can be utilized to manage the ecosystem on a scientifically sound basis. This technique is still largely empirical and needs a more profound scientific basis. Nevertheless, biomanipulation holds great promise for the management of lake and reservoir quality. It is also important to stress that biomanipulation is not limited to remediating eutrophic lakes, but can also help improve fisheries in terms of both quality and quantity of products.

This booklet, the 7th in the Guidelines of Lake Management series, explains the scientific bases of biomanipulation in detail, illustrating the techniques with case studies of successful lake recovery. Some chapters also illustrate how appropriate biomanipulation can help enhance fisheries.

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