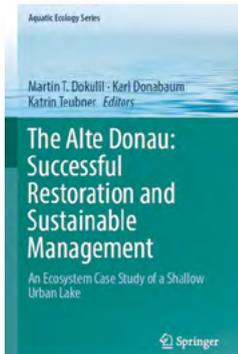


The Alte Donau: Successful Restoration and Sustainable Management – An Ecosystem Case Study of a Shallow Urban Lake



The book «The Alte Donau: Successful Restoration and Sustainable Management – An Ecosystem Case Study of a Shallow Urban Lake» (Dokullil MT, Donabaum K, Teubner K, eds) takes the reader on a popular urban lake in Vienna. This lake study over more than 20 years is released in the Aquatic Ecology Series of Springer and

illustrates the long-term restoration efforts in the urban seepage lake Alte Donau. The restoration was initiated by the municipal authority 45-Water Management Vienna (Magistrat 45-Wiener Gewässer) in 1993, and was supported by them over more than two decades. The editorial work for the book was partly financially supported by the Austrian Committee (ÖK) of the IAD.

Alte Donau is an oxbow lake, a cut-off arm of the former main channel of the Danube River (*fig. 1*). In the 1980ies, it was a mesotrophic cyprinid-dominated lake, which became hypertrophic in the 1990ies making restoration measures necessary. This book tells the story of how the transition from hypertrophic back to mesotrophic conditions was successfully accomplished. Through implementing an integrated lake management plan including external and internal measures, Alte Donau gained increasing popularity as recreational area in recent times.

The book comprises 20 Chapters and provides practical and empirical knowledge about the restoration of Alte Donau as presented by 25 authors from universities, technical offices and municipal departments in Vienna. The book covers three main aspects:

1 Site description including the history, morphometry, hydrology, sediment and climate (chapters 1–7).

This section introduces to Alte Donau and describes mainly the lake history, morphometry and hydrology. It further provides information step-by-step about the integrated lake management plan of external and internal measures and refers in particular to schedules of the chemical treatment for phosphate precipitation and to the long-term effort for sustained recovery. In addition, the physico-chemical conditions of the water body are highlighted over the times span of 28 years from 1987 onwards. These aspects are central for interpreting the response of biota to environmental change and the new public awareness of an attractive recreational area as discussed in other chapters of the book.



Figure 1. Alte Donau, an urban oxbow lake in Vienna, serves as popular recreational area (photo: 2015, www.lakeriver.at)

2 Analysis of the biota found in Alte Donau including their ecology and production (chapters 8–16).

The description of biota comprises pelagic assemblages (microbial and viral loop, ciliate protozoans and metazoans, algae and cyanobacteria), benthic macroinvertebrate assemblages, fish community, underwater vegetation including the reed belt, and water birds. For all these biotic assemblages, several phases of the ecosystem development were described. In case of planktonic heterotrophic bacteria, phytoplankton including primary- and secondary production, planktonic ciliates and other metazoan zooplankton, macrozoobenthos, yield of fish and of underwater vegetation, the book highlights inter-annual changes over up to 22 years. The superimposing climate warming in Alte Donau and its impact on zooplankton from rotifers to freshwater jellyfish further refers to the ongoing debate about global warming.



*Figure 2. Mesotrophic Alte Donau successfully restored, mirrored by the clear-water macrophyte dominated state (photo: *Myriophyllum spicatum*, 2015, www.lakeriver.at)*

3 **Hygiene aspects, design of riparian zone, new urban landscape planning and synthesis (chapters 17–20).** Hygiene aspects for bathing, the new design of the riparian zone and a new urban landscape planning (Master plan) are presented in view of the popular use of this recreational area (chapters 17–20). Finally, a synthesis summarizes scientific aspects of the successful restoration of Alte Donau.

The main path in this book starts with describing the many hydrological-chemical to biological aspects for the heavily eutrophied lake in 1993/1994. The heavy blooms of the cyanobacterium *Cylindrospermopsis raciborskii* associated with a poor water transparency in 1993/1994 prevented the use of this urban lake for bathing, fishing and other recreational activities and thus provided arguments to start restoration measures. A five-year restoration period followed, which included a treatment by chemical phosphate precipitation (Riplox-method), which was applied twice. Another seven-year period was designated to a successful re-establishment of macrophytes which was mainly due to an increase in water transparency and thus favourable underwater light conditions for stimulating the growth of submerged vegetation. The last period of once again mesotrophic «stable conditions» lasting over recent years relied mainly on the sustained underwater vegetation and the modified fish stocking of less cyprinids and more predatory fishes. According to surveys, the success of the restoration has increased public awareness of this recreational area in Vienna.

In view of lake science, Alte Donau exemplified that an in-lake restoration strategy which primarily uses a bottom up control is possible if it is going hand in hand with external measures of an integrated lake management plan. With the drastic reduction of lake-internal phosphorus, accomplished by short-term chemical precipitation treatments, the growth of underwater plants was triggered at the expense of algal growth. Different from other lake restoration strategies which attempt to strengthen the top down-control by fish removal and completely new fish stocking afterwards, for

Alte Donau no fish were removed other than by recreational fishing. A gradual transition away from overwhelming cyprinids-dominated conditions was accomplished by modified fish stocking in recent years. Thus, the sustained success of restoration in Alte Donau relies mainly on the alternate nutrient allocation from planktonic algal community to the re-established underwater plants which guaranteed primarily sustained mesotrophic conditions. The success of restoration was mirrored by high water transparency. This shift from a nutrient rich algal turbid water-body to a nutrient-poor clear-water macrophyte state (fig. 2) was linked to alterations in the planktonic food web and thus provides a further signature of sustained successful rehabilitation of Alte Donau.

The book provides practical guide for restoration measures as e.g. the phosphate flocculation in the water body, the planting of underwater vegetation and the subsequent water-plant management by mowing, the re-establishment of the reed belt and fish-stocking biomanipulation experiments in addition to the manifold other mainly scientific aspects of this successful lake restoration.

The Alte Donau book journey along the four main management periods is illustrated by historical maps, scientific tables and graphics, photographs or photo tables showing representative micro-organisms, plants and animals in this urban seepage lake. The many facets of management measures, their impact on biotic assemblages shaping habitats from sediment, water body and riparian zone of this urban lake one the hand and the implementation of landscape architecture for creating an attractive recreational area and generating a new public awareness on the other hand, highlight the diverse perspectives of such an urban lake restoration project.

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