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HANSSON, L.-A., AND E. BERGMAN. 1999. **Nutrient reduction and biomanipulation as tools to improve water quality: The Lake Rinsjön story.** Kluwer Academic. xii + 156 p. \$96.00. ISBN 0-7923-5955-0.

Good theory and hard work are sometimes not enough to restore a lake. This book describes the largely unsuccessful attempt to use biomanipulation to control algal blooms and improve the clarity of Lake Rinsjön in southern Sweden. The authors indicate that their objective in writing this book was to document lessons learned at Rinsjön, so their mistakes can be avoided elsewhere. They have succeeded admirably.

Many lakes in fertile, populous lowlands are shallow and nutrient enriched (Moss et al. 1996). Restoration of such lakes is difficult, particularly if they are large (like Rinsjön). Responses to reductions in external phosphorus loading are usually slow, they are too large to be dredged or chemically treated, and other treatments are limited by the absence of thermal stratification. Biomanipulation is becoming an increasingly popular way to treat such lakes, especially in Europe. Essentially, the biological community is altered to reduce predation on large-bodied zooplankton (especially *Daphnia*) that feed on phytoplankton; this may involve removal of planktivorous fish that prey on zooplankton, stocking of piscivorous fish, or creating refugia for large-bodied zooplankton. In theory, the more abundant large zooplankton will graze down the phytoplankton, resulting in clearer water. Biomanipulation has been used to alter zooplankton communities in enclosure and small lake experiments (Cooke et al. 1993) and was successfully used to restore more than half of 17 case studies reviewed by Hansson et al. (1998).

This book provides a detailed analysis of an attempt to biomanipulate Rinsjön, including an assessment of why it was not successful in this instance. Rinsjön consists of three shallow basins (mean depths, 3.0–6.1 m) covering 39.6 km² in a largely agricultural basin. Around 1893, the lake was moderately productive, and it was described in terms that would now be considered mesotrophic–eutrophic. In the following decades, important fisheries that had existed for at least 2,000 yr deteriorated as the lake became more productive because of agricultural runoff and poorly treated wastewater. By the 1960s, it was hypertrophic, with dense blooms of cyanobacteria. Cattle died from cyanobacterial toxins, the lake was declared unfit for contact recreation, and by 1987 it was unsuitable as a drinking water supply for nearby cities. A nutrient reduction program in the early 1980s reduced external phosphorus loading from 30 to 10 tons/yr; although the total phosphorus and chlorophyll *a* concentrations in lake water decreased, transparency (Secchi depths) did not change and water quality was still considered unacceptable.

This book presents extensive information on the lake, including a remarkably long time series for phytoplankton dynamics and waterfowl abundance starting in 1896 and 1968, respectively. After a chapter on the theoretical basis for the proposed biomanipulation, the planning and methods of fish removal are described. Between 1988 and 1992, approximately 100–500 tons of cyprinid fish (50 to 80% of the planktivore fish community) were removed from the three basins of Rinsjön. The actual impacts on fish, zooplankton, benthic invertebrates, cyanobacteria, and macrophytes are detailed, and these results are used to calibrate a model, which predicted that repeated fish removals would be required or the lake would return to its previous state in 5–20 yr.

This book concludes with a synthesis of the findings and an attempt to explain why the biomanipulation did not increase zooplankton abundance and size, which was the main objective. One of the main conclusions is that removal of cyprinid fish affects far more than a single food chain. Perhaps the most important secondary effect was a large increase in the abundance of age 0+ fish, which *increased* predation on large zooplankton (rather than the decrease that was predicted a priori). The authors also concluded that the morphometry of Rinsjön could be another reason for the poor response to biomanipulation. Rinsjön lacks sufficient shallow areas (>30% of the lake area <2-m depth) for the establishment of macrophytes, which would provide refugia for zooplankton and compete with phytoplankton for nutrients. Finally, they note that the proportion of the fish biomass that was piscivorous (10–40%) was well below the 50% proportion recommended in Danish studies. They also note that for biomanipulation to succeed, external loading should first be reduced so that total phosphorus concentration in the lake is below 100 µg L⁻¹ (Hanson et al. 1998). Others who work in this field further suggest that the size range of phytoplankton is also an important factor. Large phytoplankton, especially filamentous cyanobacteria (Moss et al. 1996), can clog the feeding apparatus of zooplankton and are not likely to be effectively controlled by a biomanipulation. This highlights the need for detailed knowledge of the food web in a prospective lake before this technique is employed.

This book consists of a collection of papers published in *Hydrobiologia* in 1999. Because they were reprinted as originally published, sections dealing with site description and background on the biomanipulation are repeated in each chapter, which became a bit tedious. I also found the price (\$96.00) rather high for a book with 156 pages, but perhaps this is not unusual for such publications.

Anyone seriously considering the use of biomanipulation to control algal blooms in a lake should read this book. It provides a sobering account of what can happen if a lake is unsuitable or if the methods are inappropriate. Biomanipulation is a technique that holds great promise for the restoration of shallow eutrophic lakes without using chemicals or dredging. Unfortunately, we are not yet at the stage where results can be reliably predicted in most lakes. We need more thorough long-term evaluations of both successful and unsuccessful case histories, such as this invaluable account of Lake Rinsjön.

Al Sosiak

Water Management Division
 Alberta Environment
 301, 2938 11 St. NE
 Calgary, Alberta, Canada T2E 7L7

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