*Limnol. Oceanogr.*, 44(7), 1999, 1844


ARTS, MICHAEL, AND BRUCE C. WAINMAN [EDS.]. 1999. **Lipids in freshwater ecosystems.** Springer-Verlag. xiv + 319 p. US$79.95. ISBN 0-387-98505-0.

Lipids and fatty acids (FA) have many important and unexpected uses in studies of aquatic ecosystems. FA are indicators of food quality, an important influence on growth and reproduction in animal populations and the efficiency of energy transfer between trophic levels; FA thus strongly affect ecosystem structure and function. The strong source-specificity of some FA also allows them to be used as markers to determine trophic relations (in much the same way as stable isotopes). This book provides a comprehensive overview of the physiological, ecological, and ecotoxicological roles that lipids and fatty acids play in freshwater ecosystems and outlines future research needs. Most of the chapters are valuable reviews of the current scientific literature and have a strong ecosystem focus.

Research on the importance of lipids and FA in determining food quality originated in medicine and aquaculture. In the 1930s J. A. Lovern published several articles on the fatty acid composition of marine and freshwater fish, zooplankton, and algae. These early results are probably the source of the common view that freshwater fish are relatively higher in 16-carbon and 18-carbon fatty acids and lower in 20-carbon and 22-carbon polyunsaturated FA (PUFA) than marine fish—despite the fact that Lovern pointed out that these differences were probably due to different diets and growth rates rather than marine vs. freshwater per se. In medicine, Dyerberg and Bang published articles about the positive effects of fish oils on human health in the 1970s and 1980s. Unfortunately, due to the lack of an interdisciplinary perspective and skepticism regarding the applicability of results obtained from mammals to aquatic organisms, limnologists took little note of these seminal studies.

Things began to change when Crawford and Marsh (1989) pointed out the conservatism of basic chemistry among life forms. Biochemically identical amino acids, chlorophyll, and hemoglobin occur in very different organisms, and biochemical cycles at the cellular level are strikingly similar throughout the animal kingdom. This implied that basic patterns found in mammals—e.g., that herbivores and carnivores have different dietary FA requirements—might also be valid for fish; and there is indeed evidence that supports this hypothesis. Docosahexaenoic acid (DHA), which is an important component of neural tissue, is a dietary requirement for cats and new-born humans but not mice, and aquaculturists know that DHA must be supplied in the diet of fish-larvae. Thus, the ecological effects of, e.g., a deficiency of essential fatty acids (EFA) may be predictable from knowledge of their well-known physiological roles in mammals. Shortages of EFA should result in altered species composition of zooplankton, zoobenthos, and fish communities, whereas the carrying capacity of the ecosystem could be controlled by a different factor, such as phosphorus. Y. Olsen pursues this fascinating line of inquiry in one of the chapters of this book.

This depth and novelty of treatment is typical of the book ***Lipids in freshwater ecosystems.*** We learn, for example, that 1) No general differences can be found in the lipid composition of marine and freshwater organisms. 2) Aquatic biota is dominated by $\omega$3 PUFA whereas terrestrial biota is dominated by $\omega$6 PUFA. 3) Algae grown at low light intensity produce more lipids, but the PUFA content is higher at higher light intensity. 4) Lipid synthesis varies with concentrations of P and N.

The book also offers an abundance of information on the impact of food quality on growth and reproduction of aquatic animals. The chapter by C. E. Goulden *et al.* summarizes a study in which the authors monitor the composition of lake seston and use *in vitro* dietary supplements to determine how total food quantity, proteins, triglycerides/non-EFA, or EFA (linoleic and linolenic acid) limit the reproduction of daphniids. Their superb experimental design—controlled laboratory experimentation together with field observations of seston—is a paradigm which future studies should emulate.

Anyone interested in the use of FA as trophic and chemical markers will find much of interest in this book. FA are shown to be taxon-specific and metabolically stable, thus providing a highly potent tool for deciphering trophic relations. The book also offers extensive information on the role of lipids in the uptake and bioaccumulation of organic contaminants.

The book contains a few flaws. In our view, the many sub-chapters (in some chapters up to four levels deep!) give an impression of a 'patchwork' and break the flow of ideas. The figures are too diverse in style, with various fonts being used even within the same graph. There is also a lot of redundancy between chapters, especially in their introductions. Some important literature is not cited (e.g., volume 38 of Freshwater Biology, a special issue devoted to food quality of zooplankton). Lastly, the use of polar-lipid FA to characterize microbial communities, which has been extensively used by soil scientists and which has great potential in aquatic studies, is not mentioned.

This book provides a timely and extremely valuable synthesis of the current state of this rapidly growing field of biochemical ecology. We strongly recommend it to anyone interested in this relatively new and exciting subject.

*Gunnel Ahlgren*

Uppsala University
Department of Limnology
SE-752 36 UPPSALA, Sweden

*Willem Goedkoop*

Swedish University of Agricultural Sciences
Department of Environmental Assessment
SE-750 07 UPPSALA, Sweden

*Reference*

CRAWFORD, M., AND D. MARSH. 1989. The Driving Force. Heinemann, London.