

# BOREAL SHIELD WATERSHEDS

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## Lake Trout Ecosystems *in a Changing Environment*

*Edited by*  
J.M. Gunn, R.J. Steedman,  
and R.A. Ryder



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## Foreword by series editor

This volume, edited by John Gunn, Rob Steedman, and Dick Ryder, pulls together an incredibly broad mix of people and topics under a single cover. As such, it is a worthy addition to the new series from CRC Press — Integrative Studies in Water Management and Land Development — that was initiated in 2002 with publication of my own edited volume, *Handbook of Water Sensitive Planning and Design*. Books like these are rare, but they shouldn't be. Complex environmental problems can only be identified, understood, and rectified through the collective actions of a diversity of approaches from a variety of disciplines. Gunn, Steedman, and Ryder well recognize this as witness to the fact that their contributors to this volume come from many different provincial, state, and federal agencies, universities, and private consulting or research organizations. Likewise, the topics covered in these pages are truly catholic in scope: natural and cultural history, stocking and management, rehabilitation, commercial fisheries, land-use modifications, reservoir creation, nutrient inputs and transformations, lake chemistry and morphometry influences, atmospheric deposition, trace contaminant cycling, species introductions, and climatic alterations. All directed toward a single sentinel species — the lake trout of the Boreal Shield — a wonderful fish I know well as a research subject (and also as a culinary object!), and in an area of the continent of incredible sublime beauty in which I have spent much time in both recreational and scholarly pursuits.

Until some future author writes a popular account of the anthropological history of the lake trout — along the lines of, for example, John McPhee's *The Founding Fish* (about the shad), Mark Kurlonsky's *Cod: A Biography of the Fish that Changed the World*, or Richard Scheid's *Consider the Eel* — the present book, with its emphasis on the management of, and environmental influences on, this particular species of fish, should become widely read. What all of these works share is their demonstration that the true distribution for certain species of fish encompasses sociological space just as much as it does Euclidian space. Lake trout, then, are a truly integrated cultural and biological symbol of the Boreal Shield ecoregion.

Another important message that one takes away from the present book — one alluded to several times but not formally enunciated — is of a compelling challenge to our myth of "pristine nature" or "wilderness" free from human influences. When looking at a map of human inhabitation in North America (or the photo of illuminated cities shown in the first chapter), one could erroneously assume that somehow the great Boreal forest is "the true north, strong and free" from human manipulation. What we learn from this book is that the Boreal Shield ecosystem is really just as much a designed landscape as any on the planet. So, in addition to the well-known artificiality of the forests due to wildfire suppression, we now realize that since soon after glaciation, the resident relict populations of lake trout have been repeatedly poked at and prodded by us. While in the past (and even in the recent past), this has been mostly through direct tinkering such as fisheries and restocking programs, today it seems that these fish populations function as barometers

of changes in both the landscape and the airspace. We would be wise to learn the lessons that these aquatic canaries might be able to tell us, and for this we should be indebted to the authors of this timely and important volume.

**Robert L. France**  
*Harvard University*

## Foreword: An ideal icon

The lake trout, a coldwater denizen of Boreal lakes, makes an ideal icon. The spectacular fish is a memory of its past and a vision for a desired future, an icon to stir human action on behalf of valued and relatively unspoiled Boreal lakes. These lakes are increasingly exposed to new and more intense human pressures. An icon can help foster the protection, management, and restoration of these treasured systems. Can lake trout be such an icon? Is this fish the only icon needed to stir the human passions to behave ethically for a sustainable future? In the Pacific Northwest, anadromous salmon, Douglas fir, marine mammals, and other components combine into a more general set of icons worth preserving because they are valued by different groups. Is the lake trout part of such a set of effective icons for the Boreal lake systems? My answer would be a hearty "yes."

This noble animal depends on the maintenance of a suite of aquatic, terrestrial, and aerial environments; thus it is an indicator not only of the deep, cold, oxygenated waters, but also of land at a landscape scale and of air at regional and global scales. Thus, the species integrates anthropogenic pressures on the environment giving further credibility to Barry Commoner's first law of ecology: "Everything is related to everything else." Does it seem inconsistent that the icon is also the indicator? I think not. This is often the case. This interlocking of the vision and the practice brings together excitement and technique, purpose and strength. Is the lake trout a sufficient indicator through which to judge status, function, and dynamics of Boreal lake ecosystems? I doubt it. The inshore fish community would be a great indicator, but not as good an icon. The spruce and the aspen, the moose and the wolf, and other components inform us about other facets of our influence that could influence the lakes, and mechanisms are equally or more important as indicators.

Challenges are many: overfishing and extraction, exotics and toxins, human population growth and expansion, energy use, and climate change. Some of these influences can be dealt with or fixed at the local, lake, or perhaps watershed level. Others are more provincial and linked to regional economic development that may undervalue ecosystem sustainability. Some of the pressures are continental with transboundary movement among nations of people, dollars, toxins, water, and exotics. Others are truly global, such as the generation of greenhouse gases or development of carbon storage.

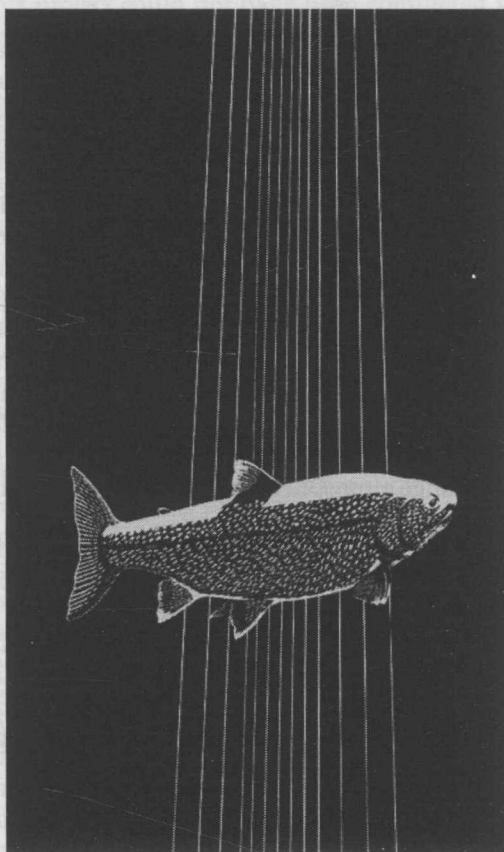
As I read the chapters, it became increasingly clear that some of these Boreal lakes are more sensitive to different pressures, and that they are not all equally sensitive to the same pressure. For example, a lake sensitive to overfishing because the trout are key to the local economy or because an urban, recreational fishing population is only a short drive away may not be the same lake that is most vulnerable to climate warming or aerially borne toxics or acids. Of this the writers are well aware.

More daunting was the realization that some lakes we can protect, some we can manage to some degree, some we can restore, but others we cannot help, at least in the short term or through local action. Changes will occur, and one needs to decide how to respond to those changes. As in the medical analogy, triage should be part of any strategy. Behaviors in respect to short-term, faster-acting pressures may differ depending on the

expected response of Boreal lakes to the long-term drivers. Sorting such things out among the various kinds of lakes is important to establishing short- and long-term strategies.

So from my point of view, the lake trout is certainly an icon and a tool that can help us realize the more desirable future. The species is perhaps uniquely suited to help achieve a sustainable future for Boreal lake ecosystems and the humans who love them. It cannot do it alone.

**John J. Magnuson**  
*Center for Limnology  
University of Wisconsin*



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## Preface: Boreal Shield ecosystems

Deep, clear Boreal Shield lakes carved from Precambrian bedrock have long defined the northern wilderness and are the ancestral home and interglacial refuge of the lake trout, *Salvelinus namaycush*. The lakes, streams, and wetlands of this ecozone are tightly linked to the austere watersheds of the north woods and are sustained by them. This land of white pine, black spruce, moose, wolf, beaver, and woodland caribou poses daunting environmental management challenges at the beginning of the 21st century. New science gleaned from these ecosystems may provide a powerful general model for those concerned about freshwater fisheries, water quality, and watershed ecosystems worldwide.

Humans have long been part of the Boreal Shield world. A few adaptive and resourceful aboriginal peoples followed fish, game, young forests, and receding glaciers northward 5000 to 10,000 years ago. The number of people living in the Boreal forest is still small relative to those in more hospitable regions, but humans continue to move northward and exert ever-increasing demands on the Boreal landscape. Now, 200 years after the area's rich fur, fish, timber, and mineral resources first attracted the interest of Europeans, forestry and mining still form the backbone of the region's economy. The unspoiled landscape and waters have become easily accessible and support a huge tourism and recreation industry. The new wave of industry and technology in distant cities now plays a dominant role in the health of Boreal Shield ecosystems through market-driven extraction and consumption of resources, through long-range atmospheric transportation of contaminants, and through changing global climate.

This book brings together a uniquely qualified group of scientists to extend and interpret the scientific legacy of the Boreal watersheds. For the last 50 years, pristine Boreal Shield waters have served as crucibles for world-class research into impacts of water pollution, acid rain, climate change, fisheries, and watershed disturbance. This book builds on that research foundation and explores the ability to manage human interactions with these unique ecosystems at local, regional, and global scales. Our ability to sustain healthy Boreal Shield waters constitutes a crucial test of ecosystem management concepts, techniques, and commitment.

**John M. Gunn**

Ontario Ministry of Natural Resources  
Laurentian University

**Robert J. Steedman**

Ontario Ministry of Natural Resources

**Richard A. Ryder**

RAR & Associates

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## About the Editors

**John M. Gunn** is a senior research scientist for the Ontario Ministry of Natural Resources and heads the Cooperative Freshwater Ecology Unit at Laurentian University. During the past 25 years much of his research has focused on restoration ecology of acid-damaged ecosystems in northeastern Ontario, with particular emphasis on the recovery of stressed lake trout ecosystems. He was the recipient of several awards, including the 2000 President's Award for Conservation from the American Fisheries Society.

**Robert J. Steedman** is a research scientist with the Ontario Ministry of Natural Resources in Thunder Bay, where he has led long-term, interdisciplinary studies of watershed ecosystem response to forest management and provided science-based policy advice to the Province of Ontario. He is presently on assignment with the National Energy Board in Calgary, Alberta, as Professional Leader, Environment.

**Richard A. Ryder** is a semiretired fisheries research scientist after a 44-year career with the Ontario Ministry of Natural Resources and its predecessor, the Ontario Department of Lands and Forests. He is the recipient of numerous awards and honors, including most recently an election into the National Fisheries Hall of Excellence (1999) and the Meritorious Service Award (2001). He has served as president of the American Fisheries Society (1980–1981) and the Canadian Conference for Fisheries Research (1987–1988).

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