Book Reviews

Invasive Species in a Changing World

H. A. Mooney and R. J. Hobbs, editors. 2000. Island Press, Washington, DC, 384 pages, $55.00, ISBN 1-55963-781-1 (hardcover); $30.00, ISBN 1-55963-782-X (paperback).

Biological invasions are widely acknowledged as a global-scale phenomenon. This volume is distinguished from others in a burgeoning number of books and conference proceedings by its stated purpose: to evaluate invasion explicitly as an agent of global change and to assess the impact of other agents of change on the prospects for invasions. This is not the first time the task has been attempted, but it is the first book-length treatment to consider carefully individual drivers of change. The volume is a SCOPE publication (from the Scientific Committee on Problems in the Environment) containing 17 chapters by an international group of contributors. Overall this is an affordable highly useful overview of the complex range of issues related to invasive non-native species.

The book opens with selections presenting the dimensions of the problem. Two review invasions in freshwater and marine habitats. The first, by Kolar and Lodge, is particularly useful in focusing on the relationships between human activities (e.g., waterway engineering and management) and nonindigenous species, both plant and animal. The other introductory chapters survey invasions in light of particular agents of change (land use change, fire, atmospheric CO_2 increase) or present overviews of microevolutionary change within invading species (a stimulating chapter by Barrett) or of assessment methods. All these are heavily weighted toward plant examples. The review of fire invasion interactions by D'Antonio is an excellent and careful consideration of the empirical record, illustrating the absurdity of simple generalizations. The assessment chapter, authored by Mack, highlights just how difficult it is to document the progress of invasions.

The second part's stated theme is the societal impact of invasions. One chapter considering the interaction of invasions with climate change would seem to belong in the previous section. A chapter on human health impacts of biotic invasions provides plenty of fearsome material for persuading the public of the issue's importance. Most relevant from the perspective of readers of this journal, though, are the several chapters dealing with economic impacts. The first of these describes changing societal attitudes toward invasions; McNeely introduces some important economic concepts such as externalities and reviews the mechanisms by which international trade agreements and patterns may influence invasions.

My favorite chapter is Naylor's excellent explication of estimating costs and benefits of species invasions, impacts, and control or mitigation measures. She describes the economic perspectives and tools most likely to be relevant to invasion biology and management. For example she outlines both an *ex post* analysis of the costs of various control measures and an *ex ante* cost–benefit analysis of various preventive measures compared with the costs of allowing an invasion to proceed. She provides clear examples of some concepts not so familiar to biologists (non-market or social costs, distortion of financial costs, difficulty of estimating indirect use costs or costs of loss of benefits, non-use values or option values, role of discount rate in valuation of strategies over time).

The last (and longest) chapter in this section, by Zavaleta, presents an impressive analysis of the invasion of southwestern U.S. riparian areas by saltcedar (*Tamarix*), documenting the enormous costs (but even more enormous benefits) of attempting control or elimination from areas already invaded. These applications of economic concepts and analysis will bring much new food for thought to most ecologically trained scientists and managers; these alone are worth the price of the book.

The book's third section presents regional examples from South Africa, Germany, New Zealand, and Chile. These chapters are heavily weighted to plant examples. It is valuable for North Americans particularly to see the level of analysis where the historical record is longer (as in Germany) or where the ecosystem impact has been more carefully documented (as for hydrologic or watershed effects in South Africa). The book closes with a summary chapter by editors Mooney and Hobbs, calling for sustained attention to the interactions among global change agents.

Overall this volume is an excellent value for anyone interested in the science or management of native ecosystems in the face of biotic invaders. Beyond the descriptions of many important examples and analyses of the most likely interactions with other environmental changes, the language and tools of ecological economics as introduced here will be of great value to those faced with making decisions about control, eradication, or prevention strategies.

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Salmon Without Rivers: A History of the Pacific Salmon Crisis

Jim Lichatowich, 1999 (paperback 2001). Island Press, Washington, DC, 333 pages, $16.95, ISBN 1-55963-361-1 (paperback); ISBN 1-55963-360-3 (cloth).

It is really surprising that this book, or something like it, was not written long ago. After all, Pacific salmon have been in decline for well over 100 years. It is possible that there is a group of fishes that has received more management attention and more money for restoration than Pacific salmon, but if there is I am not familiar with it. As conservation and restoration challenges go, managing salmon may be about as tough as it gets. One would think a chronology of successes and failures would be ample grist for any natural resource historian's mill.

Jim Lichatowich, a salmon scientist and former research manager for a state fishery agency, has written a very interesting and readable book about salmon management in the Pacific Northwest. It is notable for two reasons: First, it patiently and thoroughly documents the convoluted history of management and conservation efforts from the late 19th century to the beginning of the 21st century, and second, it paints a very unflattering picture of institutional inertia and misplaced technological optimism that has characterized decades of restoration efforts. Students of Pacific salmon should read the book for the first reason; natural resource managers in general will benefit from the warning signs of institutional myopia and premature use of untested technologies. The book is not very large, about 230 pages of text, and remarkably it contains almost 40 pages of endnotes with citations and explanations of statements in each chapter.

Chapter 1, "Hooknose," traces the evolutionary history of Pacific salmon. It is short but informative, and the account of the repeated floods caused by the post-glacial breaching of pluvial Lake Missoula helps readers understand how salmon evolved in a very disturbance-prone environment and why spreading the risk among several life cycle patterns was so necessary to long-term survival. The second chapter, "The Five Houses of Salmon," describes the early relationship of native Americans to salmon and how cultural traditions often led to management systems that were sustainable over hundreds of years. In Chapter 3, "New Values for the Land and Water," the relationship of native cultures to salmon, based on harmony with nature's cycles and reverence for salmon as a gift to be treated with respect, is contrasted with the views of Euro-American settlers and early fishing industry developers. Lichatowich calls these two views natural economy and industrial economy, and Table 3.1 summarizes how the two perspectives translated into very different management approaches. Although there may not be anything especially surprising in this contrast, Chapter 3 does illustrate how the tragedy of the commons began to affect salmon even before the beginning of the 20th century.

The real meat of the book begins in Chapter 4, "The Industrial Economy Enters the Northwest." Beginning with the Lewis and Clark expedition, Lichatowich explores the different ways in which salmon habitat was destroyed by wave after wave of land and water developments, from fur trapping to mining to logging to grazing to irrigation. Not only is this fascinating reading, it illustrates that by the end of the 19th century the Pacific Northwest was a very different place than it had been 100 years earlier. The problem, of course, was that nobody bothered to document the changes and by the time the effects on salmon became appreciated it was too late.

Chapter 5, "Free Wealth," describes the golden age of salmon exploitation in which staggeringly large numbers of salmon were harvested in the late 19th and early 20th centuries. Most of the fish went to canning operations that had sprung up along most of the region's large rivers. For major salmon-producing rivers like the Columbia River, peak harvests occurred between about 1875 and 1930. Lichatowich documents many examples of how overharvest and waste, on top of the environmental insults inflicted on salmon habitat, created serious and widespread crashes of many runs. More importantly, however, he cites numerous historical documents that show how managers either chose to ignore the problem in favor of short-term economic interest or simply deny that it existed. Chapter 5 should be read by policymakers who doubt that heeding these mistakes prevents their repetition.

By the end of Chapter 5 the reader is taken to the point at which salmon declines triggered political battles between nations, states, and local fishermen. But it closes with the promise of a new technology that could circumvent degraded habitat and create so many salmon that there would be sufficient numbers of fish for all. In Chapter 6, "Cultivate the Waters," Lichatowich shows how salmon hatcheries grew from small local operations on a few rivers in the 1870s to hundreds of hatcheries all along the Pacific coast within just a few decades. Hatcheries, after all, made great sense to developers and fishermen alike, and with the advent of hydroelectric power just around the corner in the 1930s, hatcheries could be the ultimate mitigation tool allowing the Pacific Northwest to have both salmon and all the other natural resources that came at the expense of salmon. This was when the concept of "salmon without rivers" was born.

Chapter 6 relates how few people bothered to test the basic assumptions of artificial propagation in the early years, and in some cases the few that did were largely ignored. As early as 1893 (p. 141), biologists cautioned agency heads that emphasizing the quantity of eggs produced in hatcheries over the quality of fish released into the wild was predisposed to failure. Increases in salmon

runs in rivers with hatcheries were claimed to be proof that hatcheries worked; declines were blamed on natural disasters (floods, droughts) or unregulated development. Perhaps the most telling evidence of the failure of management to accept artificial propagation on a massive scale without proper evaluation was the difference between the use of hatcheries in the United States and in British Columbia, where the seminal research of Russell Foerster convinced the Canadian government to proceed with great caution until hatchery technology was scientifically validated.

In Chapter 7, "The Winds of Change," Lichatowich describes how mounting scientific evidence began to challenge prevailing management paradigms. Natural history buffs can find some real heroes in this chapter, including Charles Gilbert and his students in the early 1900s followed by Willis Rich a decade or so later. These scientists conducted many of the studies that have given us much of what we know about the incredibly complex life cycles and habitat requirements of Pacific salmon. This body of research, often unappreciated by many biologists, forms the foundation of contemporary salmon management. Chapter 7 is short, but it is one of the most important in the book.

Chapter 8, "A Story of Two Rivers," contrasts two major river systems—the Columbia and Fraser Rivers—in the Pacific Northwest. Each river has undergone different development: The Columbia River supports an extensive hydroelectric generating system involving many large dams, whereas the Fraser River is mostly unimpounded and retains many features of a natural large river system. To mitigate for the dams, hydroelectric developers in the Columbia River Basin invested in a very large and expensive salmon hatchery network. Although the Fraser River has experienced some severe salmon habitat problems, such as the rock slides that partially blocked the Fraser River canyon and nearly extirpated sockeye salmon from the upper basin in the early 1900s, Canadian managers have consciously attempted to ensure sustainable runs by limiting commercial salmon harvests and avoiding the investment in hatcheries that occurred in the Columbia River basin. The results of the two different management approaches were such that by the end of the 20th century, a dozen stocks of salmon in the Columbia River were listed as Threatened or Endangered under the U.S. Endangered Species Act, whereas the Fraser River still supported commercial harvests of several species. Lichatowich states that managers in the Columbia River basin failed to listen to scientists, whereas those in the Fraser River basin used science to support management policies.

The current plight of Pacific salmon is detailed in Chapter 9, "The Road to Extinction." This sad story is all too familiar to those in the region trying to recover salmon and will be of interest to nonspecialists trying to understand what all the current fuss over salmon is about. Chapter 9 is significant because it suggests that we have still not faced up to the real challenges to salmon restoration but instead continue to believe that technological salvation is just around the corner. The final chapter, "Building a New Salmon Culture," reminds us that salmon have evolved in a disturbance-prone environment and are capable of extraordinary resilience if given a proper chance to recover in healthy watersheds.

One of the things that make *Salmon Without Rivers* eminently readable is that it is not really about salmon but about the people who have studied and managed them. There are heroes and villains, dreamers and schemers, brave men and cowards, but perhaps the most worthwhile message from this book is that every so often someone will come forward and challenge existing restoration beliefs with a thoughtful study or an innovative management proposal. As Lichatowich clearly shows in the case of Willis Rich, the challenge may not always be heard by one's contemporaries, but in the long run someone, somewhere, will listen.

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