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Adaptive Management of Renewable Resources

Reviewed by Stephen R. Crutchfield

Carl J. Walters New York Macmillan Publishing Company, 1986, 375 pp., \$36.00

The economic, forestry, and biological literature abounds with scholarly research into the dynamics and behavior of primary resources such as timber and forest products, wildlife, marine and freshwater fisheries, and the like. Yet, despite the increasing sophistication and complexity of our bioeconomic models of these primary resource industries, economists and biologists have generally given the actual process of managing such resources only passing attention. They have often assumed, without much consideration, that some single-valued objective function such as physical yield or net economic yield is to be maximized. It is unfortunate that these researchers have paid less attention to the process of applying management objectives to living resources. Walters' book focuses on this issue: how best to design and implement models of renewable resource management.

Walters takes a somewhat unconventional view of the proper design of models of renewable resources and the role and function of resource management. Most researchers, he says, spend too much time pursuing detailed and expensive primary biological research at the expense of larger, more global, socioeconomic issues. "It is a sad but understandable fact that most scientists base their research programs not on broad analysis of uncertainties, but instead on the investigative tools and analytical methods they learned in university or find popular among colleagues. This means that some ecological/economic research paths are deeply trodden, while others remain untouched" (p. 4).

Walters' second thesis is that the management of renewable resources is often misdirected, aiming at maintaining stability of the resource and its harvesters. He argues instead for an active, adaptive management process, where policy decisions are based on past system behavior ("feedback") and on the

deliberate attempts of managers to disturb the system (change harvest policies) so as to force the system away from biological or economic equilibrium, thereby obtaining additional scientific and economic understanding of the processes involved.

Walters stresses the difference between "passive" and "active" feedback policies. "Passive" feedback policies are based on a continuing refinement of existing models as data become available and on marginal changes in regulations based on this new information (for instance, setting total harvest of fish based on an evaluation of last year's spawning rates) in order to promote the biological and economic stability of the industry. Walters argues that this type of regulation may cause us to miss fundamental shifts in the structure of the system, either parametric changes (increases in growth rates of the resource) or fundamental structural changes (declining habitat or changes in the ecological system). "Active" management deliberately drives the system away from equilibrium (fish the stocks harder, cut more timber) and then observes how the system responds. This process, says Walters, gives much better information about the actual biological status of the resource, and it can reduce the uncertainty and imprecision associated with the models used to regulate the resource in the first place.

The book's major contributions are its discussion of (1) the means by which objectives, constraints, and available knowledge shape the modeling process, (2) a process for building models of renewable resource management that encompasses Walters' style of adaptive management, (3) the design of optimal feedback models, and (4) the implementation of the actively adaptive management strategies he promotes. Also discussed are biological and economic models of renewable resources, the implications and problems of dealing with uncertainty in stochastic resource models, and some examples of adaptive management for complex problems (acid rain and lake trout rehabilitation).

According to the introduction, the book is aimed primarily at resource managers and administrators, with more technical sections oriented toward

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resource analysts, modelers, statisticians, and research scientists. The first three chapters, which introduce the concept of adaptive management, and the introductory material in other chapters are suitable for general audiences. The rest of the book makes heavy use of calculus, high-level mathematics, and statistical theory. The reader should also have some familiarity with management theory and the theory of decisionmaking under uncertainty to appreciate fully some of the more technical material.

Despite its title (and a cover illustration of a tree), the book focuses primarily on fishery resources, forest and timber resources receive passing mention at best. This limitation narrows its appeal to resource economists interested in marine fishing industries. In fact, over a fourth of the book is devoted to detailed biological models of commercial fisheries. It would have had a broader appeal had Walters included models of timber harvest and models of wildlife use and management. A similar narrowness of scope is evident in the examples used to illustrate particular points or to develop specific applications. The vast majority make reference to the salmon stocks of British Columbia (Walters is a professor in the Department of Zoology at the University of British Columbia). Choosing examples of fisheries besides Pacific coast salmon would have given the book a broader applicability.

Somewhat disappointing is Walters' failure to consider economics directly in his management models. Although he clearly appreciates the importance of economic analysis in formulating management policies for renewable resources, his management models usually identify the objective or target to be met as maximum harvest or maximum dollar value of catch from the fish stocks. Walters focuses primarily on managing the biological side of the system, he pays

less attention to the economic issues raised by free access to common property resources. One could argue that the principles of adaptive management can be applied to the harvesting industry as well as to resource stocks themselves. It is unfortunate that Walters omits the substantial economics literature on models of regulation of renewable resource industries.

One of the book's strong points is also one of its drawbacks. Walters writes with an acerbic, strongly opinionated style. He frequently makes pointed remarks about researchers, scientists, and resource managers. For example, "Much of the literature on feedback policy design begins by pretending the problem [of changes in the amount of information available about the resource over time] away. This very bold pretense has been justified in two ways. First, it makes the mathematical analysis more tractable, and hence the analyst can publish more papers" (pp. 274-75). Although such comments, which appear throughout the book, make for lively reading, Walters sometimes appears to be talking down to his audience. Particularly troublesome in this regard is chapter 3, which in large measure is an advertisement for a workshop run by Walters and his colleagues to educate resource analysts and managers in adaptive management techniques.

Despite these problems I do recommend the book to resource economists interested in or familiar with fisheries issues. Given the orientation of the author toward commercial fish resources, the book will probably be less useful to economists or managers in other areas, who may find the technical material on fisheries models somewhat hard to follow. Those working in other fields may, however, find some of the other, nonfisheries material interesting or useful, particularly the chapters on management under uncertainty.

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