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# **Natural Environments**

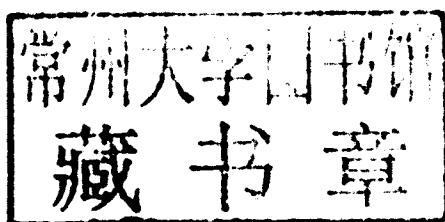
**Studies in Theoretical &  
Applied Analysis**

**John V. Krutilla**

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**John V. Krutilla**



Washington, DC • London

First published in 1972 by Resources for the Future

This edition first published in 2011 by RFF Press, an imprint of Earthscan

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Earthscan LLC, 1616 P Street, NW, Washington, DC 20036, USA

Earthscan Ltd, Dunstan House, 14a St Cross Street, London EC1N 8XA, UK

Earthscan publishes in association with the International Institute for Environment and Development

For more information on RFF Press and Earthscan publications, see [www.rffpress.org](http://www.rffpress.org) and [www.earthscan.co.uk](http://www.earthscan.co.uk) or write to [earthinfo@earthscan.co.uk](mailto:earthinfo@earthscan.co.uk)

ISBN: 978-1-61726-029-2 (Volume 6)

ISBN: 978-1-61726-003-2 (Environmental and Resource Economics set)

ISBN: 978-1-61726-000-1 (Resources for the Future Library Collection)

A catalogue record for this book is available from the British Library

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# NATURAL ENVIRONMENTS

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and Applied Analysis*

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*Studies in Theoretical  
and Applied Analysis*

*Edited by JOHN V. KRUTILLA*

*Published for*

*Resources for the Future, Inc.*

*By The Johns Hopkins University Press, Baltimore and London*

RESOURCES FOR THE FUTURE, INC.  
1755 Massachusetts Avenue, N.W., Washington, D.C. 20036

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These papers are part of the RFF natural environments program, which is directed by John V. Krutilla.

*RFF editors:* Mark Reinsberg, Vera W. Dodds, Nora E. Roots, Tadd Fisher.

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Manufactured in the United States of America

The Johns Hopkins University Press, Baltimore, Maryland 21218  
The Johns Hopkins University Press Ltd., London

Library of Congress Catalog Card Number 72-4441

ISBN: 978-1-61726-029-2

Library of Congress Cataloging in Publication data will  
be found on the last printed page of this book.



## *Acknowledgments*

The papers included in this volume were first presented at a workshop sponsored by Resources for the Future in cooperation with the University of Montana School of Forestry and the U.S. Forest Service Forestry Sciences Laboratory at Missoula. I wish to acknowledge the assistance given by Arnold Bolle, Dean of the School of Forestry, and Robert Lucas, Director's Representative of the Forestry Sciences Laboratory. A large debt of gratitude is due both George H. Stankey of the Forestry Sciences Laboratory and to Robert Wambach of the School of Forestry for attending to local arrangements and helping in a myriad of other ways. We appreciate, of course, the contributions of the authors of papers published here and the contributions of J. A. Edwards, K. G. Gibbs, L. J. Guedry, and H. H. Stoevener whose paper will be published by the Oregon Agricultural Experiment Station.

A debt that is difficult to acknowledge properly is owed the discussants who prepared written comments directed toward aiding the authors in the revision of research reports preparatory to publication. Many of these discussion papers merit publication in their own right and would have been included except for the exigencies of the volume's format. While the authors acknowledge their debt to the discussants, it is nonetheless appropriate to cite them here: Blair Bower, Resources for the Future; William Burch, Yale University; Oscar Burt, Montana State University; Charles Goldman, University of California, Davis; Jon Goldstein, Joint Economic Committee; Robert Lucas, U.S. Forest Service; Cecil Law, Queen's University; David Lowenthal, American Geographic Society; Karl-Göran Mäler, University of Stockholm; Donald McCaughron,

University of Washington; James McEvoy, University of California, Davis; Clifford Russell, Resources for the Future; Vernon Ruttan, University of Minnesota; Gunter Schramm, University of Michigan; Ervin Zube, University of Massachusetts.

In addition to the written comments, many constructive suggestions were offered in a less formal way by invited guests. To all of the participants, then, I wish to accord at least symbolic authorship and to express my gratitude for their contributions to a successful workshop.

J.V.K.

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# *Introduction*

JOHN V. KRUTILLA \*

The organization of economic activity in the United States stems from a system wherein property rights are vested in private parties. In spite of this and the historic policy designed to transfer lands from the public domain to private claimants as a means of national development, roughly a third of the land area of the United States remains publicly owned. Considering all federal, state, and local government lands, there are roughly three-quarters of a billion acres in public ownership. Nearly a half of this public land, however, is in Alaska where the final disposal of much federally-owned land is being undertaken currently as part of the arrangements associated with Alaska's relatively recent transition to statehood.

If we consider only the coterminous United States, approximately a fifth of the total area is federally owned. The Bureau of Land Management and the Forest Service, with 175 million and 166 million acres respectively in coterminous United States, are the two principal public land management agencies. Each one administers an area that approximates the combined area of Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, and Romania. It is clear then, that the lands in federal ownership represent a significant part of the nation's total land and land-related resources.

To some extent the land remaining in the public domain has not been claimed under the Homestead Act and other land disposal programs because of the characteristics of the land itself. This is true of much of the

\* Economist, Resources for the Future, Inc.

arid and semiarid land of the Southwest and the rugged terrain of the Sierras, Cascades, and Rockies. But there have also been specific reservations to preserve outstanding scenic or unusual natural areas. These reservations are exemplified by the National Park Service lands (16 million acres in coterminous United States) and the areas set aside as national wildlife refuges (9.9 million acres in coterminous United States) administered by the Bureau of Sport Fisheries and Wildlife.

Much of the land in federal ownership is undeveloped—largely for reasons that explain why it has not been privately claimed. It is inhospitable to homesteading or commercial food and fiber production. It also represents, in the main, the more marginal lands for silviculture. By the same token it represents the bulk of the remaining roadless areas within the country with much of the nation's scenic and wildlife attractions preserved on these lands.

There are currently 10 million acres of roadless, undeveloped land within the Forest Service holdings that have been established as part of a National Wilderness System under terms of the Wilderness Act of 1964. Another 4 million acres in lands classified by the Forest Service as "Primitive Areas" are being reviewed for possible inclusion within the National Wilderness System as are other roadless tracts of land administered by various agencies in the Department of the Interior. In the aggregate there may be as much as 50 million acres of wildland suitable for reservations under either the Wilderness Act or the Wild and Scenic Rivers Act of 1968.

Some of these unprotected *de facto* wilderness land and water areas have the capacity to serve incompatible objectives as well.<sup>1</sup> These lands are being looked upon to provide some of the timber for the vastly increased level of housing construction to which the Nixon Administration is committed, requiring, it is alleged, almost a doubling of the rate of timber harvest from the National Forests over the next decade. The public domain and other federal lands also represent the sites of much of the new mineral exploration. If mines are located in previously undisturbed roadless areas, they may destroy the characteristics that now make these areas suitable for consideration as additions to the protected

<sup>1</sup> While much of this land and its related resources are submarginal for the commercial production of natural resource commodities, there are numerous government policies that directly or indirectly subsidize the production of timber and minerals and the development of land and water resources. (Judged by free market criteria, such exploitation is uneconomic.) Examples of such subsidies can be found in the practice of "deficit sales" by the Forest Service; in allowing capital to be treated as current outlays in the "expensing" practices under tax regulations applying to mineral exploitation; and in the heavy capital subsidies reflected in interest rates used in federal and other public investment in water resource development.

wilderness system. Similarly, hydroelectric power and other multipurpose water resource developments often impinge on scenic areas even when such projects are not located on wilderness tracts or wild reaches of rivers. Furthermore, the reservation of wild rivers and lands for recreational purposes does not necessarily eliminate the conflict over incompatible uses, as is illustrated by the controversy over the high-density recreation development proposed for Mineral King Valley, carried to the courts by proponents of less-developed, lower-density outdoor recreation facilities.

Conflicts over using natural environments in ways that will destroy their natural characteristics have increasingly been taken to the courts. Storm King, Hells Canyon, Trans-Alaska Pipeline, Cassatot, and many others come to mind as examples where those who wish to preserve the value of environmental amenities have opposed land and water development, mining, or logging in natural environments. That the controversies are so intense and the challenge to federal agency decisions on proposed reallocation of natural areas so great are attributable to the fact that it will be difficult, if not impossible, to reverse the environmental transformations that will result from such exploitation.

With so many decisions to be made about wildlands, wildlife, aquatic environments, and scenic resources, it is important to have the best possible information available. The evolution of methodology for analyzing such problems more adequately than has been possible in the past may lead to research results that will support more informed administrative decisions by land management agencies—decisions that can be defended with sufficient cogency to avoid the tortuous route through the courts. The analytical problems are difficult ones. Yet progress is being made, and modest though it may be, there is merit in presenting results of the first round of concerted effort in this area.

This volume, then, addresses allocative decisions relevant to an enormous amount of land—some of it in private ownership but most of it public land whose resources represent the outcome of a rather selective process of public land disposal. Much of the remaining public land, as noted earlier, does not lend itself to the commercial production of natural resource commodities, but it does contain the preponderance of the grand scenic areas and other sources of environmental amenities sought by the American public.

At the root of the problem of preserving aesthetic environments are the adverse effects of extractive industries. These effects occur when private property resources are used in a way that impairs the quality or availability of common property and fugitive resources. Strip mining is a case in point. Other examples are the damming of a wild river in a

scenic stretch, and the effects on migratory waterfowl of draining wetlands in the interest of agricultural production. Static externalities of this kind constitute one of the themes running throughout the problem of managing wildlands, wildlife, and scenic resources.

Another kind of externality that presents special problems is an intertemporal externality. An action taken by one party today may have an irreversible outcome, closing out an option that would otherwise have been open to him or to another tomorrow. There is need, however, to make a careful distinction in this connection. Admittedly, almost every action has an irreversible element, and often it is no cause for concern. Even the Audubon Society, an organization dedicated to the protection and preservation of birds, can carry in its official publication a picture of a mixed bag of grouse, woodcock, and rail, along with a Parker Double used in bagging them, accompanying an article by a well-known sportsman.<sup>2</sup> The Society's view on hunting appears to be that not every bird, but rather every species of birds is to be protected.<sup>3</sup> The irreversibility is total in the demise of either the entire species or a single bird, but in the latter case there are many close substitutes represented by other members of the species. The death of the last viable mating pair, however, represents the loss of a unique element for which there is no substitute, i.e., the genetic information required for reproduction of members of the species.

The issue of irreplaceability extends beyond the survival of biological species. The question of whether Hells Canyon should be retained in its present state or developed for power turns largely on its uniqueness and scenic grandeur. One of the papers in this volume approaches this problem from an economic standpoint employing economic analysis. In other papers other disciplines are called upon. An investigation of the aesthetic dimensions of the landscape represents the application of the expertise of a landscape architect. A related paper by a psychologist tests the objective validity of the dimensions proposed by the architect. Both involve the identification, classification, and inventorying of different landscape types, ranking them in some array as a means of determining their relative scarcity, whether they lack adequate substitutes, and how this factor should be taken into account in allocating the given land area to other, and perhaps incompatible, purposes.

Not infrequently the basic information needed to form judgments about allocations is still inadequate. This is especially true of aquatic environments. One of the studies in this collection is an effort to develop means of sorting likes from unlikes as a first step toward determining

<sup>2</sup> *Audubon*, January 1972, p. 16.

<sup>3</sup> *Ibid.*, p. 98.



how many members of a given set of aquatic environments we have and which sets warrant the most concern because of the relative scarcity of their members.

### THE PAPERS IN BRIEF

The nine papers in this book are summarized below in order of their appearance. Each of them is directed toward one of the diverse problems involved in decisions about the use or management of natural areas. One of the papers represents research carried out as part of the U.S. Forest Service Wilderness Research Project, with which Resources for the Future maintains liaison. The others were undertaken directly or supported by RFF.

#### *Alternative Uses of Natural Environments*

Some attributes of the natural environment, such as the grand scenic wonders or the genetic information of given species, are the result of evolution, the accidents of geomorphology or ecological succession measurable in time spans that far exceed the planning horizon of mankind. Decisions that irreversibly affect these features of the environment entail a special responsibility and differ in character from decisions whose consequences can be undone if hindsight shows them to be undesirable. There is always the risk of shortsightedness under circumstances of this sort, and yet the conventional criteria used for choices under such situations will involve a myopic bias. Fisher, Krutilla, and Cicchetti address this problem in their paper "Alternative Uses of Natural Environments." Employing the analytics of optimal control theory, the study develops basic decision criteria for problems involving choice between incompatible alternatives with irreversible consequences.

A related issue arises from the probability that the relative benefits from the mutually exclusive alternatives may change over time because of the differential incidence of technological progress. If a natural area, being a "gift of nature" not producible by man, provides recreational services that enter directly into the utility functions of individuals, then technological advances are not likely to be able to augment the flow of such services significantly, if at all. At the same time, the gains in technology in the producible goods and services sector represent gains in real income. There is evidence, moreover, that the demand for amenity services of natural endowments is income-elastic. Accordingly, with the demand for such services increasing, but the supply remaining substantially fixed, there are grounds for expecting that the relative prices or benefits per unit of such services will increase over time along with the gains in real income.