guments & gave my method of deduction. . . . Ramsay jumps over & says in an airy manner that the deduction of at[omic] weights by the α particle method was all very well but had been completely upset by his discovery that the emanations changed into neon. I was up & in three sentences told him I didn't believe the latter. The chairman jumped in & Ramsay left. . . . [At another session] Ramsay got up & said that the neon expt. was quite sure. . . . I was called on & gave a brief account of my experiments on the changes of Eman[ation] into neon over water or rather on the absence of neon & that the neon he got was due to the air let in his apparatus.

Boltwood in reply wishes that

. . . I had only known in advance what a fine bull-baiting exhibition there was to be. . . . Why even to hear about it has done me more good than a six months vacation. . . . [Ramsay] should be absolutely discredited in all matters radioactive . . .

All the more so since Boltwood, from an earlier letter, seems to have felt Ramsay to be infectious: "What have you been doing to [Frederick] Soddy and what under heaven made him write such an asinine letter to *Nature*? Has he been bitten by Ramsay?" Finally Rutherford, in his reply, piles up such damning evidence that he seems able but reluctant to accommodate Boltwood: "I feel the Lord has delivered him into my hands but now have qualms about rubbing it in too hard."

This is an engaging and useful book, and a scholarly community of diverse persuasions might well join in thanks for having it delivered, although at a customary outrageous price, into its hands.

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Economists on Resource Management

The Pacific Salmon Fisheries. A Study of Irrational Conservation. JAMES A. CRUTCHFIELD and GIULIO PONTECORVO. Published for Resources for the Future by the Johns Hopkins Press, Baltimore, 1969. xii + 220 pp., illus. $6.

This is the latest salvo in a series of broadsides fired by a small group of economists at fishery managers, legislators, the fishing industry, and to some extent at fishery biologists over the last 15 years or so. Briefly stated, the authors' thesis is that "rational fishery management must evolve from the objectives of maximizing the net *economic* yield of the resource" (pp. 6–7). With respect to the salmon fisheries (and they observe that the same general conclusions can be drawn for any mature American fishery) they make these points:

1) Despite considerable investment in research, artificial propagation, and regulatory measures, the resource is at best holding its own and in several important areas is clearly overfished.

2) Even where stocks have been rebuilt, potential economic gains from research and management have been dissipated by free entry into the fishery, which has eliminated the economic rent that should accrue under rational exploitation.

3) The reason for this anomalous situation is that fishery resources are common property resources, or as the authors prefer to put it, "open access resources." If there is any profit in a fishery new units tend to move in until the profit disappears and fishermen make only wages, and often poor wages at that.

4) Excess fishing effort threatens the resource, and regulatory authorities are forced to react by placing increasingly stringent restrictions on efficiency.

5) The situation is aggravated by the biologist's concept of maximum sustainable yield as the objective of fishery management and his tendency to look upon the economist's criterion of maximum economic yield (because it often is reached at a considerably lower total catch than is the maximum sustainable biological yield) as leading to waste of a part of the potential harvest.

6) The solution is to reduce fishing power not by limiting the efficiency of individual units or setting catch quotas, as usually is done, but by limiting the numbers of fishermen, boats, units of gear, and perhaps processing plants to that level which will produce the maximum net economic yield. This, in effect, would create property rights in the resource, and a fishing license would become a valuable economic asset.

The argument of the economists is undeniably valid, and the soundness of limited entry is understood clearly by most of the leading fishery scientists and administrators today. Indeed, the concept in its essential features was put forward by a fishery biologist nearly 30 years ago (R. A. Nesbit, *U.S. Fish Wildlife Serv. Spec. Sci. Rep. 18* [1943], pp. 23, 61), and despite the emotional opposition that invariably accompanies such radical ideas in the fishing industry, was adopted by the State of Maryland in 1942. (See R. E. Tiller, "The Maryland Fishery Management Plan," *Maryland Board Nat. Resources Dept. Res. Educ. Ser. 1, 2, 5,* and *6* [1944–45]). That the plan did not work is no condemnation of the concept. It was an idea whose time had not yet come. Unfortunately, limited entry may still be too radical for easy acceptance.

What Crutchfield and Pontecorvo have accomplished in this study is to estimate the potential net economic yield of the Pacific coast commercial salmon fisheries. Their estimates are rough, as they freely acknowledge, but I am inclined to accept their view that they are conservative. Paucity of good economic data is a serious obstacle to accurate estimates for any fishery. The authors come up with an estimate of about $50 million as the saving that would accrue from a rational management plan for the major salmon resources of Alaska, British Columbia, the Pacific Northwest, and California. They conclude that, despite the enormous difficulties of finding politically acceptable mechanisms, the stakes are high enough to make the effort worthwhile. This is an encouraging conclusion, because economic considerations are playing an increasingly dominant role in policy and program decisions of the federal government. The Bureau of the Budget and the President's Council of Economic Advisers are aware of the present economic irrationality of fishery management and are taking a harder line on budgets for fishery research and development. The time is ripe for a thorough review of fishery policy and programs.

The principal obstacle to rational management is the impotence of the federal government with regard to domestic fishery management and the difficulty of obtaining uniform and

consistent action by the states. The government does take the lead in management of international fisheries beyond territorial waters, but the individual states defend vigorously their right to pass and enforce domestic fishery laws. The federal government has not chosen to challenge this view, although some people believe that federal regulation of species shipped and sold in interstate commerce would be proper. As this book states, federal management during the territorial regime in Alaska was not effective, not because the administrators were incompetent (in fact, the resident administrators in Alaska immediately prior to statehood were highly competent and courageous), but because the inflexibility of the regulations framed in Washington and the political power of the absentee industry (based in San Francisco and Seattle) hampered their actions.

The study proceeds systematically to examine the theory of fishery management, showing again that the biological objective of maximum (or optimum) sustainable yield needs to be modified if it is to make sense to economists. Chapter 2 explains some of the biological and economic models on which the theory is based, although it is far from a complete review of fishery population dynamics. The last section of this chapter is a good account of the frustrating cycle of problems facing the fishermen of a common property resource, but the language is more technical than what goes before. This is unfortunate, because many of the people who need to be convinced will have trouble understanding the argument. Here, as elsewhere in the book, appear terms such as "oligopsonistic" and "monopsony," used only by economists. A glossary would have been helpful.

Chapters 3 through 6 are mainly descriptive. They describe salmon fishing gear and regulation of the fishery and recount the history of the fishery and its social-political setting and the history of regulation. The authors build up a strong case for the "inevitability of economic waste under unrestricted salmon fishing; and . . . waste and confusion in any management program not geared . . . to the objective of economic efficiency in harvesting." Chapter 7 goes into the subject of potential economic yield from the Alaska salmon fisheries. Despite the admitted roughness of the estimates, this chapter is one of the most important sections of the book, providing as it does the basis for the regulatory program proposed later. Chapters 8 and 9 proceed in the same way to describe the background and history of regulation in the salmon fisheries of Puget Sound.

Chapter 10 attempts to estimate the economic potential of other important salmon fisheries, in California, the Columbia River, British Columbia, and southeastern Alaska. The figures for the Columbia River and southeastern Alaska appear to me to be mere guesses, and the authors do not claim that they are anything more, except to observe that they are conservative. They reach the following important and encouraging conclusion:

> No one should minimize the enormous difficulties of devising politically acceptable programs that would move us in the direction of an efficient fishing and management program, but it can hardly be denied that the stakes are high enough to make the effort worthwhile.

They then go on to recommend a program the essential element of which is systematic reduction in the amount of gear licensed.

The important implication of this conclusion is that if a fishery as complicated and difficult to control as the salmon fishery has this economic potential, all of our other major fisheries probably do also. This argument should be attractive to the Bureau of the Budget, but it cannot have much effect in resolving the question of federal funding of commercial fishery research and development until workable methods of limiting entry are available. Achieving limited entry will be difficult, because most fishermen do not understand the idea and each sees the proposal as likely to hurt him. Consequently the fishermen's major champions in Congress also are opposed to its implementation.

Limited entry would resolve a major problem of the fisherman, however. It is coming to be understood and appreciated by more and more people, and is almost certain to be adopted generally in the United States sooner or later. It is to be hoped that it will not be left to come about as most improvements in fishery management have, when the resource is so reduced and the economic status of industry so bad that the surviving industry will turn in desperation to any solution.

The preoccupation of economists with limited entry tends to obscure the complexities of fishery problems. Those who are not familiar with the fishing industry may conclude that a management regime designed to produce maximum economic return to fishermen and to the economy is the one thing needed to put the industry on a sound economic basis. But limited entry might not confer any advantage on the other important segment of industry, the processors and distributors, except to provide double insurance that the resource would not be overfished biologically. In some fisheries, as demand increases and technology improves, revenue and costs may be affected so that the point of maximum net economic yield approaches the point of maximum sustainable biological yield, but this stage will not be reached generally in commercial fisheries for some time, and in some fisheries probably never.

With a few exceptions, the processing segment of the U.S. fishing industry does not control the primary producing segment. As a unit, the processing and distributing segment is economically much the stronger. The large firms, which have diversified their fishery activities in various ways, use imported fish as well as fish caught domestically, and many of them also have large investments in foreign fisheries. They are virtually independent of the domestic fishery fleet, and indeed they might be better off with maximum sustainable biological yield than with maximum economic catch; in Alaska, as the authors point out on page 54, the processors' costs are more or less fixed, as they probably are in all regions, and thus profits are a function of the marginal catch.

Many smaller processors and distributors are not in this happy position. Many of them depend entirely on local production and often on a single species. Examples are the many small oyster and blue-crab processing houses and the menhaden industry on the Atlantic and Gulf of Mexico coasts and the salmon industry of Alaska. These processors are highly vulnerable to variations in the biological supply. Regulation of the fisheries for maximum net economic yield could be disadvantageous to them on two major counts: their total supply of raw material usually would be reduced, and their bargaining position with the fish-

erman could be damaged. Thus reduced political pressure from fishermen might well be balanced by increased pressure from small processors, and the ability of federal or state governments to maintain rational management regimes and effective programs of research and development might not be substantially improved. Of course, limited entry would reduce the fisherman's harvesting costs, and some of these benefits probably would be passed on to the processor, distributor, and consumer.

The authors virtually ignore these countervailing reactions and, to this reviewer, this makes the whole thing sound too easy (difficult though even these solutions are).

I noted a few errors and inconsistencies in the book. For example, on page 25 the authors say that "excessive escapement could conceivably result in slower growth, though there is no scientific evidence one way or the other." I believe there is considerable published evidence that during lake residence growth of red salmon is an inverse function of stock size. On page 46 the prohibition on monofilament nylon gill nets is cited as an efficiency-limiting regulation, and the authors leave the impression that the prohibition is economically unsound. It should be recognized that there may be sound economic arguments against the use of synthetic materials, especially on the high seas. Lost nets of virtually indestructible nylon could continue catching fish for long periods and are suspected of being a serious danger to the resource.

On page 92 it is stated that "it seems unlikely that any general basis for assessing the success of a hatchery program will be developed in the near future." On page 190, however, the authors refer to the federal-state evaluation of the Columbia River program, which they say "should provide definitive answers as to the economic contribution of [the] program." Although the published evaluations (D. D. Worlund, R. J. Wahle, P. D. Zimmer, *U.S. Fish Wildlife Serv. Fishery Bull.* **67**, 361 [1969]), which clearly demonstrate that benefits far outweigh costs, were not available at the time this book was written, the authors could scarcely have been unaware that promising results had already been obtained.

On page 201 it is stated that

> There is no record of a major fishery management scheme that was not introduced in an atmosphere of desperation after the evidence of severe depletion had become too obvious for any explanation other than overfishing.

This is not true. For example, the member nations of the Inter-American Tropical Tuna Commission agreed to a catch quota for yellowfin tuna in the eastern tropical Pacific while the resource was still in healthy condition.

Some features of the book would be annoying to me if I were not already generally familiar with the literature, and with the geography of the Pacific coast. I do not like literature citations as footnotes. They are even less helpful when they appear merely as authors' names in the text, with no other citation, as on page 25. The map on page 52 presumably was included as a guide to place names, but Yakutat, Prince William Sound, Cook Inlet, the Alaskan Peninsula, and Unimak Pass, all of which are mentioned in the text, are not identified. Anyone not familiar with the history of Alaskan salmon regulations would be hard put to find out what the "White Act," referred to on page 70, is; this is jargon for the act of 6 June 1924 (**43** Stat. 464). In several places different common names are used for the same species with no indication of their identity. The book that is entirely free of such things has yet to be written, but these imperfections suggest hasty editorial review.

The foreword, by Francis T. Christy, Jr., leaves the impression that United States fisheries are in chaos and that this all can be changed magically by limiting access. Christy says there is "no way of preventing declining yields" and that "fishery administrators have been reluctant to accept the theory and adopt the new institutions and new forms of management that are required." I challenge both statements. Yields have been maintained in various fisheries by setting quotas or by other devices. (If Christy means "no way of preventing declining yields per unit of fishing effort" he is correct.) And perhaps fishery administrators are being more practical than economists in recognizing the political realities: fishermen will not willingly accept regulation until signs of damage are clear to them, and few processors will see the logic of catching less than the biological surplus.

This book is an important contribution to the theory of fishery management. It is certain to stimulate biologists and economists to dig even more deeply. When sociologists begin to take an equal interest in the fascinating problems of open access resources and team up with economists and biologists, the differences between economists and biologists should begin to disappear.

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