SCIENTIFIC RESEARCH AND THE TWENTIETH-CENTURY FISHING INDUSTRY

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The 1981-82 California Sea Grant College Program directory includes two projects devoted to the history of public policymaking for the fisheries.[1] This indicates, I think, a new and salutary trend in the study and management of natural resources in the public domain. Long isolated in their various specializations, scientists and scholars interested in natural resources have, since the 1960s, begun to look across disciplinary boundaries for new perspectives on problems that draw their common concern. They have also begun to examine their own role in the making of policy—analyzing the ways in which scientists and other scholars, successfully or not, have tried at various stages in our history to contribute their expertise to developing government policy for resource use.

For students of law and society, J. Willard Hurst of the University of Wisconsin Law School set the example in 1964 with the publication of his monumental study of the role of law in the history of the Wisconsin lumber industry.[2] Hurst's work moved beyond the more typical, doctrinal study of legal change to analyze the ways in which law worked in society, both as an instrument and as a measure of social change. Harry N. Scheiber of the School of Law at the University of California, Berkeley, is likewise well known for his studies of property law and police power, and is currently completing a major work on the development of natural resource law in California.[3] My own work on law, ecology, and economic development in the California fisheries builds on the foundation laid by Hurst, Scheiber, and others, and accords the resources themselves their rightful places as independent agents of historical change.

Clearly, natural resources are more than mere commodities to be brought into the market as technology and demand dictate. They have histories of their own: they influence the course of human affairs through their independent dynamism and through their characteristic responses to human activities. In much the same way as Hurst and his followers have changed the study of law and society, several historians since 1970 have begun to move away from the traditional emphasis in environmental studies on intellectuals' ideas about their natural surroundings. These historians are making an effort to understand (1) how the ecology of natural resources affects their use and (2) the development of social institutions governing that use.[4]

Among natural scientists, Ciriacy-Wantrup set a similar example in a 1952 text on resource conservation, defining *conservation* as a dynamic process influenced by social, economic, and political institutions as much as by the character of the resources themselves.[5] More recently, Richard A. Walker admonished us not to forget that we do not address resource policy questions innocent of history, politics, or of "commitments to pre-existing threads of ideology passed down from those who have grappled with similar problems before."[6] Walker trenchantly observed that effective resource management requires the understanding and manipulation of the human processes that lead people to use nature in particular ways, as well as of the physical and biological processes that we try to harness to our advantage.[7]

Fishery science also has begun to take these issues seriously. The awakening here began soon after World War II, when economists interested in the "common property" problem pointed out that fishery depletion was as much a matter of economic institutions as it was one of biology or population dynamics.[8] The Fisheries Conservation and Management Act of 1976 (FCMA) institutionalized this awareness by mandating the harvest of socially and economically optimized yields (OY) from the stocks under its view.[9] Unlike the earlier, more "objective" concept of maximum sustainable yield (MSY), OY is by itself a slippery and ill-defined standard for policy, but it does oblige lawmakers to make explicit decisions about social and economic concerns—to look at the human side of resource use—when they set guidelines for industry.

All of these developments have their roots in the increasing postwar awareness of the interdependence of different economic activities and of the economy and the environment from which it draws resources. The 1970s, especially, brought a great blossoming of integrated research and legislation along these lines, in many areas of resource policy. The inflation of energy prices, the collapse of the international monetary system, and the emergence of major problems in agriculture and the fisheries worldwide stimulated the new developments of the last decade.[10]

In spite of these advances, however, there remains the old problem of bringing scientific knowledge of natural resources to bear on the legal processes it is designed to inform. Governments and universities invest a great deal of money and energy to illuminate alternatives available to policymakers, but as often as not they have little practical effect. Nowhere is this

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[1]Please see "Literature Cited," at the end of this paper, for all numbered references.

more apparent than in the area of fisheries management—a uniquely public concern, but one heavily burdened with traditional ideologies and vested interests that make it almost impossible for government to act effectively on the basis of scientific information of whatever character. Scientists in the pay of the California Fish and Game Commission, for example, pointed repeatedly to the impending collapse of the state's sardine fishery and pleaded annually for harvest restrictions for many years before the stocks finally did collapse in the late 1940s. What was it about the character of government research and policymaking, and the relationship between them, that prevented enlightened administration of the public's trust in this valuable resource?

California's public effort to adapt modern, integrated scientific research to the management of commercial fisheries began during the World War I era. The institutional structure of modern, industrial-bureaucratic fishery management took shape during this period, when technological progress and growing markets gave birth to the motorized, oceangoing fisheries of the twentieth century. From the very outset of the modern regime, there have been repeated calls from biologists, politicians, and even the industry itself for a coherent, scientific approach to fishery management, although it is only in the last decade or so that we have seen much real progress toward that end. The obstacles to integrated research and policymaking that scientists and lawmakers of the World War I era faced, moreover, were identical to those that confront their modern heirs. Many of the ideological and institutional stumbling blocks that thwarted effective use of scientific knowledge in the century's second and third decades were inherited from the nineteenth century, and continued through the twentieth to hamper California's efforts to undertake the multidisciplinary, integrated research and policymaking that its modern fisheries needed.

The scientists who came during the World War I era to study management problems in California's then-new tuna, sardine, and other pelagic fisheries brought a legacy of more than a century of government-sponsored efforts to apply scientific knowledge to the lawmaking process. According to Hurst, indeed, "no part of the legal history of the United States is more important than the relation between substantive public policy and the acquisition and application of scientific and technical knowledge."[11] The United States has a long history of cooperation between scientists and government. It began in the very earliest years of the republic, when the Jefferson administration established the Army Corps of Engineers in 1802 and in the following year packed Lewis and Clark off to take stock of the Louisiana bargain. The Smithsonian Institution, the National Academy of Sciences, and the colleges of agriculture all date from the Civil War years or earlier.[12] Efforts at wildlife conservation began at midcentury, when the environmental costs of industrialization began coming due. As pollution and waterpower development began to take their toll on the salmon fisheries of the Northeast in the 1860s, New England state governments founded administrative agencies to study fishery problems and draft remedial statutes.[13] In 1870 California organized its own State Board of Fish Commissioners, which quickly became one of the most progressive and most emulated in the country.[14] A year later, the federal government founded the United States Fish Commission as an arm of the Smithsonian Institution. In 1903, on the eve of the industrial revolution in fishing, Congress transferred the federal fishery agency to the Commerce Department, where it now survives as the National Marine Fisheries Service.[15]

State and federal governments conceived of their constitutional obligation to secure the blessings of liberty for their constituents in two ways. On the one hand, to be sure, liberty meant the pursuit of profitable self-expression unhampered by arbitrary incursions of state power. The California Constitution of 1879, for example, protected citizens' right to enter public lands and lands sold by the state to private owners in order to fish the waters that flowed through them.[16] Liberty also meant, on the other hand, possessing options, or being free to choose from a wide range of opportunities to make one's fortune.[17] Here lay the *raison d'être* of government-sponsored research and development in the nineteenth century: to provide citizens with technical information and access to tools and resources with which to increase their mastery over their physical and market environments.

Beginning in the Civil War era, as Hurst observed, the people of this nation began to realize that the most important limitations on their opportunities to use natural resources stemmed not from the sheer physical difficulty of recovering them and bringing them to market, but rather from their ignorance of how the natural environment worked and how most efficiently to work with it.[18] From this first acquaintance with the complexity of resource ecology came the approach of the early fishery agencies, with their emphases on describing the morphology and life histories of important species, transplanting exotic varieties to depleted or unproductive waters, and artificially propagating the salmon and trout species most in demand.[19]

There were serious deficiencies, however, in the structure of nineteenth-century public resource agencies and the methods they used—deficiencies that

would make heavy baggage indeed for fishery managers in the industrial age. One was that, with few exceptions, neither state nor federal governments made any effort to coordinate the research and development activities of their constituent agencies across related resource policy fields, nor any effort to establish explicit priorities for their work.[20] Related to this was the problem of divided jurisdiction: each agency had its own narrow policy concerns and its own goals and tactics for implementing them. This often led to interagency conflict, which in turn permitted special interests to harness particular agencies to their own purposes.[21]

Finally, and most important, a fundamental weakness in the nineteenth-century approach was that the primary objective of public research was to create opportunities for continued economic growth rather than to discover where the ecology of natural resources obstructed increasing harvests of timber, fisheries, and other resources. Recognizing inherent limitations in the use of particular resources and their interrelatedness with others would have obliged public agencies to make conscious trade-offs between increasing the yield of one resource or another, or between increasing yields in the short term and conserving a resource's productivity for future use. Governments, though, justified the regulatory power they vested in their administrative agencies by maintaining that they gave to industry as well as took away from it, that in addition to policing industry's use of natural resources they also created opportunities for industry to use resources in new and more efficient ways and thus to grow. Promotion and regulation thus went hand in hand in the public management of natural resources. American citizens believed they paid taxes so that government could expand their field of options, not restrict it. This would create serious political problems for twentieth-century agencies like the California Fish and Game Commission or the federal Environmental Protection Agency, which tend to be both regulatory and inhibitive, rather than promotional, *vis-à-vis* the economy.

John Radovich pointed out, for example, that the federal and California state fishery agencies have from the outset had two very different missions: that of the federal has been to promote the development of the fishing industry; that of the state has been, in the words of its charter, to "restore and preserve the fish in state waters."[22] The contrast stems from the difference in each agency's charter and in the opposing constituencies that each of them served. Federal involvement in the fisheries dates from early in the Republic, when Congress generously subsidized the cod fisheries because it believed they were strategically valuable nurseries of seamen for the navy and the merchant marine. In return for bounties on the catch, Congress demanded that the industry conform to federal regulations as to vessel safety, the citizenship of crews, and the like; the industry was in surprising degree federally controlled. Whaling, likewise, benefited from federal subsidies to U.S. shipping because it was an important source of foreign exchange in the early economy.[23] The state agency, on the other hand, was the child of well-to-do sportfishing enthusiasts who wished to restrict access to game fish to ensure an adequate supply for their purposes. These sportsmen have always played major roles on fish and game commissions in California, though at no time as significantly as they did in the commission's first half-century or so.[24]

The interests of these two groups and their captive agencies converged in the late nineteenth century. Each took a great deal of satisfaction from artificial propagation, for example, because it seemed so miraculously to keep fishermen employed and sportsmen entertained. Hatcheries, indeed, consumed by far the largest share of state and federal fishery agencies' fiscal resources until well into the twentieth century, though there was not a shred of hard evidence that they had the slightest effect on the abundance of the stocks concerned.[25] There were good, objective reasons for this emphasis. The empirical, unsophisticated character of most nineteenth-century research meant that most advances in fishery management came not from specialists but from interested amateurs like Livingston Stone, a Unitarian preacher who took up field research in California for his health, and became the guiding force of the country's hatchery movement.[26] Stone persisted in what John N. Cobb later called an "idolatrous" faith in the hatchery panacea because, as Stone put it, "should the Commission make a success of a single river . . . it would pay for all that has been expended in this direction."[27]

That public promotional-regulatory efforts could replace what economic profligacy had destroyed became a shibboleth of U.S. natural resource policy that proved very hard to discredit. A U.S. Bureau of Fisheries agent, for example, observed in the early years of the twentieth century that "through restrictive legislation and artificial propagation," California had maintained the productivity of its salmon fisheries "in the face of most unfavorable conditions."[28] Perhaps the most significant legacy from nineteenth-century fishery managers to their harassed industrial-era successors was this faith in the ability of public agencies and their scientific hirelings to rehabilitate damaged natural systems, abetted largely by economic and ecological circumstances only remotely related to the fisheries themselves. (These included changes in

temperatures and precipitation, the decline of hydraulic mining in the Sacramento watershed, and other factors.)[29]

Weaknesses built into the structure of public resource administration during the nineteenth century came into sharp focus during the early years of the twentieth, when state and national governments made new efforts to incorporate deliberate planning and advanced scientific research into the regulation of extractive industries for the now-mature industrial economy. Theodore Roosevelt's administration, highly touted for this conservationism by contemporary partisans and by historians, made concerted efforts to bring interagency coordination and expert planning to natural resource development, especially in forestry and watershed reclamation. In forestry, these efforts failed to surmount competition between special interests entrenched in the USDA's Forest Service and in the Department of the Interior. Efforts at planned, multiple-purpose watershed development fell before the resistance of the U.S. Army Corps of Engineers, the oldest expert agency in government. The Corps' opposition was crucial to the defeat of the multiple-use concept in the Water Power Act of 1920; Samuel P. Hays marked this defeat as the end of the Progressive Conservation movement.[30] During the New Deal, likewise, the Tennessee Valley Authority began as a multipurpose, multiple-agency program to enhance economic development and social welfare in a chronically impoverished area, but quickly became little more than just another power company.[31] On the West Coast, the California Fish and Game Commission entered the century "one of the oldest and most highly respected public agencies in state government" anywhere, but by the end of the World War I period was one of the most harassed.[32]

Public research and administration efforts did increase greatly in sophistication with the onset of the new age, however, especially in the fisheries. By 1910 serious declines in the productivity of fisheries in the North Sea and on the west coast of North America finally made clear to anyone who would pay attention that unregulated harvesting could in fact destroy valuable fisheries.[33] This realization, coupled with the phenomenal growth that motorized, seagoing vessels and wartime demand for processed food brought to California fisheries, led to major changes in the structure of the state's fishery management effort and brought it forward into what became essentially its modern form.[34]

The Fish and Game Commission began by retaining William F. Thompson, who in 1915 had published a pathbreaking study of the North Pacific halibut fishery for the government of British Columbia. Thompson was the first to incorporate some knowledge of economic development into his treatment of fishery problems.[35] Charged with researching the now-important sardine fishery and ensconced in a new laboratory at San Pedro, Thompson hired a skilled team of young biologists with training at California universities, including Frances N. Clark, John O. Snyder, and F.C. Weymouth. Thompson's team introduced California to the catch-per-unit-effort measure—an economic index as opposed to a strictly biological or physical one—and stressed for the first time the critical importance of analyzing natural fluctuations in sardine populations and their potential impact on the industry. The team's mission was to try to pinpoint the fishery's sustainable yield and sound the warning to the commission when the industry reached it.[36]

Other areas of government became interested in fisheries research, as well. USDA, in the service of a rapidly modernizing agricultural sector, commissioned several studies during the World War I era on the use of fishery byproducts for fertilizer and feedstocks.[37] USDA's efforts, begun in an attempt to find profitable uses for cannery waste and for species with little or no commercial value, ironically generated a huge industry devoted to producing fishmeal from whole sardines as well as from cannery offal. This new interest became one of the Fish and Game Commission's most intransigent foes during the interwar period and was ultimately responsible for the demise of the sardine stocks.[38] The California State Board of Health, after several people in other states succumbed to botulism from canned California sardines, worked with the canning industry to establish and enforce quality control standards for sardines.[39] The U.S. Bureau of Fisheries, meanwhile, experimented with processing methods for different species of fish that it felt had commercial potential. The bureau worked throughout the 1920s to improve the technology of sardine canning to help the industry provide a cheaper and better product.[40] Supposedly, this would have fattened the canners' profit margins and relieved them of their dependence on the more profitable and resource-intensive production of fishmeal, but in the absence of meaningful state controls on byproduct manufacture the bureau's promotional effort came to naught.[41]

All of these other agencies' efforts served particular constituencies desiring a steadily increasing supply of cheap raw material from the fisheries. Originally formed to serve a small group of well-to-do sportsmen, the Fish and Game Commission stood alone against these powerful and focused interests and had sole responsibility for recommending to the legislature where limits might be set. The commission's mandate,

"to restore and preserve the fish in state waters," was too broad to achieve without specific legislative priorities and adequate resources for meeting them. Thus, whatever conclusions scientists could draw from their rudimentary study of such a complex ecological system as the California Current proved vulnerable to focused political attack from industrial and agricultural interests, all with coherent programs of their own and many friends in government. "Must the scientist always be on the defensive?" complained an anonymous researcher in the commission's quarterly magazine, *California Fish and Game*.[42] "There is probably no division of state government," wailed the commissioners themselves in 1928, "confronted with such difficult and uphill problems, and yet more subject to critical scrutiny, than the Division of Fish and Game."[43] The interwar commissioners might have remembered the cry of their similarly beleaguered predecessors early in the agency's history, who observed that "neither the fish, the public, nor the future of the business appear to have many friends."[44] Faced with so powerful an array of special interests, all demanding that the government promote increased harvests, the commission could do little but plead with the legislature for restrictions. Thompson admitted as much in 1919. "As in the case of the great meat packing corporations," he wrote,

> the public is demanding an actual regulation of the whole fishing industry . . . The question of economic control is, however, not at present placed in the hands of the Fish and Game Commission. It is the Commission's concern to insure a supply, then to aid in its proper and efficient use, and not—at present—to exercise any legal control over the economic phases of the industries.[45]

In defense of the badly damaged inland salmon fisheries, likewise, the Fish and Game Commission pleaded with the California State Division of Water Rights to guarantee minimum stream flows in salmon rivers, but to no avail.[46]

There were demands like those to which Thompson referred, however. Market fishermen in the Bay Area wanted the state to manage the industry so that they might be freed from the power of wholesale fish distributors to fix ex-vessel prices at low levels. Consumers, outraged at the high cost and low quality of both fishery and agricultural produce, demanded public markets for those commodities. Within the Fish and Game Commission, scientists, lawyers, and commissioners pointed repeatedly to the futility of undertaking conservation research without the power to promulgate even emergency conservation measures, and repeatedly asked for authority to set catch limits on sardines and salmon. Bills toward these ends passed the state legislature in 1915 and 1919, but met both times with gubernatorial vetoes.[47] As the sardine fishery collapsed in the mid-1940s, the commission finally asked for power to limit the number of plants producing fishmeal so that a smaller number of firms might more profitably share the reduced supply and thus have less incentive to deplete the stocks still further. The state Attorney General again informed the commission that it did not have the power to regulate economic conditions in the fishery, even if to conservationist ends.[48]

Milner B. Schaefer pointed out in the 1960s that the commission's early disquiet with the fishmeal industry stemmed from its knowledge that the state lacked the capacity to regulate an industry of the scale that fishmeal production was assuming in the 1920s.[49] This was, in fact, the root of the state's inability to save the sardine, despite the certain knowledge of its scientists that the sardine would not long support harvests as intense as those the processors were taking, that increasing harvests were bringing only steady or decreasing catches per unit effort, and despite the annual warnings after 1930 that the fishery's collapse might be imminent. When it came, the collapse was spectacular. The shadow of this failure of the state to translate knowledge into effective law hangs over the commission, through no fault of its own, to this day.

The great growth in the funding, reach, and power of public resource agencies like the California Fish and Game Commission that took place during the World War I era left unsolved two fundamental problems. First, the fragmented structure of decision-making in public resource management served to diffuse responsibility for making policy in areas that, under the pressure of economic growth and technological change, were steadily becoming more interdependent. This decreased the likelihood that prudent, informed policymaking would take place in any of them. The traditional quid pro quo of police regulation to promote economic growth gave interests favoring intensified harvesting of depletable resources a distinct advantage over those whose mission was to limit exploitation within ecologically prudent bounds. Second, this dispersion of authority among several agencies—and the consequent ability of growth-oriented, narrow interests to capture and use them to focus their political power onto the lawmaking process—made it ever less likely that a broad range of interests would be represented fairly.[50] In the case of the fisheries, the underrepresented interests included those of the consumers, the fishermen, future genera-

tions of Californians, and even, in the last analysis, the producers and consumers of fishmeal themselves.

Much progress toward solving these problems has taken place since World War II. Economists, natural scientists, and legal scholars have begun to convince lawmakers that the fisheries and other resource industries are, in fact, human industries and that their regulation is a social and economic problem as well as a mathematical or biological one. Since the late 1960s fishery agencies have abandoned MSY as an objective of fishery regulation.[51] FCMA, like most of the environmental legislation of the 1970s, enjoins management agencies to consider the social, political, and economic interests of all the constituencies affected by their industrial policing. FCMA also, as John E. Kelly pointed out, provides an institutional framework for balancing conflicting local and national interests. Power to set optimum yields is vested in regional councils representing affected constituencies, and power to promulgate actual regulations lies at the federal level, where each of these functions might most effectively be carried out.[52]

Scientific policymaking is not and never has been a "scientific," politically neutral process. Samuel P. Hays, in *Conservation and the Gospel of Efficiency,* showed how delegating power over the economic use of resources to technically expert agencies has profoundly antidemocratic implications.[53] But, as Hurst reminded us, democracy and liberty have two aspects: they entail both being left alone in the pursuit of profit, and having options to pursue it. Two hundred years ago proponents of the new, more powerful central government outlined in the 1787 constitution answered the fears of local interests by observing that uncoordinated, decentralized government in the states had in fact failed to protect the liberty and security that the states felt were threatened by powerful national government.[54] At this point, it should be clear that only by rationally planning resource use, by severely restricting citizens' license to use the fisheries and other resources, can government hope to preserve the opportunities of future citizens to use them at all.

We should also remember, when we quail at the power of recently established environmental and resource agencies and the ambiguity of their mandates, that the common law—the foundation of our legal culture—never has required that we base regulation on perfect knowledge of the resources themselves. The California Supreme Court, for example, in a 1925 decision upholding the authority of the Fish and Game Commission to set quotas on the production of fishmeal, said only that "experience has proven" that fisheries may be depleted by a very few years of intensive harvesting, and that the state had the power to regulate or prohibit use of the fisheries in any way it chose so long as doing so *tended* to preserve the public's interest in its commonly owned wildlife resources. In that case, industry's claim that there was no apparent limit to the supply of sardines in the California Current and that the state could point to no imminent, objective danger to the stocks from the fishmeal industry was immaterial, though the "contrary was not unsupported by the facts" in the case at hand. The state, moreover, had every right to delegate "a large measure of discretion" to administrative agencies and their scientific advisers to protect that trust.[55] Intelligent eyeballing, as it were, is all that the law requires. That intelligent eyeballing failed to save the sardine fishery in the interwar period was a function of the powerlessness of the scientists who foresaw its doom and the corresponding ability of focused economic and political interests to *keep* the Fish and Game Commission powerless. The common law of wildlife empowers the state to protect its fisheries as it sees fit; however, it was up to the legislature to establish effective means of doing so.

"One might argue," Walker noted, "that in a democracy the necessary role of science is in the formulation of political positions on major issues, not in the provision of technical solutions to those issues."[56] This, in fact, is what scientists and scholars in public service have always done, whether or not they have been explicit about it or even conscious of it. Ultimately, choices and trade-offs are made politically, and the reason we put scientists on the public payroll is to help us make those choices in an informed way. With FCMA and the other now-embattled environmental acts of the late 1960s and 1970s, Congress recognized that resource management is every bit as much a political problem as it is a scientific one. The success of those programs, in turn, will demand that scientists bring to their work a knowledge of history and a willingness to examine critically their own assumptions and ideologies. In proposing and effecting intelligent resource policy, scientists must vigorously exercise their citizenship as well as their expertise on behalf of the whole people, now and in the future.

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