Pacific Salmon, Ecological Health, and Public Policy

by

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Pacific Salmon, Ecological Health, and Public Policy[1]

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Abstract

Many salmon "stocks" (a term used in fisheries management for a group of interbreeding individuals that is roughly equivalent to "population") have declined, and a significant but unknown number have been extirpated. The decline of the salmon in the Pacific Northwest has an interesting twist: No species of salmon is in danger of near-term extinction, but many individual stocks have declined, and some stocks have become extinct. Economically, the consequences of listing any significant number of salmon stocks as endangered or threatened would be massive and would dwarf the impacts of listing the northern spotted owl. As a public policy issue, the problem of reversing the decline of salmon is more correctly viewed as a choice among competing alternatives. Transferring the concept of human health to salmon policy choices may not help; in fact, it might cloud the fundamental choices society must make. This is partly because health is one of those amoeba-like words that changes to fit the surrounding conditions. The salmon problem illustrates a class of ecological policy issues that will become increasingly common. These issues share a number of general characteristics: (1) Complexity -- There is an almost unlimited set of alternatives and tradeoffs facing the public and officials responsible for making decisions; (2) Polarization -- Issues tend to be extremely divisive because they represent a clash between competing values; (3) Winners and losers -- Any decision will benefit some individuals and groups and not others, and this tradeoff is well known to the general public; (4) Delayed consequences -- There is no immediate "fix" and the benefits, if any, of painful decisions are not obvious for many years; (5) Decision distortion -- These are not the kinds of issues that a democracy addresses smoothly because it is very easy for advocates to appeal to strongly held values; and (6) Ambiguous role of science -- Scientific information is important but usually not pivotal in the choice of an alternative when the choice is primarily driven by value judgments. The expected implications of each alternative public choice should be fully and clearly explained, including the short- and long-term consequences. Scientists must exercise great care to avoid abusing their positions as independent counsel.

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Introduction

Many Pacific salmon "stocks" (a term used in fisheries management for a group of interbreeding individuals that is roughly equivalent to "population") have declined, and a significant but unknown number have been extirpated. Over 200 stocks are classified as "at risk" (Nehlsen *et al.*, 1991). There is uncertainty over the historical number of stocks (perhaps 1,000 to 2,000), the status of individual stocks, and the causes of the decline of particular stocks, but the general conclusion is clear: There *is* a widespread decline of salmon in the Pacific Northwest. California, Oregon, Washington, and Idaho represent the southern range of the geographic distribution of Pacific salmon in North America and the location where the decline is most acute. In contrast, Alaska's salmon stocks are thriving and supporting record catches (Nehlsen, 1996). Further, the aquaculture industry can spawn and raise salmon in captivity, produce a quality product, and sell it cheaper than most wild salmon. Ironically, despite the decline of salmon stocks in the Pacific Northwest, salmon have never been more abundant in the retail market because of supplies from aquaculture and Alaskan fisheries (Francis, 1996).

The well-documented decline of the Pacific salmon has an interesting twist: No *species* of salmon is in danger of near-term extinction, but many individual stocks are declining, and some stocks have been extirpated. What action -- if any -- is warranted remains one of the most contentious political issues in the region. Some advocate that all salmon stocks in danger of extinction should be listed immediately as threatened or endangered, which will invoke the full force of the Endangered Species Act. An opposing view is that less disruptive approaches, such as a moratorium on fishing, or perhaps spilling more water from the dams, should be employed before the act is used. Besides, the act with its single species approach is a simplistic last resort to addressing complex, ecologically constrained public policy questions.

Economically, the consequences of listing any significant number of salmon stocks as endangered or threatened would be massive, dwarfing even the impacts of listing the northern spotted owl. The geographic area could include the entire Pacific Northwest (Lichatowich *et al.*, 1996). Even though social and economic perturbations would be great, it has been asserted that such actions are long overdue and that they are the only way left to save the remaining salmon stocks. After all, salmon have historically served as a cultural and natural icon for the region, as well as supporting a major industry. Some argue that the Pacific salmon ought to be preserved at any cost to society.

From a political perspective, the salmon debate has split Pacific Northwest congressional delegations and parties, resulting in a highly polarized debate. There is agreement that restoration of salmon stocks, if undertaken seriously, will be expensive and socially disruptive. Some contend that the hour is late and that something drastic needs to be done before many additional stocks become extinct. But one opposing view holds that this position just reflects another example of environmental elitism. After all, there is little chance that any salmon *species* will be driven to extinction in the foreseeable future. Hatcheries can produce salmon reliably and comparatively cheaply, although the cost of producing "naturally" returning hatchery-bred salmon has increased dramatically. To most people it makes no difference whether the salmon in the creel or the supermarket was spawned in the wild or in captivity.

Values and Priorities

It is common to debate the Pacific salmon problem by focusing on public lands, especially federally controlled forest and range lands. What happens on forest and range lands is important for salmon, but it is the easiest part of the problem to address politically. The more difficult -- and critical -- part of the debate deals with policies and decisions impacting private rural enterprises (especially farming and logging); industry; electricity generation (including hydro, fossil fuel, and nuclear); national defense; urban development; transportation (including road, rail, air, and water); competing personal rights; the prerogatives and roles of local, state, and federal government, and Indian tribes; as well as policies on human population level, reproduction, emigration, and immigration. Overriding all of the policy aspects of the salmon problem is that over the past 100 to 150 centuries, the Pacific Northwest has changed from an uninhabited region to one supporting 13 million people, most of whom live in urban areas.

Viewed in broader terms, the Pacific salmon problem is a clash of fundamentally different values and priorities (Regier, 1996). One position argues that man has a moral obligation to preserve species and that the reason we are in this policy conundrum with salmon is that we failed to make the right choices when they were easier to make. In short, that man needs to adjust to and be part of the environment. Another view is that wild salmon are merely one element of what man values; the future of salmon needs to be evaluated against what the alternative benefits are or might be. This view contends that balancing competing alternatives is the practical, realistic approach, not dogmatically locking into a restrictive, narrow policy position such as saving individual species at nearly any cost.

The rivers of the Pacific Northwest have been crucial to economic development. Rivers, especially the Columbia and its tributaries, were viewed as tremendous untapped resources that could be harnessed to support a strong, productive society. Electricity generation, agriculture, mining, flood control, water and land transportation, and urban development were all dependent on modifying these rivers. As one example of the importance of rivers in the Pacific Northwest, two-thirds of the electricity used in the region comes from dams in the Columbia River basin. However, one of the costs of this development was that salmon populations suffered mightily. (Dams block or delay adults on their spawning run. Young salmon migrating to the ocean may become disoriented by long reaches of slow-moving water, suffer mortality going through or over each dam, and be exposed to voracious predators.) There are different estimates of the size of the historical Columbia River salmon run. Estimates of 10 - 16 million (Northwest Power Planning Council, 1986) and 7 - 9 million (Chapman, 1986) are based on rigorous analysis of various types of data. Before completion of the first mainstem dam in 1935, salmon runs were much reduced. Runs were reduced to about 2.5 million by the 1980s (Northwest Power Planning Council, 1986), but 80% of the Columbia River salmon are now hatchery produced (Lichatowich and Mobrand, 1995).

Perspective

To appreciate the nature of the salmon problem, it is important to understand their biology (Regier, 1996). There are seven species of Pacific salmon and several species of sea run (anadromous) trout. Five of the seven species of Pacific salmon -- chinook, coho, chum, sockeye, and pink -- are found on both sides of the Pacific; two, the masu and amago, are found only on the Asian side. Of the sea run trout, steelhead is the most common and shares many life history characteristics with salmon. Both spawn in freshwater (rivers, streams, or lakes, and certain species occasionally intertidally), spend various lengths of time in freshwater, migrate to the ocean, and spend from one to several years at sea. Depending on the species, salmon and trout from the Pacific Northwest travel along the coast of North America or make a major migration past the Aleutian Islands. Salmon and trout typically return to their stream of origin to spawn. Salmon die after spawning, whereas trout may not. Ocean conditions (especially El Nino events) have a major influence, which can be either positive or negative, on the size of a particular "year class." Adverse ocean conditions (for Pacific Northwest salmon) have existed for the past two decades.

Salmon have always been important to people inhabiting the Pacific Northwest. At the end of the last Ice Age, 10,000 - 15,000 years ago, humans and salmon expanded into the Pacific Northwest. The early aboriginal immigrants gradually developed societies dependent on the annual return of salmon. For the past 3,000 - 5,000 years, there was a rough equilibrium between salmon and human populations because the number of salmon that could be harvested was limited by lack of efficient (at least in most locations) fishing gear; inability to preserve, store, and distribute the catch on a large scale; and foremost, a relatively stable human population of only a few hundred thousand. These conditions changed markedly in the nineteenth century. The first half of the century saw a sudden decrease in human population due to exotic diseases. Starting in the middle to late 1800s, the human population grew rapidly due to major immigration from eastern North America. This growth coincided with the advent of more effective fishing gear and the ability to preserve and distribute the catch in cans. The effect on salmon stocks was massive and rapid. Within six or seven decades many stocks were reduced below levels required to support fishing; some were probably extirpated.

There were many other causes for the decline of salmon besides overfishing (Larkin, 1979). Because most of the Pacific Northwest is arid, and water is a valuable resource for irrigation, water diversions have decimated many stocks. And, since the areas's timber is of high commercial quality and extremely valuable, the harvest of this resource has also had adverse effects on salmon spawning and rearing. Floods historically have been common and devastating, at least from the perspective of most people; therefore flood control has been a societal priority for many years. Dams impede fish passage -- both for returning spawners and migrating young fish -- and hydropower operations have long been a challenge to fisheries managers. Competition for salmon harvest is also severe: recreational, commercial, and Indian fishermen demand a portion of a dwindling catch, politically pressuring fisheries managers to keep the catch high.

Some efforts, particularly artificial propagation, to enhance recovery of salmon stocks may have actually accelerated declines (Goodman, 1990; Meffe, 1992; Waples, 1994; Lichatowich, 1996). Pacific salmon can be easily spawned and raised under artificial conditions in hatcheries. Since the late 1800s, when hatcheries first were used to help enhance salmon stocks, attitudes have evolved from near universal support to widespread skepticism of enhancement. Many individuals are now openly hostile to the use of hatcheries, contending that the 90 hatcheries releasing salmon into the Columbia River system actually worsen conditions for naturally spawning salmon (Wright, 1993). Hatchery produced fish may introduce diseases, compete with naturally spawned fish, and alter genetic diversity (Meffe, 1992). The decline of wild stocks is often masked by the presence of hatchery bred salmon, a situation that takes place even in the presence of near pristine habitat (Goodman, 1990). Others regard this anti-hatchery view as another example of environmental and cultural elitism: Why should society pay for the costs of maintaining wild salmon so a few, affluent individuals can fish for "trophies"? The economic and social cost of maintaining wild salmon stocks is high and will be borne unfairly by the poor, the disadvantaged, and those from communities dependent on natural resources. Still others argue that long-term evolution and survival of salmon depends on the existence of a multitude of viable wild stocks to provide the diverse gene pool required to adapt to future habitat conditions.

Other factors have complicated the salmon problem. One especially troublesome development has been the introduction of non-native species such as walleye, shad, brown trout, brook trout, smallmouth bass, bluegill, crappie, carp, and various minnows. As salmon stocks declined and habitats were altered, these other species moved in to occupy vacated ecological niches. Once these exotic species were established, it was extremely difficult for salmon to reestablish viable stocks against such formidable competition and predation, coupled with an altered habitat no longer favorable to salmon.

Oceanic and climatic factors play an important role in salmon production on both sides of the North Pacific Ocean (Pearcy, 1996). For example, the long-term pattern of the Aleutian low pressure system corresponds with trends in salmon catch (Beamish and Bouillon, 1993). On shorter time scales, El Nino events have a definite effect on salmon stocks. As a practical matter, it is often difficult to determine whether changes in the condition of salmon stocks are due *primarily* to oceanic factors, land-based factors, or natural variation in stock size. Yet, oceanic *and* freshwater conditions affect salmon stocks substantially (Lichatowich, 1996).

Climatic change also affects the condition of salmon stocks although the type and degree of effect are rarely clear. Recent examples of climatic change in the Pacific Northwest are the severe winters of the 1880s when most range cattle were killed, the extreme droughts of the 1910s and 1930s when many farmers were driven off arid lands, and the general drought of the 1970s and 1980s when water use conflicts were exacerbated. If future man-made (or natural) climatic change causes the region to warm, part of the current range of Pacific salmon will be occupied by other fishes better adapted to warmwater habitats.

Policy

From a policy perspective, what is the solution to the Pacific salmon *problem*? The answer to this deceptively simple question is crucial. On the simplest level, salmon stocks are declining and the "public" wants action. As a public policy issue, the question is more correctly addressed as a *choice* among competing alternative solutions (Lee, 1993b). But, are the usual alternatives (e.g., jobs vs. the environment) too simplistic? Do jobs *come* from the environment (Nehlsen, et al., 1992)? Couldn't the policy "problem" be equally formulated in terms of protecting agriculture? Or, maintaining the availability of inexpensive electricity? Even if we decide that the problem ought to be defined in "fish" terms, are we primarily interested in preserving all stocks, or just the most important stocks? From an evolutionary perspective, is it even possible to identify the most "important" stocks? Or, are we interested in maintaining relatively high stock levels so that they are *fishable*? Such questions are not unusual in public debates and public choice. A similar set of questions exists for policies on abortion, welfare, and disease management. Because these kinds of questions are fundamental, yet so difficult to answer, it is often left to the province of *crats* (bureau*crats* and techno*crats*) to implicitly answer them. When *crats* can't satisfactorily answer these questions, the courts will.

Nothing is free when resolving contentious issues in a democracy, and the salmon problem is no exception. For every benefit, there is a cost. Costs, of course, are only partially measured in cash. Other, often more important, costs might be loss of personal freedom and civil rights, including property and fishing rights. Many of the options revolve around decisions about the relative importance of an individual's benefits and rights compared with societal benefits. Further complicating policy analysis is the fact that there are multiple costs -- and benefits -- with each alternative decision. Depending on one's values and political perspective, the terms "good" and "bad" can apply to very different people and institutions.

The political constraints for resolving the salmon problem have evolved over time. Classical natural resource management is divided into a set of decision variables (elements a manager might control such as harvest rates, habitat, and supplemental stocking) and constraints (e.g., species being driven to extinction without due legal process; Lackey, 1979). What is treated as a *constraint* and what is treated as a *decision variable* does change over time. In practice much of what passes for fisheries management is a themeless collage -- "surrealistic aggregations of incongruent management goals, objectives, and actions suggestive of many value systems but truly indicative of none" (Scarnecchia, 1988).

Have fisheries scientists and other technical experts actually hindered resolution of the policy choices surrounding the salmon issue? Natural resource scientists in general, and fisheries scientists in particular, tend to focus on immediate stressors rather than on the socioeconomic decisions that can drive declines in salmon stocks (Hughes, 1996). For example, it is much easier to study the effect of different widths of streamside buffers than to evaluate the effects of subsidized irrigation on salmon stocks. There are good reasons why scientists reduce research problems to such narrow, technical levels. A reductionist approach tends to focus on what is tractable scientifically, but often overlooks the scientific information that is really important in policy analysis. Narrow technical questions are amenable to the classical hypothesis testing traditionally favored in science, but reflect a naive view of ecosystems as machines that can be reduced to their individual parts (Francis, 1996). Effective use of hypothesis testing to better manage ecological resources requires that *treatments* can be manipulated; i.e., dams, dam operation, flow diversions, agricultural runoff, and predation by marine mammals. But such treatments can only be manipulated over a narrow range of alternatives. After all, would society allow for the elimination of agriculture in the Columbia Basin to test its effects on salmon?

Is the salmon problem a local, regional, national, or international issue? Benefits and costs are distributed very differently, depending on the geographical context. For example, if the salmon decline issue is viewed in a national context, benefits of maintaining salmon runs will be "shared" throughout the nation, although the costs (higher electricity rates, fewer agricultural jobs, less commercial development, etc.) will be largely borne locally and regionally. Therefore, whether the salmon problem is viewed as a local or regional problem, or a national one, is a crucial decision.

Health

One increasingly popular approach in describing the salmon problem is to invoke the concept of "health." *Health* is one of those amoeba-like words that changes to fit the surrounding conditions. It is also a word increasingly used to describe ecological resources (or ecosystems) in ways divergent from those applied to individuals. The concept of "health" applied to ecological systems has a common-sense appeal, and many have struggled to rationalize the application of "health" to ecological systems (Beasley, 1993; Norton, 1991; Rapport, 1995).

Everyone wishes to preserve his health. The metaphor of ecological or ecosystem health is superficially appealing. However, some argue that the metaphor is wrong or, at best, of limited utility (Suter, 1993). Among the arguments against using the health metaphor are (1) ecosystems are not organisms and do not behave like organisms, (2) there are no indices of ecosystem health nor is it possible to develop any, (3) use of the term in political debates masks the value judgments that were made --- judgments that are policy choices, not scientific choices. Others (Rapport, 1995) argue in favor of the metaphor as a very useful tool, although not perfect.

At least in a general sense, there is societal consensus about whether an individual person, dog, or cow is healthy. However, when the concept is applied to ecological systems, there is an implicit assumption that there is some ecological condition or state that is *desired or preferred*. To be healthy is desirable; to be sick is not. The condition of salmon stocks is often described against the norm of a healthy stock. Further, the health of salmon stocks is often offered as a valid surrogate for the health of ecosystems. Appealing as health might be for people, there are serious problems in transferring the concept of human health to ecological resources and ecosystems. The word "health" carries so much value-laden meaning from everyday life that it is difficult to use it as a descriptor of ecosystems.

One approach to maintaining ecological "health" is to preserve species from extinction. The Endangered Species Act is the most visible instrument. For the purposes of the act, a "species" (also sometimes referred to as an evolutionarily significant unit) is legally defined as "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." (Waples, 1991). The application of this legal definition to salmon has challenged scientists and policy analysts since passage of the act. At one extreme, a single "species" of salmon, for example, chinook, would be composed of hundreds of "species" (stocks), each of which would have to be protected. At the other extreme, there would be only a single "species" of chinook salmon. The same approach would probably show that many other *species* of fish could be treated similarly. The policy implications of applying the stock concept to all species of fish is beyond comprehension.

The role of science and scientists in defining ecosystem or ecological health is contentious. To categorize something as "healthy" requires an implicit determination of the desired or preferred state (Rapport, 1995). For example, to say that a patch of land is ecologically healthy implies something good, something desired, something preferred to alternative states. However, that same patch of land might be a pristine forest, a highly productive dairy pasture, a fertile field of corn, or a bustling university campus. Which ecosystem is healthiest? In a similar light, why should we define the problem in the Pacific Northwest as a salmon problem? Does that mean that we have tacitly placed salmon ahead of other aspects of our environment? Why not focus on the problem of enhancing inexpensive urban housing, maintaining the availability of cheap food, or minimizing flood risk?

Using the "health" concept in ecosystem management may not clarify, but actually cloud the fundamental choices society must make . Health has moved into the political lexicon, along with words such as *fairness, empowerment, reform, justice*, and so forth, as a term with a politically loaded meaning. After all, who is against any of these? It is only when these terms are defined specifically that the true policy differences are clear. However, Lee (1993a; 1993b) contends that sustainability and ecosystem health are goals, not fixed endpoints, and that these goals should be used as guides to constructive societal decision making. Further, pluralistic societies, in which diverse values can be aired and debated, are actually more effective in solving complex ecological problems than closed societies where optimal solutions are defined centrally (Lee, 1993a; 1993b).

Conclusion

The salmon problem illustrates a class of socially wrenching policy issues that will become increasingly common (Homer-Dixon *et al.*, 1993). Examples are the human response to drought, limitations on property rights, abortion, and the rights of certain individuals vs. the rights of others. These issues share a number of general characteristics: (1) *Complexity* -- There is an almost unlimited set of alternatives and tradeoffs to present to decision officials or the public; (2) *Polarization* -- These issues tend to be extremely divisive because they represent a clash between competing values (Smith and Steel, 1996); (3) *Winners and losers* -- Some individuals and groups will benefit from each choice, while others will not, and the existence of such tradeoffs is well known to the general public; (4) *Delayed consequences* -- There is no immediate "fix," and the benefits, if any, of painful decisions are not obvious for many years; (5) *Decision distortion* -- These are not the kinds of problems that a democracy addresses smoothly because it is very easy for advocates to appeal to strongly held values; and (6) *Ambiguous role of science* -- Scientific information is important but usually not pivotal in the choice of an alternative when the choice is primarily driven by value judgments.

It is easy to despair and conclude that it is impossible to make a choice. The fact is, choices are being made -- even the "no action" option is a choice. They may not be the best choices (*best* being defined as the desires of the majority and the choices being without unexpected consequences), but choices are being made. The will of the majority is tempered, however, with some deference to the "rights" of the minority -- an uneasy political balance at best. Democracy may not be efficient, but history and recent world events show the alternatives to be worse.

An informed public is crucial to choosing the "best" solution to the salmon problem in the Pacific Northwest. It is not easy for the public, or anyone, to deal with the technical complexity of the salmon problem and similar complex environmental policy problems. One critical role of scientists is to provide the scientific information in ways that help create an informed citizenry without advocating any one particular policy choice. This is not a comfortable role for some scientists who hold strong personal views. Some argue that scientists have a right, even an obligation, to advocate policies as citizens in their areas of scientific expertise.

Finally, those of us who are technocrats, scientists, biological resource managers, or scientific advisors should remain humble in our dealings with the public and elected officials and overcome the tendency to advocate *political* choices driven by strong personal interest and packaged under the guise of a scientific imperative. However, it is equally important not to permit tough policy choices to masquerade in the cloak of scientific imperative -- a prostitution of science and scientists that sometimes provides a convenient cover for avoiding difficult social choices. The complete implications of each alternative public choice should be fully and clearly explained, including the short- and long-term consequences. This is the proper role of scientists, and we must exercise great care not to abuse our positions as independent counsel.

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