

## Options to Protect, Restore, and Enhance Wild Salmon: *Insights from the Salmon 2100 Project*<sup>1</sup>

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## Abstract

*The overall public policy goal of restoring runs of wild Pacific salmon in California, Oregon, Washington, Idaho, and southern British Columbia enjoys widespread public support. Billions of dollars have been spent in a so-far failed attempt to reverse the long-term, general decline of wild salmon in this region of western North America. Of the Earth's four regions where salmon runs occurred historically (Asian Far East, Atlantic Europe, eastern North America, and western North America), it appears probable that this region of western North America, without a dramatic change in current and long-term trends, will emulate the other three: extirpated or much reduced runs. Since 1850, an array of factors has caused the decline and a plethora of specific impediments has prevented their recovery. The primary goal of the Salmon 2100 Project was to identify practical options that have a high probability of maintaining biologically significant, sustainable populations of wild salmon. The Project enlisted 33 scientists, policy analysts, and policy advocates, all well versed and experienced in salmon science and policy. Three overarching realities must be addressed if society wishes to prevent the remaining current runs from becoming remnant populations by 2100: (1) in large part, because of altered and restricted freshwater habitat, salmon runs continue to be at low levels compared to historical abundances and thus recovery efforts start with relatively few wild fish; (2) restoring wild salmon is only one of many priorities that society professes and society must make drastic changes in individual and collective life style choices if wild salmon have any chance at recovery; and (3) the human population trajectory for British Columbia, Washington, Oregon, and Idaho must change dramatically for any wild salmon recovery effort to have much chance of success (California's human population is already large and will be much larger by 2100). The Salmon 2100 Project developed 23 different recovery strategies, each of which likely would be ecologically viable (i.e., it would actually recovery wild salmon) and appreciably less socially disruptive than are current strategies, but each of the 23 options also has much more modest restoration objectives, requires extensive hatchery or other aquacultural intervention, and/or involves creating protected areas. Most policy prescriptions fall into one of four general categories: (1) technological intervention often accompanied by a recalibration of the notion or definition of what is a "wild" salmon; (2) triage approaches that would concentrate recovery efforts on areas where successful recovery is most likely; (3) revamped salmon recovery bureaucracies and institutions including jettisoning "symbolic politics" pervasive in salmon policy; and (4) changed individual and societal behaviors. The policy prescriptions developed as part of the Salmon 2100 Project, if implemented, would likely restore wild salmon runs, though most would require significant alterations in people's lifestyles.*

## Introduction

When asked to present my thoughts about the future of salmon, I was reluctant. Mostly I was reluctant because what can anyone add to what is reported about salmon recovery nearly every day in newspapers and newscasts? We are bombarded with information about salmon — not just science and technology, but arguments about complex, unpleasant policy choices, and, of course, advocacy spin from across the political spectrum. Many of us I know and the public I suspect suffer from salmon fatigue.

But the request from the conference program committee was not your everyday, generic request for a boilerplate discussion of salmon recovery. It turned out that what they wanted from me was an unvarnished assessment of the long-term future of wild salmon and, equally important, what society must do if wild salmon runs are to be restored.

They challenged me to characterize the fundamental, the critical, the basic barriers that must be breached in order to recover wild salmon runs. The challenge sounded enticing, but I could see through such a request. I was being set up to provoke, to challenge, to roil the placid waters of conventional wisdom. But, as all successful program committees must be, they were persistent, persuasive, and, in the end, convincing.

So, against my natural inclinations to recite the typical, generic discourse — light, amusing, fluffy, general, safe, long on bureaucratic process, short on biological results — banished from my assessment will be the usual (1) feel-good platitudes about the importance of restoring wild salmon runs, (2) the appeals to delusional reality that most of us in the salmon business know are simply rhetoric, (3) the cheer-leading for enticing, but unattainable policy objectives, or (4) the win-win happy talk that these days often passes for serious policy deliberation.

Nor will I (1) add another gloom-and-doom talk to the dozens most of us have already heard, (2) contribute another to the long list of feel-good technofix bromides, (3) effuse over the apparent recent improvements in wild fish runs, and, most important, pitch the policy objectives of any particular organization, including my own.

I have made my share of all those kinds of contributions, but not here, not where the focus is on serious analysis of watersheds and sustainability. I will step back from the details and particulars of salmon science and policy and add a small dose of reality. Perhaps it will be an unpleasant, even unwelcome dose to some, but a necessary dose of reality as I see it.

In short, I will try to answer a simple, but incendiary question: *“What are the fundamental barriers to recovering Pacific Northwest wild salmon and how might these barriers be breached?”* My answer consists of only three barriers: *legacies, choices, and trajectories.*

## Legacies

As we move into a new century, Pacific Northwest wild salmon, in spite of ups and downs, good years and bad years, favorable and unfavorable ocean conditions, and newspaper accounts of record runs, have been on a 150 year downward trend — and they are now at very low levels (Lichatowich 1999, Lackey 2003).

Wild Pacific salmon in the lower 48 states are well on their way to attaining a status enjoyed by some of their notable brethren — wolves, condors, grizzlies, bison — wild animals that are unlikely to disappear entirely, but struggle to hang on as remnants of once flourishing species in small portions of their original range. Ted Turner of CNN fame may be marketing the superior taste of buffalo burgers, but *wild* bison hang on as a remnant population in Yellowstone and a few other refuges. So it has also become for wild salmon in this part of the world.

Wild salmon are on the road to becoming remnant populations in the lower 48 (Lackey et al 2006). This prognosis should not surprise anyone even marginally familiar with the state of salmon runs. Consider the following facts about the state of wild salmon in California, Oregon, Idaho, Washington, and the Columbia Basin portion of British Columbia. Many runs are reduced to less than 10% of their historical numbers; some are much less than 10%; some are gone. Other salmon runs are dominated by hatchery-bred fish. Even for the Columbia, once the mightiest salmon-producing river south of Canada, over 80% of the total run is now comprised of hatchery-bred fish (Lackey 2003).

Celebrating the “record” salmon runs from the past couple of years, due mainly to favorable ocean conditions, reflects a recalibration of what constitutes “good” runs. If doubling a run from 5% to 10% of the historical level is what we now call success, we are there! And, even with this modest increase, the majority of these runs continue to be hatchery-bred fish.

People in the Pacific Northwest were — and remain — concerned about the decline of the once immense salmon runs. Billions of dollars already have been spent in a so-far failed attempt to reverse the long-term decline (GAO 2002).

This region’s trend of salmon decline is not unique. Of the Earth’s four regions where Pacific and Atlantic salmon runs originally occurred (the other three being the Asian Far East, Atlantic Europe, and eastern North America), it looks increasingly like western North America by 2100 will emulate the other three: (1) extirpated or much reduced runs in the southern portions of the distribution; and (2) larger runs, often much reduced but at least closer to historical levels, in the northern portions.

This is a brief synopsis of the legacies that must be overcome if society is really serious about restoring wild salmon. Perhaps it is sobering to some, but it is based, from my perspective, on a realistic assessment of the current situation and the future.

The legacy of much diminished runs of wild salmon is in large part due to altered or inaccessible freshwater and estuarine habitat. The option of using hatcheries or other aquacultural intervention to maintain runs is another story, but given the limited quantity and quality of spawning and rearing habitat now available to salmon, the region will not support self-reproducing runs of *wild* salmon even remotely like those of 1850.

Some wild salmon and habitat restoration possibilities are definitely better than others (Rahr et al 1998). There are relatively healthy runs of wild salmon (and habitat) in some locations. In general, most promising are the coastal watersheds of Northern California, Oregon, Washington, and some areas of southern British Columbia, especially the Fraser River where salmon can reach relatively unaltered interior portions of the watershed. The most efficient way to breach this barrier for wild salmon would be to focus recovery efforts in those geographic locations with the best chance of success, the coastal watersheds.

## Choices

Our choices, both individually and collectively, are perhaps the most obvious, and arguably the most important determinant of the future of wild salmon. Salmon are only one of many, usually conflicting, priorities that society professes to rank high (Lackey 2001b). Societal priorities are dynamic, difficult to forecast, subject to rapid change and, perhaps most frustrating to us salmon technocrats, impossible to rigorously determine in real time. Remember how the recent Pacific Northwest drought and California blackouts affected thinking. Or even more recently, how the terrorist attacks have so drastically recalibrated our collective priorities.

I want to be realistic here and avoid rhetoric and cheer-leading: where does salmon restoration rank within the myriad of competing societal priorities? I do not know the precise answer, but society's collective behavior, not public opinion polls, will give us some indication. Let me recap the past 150 years from a salmon-centric policy perspective and offer several specific examples.

**1820** — With the arrival of substantial numbers of trappers in the early part of the 19<sup>th</sup> century, the systematic harvest of beavers began in earnest. Large numbers of beaver can considerably alter the aquatic environment and in most cases such alterations improves salmon rearing habitat. As beaver populations declined from trapping, many salmon runs were adversely affected. As competition intensified between the United States and Britain for control of the Pacific Northwest, the British Hudsons Bay Company adopted a policy of leaving no beaver in the watersheds they trapped. Without beavers to trap, the American fur trappers (and settlers) would be less likely to come to the Pacific Northwest. The overall effect on salmon of the loss of beavers is unknown, but is likely to be very great.

**1848** — The question of whether wild salmon will continue to exist in the western United States is not a new one. The decline started in earnest with the 1849 California gold rush. By the 1850s, excessive harvest and the impacts of mining activities were decimating salmon in streams surrounding the California Central Valley. In response, by the 1870s the Federal government had begun a massive California hatchery program in an unsuccessful attempt to reverse the decline.

**1870** — In the Central Valley of California, after a 30 year decline in salmon runs, supplemental stocking from hatcheries was widely viewed as the solution to declining salmon runs (Black 1995). In salmon policy debates, by the beginning of the 20<sup>th</sup> century, hatcheries had won out over preserving or restoring natural habitat, and hatchery-bred fish won out over wild salmon. Little more than a century later, protecting *wild* salmon is the paramount statutory dictum. Now hatchery bashing is in vogue, and it is hatcheries that are under siege as the nemesis of restoring wild salmon runs (Taylor 1999). There continues to be discussion about closing some, or even all, salmon hatcheries. To be sure, part of the change in society's priorities is due to better understanding of the biology of salmon, but most is due to changing values.

**1905** — The mantra was “reclaim the Klamath Basin.” Create productive farmland by irrigation. In the competition between societal priorities, irrigated agriculture won out over salmon. Over the next several decades, millions were spent to develop an elaborate system of dams and canals in the Basin. Now, at least for the Klamath Basin, based on regional and national polling data, society ranks salmon and suckers above agriculture for use of scarce water.

**1933** — The mantra was “put people to work.” Combat the devastating social effects of the Great Depression. Massive public works projects, such as many of the high dams of the Columbia Basin, were built even though the ruinous effect on wild salmon was well known. A single dam, the Grand Coulee, completely and permanently blocked a quarter of the Columbia Basin to migratory salmon, a thousand miles of the mainstem river lost to salmon in a single action. We knew precisely what would happen to those runs of wild salmon. The Depression and public works projects won out over salmon. Now, we are less sure of our priorities and spend millions, even billions, trying to compensate for this lost habitat (GAO 2002).

**1942** — The posters proclaimed “America — the Arsenal of Democracy.” Electrical generation in the Pacific Northwest was greatly increased to supply the voracious appetites of aluminum smelters. The hydro-power was here; the war-time demand for aluminum was acute; the public support was near universal. Turbines, operating at maximum capacity seven days per week, 24 hours per day, for four years, chewed up salmon at devastating rates. It was a war, after all, and bombers won out over salmon. Now most Pacific Northwest aluminum smelters are shut down because they can make more money selling their electrical contracts than manufacturing aluminum.

**1948** — Widespread floods caused disastrous effects across this region. Vanport, adjacent to the Columbia River and the second largest city in Oregon, was swept away. The politicians of the day heeded the public’s call for protection and we built many flood control dams in Washington, Oregon, Idaho, and British Columbia. Society collectively demanded that human life and property be protected (Buchal 1998). Flood control won out over wild salmon. Now, a major flood, such as the one that occurred in 1996, brings few calls for additional flood control.

**1991** — The first salmon “distinct population segment” was listed under terms of the Endangered Species Act. With this action, the policy debate shifted away from restoring salmon runs in order to support fishing to protecting salmon runs from extinction, two very different policy objectives (Lackey 2001a). A century ago no one cared much whether a salmon started life in a hatchery or in a stream. Now, hatchery-produced salmon are not the restoration solution, they are part of the restoration problem, at least according to many (Scarce 2000).

**2001** — Just a decade later, a severe drought, combined with ongoing California blackouts, provoked the Bonneville Power Administration to declare a power emergency, abandon previously agreed upon interagency salmon flow release targets, and generate electricity using water reserved to help salmon migrate. In one of the most striking recent barometers of competing societal priorities, electricity won out over salmon, and with scant public opposition.

Not one of these public policy decisions made over the past 200 years was inherently good or bad. Each simply reflected the priorities or legal interpretations of the time, coupled with a strong dose of optimism that we could have our cake and eat it too.

So that is the second barrier: *society’s choices*, the many competing, conflicting, divisive priorities, and the fact that, when forced to make a choice, most people will trade wild salmon recovery for another alternative. I am not cheer-leading for or against wild salmon, electricity, property rights, salmon hatcheries, dredging shipping channels, or any other societal priority. It is naive, however, to consider salmon recovery as anything but one element, often one minor element, in a constellation of competing, often mutually exclusive, societal wants, needs, and preferences. It appears that most people are, or at least have been, willing to sacrifice wild salmon to achieve a suite of other priorities.

## Trajectories

This barrier is perhaps even more important than the first two, but is the easiest to gloss over. As one of my colleagues cautioned me when we discussed barriers to salmon recovery: “You are absolutely right, most people already know it, and that is exactly why you should let it rest.” Undoubtedly he offered very good advice. If society wishes, however, to do anything meaningful about moving wild salmon off their current long-term downward trend, then something must be done about the unrelenting growth in the number of humans in the Pacific Northwest. The simple fact is that the human population level that we should realistically anticipate by the end of this century is a serious barrier, a show stopper, to achieving any kind of significant long-term wild salmon recovery (Lackey 2001b).

Currently, Washington, Oregon, Idaho, and British Columbia are home to 15 million humans. Assuming a range of likely human reproductive rates, internal migration to the Pacific Northwest, and continuing immigration policy and patterns, in 2100 this region’s human population will be somewhere between 50 and 100 million: a quadrupling of the region’s human population by the end of this century — less than 100 years from now (Lackey 2003).

If we end this century with 50 to 100 million people inhabiting this region — and their demands for housing, schools, tennis courts, football stadiums, expressways, planes, trains, automobiles, Starbucks, MacDonald’s, WalMarts, electricity, drinking water, pipelines, marinas, computers, HDTVs, movie theaters, ski resorts, golf courses, sewer treatment plants, hotels, and conference centers — then society’s options for having wild salmon in significant numbers in this part of the world are just about non-existent. Good water quality is achievable. Maintaining prosperous populations of fish species better adapted to altered aquatic environments (*e.g.*, walleye, smallmouth bass, and American shad) is also possible. But with high human populations and their associated lifestyle requirements, the future of *wild* salmon is not good (Hartman, Groot, and Northcote, 2000).

There is not an exact one-to-one relationship that a given human population increase inexorably results in a predictable decrease in salmon run size, but the general, unmistakable relationships are there: (1) as the human population of the Asian Far East expanded, so salmon runs declined; (2) as the human population of Europe expanded, so salmon runs declined; and (3) as the human population of eastern North America expanded, so salmon runs declined.

The Pacific Northwest human population trajectory will have to be changed dramatically for wild salmon to have any chance to recover (Hartman et al 2000). *Could* society reverse the trajectory? Yes, it is possible. It is happening in some European countries and Japan, but, as I interpret the demographic data, there is little indication that it will happen any time soon in the Pacific Northwest. World-wide birth rates are generally declining, but they are still above replacement levels in the Pacific Northwest. And, of course, the proclivity of people moving into the region shows no sign of abating.

*Should* the rate of Pacific Northwest human population growth be slowed or even stabilized? That question will be answered by society collectively and individuals personally through decisions made over decades. All of us can assess the inevitable consequences for wild salmon, but that does not mean that society *ought* to change public policy on human population growth.

*Assuming* that society collectively wants to do something about population growth, and that is a contentious assumption, how could it be done? To illustrate the kind of personal and societal changes that might be made, let me be specific by offering some concrete examples. An obvious point of influence is personal mobility, the fact that two-thirds of the growth rate is caused by people moving to the Northwest from elsewhere. Restricting personal mobility would have a major effect on the trajectory, but, as I read the public's mood, it does not appear to me that personal mobility, the freedom to relocate as desired, will be restricted any time soon.

Another point of *possible* influence on human population growth, and equally controversial, is tax policy, the fact that taxpayers have, intentionally or not, for a long time, and currently still do, provide direct monetary subsidies to those members of society who reproduce. As with personal mobility, I do not see the public any time soon shifting away from supporting such tax deductions, or even tax credits, for each new child born. I could be wrong, but I do not see such issues on the legislative table for the foreseeable future.

There are many other public policy choices that could alter the Pacific Northwest human population trajectory, but none appear likely to be widely embraced in the near future. Whether my assessment is right or wrong, population issues are not easy ones to raise, much less discuss without resorting to policy advocacy, but the current and expected population level is at the core of any credible analysis of potential recovery strategies, or at least those strategies that are offered as serious attempts to actually recover wild salmon.

## The Salmon 2100 Project

The Salmon 2100 Project began in 2003 as a response to the apparent dichotomy between public and private understanding of the likely future of wild salmon in the region. The overarching goal of the Project was to assess the potential policy options needed to protect and restore wild salmon runs from southern British Columbia southward.

We enlisted 33 salmon scientists, salmon policy analysts, and salmon advocates. They range from hardcore technical scientists to aggressive champions of particular salmon recovery policies, representing a spectrum from quasi-institutional to highly individual opinions. The authors often do not agree with each other, to put it mildly, and several only grudgingly concede each others' right to an opinion about salmon recovery. Nonetheless, all their views enrich the current debate and the book, whether we agree with them or not.

We asked project participants to identify and describe practical policy options that, if adopted, could successfully sustain significant runs of wild salmon in California, Oregon, Washington, Idaho, and southern British Columbia. We did not define what should be considered a significant run, but it was something sufficient to allow for at least some level of sustainable fishing.

Everyone who participated in the project recognized that restoring and maintaining wild salmon in significant numbers through this century is a daunting challenge. Since 1848 with the discovery of gold in California, salmon runs have dramatically declined across the region due to many direct causes: water pollution; loss of spawning, rearing, and riparian habitat from a multitude of human actions; a history of over-fishing; dam construction and operation; water withdrawal for irrigation and industrial cooling; competition with hatchery-produced salmon; competition with various non-indigenous fish species; predation by marine mammals and birds; and climatic and oceanic shifts. These direct causes of the decline were the result of policy choices that arguably reflected society's overall priorities.

The project neither rejects nor advocates any particular policy or class of policies, but we do advocate a serious and informed dialog about the current state of wild salmon, their likely future, and the choices society has to alter that future. The prescriptions offered in the book are universally candid, sometimes uncomfortably radical, and occasionally sobering. Nearly all conclude that major, sometimes wholesale modification of core societal values and preferences will have to occur if significant, sustainable populations of wild salmon are to be present in the region by 2100.

## Policy Prescriptions that Would Work

All Salmon 2100 Project participants were asked to address the same question:

*What specific policies must be implemented in order to have a high probability of sustaining significant runs of wild salmon through 2100 in California, Oregon, Washington, Idaho, and southern British Columbia?*

It is a challenging question and one that forced project participants to address society's failure to restore wild salmon. The salmon recovery policy debate is a puzzle that is characterized by: (1) claims by a strong majority to be supportive of restoring wild salmon runs; (2) competing societal priorities which are at least partially mutually exclusive; (3) the region's rapidly growing human population and its pressure on all natural resources (including salmon and their required habitats); (4) entrenched policy stances in the salmon restoration debate, usually supported by established bureaucracies; (5) society's expectation that experts should be able to solve the salmon problem by using a technological scheme; (6) use of selected experts and "scientific facts" by political proponents to bolster their policy positions; (7) inability of salmon scientists to avoid being placed in particular policy or political camps; and (8) the confusion caused by couching policy positions as scientific imperatives rather than value-based societal preferences.

Somewhat surprising to us, nearly every project participant concluded that current recovery efforts have a low probability of successfully restoring or even sustaining wild salmon runs through this century from southern British Columbia southward. None of the project participants considered recovery hopeless and all concluded that salmon recovery could be accomplished. There was, however, considerable disagreement about how best to recover wild salmon runs, but each author was able to formulate at least one recovery strategy or policy prescription that, if implemented, would successfully restore wild salmon runs to significant levels.

Policy prescriptions tend to fall into one of several broad categories. The categories do not form a clean classification scheme, but we developed the following categorizations to describe what was proposed.

## Category #1 — Employ Technological Intervention

Several authors proposed habitat enhancements (or replacement) based on existing scientific and technological knowledge, including creation of new streams that replace lost or suboptimal salmon habitat. As proposed, an engineered stream could duplicate or even improve natural habitat by providing excellent security, flow control, and nutrient productivity. While much of the technological and scientific knowledge exists to construct these streams, the proponents recognized that new technologies will be needed for efficient operation and refurbishing of streams. Greater genetic knowledge of local stocks would be critical to maintaining salmon distinct to particular watersheds. These proponents suggest that by using what we currently know about salmon habitat and existing technology, society could reverse the proximal causes of salmon habitat loss including removal of dams, allowing floods, restoring vegetation, and reducing logging and road building.

Several authors argued that supplemental stocking from salmon hatcheries will be required to sustain salmon production at fishable levels. While most authors found fault with current hatchery practices, a few suggested that the controversy over *wild vs. hatchery* salmon is misplaced. They argued that the dispersal of hatchery fish to different streams over many decades has resulted in a massive mixing of the gene pool. Recovery programs to achieve genetic purity are thus unrealistic and unnecessary.

Many authors suggested that if a harvestable number of salmon is desired by society, improvements in hatchery effectiveness will be critical. In their view, technology is currently available or could be developed in the near-term to make supplemental stocking a useful tool to assist in salmon recovery.

## Category #2 — Apply Ecological Triage

One of the common types of policy prescriptions was a version of protecting the most productive watersheds by concentrating resources and recovery efforts on them. The rationale for adopting such an approach is that we have not had much luck restoring runs once they have become threatened or endangered, in spite of spending billions of dollars and many years in the effort.

Various authors proposed different types of “triage” approaches, but they shared a common philosophy that at least some streams should be managed as refugia where there is no salmon harvest or other detrimental practices allowed. One proposed, for example, a Wild Salmon National Park distributed across the area and purchased with public money. In support of this policy prescription is the observation that one of the most successful methods for protecting endangered species is to provide national parks where citizens are allowed to experience species in their habitat.

Another proposed approach involves creating salmon sanctuaries in watersheds where society has chosen to ensure that salmon will be protected and restored over the next 100 years. A sanctuary system is thus a social commitment to ensure the survival of salmon given the downward pressures they will face in California, Oregon, Washington, Idaho, and southern British Columbia through this century.

With nearly all the triage strategies, there was a reluctance by proponents to be explicit about writing off (from a wild salmon perspective) the watersheds and regions that show little promise for maintaining wild salmon runs through the century. Based on follow-up conversations with these individuals, there was great reluctance to bluntly identify the “downside” of proposed policy prescriptions.

### **Category #3 — Change Bureaucracy**

Several authors apportioned responsibility for the failure of wild salmon recovery to deficiencies in various elements of governance, decision-making processes or procedures, or failures of specific organizations. From the perspective of these authors, successful salmon recovery would require major changes in what we loosely categorized as the bureaucracy.

The prime candidate for overall change was generally described or categorized as institutional arrangements. Criticisms cover the range from institutions being too centralized to institutions that are too fragmented and decentralized.

Several authors observed that bureaucratic institutions, especially state, provincial, and federal management agencies, are particularly stable with many practices, policies, and ideologies supporting the continued existence of the institution rather than the solution of any particular problem.

Authors identified many examples of what they perceive to be institutional incompetence in salmon recovery: applying standard, inflexible rules, protecting the institution (or individual) rather than the salmon, and allowing elected officials and/or citizens to make recovery decisions not based on the best available science.

Policy prescriptions included moving toward a much more decentralized recovery effort with rural residents playing leadership roles. Others encouraged the appointment of government leaders who are more willing to solve problems using the best available science rather than personal policy preferences or philosophical beliefs that appear to be at variance with the majority.

## Category #4 — Domesticate the Policy Issue

The prescriptions from some of the authors fell into a category of what political scientists call “domesticating” the policy issue.

Domestication is the process of taking difficult, divisive policy issues off the table until a solution emerges or the problem disappears by solving itself (e.g., the species is extirpated). The most common forms of domestication are funding more research or scientific activity, more workshops and venues to get stakeholders involved through collaboration, and tweaking current regulations or policies that provide the illusion of substantive action.

It is easy to see why offering policies to *domesticate* the salmon decline policy challenge is easier than developing explicit policies that would actually work. Reversing the long-term decline requires changing at least some of the current and entrenched political realities: (1) most rules of commerce and economic growth work against salmon recovery; (2) increasing scarcity of key natural resources, especially high quality water, will constrain ecological options; (3) the current trajectory for the region’s human population precludes some frequently stated recovery goals; and (4) individual and collective life-style preferences demonstrate that recovery is less important than many advocates assert.

Few authors explicitly proposed ways to change the political realities about the salmon decline issue. Instead, they suggested variations on existing policy options to revise the Endangered Species Act (U.S.) or the Species at Risk Act (Canada), protect more and/or different salmon habitat, create new hatchery practices, change K-12 education, and/or transform people’s attitudes.

The domesticating strategies proposed by some authors are requests for extensions of practices already in place and they do not propose revolutionary approaches or challenge existing beliefs. They tacitly assume that at some future time we will formulate and agree on a viable solution. In reality, the public may not even be sure what the problem is, much less know what possible solutions exist.

### Reflections about the Salmon 2100 Project

Given the complexity of our salmon recovery question, we consider the authors who took us up on the offer to contemplate the future of salmon in 2100 as exceptionally brave. They ended up having to reflect on their own training, organizational and professional careers, and political ideologies, which turned out to be a disconcerting experience for many, as described in the epilogue of the book. A few discovered that the political fallout was severe when they expressed personal opinions that differed from the “agency storyline.” Several early participants dropped out once they grasped the difficulty of the assignment. Others ended up with conclusions that surprised and disappointed themselves.

The group of authors is diverse, and a handful would much rather not have appeared together between the same book covers. Their diverse policy perspectives aside, very few of them seriously challenged the core drivers proposed by project organizers in Chapter 3 (Lackey et al. 2006). All thought that, although the wild salmon conservation problem is indeed wicked, there are still workable solutions. Collectively, they believed we need to engage new ways of thinking; we need to recognize that politics and power structures, not science, make natural resource decisions; and that transformation of our approach is essential if indeed we wish to save wild salmon in appreciable numbers by 2100.

Most authors recognized that the way forward will not be through a single solution: more science will not restore significant, sustainable runs of wild salmon if institutional arrangements are inflexible; new institutional arrangements will not restore salmon runs if economic priorities are not reassessed; and technological fixes will not in and of themselves allow us to muddle through this phase of problem solving. There is not a single policy prescription (that has any chance of widespread adoption) that will quickly restore endangered salmon.

The human population trajectory for the region was recognized by all authors as a major policy driver, but most authors effectively accepted the trajectory as an unchangeable fact. Washington, Oregon, Idaho, and British Columbia combined are now home to 15 million humans. Assuming a range of likely human reproductive rates, ongoing migration to the Pacific Northwest from elsewhere in Canada and the United States, and continuing immigration policy and patterns, by 2100 this region's human population will not be its present 15 million, but rather will be somewhere between 50 and 100 million — a quadrupling or more by the end of this century. As with any forecast a century ahead, there is considerable debate, but all authors agreed that there will be many, many more people in the region by the end of the century.

Few authors bluntly and candidly addressed the importance of changing the human population trajectory as part of a recovery policy prescription. There are policy options that would likely alter the expected population growth, but almost no one involved in the Project was willing to propose any such policy changes.

Another chapter author tackled the phrasing and implications of the core policy driver asserting the apparent unlikelihood of widespread and major changes in individual and collective preferences. He noted that it is more important that we stop making linear presumptions (as this core policy driver does) that are often incorrect in a nonlinear world. In his view such thinking leads to the assumption that our own actions do not directly affect the status of salmon or are so small as to be inconsequential.

It would be easy to consider most of the authors to be unrealistic in their understanding of the social and political consequences of their proposed prescriptions, but that would be unfair. Policy changes that would likely work involve values that many people hold dear. Salmon are dependent on habitat that provides water, power, food, and recreation to an increasing number of people in California, Oregon, Washington, Idaho, and southern British Columbia. Practices and policies for providing these services are based on rules, regulations, and values that are deeply embedded in individual, organizational, and cultural value systems. Values surrounding private property rights and individual freedom of choice are particularly deeply held.

Most people report that they want to support the common good of sustaining significant runs of wild salmon, but in our experience, few people are willing to give up any freedom to decide how to manage their property or how they live their lives. Arguably they are becoming reluctant to pay more for the sustenance of public services such as education, transportation, and environmental protection. What would it take for the public and private sectors to give even more to salmon recovery in their everyday political, economic, and social choices?

Based on informal discussions with the authors, many were well aware of the general reluctance of the public to change certain priorities or behaviors. No one mentioned changing property rights, for example, and only a few suggested stopping or even curtailing fishing. No one suggested abrogating treaties to eliminate tribal rights to a certain portion of the wild salmon harvest. Except for a few brave authors, there was little apparent support for shifting away from hydropower toward potentially more salmon friendly forms of energy production such as coal, nuclear, and/or tar sands. While some authors did propose shifting to renewable energy sources beyond hydropower, few grappled with the fact that without either hydropower or nuclear power, there probably is not enough renewable energy to power the North American economy in the foreseeable future. None of these solutions is socially or politically acceptable given current conditions. If we accept the future challenges, however, we have to accept that some of the current “unmentionables” may become more politically and socially palatable over the next 100 years.

What else is likely to change between now and 2100? Forecasts of the future are based on a few assumptions: (1) until major crises occur, current practices will continue with only slight modifications; (2) there will be major crises (most likely to be related to energy and water shortages); and (3) there will be unimagined technological changes. It is easy to speculate about new forms of energy, for example, but commercially viable, cost effective advances will take decades or longer to develop and deploy.

## The Near-term Future for Wild Salmon

We are currently in a holding pattern since the salmon recovery problem has been largely domesticated politically. As a society, we appear to be waiting for something to change, be it in the science, technology, economy, or even public attitudes, something that will shake us into a place where the problem becomes so apparent that the way forward is both clear and acceptable.

Society may eventually decide that the best we can do is to create large-scale salmon zoos like we have for buffalo in Yellowstone so that our great-grandchildren will have a tangible reminder of California, Oregon, Washington, Idaho, and southern British Columbia of the 1800s. Historians of 2100 may wonder why we spent billions of dollars on recovering salmon when we had so many other pressing needs including poverty, defense, health care, drug abuse, education, crime, and disaster relief. The list of things we could be spending our money on is long and each item has advocates.

Part of the current impasse is caused by the fact that we cannot assess the appropriateness of any policy choice because, as a society, we have not clearly agreed about whether there even is a problem worth fixing.

## Conclusion

We want the collective output from the Salmon 2100 Project to serve as court jester, Greek chorus, cage rattler, and straw man to decision-makers, elected and appointed officials, and others who have various mandates to address the decline of wild salmon runs along the west coast of North America. We offer no easy, cheap, painless solutions, but we propose a set of alternative strategies that would likely sustain significant, sustainable runs of salmon through and beyond 2100.

Ultimately, of course, it is the general public that must become knowledgeably engaged in salmon policy debates if intelligent, informed, efficacious decisions are to be made. Therefore, we present this book and its policy prescriptions to the general public in a quest to define clearly what would have to change if wild salmon recovery efforts are to have a reasonable likelihood of success.

I have identified the three fundamental barriers that must be breached before the long-term decline of wild salmon can be reversed. There are certainly other, formidable obstacles that also hinder recovery, but for these others to have any lasting effect, the central barriers — the legacies, the choices, the trajectories — need to be breached.

My role as a provider of scientific information is one I take seriously, but scientific information is only one piece of decision-making. More important, it is society *collectively* that sets policy priorities, weighs competing alternatives, and ultimately charts the policy course. To the extent that I, or anyone else who works daily on salmon science policy, can be a detached observer about the future of wild salmon, I remain skeptical that, even given *all* the facts, society will opt to pay the required social and economic costs to bring back significant runs of wild salmon.

I conclude with a prediction, and also offer a challenge, especially a challenge to those early in their careers: “Any policy or plan targeted to restore wild salmon runs must at least implicitly respond to these three barriers or that plan will fail. Otherwise, it will be added to an already long list of prior, noble, earnest, and failed restoration attempts.”

Look down the road to the end of this century, to 2100, less than 10 decades away, only a few dozen generations of salmon beyond today’s runs, just 2 or 3 Pacific Decadal Oscillations from now, to a time when this region’s human population will not be its present 15 million, but rather will be somewhere between 50 and 100 million. Even given all this, there are still salmon recovery options that are likely to be ecologically viable and probably socially acceptable, but the range of options continues to narrow.

In my view, for fisheries experts, especially for those of us who work daily on salmon science and policy, it is a time for neither crippling pessimism, nor for delusional optimism. Rather, it is a time for uncompromising ecological realism and forthright policy analysis.

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## Literature Cited

Black, Michael. 1995. Tragic remedies: a century of failed fishery policy on California's Sacramento River. *Pacific Historical Review*. 64: 37-70.

Buchal, James L. 1998. *The Great Salmon Hoax*. Iconoclast Publishing Company, Aurora, CO.

Government Accountability Office (GAO). 2002. *Columbia River Basin Salmon and Steelhead: Federal Agencies' Recovery Responsibilities, Expenditures, and Actions*. United States General Accounting Office, Report # GAO-02-612, 86 pp, Washington, DC.

Hartman, Gordon F., Cornelis Groot, and Thomas G. Northcote. 2000. Science and management in sustainable fisheries: the ball is not in our court. In: Knudsen, E. Eric, Cleveland R. Steward, Donald D. MacDonald, Jack E. Williams, and Dudley W. Reiser, Editors. *Sustainable Fisheries Management: Pacific Salmon*. Lewis Publishers, Boca Raton, Florida, pp. 31-50.

Lackey, Robert T. 2001a. Pacific salmon and the Endangered Species Act: troublesome questions. *Renewable Resources Journal*. 19: 6-9.

Lackey, Robert T. 2001b. Defending reality. *Fisheries*. 26: 26-27.

Lackey, Robert T. 2003. Pacific Northwest salmon: forecasting their status in 2100. *Reviews in Fisheries Science*. 11(1): 35-88.

Lackey, Robert T., Denise H. Lach, and Sally L. Duncan. Editors. 2006. *Salmon 2100: The Future of Wild Pacific Salmon*. American Fisheries Society, Bethesda, Maryland.  
<http://oregonstate.edu/dept/fw/lackey/Salmon2100.htm>

Lichatowich, James A. 1999. *Salmon Without Rivers: A History of the Pacific Salmon Crisis*. Island Press, Washington, DC.

Rahr, Guido R., James A. Lichatowich, Raymond Hubley, and Shauna M. Whidden. 1998. Sanctuaries for native salmon: a conservation strategy for the 21<sup>st</sup> century. *Fisheries*. 23(4): 6-7, 36.

Scarce, Rik. 2000. *Fishy Business: Salmon, Biology, and the Social Construction of Nature*. Temple University Press, Philadelphia, PA.

Taylor, Joseph E. 1999. *Making Salmon: An Environmental History of the Northwest Fisheries Crisis*. University of Washington Press, Seattle, WA.

**Author's Biographic Sketch**

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