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Challenges to Sustaining Diadromous Fishes through 2100: Lessons Learned from Western North America

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Abstract.—An evaluation of the history of efforts to reverse the long-term decline of Pacific salmon in western North America provides instructive policy lessons for the potential recovery of diadromous fishes throughout the world. From California to southern British Columbia, wild runs of Pacific salmon have universally declined and many have disappeared. Billions have been spent in so-far failed attempts to reverse the decline in response to the requirements of the U.S. Endangered Species Act, the Canadian Species at Risk Act, or other laws or policies. The annual expenditure of hundreds of millions of dollars continues, but a sustainable future for wild salmon in this region of North America remains elusive. Despite documented public support for restoring wild salmon, the long-term prognosis for a sustainable future appears problematic. After considering various policy options to increase the numbers of wild salmon and other diadromous species, the major lessons learned were (1) the rules of commerce, especially trends in international commerce and trade, tend to put relentless downward pressure on their numbers; (2) competition for critical natural resources, especially for high quality water, will continue to be great and will work to constrain the numbers of most diadromous species; (3) the aggregate demands of humans will continue to swell, thus tending to limit the available habitat for diadromous species; (4) individual and collective preferences directly determine the future of diadromous species, and there appears to be little indication of a massive and widespread change in those individual and collective preferences; (5) there is an almost insurmountable tendency on the part of elected and appointed officials to avoid explicitly confronting difficult, divisive ecological policy issues; and (6) there is a systematic, often subtle, pressure on fisheries scientists, managers, and analysts to avoid explicitly conveying unpleasant facts to the public, senior bureaucrats, and elected or appointed officials. Fisheries biologists and others continue to craft restoration plans, but an easy, effective approach has yet to emerge that will actually restore and sustain most runs of wild salmon in the region. For most diadromous fishes, restoration options exist that offer both ecological viability and appreciably reduced social disruption, but these options also tend to have more modest restoration objectives.

Introduction

If you read the majority of the other papers in this proceedings, you will learn about the poor state of many diadromous fish runs. There are the latest assessments about the causes of the declines. You can read well-informed judgments about the relative importance of this or that causal factor. Mostly, you will read explanations offered by biologists about their interpretations of the how and the why of the current state of diadromous fishes.

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It is good stuff for a fisheries biologist and I feel right at home. It is an interesting story to be sure and one to which I am usually inclined to contribute my two cents worth. But it is time to shift to the "so what" question. What does all this science really mean? Is it relevant to the public in general and decision makers in particular? Does either group really care? Does the science make a difference to anyone but us? How are the myriad scientific facts relevant in public policy?

The steering committee knew about the Salm-

on 2100 Project and its no-nonsense analysis of the future of salmon in western North America (Lackey et al. 2006a). Specifically, of the nearly 1,400 historical populations of Pacific salmon (and steelhead *Oncorhynchus mykiss*) in California, Nevada, Oregon, Washington, Idaho, and southern British Columbia, 29% are estimated to have disappeared (Gustafson et al. 2007). Given current long-term trajectories, the future viability of many of the remaining populations looks bleak (Lackey et al. 2006b).

The committee's charge to me was blunt and unequivocal: offer answers to the "so what" questions. Look forward, predict, speculate, and consider the most likely future of diadromous fishes. And, while you are at it, identify what must change if the long-term, downward trajectory in wild diadromous fishes is to be reversed.

And how was the so-called future to be defined? "Use your own judgment" was the answer. Those of us who provide science to decision makers and politicians know that the typical time frame of interest may extend to next year, perhaps on some occasions it might be a few years, a salmon life cycle possibly, but surely no longer.

Let me switch from a decision maker's or politician's perspective to a policy analyst's perspective. We need to get real about a time context! A century is the correct time frame. One of the take-home lessons from the Salmon 2100 Project was that 2050 was just too soon to assess the efficacy of the various policy options. A single ocean cycle may last three or four decades. The changing hydrograph from a major dam may take half a century to show its full influence. A mature forest may take well over a century to fully recover from a major fire or an extensive logging effort.

Using 2100 as the time horizon means forecasting nine decades out and doing so publicly. Of course, most of us secretly have a forecast about the long-term future of our favorite species, but we keep it to ourselves; perhaps we might share it with a few close colleagues and such colleagues must be trusted and reliably discreet. Most of us are not willing to publicly speculate, much less publish, about diadromous fishes over the longer term.

At least in some ways, it is easier to forecast the long term. It does tend to dampen the confusion caused by year-to-year and decade-to-decade variations in ecological and social factors that often mask fundamental, underlying trends in fish populations.

I am well aware that it is easy to dispense generalities and feel-good platitudes, but I will try to be candid and frank. You may well argue with my take on science and policy, but I do not want to be Pollyannaish nor fatalistic. So forget both the temptation to be unduly optimistic and the tendency to be unnecessarily pessimistic. What follows is my stab at forthright realism.

Let me begin with my simple take-home message:

> In spite of abundant uncertainty about the relative importance of the various factors that drove the declines of most diadromous species, we fundamentally recognize and know the direct causes of nearly all long-term declines.

Most scientists tend to focus on what we do not know, but we know a lot. As we have examined at this symposium, and elsewhere, the causes have been, and often still are

- intense commercial, recreational, and subsistence fishing;
- freshwater, estuarine, and marine habitat alteration due to many human activities as well as changes in climate and shifts in ocean regimes;
- dams built and operated for electricity generation, flood control, irrigation, and other purposes;
- water withdrawals for agricultural, municipal, or commercial requirements;
- stream and river channel alteration, diking, and riparian corridor modifications;
- climatic changes caused at least in part by human actions;
- predation by marine mammals, birds, and other fish species often exacerbated by unintentionally concentrating diadromous fish or their predators (e.g., near dams, near hatchery release sites, or on islands created by discarded dredged material);
- competition, especially competition with exotic or nonnative fishes, many of which are better adapted to the highly altered aquatic environments we now have in many regions;
- introduction and spread of exotic diseases and

parasites, caused in some situations by aquacultural operations; and
- reduction in the annual replenishment of nutrients from decomposing, spawned-out diadromous fish.

In a few highly visible cases, supplemental stocking from hatcheries for sustaining high levels of fishing may have exacerbated the decline of naturally spawning runs.

It is a long list and it encompasses most of the entire human enterprise. In the background, of course, is the knowledge that changes in ocean and climatic conditions occur even in the absence of human activities or influences, and they have immense influence on diadromous fishes.

We can argue endlessly over details of the science or the relative importance of anthropogenic and natural causes, but consider my basic assertion that the primary cause of most long-term declines is anthropogenic and we pretty much know the key reasons why each decline happened. There are exceptions, but let us not quibble over these or lose sight of what we do know with reasonable assurance.

We know much more than we sometimes admit about the decline of diadromous fishes, especially about its trajectory. Based on what we found in the Salmon 2100 Project, I propose another statement of fact that applies to most other diadromous species:

> As we move forward in this century, in spite of ups and downs, good years and bad years, favorable and unfavorable ocean conditions, even newspaper headlines proclaiming some species have recovered, diadromous fishes have been on a long-term downward trend and many species are now at very low levels.

It is not easy to focus on the long term when most of us are thinking about this year's runs or perhaps living dangerously by speculating about next year's runs or those in 2011. 2100 seems way too far removed from the press of day-to-day business, but it provides the necessary policy perspective.

How can it be that the reasons for the declines are usually pretty well known, that in many cases they have been studied in grand detail, that typically the public appears to support reversing the long-term downward trends, yet the recovery prognosis is usually poor?

The answer is another simple policy statement of fact:

> Effecting any change in the long-term downward trend for wild diadromous fishes is impossible in the absence of shifts in the core policy drivers.

It is the core policy drivers, the root causes, that have determined the status of diadromous species and will continue to determine their status through this century. As we learned in the Salmon 2100 Project, habitat alteration, dams, water withdrawals, fishing, supplemental stocking from hatcheries, and many more causal agents are simply the way in which the core policy drivers are expressed.

No one is bent on eradicating salmon or other diadromous species, and we usually know the reasons for the declines. It is not sinister motives nor is it lack of knowledge, but rather it is that policy choices are made between conflicting and desirable alternatives. In real life, benefits come with costs. In short, ecological policy focused on the goal of restoring diadromous species is a zero-sum game (Lackey 2006). There are always winners and losers.

What then are the specific lessons I have learned from a 4-year involvement with the Salmon 2100 Project? These lessons could perhaps be more accurately called inconvenient truths. Whether called lessons learned or inconvenient truths, they drive ecological policy in general and will also define the future of wild diadromous species.

Lesson #1—The Marketplace Is Fundamental

My first lesson learned was that for wild salmon and other diadromous species, the rules of commerce, especially trends in international commerce and trade tend to work against increasing their numbers.

The rules of commerce over the long term are not fish-friendly. The drive for near-term low-cost production in free market economies is a widely professed approach to trade, both within nations and between nations. We can argue about whether so-called "free" markets are actually free; my purpose is not to argue either in favor of or against such a philosophy of commerce, but rather to note its impact on populations of diadromous fishes.

My presumption is that free trade and market-

driven economies will continue to be a dominant government policy through this century. One consequence of such an approach to commerce is that noneconomic values, such as preserving declining or remnant diadromous fish runs, tend not to get weighted very heavily in decision making (Lackey 2005).

This tendency is not inherently good or bad, just a fact. We obtain our computers from wherever they can be manufactured most cheaply. We move our automobile assembly plants to wherever they can produce cars most inexpensively. We tend to produce electricity in the most cost-effective way. We obtain most of our wheat where it can be grown most productively and consistently. We obtain wood products where they can be grown and harvested most efficiently and sold at the lowest price. Yes, we have trade disputes, but most everyone seems to accept the basic value of free trade.

Our individual and collective choices are not entirely driven by cost, of course. Perception, personal preferences, and risk tolerance play important roles. Consider how we choose to generate electricity. Generating electricity from dams is usually inexpensive and does not produce greenhouse gas emissions, but it is not beneficial to diadromous species. Wind power is comparatively expensive but is greenhouse gas friendly. Unfortunately, it is not ideal for birds, nor for improving viewsheds. Depending on a person's perceptions, preferences, and risk tolerance, nuclear, coal, natural gas, solar, biofuels, and wave power all have their own strengths and weaknesses; thus, it is not merely cost that determines a market preference.

Considering the results of the Salmon 2100 Project, the benefits of public policies that favor free market economies are well recognized, but there are also consequences that are not all that favorable to diadromous species. How much more are people willing to pay for bread, for electricity, or for automobiles produced in ways that will help restore wild salmon or other diadromous species? Avoid the balderdash that bread, electricity, and automobiles can be produced just as cheaply in a salmon-friendly manner. As with all policy choices, there are winners and there are losers and we should make that point clear to all.

Searching for the nonexistent but ever politically tantalizing win–win salmon recovery solution often ends up frustrating everyone. Except for the most trivial policy aspects of salmon recovery, compromise is necessary to craft a proposed policy that is democratically possible. Thus, salmon policy winds up as the classic zero-sum game. Accepting this reality encourages serious discussion about how to best resolve what appears to be an intractable issue.

As I observe consumer behavior today and guess about the future, I do not see much willingness on most people's part to pay substantially more for salmon-friendly products. This lesson learned does not in itself discourage me, but failure to recognize its reality does.

Lesson #2—Competition for Scarce Resources Is Unyielding

My second lesson learned was that for wild salmon and other diadromous species, competition for critical natural resources, especially for high quality water, will continue to be great and will work against increasing their numbers.

You might argue that this lesson learned borders on the brilliantly obvious. It does. Perhaps that is why it is so often overlooked in policy analysis and forecasting. The region where we did the Salmon 2100 Project (California, Oregon, Washington, Idaho, and southern British Columbia) suffers from water shortages, especially shortages of high quality water. Unless the competition for scarce water bubbles into open political conflict, most people are oblivious of the severity of the challenge. Even with the myriad media stories about impending water scarcity, most written in a doom and gloom style, our seemingly insatiable demand for freshwater shows little sign of letting up.

I am not arguing that allocating water for salmon or other diadromous species is more important than allocating it for alternative uses, but consider the importance of these competing needs. As competition for scarce water continues and gets much more intense, how will advocates for diadromous species fare relative to advocates for competing priorities such as water for drinking, irrigation, manufacturing, generating electricity, or any of a thousand other needs?

The decades-long and continuing water war in the Klamath basin, along the California–Oregon border, gives us an indication of the future. Newspapers describe farmers defying law enforcement

agents and illegally opening locked valves and releasing water to irrigate their fields. The television evening news shows streams choked with dying salmon caused by low water flows, poor water quality, and virulent diseases sustained by warm water. Lawyers from various competing interest groups duel in court over who will get how much water. Always, at the end of the day, every faction in the battle is dissatisfied with the result, feels their interest did not get a fair share of the water, and grapples for ways to be more politically effective in next year's battle.

Water is not the only resource in limited supply. Some argue that competition for high quality soil, especially for agricultural uses, is most crucial (Salonius 2007). Whether water or soil, as key natural resources become scarcer through this century, the individual and collective choices that permit long-term abundance of many diadromous fishes likely will become increasingly unacceptable to more and more people. For those of us who spend our working lives concerned with creatures with fins, no matter how economically, socially, or culturally important they might be to segments of society, it is a challenge to acknowledge that our focus of attention is just one of a set of multiple and competing priorities.

Lesson #3—The Human Population Exerts a Pervasive Influence

The third lesson I came to concede, albeit grudgingly, was that for wild salmon and other diadromous fishes, the aggregate resource demands of humans will continue to swell, thus tending to work against increasing the numbers of most diadromous species.

The most probable scenario for the human population trajectory through this century for places like the U.S. Pacific Northwest and British Columbia is upward, substantially upward. Any serious discussion about the future of diadromous species must consider the human population trajectory, but it is not fashionable to raise this issue.

Environmental advocacy groups avoid it like a pestilence, even though it dwarfs most of the human behaviors they are trying to modify. Even fish advocacy groups rarely mention it, much less take a clear policy position. It is the proverbial elephant in the room that few want to acknowledge. As one of my colleagues warned me during the planning of the Salmon 2100 Project,

> Bob, you are absolutely right, most people already know it, and that's exactly why you should let it rest. Back off. You'll leave the proponents of wild salmon restoration depressed. Worse, you'll have the rest of the audience wondering why you are pontificating on the intuitively obvious. And you run the risk of being attacked as a racist, nativist, xenophobe, cultural imperialist, sexist, or, at the least, an economic elitist.

Undoubtedly, very good advice. However, if society wishes to do anything meaningful about moving many diadromous species off their current downward trajectory, then something must be done about the unrelenting growth in the number of humans generally and especially in areas like the Pacific Northwest. It is not simply the number of people that causes problems for diadromous species, but it is also our individual and collective ecological footprint. Based on assessing our individual lifestyle choices, one car is no longer sufficient, nor is even two. Many families now have three cars, along with a three-car garage. To some of us, one house is apparently no longer adequate. We have a second home. Should any of us be expected to get by without a hot tub, central air conditioning, and three TVs?

I am not arguing that we necessarily ought to change any current public policy or our individual priorities. I am arguing that we should be candid and truthful about reality. A simple and inescapable fact is that the growth in the human population level that we can realistically anticipate through the rest of this century will create a serious barrier to achieving any significant long-term recovery of diadromous species. In regions such as the Pacific Northwest, what demographers like to call "fill-in" country, the consequences of a larger human population on diadromous species will be severe.

The latest demographic forecasts show a slowing of the world population through this century with a leveling off toward 2100. Yes, a leveling off is predicted, but at 9 billion people. As we found in the Salmon 2100 Project for the Pacific Northwest, however, there is a different story. It is largely one of past, current, and future immigration. Currently, Washington, Oregon, Idaho, and British Columbia

are home to 15 million humans. Assuming a range of likely human reproductive rates, 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 of the region's human population by the end of this century.

Visualize 50 or 100 million people in the Pacific Northwest, and their demands for housing, schools, tennis courts, football stadiums, expressways, planes, trains, automobiles, Starbucks, McDonalds, Wal-Mart, electricity, drinking water, pipelines, marinas, computers, DVDs, 12 screen movie theaters, ski resorts, golf courses, lush weed-free lawns, and ocean front hotels. For my Canadian colleagues, add to the list Tim Hortons, Canadian Tire, Zellers, and The Bay.

Visualize the western region of the state of Washington and southwestern corner of British Columbia in 2100 with its metropolis of Seavan. Seavan morphed into a truly great metropolis as smaller, discrete cities grew together. Seavan in 2100 stretches from Olympia in south Puget Sound northward through the once stand-alone cities of Tacoma and Seattle and on to Vancouver, east to Hope, and west to cover the southern half of Vancouver Island. Rather than the 6 million people back in 2009, Seavan in 2100 rivals present-day Mexico City and Tokyo with its 30 million inhabitants. Or think about the New York City—Boston corridor transplanted to the Pacific Northwest. It is within this context that salmon recovery strategies need to be developed if they have any chance of succeeding.

Regardless of the accuracy of my forecast, population issues are not easy ones to highlight without implying a preferred policy option. After all, there are understandable, strategic reasons why the big environmental groups, most groups in fact, stay clear of population issues these days, but a recognition of the expected overall increase in world population, coupled with the spectacular increases in certain "fill-in" regions such as western North America, must be at the core of any credible analysis of potential recovery strategies of diadromous species. Without such recognition, recovery strategies for salmon and other diadromous fishes are doomed to fail.

Lesson #4—Individuals Select from Among Desirable Alternatives

A straightforward lesson learned was that for wild salmon and other diadromous species, our individual and collective preferences directly determine their future, and substantial and pervasive changes must take place in these preferences if current long-term downward trends are to be reversed.

This lesson learned is perhaps the most obvious and arguably the most important. Among most fisheries scientists, it is easy to assume that charismatic and/or economically valuable diadromous species are near the top of the public's priorities. Just look at the polling results regarding restoring depleted salmon runs in the Pacific Northwest. Everyone supports salmon and especially wild salmon. But, the fact is that salmon recovery is only one of many priorities that individuals, when not forced to make a choice, profess to rank high. When forced to make a choice, salmon recovery drops substantially in importance as compared to other priorities. I have some difficulty conceiving of this, but that is the situation out there in the authentic world. Even my children, who I have had well over three decades to inculcate, regularly admonish me:

> Dad, get a life. Most people out here in the real world just don't care that much about restoring wild salmon. We have other things to worry about!

Society's collective behavior, not public opinion polls, not thick recovery plans, but people's individual and collective behavior, gives us the best indication.

Consider this example. In 1991, the first salmon "distinct population segment" in the Pacific Northwest was listed under terms of the U.S. Endangered Species Act. With this listing of salmon as a legally protected species, the policy debate shifted in California, Oregon, Washington, and Idaho away from restoring salmon runs in order to support fishing, to protecting wild salmon runs from extinction, two very different policy objectives. Starting with the first listing, followed by many others, protecting at-risk runs of wild salmon won out over maximizing fishing opportunities through stocking from hatcheries or through other efforts to put fish on the hook or fish in the net. The residents of the western United States apparently made a choice. Or did they?

Jump ahead 10 years to 2001. Just a decade after the first salmon listing, a severe drought, combined with ongoing electrical blackouts in California, prompted the Bonneville Power Administration to declare a power emergency, abandon previously agreed upon interagency salmon restoration commitments, and generate electricity at maximum capacity using water reserved to help salmon migrate later in the year.

In one of the most striking and recent barometers of competing societal priorities, air conditioners, electricity to be exact, won out over both wild and hatchery-bred salmon and with scant public opposition. No street protests. No legal challenges. No elected officials publicly pleading for salmon. No environmental group blanketing the Internet with calls to mobilize fax machines in defense of salmon. Near complete silence.

Over the past 150 years, each of us has made plenty of these kinds of choices: often contradictory and apparently inconsistent, and these choices roughly reflect our collective and relative priority for various diadromous species. These choices are tradeoffs, and we continue to make them and they are a real measure of the relative importance of salmon and other diadromous species. That is not good or bad, just a fact, however unpleasant to some.

Now, I am not cheerleading for wild salmon or for any other diadromous species or for electricity or for property rights or for hatcheries or for having a McDonalds, Tim Hortons, and Starbucks on every corner, but it is naive to consider salmon recovery as anything but one often minor element in a constellation of competing, often mutually exclusive, wants, needs, and preferences.

Lesson #5—Policy Domestication Is Ubiquitous

Regarding the "users" of science and policy analysis (politicians and other decision makers), a sobering lesson learned was that there is an almost insurmountable tendency on the part of elected and appointed officials to avoid explicitly confronting difficult, divisive policy issues.

Even many of the participants in the Salmon 2100 Project (and they were selected in part for their ability to address complex science and policy issues in a direct and candid manner) had a tendency to slip into the mode of what political scientists call "domesticating" the policy issue. Policy 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 indicators of domestication are funding more research or scientific reviews, holding more workshops and venues to get stakeholders involved through collaboration, forming more planning teams to assess policy options, and tweaking current regulations or policies. Such activities provide the illusion of substantive action.

It is easy to see why offering political actions to domesticate the salmon decline policy challenge, for example, is easier than developing explicit policies to reverse the decline. Reversing the long-term decline of salmon and other diadromous species requires changing at least some of the current political realities about the decline.

Few elected or appointed officials ever explicitly propose ways to change political realities about recovery of diadromous species. Instead, they suggest variations on existing policy options to revise the Endangered Species Act (U.S.), the Species at Risk Act (Canada), or similar legislation; protect more and/or different salmon habitat; create new hatchery practices; change K–12 education; and/or somehow transform people's attitudes.

Domesticating strategies are typically 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.

Lesson #6—Delusional Reality Is Tempting and Widespread

The final lesson learned was that there is a systemic, often subtle, pressure on fisheries scientists, managers, and analysts to avoid explicitly conveying unpleasant facts to the public, senior bureaucrats, and elected or appointed officials.

During the planning and implementation of the Salmon 2100 Project and the resulting book, the most fascinating aspect was the recurring sug-

gestion, even a plea, to lighten up and be more optimistic and positive in assessing the future of wild salmon. The entire premise of the project was to be blunt, direct, and realistic and to avoid both pessimism and optimism. Outside reviewers (mostly scientists long active in salmon science, management, or policy) of the individual book chapters concluded that the results were realistic in content and conclusion, but at the same time, many of them encouraged us to abandon the blunt realism and forthright honesty in favor of a more encouraging sense of optimism.

Similarly, reacting to articles I had written, several reviewers suggested that if my objective in writing was to help save wild salmon (it was not), then the accurate, realistic message would leave proponents dejected. This common sentiment is captured by the following: You have to give those of us trying to restore wild salmon some hope of success.

Conversely, a few veterans of the salmon wars confessed their regret over the optimistic approach that they had taken during their careers in fisheries, and they endorsed the "tell it like it is" tactic. They felt that they had, especially early in their careers, given false hope about the effectiveness of fishways, hatcheries, and the ability of their agencies to manage mixed-stock fishing. I was left with a feeling that many professional fisheries scientists have been, and still are, subtly pressured by employers, funding organizations, and colleagues to spin fisheries science and policy realism to accentuate optimism.

Other reviewers took professional refuge in the reality that senior management or policy bureaucrats select and define the policy question to be addressed, thus constraining and bounding the research questions to be addressed. The result is often narrowly focused, reductionist, and constrained scientific information and assessments. Rarely are fisheries scientists empowered to provide big picture assessments of the future of salmon. Whether inadvertent or not, such information often misleads the public into endorsing false expectations of the likelihood of the recovery of wild salmon. For many of us, such implicit optimism is a healthy, rewarding way to go through life.

Is adopting unfounded professional optimism a harmless adaptive behavior of little import? After all, think positive slogans are a hallmark of many self-improvement programs. What is wrong is that optimism does not convey what is happening with wild salmon and it allows the public, elected officials, and fisheries managers to escape the torment of confronting triage. No one ever argues that you can have wild salmon everywhere they once were, but few are willing to be explicit about identifying those locations where the cost is very high and chance of success is very low. Triage, whether in medical emergencies or ecological crises, is difficult, but necessary.

Fisheries scientists should be realistic and avoid being either optimistic or pessimistic. This professional stance does not covertly argue in favor of an imperative to save wild salmon or any other diadromous species regardless of the cost to society, nor does it necessarily support a defeatist strategy. Such choices should be made by an informed public that is aware of the difficult trade-offs. Restoring diadromous species is only one of many competing, important priorities, and the public is entitled to be accurately informed about the long-term prospects of success.

In discussions about the future of salmon, it is easy to find comfort in debating the nuances of hatchery genetics, evolutionarily significant units, dam breaching, smolt barging, selective fishing regulations, predatory bird control, habitat restoration, and atmospheric and oceanic climate, and unintentionally mislead the public about the realities of the situation. As discomforting as it may be to disclose the future of wild salmon and other diadromous species relative to society's apparent values and preferences, our most useful contribution as fisheries scientists is providing information and assessments that are policy-relevant but policy-neutral, understandable to the public and decision makers, and scrupulously realistic about the future. Otherwise, we simply squander our professional credibility to become acolytes of delusion.

Conclusion

I have now presented my analysis of the most likely future of diadromous fishes, identified those policy factors that would have to change if the long-term, downward trajectory is to be reversed, and offered a few lessons learned from the Salmon 2100 Project. To some, my commentary may not be all that uplifting. A greater worry to me is that we will probably continue to spend billions of dollars in quick-fix restoration and management efforts that will in many cases

be only marginally successful. One of my colleagues calls such expenditures "guilt money," a tax we willingly bear to alleviate our individual and collective remorse, money spent on activities not likely to achieve the stated purpose, but it makes us feel much better as we continue enjoying our current lifestyle.

As we found in the Salmon 2100 Project, there are options that we believe would work if implemented, but they each acknowledge people's priorities for what they are, not what some might want them to be. There were 23 different policy prescriptions developed as part of the project, each of which would work for recovering wild salmon runs (Lackey et al. 2006a) and, I would assert, for recovering most runs of diadromous fishes. We need to offer the public effective options for recovering diadromous species; there is no place for delusional reality, be it groundless optimism or needless pessimism.

In conclusion, I tender a challenge to those concerned with diadromous fisheries issues:

> Any policy or plan targeted to restore any diadromous species must incorporate the above lessons learned or that plan will fail. It will be added to an already long list of prior, noble, earnest, and failed fisheries management strategies.

Consider 2100, less than 10 decades away, only a few dozen generations of diadromous fishes beyond today's runs, just a few ocean oscillations from now, to a time when the world's population will likely be 50% greater and, in some regions, quadrupled. Even given all this, there are still sustainable management options that are likely to be ecologically viable and probably socially acceptable, but the range of options continues to dwindle. For professional fisheries experts—for fisheries scientists, technocrats, analysts, and managers, for those of us who are involved with diadromous fishes—it is a time for neither crippling pessimism nor delusional optimism; rather, it is a time for uncompromising ecological realism and honest, blunt, and unbiased assessments of the consequences of various policy choices to sustain diadromous fishes through 2100.

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