The Salmon Recovery Industrial Complex: Ten Policy Realities

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Abstract

The United States has spent, and continues to commit, billions of dollars to reverse the decline in the abundance of wild salmon (*Oncorhynchus spp.*) and steelhead (*O. mykiss*) along the West Coast of North America (California, Oregon, Washington, and Idaho). Despite sustained multibillion-dollar expenditures and an immense, ever-expanding body of peer-reviewed scientific literature, sustained improvement in wild salmon abundance attributable to these recovery efforts has been scant. This situation is not new. The basic scientific facts about the causes are comparatively well known. Thousands of individuals are employed in what I characterize as the Salmon Recovery Industrial Complex (SRIC). I explore two questions: (1) why have the billions spent on recovery efforts not successfully improved wild salmon runs, and (2) why is it likely that this expenditure will continue to produce a similar outcome? Technical fixes (i.e., fish ladders, hatcheries, habitat restoration) have not, and likely will not, overcome core policy drivers that are mostly decisions associated with collective societal priorities, coupled with individual decisions about a host of other priorities not obviously directly linked to salmon. Fisheries managers, scientists, policy makers, and the public confront an uncomfortable and ongoing truth: although returning wild salmon to sustained, harvestable abundance (roughly a third of historical levels) may be theoretically possible, society is collectively unlikely to fundamentally decrease commonly preferred standards of living, or constrain their individual personal choices. West Coast wild salmon recovery efforts likely will continue as largely symbolic gestures: expensive, politically convenient, but largely ineffective.

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1. Introduction

The United States has spent, and continues to commit, billions of dollars to reverse the decline in the abundance of wild (as opposed to hatchery-origin) salmon (*Oncorhynchus spp.*) and steelhead (*O. mykiss*) along the West Coast of North America (California, Oregon, Washington, and Idaho). After spending billions, success beyond maintaining the status quo or modest run increases, if any, has been limited (Gustafson et al. 2007, Jaeger and Scheuerell, 2023, Bilby et al. 2024, Ford et al. 2025). How can so much money be spent for so long with such disappointing results? Perhaps an even more interesting question is, why is the situation likely to continue?

The focus here is on six anadromous West Coast salmonid species:

- Chinook Salmon (also called King Salmon), *Oncorhynchus tshawytscha*
- Coho Salmon (also called Silver Salmon) *O. kisutch*
- Sockeye Salmon (also called Red Salmon) *O. nerka*
- Chum Salmon (also called Dog Salmon) *O. keta*
- Pink Salmon (also called Humpback Salmon) *O. gorbuscha*
- Steelhead (the anadromous form of Rainbow Trout) *O. mykiss*

Although steelhead are classified as trout, I include them when I refer to West Coast "salmon."

I assert here that the failure of West Coast salmon recovery is politically disappointing, but it is fundamentally not due to a lack of scientific information or understanding. Rather, it is because the policy problem has been treated simplistically, and with a bureaucratic/legal approach doomed to fail, leaving nearly all interest groups dissatisfied. My perspective is that the full complement of politicians, bureaucrats, scientists, technicians, and policy advocates engaged (and often funded) in some aspect of salmon recovery is partly inspired by President Eisenhower's famous 1961 speech about the risks of creating a *Military Industrial Complex* (Fallows 2002). Extending his perspective to salmon recovery efforts, I will label the analogous assemblage of individuals and organizations, funded by the multibillion-dollar expenditures from many sources, as the *Salmon Recovery Industrial Complex* (SRIC).

Currently, the SRIC is well funded by a mix of government and private support. Individuals employed in the SRIC are paid directly, often through contracts or grants, by governments (Federal, State, local, and tribal organizational and administrative units and government and private universities), or private parties (advocacy or interest organizations, foundations, professional groups, companies and corporations, and consultancies). Nominally *private* funding organizations are often supported by tax-advantaged (e.g., tax-deductible) donations from individuals and organizations. Such private funding is, therefore, subsidized by taxpayers. Policy advocacy groups representing many different political perspectives abound, and many have extensive paid scientific, legal, and lobbying staff to advance their goals. Either by their paid staff or under contract to outside experts, advocacy organizations often produce peer-reviewed scientific products relevant to their organizations' policy preferences.

Delusional biological realities and pervasive optimism abound despite sustained multibillion-dollar expenditures and little recovery success (Gayeski et al. 2018, Lackey 2015). All this exists, despite a massive, ever-expanding peer-reviewed scientific literature and, perhaps, partially driven by a vague, but unfounded optimism in engineering or technological solutions. For example, based on my personal interactions, it is frequent within the SRIC for individuals to assume some variation of the notion that, *"If the public and policy makers just understood the science relative to the 200-year decline of West Coast salmon, then the path to restoration would be obvious, and the difficult, but necessary political decisions would be broadly supported."*

Insert Figure 1

To some scientists in the SRIC, this belief leads to an assumed maxim: *"Everyone knows what the salmon recovery goal should be. We understand the science, now listen to us about what should be done."* But what is the recovery goal? Is it to avoid an Endangered Species Act listing, levels which could be a few percent of historic numbers? Is the goal to sustain runs to support a limited harvest, perhaps a third of each historical (1850s) run size? Is it to return salmon runs to 100% of historical (1850s) levels? What role, if any, should hatchery fish play in sustaining or increasing run size? If the overarching goal is to return *wild* runs to some historical level, why should *any* harvest of hatchery-origin salmon be permitted because some wild fish are killed in the process? Although these questions are central to any recovery program, they are rarely explicitly agreed to by *all* participants.

Why does the SRIC continue unabated when there is essentially no significant indication of success (i.e., there is little evidence that wild runs are increasing as a result of the SRIC's actions) (Jaeger and Scheuerell 2023)? If the path to salmon recovery is clear, why is it not supported more generally across the political spectrum? Or, perhaps the SRIC is an example of *symbolic politics* (i.e., the implementation of an aggressive effort to meet a publicly stated policy goal that is unlikely to be successful, but will demonstrate to concerned citizens and, more broadly, the electorate that the problem *is* being addressed)?

Or, perhaps, it is an example of *virtue signaling* (i.e., expressing sympathy for a popular policy goal without the expectation of the action making much difference)?

My goals here are to propose answers to two questions: (1) why did the billions spent by the SRIC not successfully recover salmon runs, and (2) why is it likely that this expenditure will continue, with the same outcome?

2. The History of the SRIC

This policy case study is not new, and the basic facts about the overall failure of salmon recovery are well documented (Nehlsen et al. 1991; Gustafson et al. 2007; Waldman and Quinn 2022; Quinn 2018, 2025). Further, the choices that have been made about West Coast salmon since the mid-1800s are fundamentally similar to those in other 3 places where salmon originally occurred (i.e., the Asian Far East, Western and Northern Europe, and Eastern North America) (Lackey et al 2006). Lack of scientific understanding was rarely the primary cause. The general pattern of decline nearly always followed a well-established inverse correlation: as the number of people and their associated activities intensified, the size of salmon runs decreased.

Although not well documented, the current West Coast salmon decline arguably began in the early 1800s with the creation of the *Fur Desert Policy* in what is now Idaho, Oregon, Washington, and British Columbia (at the time, called the Oregon Territory). At the time, conflict between Great Britain and the United States was intense over the lucrative Beaver (*Castor canadensis*) fur market. The British Hudson's Bay Company (HBC) tried to keep American Beaver trappers from moving northward into what is now British Columbia by implementing a policy of aggressively trapping <u>all</u> Beavers inhabiting the Columbia River Basin and the surrounding area (Ott 2003). This created a large "fur desert," an area nearly devoid of Beaver. The hope was that American Beaver trappers would shun these areas of disputed sovereignty. With the demise of the Beaver population, the ubiquitous Beaver dams soon disappeared. At the time, the effect on salmon runs was unknown and not a concern to the HBC, but it was likely ecologically significant because Beaver dams benefit some salmon species (Pollock et al., 2004). Politically, the Beaver eradication plan worked as intended: the American fur trappers avoided areas where Beaver populations had been eliminated or much reduced.

The subsequent (1848) discovery of gold at Sutter's Mill, Coloma, California, with the ensuing influx of gold miners, soon followed by widespread West Coast mining activities, accelerated the decline of salmon. This decline is generally well known and documented (Lackey et al 2006). Beyond California, in Oregon, Washington, and Idaho, the salmon decline began in the 1860s with extensive mining, logging, agriculture, and dam construction. By the late 1800s, even the Columbia River Basin — once home to legendary runs — had lost most of its salmon. The decline in salmon runs was apparent and commonly reported in contemporary news articles. Hatchery programs, initiated in the 1870s, became the primary technique to sustain the West Coast salmon runs. For over a century, supplemental stocking from hatcheries has been employed to sustain or increase declining runs and harvests (Courter et al. 2023; Brummett et al. 2026; Harrison et al. 2026). Even with hatchery supplementation, over decades and centuries, wild salmon runs dwindled to very low numbers, as they are now. Today, most salmon in West Coast streams and rivers are the progeny of parents who spawned in hatcheries, and the existing recreational, commercial, and tribal harvest is principally supported by hatcheries (Gustafson et al. 2007, Naish et al., 2007).

The decline of West Coast salmon runs followed the pattern that previously occurred in (1) the Asian Far East at least a thousand years ago, (2) Europe starting 500 years ago, and (3) eastern North America starting in the 1600s. At its core, the general pattern is that when human populations (and their associated economic activities) expanded and landscapes transformed, salmon runs diminished (Lackey et al. 2006).

Salmon consumers, unfamiliar with the West Coast's current salmon status — that many current runs have been extirpated while the remaining runs are at single-digit levels of the 1850s run sizes — may wonder how salmon can be available year-round in their local retail market, yet are now a remnant of their former abundance in the wild. The much-reduced size of the runs is obscured because (1) pen-raised salmon, grown in marine environments mainly in British Columbia, Chile, and Norway, are readily available year-round in the retail market, and (2) *wild* Pacific salmon are abundant elsewhere, especially in Alaska, and these harvests also support the West Coast retail market.

It is indeed ironic that retail salmon are available year-round on the West Coast, yet the local runs are shadows of their former levels, and many are listed as either threatened or endangered under the U.S. Endangered Species Act. Today, roughly 70-80% of salmon in the region are hatchery-origin. While hatchery salmon releases provide most of the harvest, politically they complicate recovery by masking the severity of the declines and scientifically by potentially introducing genetic and ecological risks to wild stocks (Lackey et al. 2006; Lorenzen et al. 2012; Harrison et al. 2026).

3. The Scientific and Policy Context

Salmon are resilient animals. In fact, no *species* of Pacific salmon faces extinction, but many local populations (i.e., stocks, runs, distinct population segments, or evolutionarily significant segments) are gone, and hundreds more are at risk (Gustafson et al. 2007, Ford et al. 2025). Of the over a thousand geographically distinct populations in California, Oregon, Washington, and Idaho that existed before the early 1800s, nearly 30% are extinct, and the surviving runs are all much reduced (Gustafson, R.G., et al., 2007). The causes — habitat alteration, dams, irrigation, harvest, climatic changes, competition with non-native fish species, interactions with hatchery-origin salmon, and many others — are well-documented in an immense peer-reviewed scientific literature (Quinn 2018, 2025). What remains contested is the *relative* importance of these factors and, more fundamentally, the *willingness* of society to make the trade-offs necessary for recovery. The stark reality is that, despite billions of dollars invested and decades of scientific effort, the recovery of wild salmon remains elusive.

The geographic scope of this article is focused on the West Coast (California, Oregon, Washington, and Idaho), and, indirectly, the North Pacific Ocean to the extent that salmon originating from those four states use the marine environment during their life cycles. Especially in the far north (adjacent to Alaska and the Russian Far East), the North Pacific Ocean is warming, and this correlates with important ecological changes. For historical context, substantially due to heavy releases from hatcheries, the *overall* salmon abundance in the North Pacific is higher now than at least since the 1970s (Ruggerone et al. 2010). Whatever ecological conditions or human interventions are driving the increase (e.g., warmer ocean temperatures, industrial-scale major increases in stocking from Alaska, Japanese, and Russian hatcheries, or others), the species primarily benefited are pink and chum salmon (Connors et al. 2025).

This two-century, persistent, and predictable West Coast salmon decline raises two fundamental *policy* questions: (1) What precisely does society wish to recover? and (2) Why have recovery efforts nearly always failed to achieve their publicly stated goals? I argue here that the answer lies not in inadequate science or bad actors, but with a suite of policy realities that capture the interplay of ecological constraints, societal priorities, individual (personal) preferences, and a failure to incorporate overall policy *realities* into recovery goal setting. Even in those few cases along the West Coast where runs have increased (at least temporarily), it is rarely linked clearly to specific SRIC recovery efforts.

Scientific information is helpful, even frequently necessary, to unravel the *causes* of the long-term decline of West Coast salmon, but unraveling the *policy context* is essential to selecting a salmon recovery program that would actually work. Here are the core *policy realities* that have driven, and will drive (and constrain), any credible West Coast salmon recovery program. It is within these policy realities that explain (1) why past SRIC recovery efforts have usually not succeeded and (2) which policy changes must happen if wild salmon recovery is to be achieved?

3.1. Reality 1: Salmon recovery is a wicked policy problem with zero-sum tendencies.

From a *political science* perspective, sustaining (or increasing) salmon run sizes is a classic "wicked" policy challenge. A wicked policy problem is politically intractable, has no scientifically definitive solution, involves multiple stakeholders with mutually exclusive policy preferences, and is characterized by uncertainty, conflicting values, and interdependent causes (Termeer et al. 2019). The salmon recovery case study meets all these criteria. Additionally, the SRIC operates in a political environment where *any* proposed efficacious (for salmon recovery) policy choice results in unmistakable (and vocal) policy losers (the zero-sum characteristic). Predicting with high confidence the economic and political consequences of many recovery policy choices is problematic, and this uncertainty skews policy-makers away from bold changes toward ones that have uncertain outcomes. For those employed in the SRIC, but without a sense of the overall policy context, the sense of a possible "win-win" policy choice sounds tantalizing. However, it is an unachievable aspiration that quickly becomes apparent after routine policy analysis. In short, there are always policy winners and losers in assessing salmon recovery policy options, but pitching the win-win is unquestionably tempting. An old policy cliché is especially apropos for the SRIC: *"Policy making is all about picking winners and losers."*

3.1. Reality 2: The SRIC funding model encourages a public optimism bias.

A near-universal optimism bias emanating from the SRIC creates unrealistic public expectations about what level of salmon recovery likely will be achieved by the billions of dollars being spent (Lichatowich 2013). In part, optimism is understandable because most SRIC funding is "soft money," and it must be regularly "sold" for it to continue, and funders are more likely to financially support programs that imply success. Also, because SRIC funding is a mix of taxpayer and nominally private sources (i.e., many private funders provide money that is subsidized by being classified as a tax-advantaged, tax-deductible, or tax-favored donation), it is important to wrap funding pitches in optimism because even private funding is partially subsidized by taxpayers. Unsurprisingly and for different reasons, this competition for funding creates an understandable incentive for scientists, managers, administrators, and policy makers to convey *policy optimism*, even when evidence and experience suggest otherwise. Such bureaucratic optimism is characteristic of many programs that rely on competitive funding. For the SRIC, the result is a proliferation of narrowly focused studies and sophisticated technical debates about hatchery and wild fish genetics, dam passage efficiency, likely climate change influences, possible pesticide effects, competition and predation impacts, and many others) that, while generally well-intentioned, often scientifically rigorous, and worthy of publishing in the peer-reviewed scientific literature, rarely address the overarching question: what level of *wild* salmon recovery is ecologically, politically, and economically feasible?

3.1. Reality 3: The U.S. Endangered Species Act (ESA) encourages lawfare.

The ESA has been the dominant policy driver of West Coast salmon policy and management for four decades. For salmon recovery, some critics of the *status quo* assert that ESA has fostered "lawfare" (i.e., suing, or the threat of suing, to achieve desired salmon policy objectives) rather than supporting recovery programs that might actually restore salmon runs. They may also contend that the cost of some construction and development escalates for no demonstrable sustained improvement in salmon runs. Conversely, ESA supporters typically argue that ESA is the most effective advocacy weapon available to them and, for some advocacy organizations, it has proved to be a powerful weapon. In direct response to such lawsuits (or the threat of lawsuits), the SRIC's overall budget has increased significantly. Economic analysis of Columbia River Basin expenditures, for example, has indicated that *billions* of dollars are now spent annually by the SRIC to comply with salmon ESA-compliance issues, but salmon runs have rarely improved (Jaeger and Scheuerell 2023; Ford et al. 2025). Beyond the substantial economic cost, ESA enforcement continues to create seeming policy paradoxes: (1) ESA-listed salmon are still routinely harvested under government approval; (2) hatchery supplementation, mandated by other legislation to sustain fishing, is often challenged by ESA lawsuits as putting wild salmon at genetic risk; (3) unlike most other ESA-listed "species," no *biological* salmon species is at risk of extinction because ESA enforcement treats "populations" as "species;" (4) it is now typical along the West Coast for most salmon in a particular run (of one species) to be of hatchery origin rather than the offspring of salmon that spawned naturally in a stream (i.e., wild-origin individuals); and (5) most salmon in the *retail* market are raised in net pens and are not derived from natural spawning or the product of hatcheries, thus there are abundant salmon available in grocery stores and restaurants. The current policy reality is that since the first West Coast ESA salmon listing in 1989, not one population has recovered sufficiently to warrant delisting (Ford et al. 2025).

Insert Figure 2

3.1. Reality 4: Competing policy priorities circumscribe the realistic salmon recovery choices.

Unlike a few other ESA-listed species (e.g., wolves and grizzlies), no one has ever sought to eradicate salmon, but sustaining or increasing salmon runs competes with a diverse and sizable set of individual and collective personal priorities. For example, people also want (1) low-cost and desirable *food*, (2) abundant, reliable, and cheap *energy*, and (3) an economy that creates and sustains high-paying *jobs*. For salmon, adequate water of sufficient quality is an ecological necessity. For *food* production, farmers need water, and often in large amounts, which reduces the amount or quality of water available for salmon. For *energy* needs, baseload electricity production in many high- and medium-income countries is generated by hydro power (which is detrimental for salmon). As for high-paying *jobs*, energy production and national wealth are related. Broadly speaking, the more energy available, the higher a country's GDP (not an advantageous political landscape for salmon recovery advocates confronting hydro generation). As for providing salmon for the retail market, there is high demand. This market, however, is not supplied by free-living (i.e., wild) salmon, but by aquaculture (mainly net-pens in marine, near-shore environments). In California, Oregon, Washington, and Idaho, despite the poor state of West Coast runs, salmon in the retail market are available year-round largely because of imported, net-pen raised salmon.

3.1. Reality 5: Competition for water and watersheds is fierce and highly litigious.

As it is for many ecological policy challenges, competition for water (as well as watersheds) is often a defining flashpoint in salmon policy. In the western United States, competing demands — for agriculture, municipal use, forest products, industry, artificial intelligence data centers, and electricity generation — usually mean that wild salmon advocates are competing for an essential commodity (of which the water itself is only part) that many other policy advocates also value highly. For example, the recent removal of several relatively large West Coast dams, such as the two on the Elwha River (Washington) and four on the Klamath River (California/Oregon), involved structures that were no longer economically viable as electricity producers, afforded minimal flood protection, and supplied a relatively small number of farmers with irrigation water. Had these six dams generated substantially more electricity at lower cost, provided greater flood protection, or supplied irrigation water to politically powerful farmers, then it is likely that there would have been insufficient political support for their removal.

Insert Figure 3

3.1. Reality 6: The regional human population trajectory is a major policy constraint.

Because the West Coast is demographically a "fill-in" region, the size of its future human population is especially difficult to predict because both future immigration, emigration, and birth rates are all challenging to forecast. Regardless, the demands of the human population will be a major factor limiting salmon recovery options (Franks and Lackey 2015). The current population of California, Oregon, Washington, and Idaho is approximately 54 million. Although birthrates have declined markedly in many countries to *much* less than the ~2.1 per female needed for population stability, the West Coast population is growing relatively rapidly, mostly from new residents arriving from within the U.S., as well as from immigration. Without the typical age profile (i.e., "skewed old") of many regions of the world, the West Coast will assuredly grow at least by half, from the current 53 million to 80 million by 2100, possibly many more. Regardless of the actual human population along the West Coast through this century, they will collectively require more housing, schools, roads, airports, mass transit, energy production, reliable electrical grids, food, and recreational opportunities — demands that translate (for salmon) into less or suboptimal habitat, poorer quality water, competition for water with energy intensive computer farms to support artificial intelligence computer programs, agriculture growing and processing operations, and others. Yet, in most salmon policy analyses and discussions, the *additional* human population effect on salmon runs is rarely explicitly considered in recovery strategies. Rather, it is often treated as an unstated and inflexible policy constraint, and, if considered, is buried in ambiguous wording and rarely noticed, much less discussed (Lackey 2015).

3.1. Reality 7: Cheap, abundant, and reliable energy is a competing salmon recovery priority.

Worldwide, energy use (especially electricity) is positively correlated with the standard of living. There are no high-income, low-energy-use countries. For energy production, the West Coast has many large, high-gradient rivers, the requisite for a large hydroelectric facility. Hydro generation is reliable, relatively cheap, and overall, an ideal source of *baseload* power. Irregular or intermittent energy sources (primarily solar and wind) must have sufficient baseload power generation (or battery storage) to offset their intermittent nature. In regions where it is viable, hydropower has proven to be a dependable (and relatively cheap) source of *baseload* electricity. Conversely, there is a well-known downside to dams: those people prioritizing anadromous fish runs become policy losers when a river is dammed. From a scientific perspective, there is no "right" balance between baseload power production, irrigation water, flood control, data center operations, or recovering salmon runs. Rather, the decision is an excellent example of the assertion that *"Policy making is all about picking winners and losers."*

3.1. Reality 8: Floods produce anxiety and a demand for flood protection.

For good reasons, floods have been feared by people for millennia, and much of the West Coast is exceedingly flood-prone (Engstrom, W.N. 1996). For example, in the winter of 1861-62, the entire California Central Valley, the Klamath River and its tributaries, the lower Columbia River and its tributaries, and many other West Coast watersheds experienced catastrophic floods (Miller, G.R. 1999). Not surprisingly, flood control has long been a political priority on the West Coast. The ability to decrease flood risk has increased markedly since 1861 with the increasing capability to build large, reliable dams that substantially regulate flows. However, dams block or at least hinder migrating salmon (both those returning to freshwater to spawn and those leaving freshwater nursery areas for the sea). Nor are the lakes created behind the dams helpful to sustaining salmon abundance (Lichatowich 2013). Fishways of many designs are successful to varying degrees, but a free-flowing river is nearly always superior for salmon returning to freshwater or leaving freshwater for the ocean (Keefer et al 2021). Other flood control activities (i.e., channelization, filling flood-prone areas, bank armoring, levee construction, etc.) further alter the landscape upon which salmon are dependent. Despite most people's inherent political support for sustaining salmon runs, this support generally does not often override the desire to avoid future floods.

3.1. Reality 9: Many people place a high value on harvesting salmon beyond their food value.

For the foreseeable future, net pen production in Europe, North America, and South America will provide sufficient salmon for the retail market. However, for the West Coast, sustaining a substantial salmon *harvest* (recreational, commercial, and tribal fishing) without hatcheries has not happened. Most remaining runs of *wild* salmon in California, Oregon, Washington, and Idaho are at a fraction of their 1850s run levels and will not sustainably support substantial fishing pressure (Katz et al. 2013). Juvenile salmon releases from hatcheries currently number in the many billions, and *these* fish (as returning adults) provide most of the West Coast salmon fishing opportunities. Perhaps, as some argue, continuing to rely on hatcheries dooms any future recovery of *wild* salmon runs (Lichatowich 2013), but others observe that wild salmon are currently such a small percentage of most West Coast runs that they could not support sustainable harvests. For those who value harvest (recreational, commercial, and tribal) on the West Coast, there is no other realistic near-term option to sustaining harvestable run sizes except hatcheries.

3.1. Reality 10: Lack of trust in the impartiality of SRIC scientists constrains their policy impact.

Scientific facts *should be* an important component of salmon policy debates, but facts are only a part of *policy* disagreements because most such conflict is over competing *values* and deciding between mutually exclusive policy choices. The scientific enterprise comprises individuals who nowadays are highly partisan in their political leanings (Motta 2018, Ross et al. 2018). In some cases, scientific information used in policy debates is little more than policy advocacy masquerading as relevant science. Even more shrouded, *normative* science or *religious* ecology is often used to covertly advocate for particular and predetermined *policy* preferences (Lackey 2026). Perhaps not surprisingly, it is typical for every policy advocate or advocacy organization in salmon policy deliberations to offer science that implicitly supports *their* particular policy inclination. Conversely, rather than demand policy neutrality, some *policy makers* appear to encourage scientists to "tell us what we should do," even though the core of most salmon policy debate hinges not on *scientifically*-driven, but on *value-driven* policy preferences. If scientists are to play a helpful role in such policy debates (and they should), policy makers must trust in their impartiality. Ultimately, scientists must be trusted, or their input will be categorized as simply another advocacy pitch and categorized accordingly.

4. Implications and Conclusions

The lack of West Coast salmon recovery was not caused primarily by ignorance, much less can it be ascribed to a lack of sound scientific understanding. Rather, it is a reflection of the failure to describe openly the mix of evolving, uncertain, competing, politically divisive, and often mutually exclusive policy choices. Every potential policy choice has its own set of policy winners and losers, and in most cases, "paying off" the losers has not led to a stable political compromise. Future salmon recovery strategies that ignore this policy reality are destined to fail, as they have for at least the past two centuries. Technical fixes (e.g., fish ladders, hatcheries, habitat restoration) cannot overcome core policy drivers such as the ecological effects of human population growth, market and personal economic choices, lifestyle preferences, a warming climate, and individual choices about a host of decisions (Franks and Lackey 2015). Such realities should be clearly explained to policy makers, the public, and other interested parties, even if it is reasonably certain that the political dynamic will only support the current, failed recovery strategy.

Meaningful salmon recovery requires transformative changes that are politically unsettling to many: (1) revising ESA to enable strategic prioritization as is typically allowed for non-ESA policy tradeoffs, (2) confronting unpleasant ecological realities such as the fact that many aquatic environments are now better suited for many nonnative fish species, (3) finding a better way for the public to decide how to balance the various water and watershed demands (e.g., weighing the importance of sustaining baseload power generation vs. restoring wild salmon runs), and (4) accepting that nearly everything that humans value directly competes with restoring salmon runs (e.g., reducing the risk of floods with dams almost always adversely affects salmon runs). Such policy changes entail major costs — economic, political, and cultural — that society has historically been unwilling to bear (Lackey et al. 2006). Along with the political winners, there will be political losers: for the losers, they usually *know* they will be losers, and they most likely must be accommodated to create a viable, sustainable political compromise.

Considering the remainder of this century and absent transformative change in society's priorities, salmon recovery efforts will continue as largely symbolic gestures: expensive but politically useful, tangible, but largely ineffective. Perhaps these expenditures will continue to successfully serve as "guilt money," a collective salve (and political cover) for the discomfort of ecological loss. *If* the policy goal is genuine recovery to anything approaching sustainably harvestable runs, candor about trade-offs is imperative, and the legal constraints caused by ESA need to be explicitly addressed. Otherwise, scientists, policy makers, and the public must confront the uncomfortable and ongoing truth: returning *wild* salmon to sustainable, harvestable abundance is ecologically and theoretically possible, but only if society is willing to make currently unpopular, but effective, choices that fundamentally alter how people live. To imply that wild salmon recovery can be done otherwise is to perpetuate a delusional reality.

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Figure 1. Fishways are designed to facilitate dam passage of returning upstream-swimming adults and downstream-swimming juveniles. To a degree, these structures work, but the collective negative effect of dams (and many other threats) reduces the quality of the overall environment for most anadromous species. One result of using such technological solutions is an optimism bias that pervades the SRIC and creates unrealistic expectations by the public and some elected or appointed officials about what level of salmon recovery, if any, will be achieved by the billions being spent. (Photo courtesy U.S. Army Corps of Engineers)

Figure 2. The Endangered Species Act has been a primary driver (and constraint) of West Coast salmon management for decades. Lawfare (i.e., suing or threatening to sue, to achieve desired salmon policy objectives) has become routine and has proved to be a powerful legal weapon. In direct response to such lawsuits (or the threat of a lawsuit), the SRIC's overall budget has been significantly increased. (Photo courtesy Oregon Department of Fish and Wildlife)

Figure 3. Four Klamath River dams near the California-Oregon border were recently removed after years of political controversy (the location of one dam is visible in the center of the photograph). The removal of these relatively large dams became politically viable when they were no longer profitable as electricity producers, supplied a relatively small number of farmers with irrigation water, and afforded minimal flood protection. (Photo courtesy U.S. Department of the Interior)