The Future of Salmon Management in the Columbia River Basin

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Introduction

In nearly every Northwest conference that discusses salmon, attendees will hear plenty about the sorry state of anadromous fish runs. This conference has followed the same pattern. We've been offered the latest assessments about the causes of salmon decline. We've heard judgments about the relative importance of this or that causal factor. Mostly we've listened to explanations offered by biologists about their take on the how and the why of what happened. Good stuff. Those of us who are biologists feel right at home. It is an interesting story to be sure, and one to which we are usually inclined to contribute our two cents worth.

At a symposium like this one, where the focus is *future* policy and management, 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? Should either group care? Does science make a difference to anyone but technocrats? How are the myriad scientific factoids relevant to public policy and what is all this information telling us about the likely future of salmon management in the Columbia Basin?

It's time for a realistic perspective. In these venues, our charge as salmon experts should be blunt and unequivocal: offer answers to the "so what" questions. And, look forward — predict — speculate — consider the most likely future for anadromous salmonids — and identify what must change if the long-term, downward trajectory in wild salmon and steelhead abundance is to be reversed. In short, please tell us what we *need* to hear, not what we *hope* to hear.

We're aware that it is easy to dispense generalities and feel-good platitudes — but we'll try to be candid — and frank. We won't argue for or against any particular policy prescription; rather, our goal is to outline the *likely* future for salmon management in the Columbia, given what we know about salmon biology and the continuing expansion of human influence in the Pacific Northwest. We aim to be candid, but policy neutral. You may argue with our take on what the science tells us about the future for salmon in the Columbia River, but we don't want to be Pollyannaish — so here's our stab at forthright *realism*.

Here's a statement of fact, one that will likely engender little argument:

> *". . . despite abundant uncertainty about the relative importance of the various factors that drove the declines of most anadromous species, we fundamentally recognize — we fundamentally know — the direct causes of nearly all long-term declines."*

The causes have been, and often still are:

- fishing
- habitat alteration
- changing climate and shifts in ocean regimes
- dams
- water withdrawals
- channel alteration
- delinquent hatchery practices
- predation
- exotic species
- exotic diseases and parasites
- pollution
- and to be safe — possibly other factors.

It is a long list that covers most of the entire human enterprise. In the background, of course, is the knowledge that ocean and climatic conditions greatly influence anadromous species — even if we don't understand exactly how they work — or when they will shift.

We could argue over details of the science or the relative importance of anthropogenic and natural causes, but consider our basic assertion that the primary cause of most long-term declines is anthropogenic — and we pretty much know the key reasons why each happened. There are exceptions — but let us not quibble over these or lose sight of what we do *know* with reasonable assurance. We know the trajectory of salmon populations in the Columbia and elsewhere in California, Oregon, Washington, and Idaho (Figure 1).

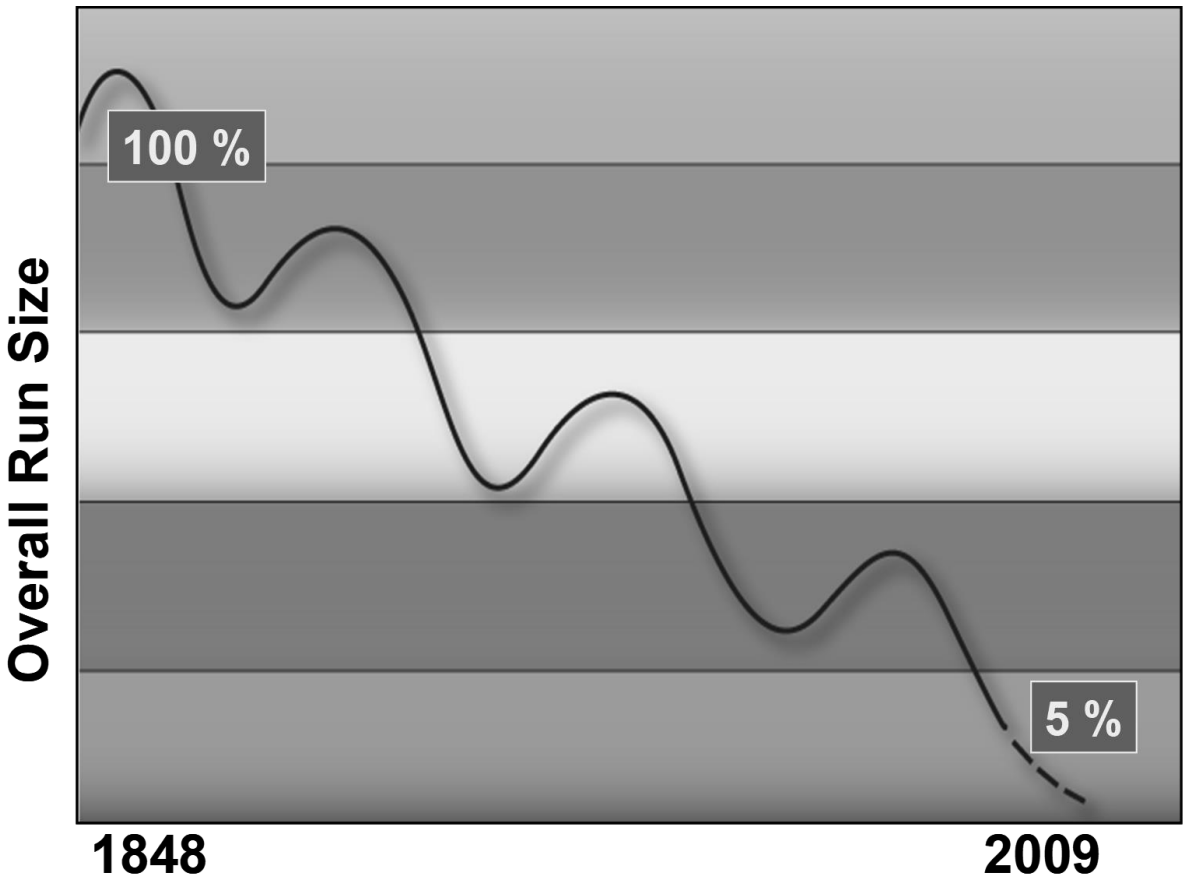

Figure 1. Conceptual depiction of the Columbia Basin salmon decline highlights the importance of ocean conditions. Limited data sets gathered during favorable ocean cycles may lead to errors in predictions. The long term trajectory for salmon remains downward despite cyclical upswings in abundance. Since the mid-1800s, salmon abundance in the Columbia has declined to roughly 5% of pre-European settlement levels (Lackey et al. 2006).

Let us offer a second statement of fact that applies to most Columbia River basin salmon and steelhead populations:

> *". . . as we move forward in this century — despite ups and downs — good years and bad years — favorable and unfavorable ocean conditions — even newspaper headlines proclaiming some species have recovered – anadromous fish have been on a long-term downward trend — and many species are now at very low levels."*

How can this be, given the demonstrated public support for reversing long-term downward trends, not to mention the billions of dollars being pumped into habitat restoration projects, salmon-friendly infrastructure projects, research, etc.? The answer is simple: a change in the downward trend for wild salmon is futile in the absence of shifts in the *core policy drivers*. The core policy drivers have and will continue to determine the status of anadromous fish throughout this century. Habitat alteration, dams, water withdrawals, fishing, supplemental stocking from hatcheries — and many more causal agents — are simply how the core policy drivers are expressed. These drivers include the rules of commerce, increasing scarcity of key natural resources, individual and collective preferences, and regional human population levels (Lackey et al. 2006). It's unlikely that these core policy drivers will change in the foreseeable future; thus, the magnitude of the human influence on salmon can, in a simplistic way, be measured in terms of human population growth.

Consider conservative estimates of population growth in the Pacific Northwest over the next century (Figure 2). These estimates don't need to be exact. In fact, the values themselves are less important than the trend — our population is growing, and the level of pressure on our natural resources, including salmon. No one is bent on eradicating salmon, but policy choices are made between conflicting alternatives. In short, ecological policy is a zero-sum game. There are always winners and losers.

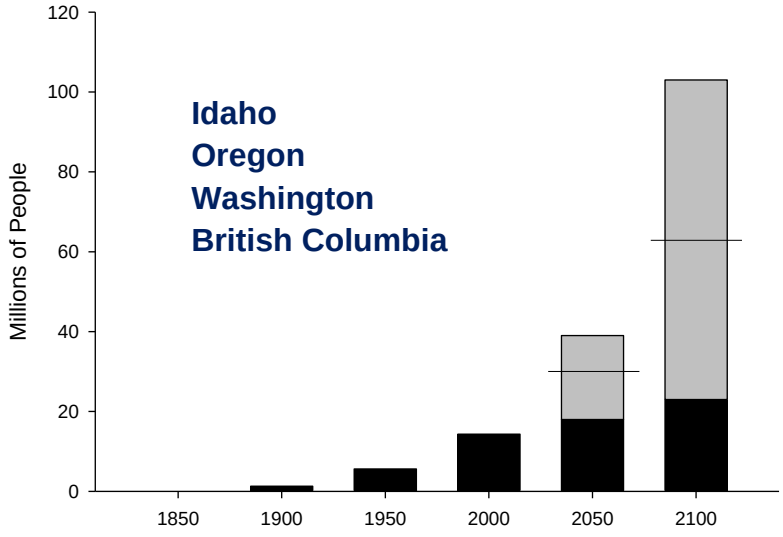

Figure 2. Estimated population growth in the Pacific Northwest over the next 100 years. The top of the grey bars represents PNW population levels if growth continues at the same rates observed between 1950 and 2000. The grey zones assume a degree of slowdown in the rate of growth. From Lackey (2003).

Are Salmon Worth Saving?

Anadromous fish populations play numerous ecological and cultural roles. We're all familiar with the usual explanations about the importance of marine-derived nutrients and the integral role salmon play in sustaining our natural systems. We can even appreciate the intrinsic value of these hardy fish and their inspiring life cycle. There are many good reasons for saving salmon; however, we don't think they're enough to alter the core policy drivers, at least not dramatically. Moreover, it's doubtful the ecological or intrinsic value of the anadromous life history has been the primary source of societal interest in salmon restoration. Fishing (sport, commercial, and subsistence) is the foremost reason salmon have become an icon species in the Pacific Northwest, and fishing continues to be the focus of Columbia River salmon management, which explains the critical role of hatcheries and the heroic efforts to maintain fishing even as naturally spawning salmon and steelhead populations continue to decline.

Hatcheries are the primary means of salmon mitigation in altered watersheds. With only a few exceptions, hatcheries have the explicit goal of bolstering fishing. On average, hatchery fish constitute roughly 80% of the Columbia River salmon harvest annually. Ironically, hatcheries are blamed for the salmon decline. Hatchery fish can impair wild stocks through genetic introgression, competition for space and food, sustaining artificially high fishing levels, and providing an abundant food resource for predators like terns and sea lions.

Fishing, and the important role of hatcheries, creates a conundrum. On the one hand, fisheries, and the tools necessary to sustain them, contribute to the decline of wild stocks. On the other hand, public support and subsequent allocation of resources for salmon protection and enhancement would likely wane in the absence of fishing.

The Future of Salmon Management

The scientific information about salmon in the Columbia is vast, perhaps even overwhelming. Attempting to synthesize this information and predict the future of Columbia salmon management is difficult in the face of considerable uncertainty and complexity. However, all this science, combined with our understanding of the four key policy drivers, does tell us one thing for certain: *society's policy options are highly constrained*.

The following is our perspective on the likely future of Columbia River salmon management, but first, a disclaimer. None of our predictions stem from what we believe "should" or "should not" be the course for salmon management. We're scientists; thus, our forecasts are based on direct observation and analysis, including awareness of the current political and economic climate and what we know about salmon biology. Furthermore, the precision of our predictions relies on the accuracy of the following assumptions:

1. *Significant changes to the four core policy drivers will not occur within the foreseeable future.*

2. *The overarching goal of salmon management will continue to include maintenance of fishing and protection of naturally spawning "wild" stocks.*

We acknowledge that the current strategy is not working, a conclusion shared by all policy advocates and all who have a stake in the Basin. Therefore, if we are to achieve societal goals for salmon, future Columbia River management will look very different from current practices. Basic hatchery reform is only the tip of the iceberg. We predict dramatic changes in augmentation strategies to minimize hatchery and wild fish interactions while maximizing access to hatchery fish for commercial fishermen and anglers. Fish from augmentation hatcheries and aquaculture programs will be segregated from wild stocks via revised practices, and where necessary acclimation and release sites will be relocated.

All hatchery fish will be marked and selective, hatchery-fish-targeted fisheries will become the standard for all mixed-stock ocean and in-river fisheries. Additionally, terminal fisheries will be established, particularly in the lower Columbia and along the Oregon and Washington coasts. These terminal fisheries will become the mainstay of commercial harvest. Fortunately, we don't have to look far for examples of similar changes implemented with reasonable success in fisheries throughout the Pacific Northwest and Alaska:

Case study 1: Medvejie Hatchery, Southeast, Alaska

The Northern Southeast Regional Aquaculture Association (NSRAA) is a private non-profit cooperative established in the late 1970s to increase the harvestable surplus of salmon in Southeast Alaska. Medvejie Hatchery, one of NSRAA's most important programs, operates on the outlet of Medvejie Lake, also known as Bear Lake. The hatchery produces Chinook, coho, and chum salmon for local seine, troll, gillnet, and sport fisheries. The hatchery location was chosen to minimize impacts on local wild stocks and maximize harvest potential. For this example of a terminal fishery, we provide data on chum salmon, the most prolific and lucrative

of the three programs. Roughly 50 million chum salmon fry are released annually into the short stretch of river between Bear Lake and Deep Inlet at approximately $700,000. The program's benefits are impressive — adult chum salmon harvest averages 1.5 million fish annually (Figure 3). The total value of the resulting harvest in 2008 was estimated at almost $9,000,000, including cost recovery. That is greater than a 12:1 benefit-to-cost ratio.

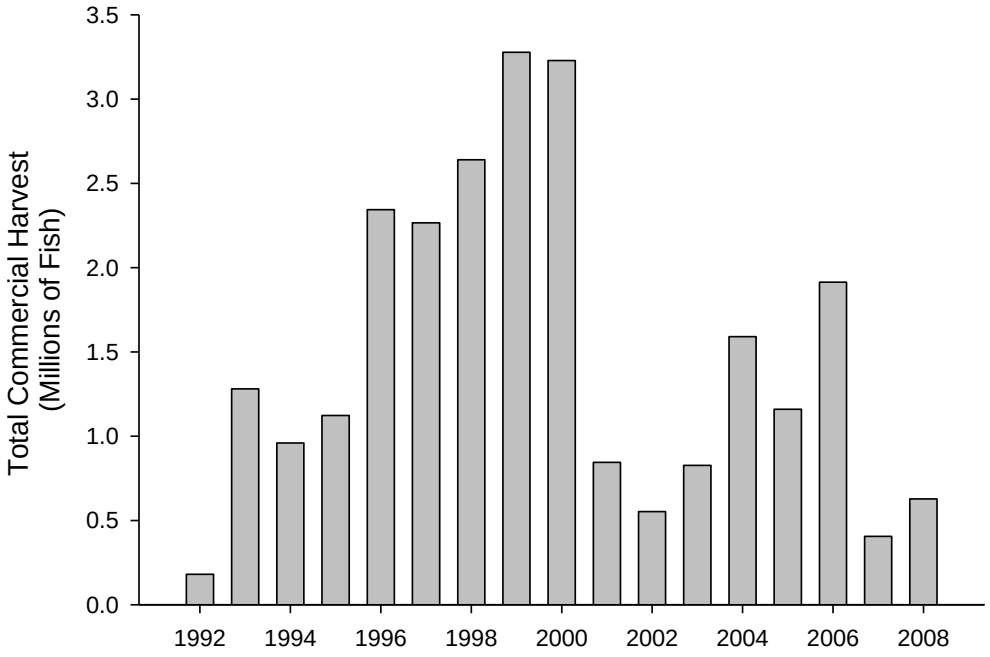

Figure 3. Annual commercial chum salmon harvest resulting from the Medvejie Hatchery program. Data provided by Chip Blair, NSRAA.

Fisheries management tools like those used in the Medvejie Hatchery program are not a panacea. Naturally spawning stocks will continue to need protection and terminal fisheries will inevitably impact other non-target species. That said, terminal fisheries show promise and appear to be one of the few remaining options available if significant commercial fishing persists in the Columbia River. Existing terminal fisheries in the lower Columbia, such as Young's Bay near Astoria, Oregon, appear to be successful at bolstering commercial catch while minimizing hatchery salmon straying and competition with wild fish. Although there is some uncertainty about the biological costs of widespread terminal fisheries, one thing is certain: hatchery-supported terminal fisheries, if implemented properly, would constitute a significant advancement toward achieving at least *some* societal goals for salmon.

Case study 2: California mark-selective fishing

A movement has arisen in California supporting the marking of all hatchery Chinook salmon to protect wild stocks and ocean fisheries. Current management allows for the commercial harvest of Chinook regardless of origin (hatchery or wild) because not all hatchery fish are fin-clipped before release. This means that fishermen cannot always distinguish between hatchery and wild fish. A subsample of hatchery fish are tagged and fin-clipped. Tagged fish caught in fisheries are then used to estimate the proportion of hatchery fish harvested relative to wild fish.

Although roughly 70-90% of Chinook off California, Oregon and Washington coasts are hatchery-origin, opportunities to harvest these fish are often limited due to the inability to manage the take of assorted ESA-listed fish adequately. California coastal Chinook have received heightened attention because of recent downturns in California Central Valley (CV) Chinook abundance and continuing concern about struggling stocks, such as Klamath fall Chinook. Managers, fishermen, and conservationists recognize the need to develop a new strategy for Chinook fisheries off the California Coast.

The proposed solution is a total marking program for California hatchery Chinook. This would allow enforcement of selective harvest of hatchery-origin Chinook, thereby reducing fishing-related mortality for wild stocks and increasing access to abundant hatchery fish. Cramer et al. (2008) conducted modeling simulations assuming implementation of a total marking program and 40-60% harvest rates on marked California Coastal Chinook. Results indicated an 11-22% reduction in mortality of naturally spawning CV fall Chinook and total California Chinook landings equal to or exceeding harvest under current management practices by as much as 57%. Furthermore, total hatchery Chinook escapement was expected to decrease while wild Chinook escapement increased (Figure 4), reducing the impacts of hatchery strays and maximizing wild Chinook spawner abundance (Cramer et al. 2008).

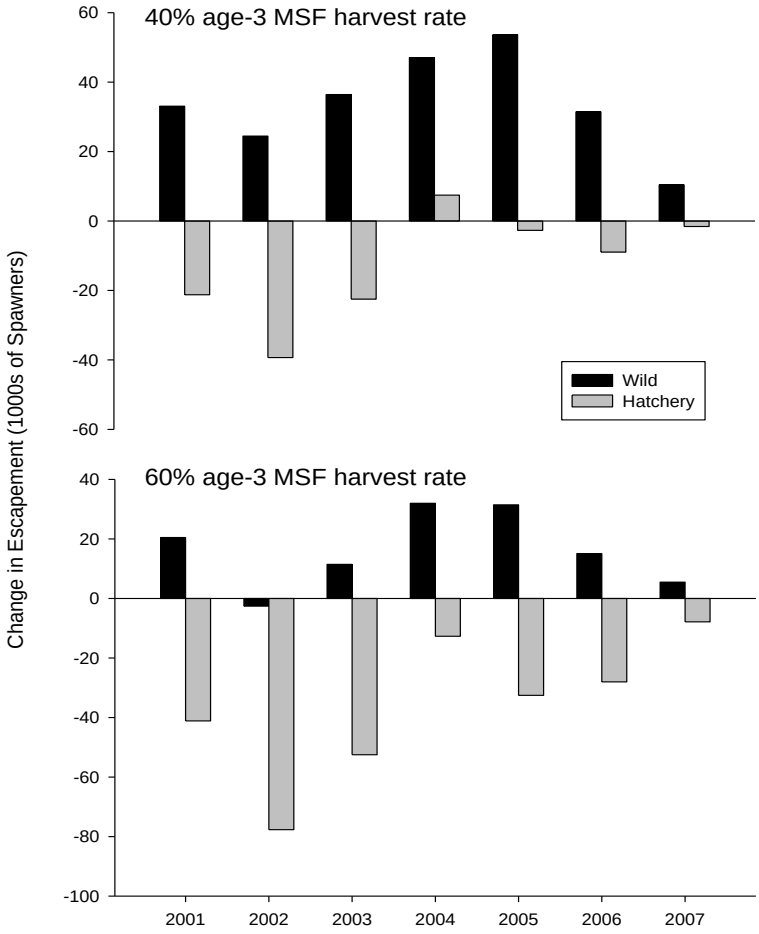

Figure 4. Simulated change in wild and hatchery CV Chinook salmon spawner escapement, 2001-2007 under two mark-selective fishing scenarios compared to the actual number of spawners, assuming a 20% hatchery stray rate and 80% hatchery fraction of age-2 recruits. Original figure in Cramer et al. (2008).

We're not advocating for the use of mark-selective programs as a panacea. We aim to point out that mark-selective fishing appears to be a likely future strategy given the two-pronged goal of protecting wild stocks and fishing in the Columbia Basin. Marking hatchery fish is more extensive in the Columbia Basin than in California; thus, marking all hatchery salmon and steelhead is less daunting. However, implementing mark-selective salmon fishing in the Columbia will require significant hatchery and fisheries management changes. Like terminal fisheries, mark-selective fisheries are not a fix-all, but they constitute an improvement over current management strategies.

Conclusion

Human population growth accompanied by development, economic expansion, and continued competition for scarce natural resources in the Pacific Northwest is expected to continue to threaten already dwindling salmon and steelhead populations in the Columbia Basin. The societal goal for salmon appears to be two-fold: protect wild, naturally spawning stocks and maintain economically and culturally important fisheries. Given the core policy drivers and goals for salmon, it appears likely that two central fisheries management strategies will be extensively applied in the Columbia Basin: (1) terminal fisheries and (2) mark-selective fisheries. Columbia River policy makers should be aware of these expected changes and plan with future fisheries management needs in mind.

To wrap up, you may have wished for more cheerleading, optimism, or calls for society to reinvent itself — but the time for such messages has passed. Delusional proposals do not lead to solutions; rather, they have become part of the *problem* in the Columbia Basin. We need candid dialogue with the public, stakeholders, and those who will pay the bill now. We need collective recognition that the current system is broken, and fixing it will require *dramatic* changes. We have policy and management options to maintain fishable salmon runs in the Columbia. Still, they are highly constrained by competing resource interests such as hydropower, flood control, water withdrawals for irrigation and municipal use, urban development, and many others. When pitted against the needs of a growing populous, salmon are bound to lose; thus, it is imperative that we aggressively pursue the few remaining realistic management options.

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