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***HOW WOULD COLUMBIA RIVER SALMON (AND STEELHEAD) ABUNDANCE BE IMPACTED IF BASIN-WIDE HATCHERY RELEASES and ALL HARVEST WERE TERMINATED?***

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By Brad Halverson, September 2022

Earlier this month, Dr. Robert Lackey, OSU Department of Fisheries, Wildlife, and Conservation Sciences professor posed a similar question to an ad hoc group of national and international fisheries scientists, all of whom are “*well known in the world of professional salmon scientists, managers, and policy makers*”, and are considered experts on the Columbia River salmon question. Dr. Lackey teaches a course on policy and the environment to aspiring student scientists at Oregon State, and I surmise he will craft the answers he received to this question into an interesting policy debate, as the implications are vast.

Probably because of my exposure from the Oregon Hatchery Research Center board I was also asked for my take on whether or not eliminating all hatchery and harvest activities forever from the Columbia River basin would make a difference to wild abundance? But, before I weigh in let’s review the responses from the experts. They may surprise those of us aligned with the pro-hatchery pro-harvest community who correctly or incorrectly perceive there to be anti-hatchery bias from the scientists and agencies managing this resource.

Dr. Lackey set the historical context for this question by reviewing pre-1850’s run abundance, changes to quality spawning and rearing habitat over the period since, unsustainable commercial harvest and the advent of hatcheries to mitigate for that, the Endangered Species Act and its implications for policy, ecological (hydropower projects) and biological (non-native species well adapted to changing aquatic environments) alterations to the nature of the Columbia River basin over this period, and the hierarchy of core societal values that influence fish policy.

Before we examine this experiment, it is helpful for each of us to answer for ourselves whether or not we believe wild salmon on the Columbia River can be recovered, and to what end? Billions of taxpayer dollars have been invested in this venture but the overall trajectory of run size has been downward. While it seems to have stabilized at historically anemic numbers (2-4% of pre-1850’s abundance) for several decades, the trend line is not ascending and has not been for over 170 years. If we agree salmon stocks cannot recover to historic numbers, can they at least endure at current levels (which do not permit harvest on wild stocks in most cases), or is the best outcome the mere slowing of their progression to extinction? Finally, ponder the value of restoration absent harvest.

If you believe these stocks cannot be recovered or even prevented from becoming extirpated from the Basin, then the policy solution is to cut your losses and invest those dollars on other social imperatives. And, learn how to fish for the non-native stocks now abounding such as

large and small mouth bass, bluegill, shad, walleye, crappie, yellow perch, channel cats and northern pike.

On the other hand, if you presume either we can slow the downward trend or reverse it given today's population realities then it is prudent to take measures to facilitate that recovery. And, this is the point where Dr. Lackey's question has relevance, because policy tradeoffs arise when developing and executing recovery plans. More hatchery supplementation? Less? More harvest? Less? And, by no means are hatchery and harvest activities the only levers to be pulled on this journey. But, they are the only ones addressed in his "thought experiment" so we fix our sights on those exclusively.

Let's get started: ***"After 20-30 years or so of (1) zero hatchery releases; and (2) zero targeted fishing...roughly what would be the overall run size in the Columbia Basin compared to current average runs?"*** His key findings were (1.) 83% of the respondents predicted current wild plus hatchery abundance would decline in the absence of hatchery stocking and harvest. (2.) 12% predicted increased abundance. (3.) Most experts projected wild-only abundance would not be greatly altered from current levels by eliminating hatchery and harvest activities. (4.) The majority of this audience did not believe these two events are drivers of low wild salmon stocks in the CR Basin, and concluded ceasing their action would not much change the wild salmon situation here.

In his article, Dr. Lackey shares several of the respondent's comments. Of interest was the varied response from what can be perceived to be a homogenous collection of experts: from complete extirpation without hatchery supplementation to a return of as high as 50% of pre-1850's abundance, and everything in between.

One reader of this blog stated "fish and wildlife experts are notoriously bad at assessing population-scale problems." The reason, I believe, is because we just don't perform enough population-scale research. Much if not most of the research relied on for policy is based on individual genetics or behavior.

Now, as to my take on all this. First, we can't participate in a hypothetical exercise about hatchery releases and harvest angling in the Columbia River basin without giving credence to the role tribal nation's play in managing these resources. Codified treaty obligations authorize sustained tribal hatchery releases and consumption in perpetuity. So, those activities would skew the outcomes of federal and state cessations of such practices.

Next, hatchery practices are presumed to influence wild abundance through the mechanism of Relative Reproductive Success. While there is some argument for ecological impacts to wild abundance (increased predation, competition for food spaces and spawning geography and facility impacts to feeder streams) the primary concern from hatcheries is biological, reduced fitness from hatchery-origin/natural-origin pairings in the wild. But, alternative research is also credible, no such fitness decline results in the first generation and less so in future generations. So, my contention is eliminating this "risk" from the Basin is unjustified and counterproductive to the questionable need to augment an unsustainable level of wild genetics.

When assessing recovery programs, an important metric as to the effectiveness of those programs is SAR's, or smolt-to-adult return ratios. The percentage of fish that return as adults is the only relevant measurement of progress toward recovery. And SAR's is unaffected by hatchery releases. The percentage for natural-origin returns is quite similar to hatchery-origin returns, 2-4% for either one. It is determined that a minimum SAR of 2% is required just to maintain existing population levels. But, for recovery to occur SAR must exceed 2%, and more closely approach 6%. A 2006-2015 Basin study revealed those upper-Columbia River stocks influenced by the four Lower Snake River Dams experienced greater than the allowable threshold 98% mortality needed for sustainability. So even if all hatchery and harvest activities are eliminated, these stocks will still go extinct without addressing the hydropower conundrum. This study did reveal, however, a somewhat positive finding that mid-Columbia wild populations have fallen within this 2-6% range of returning adults.

In order to connect a few variable threads so far recall that the initial question postulated by Dr. Lackey deals hypothetically with restoration of wild salmonid stocks on the Columbia River. Further, we stated that SAR's is the primary metric used to determine the efficacy of a restoration program, and hatchery supplementation does not impact this metric. Again, we are working only with the controls of hatchery operations and harvest activities in our quest to restore these stocks.

Next, therefore, let's address harvest impacts on SAR's. It is reasonable to presume harvest will impact adult returns. But, to what degree? Revisiting smolt-to-adult return data we see that somewhere between 94-98% mortality is exacted upon all smolts migrating up and down the Columbia River during their life cycle prior to spawning activities in the wild. It is further presented that approximately 70% of that mortality occurs prior to departing freshwater habitat for the marine phase of their life cycle, primarily due to hydropower trauma and avian, mammalian, and piscivorous fish predation. So, the majority of harm is not caused by angling pressure. But, some is. How much? Sports and commercial harvest in the Columbia River basin is strictly co-managed by Washington and Oregon State agencies to allow for sustainable escapement, defined quite simply as how many salmon are able to "escape" premature death (by predation, environmental impacts, harvest, etc.) and complete their full life cycle (including spawning the next generation). As sports anglers we can frustratingly verify we are rarely allowed to fish during the peak return periods, thereby protecting these stocks from mortality due to harvest handling.

Before concluding, we should examine the variation in annual returns of adult chinook estimated at Bonneville Dam in the 20<sup>th</sup> century (1938-1999) versus the 21<sup>st</sup> century (2000-2022). According to DART data from the USACE, for the former period the average annual return was 336,000. For the latter era it was 714,000. The largest return recorded in the former was 508,000. The latter 1,337,000. Hatchery and harvest activities were robust all through the entire epoch. So, what would explain the better performance in the later time frame? Some might argue more favorable marine conditions in the 21<sup>st</sup> century set against the 20<sup>th</sup> century; but the Big Blob in the Pacific Ocean and the strongest recorded El Nino (warmer ocean temperatures and hence limited forage copepod and krill populations) occurred in 2013-2016. The cause is an open question at this time.

In conclusion, to answer Dr. Lackey's original question about the impacts to wild salmon stocks in the Columbia River basin by terminating all hatchery and harvest activities, my response would be that those stocks would continue their deterioration to extinction without supplementation. I prefer, however, to examine the influences on total wild plus hatchery abundance as the ultimate objective.