Management of Present Day Hatchery Program Size

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We have depended on hatcheries in the Pacific Northwest for over 150 years to mitigate for lost habitat; and sustain tribal - commercial - recreational fisheries. They are managed by fish and wildlife agencies in this region following federal policy set by the Hatchery Scientific Review Group. The HSRG is itself heavily influenced by constraints from the Endangered Species Act and resulting ESA listed salmon and steelhead stocks in our region. We understand, therefore, that many contending and often divergent forces influence their management.

But, of importance to us as sports anglers is the rationalization for agency policy and practices affecting the abundance of harvest opportunities. The 2020 study titled ***"A Review of Hatchery Reform Science in Washington State"*** will serve as our guide to uncover the basis for hatchery practices. Our region's fisheries are over 70% dependent on hatchery production, often referred to as *program size* or number of juveniles released. Management policy driving program size is substantially influenced by peer reviewed scientific scholarship. The above study was initiated, therefore, to better understand the science that has emerged since WDFW last adopted HSRG recommendations as the foundation for their 2009 Commission Policy C-3619.

The core hatchery policy objectives of conservation on the one hand and harvest on the other are often opposing and unequal. Federal directives tip the scale in favor of preservation of wild genetics. But, the conundrum lies in the desire to preserve wild fitness and diversity and still produce sufficient harvest opportunities for tribal, commercial and recreational fisheries.

The fundamental focus of hatchery management and reform is to manage *gene flow* between hatchery origin populations (HO) and their companion natural origin (NO) populaces, in order to minimize the perceived fitness loss of reduction in reproductive success, and lowered genetic diversity within and among populations when hatchery and natural fish comingle in the wild. HSRG devised a method for discerning fitness and diversity loss to natural fish due to hatchery operations. It is the risk metric known as pHOS or proportion of hatchery origin spawners, and is the primary basis for program size constraint. It depicts the *gene flow* from the hatchery to the wild. Restrictors of pHOS include weirs and diversion dams at hatchery sites, and marked selective fisheries, but agencies depend predominantly on program size to control pHOS. Hence, the corollary may also be true: pHOS controls program size.

So it is the intersection of pHOS and program size that produces the level of production and therefore angling opportunity we may or may not experience. Might there be an alternative to pHOS for managing program size? pNOB, which stands for proportion of natural origin broodstock depicts *gene flow* from the wild into the hatchery. While not a measure of risk, it is used in conjunction with pHOS to manage hatchery production. Interpreting substantial peer reviewed science, pNOB could be considered to be an even superior facilitator of sustaining wild diversity and fitness than pHOS. We have learned that hatchery programs using 100% natural origin broodstock provide demographic conservation benefits without weakening the genetic

diversity or fitness of wild stocks[1]. Studies of Coho in the Columbia River basin point to the indisputable success of reintroducing natural origin spawning using natural broodstock in the hatchery[2]. Clearwater River[3] and Yakima River[4] research also demonstrate beneficial hatchery supplementation where adult natural origin returns pre-supplementation were insufficient to reach juvenile carrying capacity, yet achieved increased redds, spatial distribution and harvest opportunities post supplementation without distressing wild returns. Both programs depended exclusively on natural origin spawners in the hatchery (broodstock). Additionally, we found that generation one hatchery origin Johnson Creek spring chinook produced 2.5 times more natural origin grand offspring in generation 3 while using 100% natural origin broodstock than did generation one wild fish[5]. Science also shows us that larger broods sustain greater genetic diversity than smaller broods[6]. If we link these two discoveries, we may conclude that large programs using 100% natural origin broodstock produce little variance in relative reproductive success (RRS) or diversity from their associated natural populations[7]. To better understand the use of pHOS and pNOB in constraining hatchery program size I urge you to read Craig Busack's work on proportionate natural influence (PNI) prior to his retirement from NOAA Fisheries.

A goal of 50% Proportionate Natural Influence (derived from an equation using pHOS and pNOB) is the desired target in order to manage gene flow. If PNI is less than 50%, greater hatchery influence results. PNI greater than 50% means natural origin genetics predominate in comingled spawning occurrences. When using 100% natural origin broodstock, a pHOS as high as 30% may still be an efficient use of threatened wild genes. Whereas the use of 100% hatchery origin broodstock can compromise wild genetics at the very low pHOS threshold of 5%. This is relevant because hatchery program size is dependent on pHOS and the greater the threshold allowed, the greater the number of hatchery juveniles will be released.

Conceptual flaws with dependence on pHOS are (a.) the lower regard for other tools to control hatchery adults spawning in the wild such as weirs and dams at hatchery sites and marked selective fisheries; (b.) the difficulty measuring it and hence it's imprecision as a management metric; and (c.) the perception that salmon stocks **are** *recovering*.

This latter topic is worth considering. The justification for cautious use of wild fish for brood stocks in hatcheries is that they are declining and their diverse, higher fitness genes need to be preserved. Taking them into the hatchery, many will argue, just to produce domesticated hatchery offspring is inconsistent with the conservation goal of sustaining or recovering their population abundance. But, ask yourself to envision the terminus of their current journey toward decline. Do they linger until extirpation? Can they be recovered? How you answer those questions will inform how you would allocate their portion in the hatchery brood. I recommend you review Dr. Robert Lackey's exceptional work titled Science and Salmon Recovery as part of his contribution to the Salmon 2100 Project – Recovery of West Coast Salmon: Alternative Long-term Futures.

It is important to understand that hatchery management and hatchery reform not only encompass breeding, rearing, and release protocols but a whole suite of social values and goals delineated in Dr. Lackey's work that create a hierarchy of essential public imperatives where,

unfortunately, salmon recovery holds a subordinate position to numerous other social requirements.

Hatchery reform alone cannot affect meaningful salmon recovery. Unless those factors that caused the original and continuing decline in these stocks are identified and restructured, recovery is unattainable. While both HSRG and WDFW acknowledge the merits of an ***"all H"*** strategy – hatchery management, habitat restoration, hydropower projects and harvest policy – in their own words ***"this goal has rarely been realized."*** Therefore, recovery is unlikely. If this is your inference, as it is mine, then it seems more prudent to take all available wild stocks into the hatchery to endeavor to produce as great of quantity of best practices hatchery origin stocks as possible. We see from peer reviewed scientific studies that using 100% natural origin broodstock achieves that.

In conclusion, it is time for a paradigm shift in hatchery program size management away from pHOS to pNOB, to produce greater release abundance leading to improved angling opportunities for all harvest stakeholders – tribal, commercial and recreational - while conveying the desired conservation benefits of preserving fitness and diversity in wild stocks.

FOOTNOTES:

[1]A Review of Hatchery Reform Science in Washington State by WDFW

[2]Galbreath et al. 2014

[3]Sharma 2006

[4]Fast et al. 2015; Waters et al. 2015

[5]Janowitz-Koch et al. 2019

[6]Allendorf et al. 2013

[7]Waters et al. 2015