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Summary Comments on Peer Reviewed Research Documenting Adverse Impacts of Hatchery Salmon on Wild Salmon

Board Of Fisheries Hatchery Meeting
OCTOBER 14, 2023

BOF Question: Should independent research be conducted to ascertain what, if any, impact the hatcheries' release of pink salmon may have on other species?

YES - **however the weight of evidence from the peer reviewed literature and the scientific community is sufficient to make many policy decisions regarding large-scale hatchery production.** Hatchery production in Alaska should be capped and reduced to levels that allow for management of the wild populations and no over harvest of wild populations, while also minimizing unintended competition among hatchery and wild salmon at sea (e.g., Holt et 2009, Ruggerone et al. 2023).

BOF Question: Is a precautionary approach being implemented when managing hatcheries? If so, is it working?

No – due to documented impacts hatchery salmon on wild salmon populations - Please see COMMENTS below.

BOF Question: Should the Alaska salmon fishery enhancement program be used to rehabilitate depleted king salmon runs across Alaska?

Absolutely NO. Please see COMMENTS below

COMMENTS

Effects of hatchery harvest on wild salmon.

1. **Hilborn (1992):**

   "Large-scale hatchery programs for salmonids in the Pacific Northwest have largely failed to provide the anticipated benefits; rather than benefiting the salmon populations, these programs may pose the greatest single threat to the long-term maintenance of salmonids."

2. **A survey of 206 peer-reviewed science publications reported that 83% of the studies found adverse or minimally adverse effects of hatchery salmon on wild salmon (McMillan et al. 2023).** Adverse genetic effects on diversity were most common, followed by effects on productivity and abundance via ecological and genetic processes. Few

publications (3%) reported beneficial hatchery effects on wild salmonids, nearly all from intensive recovery programs used to bolster highly depleted wild populations.

3. **Hatchery salmon can tolerate a higher harvest rate than wild salmon, leading to overharvesting of wild salmon** (especially the less productive populations), **and/or to numerous hatchery salmon spawning in the rivers with wild salmon.** Mixed stock fisheries require much more monitoring and funding, which is typically insufficient for management of the wild populations.

4. **Hatchery salmon compete with wild salmon for spawning and rearing habitat in rivers (see ISAB 2015-1), and for prey at sea** (McMillan et al. 2023).

5. **In Prince William Sound, large releases of hatchery fish replaced rather than augmented wild fish and escapement of wild fish declined due to overharvest associated with hatchery fish** (Hilborn and Eggers 2000).
   Large releases of hatchery fish result in mixed-stock fisheries where wild and hatchery fish are comingled in the harvest. The problem is , but the high harvest rates on more abundant hatchery fish leads to unsustainable harvest rates on less abundant wild stocks (Naish et al. 2007).

6. **Large releases of early-timed hatchery fish combined with high harvest rates on co-existing hatchery and wild stocks contributed to severe depletion of early-timed winter steelhead and significantly altered the run timing of wild populations** (McMillan et al. 2022).

High Straying Rates for Hatchery fish

Hatchery fish have a higher straying rate than wild stocks. Straying of hatchery salmon is a widespread and well documented threat to wild stocks.

1. For example, ADF&G biologists have documented straying of Prince William Sound pink salmon staying over 250 miles from their hatchery release sites to spawn amid wild pink salmon stocks in Kachemak Bay (Otis and Hollowell 2023; Otis et al. 2018).

2. Stray contributions of hatchery Chinook in several rivers in Washington State ranged from 1-88%, highlighting the uncertainty of where hatchery fish will ultimately end up – in the intended fishery or another far off river (Pearsons and Miller 2023).

Loss of fitness and genetic changes in hatchery salmon

1. **Research shows that hatchery fish after just a 1-3 generations have much lower reproductive success in nature than wild fish.**
   Comparison of 51 estimates of relative reproductive success (i.e., how many offspring produced by hatchery vs wild adults) across six studies found early-generation hatchery fish derived from wild fish averaged only half the relative reproductive success of wild fish (Christie et al. 2014). Importantly, the study only looked at "early-generation" hatchery fish that were derived from local populations of wild fish, **which indicates that even wild fish brought into a hatchery will have – on average – substantially lower fitness in nature than the wild fish**.

2. **Hatchery rearing can create substantial genetic changes in salmonids in as short as one generation.**
   A study found that 723 genes were differentially expressed in steelhead after just one generation in a hatchery, and those were linked to adaptations to crowded rearing conditions in raceways (Christie et al. 2016).

3. **Hatchery fish may provide a short-term boost, but over the long-term, their reduced fitness will contribute to depletion of wild population. Evidence suggests long-term stocking will result in depletion of co-existing wild stocks.**
   For example, Bowlby and Gibson (2011) found that continual supplementation with hatchery fish enables the population to build from critically low abundance levels, even under high rates of fitness loss (ability to reproduce in the wild). **However, beyond 4–6 generations, loss of fitness outweighs any increase in abundance and causes the population projection to start to decline.** This is problematic because based on Christie et al. (2014), the average fitness loss is about 50%, which suggests long-term stocking will inevitably result in depletion of co-existing wild stocks.

Ecological effects

1. A large-scale experiment with Oregon coast coho salmon found that the productivity of wild coho salmon decreased as hatchery coho releases increased and competition due to hatchery juveniles produced negative density-dependent effects that were ∼5 times greater than those of wild spawners (Buhle et al. 2009).
2. Another study on Oregon coho attempted to plant hatchery juveniles and found that stocking reduced the abundance and production of wild juvenile coho salmon (Nickelson et al. 1986).
3. Naman et al. (2012) found that releases of hatchery juveniles can lead to high rates of hatchery fish preying on wild fish.

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References are found in McMillan et al. submitted as separate RC on 10/14/23

---End of Comments---