Considerations for the use of segregated vs. integrated steelhead hatcheries in the Lower Columbia Region

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Background

The Statewide Steelhead Management Plan (SSMP; Scott and Gill 2008) and reviews of steelhead hatchery programs by the Hatchery Scientific Review Group (HSRG; Mobrand et al. 2005) provided recommendations for the operation of steelhead hatchery programs in order to minimize their negative impacts on wild populations. Both of the SSMP and HSRG considered two types of hatchery programs and provided separate operational guidelines for them—*Segregated Programs* in which only hatchery individuals are used in hatchery broodstocks and greater domestication selection may occur (including intentional selection to alter spawn timing of hatchery stocks with the goal of minimizing reproductive interactions between hatchery and wild steelhead), and *Integrated Programs* in which a high proportion of wild individuals are incorporated in the hatchery broodstock each generation, maintaining genetic similarity of wild and hatchery stocks, but potentially resulting in greater reproductive interactions between the two (e.g., Mobrand et al. 2005, Scott and Gill 2008).

In order to reform its segregated hatchery steelhead programs in the Lower Columbia Region to meet conservation objectives WDFW evaluated which program type best met the agency's conservation and fisheries management objectives. We ultimately determined that maintaining segregated hatchery programs and operating them in a manner consistent with HSRG and SSMP guidelines rather than transitioning to integrated programs better met conservation and management objectives in most watersheds. The following is a brief outline of our rationale:

Integrated vs. Segregated Comparison

1. *Genetic fitness effects of the two program types are equivocal:*

Deleterious genetic effects of a hatchery program on a wild population are a function of both the fitness of the hatchery stock in question relative to its sympatric wild population, and the extent to which hatchery and wild fish spawn together. Relative reproductive success (a proxy for fitness) of integrated stocks is generally higher than that of segregated stocks (Araki et al. 2007), resulting in lower per capita genetic impacts of integrated steelhead that spawn with wild steelhead. However, due to less temporal segregation of spawning between integrated hatchery steelhead and wild steelhead relative to segregated stocks (e.g., Chambers Creek stock; Crawford 1979), a greater incidence of interbreeding may occur between integrated stocks and wild stocks, negating the benefit of the greater fitness of integrated stocks. Whether an integrated or segregated program represents a greater genetic fitness threat to wild stocks therefore depends on the specifics of the program—the relative reproductive success and the rate of interbreeding.

2. *Integrated stocks pose a greater risk in terms of ecological interactions:*

Several studies have demonstrated the residualism rates—the tendency for planted hatchery smolts to remain in the river—are significantly greater (up to 7-10 times as high) for integrated than segregated programs, (Reisenbichler et al. 2008, Sharpe et al. 2007, WDFW, unpublished data from the Sol Duc River, Viola and Schuck 1995). Residual hatchery fish may compete with and prey upon wild fish and thus pose a threat to wild populations (McMichael et al. 1997).

3. *Integrated hatcheries require mining of wild populations annually whereas segregated hatcheries do not.*

4. *Fisheries targeting integrated steelhead may have greater impact rates on wild stocks:*

Due to more similar run timing between integrated hatchery and wild stocks, fisheries targeting integrated hatchery winter steelhead may result in a higher handle rate of wild steelhead, whereas fisheries targeting segregated hatchery stocks may be designed to end before the majority of wild fish enter the fishery area. Impact rates on wild summer stocks may be limited by restricting the fishery area to lower portions of watersheds that summer steelhead transit more quickly than winter steelhead.

5. *Integrated hatchery steelhead production complicates monitoring of wild stocks using current methods.*

Redd-based abundance estimates are currently used to estimate steelhead abundance for the vast majority of Lower Columbia River stocks. Due to the greater overlap in spawning time between integrated hatchery and wild steelhead, redd-based wild abundance estimates may be compromised in areas with a large proportion of hatchery fish. Obtaining estimates of the proportion of hatchery spawners is not possible using methods commonly used for salmon (carcass origin) because most steelhead do not die immediately after spawning).

6. *Integrated hatchery steelhead programs are more logistically complex to operate properly:*
    a. Integrated hatcheries require adult collection facilities for wild stocks, which are uncommon in most Lower Columbia watersheds.
    b. Integrated hatchery steelhead are harder to rear in the hatchery environment. This results in greater variance in smolt size and generally smaller, lower quality smolts (Sharpe et al. 2007).

7. *Conservation benefits of integrated hatcheries are unsupported by the scientific literature:*

One initial goal of integrated hatcheries was their ability to "supplement" wild populations by providing a demographic boost to wild populations during periods of reduced wild abundance. Recent research has demonstrated that the fitness of integrated steelhead stocks is lower than wild stocks (Araki et al. 2007, Berntson et al. 2011) and that this effect may be passed on to wild-spawning offspring of these integrated hatchery steelhead (Araki et al. 2009). Furthermore, the premise that hatchery steelhead could provide a demographic boost to wild populations by spawning in the wild relies on the assumption that wild populations are under capacity which may not always be the case, even for listed populations (Walters et al. 2013), and therefore supplementation may not increase production in wild populations (Byrne and Copeland 2012).

8. *New local-origin segregated stocks could be developed to reduce risks from out-of-ESU introduced stocks (e.g., Chambers Creek winter steelhead):*

Currently WDFW uses Chambers Creek winter steelhead (e.g., Crawford 1979), which were domesticated from Puget Sound steelhead stocks and introduced to the Lower Columbia. In order to reduce risks posed by out of ESU stock transfers, WDFW could explore opportunities to develop segregated winter steelhead stocks in the Lower Columbia Region using native stocks. However, development of some of the positive attributes of current segregated stocks (differentiated spawn timing and reduced residualism) could take several generations.

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