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# Integrated vs. Segregated Hatchery Programs in California

The CA HSRG Perspective

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# In the beginning, there were the dams.... Then came the salmon hatcheries



- Nearly all hatcheries in California established to replace production of salmon and steelhead in natural areas above the dams.
- Hatcheries are a surrogate for spawning and rearing habitat.



# Hatcheries in salmonid management

- **Hatcheries are powerful tools to modify salmonid populations. Modifications can be of negative, positive or neutral with respect to population/ESU viability and evolution.**
- The Devil is in the Details! Must use science-based approach informed by monitoring to direct operations and to evaluate where in the spectrum effects are occurring and mitigate appropriately.
- Considerations very different for large- and small-scale hatchery programs, and for different species.

# Hatcheries in salmonid management

## Potential negative hatchery effects

- **Ecological effects-** Competition, direct predation, disease vectors.
- **Domestication selection-** Can be of many types, may ultimately result in loss of local adaptation and decreased fitness for both hatchery and natural fish reproducing in natural areas.
- **Ryman/Laikre effect-** Decrease in overall effective population size due to increased survival of hatchery fish. Most problematic when due to density dependence at juvenile or spawning stages.
- **Inbreeding depression-** Decrease in fitness, due to mating between related individuals.

# Hatcheries in salmonid management

## Potential beneficial hatchery effects

- **Refugia-** Hold fish from remnant populations through high mortality life stages to ensure persistence. Many hatchery stocks also contain a significant portion of the remaining genetic legacy of the natural stock
- **Reintroduction:** Powerful mechanism to re-establish extirpated stocks
- **Demographic effects-** Population subsidies may reduce negative impacts of transient population declines, due to external effects
- **Societal goals-** Provide sufficient numbers of fish for desired fisheries and/or other goals
- **Treaty obligations-** Provide sufficient numbers of fish to meet tribal trust and other obligations.

# Integrated vs. Segregated Hatchery Programs in California

(Section 2.2, California HSRG Report)

Previous HSRG reports used a dichotomous classification system for hatchery programs

- **Integrated** programs intend to minimize genetic divergence between the hatchery stock and the natural population with which it is expected to exchange spawners.
  - Proportion of hatchery fish on natural spawning areas AND proportion of natural fish in hatchery broodstock both  $> 0$ .
- **Segregated** programs intend to minimize interbreeding between hatchery stock and natural population, maintaining high genetic divergence.
  - Proportion of hatchery fish on natural spawning areas AND proportion of natural fish in hatchery broodstock both  $= 0$ .

# Integrated vs. Segregated Hatchery Programs in California

(Section 2.2, California HSRG Report)

California HSRG members concurred that true **Segregated** hatchery programs, with no hatchery fish spawning in natural areas, are not feasible in California.

- There is a fundamental problem with **Segregated** programs in that the more genetically and phenotypically divergent the hatchery and natural stocks are, the more detrimental it is likely to be to the natural stock when hatchery fish (inevitably) spawn in natural areas.
- Therefore, the California HSRG concluded that all hatchery programs in California should be managed as **Integrated**, with the goal of minimizing the divergence between the hatchery stock and the natural population to which it contributes.
- Important to note that it is combinations of genes in hatchery fish, not the genes themselves, that may be detrimental. Rehabilitation.

# Effects of hatchery fish on natural populations are mainly in vicinity of hatchery with natural homing patterns

- In Klamath basin, genetic and tag analyses show that salmon interbreeding drops off quickly with distance from hatchery. **Onsite** releases encourage homing back to hatchery. Substantial structure maintained, allowing local adaptation.
- In Central Valley, genetic and tag analyses show rampant interbreeding in all tributaries, regardless of distance to hatchery source. **Offsite** releases result in huge increase in straying. No structure, or local adaptation, remains in fall Chinook.

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- **Offsite** releases spread effects of hatchery fish on natural stocks and result in loss of local adaptation.

# **Appropriate levels of interaction between hatchery and natural fish**

- California HSRG did not believe that adequate information was available in most cases to recommend specific targets and thresholds for the proportion of hatchery spawners in the natural populations that they affect or for the proportion of natural spawners in hatchery broodstock.
- Robust Monitoring and Evaluation programs are needed to provide information to appropriately manage these programs and eventually set targets and thresholds for these interactions. Such programs are outlined in the CA HSRG Report Appendix IV.