Monitoring Puget Sound early winter steelhead hatchery releases



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Genetic and ecological concerns of hatchery programs

Evidence that hatchery-origin fish have lower reproductive fitness than natural-origin fish

Araki et al. 2008 Evol App, Araki et al. 2009 Biol Letters, Christie et al. 2014 Evo Apps

Large hatchery releases may be associated with decreased survival of wild fish via ecological mechanisms Kostow 2009 Rev Fish Biol Fisheries

- Competition for limited food or rearing territories
- Predation on smaller-bodied salmonids

Genetic and ecological concerns of hatchery programs

Residual: hatchery fish that fails to out-migrate with cohort

- Undersized, immature parr
- Large, precocial males

Release strategies and residualism

Volitional migrants: fish that volitionally migrate from hatchery

- Better survival, fewer residuals (Snow et al. 2013, Moran 2016, Tatara et al. 2016)
- Faster migration (Moran 2016)

Non-migrants: fish that fail to migrate from hatchery

- Greater chance of residualism (Snow et al. 2013, Moran 2016, Tatara et al. 2016)
- Male biased (Sharpe et al. 2007, Berejikian et al. 2012, Tatara et al. 2016)
- Undersized fish (parr) or precocious fish

Puget Sound early winter steelhead hatchery programs



- Support harvest opportunities
- Segregated program
- Intentional selection of early maturing fish to advance spawn timing
- 1-year accelerated smolt program
- Programs authorized via 2016 BiOp (NMFS)
 - Nooksack, Stillaguamish, Skykomish, Snoqualmie, Dungeness
 - Stipulates < 2% gene flow from hatchery programs into wild populations

Early winter steelhead release guidelines

- Fully smolted fish
- Fish of uniform size, that meet minimum size criteria
- Volitional release





MINIMIZE ecological and genetic risks

MAXIMIZE adult returns

Objective: evaluate EWS hatchery releases

- Evaluate the potential for residualism via release sampling
 - Estimate rate of precocious male maturation
- Evaluate the potential for ecological effects during outmigration *via smolt trap catches*
 - Estimate rate of outmigration





2017 early winter steelhead releases



Facility	Release Start	Release End	Fish Released	
Whitehorse (Stillaguamish)	Apr. 15	May 15	102,167	
Tokul (Snoqualmie)	Apr. 15	Apr. 30	66,895	
Dungeness	May 1	May 10	10,195	



2017 hatchery release sampling

Pre-release sample Post-release sample (non-migrants)

N = 200

- Fork Length (mm)
- Wet weight (g)
- Smolt index

N = 100 (lethal samples)

- Metrics above
- Gender
- Gonad weight
- Visual maturation determination















Potential residuals

Pre-release	Fish Released	Percent male	Estimated males	Percent mature	Mature males released	Percent of release
Tokul Creek	66,895	56%	37,461	1.8%	674	1.0%
Whitehorse	102,167	53%	54,624	5.6%	3,059	3.0%
Dungeness	10,195	51%	5,199	3.9%	203	2.0%

Characteristics influencing precocity



Conclusions: release sampling

- Evidence of precocious maturation
- Differences between pre-release and post-release fish (non-migrants)
- Volitional release strategy important to minimize number of residuals
- Impact likely varies
 - o Annually
 - Survival of residuals
 - Spawning success
- Important to continue to monitor, collect empirical data

Puget Sound smolt sampling



Dungeness

May 10

10 RM

Fish counters



Migration timing: hatchery release to smolt trap



Temporal overlap with wild steelhead



Conclusions: smolt trap catches

- Hatchery fish encountered at downstream smolt traps
- Time in system varied
 - Distance
 - Flows, weather
- Hatchery migration matched wild steelhead migration
- Impacts likely vary annually
- Continue to monitor, make improvements to methods

Future sampling

Release sampling & residualism

- Increase sample size
- Sample at all EWS facilities
- Sample closer to release date
- Histopathology-gonad development
- Residual stream surveys or PIT tags

Smolt trap catches

- PIT tags or marks
- Steelhead efficiency trials -> production estimates





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