Effects of hatchery rearing and release practices on olfactory imprinting and homing

Andrew Dittman¹
Darran May²
Ryan B. Couture³
David L.G. Noakes⁴
Paul Hoppe⁵

1. Northwest Fisheries Science Center, NOAA Fisheries, Seattle, WA
2. School of Aquatic and Fisheries Sciences, University of Washington, Seattle, WA
3. Oregon Hatchery Research Center/ODFW, Alsea, OR
4. Fisheries and Wildlife, Oregon State University, Corvallis, OR
5. Ocean Associates Inc., Seattle, WA
Olfactory imprinting and homing
Why do salmon stray?

Failure to home
- Imperfect imprinting
- Memory loss
- Sensory failure
- Signal changed or masked
- Exhaustion

Decision to stray
- Tradeoff between homing and spawning site selection

Genetic strategy
- Dynamic equilibrium between homing and straying; metapopulations

After: T. Quinn
Do hatchery salmon stray more?
Do hatchery salmon stray more?

Not necessarily

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<th>Species</th>
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</table>

Quinn and Dittman 1992
Do hatchery salmon stray more?

**Not necessarily**
But the things we do can definitely increase straying

- Transport and release away from the natal hatchery
- Release at inappropriate developmental stages
- Acclimation strategies
- Release into inappropriate habitat
- Rearing environment
  - Environmental complexity
  - Developmental/epigenetic processes
Do hatchery salmon stray more?

Not necessarily, but.....

Transport and release away from the natal hatchery

Lasko et al. 2014
Do hatchery salmon stray more?

Not necessarily, but.....
Transport and release away from the natal hatchery
Do hatchery salmon stray more?

Not necessarily, but.....
Release at inappropriate developmental stages

Pascual et al. 1995

Unwin and Quinn. 1993
Do hatchery salmon stray more?

Not necessarily, but.....
Acclimation strategies/Release into inappropriate habitat

Acclimation: location, timing, duration
If you build it, they will come.
IF YOU BUILD IT,
THEY MAY OR MAY NOT COME.
Do hatchery salmon stray more?

Not necessarily, but…..

Rearing environment:
Environmental complexity/developmental/epigenetic processes

Does hatchery rearing affect the olfactory system?

Kihslinger and Nevitt 2006
Does hatchery rearing affect the olfactory system?

Olfactory Rosette

Olfactory Epithelium

from Weth et al. 1996

Carla Stehr
Does it matter what water source salmon are reared in?
Smolting-associated changes in odorant receptor expression

Wallowa Hatchery steelhead

Reared to yearling stage at Big Beef Creek hatchery in well water

Initiate surface water experiment Jan. 20
2 tanks well water
2 tanks surface water

Sample fish for olfactory tissue every 3 weeks

Analyze olfactory development (OR expression)
Smolting-associated changes in odorant receptor expression

Graph showing relative BAAR mRNA expression over time with different water sources.
Amino acid profile of well water vs. stream water

Concentration (nM)

Amino acids

Well water at BBC hatchery

Big Beef Creek water
Does hatchery rearing affect the olfactory system?

Incubation water in Columbia River hatcheries

- Well water: 20 hatcheries
- Spring Water: 4 hatcheries
- Surface Water: 10 hatcheries
- Both: 3 hatcheries
Does hatchery rearing affect the olfactory system?
Effects of origin on straying by naturally spawned salmon

Ford et al. 2015. Molecular Ecology
Effects of hatchery rearing on olfactory system and olfactory imprinting

- We observed differences in imprinting-associated olfactory gene expression in steelhead reared in different water sources.

- We observed differences in olfactory gene expression in naturally migrating hatchery vs. wild steelhead.

- In future studies, we hope to assess these differences in a controlled experiment and assess mechanisms.

- We have developed effective physiological tools to assess anthropogenic effects (e.g. transport, hatchery practices, etc) on olfactory imprinting.
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