Domestication and fitness in steelhead: can we make hatchery fish more like wild fish?

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The problem:

Fitness differences when H & W spawn in the wild

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Our goal: create Hatchery fish that are more like wild

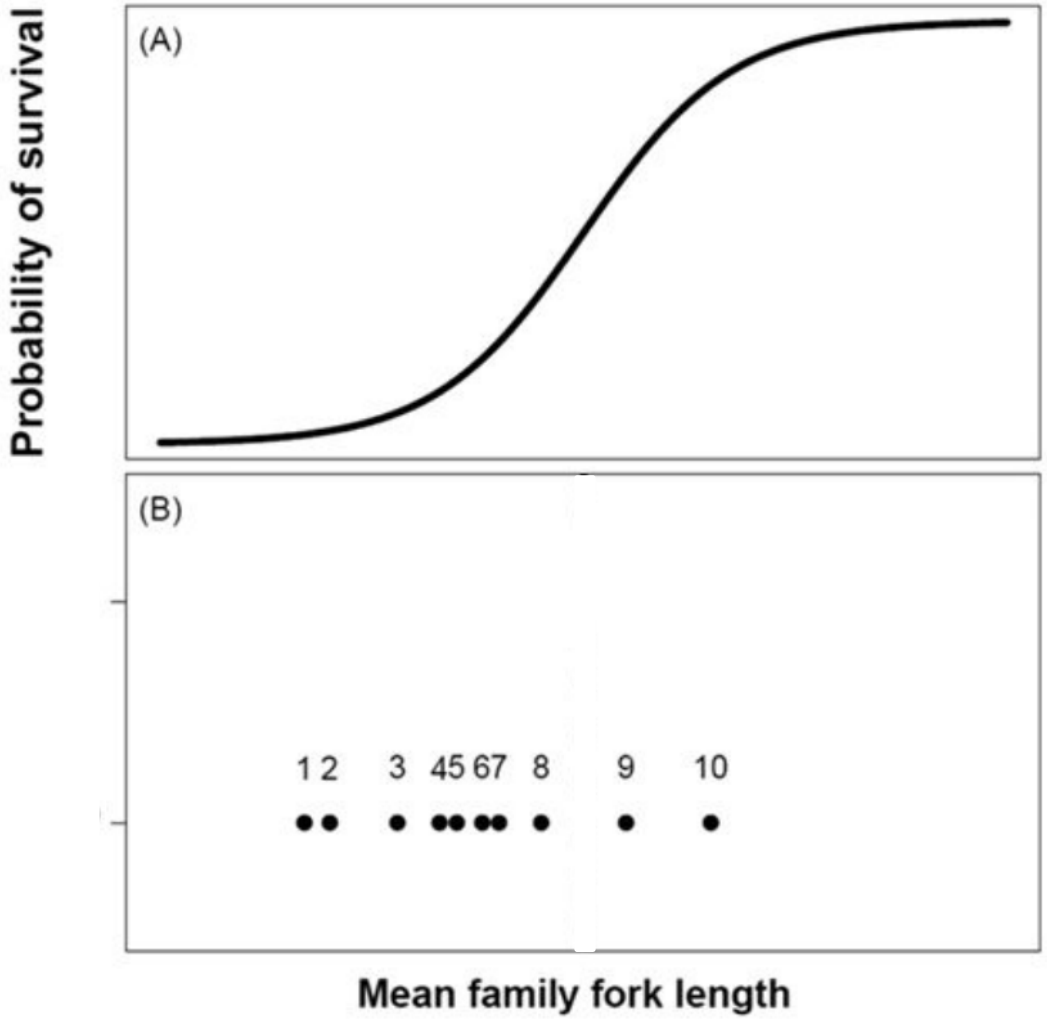
What is under selection?

Observations:

1. families vary in ability to grow under hatchery conditions

e.g. family identity explains 25-60% of variance in size

2. larger smolts have better survival at sea


Probability of survival
(A)
(B)
1 2
3
45
67
8
9
10
Mean family fork length

Hypothesis:

3. Therefore, selection favors families having *certain traits* (behavior, physiology, etc.)

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3. Therefore, selection favors families having *certain traits* (behavior, physiology, etc.)

4. *But*, traits favored in hatchery not favored in the wild

Wild: tradeoff between growth and survival

Hatchery: maximize growth only

vs

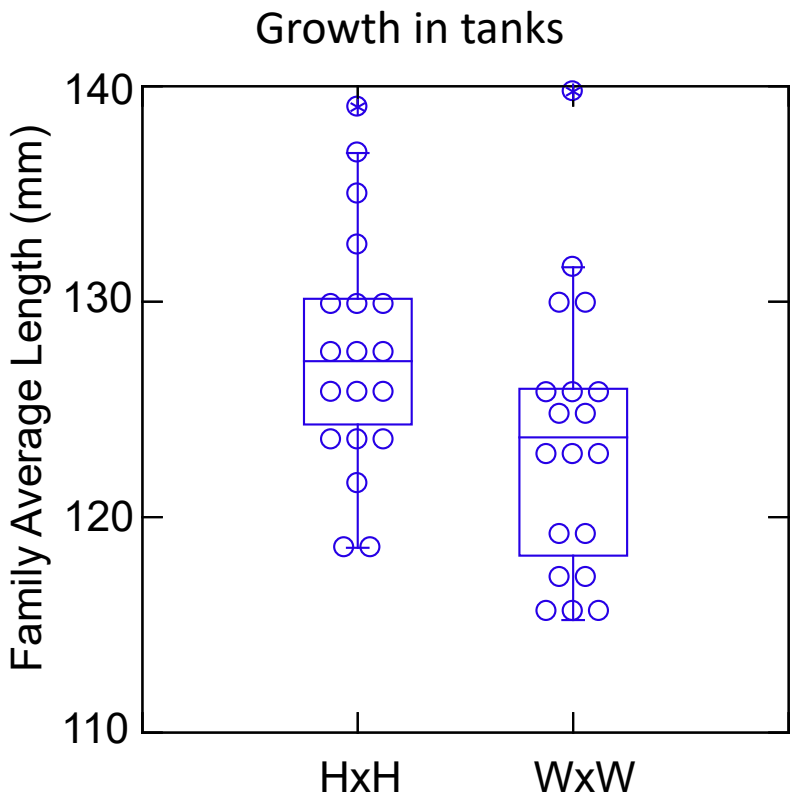
Test of our hypothesis

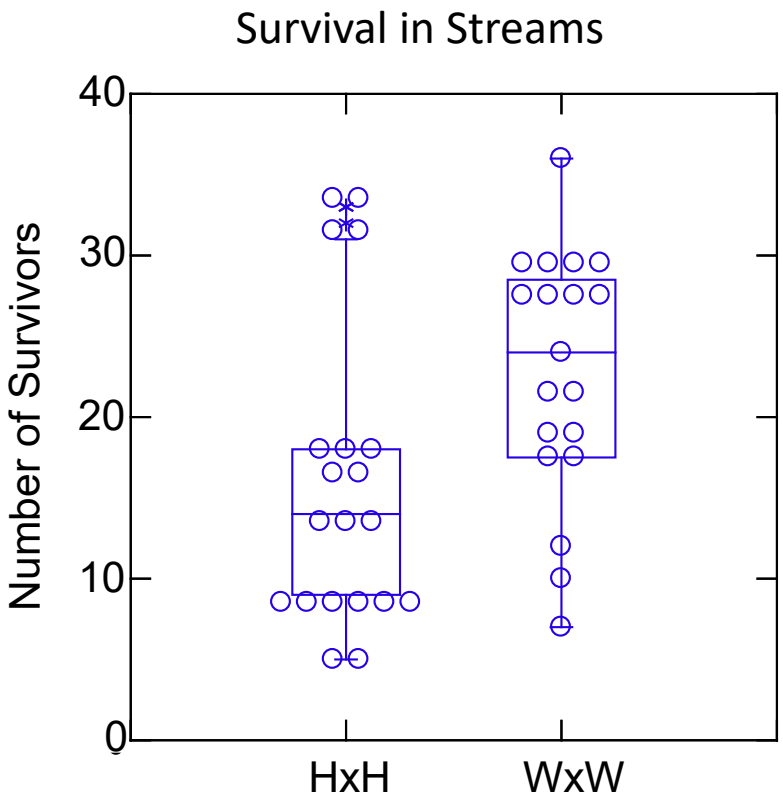
19 HxH families & 19 WxW families

Raised in tanks and in artificial streams

Aquatic Animal Health Lab, OSU

Oregon Hatchery Research Center

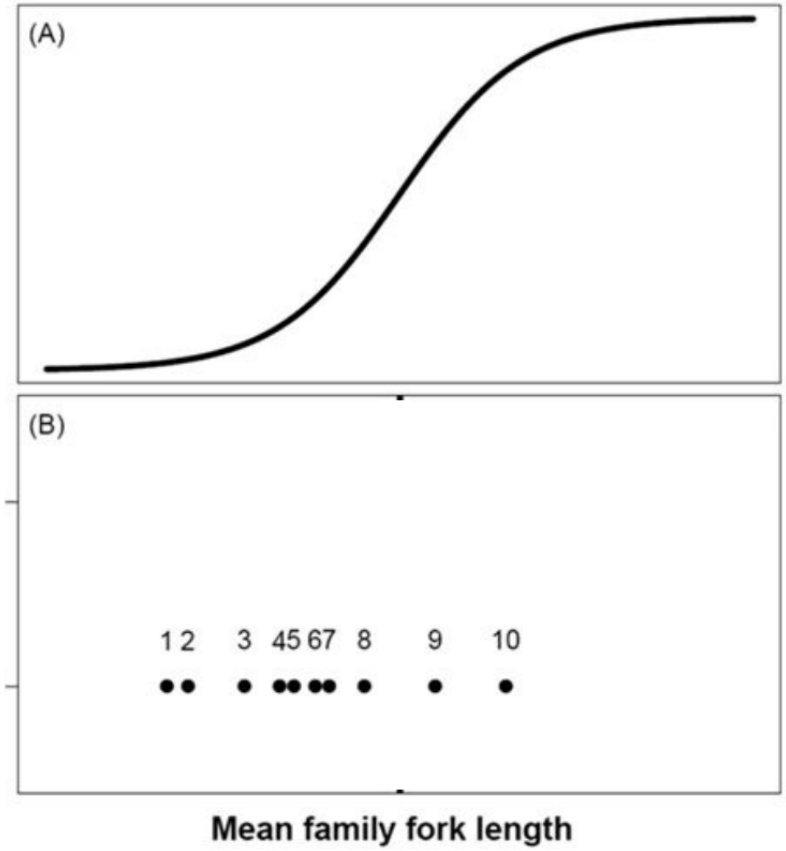




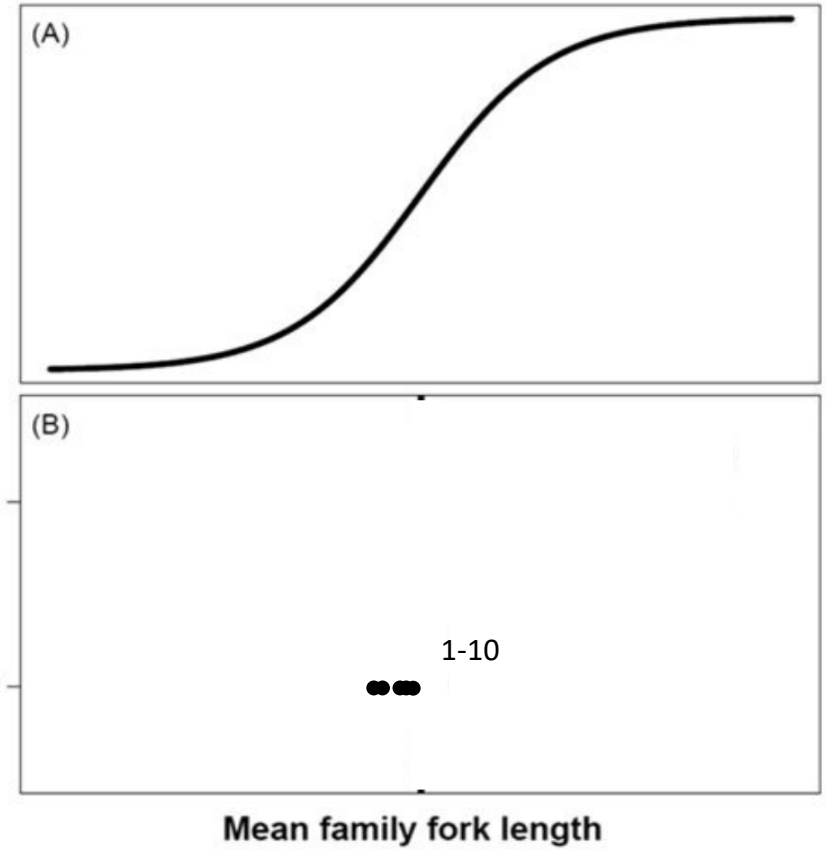
Blouin et al., 2021 *PLOS One*

How to reduce selection?

Standard Hatchery Environment



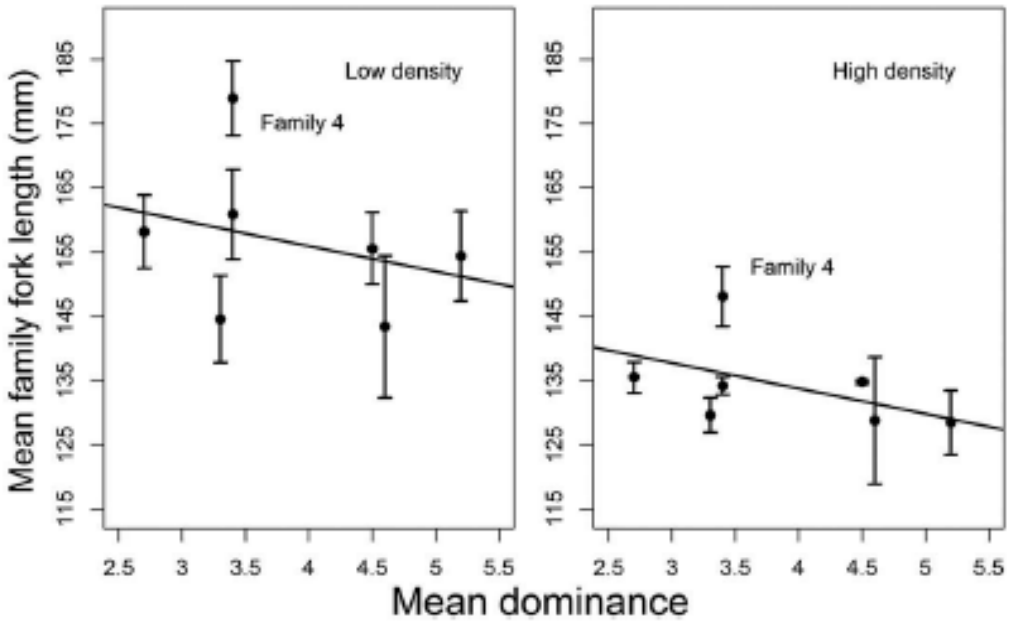
Modified Environment



So what traits are under selection hatcheries?

- Physiology
- Behavior - generalized boldness?

Dominance



Thompson and Blouin 2016, *Trans Am Fish Soc*

Propensity to feed at the surface

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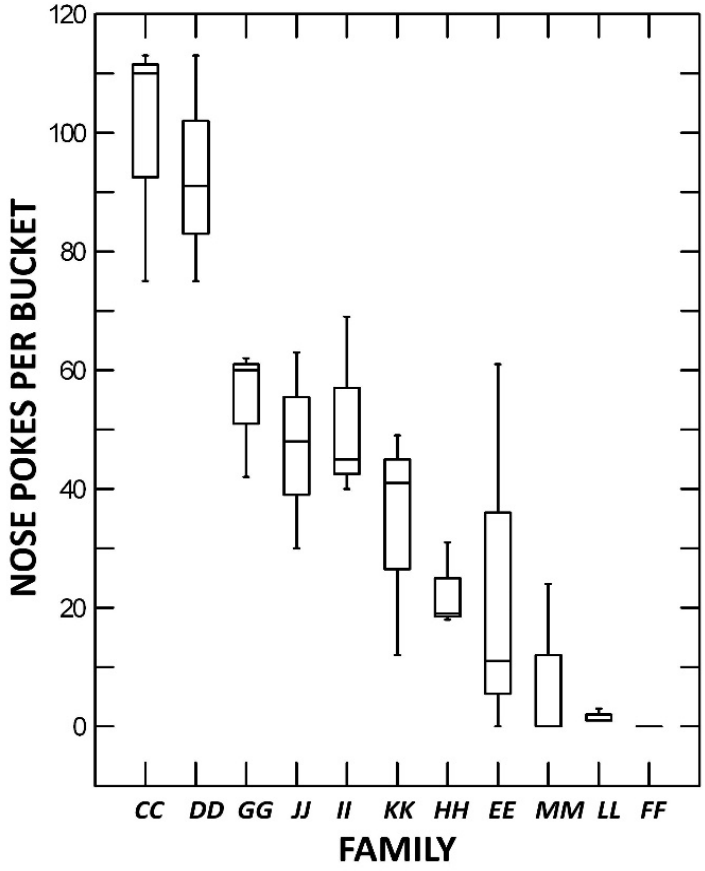
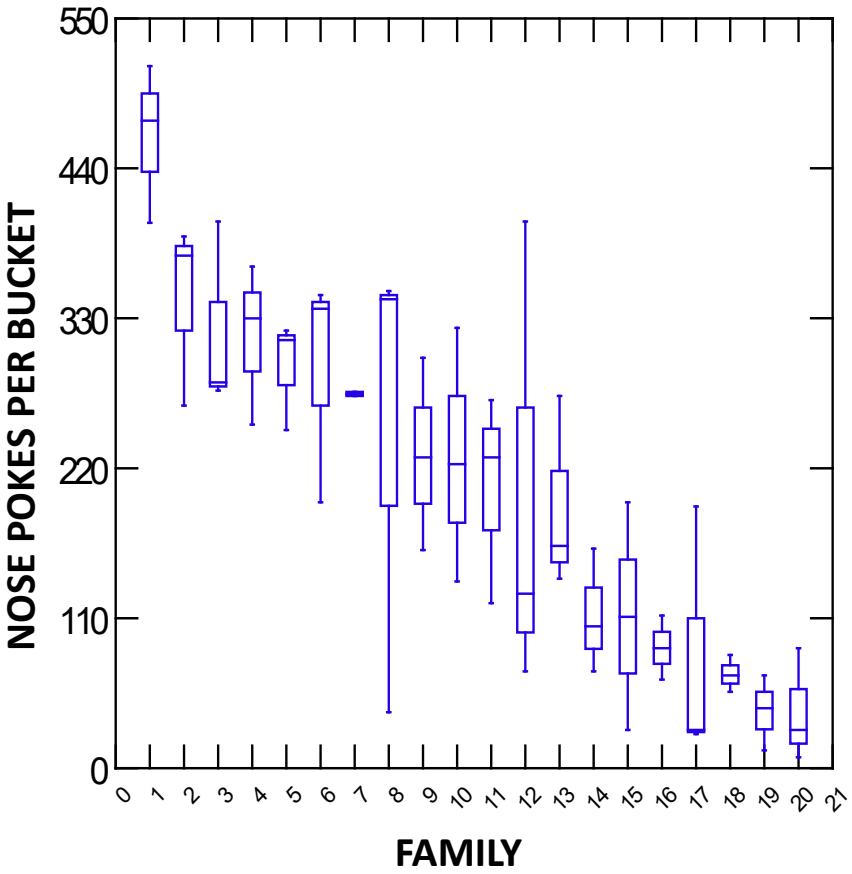
2018 data – Wilson River steelhead

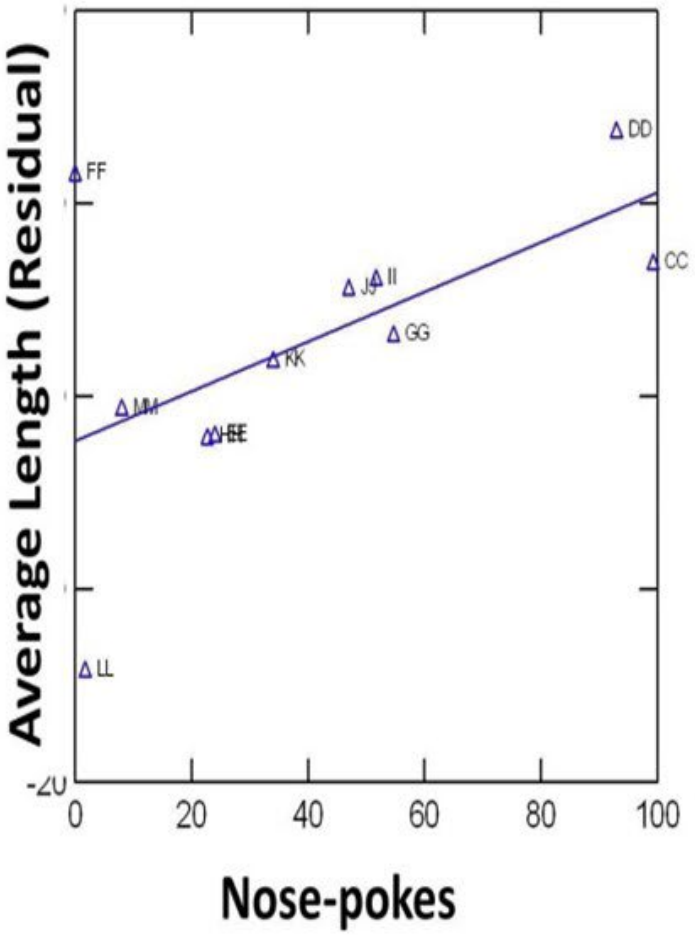


2020 data – Siletz River steelhead

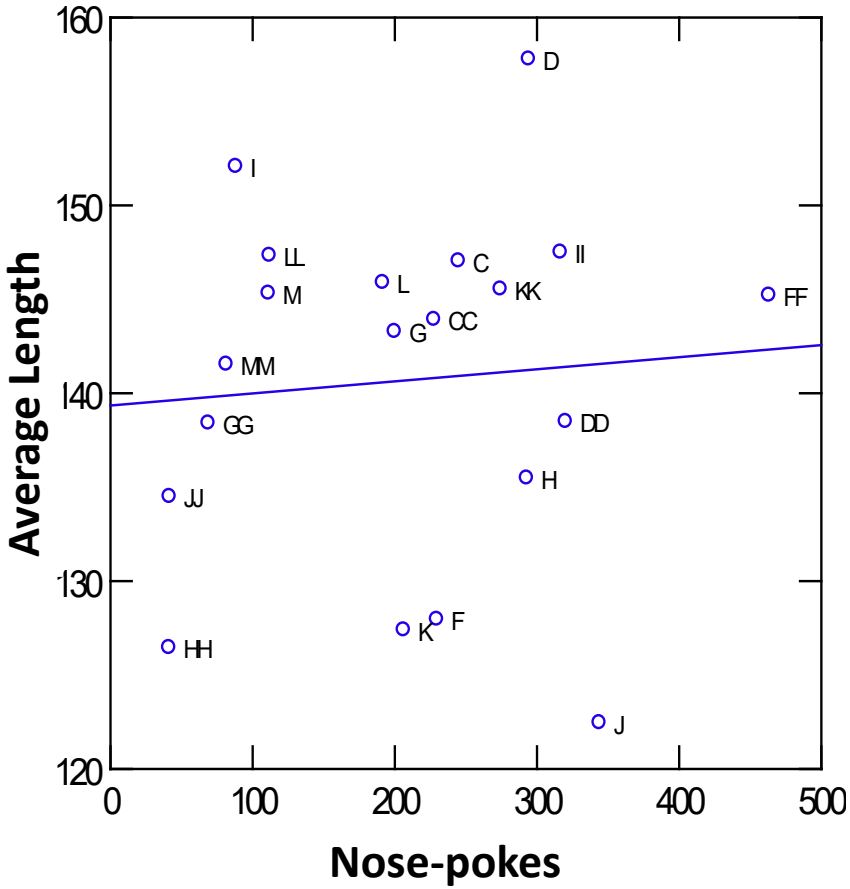


Correlation with growth rate?

2018 Wilson fish



2020 Siletz fish



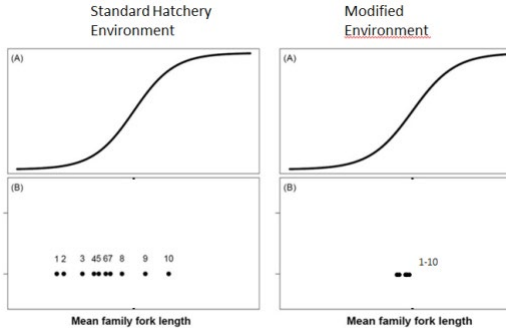
Test environmental condition

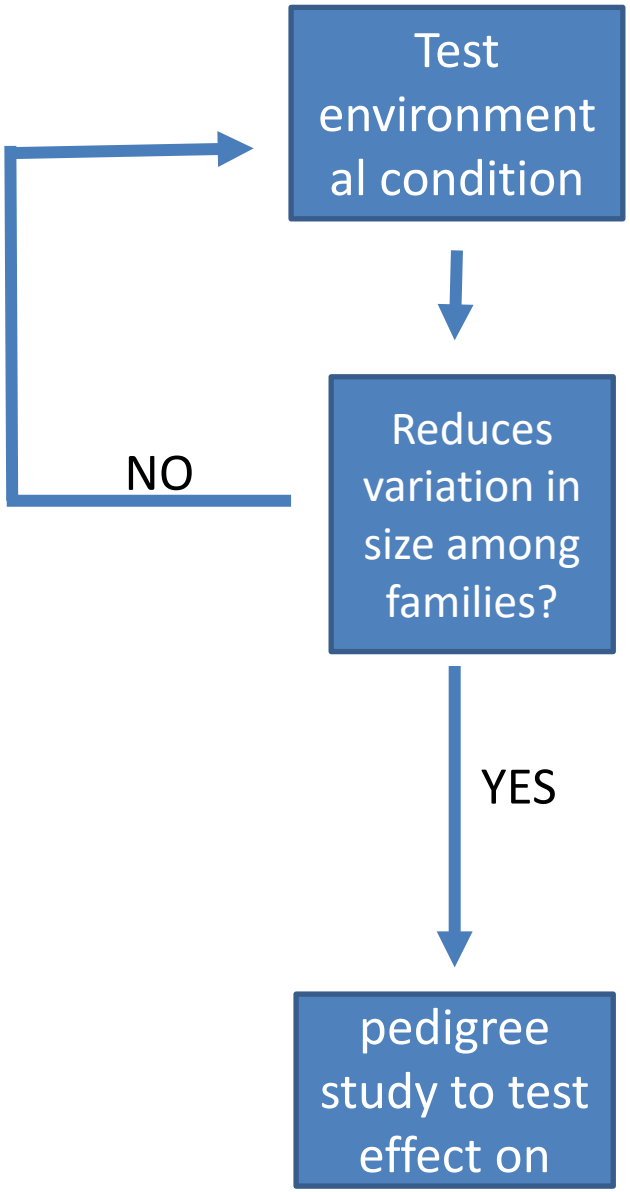
Reduces variation in size among families?

NO

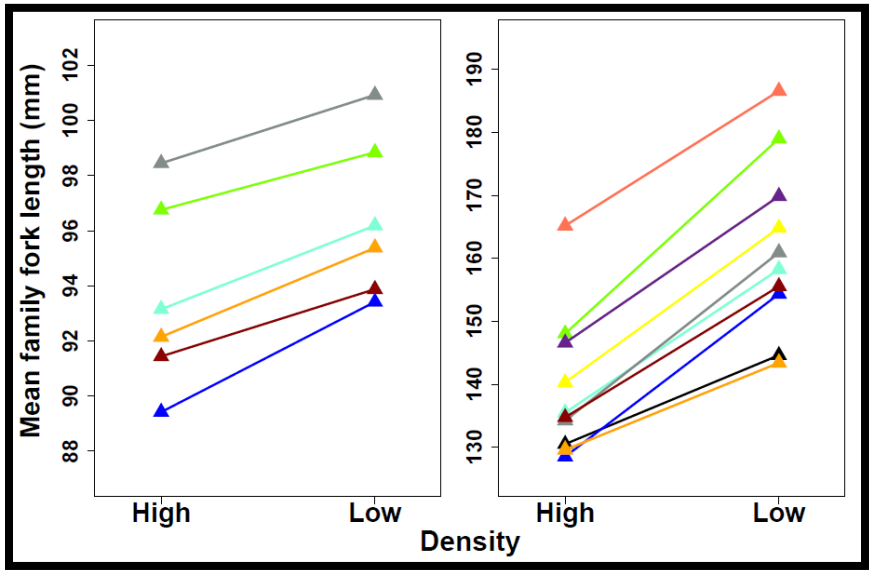
YES

pedigree study to test effect on




Test environment al condition
Reduces variation in size among families?
NO
YES
pedigree study to test effect on

e.g. density


Mean family fork length (mm)
88
90
92
94
96
98
100
102
130
140
150
160
170
180
190
High
Low
High
Low
Density

Conditions tested:

Density

Hand vs auto feeding

Satiation feeding

High vs low fat feed

Under way:

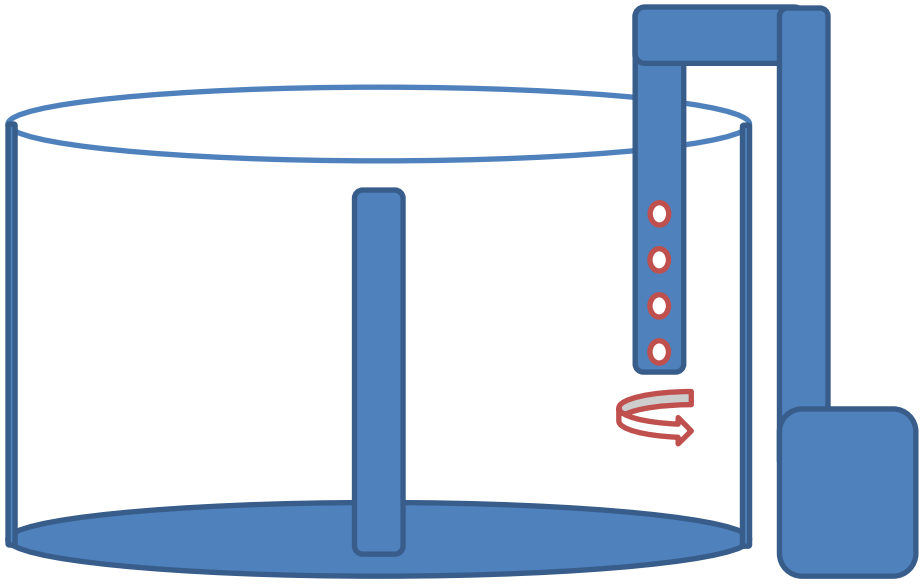
Circulating water

Enriched environment

Grading

Structure

Flow



Summary

- Hatchery fish are different from wild fish, and its genetic
- Mechanism is probably selection for traits that favor fast growth in novel environment
- Possible to modify hatchery to reduce selection pressures?

Thanks!

BONNEVILLE POWER ADMINISTRATION

OREGON Fish & Wildlife

OREGON HATCHERY RESEARCH CENTER

John L. Fryer Aquatic Animal Health Laboratory

OSU Oregon State UNIVERSITY

Questions: