

A New Approach to Reproductive Sterility in Salmonids

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20,000 SF FW/marine RAS aquaculture facility



Spawning Atlantic salmon



Sterility in Farmed Fish: the Rationale

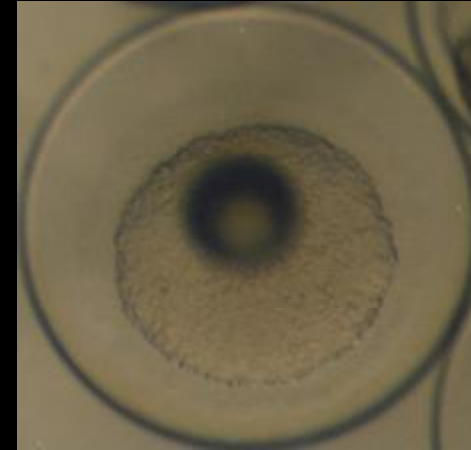
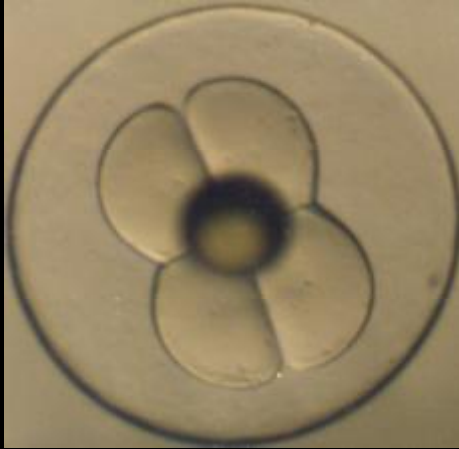
- Achieve better somatic growth (no early maturation)
- Prevent deterioration of flesh quality and mortality
- Protect IP strains
- Biological containment: prevent propagation of farmed/domesticated, non-native and GM fish

flesh

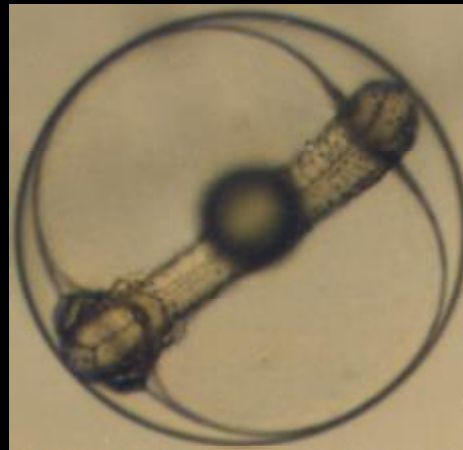


ovaries: 20%

The Search for a Different Approach to Sterility- Disrupting Early Reproductive Development



48-72 hrs

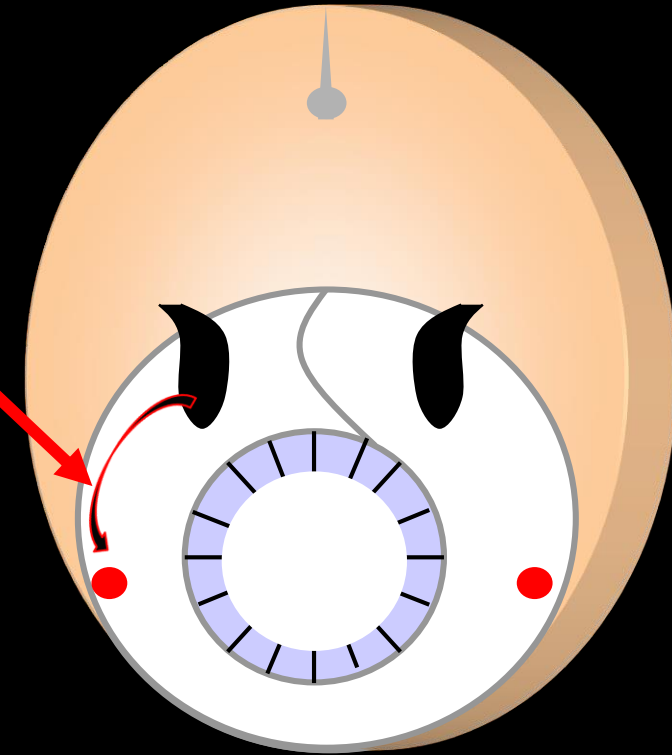


Early Migration of Primordial Germ Cells (PGCs)

Migrating primordial
germ cells



Dnd
protein



PGCs are reproductive “stem” cells that migrate to the developing gonads; the Deadend (Dnd) protein is essential for that migration

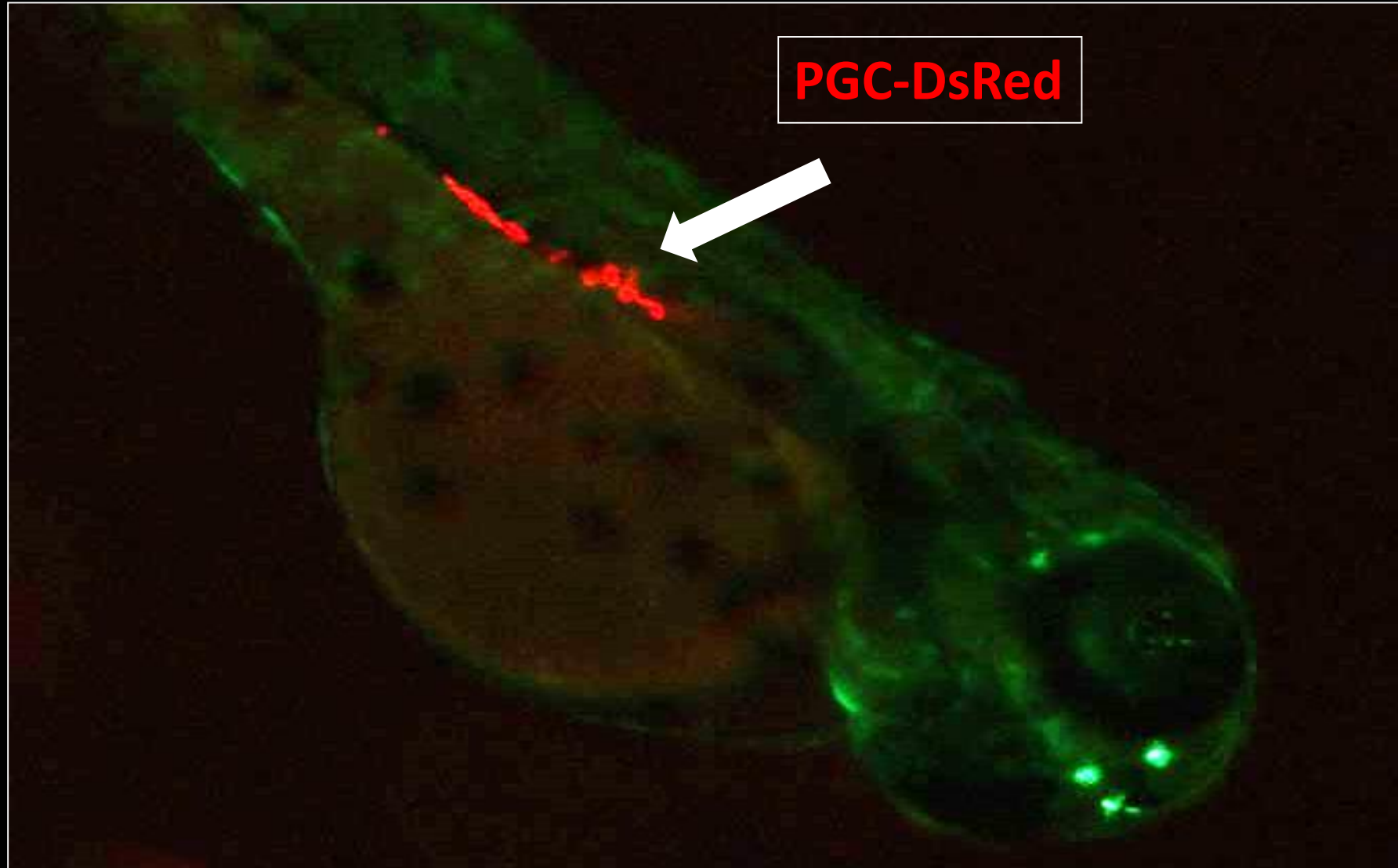
Our Approach to Sterility: Disrupt the Early Migration of the PGCs

M



No PGC migration
No gonads

Transgenic fish for visualizing migration

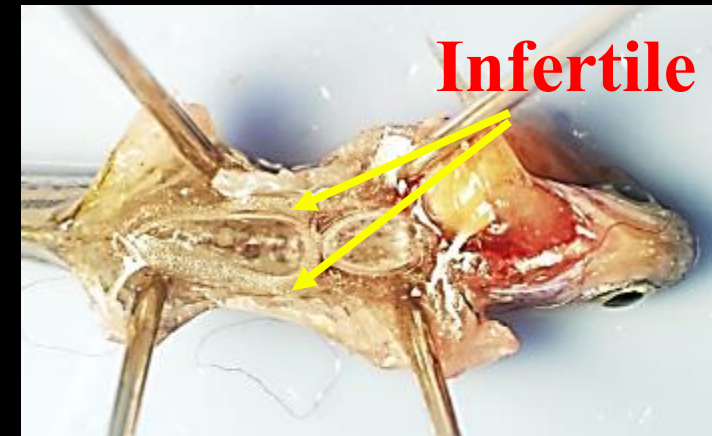
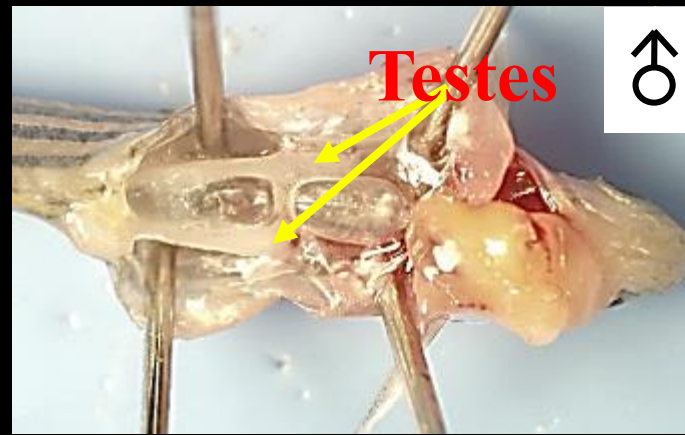
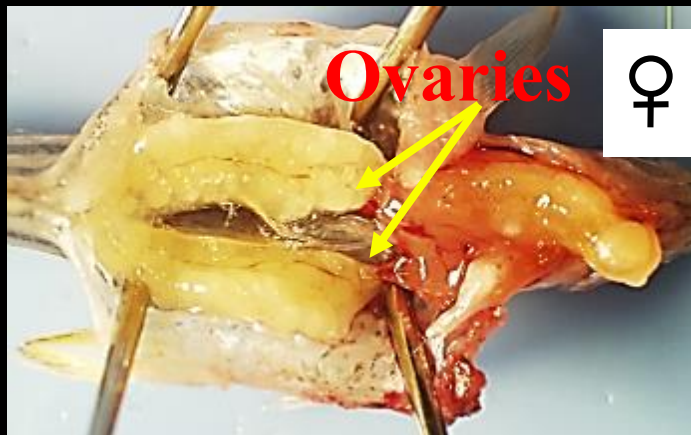
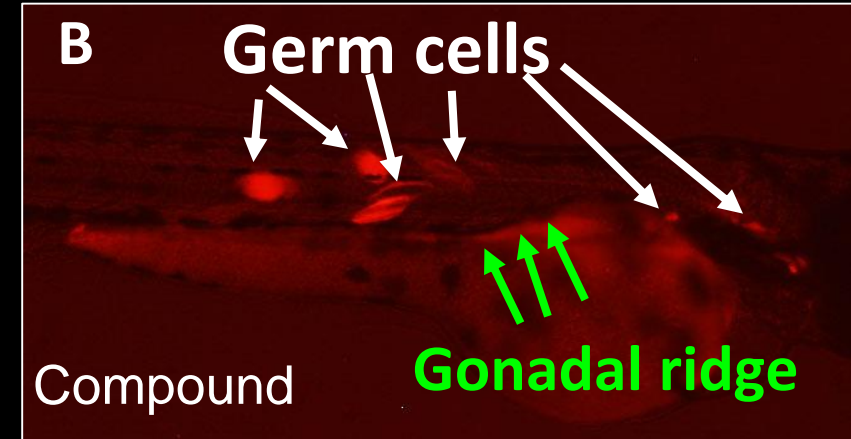
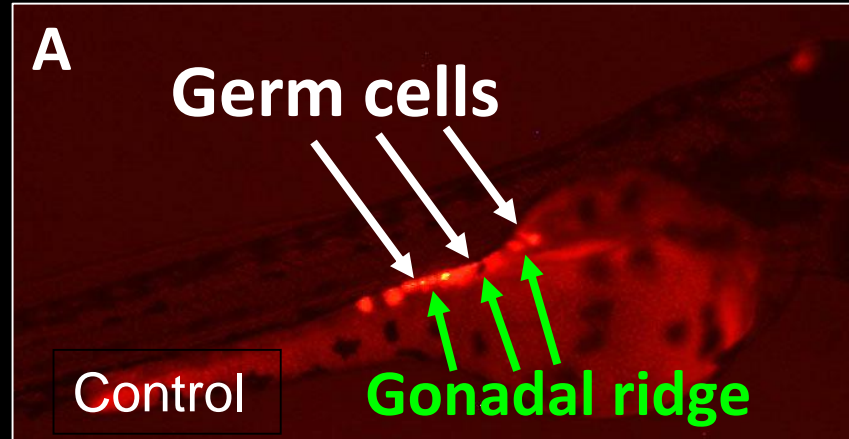


Gene Silencing (KD) Strategy For Producing Sterile Fish

- Use Tg fluorescent zebrafish (PGCs) to screen (via immersion) for gene silencing compounds (MO) that disrupt the early migration of the PGCs and induce sterility
- Determine minimal doses, duration and timing of immersion
- Select compounds and conditions to study in salmonids (and other species)



Immersion in PGC silencing compounds (5 hrs) led to their mis-migration and 100% sterility in zebrafish



Sdf1; Cxcr4; **Dnd**, nanos.....

Wong and Zohar, 2014, 2015

Implementing the findings in rainbow trout and Atlantic salmon

**USDA-WV
(NCCCWA)**



Troutlodge- WA



**USDA-ME
(NCWMAC)**



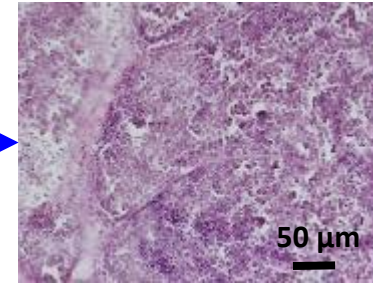
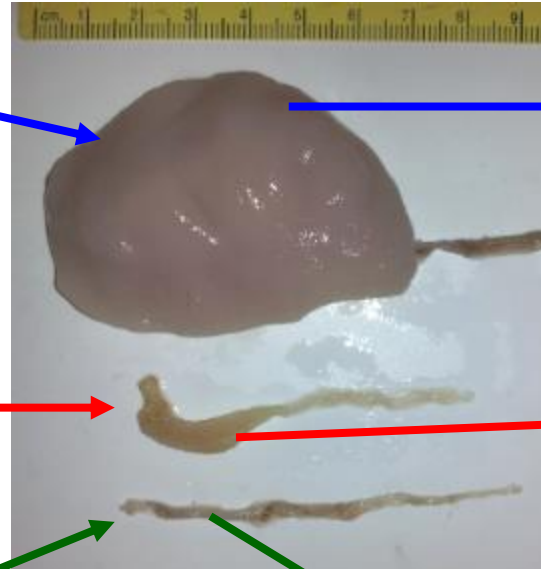
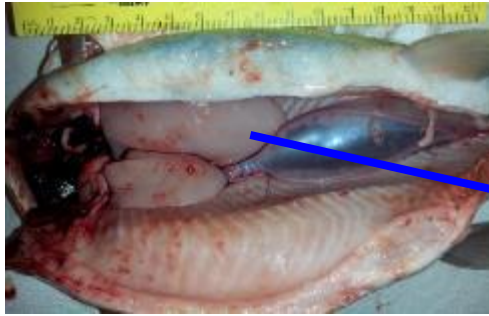
AquaGen- Norway



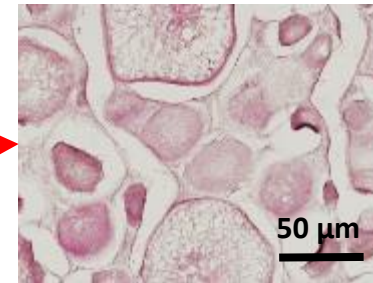
Production of sterile rainbow trout

14 months old (48 hour immersion in Dnd-MO-Vivo at fertilization)

Male
Control



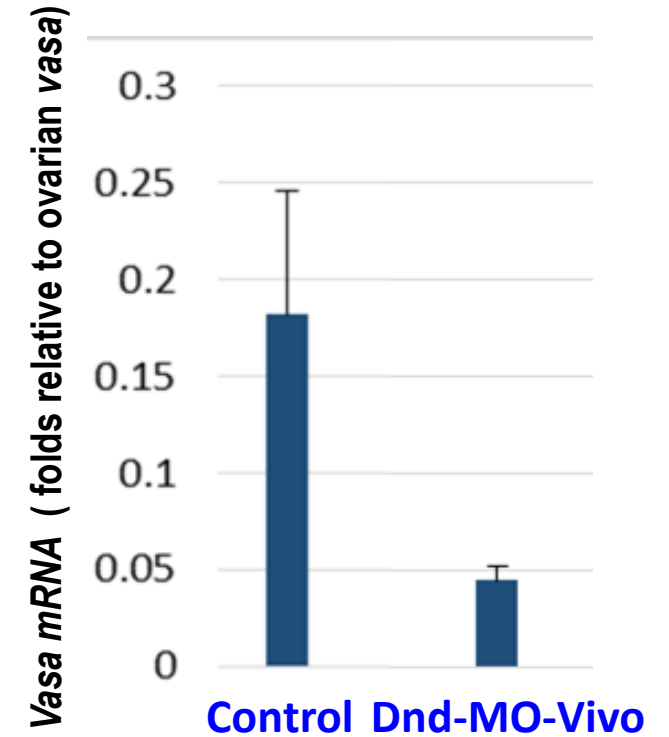
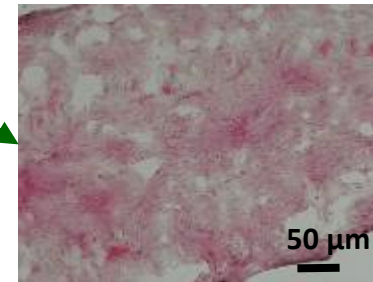
Female
Control



Sterile fish
Treated (85%)



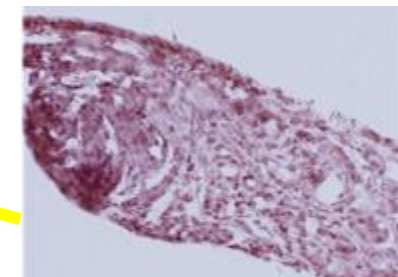
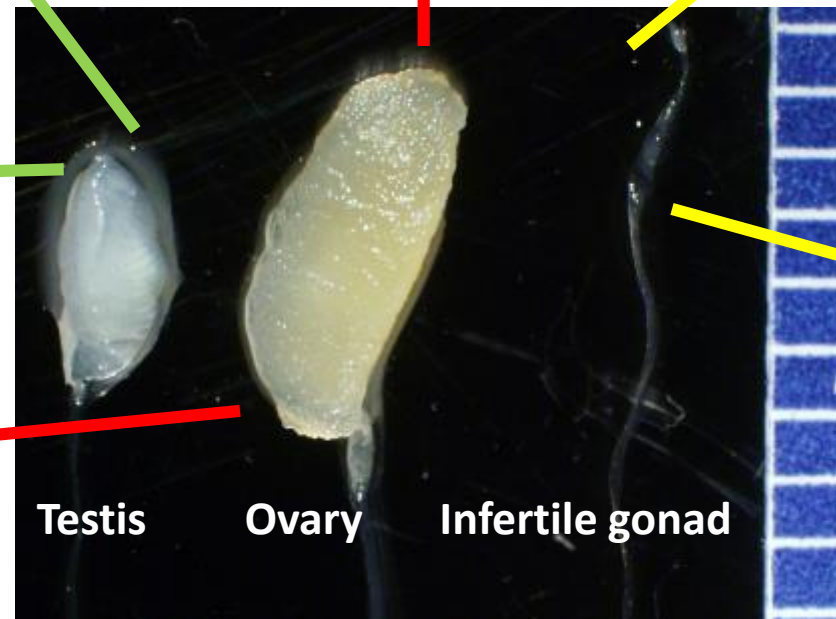
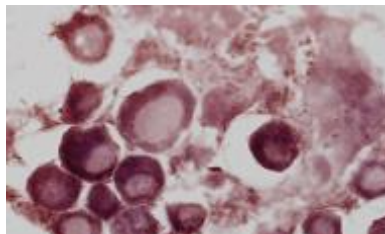
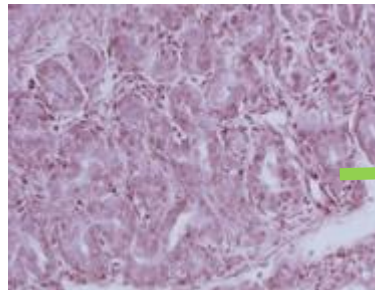
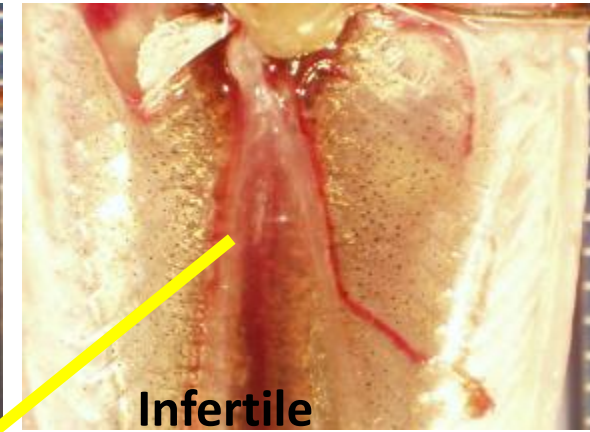
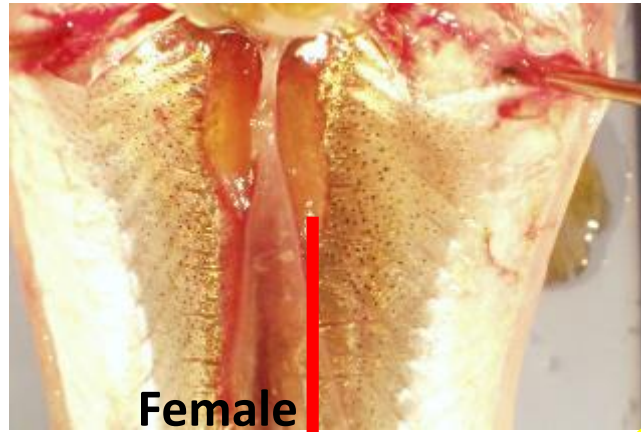
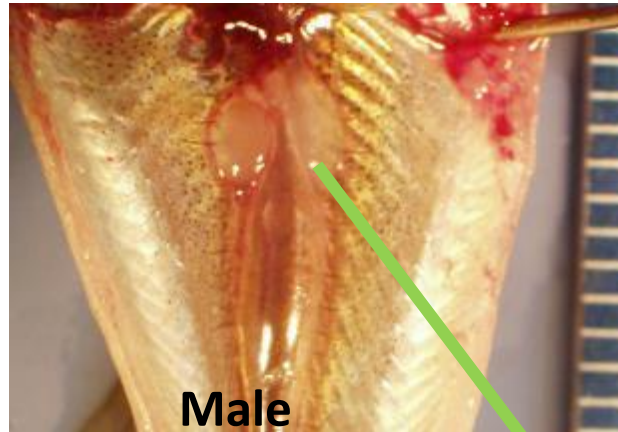
Infertile fish



85% sterility, similar growth rates to 800 gr.

Production of sterile Atlantic salmon

9-10 months old (48 hour immersion in Dnd-MO-Vivo)

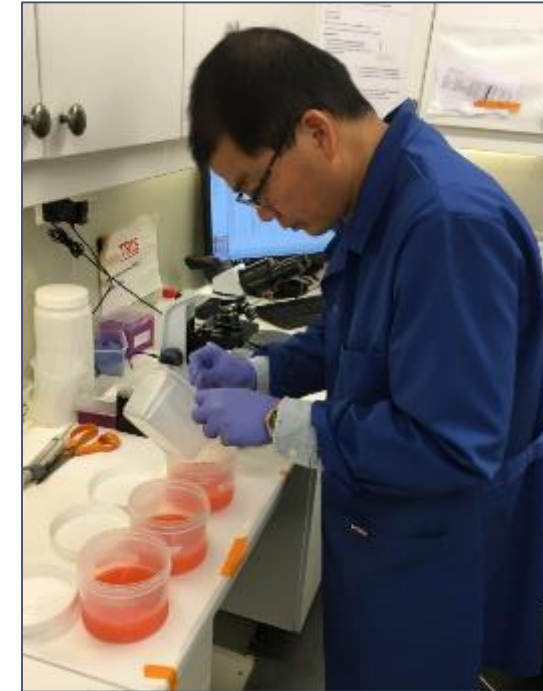
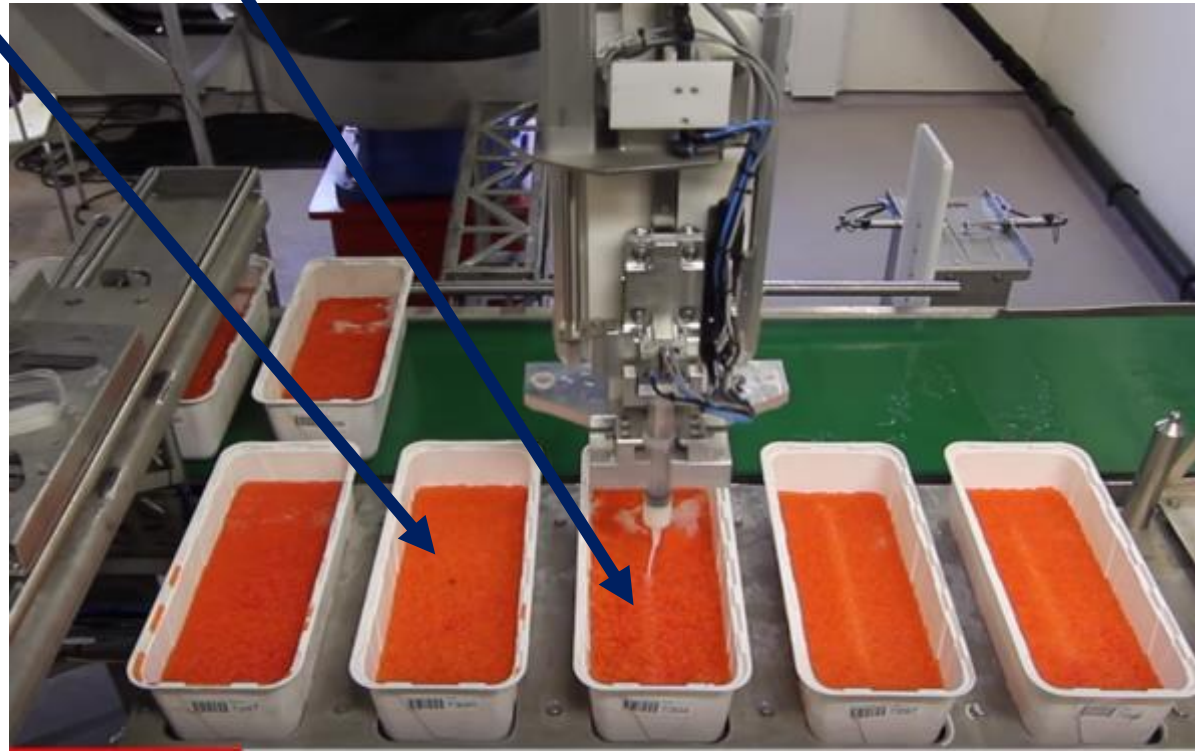


Current trials: Optimization of Conditions

For 100% sterility

At fertilization immersion for (24-48 hrs)

- Micropyle open
- Water uptake
- Permeable chorion
- Egg swelling
- Better uptake
- Egg hardening
- Lower doses



Ten-Tsao Wong

Dnd anti-sense
(MO)

+

Molecular transporter
Vivo/ZP9

A large circular fish tank in an industrial facility, likely a research or aquaculture center. The tank is filled with many fish swimming in greenish water. A white cylindrical structure is visible in the center of the tank. The background shows industrial equipment and pipes.

Thank you

Many Collaborations

National Center for Cool and Cold Water Aquaculture Research (ARS/USDA), WV

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Kyle Martin, Douglas Dickson, Austin Franklin

AquaGen, Norway

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Iceland Institute of Marine and Fresh Water Research, Iceland

Ragnar Johannsson, Agnar Steinarsson

NIWA, New-Zeland

Alvin Setiawan, Andrew Forsythe, Steve Pether



ACDPHARMA
INNOVATIONS IN AQUACULTURE



MABIT
Et næringsrettet FoU-program innen
marin bioteknologi i Nord-Norge



National Marine Aquaculture Program



**Biotechnology Risk Assessment Program
Aquaculture Research Program**

Screening for compounds in the zebrafish model

Control



Compound

