

**EARLY MATURATION OF ATLANTIC SALMON IN LAND-BASED CLOSED  
CONTAINMENT RAS**  
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# Background:

## Atlantic salmon growout trials



# Grilsing



**Precocious maturation**

**A significant initial hurdle for land-based salmon production**

# Historical background

- Long history of maturation affecting Atlantic salmon production:
  - Major source of economic loss for farmers
    - Johnston et al., 2006; McClure et al., 2007
  - \$11M – 24M in annual lost revenue (\$250M industry)
    - McClure et al., 2007
  - In-cage grilising estimated at 20-30% (1998-2002)
    - Peterson et al., 2003



Courtesy of the BC Salmon Farmers Association

# *Salmo salar*: A highly flexible life history

- **Many variations in life history traits among and within populations**
  - Freshwater occupancy/age at smoltification (Randall et al., 1987; Økland et al., 1993)
  - Time of ocean residency and age at reproductive maturity (Scarnecchia, 1983; Saunders, 1986; Thorpe, 1986)
  - Adult size at maturity (Hutchings and Jones, 1985; Saunders, 1986)
  - Non-anadromous versus anadromous forms (Berg, 1985).
- **Evolutionary strategy designed to maintain biodiversity and genetic contribution of a cohort** (Saunders and Schom, 1985).
- **Evolutionary adaptation to optimize reproductive success and to perpetuate the species** (Fleming, 1996; Thorpe et al., 1998).
- **The Atlantic salmon life cycle is motivated by procreation and recruitment of successive generations.**

# *Salmo salar*: A highly flexible life history

- The path to reproductive maturity is likely triggered by a combination of heritable, physiological/biochemical, and environmental factors and their interactions.
- Saunders (1986) proposed that genetic influence provides a basis for maturation but with “rather wide latitude,” when the appropriate environmental and physiological/biochemical conditions are met.
- Mangel and Satterwaite (2008) described optimization of environmental conditions as creating an opportunity for maturation along with traits that typically parallel optimal growth performance, such as the accumulation of adipose tissue.

# Maturation in Atlantic salmon

## Sexual maturation in *S. salar*:

### A highly flexible process, influenced by

- Photoperiod
- Water temperature
- Feed intake
- Nutrition
- Lipid reserves
- Growth rate
- Stock genetics
- Etc.



# Grilsing

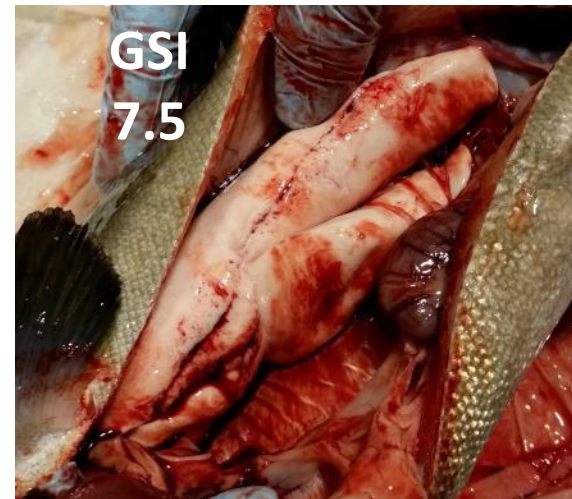
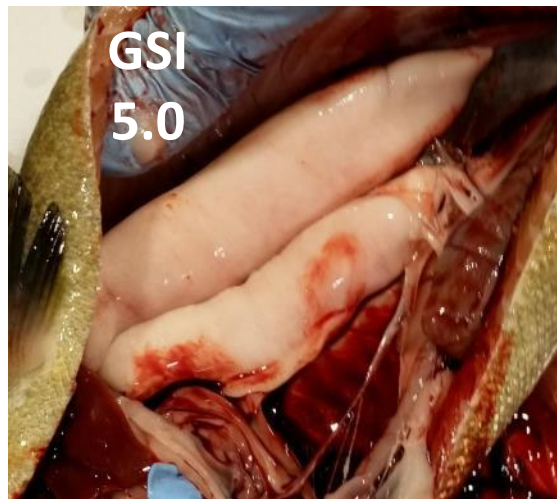
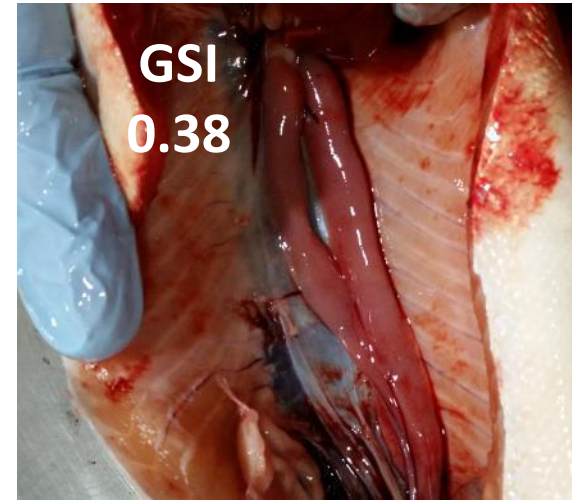
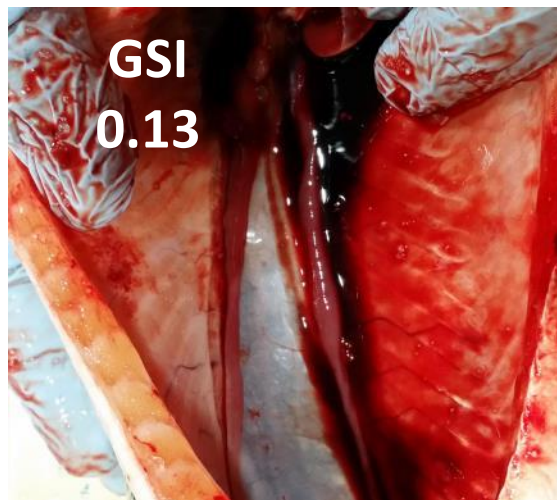
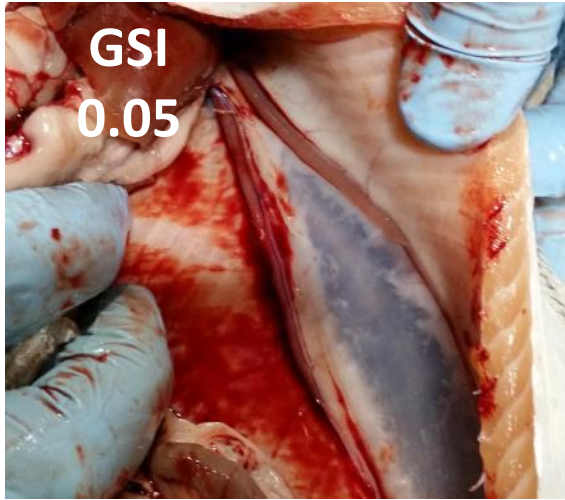


# Negative consequences of maturation

- Decreased growth and feed conversion
- Reduced product quality
- Increased susceptibility to opportunistic infections



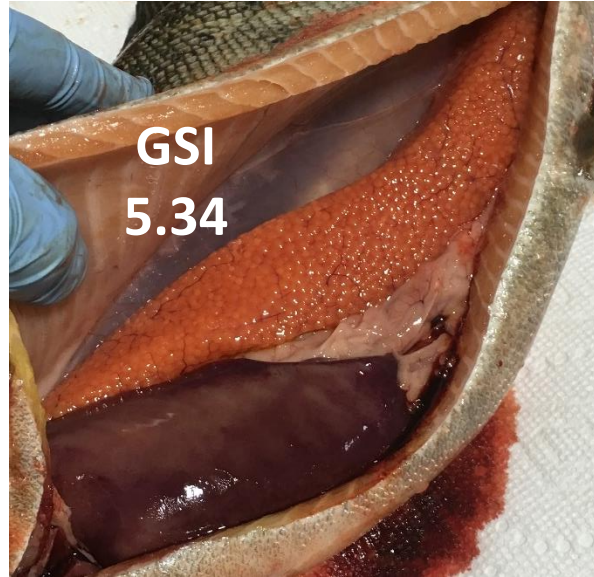
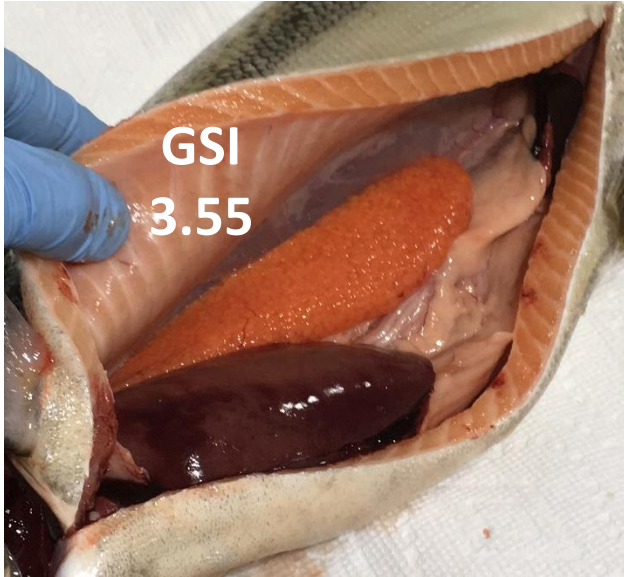
# Male Atlantic salmon 1,200g – 1,800g



|                            | Euro 6       | Euro 7       |
|----------------------------|--------------|--------------|
| Thermal Growth Coefficient | 1.67         | 1.94         |
| Feed Conversion Ratio      | 1.16         | 1.07         |
| Time to reach 4 Kg         | ~25.1 months | ~21.7 months |
| Maturation                 | 67%          | 13%          |

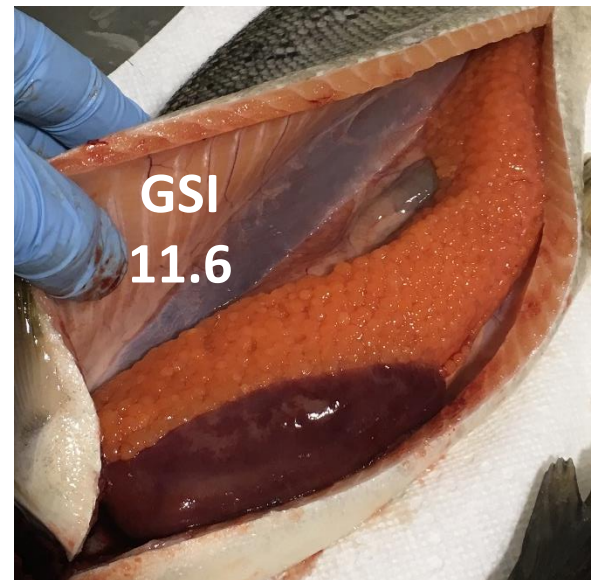
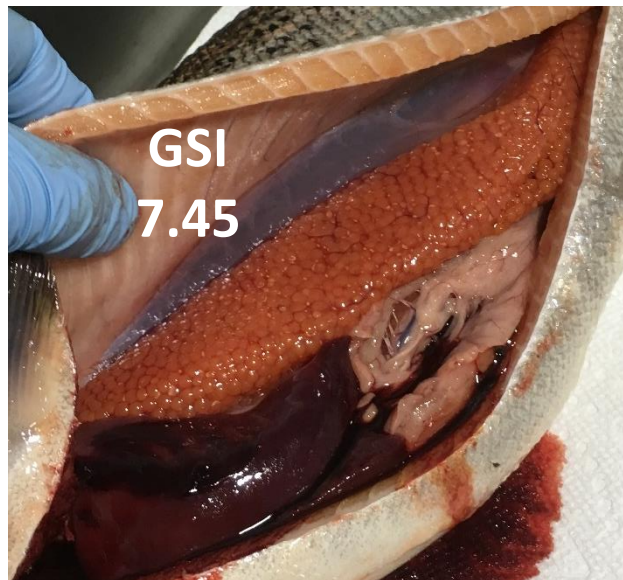
# All-female Atlantic salmon

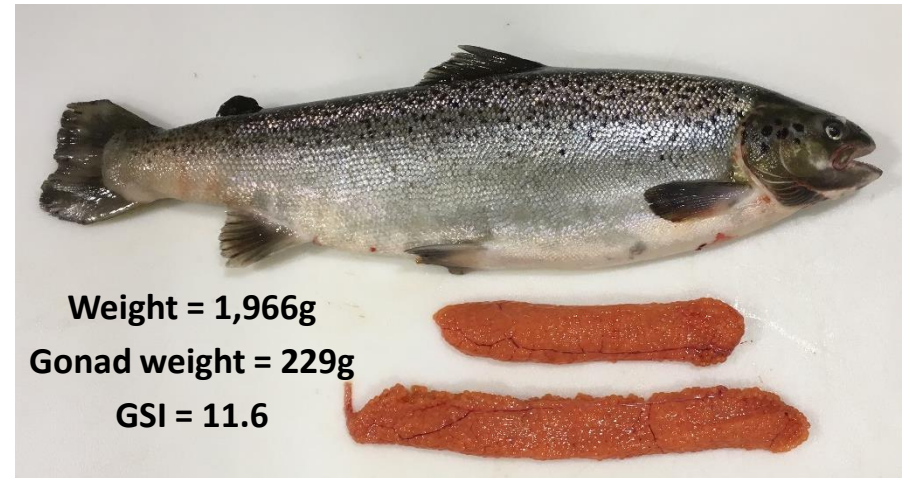
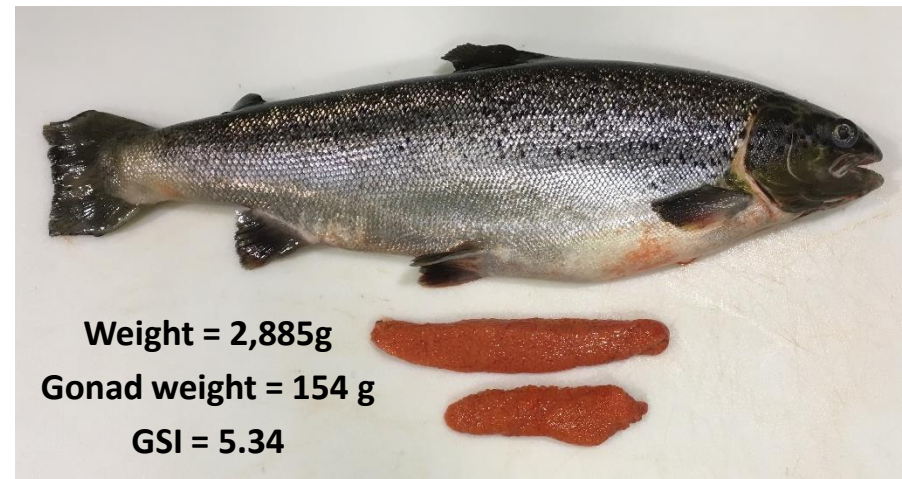
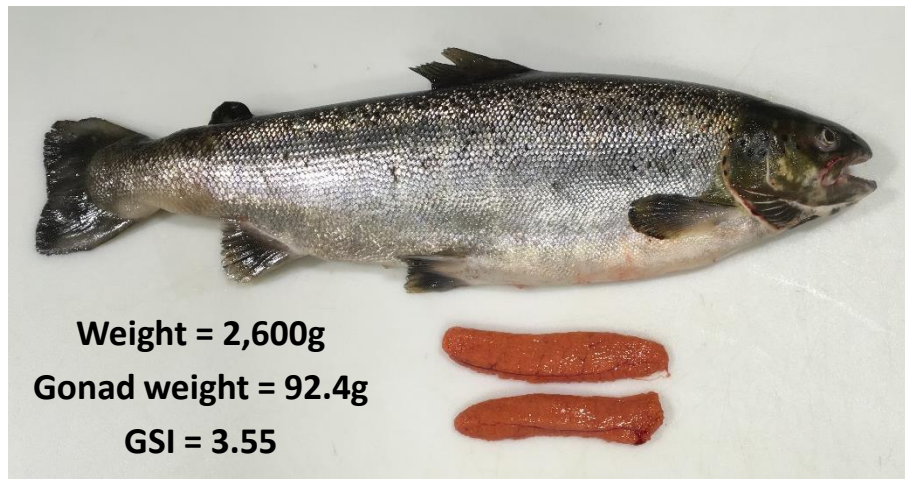




# Gonads *In Situ*

All-female Atlantic  
salmon, ~2-3 kg





# Gonads

All-female Atlantic salmon, ~2-3 kg

# Current state of the industry...

- Producers are becoming more aware of the effects of temperature, and reducing temperature is showing significant results
- RAS post-smolt production (Norway) continues to have issues with “stealth-mature” post-smolts (200-300 g)
- Current research at FI: determining if there is a smolt / post-smolt size threshold for temp-induced maturation

## The Freshwater Institute Team

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