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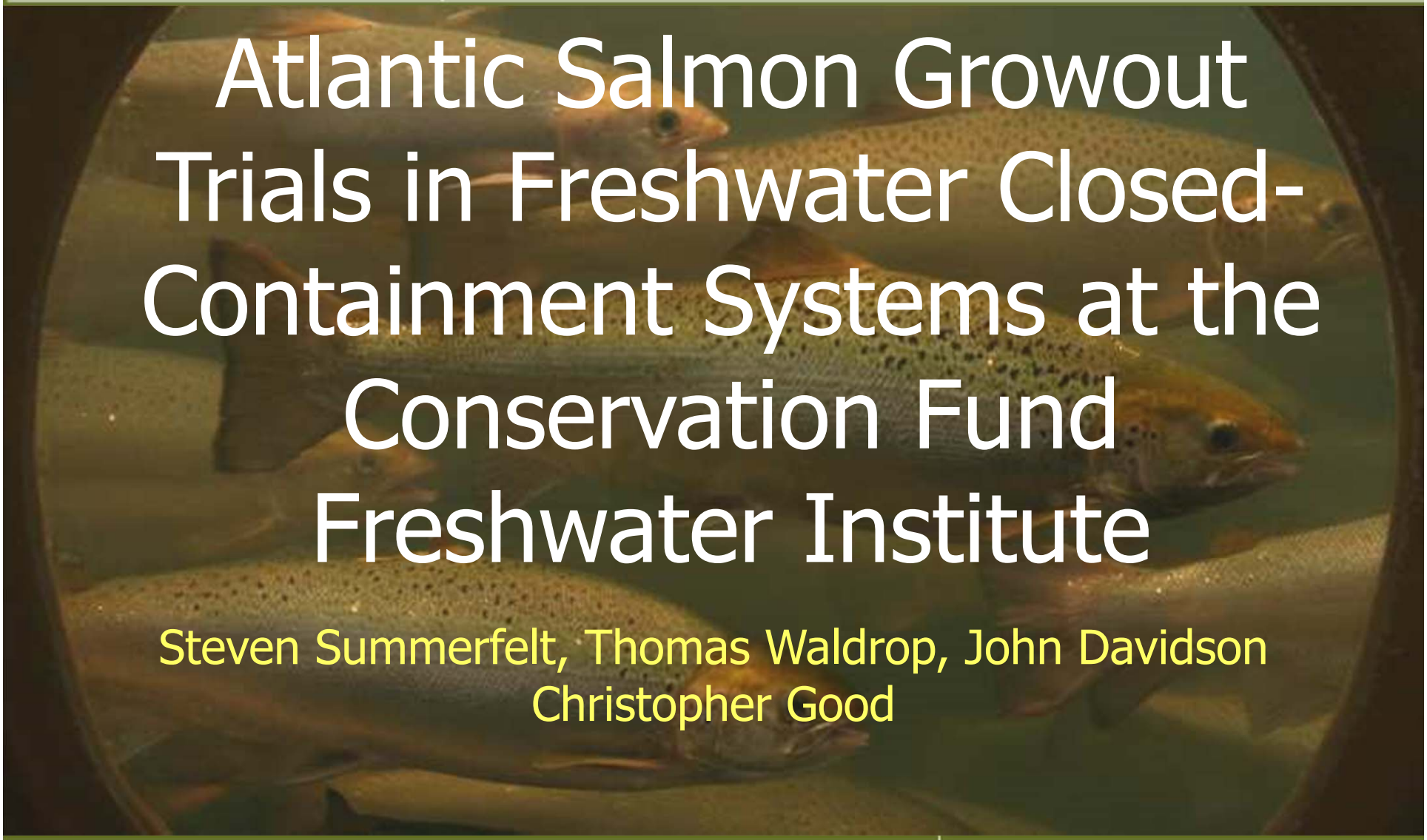

Atlantic Salmon Growout Trials in Freshwater Closed-Containment Systems at the Conservation Fund Freshwater Institute

Steven Summerfelt, Thomas Waldrop, John Davidson
Christopher Good

Producers Workshop
Vancouver, BC, April 23, 2013

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Acknowledgments

- Support for **TCFFI**:
  - **U.S. Department of Agriculture, Agricultural Research Service**
    - 1st salmon studies finished in 2011
    - Gaspe and St John River strain
  - **Atlantic Salmon Federation**
    - 2nd Growout Trial finished in 2012
    - St John River strain salmon @ 40 kg/m3
  - **Moore Foundation**
    - **3rd Growout Trial finished in 2013**
    - **Cascade strain salmon @ 100 kg/m3**
  - **Moore Foundation & ASF**
    - 4th Growout Trial to finish in 2014
    - Cascade strain salmon @ 2 photoperiods

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Containment is Necessary for Sustainable Aquaculture

- Land-based, closed-containment systems:
  - Exclude chemicals & obligate pathogens
    - No pesticides, antibiotics, & chemotherapeutics in closed-containments systems w/ over 10 yrs operation at TCFFI
  - Prevent escapees & disease interaction between wild & farmed fish
  - Minimize water use & release of pollution
  - Optimize water temperature & photoperiod
  - Locate farm in best location & away from sensitive ecosystems

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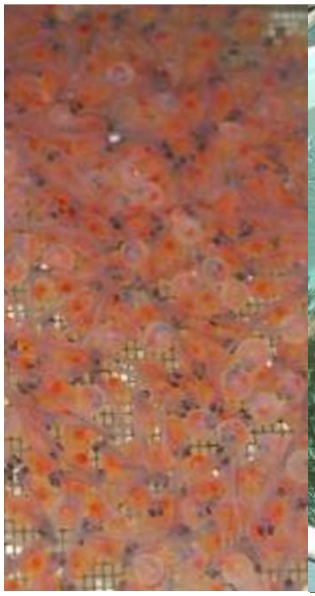
Atlantic Salmon Growout Trial

- Atlantic salmon - Cascade Strain
  - eggs purchased from American Gold Seafood (WA)
- Jan 5, 2011 – Eyed eggs received
- January 21, 2011 – 50% hatch (day 1)
- February 23, 2011 - First feeding (day 34)
- Aug-Sept 2011 – Photoperiod manipulated to S0 smolt
- March 12, 2012 – Moved into growout system (day 417)

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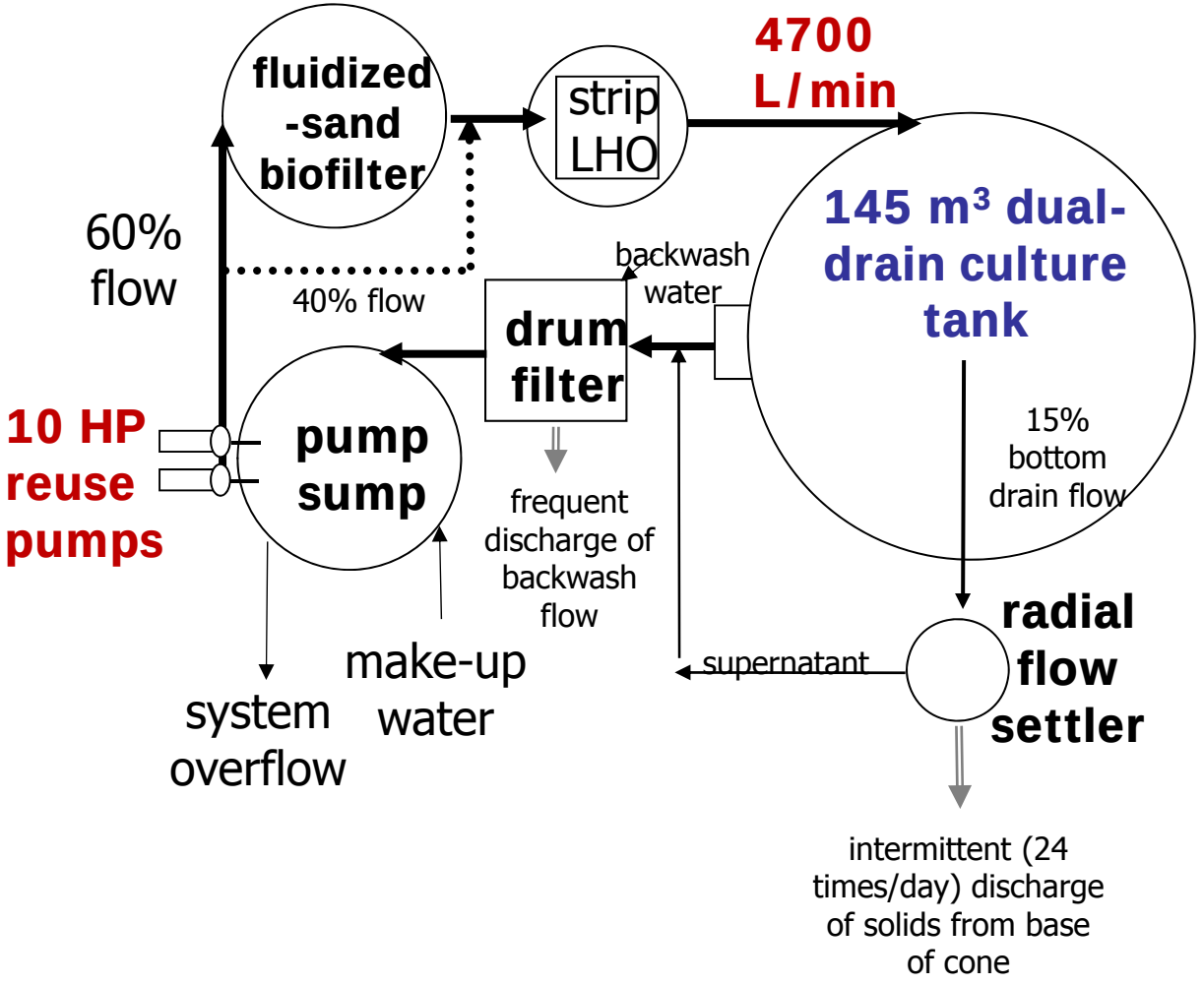
CO2 stripping unit stacked over a LHO & sump tank

Process Flow Drawing of Closed-Containment System



Closed-Containment System

- 145 m^3 Culture Tank Volume
  - 4900 L/min recirc flow
  - 30 min HRT
- 260 m^3 System Volume
  - 45 L/min mean makeup
  - 8 to 150 L/min makeup
  - 4 day HRT (1.2-23 day)
  - 99.8 to 96.9% flow reuse

High flushing rate to keep water ≤ 17˚C in summer

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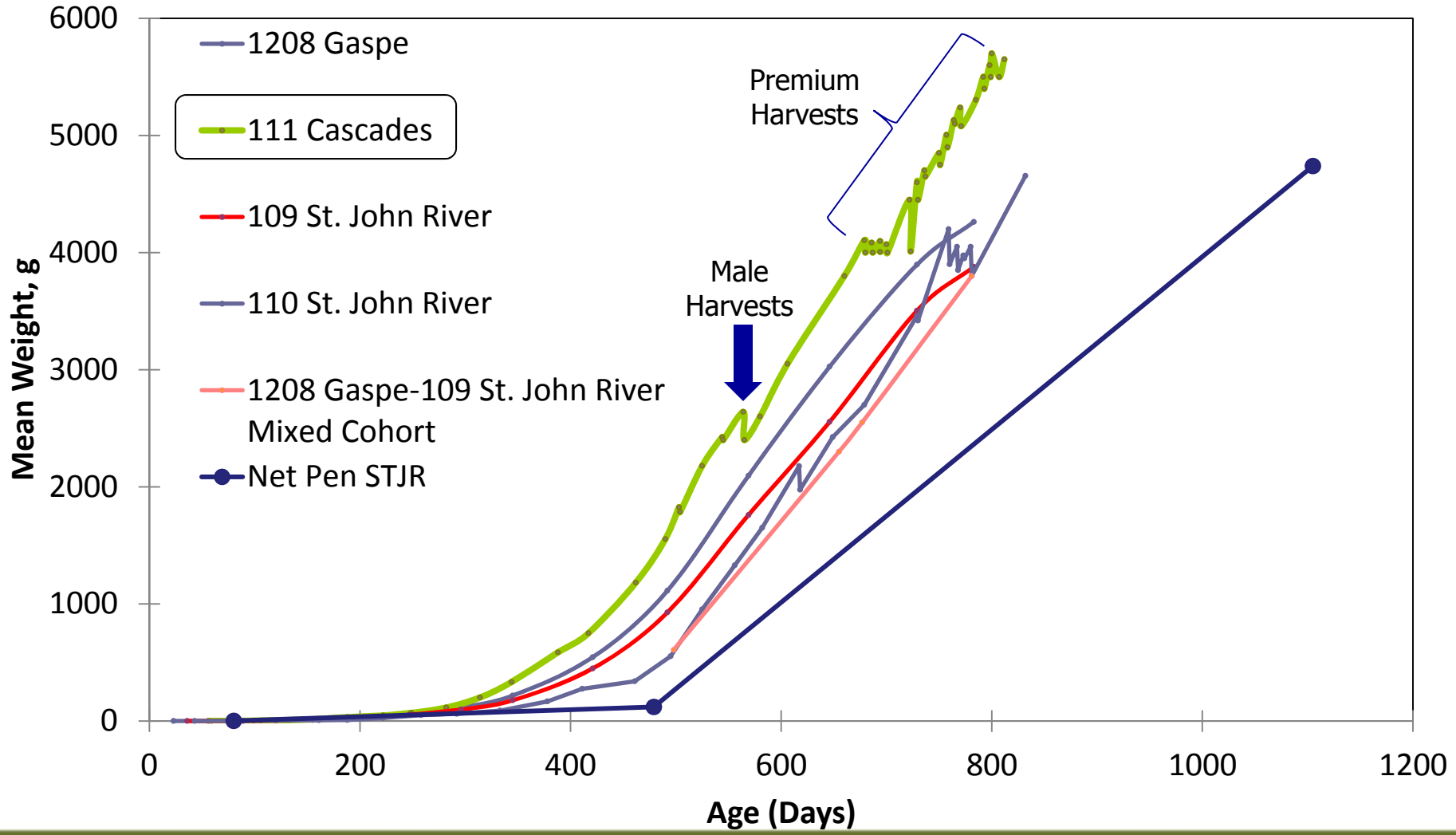
Atlantic Salmon Growout Trial



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Atlantic Salmon Growout Trial

- **430 g Post-smolt at 12 months post-hatch**
- **Maturing Male Harvests**
  - **2.6 kg mean size**
  - **Aug 6, 14, 22 (2012)**
  - **Days 564, 572, 582 post-hatch**
- **Premium Salmon Harvest**
  - **4.2 to 5.6 kg mean size**
  - **Nov 29 (2012) to April 11 (2013)**
  - **Days 679 to 812**
  - **16 harvest events (~ weekly)**

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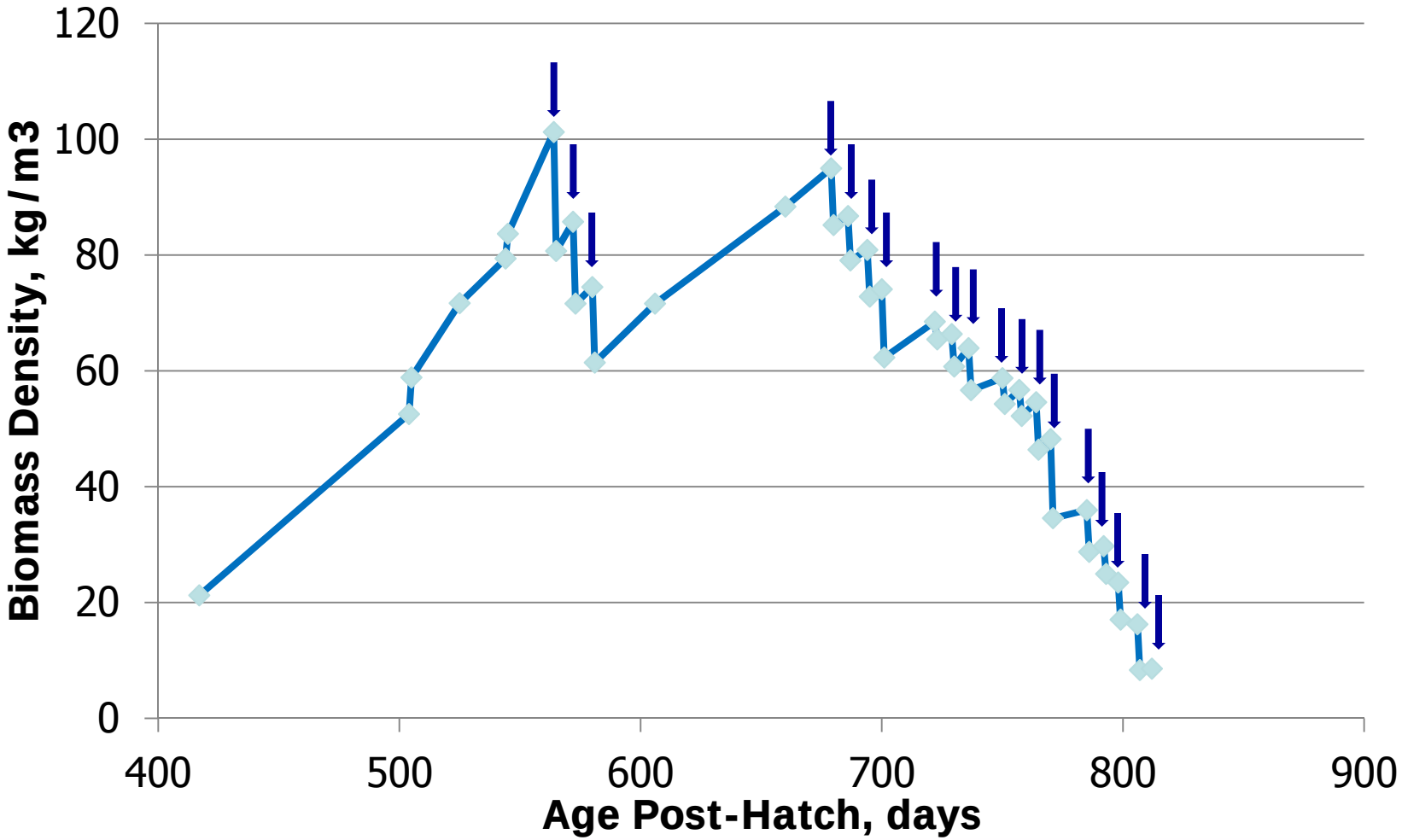
Salmon Biomass Density



Arrows Indicate Harvest Events

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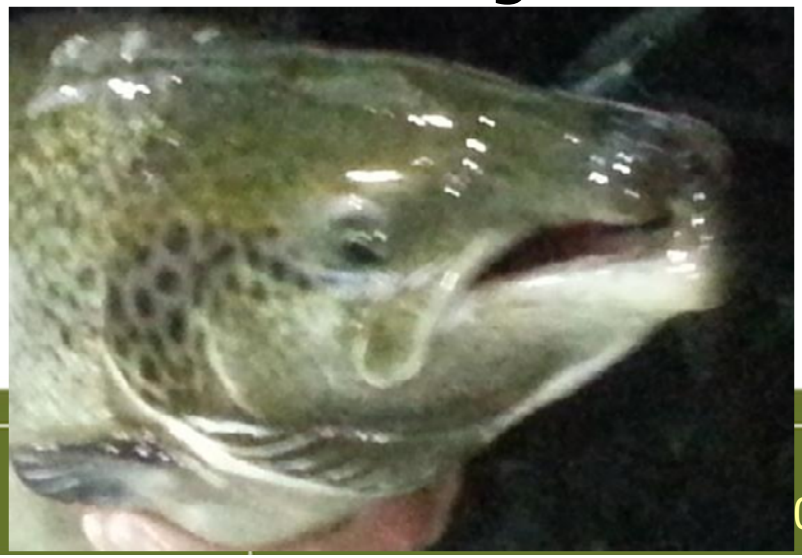
Atlantic Salmon Growout Trial

- 37% of the population harvested Aug., 2012
  - biomass at 100 kg/m3
  - **all maturing males** (slightly larger than females)
  - mean fish size at 2.64 kg
  - 5.4 metric tonne (12,000 lb)
  - sold to a local processor for hot smoking



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Atlantic Salmon Growout Trial

- Premium salmon:
  - 4.3 kg mean size achieved in early December 2012
    - 22.6 months post-hatch
  - biomass density reached 94 kg/m3
    - Good fin condition
  - produced 17.5 metric tonne
- Total Harvests (maturing male + premium)
  - 23 tonne
  - 145 m3 culture tank

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Mortality, Jumpers, and Culls

- Mortality 2.7%
- Culls 3.9%
- Jumpers 0.4%
- Total 7.0%

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ASF Grow-Out Trial Results
St John River Strain

- **Feed Conversion of 1.07 feed : 1.0 gain**
- Commercial diet with ~ 40:30 protein: fat

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Atlantic Salmon Growout Trial

- **No sea lice**
- **Obligate pathogens screening conducted (waiting on results)**
- **No kudoa**

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Atlantic Salmon Growout Trial

- No vaccination (saves $$ & stress)
- No antibiotics or pesticides used at any time
- No formalin used at any time
- Some hydrogen peroxide (H_2O_2) used in the sac fry and early parr stage to treat fungus.
- Total salt used to treat fungus: 14,400 lbs.

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Escapees

- **No escapees - One Atlantic salmon parr removed from the effluent fish exclusion area.**

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Product Quality Results

- MUST DEPURATE salmon for 10 days after removing harvested fish from recycle system
  - Depurate in partial reuse system with little biofilm
  - Purges off-flavors, i.e., geosmin and MIB, produced by bacteria (***actinomycetes***)

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Post-Harvest Slaughter

Rapid & Humane

- Percussive Stunning
  - MODEL SI-7 (Seafood Innovations)

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Growout Trial Results: Product Quality

- 56.6 ± 0.6% skin off & trimmed fillet yield
  - after 11 day depuration
- 1.77 ± 0.05 g/mm3 condition factor
  - net pen industry is ~1.3
- 15.2-17.0% lipid content in fillet

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Growout Trial Results: Product Quality

- Good fillet color (26-28) & lipid content (15-17%)

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Growout Trial Results: Product Quality

- Premium salmon sold to Albion Seafood and distributed through Safeway in Vancouver

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CONCLUSIONS: Atlantic Salmon Growout Trial

- Good growth in freshwater
  - Harvest 9-10 months sooner than net pens
- Good survival (95%) and feed conversion (1.07:1)
- Density can reach 100 kg/m^3
- Should use all female eggs to avoid precocious males

We don't need seawater to farm Atlantic salmon