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Update on Land-Based Closed-Containment Systems For Food-Fish

Steven Summerfelt

Producers Meeting
Nanaimo, BC, June 3, 2015

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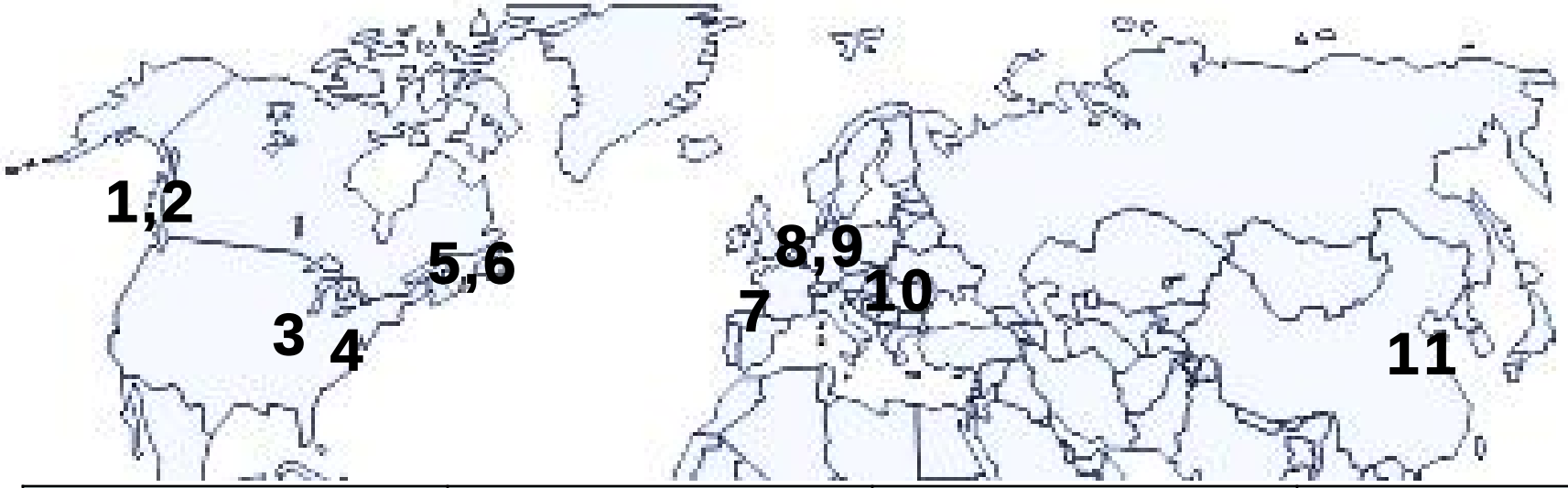
Land-Based **Salmon** Growout



1. Kuterra (Canada)	**2. Golden Eagle Aqua** (Canada)	**3. Bell Aqua** (USA)	
4. Freshwater Institute (USA)	**5. Sustainable Blue** (Canada)	**6. Canaqua** (Canada)	**7. BDV (France)**
8. Langsand Laks (Denmark)	**9. Danish Salmon** (Denmark)	**10. Jurassic Salmon** (Poland)	**11. Shandong Oriental OT** (China)

(Facilities harvesting fish or at least with eggs stocked)

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Land-Based Growout: **Other** Species

1. Target Marine, sturgeon (Canada)	**2. Taste of BC, steelhead** (Canada)	**3. Stolt Sea Farm, sturgeon** (USA)	**4. Bell Aqua, steelhead** (USA)
5. American Maricult, shrimp (USA)	**6. Blue Ridge, tilapia** (USA)	**7. Australis, barramundi** (USA)	**8. Canaqua Halibut** (Canada)
9. Danish Model Farms, trout (Canada)	**10. Aquatic, sturgeon** (Moldova)	**11. Xinjiang Ehe, steelhead** (China)	**12. Hayashi , steehead** (Japan)

Food-Size Tilapia Farming in NA

- Blue Ridge Aquaculture, Martinsville, VA
  - 2000 MT/yr

Google Earth

Food-Size Atlantic Salmon Farming

- Land-based closed-containment systems now operating with eggs or fish to harvest in 2015
  - *Langsand Laks* and *Danish Salmon* (Denmark)
  - *Kuterra*, *Canaqua*, & *Sustainable Blue* (Canada)
  - *BDV SAS* (France)
  - *Jurassic Salmon* (Poland)
  - *Yantai* (China)
  - *Freshwater Institute* (USA)
- Farm capacity should exceed 5000 tonne/yr

Coho Salmon & Steelhead Farming

- Land-based closed-containment systems operating:
  - *Taste of BC*; **steelhead** (Canada)
  - *Bell Aquaculture*; **steelhead** and **Coho** (USA)
  - *Golden Eagle Aquaculture*; **Coho** (Canada)
  - *Hudson Valley Fish Farms*; **steelhead** (USA)
  - *Spring Salmon*; **steelhead** (USA)
  - *Xinjiang Ehe*, **steelhead** (China)
  - *Hayashi*, **steelhead** (Japan)
  - *Danish Model Trout Farms*; **trout** (Denmark)

Coho Salmon & Steelhead Farming

- Land-based closed-containment systems for Coho salmon that have failed
  - *Sweet Spring Salmon* (USA)
  - *Teton and East End Hutterite farms* (USA)

Miller Colony pulls plug on commercial salmon farm

By Nancy Thornton
Acantha reporter

The Miller Hutterite Colony recently shut down what had been the first private, commercial salmon farm in the state that opened in December 2010.

A sister colony in Havre has also ceased raising salmon in a similar facility that used cutting-edge filtration technology to recirculate 99 percent of the groundwater used in the fish tanks.

David Wipf, Miller Colony's spokesman and secretary/treasurer, confirmed on Jan. 24 that the colony

however, the harvested fish were smaller than projections, reaching just four pounds on average.

It shipped the salmon in 50-pound cases to its West Coast partner/distributor for sale under the label, SweetSpring Salmon.

More than three years ago, after it suspended pig farming (Midway Colony south of Conrad continues that enterprise), Miller Colony began researching other agricultural businesses that would provide income, Wipf said in the earlier interview. Envirotech Ag Systems of Winnipeg, Manitoba, introduced the Miller Colony re-

farm in Montana.

SweetSpring Salmon, in turn, contracted with the Overwaitea Food Group for the estimated production from the two colonies and one in Rochester.

Miller Colony's new venture required approval of the state that licenses controlled species. The salmon could not be shipped live, for example, a measure to protect native fish populations in the event of an escape.

Last week, telephone and e-mail messages from the Acantha to AquaSeed, SweetSpring and Envirotech were not returned.

Holder of JLH Consulting
Holder Timmons Engineer-
C., who helped develop the
recirculation system, said he could

was to demonstrate the technical and financial feasibility of on-land closed containment aquaculture technology.

The February 2012 document estimated that a facility producing between 200,000 and 400,000 pounds of fish might have between $998,000 and $1,594,000 in net operating expenses, but still have between a 15.9 percent and a 32.4 percent profit, respectively.

John G. Nickum, a retired biologist who has extensive knowledge of aquaculture and who wrote an in-depth article about the colony/SweetSpring partnership, available on the Web, said he would be very interested to know what happened, whether the suspension had to do

the colony's attorney.

Choteau Acantha, Jan. 30, 2013

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‘Namgis/Kuterra Land-Based Salmon Farm, Port McNeill, BC

- 300-500 tonne/yr initial module (3-7 ppt)
- First premium harvest in April 2014

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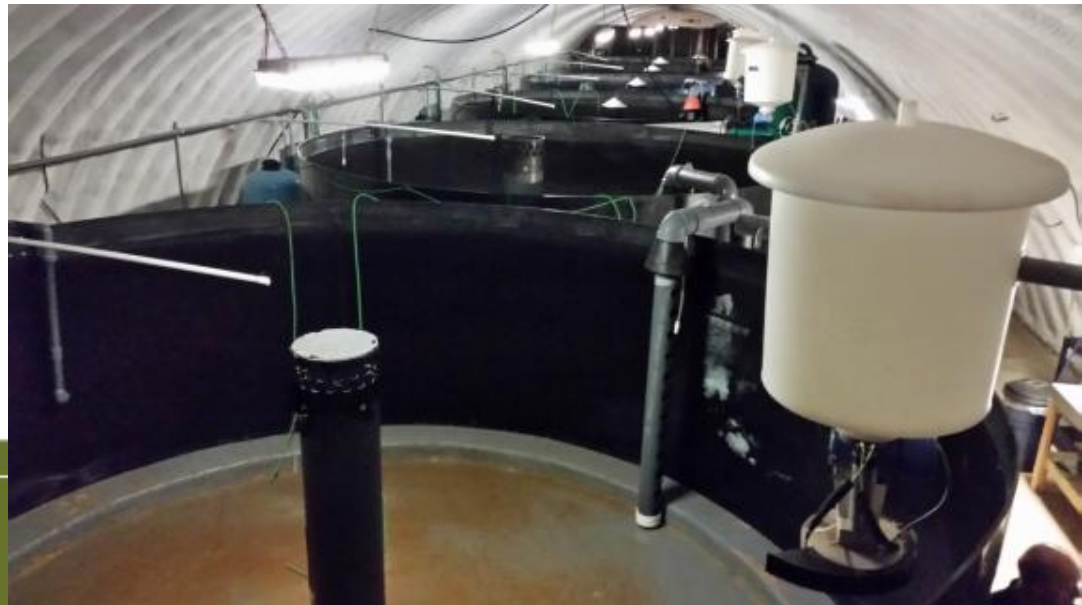
Sustainable Blue, Centre Burlington, Nova Scotia

- 100 MT/yr initial module & 500 MT expansion
- Stocked with eggs & smolt in 2013
- Lost largest cohort to power failure in 2014
- new hatchery with 5 RAS for culturing eggs to smolt; new cohort every 1-2 months
- 2 kg salmon now
- 25 ppt seawater
- Zero flushing



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Canaqua, Advocate, NS, Canada

- < 100 MT/yr initial production
- 3 kg salmon on site with 2 smaller cohorts
  - Low grilse
- 32 ppt salinity, 3-13˚C, natural photoperiod
- Working to fund 1000 MT/yr RAS expansion

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Spring Salmon, Rochester, WA

- Formerly *Sweetspring Salmon* (new owners)
- 100+ tonne/yr Steelhead, freshwater (0 ppt)

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Bell Aquaculture, Albany, IN

- Vertically integrated
  - nursery, growout, feedmill, processing, fertilizer
- 1000 MT/yr steelhead & Coho Salmon
  - freshwater

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Hudson Valley Fish Farms, W. Ghent, NY

- 1000 MT/yr steelhead to be stocked summer of 2015
  - freshwater

Fish farming resurfaces in county

April 2, 2015 by PARRY TEASDALE

W. GHENT–John Ng says industrial scale fish farming is a lot like his family's primary business, metal recycling. Adding weight to that claim is the $11 million his company, Fortune Group, has invested so far in its Hudson Valley Fish Farms in Greenport.

Mr. Ng was a featured speaker at the annual meeting of the Columbia Economic Development Corporation (CEDC) at Kozel's restaurant Tuesday morning, March 31. In introducing Mr. Ng, CEDC Executive Director Ken Flood acknowledged that this was not the first fish farm to have occupied the site on Route 9 south of Hudson. A start-up called Local Ocean opened several years ago to much fanfare and then abruptly closed in 2013, abandoning both the facility and the fish inside, with the cou project is unrelated to the earlier one, and Mr. Flo were the walls of the building.Mr. Ng said his

The Columbia Paper, April 2, 2015

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Langsand Laks- Atlantic Sapphire Hvide Sande, Denmark

- 1000 tonne/yr Atlantic salmon, brackish water
  - Harvesting salmon in 2013-2014 then emptied, disinfected, & restocked to eliminate furunculosis

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Danish Salmon, Hirtshals, Denmark

- 2000 tonne/yr (seawater)
- Salmon eggs hatched April 2013
- Expected to harvest in 2015

http://sorenfrandsen.wix.com/danishsalmon#!danish-salmon/c1l4l

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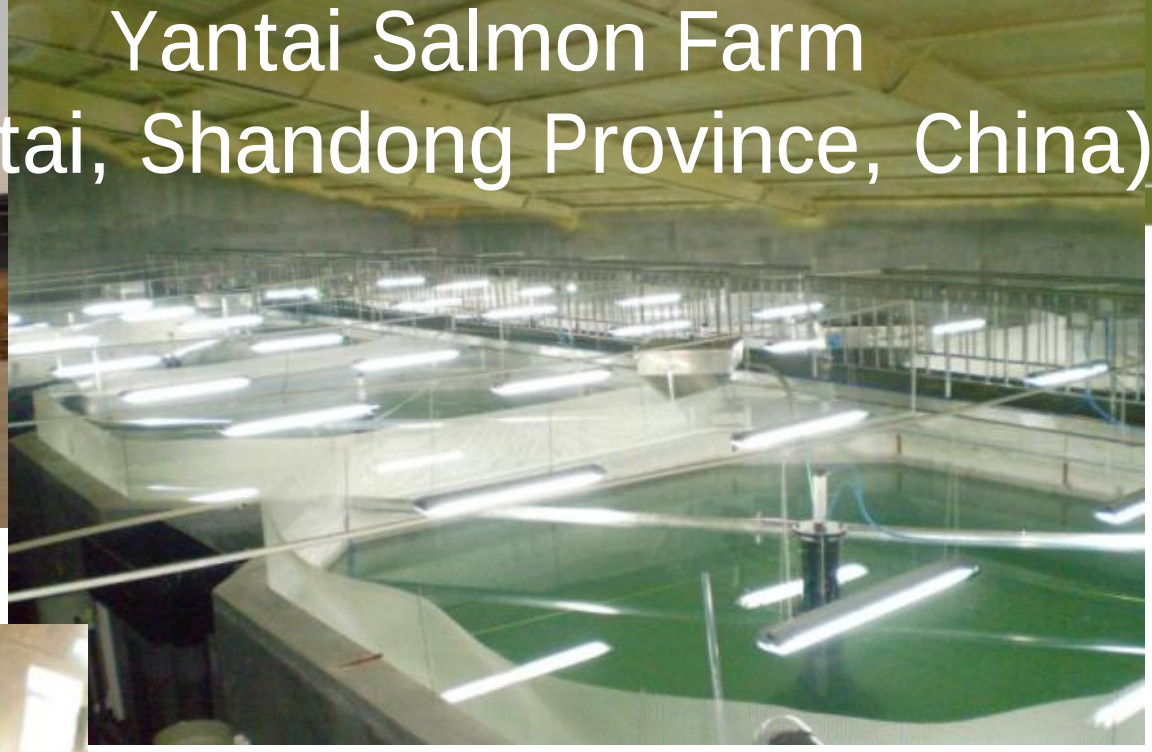
BDV SAS (Normandie, France)

- Already producing Atlantic salmon for several years in 20 ppt salinity

(Photo courtesy of Jonas Langeteig)

Yantai Salmon Farm (Yantai, Shandong Province, China)



Shandong Oriental Ocean Sci-Tech Co.
(slide courtesy of Idar Schei, AquaOptima)

Yantai Salmon Farm

- Now producing over 100 tonne/yr Atlantic salmon with plans to expand
  - *See article by Mark Godfrey, SeafoodSource contributing editor reporting from Beijing, China*, 01 August, 2013

Xinjiang E'he Construction and Investment Company, China

- 1000 tonne/yr growout farm in Gobi Desert
  - Commissioning with steelhead & switching later to Atlantic salmon

undercurrentnews
seafood business news from beneath the surface

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Danes build salmon farm in Gobi desert

August 23, 2013, 8:05 am

Undercurrent News

A Danish company is establishing a recirculation farm to grow salmon in the unlikeliest of places, the middle of China's Gobi desert.

In association with a Chinese state-owned water supply

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Jurrasic Salmon, Szczecin, Poland

- 1000 MT/yr Atlantic salmon
- 3 cohorts on-site, including post-smolt
- Brackish water

Salmon Smolt Production RAS

- Large RAS expansions in Americas & Norway
  - To meet increasing smolt production requirements
  - To increase capacity to produce larger post-smolt (200 to 1000 g) on land
  - Enormous investment
    - Almost all new facilities are RAS
    - $100 million capital investment in single facilities
  - Technology is advancing rapidly to achieve economies of scale

Farms Preparing To Producing Food-Size Salmon in Land-Based Systems

- Approximately 1 dozen other land-based growout facilities expected to break ground or planned
  - USA, Canada, Norway, Sweden, & Switzerland
  - Potentially another 10,000+ MT/yr of food-size salmon

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Conclusions – Land Based Salmon Growout

- Lessons to be gleaned from commercial farms
  - Technical: Water quality and RAS performance
    - Freshwater or brackish water operation, temp, & photoperiod
  - Biological: Fish growth, survival, harvest size, color, flavor
    - Availability of eggs/smolt
    - Early maturing males, if any
    - Disease & therapeutic use, if any
  - Economics: Fixed capital investment & operating costs
    - Farm gate sales price
    - Co-products being marketed, if any
  - Market acceptance

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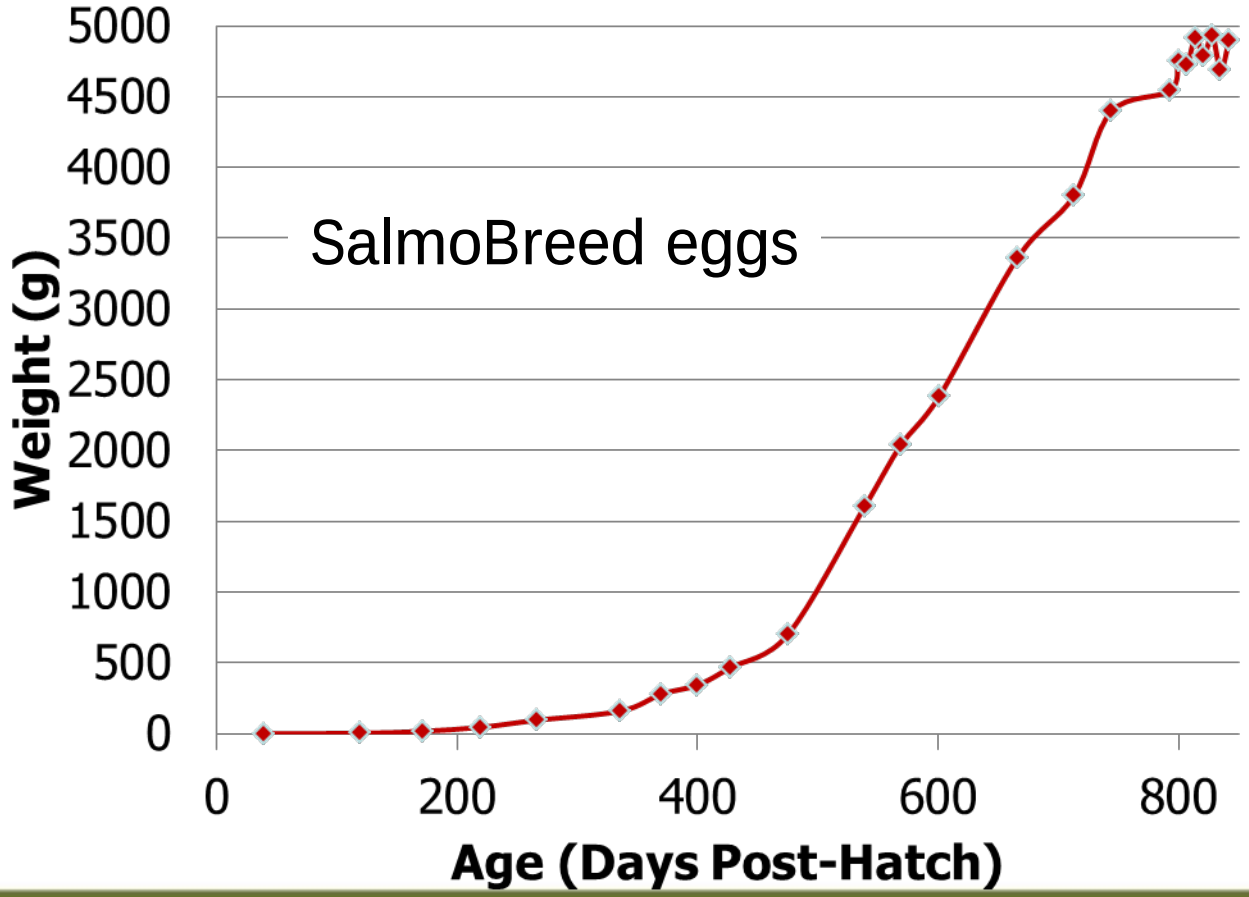
Recent Freshwater Institute Research

Producers Meeting
Nanaimo, BC, June 3, 2015

Freshwater Institute Research

- Last Atlantic salmon growout trial



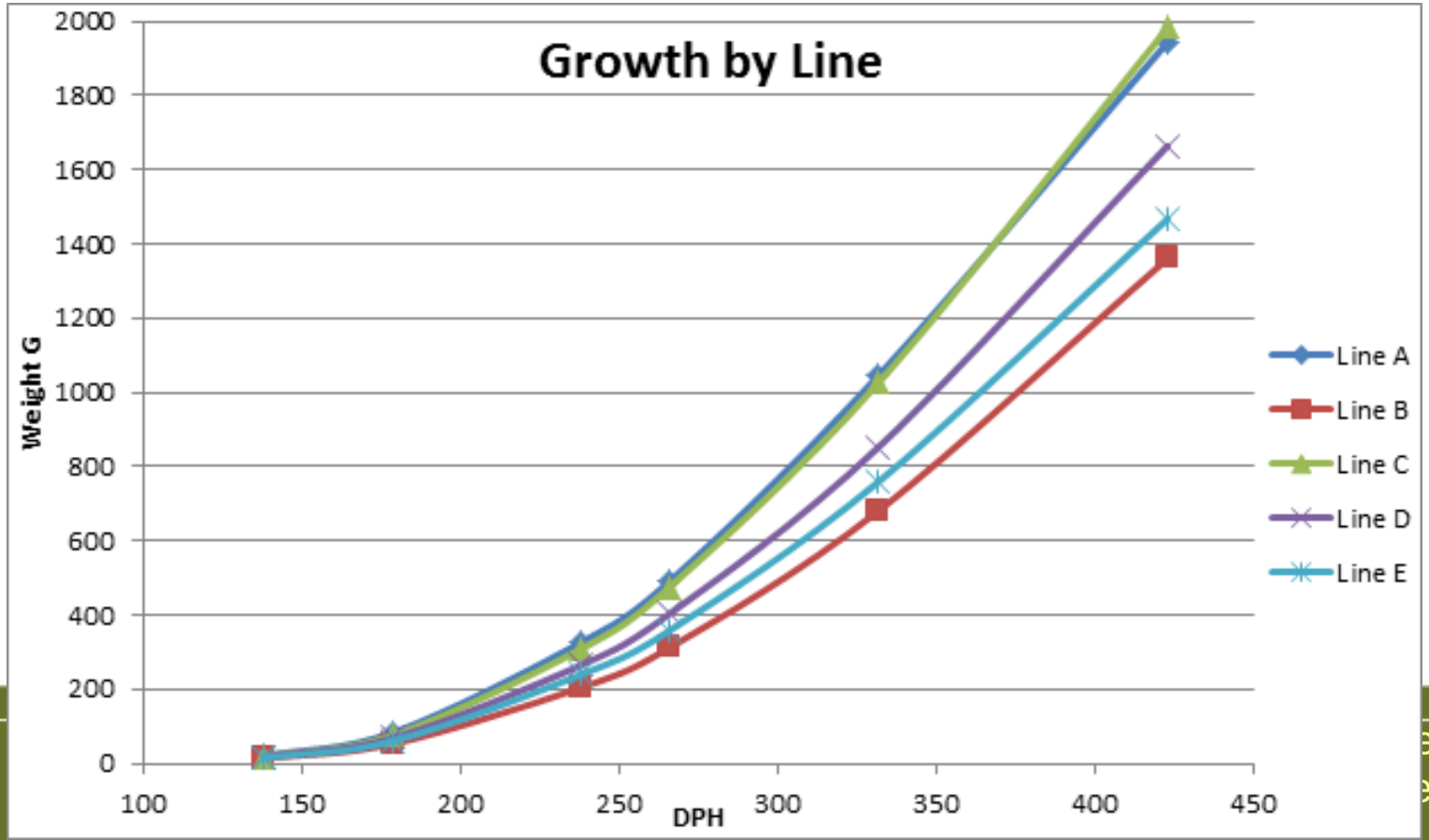
3.5% mortality during growout; no fungus

Freshwater Institute Research

- Next Atlantic salmon growout trial to evaluate a sustainable formulation:
  - Fishmeal free
  - GMO free
  - Zero Fish in: fish out (by Seafood Watch)
  - North America sourced ingredients
  - Natural pigment added (Astaxanthin from non-gmo phaffia yeast)
  - only fish oil (byproduct of processing residuals)

USDA-Freshwater Institute Research

- Assessment of Genetic X Environmental Interactions on Growth Performance of **Five Lines of Rainbow Trout** Raised In Unique Environments



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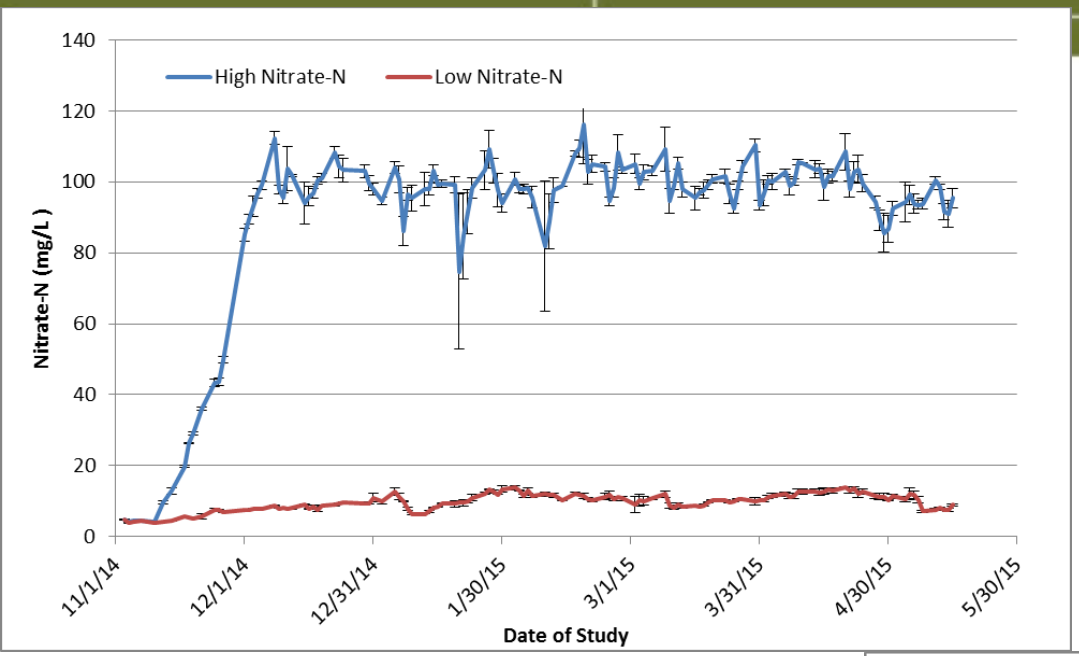
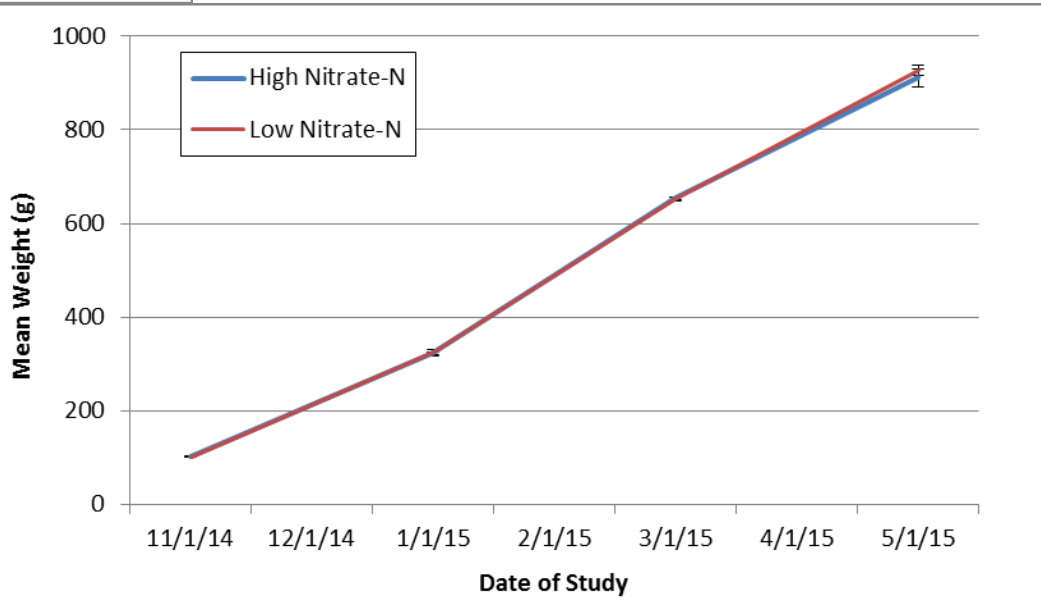
Atlantic Salmon – Nitrate Research



- Post-smolt Atlantic salmon (100 g to begin) were cultured in replicated RAS at two NO_3-N levels
  - 99 ± 1 mg/L
  - 10 ± 0 mg/L

- After 6 months of exposure no differences in growth, survival, swimming behavior, or the rate of early maturation has been observed

- Blood chemistry, histopathology, and sex steroid level results are pending



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CtrlAQUA

Centre for Research-based Innovations in Controlled-environment Aquaculture -
to develop closed-containment concepts of the future

8-yr Project, Led by NOFIMA,

Industry & Research Collaboration

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Acknowledgements

- Research support

USDA

Gordon and Betty MOORE FOUNDATION

TIDES canada

Atlantic Salmon Federation • Fédération du Saumon Atlantique •

SalmoBreed