SWITCH OVER FROM FLOW THROUGH TO RAS IN CHILE

Knowledge, Experience and Innovation for Aquaculture

Claudio García-Huidobro
claudiogh@recirculacionchile.cl

Advisories assessment, design, implementation, operation and improvement of Recirculation Systems for Aquaculture
CHILEAN SALMON INDUSTRY

- Total production 750 thousand ton
- Total income USD 2.500 Millions
- Total export 450 thousand ton
- 55,000 employments
- FW production 9 regions
- SW production only 3 regions
- Seawater temperature 7-14 °C
- Seasite 850
- FCRe 1,5
- Production cost USD 3,5 - 4
SWITCH OVER FROM FLOW THROUGH TO RAS

- From 1998, 1999 and 2000 Hatcheries had sanitary problems
- Start to discuss about RAS in 2000
- Danish RAS technologies
- First project “Salmon Free disease”
EVOLUTION OF RAS AND SUPPLIERS

- First projects were purchased turnkey
- Commissioning problems
- Producers know and understand RAS
- Producers proposing modifications
- Producers participate in desing and specifications
- Suppliers change from importers to be integrators with local offices
- Suppliers receive feedback and improve RAS
RAS TIME LINE BUILDING AND OPERATION

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<tbody>
<tr>
<td>Sites</td>
<td>Camanchaca</td>
<td>Río Petrohué</td>
<td>Camanchaca</td>
<td>Río Petrohué</td>
<td>Tornagaleones</td>
<td>Los Chicos</td>
<td>S. Humboldt</td>
<td>Santa Juana</td>
<td>Invertec</td>
<td>Lago Verde</td>
<td>AquaChile</td>
<td>Chaicas</td>
<td>S. Dalcahue</td>
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<td>M. Harvest</td>
<td>Río Blanco</td>
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<td>Pichichanlelu</td>
<td>Rauco</td>
<td>S. Humboldt</td>
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<td>S. Captren</td>
<td>Chinquihue</td>
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Fingerlings
- Skysal Mina
- Yadran Río Chico
- Nalcahue Chesque Alto
- Patagonia Puyuhuapi

Smolts
- Ecofish Correntoso
- Multiexport Puerto Fonk
- Multiexport Molco
- Mainsteam Río Pescado
- Sealand Pargua
- Sealand Pargua
- Sealand Pargua
- Sealand Pargua
- Sealand Pargua
- Skysal Punta
- Novofish Huelmo
- Novofish Huelmo
- Novofish Huelmo
- Camanchaca Río Petrohué
- S. Magallanes Hollenberg
ALTERNATIVES USED FOR SMOLTIFICATION

HATCHERY FLOW THROUGH/RAS → LAKES → ESTUARIES → SEASITE

LAKES

ESTUARIES

SEASITE
LAND BASED CAPACITY FOR SMOLT PRODUCTION

- Smolt production capacity 141 millions

Capacity land based ponds for salar smolt production, year 2013.

- 76 MILL 54%
- 65 MILL 46%

Smolt in RAS  Smolt flow through
HATCHERY FACILITY
SMOLT FACILITY
RAS PROJECTS AND SUPPLIERS IN CHILE

- RAS projects built: 35
- RAS for fingerlings: 20
- RAS for smolts: 15
- Companies with RAS: 17

- Billund aquaculture
- Akva
- Aquatec Solutions
- Atlantech
- Ocea
- PRaqua

> 80 %
### Type of RAS and Biofilters

<table>
<thead>
<tr>
<th>Type</th>
<th>Flow Through</th>
<th>Semi Recirculation</th>
<th>Recirculation</th>
<th>Intensive Recirculation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40.000 - 50.000 lt/kg food</td>
<td>4.000 - 5000 lt/kg food</td>
<td>600-1000 lt/kg food</td>
<td>100-600 lt/kg food</td>
</tr>
</tbody>
</table>

#### Pie Chart

- Fixed Biofilters: 54%
- Moving Bed Biofilters: 29%
- Combinations Fixed and MB: 17%

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CHALLENGES TO IMPROVE SMOLTS RAS

- Reduce energy consumption and investment
- Trained staff
- Acclimatization units
- Specialized food
  - Bouyancy
  - Composition
  - Energy
  - Pigment
  - Consistency
  - Palatability
RAS FUTURE PROJECTS

Projects approved for pre grow
- S. Humboldt
- S. Magallanes

Projects approved for grow out
- Neosalmon 15.000 ton/year

Projects permits in process for pre grow, pre Brooodstock and Harvest size
- Recirculacionchile
# INVESTMENT AND OPERATIONAL COST IN RAS

<table>
<thead>
<tr>
<th>Item</th>
<th>Stage</th>
<th>Measure unit</th>
<th>Investment</th>
<th>Cost</th>
<th>Scale</th>
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</thead>
<tbody>
<tr>
<td>Broodstock</td>
<td>Eyed eggs</td>
<td>USD/EE</td>
<td>0.2 - 0.3</td>
<td>0.06 - 0.09</td>
<td>30.000.000</td>
</tr>
<tr>
<td>Smolts</td>
<td>Eyed eggs - Smolt</td>
<td>USD/Smolt</td>
<td>1.8 - 2.5</td>
<td>0.9 - 1.2</td>
<td>6.000.000</td>
</tr>
<tr>
<td>Pre grow</td>
<td>Smolt - 350 gr</td>
<td>USD/Smolt</td>
<td>2.4 - 3.5</td>
<td>1.5 - 2</td>
<td>6.000.000</td>
</tr>
<tr>
<td>Grow out</td>
<td>Smolt - 4.5 kg</td>
<td>USD/kg</td>
<td>4.8 - 5.5</td>
<td>3 - 3.3</td>
<td>5.000.000</td>
</tr>
<tr>
<td>Grow out</td>
<td>Eyed eggs - 4.5 Kg</td>
<td>USD/kg</td>
<td>6.5 - 9.0</td>
<td>2.6 - 3.2</td>
<td>5.000.000</td>
</tr>
</tbody>
</table>

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RAS GROW OUT EXPERIENCES IN CHILE

Grow out land based experiences in Chile
Neosalmon pilot project
- 5 batch
- 12 months (smolt to harvest size)
- FCRE 1
- < 2% mortality
- Not use of antibiotics
RAS GROW OUT EXPERIENCES IN CHILE
CHALLENGES FOR GROW OUT IN RAS

• Achieve grow time expected
• Specialized food
  – Organic food
  – Bouyancy
  – Composition
  – Energy
  – Pigment
  – Consistency
  – Palatability
• Early maduration
  – Condition
  – Photoperiod
  – Density
  – Water quality, Temperature, Salinity
  – Swimming velocity
  – Genetic
  – Monosex
THANKS