Accelerating Aquaculture Production

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Sustainability Challenges

- During the last 20 years, challenges have emerged as aquaculture has grown rapidly around the world
- Can we accelerate production, but avoid these pitfalls?
- Challenges
  - Environmental
  - Social
  - Food Safety
  - Animal Welfare
  - Traceability
Mangrove Habitat
Resource Limitations

- Water
- Land
- Energy
- Feed
- Labor
Water

• Freshwater is becoming scarce and precious

• FAO calculated an index for efficiency of use of freshwater for aquaculture
  – Tons of production per cubic kilometer of annual precipitation minus annual evapotranspiration
  – China produced 1,777 t/km³/y
  – Korea produces 317 t/km³/yr
  – Global average is only 200 t/km³/yr
• Protected Near Shore Sites are Scarce
• Open Ocean Technology is Still Evolving
The Chilean Salmon Case
World Salmon Production in 2008

- Chile: 34%
- United Kingdom: 7%
- Canada: 7%
- Faroe Islands: 2%
- Other: 6%
- Norway: 44%
Outbreak of Infectious Salmon Anemia (ISA) in Chile in 2008

- Biosecurity was weak
  - Imported infected eggs from Norway
  - Cage sites too close together
  - Stocking densities too high
- Industry was too excited about growth, and got a little sloppy.
Farmed Atlantic Salmon Production

Source: Kontali
Movement of goods and materials helps the dispersion of disease agents.
Average Monthly Mortality

- Coho
- Salmon
- Trout

Graph shows the average monthly mortality rates for Coho, Salmon, and Trout from January 2008 to July 2009.
Salmon Farming in Chile
The Shrimp Farming Case
<table>
<thead>
<tr>
<th>Year</th>
<th>Countries</th>
<th>Disease</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>Ecuador</td>
<td>BP</td>
<td>Mortality in hatchery</td>
</tr>
<tr>
<td>1988</td>
<td>Taiwan</td>
<td>YHV</td>
<td>80,000 to 25,000 mt</td>
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<tr>
<td>1992</td>
<td>China</td>
<td>WSSV</td>
<td>220,000 to 50,000 mt</td>
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<tr>
<td>1994</td>
<td>Ecuador, Mexico</td>
<td>TSV</td>
<td>TSV resistant stylirostris sent to Brunei (2000)</td>
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<tr>
<td>2002</td>
<td>Thailand, Indonesia</td>
<td>MSGV</td>
<td>Reduced profitability</td>
</tr>
<tr>
<td>2004</td>
<td>Brazil, Indonesia</td>
<td>IMNV</td>
<td>Reduced profitability</td>
</tr>
<tr>
<td>2006</td>
<td>Belize, Mexico</td>
<td>PvNv</td>
<td>Reduced profitability</td>
</tr>
</tbody>
</table>
Specific Pathogen Free *Penaeus vannamei* developed and bred for performance
SPF stocks enable more efficient selective breeding
Relative Genetic Gain in Growth Rate

Percent of 1940


Chicken
Tilapia
Salmon
Swine
Shrimp
Beef Cattle
Aquabounty GMO Salmon

Size comparison of an AquAdvantage® Salmon (background) vs. a non-transgenic Atlantic salmon sibling (foreground) of the same age
Technology is Changing the Business

- More sustainable
  - Greatly reduced mangrove destruction and effluents
- More consistent
  - Less vulnerable to epidemic diseases
  - High margin (30-50%) and high volatility are giving way to lower margins (10-20%), higher volume, and better quality.
- More cost effective
  - Cost of feed and postlarvae declining
  - Genetic improvement expected to yield 10-15% increase in growth rate per year
The Lesson

• To improve profitability, it is important to stay abreast of the latest technology
  – Identification of new diseases
  – SPF genetically improved monodon
  – Intensive ponds with minimal water exchange
  – Probiotics and bioflocs
Bioflocs and Probiotics

CHANGING PARADIGMS IN SHRIMP FARMING:
V. ESTABLISHMENT OF HETEROOTROPIC BACTERIAL COMMUNITIES