Thank you to E2Tech’s Top Sustaining Partners!

SUSTAINING CHAMPION

BURNS MCDONNELL

Sustaining Leader

BERNSTEIN SHUR
Sebastian Belle

Maine Aquaculture Association
Land-based From a Growers Perspective.

Sara Rademaker
President and Founder of American Unagi
World Capture Fisheries and Aquaculture Production

Source: FAO 2016 SOFA report
 WHY AQUACULTURE

Growing Population in need of efficient protein.

Seafood Averages Less Resources per Pound Production
WHERE IS IT BEING PRODUCED?

**TOP 25 PRODUCERS AND MAIN GROUPS OF FARmed SPECIES IN 2014**

<table>
<thead>
<tr>
<th>MAJOR PRODUCERS</th>
<th>INLAND AQUACULTURE</th>
<th>MARINE/COSTAL AQUACULTURE</th>
<th>MOLLUSCS</th>
<th>CRUSTACEANS</th>
<th>OTHER AQUATIC ANIMALS</th>
<th>TOTAL AQUATIC ANIMALS</th>
<th>AQUATIC PLANTS</th>
<th>TOTAL AQUACULTURE PRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>26 029.7</td>
<td>1 189.7</td>
<td>13 418.7</td>
<td>3 993.5</td>
<td>839.5</td>
<td>45 469.0</td>
<td>13 326.3</td>
<td>58 795.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2 857.6</td>
<td>782.3</td>
<td>44.4</td>
<td>613.9</td>
<td>0.1</td>
<td>4 253.9</td>
<td>10 077.0</td>
<td>14 330.9</td>
</tr>
<tr>
<td>India</td>
<td>4 391.1</td>
<td>90.0</td>
<td>14.2</td>
<td>385.7</td>
<td></td>
<td>4 881.0</td>
<td>3.0</td>
<td>4 884.0</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>2 478.5</td>
<td>208.5</td>
<td>198.9</td>
<td>506.2</td>
<td>4.9</td>
<td>3 397.1</td>
<td>14.3</td>
<td>3 411.4</td>
</tr>
<tr>
<td>Philippines</td>
<td>299.3</td>
<td>373.0</td>
<td>41.1</td>
<td>74.6</td>
<td></td>
<td>788.0</td>
<td>1 549.6</td>
<td>2 337.6</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1 733.1</td>
<td>93.7</td>
<td></td>
<td>130.2</td>
<td></td>
<td>1 956.9</td>
<td></td>
<td>1 956.9</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>17.2</td>
<td>83.4</td>
<td>359.3</td>
<td>4.5</td>
<td>15.9</td>
<td>480.4</td>
<td>1 087.0</td>
<td>1 567.4</td>
</tr>
<tr>
<td>Norway</td>
<td>0.1</td>
<td>1 330.4</td>
<td>2.0</td>
<td></td>
<td></td>
<td>1 332.5</td>
<td></td>
<td>1 332.5</td>
</tr>
<tr>
<td>Chile</td>
<td>68.7</td>
<td>899.4</td>
<td>246.4</td>
<td></td>
<td></td>
<td>1 214.5</td>
<td>12.8</td>
<td>1 227.4</td>
</tr>
<tr>
<td>Egypt</td>
<td>1 129.9</td>
<td></td>
<td>7.2</td>
<td></td>
<td></td>
<td>1 137.1</td>
<td></td>
<td>1 137.1</td>
</tr>
<tr>
<td>Japan</td>
<td>33.8</td>
<td>238.7</td>
<td>376.8</td>
<td>1.6</td>
<td>6.1</td>
<td>657.0</td>
<td>363.4</td>
<td>1 020.4</td>
</tr>
<tr>
<td>Myanmar</td>
<td>901.9</td>
<td></td>
<td></td>
<td>42.8</td>
<td>15.6</td>
<td>962.2</td>
<td>2.1</td>
<td>964.3</td>
</tr>
<tr>
<td>Thailand</td>
<td>401.0</td>
<td>19.6</td>
<td>209.6</td>
<td>300.4</td>
<td>4.1</td>
<td>934.8</td>
<td></td>
<td>934.8</td>
</tr>
<tr>
<td>Brazil</td>
<td>474.3</td>
<td></td>
<td>22.1</td>
<td>65.1</td>
<td>0.3</td>
<td>561.8</td>
<td>0.7</td>
<td>562.5</td>
</tr>
<tr>
<td>Malaysia</td>
<td>106.3</td>
<td>64.3</td>
<td>42.6</td>
<td>61.9</td>
<td>0.6</td>
<td>275.7</td>
<td>245.3</td>
<td>521.0</td>
</tr>
<tr>
<td>Democratic People's Republic of Korea</td>
<td>3.8</td>
<td>0.1</td>
<td>60.2</td>
<td>0.1</td>
<td>64.2</td>
<td>444.3</td>
<td>508.5</td>
<td></td>
</tr>
<tr>
<td>United States of America</td>
<td>178.3</td>
<td>21.2</td>
<td>160.5</td>
<td>65.9</td>
<td></td>
<td>425.9</td>
<td></td>
<td>425.9</td>
</tr>
</tbody>
</table>
Extensive Aquaculture

Intensive Aquaculture

Low Yield

High Yield
LAND-BASED RECIRCULATING AQUACULTURE

- Most intense and highest yielding aquaculture production method
- All aspects of production can be closely controlled and monitored
- Insulation from deterioration in natural environment (red tides, acidification, etc.)

- Better Stock Management
- “Traceability”
- Consistent product
- Certification Ability
- Carbon Footprint Impact
WHY LAND BASED, WHY NOW?
THE LAND BASED OPPORTUNITY

- Existing and growing US Seafood Market
  - Growing Acceptance for Aquaculture Products

- Species Options Increasing
  - Proven Species
  - Market Opportunities
  - Opportunity Species

- Technology
  - More Proven System Designs
  - Efficiency and Design Improvements
  - Manufacturing Improvements
Standard Land-Based Facility

Components
- Hatchery System
- Production System
- Filtration System
- Water Treatment
- Holding/Shipping
- Processing
- Office Area

- Controlled environment
- 24/7 monitoring
- Back up power generation for facility and well
- Back up oxygenation system on site
RAS Process

1. Filtration System
2. Solid Removal
   - Solids such as fecal material are removed by mechanical filtration
3. Dissolved Gas Control
   - CO2 gas is removed and oxygen is added before water is recirculating back to culture tanks
4. Bio-Filtration
   - Beneficial bacteria breakdown Ammonia into nitrogen
Land-Based Aquaculture: from the state’s perspective

Meredith Mendelson

www.maine.gov/dmr
A short history lesson

• Many species have been or are being grown in land-based facilities in Maine.

• Jurisdiction:
  • LBA permitting authority--Maine DMR 2009 - 2017
  • LD 1502 (128th) transferred permitting authority to DACF
  • LD 1763 (129th) transferred permitting authority back to DMR
Permitting: Maine

DMR:
- DMR LBA Permit (12 MRSA §6085)
- Importation/Transfer Permits (if applicable)

DEP:
- Site Location of Development
- NRPA
- Wastewater Discharge (if applicable)

DIFW:
- Fish Cultivation Permit (12 MRSA §12057)
- Importation/Transfer permits (if applicable)
A. Risk of accidental or intentional introduction of marine organisms or marine organism products into the coastal waters of the State;
B. Risk of the introduction or spread of disease within the State; and
C. Interference with the enforcement of possession, size or season limits for wild marine organisms
Challenges and Opportunities

+ Potentially less conflict issues than marine sites
+ The Maine brand
+ Strong seafood economy
+ Marine science network
+ Proximity to major centers of population
+ Economic opportunity and good jobs in rural areas of Maine
+ Improved access to local seafood

- Resources
- Interagency coordination
- Deliberative change
Why are we seeing a RAS boom in Maine, and what does it mean?
Key drivers for RAS emerging as a viable production method

Net pen production costs doubled in the past 10 years

Ongoing risk reduction in RAS enabling scaling up

Cost and environmental advantage of producing close to consumer

Scaled-up and professionally managed RAS can achieve cost-parity with net pens
The case for producing a lot more seafood in the US - the US is currently ranked # 16 in aquaculture (NOAA)

- **High growth:**
  - 7.4 % seafood consumption increase in 2017 in the US
  - **Intrafish**

- **High trade deficit:**
  - The US has a 94 % and growing seafood deficit
  - **FDA**

- **Low traceability:**
  - Less than 1 percent of imported seafood to the US is inspected
  - **FDA**
Scalable seafood brand

Cold and clean water resources

Proximity to large consumer markets

Academic institutions

An opportunity space to diversify the seafood industry in Maine

Unpredictable permitting process

Regulatory framework

Development concerns

Lacking supporting value chain
Opportunity space

Up-stream
- Financing
- Construction
- Vendors
- Production inputs
- Services

Production
- 5 projects in various stages
- Room for more
- Fish, shrimp, etc.
- Various species possible
- Other seafood segments

Down-stream
- Processing
- By-products
- Biotech
- Sales & marketing

Education  Work force  R&D  Regulatory  Investment capital  New investment
What it could mean for Maine in the next five years

1-2 billion USD + in investments

Many new jobs

Millions in tax revenue

Expanded education opportunities

More diversified and resilient seafood sector

Climate / environmental leadership
But Maine should proceed in a controlled pace - there will be “bumps” along the way

- Public education and regulatory system to support responsible development
- Strong capabilities required to successfully design and operate large RAS operations
- Long-term and patient investors are required
- Few people in Maine with a track-record in commercial RAS production
- Scale is needed to succeed financially
- Maine should set strict standards to develop “best in class” industry
THANK YOU

NORDIC AQUAFARMS
SUSTAINABLE AQUACULTURE
Fish Out of Water: Land-Based Aquaculture in Maine

Platinum Sponsor

GOLD SPONSORS

SILVER SPONSORS
Thank you to E2Tech’s Top Sustaining Partners!

SUSTAINING CHAMPION

BURNS MCDONNELL

Sustaining Leader

BERNSTEIN SHUR