Aquaculture in Atlantic Canada

Peter Warris
R&D Coordinator

Prince Edward Island
AQUACULTURE
ALLIANCE
Aquaculture is probably the fastest growing food production system in the world \textit{(FAO)}

Aquaculture produces nearly 50\% of global aquatic food production \textit{(FAO)}

Aquaculture accounts for 14\% of total seafood production (volume) and 35\% of its value in Canada \textit{(DFO-2009)}
Cultured Species in Atlantic Canada

- **Shellfish**
  - Blue mussel (*Mytilus edulis*)
  - Eastern oyster (*Crassostrea virginica*)
  - Other species (clams, scallops)

- **Finfish**
  - Atlantic salmon (*Salmo salar*)
  - Rainbow trout (*Oncorhynchus mykiss*)
  - Atlantic halibut (*Hippoglossus hippoglossus*)
  - Other species (Char, Cod)

- **Aquatic Plants**
Mussel Culture History

- Blue mussels have been harvested for centuries, shells have been found in kitchen refuse dated at 6000 B.C.
- In France, mussel aquaculture dates back to as early as the 13th century using wooden poles called "bouchots"
- In the 1970s the new development of using suspended culture (long lines) was introduced
- Mussels are now Canada’s most valuable cultured shellfish species
Blue Mussels (*Mytilus edulis*) have a high tolerance for varying environmental conditions and therefore a wide distribution:

- Salinity (estuarine areas to full seawater)
- Desiccation (high intertidal to sub-tidal)
- Temperature (nominal 5-20 °C, can withstand freezing temperatures for several months and an upper level of 29 °C for adults)
Basic Biology

- Mussels begin spawning when the water reaches about 15°C
- High fecundity (during spawning a female can release between 3 - 20 million eggs) and a mobile free living larval phase
- After about 15-35 days (depending upon environmental conditions) they settle on a solid surface
- Attach by byssal threads secreted by a gland in the foot
- Juveniles with a hard shell are known as “spat” or “mussel seed”
Seed Collection

- Natural mussel seed is collected from the open water
- Seed collectors are made from lengths of used rope
- These are attached to a backline and weighted to keep them suspended vertically in the water
- Larvae settle on these collectors and grow rapidly, reaching 1 to 2.5 centimetres by fall
Grading and Socking

- Mussel seed is stripped from the collectors in the fall
- Using specialized equipment it is graded (cleaned and sorted) into different size classes
- Socking is the process of loading seed mussels into mesh socks
- A sock is a long mesh tube about 4 cm in diameter
- Socks can be made of a variety of materials with a wide range of mesh sizes
Grow Out

- The suspended long-line system is the culture method used for mussels throughout PEI.
- Continuous socking is another system used in Nova Scotia and Newfoundland.
- The line is held near the surface by buoys and anchored at each end by cement or screw anchors.
- An anchor line runs to a surface marker buoy which enables growers to identify and locate the line.
Harvest

- After 12 to 18 months of growing in the sock, the mussels are ready to be harvested.
- Market size mussels will be 6 - 7 centimetres.
- In the summer months harvesting is carried out using boats.
- In the winter, on PEI particularly, long-lines are winched through holes cut in the ice and the mussels are hauled to shore on sleighs.
Oyster Culture History

- Oysters were likely the first sea animal transported from one area to another and cultivated as food; artificial oyster beds are mentioned in 95BC.
- Oyster production has been part of the region’s seafood industry since 1865 when individuals were licensed to lease specific areas of water to bottom-cultivate oysters.
- Oyster landings can include both cultured and public fishery harvest.
Atlantic Oysters (Crassotrea virginica) tolerate a wide natural variation in:

- Salinity (estuarine areas to full seawater)
- Temperature - Oysters from different areas have different requirements related to their history. Reported natural temperature limits for the eastern oyster are -2 to 36°C
- Suspended sediments
- Dissolved oxygen
Basic Biology

- Oysters are either male or female (but can change over their life span)
- Spawning begins when water temperature rises above 20°C
- The larvae begins to form a shell after 24 hours
- After feeding and drifting for up to 3 weeks the larvae attach to suitable surface with a cement like adhesive
Seed Collection

- Collectors coated in cement (cultch) are put out in selected areas
- Various styles are used: Chinese hats, pipe and tiles
- Seed can also be produced by land based hatcheries, something that is currently more common for the eastern US industry
Thrashing & Grading

- By fall, the seed will have grown large enough to be removed from the collectors (thrashing).
- Throughout the next year the oyster seed is graded and the densities in the bags are reduced to prevent overcrowding.
Grow Out

- Oyster culture leases are designated either bottom or off-bottom
- Bottom cultured oysters are placed directly on the bottom
- Off bottom growers can use a variety of methods to hold oysters suspended in the water column
- These include rack & bag, French tables, floating bags and cages
After approximately three to four years the oysters are ready to be harvested
- Bottom cultured oysters are tonged up, similarly to the wild fishery
- Mechanical harvesters can also be used
Fish have been raised in captivity for thousands of years, possibly since 2000 BC.

475 BC, in China Fan Lai wrote “The Classics of Fish Culture”.

Aquaculture in Canada dates back to 1857 when the first Superintendent of Fisheries in Lower Canada studied the incubation and hatching of Atlantic salmon and brook trout eggs.
Basic Biology

- Oxygen requirements depend on the species but the minimum is generally considered 5mg/l
- Optimal grow out temperatures
  - Trout - 16°C
  - Arctic char – 10-14°C
  - Salmon - 14-18°C
  - Atlantic halibut 3-13°C
Cultured Atlantic Salmon

- Canada is the fourth-largest producer of farmed salmon in the world.
- Atlantic salmon is Canada’s top aquaculture export (BC, NB, NF and NS)
- On PEI Atlantic salmon eggs and juveniles are exported for grow out across Atlantic Canada from land-based hatcheries
Farmed Atlantic Salmon Life Cycle

- **Eggs** - 40 days to hatch
- **Spawning** - Oct - Dec
- **Sac fry** - 25 days to first feeding
- **Fry / parr**
- **Smolt** - 12 - 18 months from egg
- **Market** - 3-4 years from egg
- **Eggs** - 4+ years from egg
- **Market** - 4+ years from egg
- **Market** - 3-4 years from egg

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Smolt Transfer
Rainbow Trout

- Rainbow trout are the most common freshwater fish farmed in Canada.
- Rainbow trout that spend part of their life at sea or are farmed in saltwater are referred to as Steelhead trout.
- On PEI imported trout eggs are hatched and reared to juveniles.
- Once ready they are exported to sea cage sites in Atlantic Canada.
Halibut culture has been developing and expanding in Atlantic Canada over the last decade.
- Wild stocks are in global decline.
- On PEI they are grown on land using salt water wells, in NS they are reared in open net pens as well.
Statistics

- New Brunswick
- Nova Scotia
  + http://novascotia.ca/fish/
- Newfoundland
  + http://www.fishaq.gov.nl.ca/stats/index.html
- PEI
- Canada
  + www.dfo-mpo.gc.ca/aquaculture/sector-sector/sector-secteur/index-eng.htm
Impact of the Environment

- The majority of aquaculture takes place in the open environment.
- Except for land based hatcheries and grow-out operations aquaculture is 100% dependent on the environment, there is no method that can regulate it.
- Shellfish feed only on the naturally occurring organisms, therefore shellfish farmers depend on clean, nutrient-rich waters.
- Any change to this environment will have an immediate impact on the industry.
Potential examples

- **Rainfall**
  - Increased run off
  - Water quality closures
  - Siltation
  - Anoxic conditions

- **Storms**
  - Access to product
  - Lease infrastructure damage
  - Shore based facilities
  - Harbours

- **pH / acidification**
  - Shellfish seed survival
  - Growth rates
  - Food availability
  - Stress on product

- **Water temperature**
  - Unpredictable ice conditions
  - Growth rates
  - Spawning times
  - Disease / pest / predator
Thank you for your attention. Any questions?