Development and Expansion of Marine Aquaculture in North Carolina: Challenges and Opportunities
Aquaculture in North Carolina

✓ 15th most productive state in US
✓ Farm gate value = $60 million
✓ Very diverse industry, mainly freshwater
✓ Rainbow trout, hybrid striped bass, catfish, tilapia

✓ Significant room for growth in marine sector
Marine Aquaculture in North Carolina

Soft shell crabs (2.25 million)

Clams (300 K)

Oysters (479 K)

Finfish and additional crops (< 100 K)
Soft shell blue crabs, *Callinectes sapidus*
2015 North Carolina Blue Crab Shedding Industry Status Permits

268 permits (+ 0.0%)
2015 NC Blue Crab Shedding Permits by County
2015 North Carolina Blue Crab Shedding Industry Status
Production and Farm-Gate Value

380,375 lbs (+ 3.6%)  $2.25 mill (+ 5.1%)

Production (1,000lbs)

Value ($ million)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (1,000lbs)</th>
<th>Value ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>446.4</td>
<td>2.08</td>
</tr>
<tr>
<td>2012</td>
<td>325.4</td>
<td>1.50</td>
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<tr>
<td>2013</td>
<td>317.4</td>
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<tr>
<td>2014</td>
<td>367.3</td>
<td>2.14</td>
</tr>
<tr>
<td>2015</td>
<td>380.4</td>
<td>2.25</td>
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Soft shell blue crabs

- Crabs collected from wild
- Held in shedding tanks or trays
- Shed or molted crabs removed before hardening

Crab shedding tanks

Blue crab before molting

Molting crab

End product
Pros
✓ Established high end market
✓ Minimal land/space required
✓ Minimal production time

Cons
✓ Dependent on wild harvest
✓ Extremely seasonal
✓ Very labor intensive
Increasing use of recirculating aquaculture systems

Mortality events

Interest in hatchery and nursery production of peeler crabs

Alternate crops for off-season production
Finfish and additional crops

- Finfish for food, bait, ornamentals
- Superintensive shrimp production
- Marine invertebrates (e.g. sea urchins)
- Marine plants and seaweeds
- All in R&D stage
Pros
✓ Potential niche market capture
✓ Significant growth potential
✓ Ability to locate inland with RAS
✓ “When, not if”

Cons
✓ Database limited
✓ High cost of operation, esp. RAS
✓ Limited use of existing natural resources
✓ Competition with wild caught product
✓ Discharge restrictions and concerns
Hard clams
*Mercenaria mercinaria*

Eastern oysters
*Crassostrea virginica*
2015 North Carolina Shellfish Aquaculture Status
Leases and Acreage

266 Leases (+ 14.2%)  1,835 Acres (+ 6.2%)
2015 NC Shellfish Aquaculture Leases and Acreage by County
2015 North Carolina Shellfish Aquaculture Status
Clam Production and Farm-Gate Value

2015 = 3,286 Bushels (-16.9%)  $299,906 (+34.4%)
2015 North Carolina Shellfish Aquaculture Status
Oyster Production and Farm-Gate Value

2015 = 27,604 Bushels (+ 30.5%)  $478,856 (+ 6.5%)

Production (bushels)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
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<tbody>
<tr>
<td>2011</td>
<td>11,494</td>
</tr>
<tr>
<td>2012</td>
<td>8,950</td>
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<tr>
<td>2013</td>
<td>14,489</td>
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<tr>
<td>2014</td>
<td>21,157</td>
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<tr>
<td>2015</td>
<td>27,604</td>
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Value (1,000$)

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>332.6</td>
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<tr>
<td>2012</td>
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<tr>
<td>2013</td>
<td>310.0</td>
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<tr>
<td>2014</td>
<td>449.5</td>
</tr>
<tr>
<td>2015</td>
<td>478.9</td>
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</tbody>
</table>
## 2015 Farm Gate Shellfish Value (millions USD)

<table>
<thead>
<tr>
<th></th>
<th>North Carolina</th>
<th>Virginia</th>
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</thead>
<tbody>
<tr>
<td>Clams</td>
<td>0.30</td>
<td>32.3</td>
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<tr>
<td>Oysters</td>
<td>0.48</td>
<td>16.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.78</strong></td>
<td><strong>48.3</strong></td>
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Shellfish Aquaculture by State percent of total East Coast $156 million farm gate
Why the great potential?

Natural Resources and Markets
There are 3 phases of shellfish aquaculture:

- Hatchery
- Nursery
- Growout

In NC most growers buy advanced seed and bypass the hatchery and initial nursery phases.
Hatchery phase

Broodstock spawning

- Broodstock induced to spawn
- Eggs hatch and larvae fed cultured algae
- Larvae sieved and restocked regularly
- Very labor intensive and specialized skills involved

Algae culture

Larval tanks

Veliger stage

Sieving larvae
Setting

“eyed” pediveliger larvae ready to set

✓ Setting = free swimming to sedentary life
✓ Clam larvae don’t require substrate
✓ Oyster larvae can be set on shell/other substrate for clump oysters
OR set on microculch for single seed

1.5 million late stage oyster larvae

Spat on Shell

Single Spat
Nursery phase

- Clam spat and single spat oysters raised using land based or floating upweller systems
- When of appropriate size, seed are ready for planting/stocking
- Spat on shell/substrate oysters planted about a week after setting
Growout phase - clams

- Seed stocked into mesh bags on bottom or directly on bottom and covered with protective netting
- About two years required to produce 2” market clam
- Marketed whole, some interest in value added
Oyster growout: bottom culture

- Spat on shell/substrate stocked directly on bottom
- One to three years to market
- Harvested by dredging primarily for shucked market

Clumped oysters produced by bottom culture

Oyster spat attached to adult oyster shell 15 months later

Oyster dredging

Shucked meats
Oyster growout: water column culture

- Allows production of single oysters for half shell market
- Seed stocked into various off bottom, floating, or suspended gear types, culled and graded regularly to adjust density
- Harvest at one to two years

Floating bags

Off bottom cage

Longline culture system
Increased number of leases and acreage devoted to water column leases

2015 – 35 leases (+ 6.1%)
110 acres (+ 8.9%)
Pros
✓ Established high end market
✓ Niche marketing available for half shell oysters
✓ No to minimal land required
✓ Relatively low operating costs

Cons
✓ Initial investment (gear)
✓ First crop(s) not immediate
✓ Vulnerable to loss from storms and poaching
✓ Labor and management critical
Benefits of shellfish aquaculture

✓ Creates jobs and economic opportunities for coastal communities
✓ Produces high quality, locally sourced seafood
✓ Shellfish filter the water improving its quality
✓ Shellfish farms attract and provide habitat for sea life
Efficient siting and leasing
Minimizing user conflict
Public awareness
Increasing production efficiencies, BMP development
Genetic improvement, strain development
Disease monitoring
Market expansion
2015 Shellfish Aquaculture Legislation

- Increased research and outreach
- Demonstration hatchery/nursery facility
- Increased disease surveillance
- Increased penalties for shellfish theft/poaching
- Enhanced lease program
Upcoming Legislation

✓ Core Sound and Brunswick County
Expansion and Diversification of the North Carolina Shellfish Aquaculture Industry

Aquaculture Extension and Technology Transfer Program

- Establish shellfish aquaculture demonstration centers
- Evaluate culture gear types and oyster strains
- Explore new species for culture
- Shellfish market demand and product development
Bogue Sound
Assessment of current production practices and economics of the developing North Carolina oyster aquaculture industry
Evaluation of methods to control biofouling

Multi-state project (LA, MS, AL, FL, SC, NC)
Links

NC Sea Grant – marine aquaculture page: https://ncseagrant.ncsu.edu/aquaculture/

North Carolina Shellfish Growers Association http://www.ncshellfish.org/

East Coast Shellfish Growers Association http://www.ecsga.org/

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