

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





# Aquaculture in North Carolina

- ✓ 15<sup>th</sup> 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

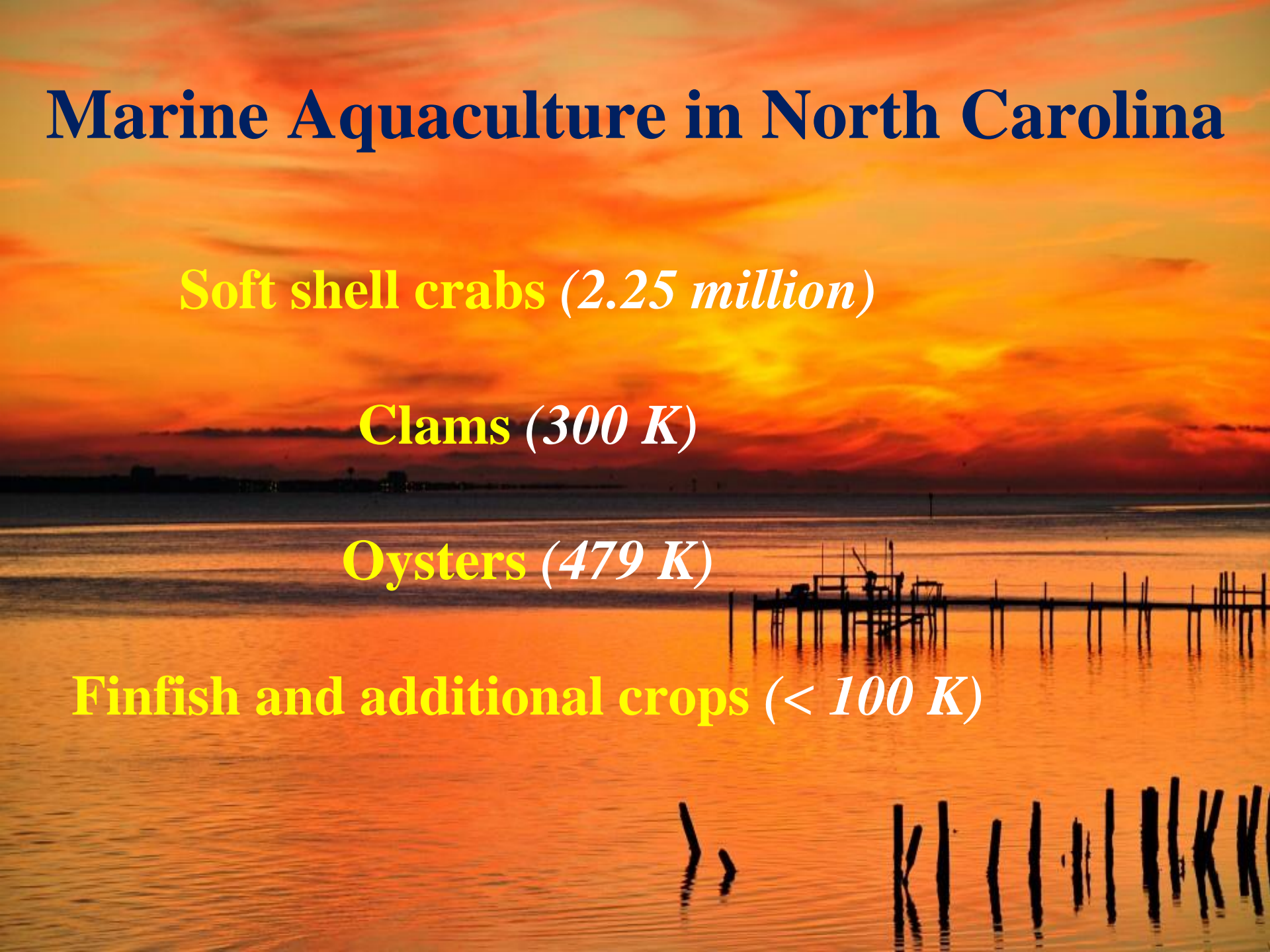
# Marine Aquaculture in North Carolina

**Soft shell crabs** (*2.25 million*)

**Clams** (*300 K*)

**Oysters** (*479 K*)

**Finfish and additional crops** (*< 100 K*)





**Soft shell blue crabs, *Callinectes sapidus***

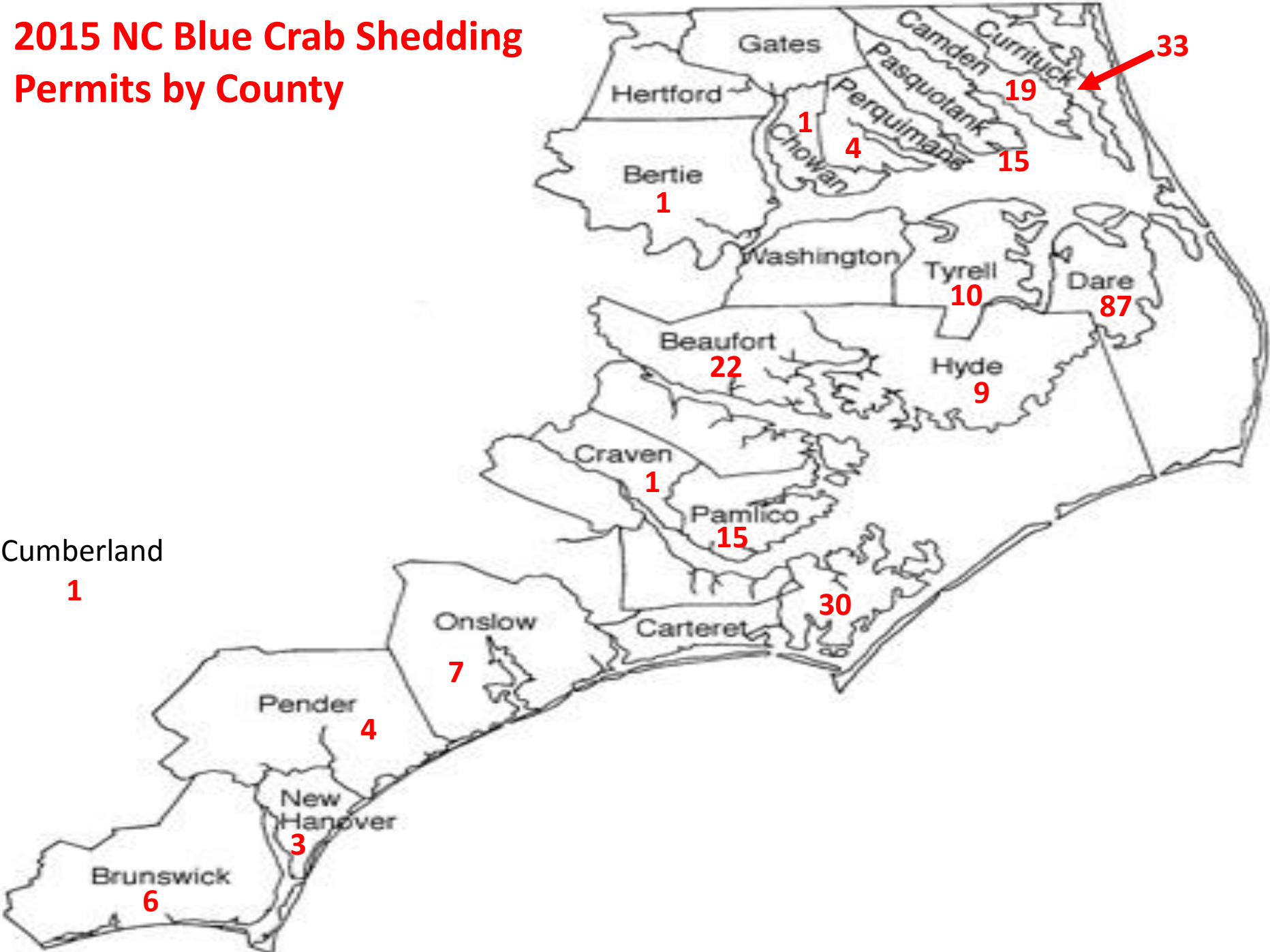


## 2015 North Carolina Blue Crab Shedding Industry Status Permits

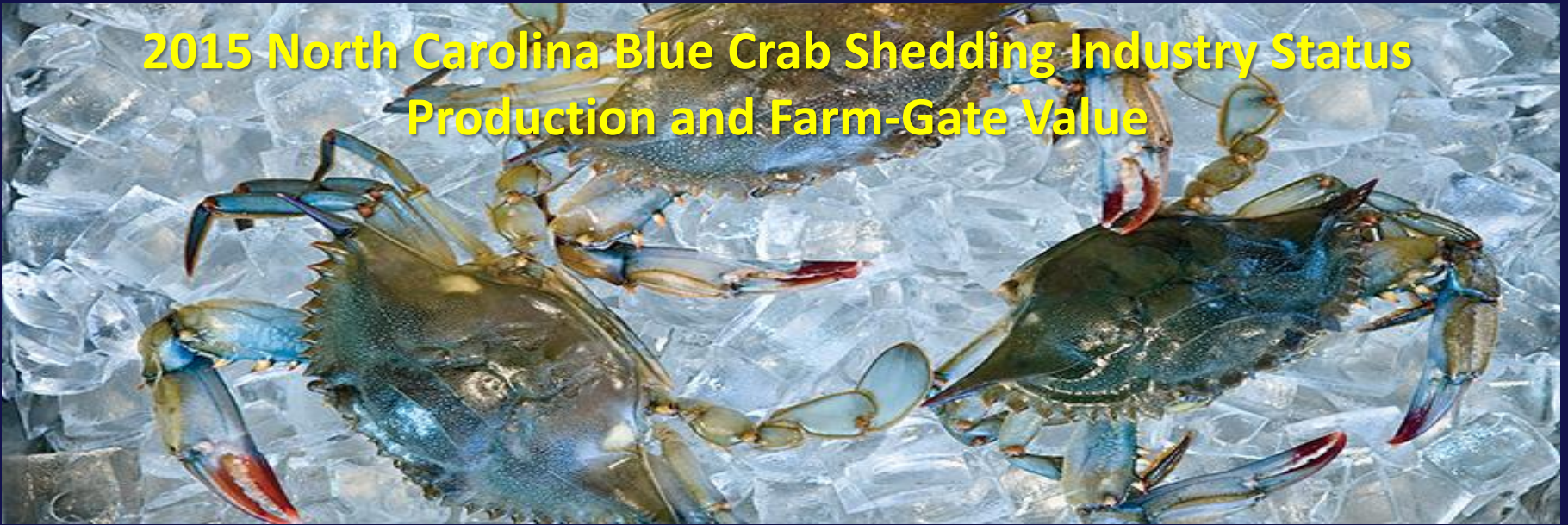
268 permits (+ 0.0%)



# 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)



# 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



Aquacultured black sea bass



Recirculating aquaculture facility



Seaweed aquaculture



## 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

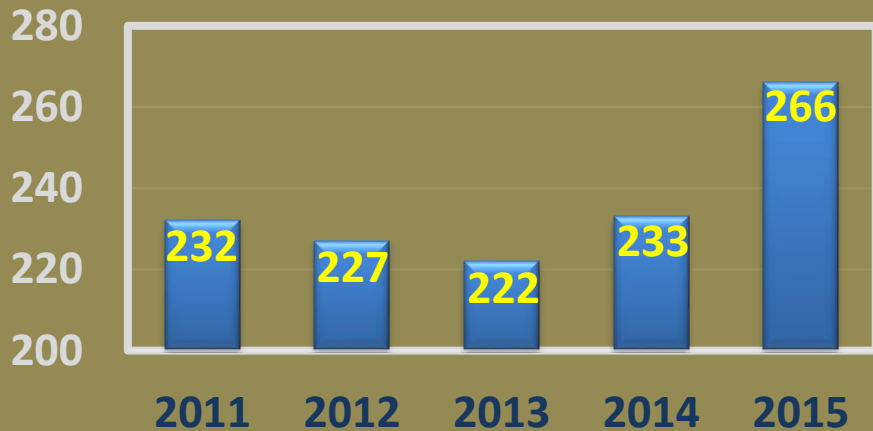
## Leases and Acreage



**266 Leases (+ 14.2%)**

**1,835 Acres (+ 6.2%)**

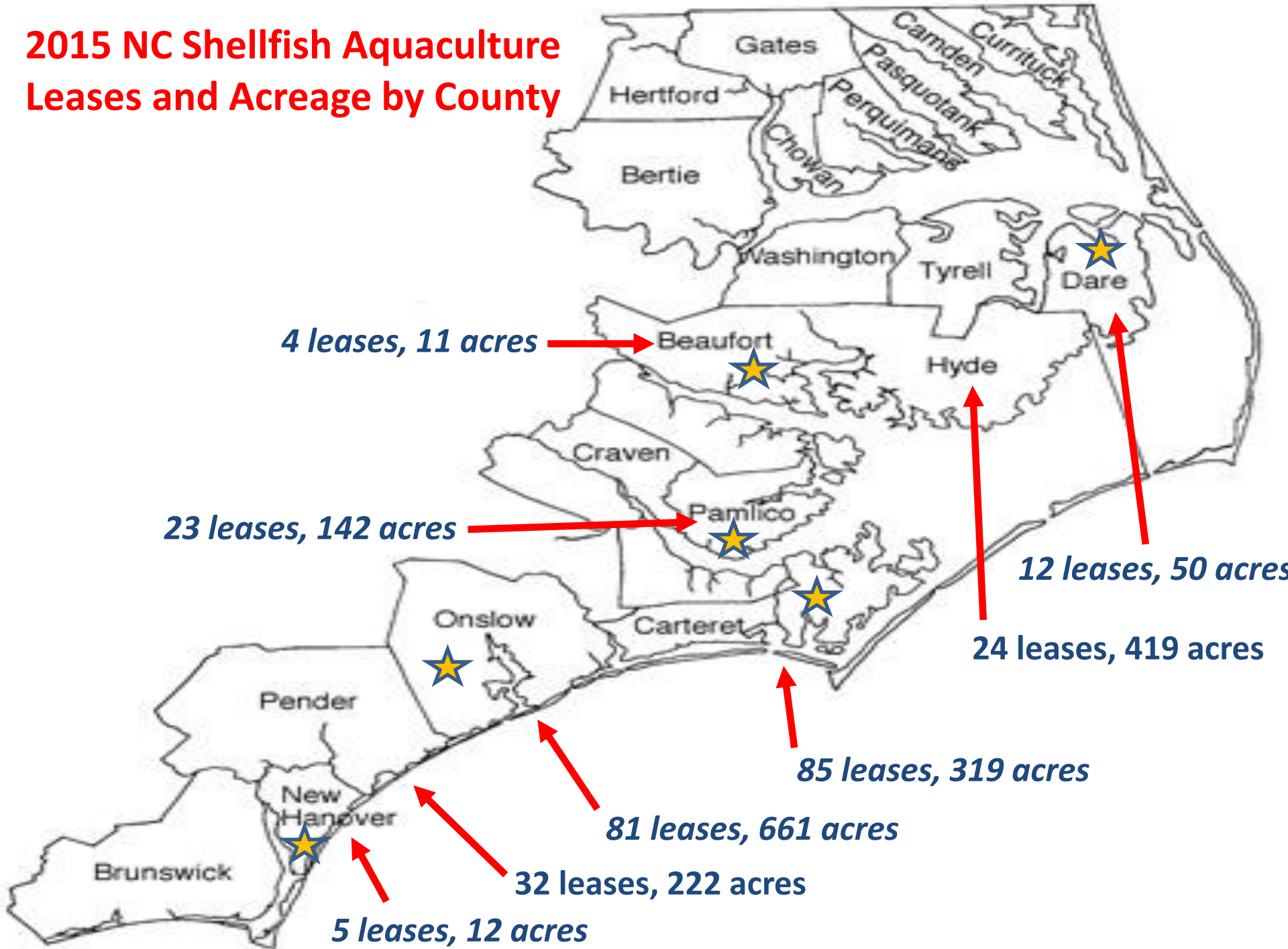
### Leases



### Acreage



# 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%)

### Production (bushels)



### Value (1,000\$)





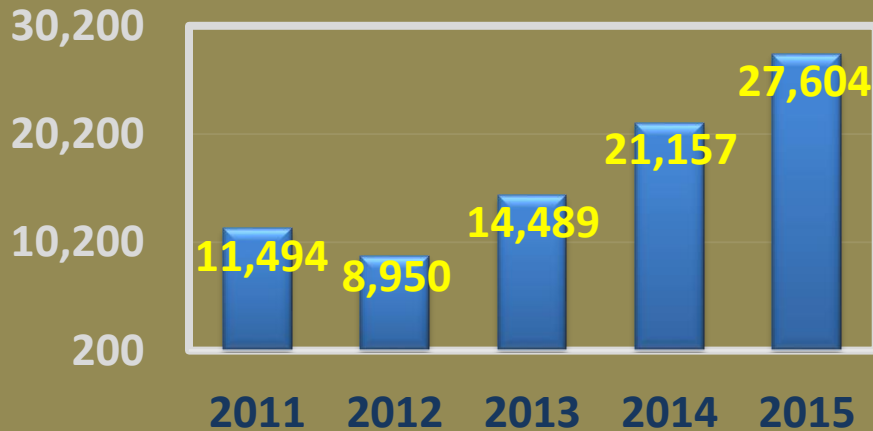
# 2015 North Carolina Shellfish Aquaculture Status

## Oyster Production and Farm-Gate Value

**2015 = 27,604 Bushels (+ 30.5%)**

**\$478,856 (+ 6.5%)**

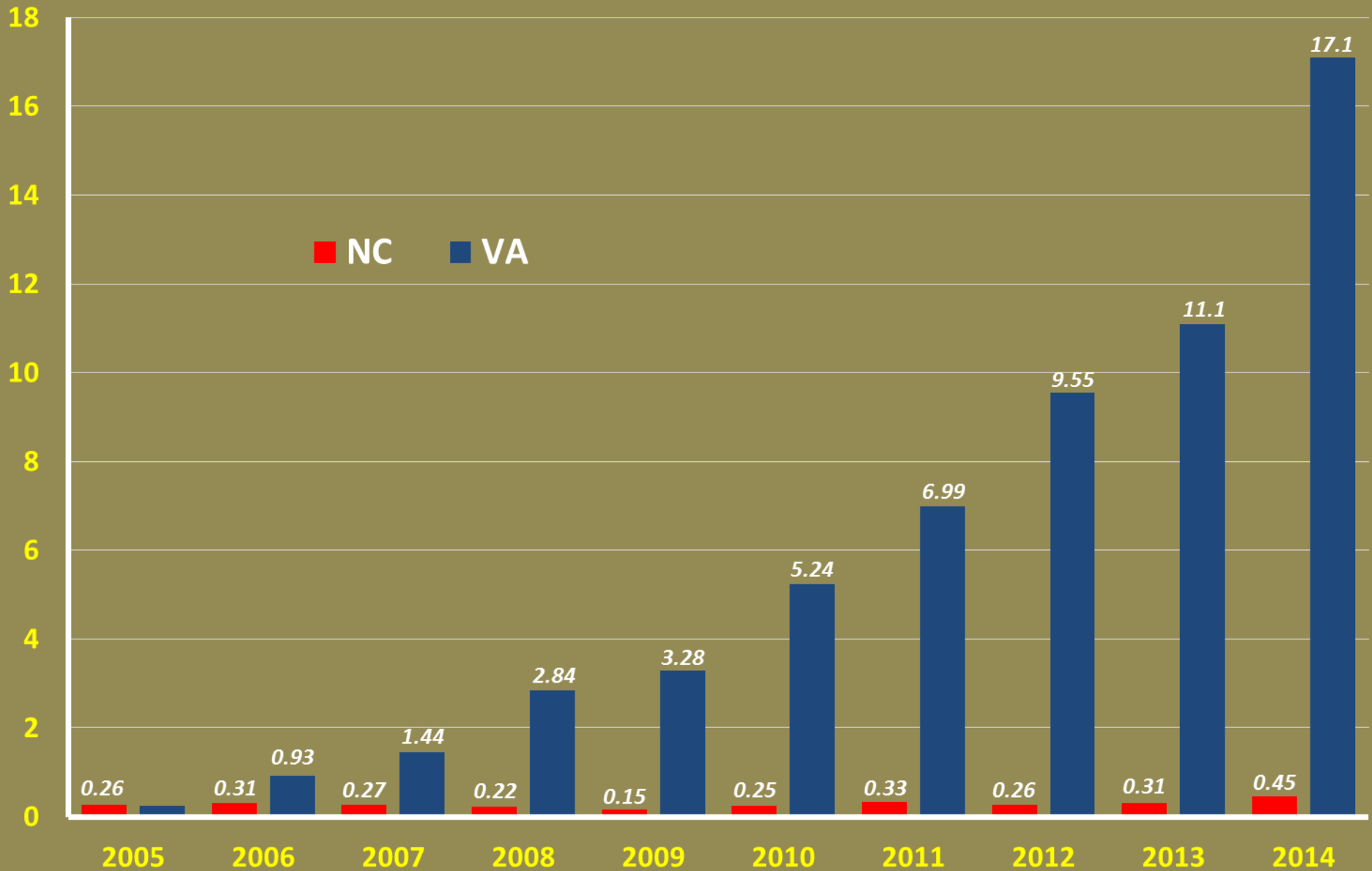
### Production (bushels)



### Value (1,000\$)



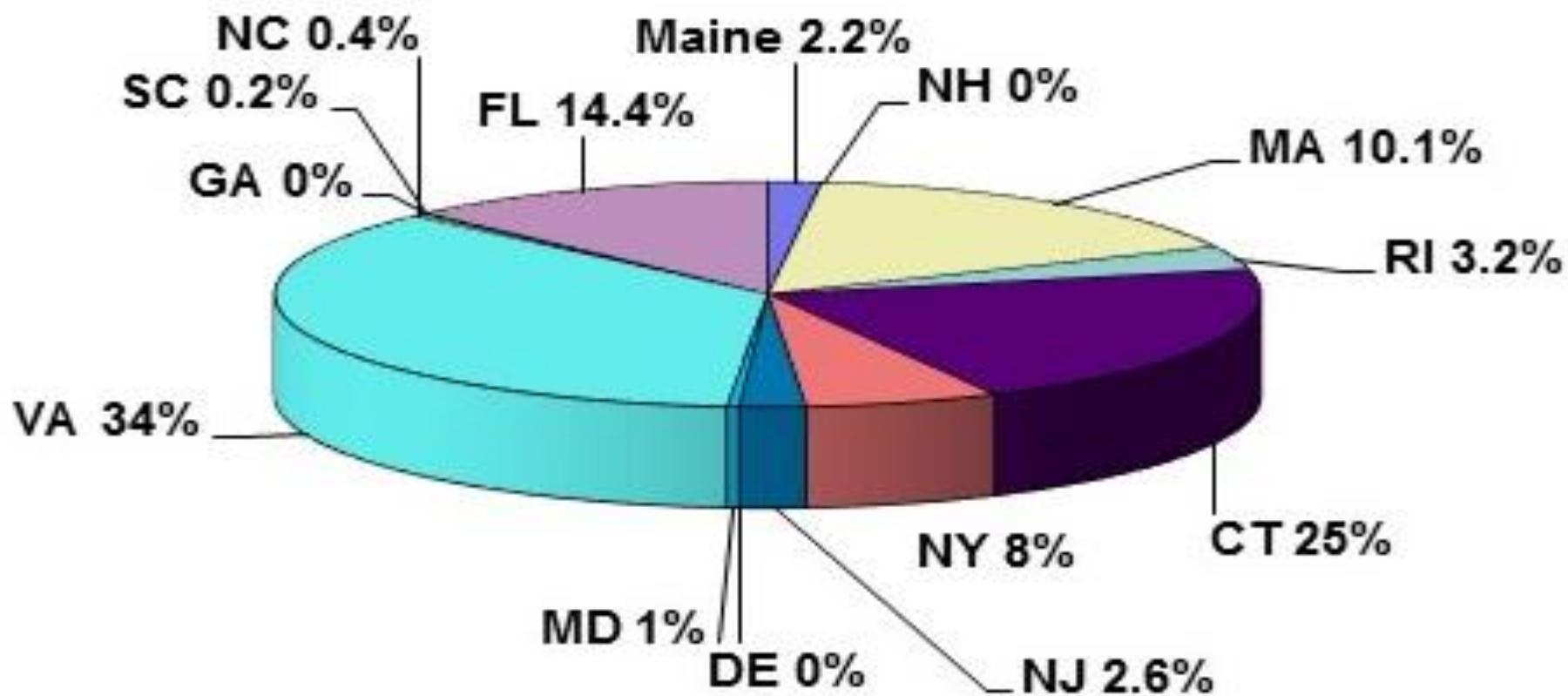
# Farm Gate Oyster Value (millions USD)



# 2015 Farm Gate Shellfish Value (millions USD)

	North Carolina	Virginia
Clams	0.30	32.3
Oysters	0.48	16.0
Total	0.78	48.3

**Shellfish Aquaculture by State**  
**percent of total East Coast**  
**\$156 million farm gate**



# Why the great potential?

## *Natural Resources and Markets*



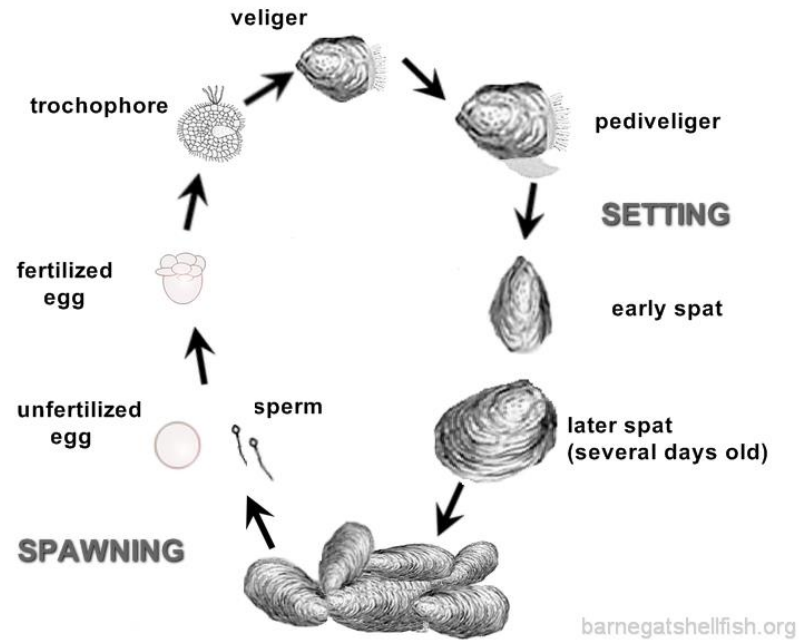
# There are 3 phases of shellfish aquaculture

- ✓ Hatchery
- ✓ Nursery
- ✓ Growout

*In NC most growers buy advanced seed and bypass the hatchery and initial nursery phases*

# Hatchery phase

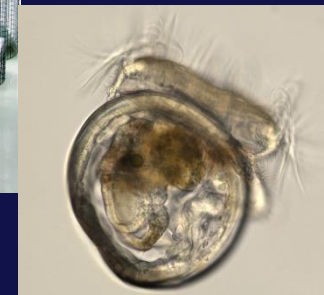
## Broodstock spawning



## Algae culture



## Larval tanks



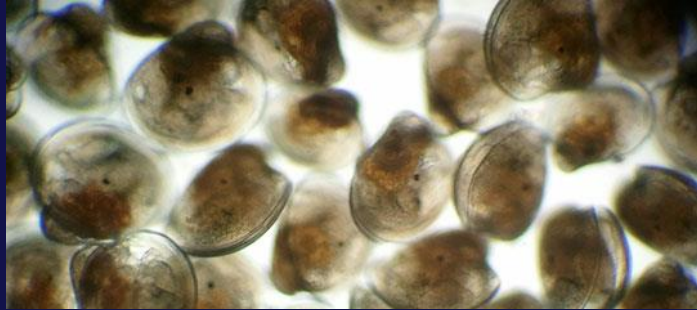
## Veliger stage



## Sieving larvae

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

# Setting



“eyed” pediveliger larvae ready to set

1.5 million late stage oyster larvae



- ✓ 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 microcultch for single seed



# 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



Upweller tanks



Oyster seed ready for growout phase

# 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

Stocking seed clams



Clam lease with mesh bags on bottom



Predator netting at low tide



# 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



Oyster spat attached to adult oyster shell

15 months later

**Clumped oysters produced by bottom culture**



**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



Off bottom cage



Floating bags



Longline culture system

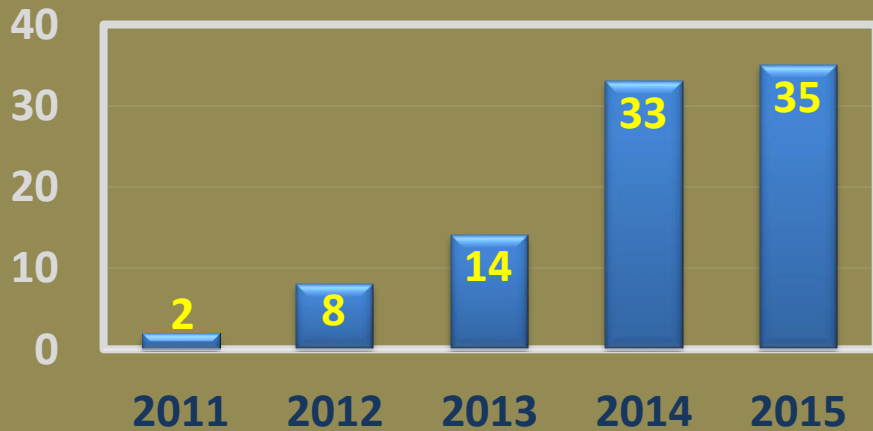


# Increased number of leases and acreage devoted to water column leases

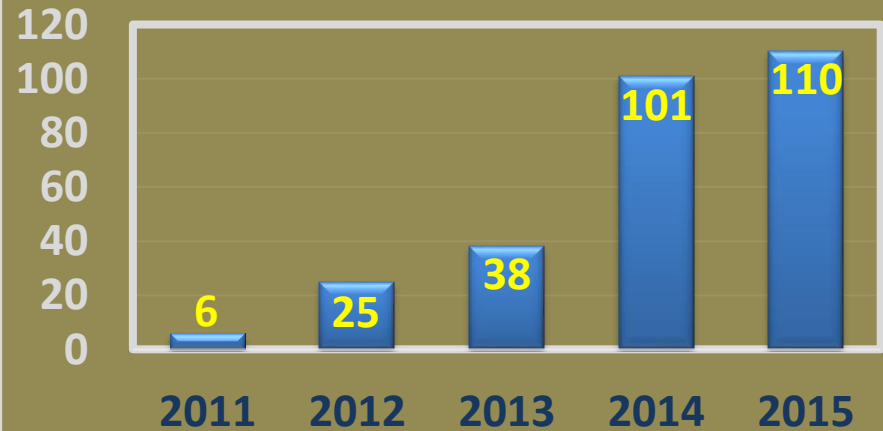
2015 – 35 leases (+ 6.1%)  
110 acres (+ 8.9%)



## Water column leases



## Water column acreage





## 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**



***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://ncseagrants.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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