Clam Hybrids

Evaluation of stock hybridization to improve clam production in Florida

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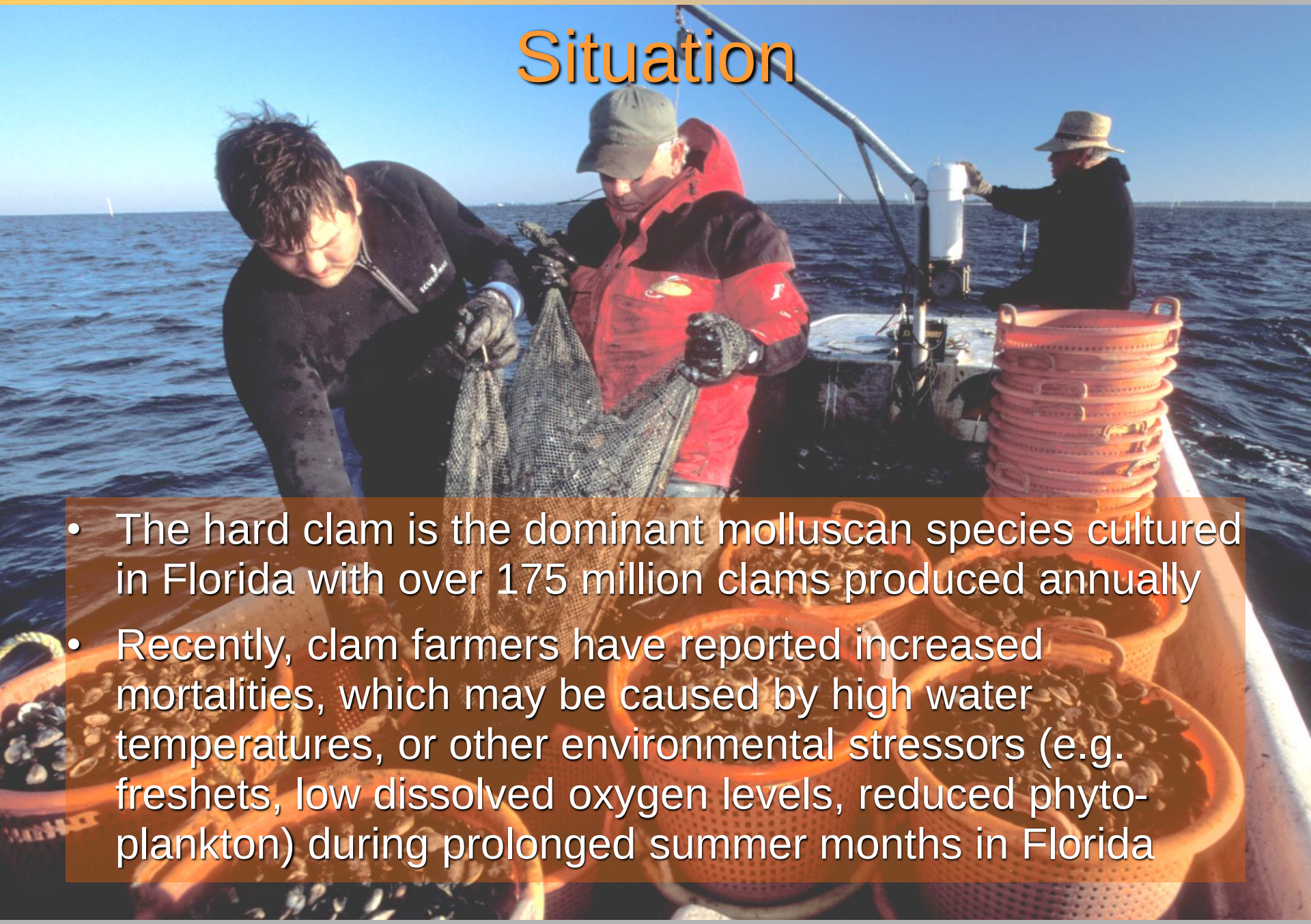
Sea Grant
Florida

Situation



- The hard clam is the dominant molluscan species cultured in Florida with over 175 million clams produced annually
- Recently, clam farmers have reported increased mortalities, which may be caused by high water temperatures, or other environmental stressors (e.g. freshets, low dissolved oxygen levels, reduced phyto-plankton) during prolonged summer months in Florida

Photo Courtesy: Carlton Ward, Jr., LINC Foundation

What is Hybridization?

- Hybridization is a breeding technique used in commercial agriculture and finfish aquaculture
- Hybrids have superior traits to either parent species, ie. improved growth or environmental resistance
- The use of clam hybridization for “mariculture” potential was examined by Winston Menzel at Florida State University in the 1960-70s
  - Showed hybrids had superior commercial traits to either parent species, ie. growth, shelf life
  - Little data reported on merit of hybrids for improved survival

Clam Species

- The northern hard clam supports fisheries and aquaculture industries along the Atlantic coast from Massachusetts to Florida
- The southern quahog found from North Carolina to the Caribbean is only recreationally fished
- *Mercenaria* species are normally separated by environmental tolerances, but readily hybridize where they do co-occur or under hatchery conditions

Northern hard clam
Mercenaria mercenaria

Southern quahog
Mercenaria campechiensis

Project Rationale

- Southern quahogs may have production traits for resisting environmental stressors
- However, southern quahogs are not cultured because of their tendency to gape in refrigerated storage
- Funds obtained through USDA CSREES Special Research Grants Program allows for a rigorous examination of clam hybridization
  - To improve production
  - To assure product quality

Project Objectives

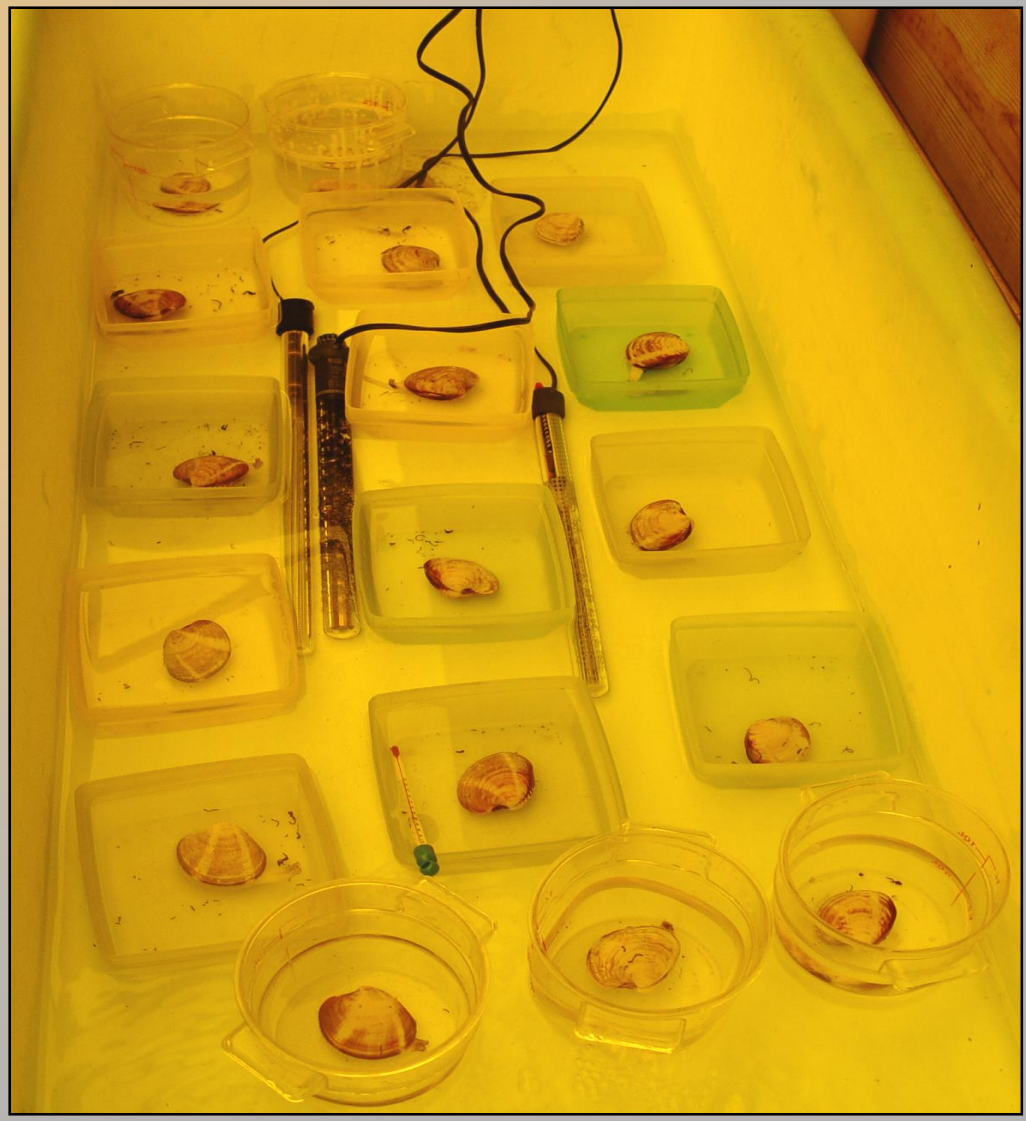
- Produce multiple families of hard clams, southern quahog clams, and their reciprocal hybrids
- Grow under commercial field conditions
- Compare production performance at several stocking densities, site locations, and growout methods

Hybrid seed, *M.c. x M.m.*

- Document shelf life (survival of stocks in refrigerated storage)
- Compare responses of these clams to controlled laboratory environmental challenges

Hatchery Production

- Northern hard clams obtained from a Florida hatchery
- Southern quahogs obtained from the wild (Sarasota), where highly pure populations are know to exist
- Clams spawned by thermal stimulation
- Single parent crosses utilized



Hatchery Production

- Difficult to have spawns occur at same time
- Five spawns accomplished with different sets of parents, October-December, 2007
- Differences in fertilization between hybrids noticed

Hatchery Production

Larval culture, setting, and post-set rearing performed using standard hard clam culture protocols

Hatchery Production

Parental shells (left) and resulting post-set juveniles from 10.24.07 spawn (right). Crosses are listed female by male.

Genetic Analysis

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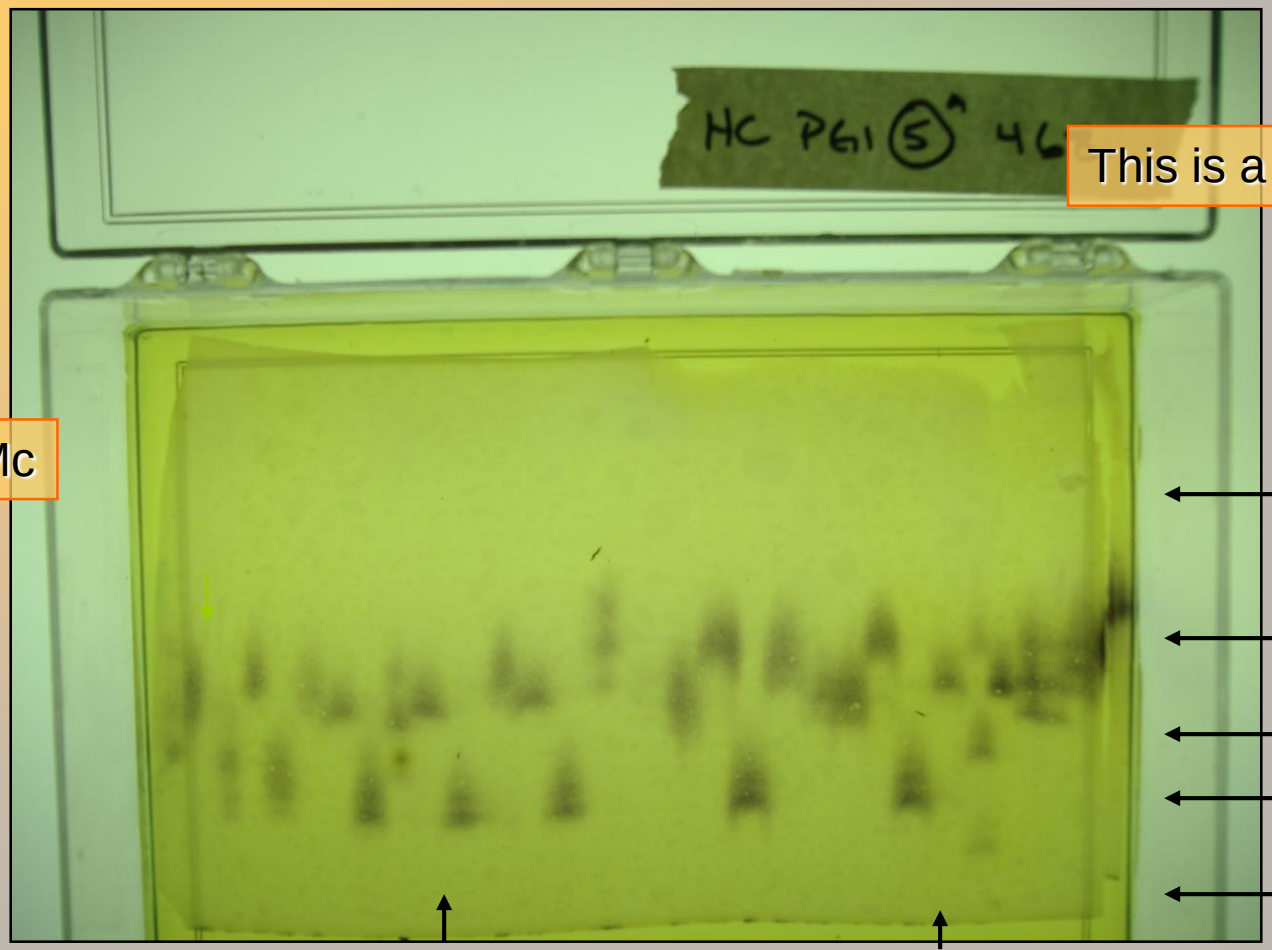

This is a 130:120 = Mc

120:120 = Mc

130
120
110
100
95

These two are 100:100 = Mm

125:95 = unusual hybrid

Starch gel of PGI exhibiting allozyme differences between Northern and Southern hard clams.

Genetic Analysis

- FWC Results

Nursing Hybrid Seed

- Standard hard clam protocols used
- Land-based nursing
  - Downwellers
  - March-June 2008
  - Cedar Key
- Field nursing
  - Bottom bags, 4mm
  - June–September 2008
  - Cedar Key

Nursing Hybrid Seed

- Growth differences negligible, data not compiled
- Differences in survival, not statistical analyzed
- About 600,000 seed from three families nursed for growout evaluation

Stock	Survival (%)
Mm x Mm	73 ± 8
Mm x Mc	82 ± 14
Mc x Mm	79 ± 9
Mc x Mc	74 ± 11


Mm x Mm


Mm x Mc


GROUP 3 5.19.08
Mc x Mm


Mc x Mc

Growout Trials

- Stock Comparison
- Replicated plants - Parental stocks and reciprocal crosses from 3 families
  - Cedar Key
  - Sept 2008-Sept 2009
- Standard planting procedures
  - Bottom bags, 9 mm
  - Net coated and covered with wire
  - Stocked at 1150/bag (72/ft^2)

Growout Trials

- Stocking Density Comparison
  - Parental stocks and reciprocal crosses from 1 family
    - Cedar Key
    - Sept 2008-Sept 2009
  - Bottom bags stocked at
    - 960/bag (60/ft$^{2)}$
    - 1150/bag (72/ft^2)
    - 1360/bag (85/ft^2)
- Site Comparison
  - Multiple commercial leases
  - Cedar Key
  - SW Florida
- Gear Comparison
  - Bottom bag
  - Bottom plant

Comparison of Production Characteristics

- Sampling every 4 months and at harvest (12 months)
- Growth – SL, SW, total and meat weight
- Survival
- Condition index – measure of degree of fattening or nutritive status
- Histology – determine gonadal stage and reproductive potential

Product Quality

- Document shelf life
  - Survival in refrigerated storage (45ºF)

- Market acceptance
  - Appearance
  - Taste

Laboratory Experiments

- Laboratory challenges conducted under controlled conditions
  - Water temperature - 88 ºF
  - Salinity - 15 and 25 ppt
  - Oxygen - normoxia and hypoxia
  - Clam size - 15-20 mm SL seed and littleneck
- Scope-for-growth
  - Measure oxygen uptake
  - Determine energy budget

What's Next?

- Preliminary information available at Fall 2009 Clam Industry Workshop
- Back cross F1 hybrids with hard clams, 2009-10
  - Evaluate under commercial conditions and laboratory challenges