Clam Aquaculture for New Growers

The Basics of Buying, Handling and Planting Clam Seed

- Certification and Best Management Practices for seed
- Lease markers and boat requirements
  - Clam seed suppliers
- Basic seed descriptors – sieve sizes, lengths, volumes
  - How to transport and handle seed
  - Water conditions at lease sites
  - Clam bag sizes and suppliers
- Stocking rates for nursery and growout seed
- Planting strategies and growth rates
- Survival and additional predator protection
  - Other considerations

Updated August 2014
Aquaculture Certification
“AQ” Card

- Obtained from Department of Agriculture and Consumer Services (DACS), Division of Aquaculture
- Any person engaged in aquaculture required to obtain aquaculture certification ("AQ" card)
- Identifies the aquaculturist, lease, product and facility
- Authorized user agreement for sharecroppers or employees
- Renewed annually
- Cost of $100
- Valid from July 1 to June 30
- Contact DACS for more info at (850) 617-7600
Harvester and Aquaculture Education Training Requirements

• As of January, 2014 the NSSP Model Ordinance was modified to include new food safety training requirements. These changes are outlined in NSSP Guide Section II, Model Ordinance Chapter X.

• Under the new mandate, shellfish lease holders, authorized users, water lease workers or shellfish harvesters are required to obtain approved training on processing, handling, and transportation practices prior to certification or recertification.

• No aquaculture certificate will be issued without proof of training.

• Training must be completed every year.
Best Management Practices
(Excerpted from Florida Aquaculture Policy Act, Chapter 597 F.S.)

- All certified aquaculturists must abide by BMPs
- BMPs are developed for each segment of the aquaculture industry
- BMPs consist of general and specific instructions that address construction, operation and management of an aquaculture facility which results in minimal environmental impacts
- BMPs do not supersede applicable federal or local authorities
- Contact staff at the DACS Division of Aquaculture office in Tallahassee for more info on clam BMPs, Phone: (850) 617-7600, or visit their website http://www.freshfromflorida.com/Divisions-Offices/Aquaculture
Best Management Practices pertaining to Hard Clam Seed Stocks

- **Genetic Protection**
  - Hatchery operators must use hard clam broodstock from Florida waters in their genetic selection program.
  - Documentation of broodstock origin must be obtained by seed buyer.
  - If out-of-state seed is bought, the hatchery must use Florida broodstock.
  - Seed shipped from hatcheries must be in distinct containers with the producers AQ #.
Best Management Practices pertaining to Hard Clam Seed Stocks

Disease Prevention
- Seed imported from out-of-state for aquacultural purposes must be accompanied by documentation from a licensed veterinarian certifying that stocks do not show clinical signs which may pose a threat to natural shellfish populations.
- For clams, stocks must be free of QPX.

Public Health
- Seed clams must be relocated to a growout lease prior to reaching 16 mm in shell length
Aquaculture Lease Markers
(Excerpted from Lease Instrument and Chapter 18-21, F.A.C.)

- **SIGNS**, 3’ by 3’, usually on 6” PVC pipes, mark corners and specific perimeter points in aquaculture use area
  - 2” border and “diamond” symbol using orange reflective tape
  - Contains informative language in 2” black characters on white background

- **POSTS or STAKES**, usually 2” PVC pipe, mark corners of individual parcels
  - Field at least 2 ½” wide by 20” long
  - Band of orange reflective tape above below field
  - 2” black characters for lease number and corner information (NW, NE, SW, SE)
Aquaculture Lease Markers

- HDLA or AUA lease corners and perimeters ("A")
- Lease parcel corners
  - Buoys ("B") or
  - Posts/stakes/PVC Pipes ("C")
Other Aquaculture Info Signs
(Excerpted from Lease Instrument and Chapter 18-21, F.A.C.)

➢ Educational signs
Boat Requirements for Clamming
(Excerpted from Comprehensive Shellfish Control Code, Chapter 5L-1)

- Constructed, operated and maintained to protect clams from contamination
- Fuel tanks or other contamination sources may not come into contact with clams
- False bottoms and bulkheads fore and aft to prevent clams from coming in contact with bilge water
- No dogs or other animals allowed on boat at any time
- Type III marine sanitation device, portable toilet, or other sewage disposal receptacle that will not spill
- Effective shading to protect clams from exposure to sun, birds, and other adverse conditions
U.S. Coast Guard Requirements for Commercial Fishing Vessels (16-26’)

- Boat must be registered commercial and comply with U.S. Coast Guard commercial fishing industry vessels
  - Personal Flotation Devices – Type I, II, III, V
    - One PFD per person on vessel
    - 62 square inches of reflective tape (31 inches$^2$ front & back)
    - Approved PFD light attached to front shoulder area
    - Vessel name or FL number
  - Throwable Flotation Device
    - 1 cushion or a orange 24 inch ring life buoy with 60 feet of line
    - Vessel name or FL number
U.S. Coast Guard Requirements for Commercial Fishing Vessels (16-26’)

- Boat must be registered commercial and comply with U.S. Coast Guard commercial fishing industry vessels
  - Distress Signals
    - Day: one flag or smoke signals or 3 approved flares for both day and night
  - Fire Extinguishers
    - Outboard engine and portable gas tanks: not required
      - 1 B-1 type
    - Sound producing device
  - Marine Safety Office Inspections
    - No charge, receive decal
    - Check with local USCG Marine Safety Officer or USCG Auxiliary
Clam Seed Suppliers

- Check the annual Florida Clam Seed Suppliers List posted at http://shellfish.ifas.ufl.edu

- Check the annual East Coast Shellfish Seed Suppliers List posted at http://www.ecsga.org
How to describe clam seed?

- Sieve size used in size grading (mm)
  - Based on bar mesh
  - 1 inch = 25 mm
How to describe clam seed?

- Volumetric (number/ml)
  - 1000 milliliters (ml) = 1 liter (l)
  - 1 liter = approx. 1 quart

- Sub-sampling / Counting
How to describe clam seed?

- Shell length (mm), longest distance across shell
  Note 1 inch = 25 millimeters (mm)
<table>
<thead>
<tr>
<th>Bag Mesh Size</th>
<th>Sieve Mesh Size (mm)</th>
<th>Seed Size (length, mm)</th>
<th>Seed Count (number/ml)</th>
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<tr>
<td>Nursery (3 mm)</td>
<td>3.3</td>
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<td>15-20</td>
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<tr>
<td>Nursery (4 mm)</td>
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<td>9-12</td>
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<tr>
<td>Growout (9 mm)</td>
<td>7.5</td>
<td>12.0</td>
<td>1-2</td>
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<tr>
<td>Growout (12 mm)</td>
<td>12.0</td>
<td>15.0</td>
<td>0.5-0.9</td>
</tr>
</tbody>
</table>
Clam Seed Transporting Tips

- Transport “out of water” for limited period of 24 to 36 hours
  - Includes time seed is sieved, packed and transported

- Transport cool and moist
  - Temperature around 65-70 °F
  - Seed wrapped in an absorptive-type material that maintains moisture but is porous

- Transport in insulated cooler with gel packs or frozen jugs
  - Do not let seed get in direct contact with gel packs, wrap in newspaper
  - Keep seed off bottom of cooler
Clam Seed Handling Tips

- Check weather conditions before arranging for seed delivery.
- Make sure you can get to lease site ASAP to plant seed.
- Make sure bags and supplies are ready for planting.
- Get seed information from supplier (e.g., number per ml).
- Check seed upon arrival to be sure it is alive.
- Clams that are gapping and do not shut when tapped will eventually die. Seed should not be warm upon arrival.
- There should be no foul odor.
- Do not place seed in direct sunlight. Provide shading at all times, but do not use a nonporous material.
- Salinity values at lease area should be within 5 ppt of the water from which seed was obtained.
Water Conditions at Lease Site and their Role on Clam Production

- Necessary for clam farmers to assess environmental conditions at lease and apply management strategies
- Important water quality parameters controlling survival and growth of clams
  - Water temperature
  - Salinity
  - Dissolved oxygen
- Clams are grown in inshore coastal waters where water conditions fluctuate and can exceed clam tolerance limits

Publications on the role of temperature, salinity and dissolved oxygen on hard clam production can be found online at [http://shellfish.ifas.ufl.edu](http://shellfish.ifas.ufl.edu)
Water Conditions at Lease Site: WATER TEMPERATURE

• Definition
  – Measure of water’s warmth or coldness with reference to a standard value

• Units
  – Celsius (C) / Fahrenheit (F)
    • Boiling point: 212 °F
    • Freezing point: Fresh water: 32 °F, Sea water: 28 °F

• Characteristics
  – Essential for water data collection
  – Other measurements / determinations rely on temperature
    • Dissolved oxygen, Conductivity
    • Plant photosynthesis, Metabolic rates of aquatic organisms
**Water Conditions at Lease Site:**

**WATER TEMPERATURE**

- **Influencing Factors**
  - Seasonal weather changes
  - Mixing of water due to tides, wind, storms
  - Water depth

- **Effects on Clams**
  - Clams are cold-blooded animals
  - Metabolic rate directly influenced by water temperature
  - Growth greatly affected by temperature
    - Optimum: 60-80 °F
    - Growth ceases < 48 °F and > 88 °F
    - Adverse effects > 90 °F
    - Adult clams survive temperatures below freezing for short durations by burying
How to measure TEMPERATURE?

- HOBO® Pendant Temperature Data Logger
- Small (2.3 x 1.3 x 0.9 inches)
- Waterproof, can be placed inside a clam bag
- Inexpensive
- http://www.onsetcomp.com

Continuous information
Can be programmed to record every 30 minutes for up to six months, or every two hours for 17 months

Peak Summer Water Temperatures at Dog Island Lease Sites, Levy County

Water Temperature (°F)

<table>
<thead>
<tr>
<th>Date</th>
<th>DI809D</th>
<th>DI815M</th>
<th>DI816D</th>
<th>DI818S</th>
<th>DI820S</th>
<th>DI824S</th>
<th>DI Sonde</th>
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</tbody>
</table>
**Water Conditions at Lease Site: SALINITY**

- **Definition**
  - Relative salt content in waters
  - Measured by conductivity

- **Units**
  - Parts per thousand (ppt)

- **Characteristics**
  - Fresh water: 0 ppt
  - Sea water: 30-35 ppt
  - Estuaries: waters where fresh and seawater join and mix
    - Salinity can exceed sea water values during long periods of drought
    - Short-term and long-term fluctuations in salinity are natural in estuaries
Water Conditions at Lease Site: SALINITY

• Influencing Factors
  – Varies within an estuary due to
    • Distance from freshwater sources, Movement of tides
    • Dilution by rainfall, Mixing of water by wind
  – Determines stratification in an estuary
    • Increases with water depth
    • Tides, wind and storms can eliminate layering
    • Also shape of estuary and volume of fresh water inflow

• Effects on Clams
  – Growth also affected by salinity
    • Optimum range: 20-30 ppt
    • Growth ceases <18 ppt
Water Conditions at Lease Site: SALINITY

• Effects on Clams (continued)
  – Survival affected by salinity
    • Can survive periodic fluctuations and periods of lower salinities by closing valves, or shells
    • Adults can survive salinity ≤ 10 ppt
    • Juveniles are more vulnerable
    • Seed will die at < 15 ppt for extended periods
    • Other factors
      – Source of freshwater
      – Rate of salinity change
      – Water temperature
        » Growth and survival decreases sharply when salinity low and temperature is high
  • Begin to die at > 40 ppt
How to measure SALINITY?

- Refractometer (ppt)

- Hydrometer - Measures specific gravity and then convert to ppt

- Purchase at aquaculture equipment suppliers
  - Pentair Aquatic Ecosystems
Real-time WATER QUALITY information
http://sondes.floridaaquaculture.com/sondes/

Dog Island Data Sonde

<table>
<thead>
<tr>
<th>Location Maps</th>
<th>Archived Data</th>
<th>Sonde Home</th>
<th>Aquaculture Home</th>
</tr>
</thead>
</table>

Dog Island

- Time of Collection: 10:30 AM 11/3/2014

Gulf Jackson

- Wind Speed: 0 MPH
- Relative Humidity: 64.7%
- Air Temperature: 54.24°F

Salinity

- Parts Per Thousand

Dissolved Oxygen

- Milligrams Per Liter

Water Temperature

- Fahrenheit

Barometric Pressure

- 30.39 inHg

Turbidity

- NTUs

The information found on this website is actual, unadjusted data collected routinely from scientific YSI 6600-V2 sondes and Vaisala WXT510 weather stations. The Florida Department of Agriculture and Consumer Services, unless otherwise noted, makes no representations, warranties or claims that the information collected from this equipment is...
Clam Culture Bag

- Polyester mesh sewn in the shape of a bag
- Spout (about 8”) on one corner
- Various mesh sizes
- Field nursery
  - 3 and 4 mm
- Growout
  - 9 to 12 mm
- Several bag dimensions
  - Usually 4’ by 4’

- Developed for Florida because of subtidal growing conditions and lease restrictions on harvesting
- Serves as predator protection
- Used as harvesting device
Clam Culture Bag

- Planted as single bag
- Planted in belts of 5 to 10 bags
- Staked to bottom using a variety of materials
  - PVC pipe
  - Pencil rod
  - Rebar
- Naturally occurring sediments serve as substrate
Clam Bag Suppliers

- Requires serged seam to handle clam weight
- Several clam bag manufacturers in Florida
- Fabric and thread suppliers
- Check the annual list of suppliers posted at http://shellfish.ifas.ufl.edu
Clam Bag Tags

- Various tags are used by growers to provide identification as well as information, such as planting date, stocking rate, or seed source.
- Pilot crop insurance program requires growers to place tags in bags with their name and AQ certification number.
- Check the list of suppliers posted at http://shellfish.ifas.ufl.edu
# Clam Bag Stocking Info

<table>
<thead>
<tr>
<th>Bag Mesh Size</th>
<th>Stock Rate* (#/bag)</th>
<th>Stock Volume (ml/bag)</th>
<th>Stock Density (number/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery (3 mm)</td>
<td>10,000</td>
<td>500-650</td>
<td>625</td>
</tr>
<tr>
<td>Nursery (4 mm)</td>
<td>10,000</td>
<td>800-1000</td>
<td>625</td>
</tr>
<tr>
<td>Growout (9 mm)</td>
<td>800-1200</td>
<td>400-1200</td>
<td>50-75</td>
</tr>
<tr>
<td>Growout (12 mm)</td>
<td>800-1200</td>
<td>800-2400</td>
<td>50-75</td>
</tr>
</tbody>
</table>

* Assuming bag is 4’ by 4’ in dimensions or 16 square feet
When to plant clams?

- Plan for year round production
- Minimize mortalities by not planting seed in excessive heat of summer or cold of winter
- Determine when may have seasonal low salinities
- Evaluate seasonality of predators and abundance
- Determine seasonal closures
  - For example, red tide
- Assess risks associated with storms and excessive heat
- Document seasonal growth
When to plant clams?

Seasonal growth of clams in Cedar Key

Littleneck size clams
Clam Crop Survival

- Environmental conditions associated with clam mortalities
  - Low salinity events
  - Freeze
  - High water temperatures (>95 °F)
  - Anaerobic conditions
- Susceptibility (tolerances) to these conditions related to
  - Size and age of animal
  - Physiological condition
  - Acclimation history
  - Other adverse conditions
- Other risks – storms, hurricanes

Unexplainable losses
Clam Crop Survival

- Biggest threat to clam production is predation
  - Crabs
  - Conchs and whelks
  - Rays
  - Drum
- Clam bag, cover netting, and net coating designed to minimize predation
- Evidence of predation – shells, bag
- Threats are dependent on clam size and seasons
Clam Bag Covering Netting

- Need for additional predator protection
  - Losses associated with crabs and drum
- Facilitates making belts
- Helps manage fouling or encourages fouling
- Adds to cost of culture equipment
- Site specific in terms of which material to use

- Variety of materials used
  - Larger polyester mesh netting
  - Plastic “bird” netting
  - Chicken wire (1 or 2” hex mesh)
Clam Bag Net Dip

- Need for additional predator protection
  - Losses associated with cownose rays
- May eliminate need for cover netting
- May encourage fouling
- Site specific in terms of which net dip to use
- Requires DACS written approval
• Requires DACS approval
• See DACS Technical Bulletin #4: Shellfish Nets and Net Coatings

- Reviews pertinent regulations, food safety issues and approval process
- Provides recommendations on how to apply, handle, store and cure

- Products approved by DACS
  - Latex (water-based), alkyd
  - Acrylic polymer
Drift Algae Problems

- Drift algae or “rolling moss”
  - Several types – red, green
  - Seasonal and site specific
  - Problematic on leases – east coast and SW Florida
  - Can form dense mats
  - Can result in clam suffocation and mortalities in summer

- Control by harvesting / removing from lease area
Fouling Problems

- Sea squirts (tunicates), Oysters
  - Seasonal and site specific
  - Can form dense mats
  - Can result in slower clam growth and possible mortalities in summer

- Control by going to 3-step growout, removal/replacement of cover nets
- No approved anti-fouling net coating available yet
Other Clam Culture Considerations

- Bottom net culture
  - Developed for intertidal culture
  - Used primarily in Northeast
  - Consists of single layer of predator protection netting
  - Allows clams to bury deeper in substrate
Other Clam Culture Considerations

- Bottom net culture
  - In Florida may allow clams to bury deeper to escape heat stress
  - Deploying in deep waters may be difficult
  - Harvesting must be done by hand not mechanical dredging on shellfish aquaculture leases
Record Keeping

- Allows grower to manage information concerning nursery and growout farming operations
- Able to better keep track of inventory
- Map of lease site to keep track of clams plants
- Allows for monitoring of growth and survival
- Document crop losses

C.L.A.M. Software
Noninsured Disaster Assistance Program, or NAP
- Administered by the USDA Farm Service Agency (FSA)
- Provides catastrophic coverage of clam crops
- Coverage level is 50/55
- Crop year: October 1 thru Sept 30
- $250 administrative fee

Sign-up by September 1

For complete listing of FSA county offices in Florida:
- Go to the website, www.fsa.usda.gov,
  Click on “State Offices” in top menu,
  Click on Florida in map, In left-hand menu, click on “County Offices”
“Location, location, location…the most critical step.”

“Start off small, allow time to move up the learning curve.”

“You can learn as much by killing 100,000 seed as with a million.”

“You don’t make money growing shellfish, you make money selling ’em…if you get a good enough price.”

“Approached in a logical, well-informed manner, clam farming has the potential for returning a profit on your efforts. But, done without adequate planning it is guaranteed to lose you money.”

“It spite of available information, it will still be your time, money and dedication that will be required for a successful clam farm.”