Florida Molluscan Shellfish Aquaculture Industry

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Shellfish Aquaculture Extension Program

Cedar Key, Florida

UF IFAS UNIVERSITY of FLORIDA

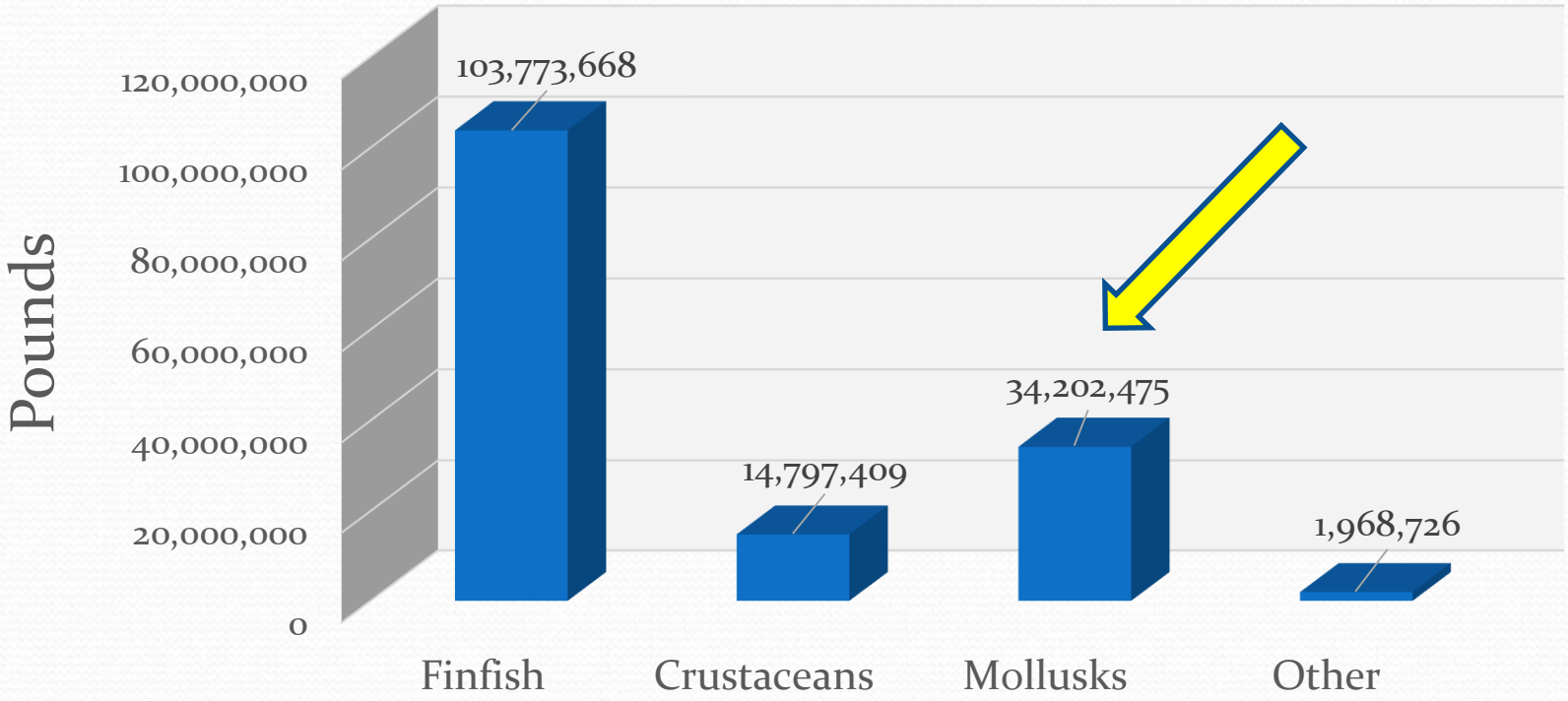
Sea Grant Florida

In collaboration with

Florida Department of Agriculture and Consumer Services • Adam H. Putnam, Commissioner

Global Molluscan Aquaculture

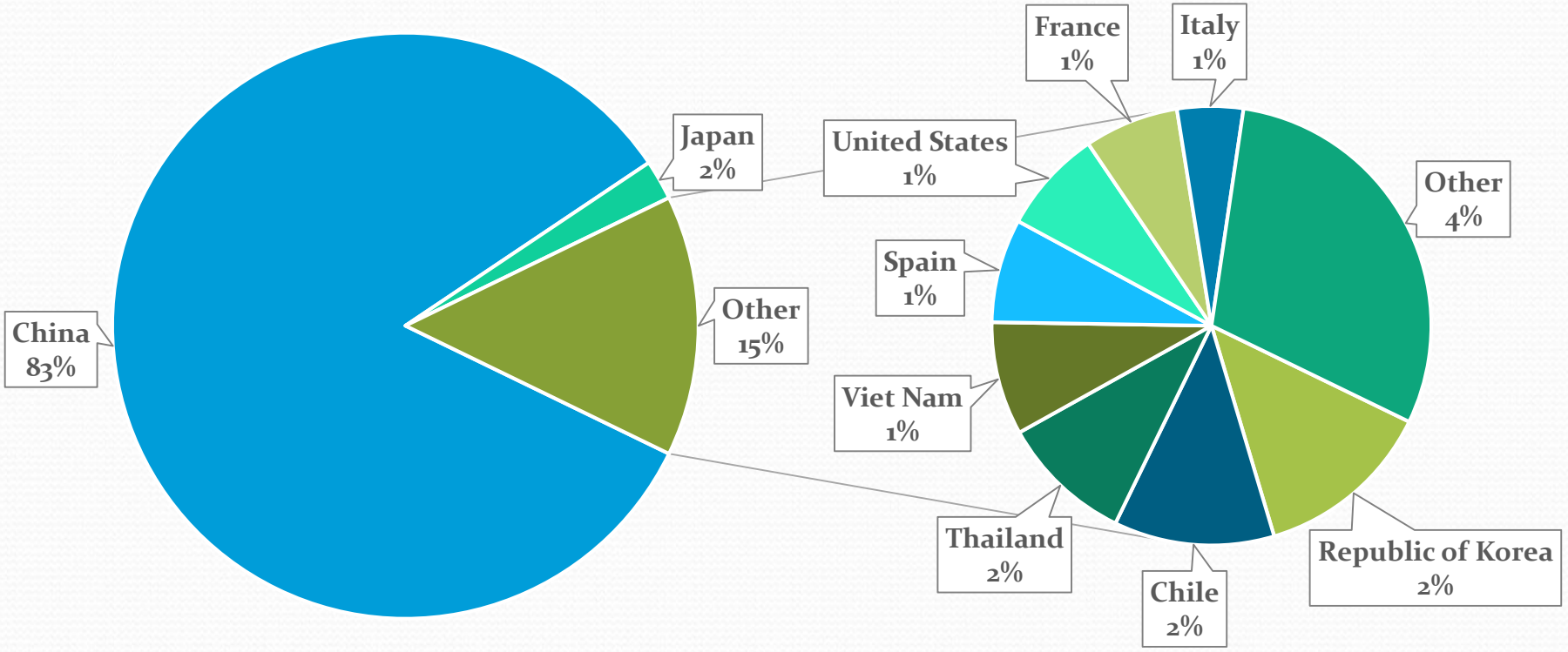
Worldwide Aquaculture Production (FAO 2013)



In 2013, 34 million pounds of mollusks were grown globally!
Molluscs are the #1 mariculture product in the world!

Global Molluscan Aquaculture

Mollusk Production by Nation



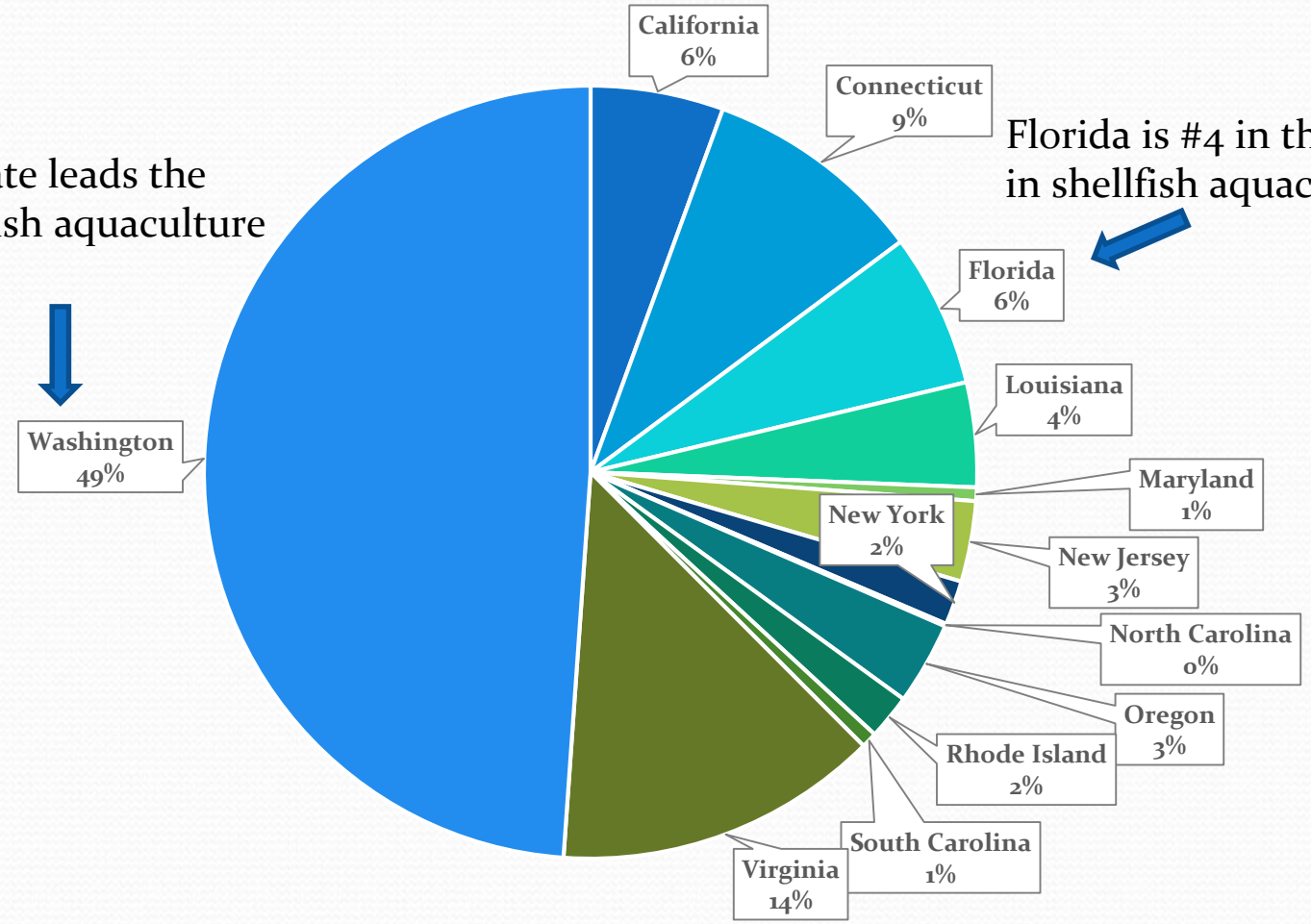
China produces a vast majority of the worlds mollusks.

U.S. Mollusk Aquaculture Industry

Annual Sales by State (% of national sales)

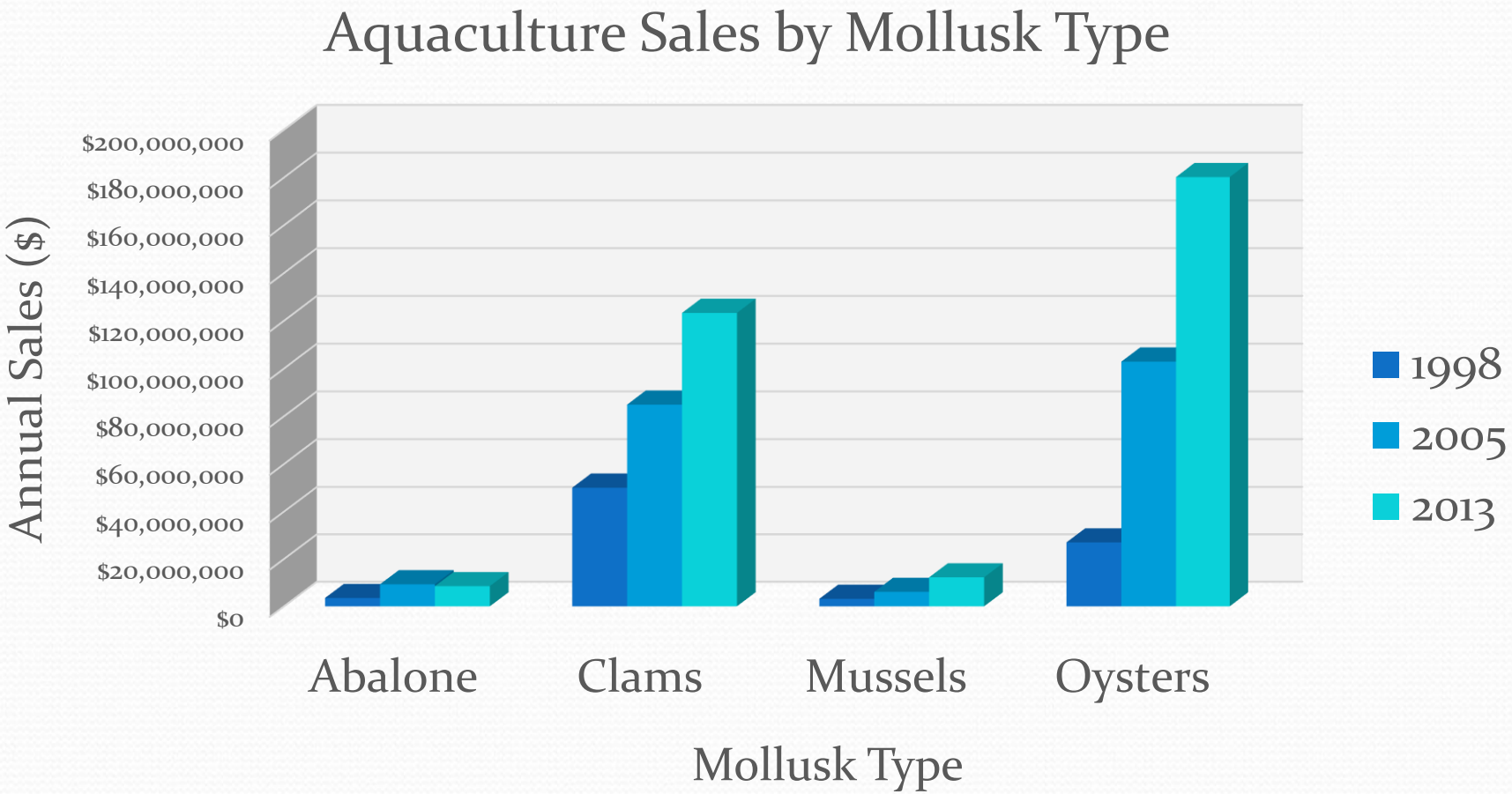
Washington state leads the nation in shellfish aquaculture

Florida is #4 in the nation in shellfish aquaculture!



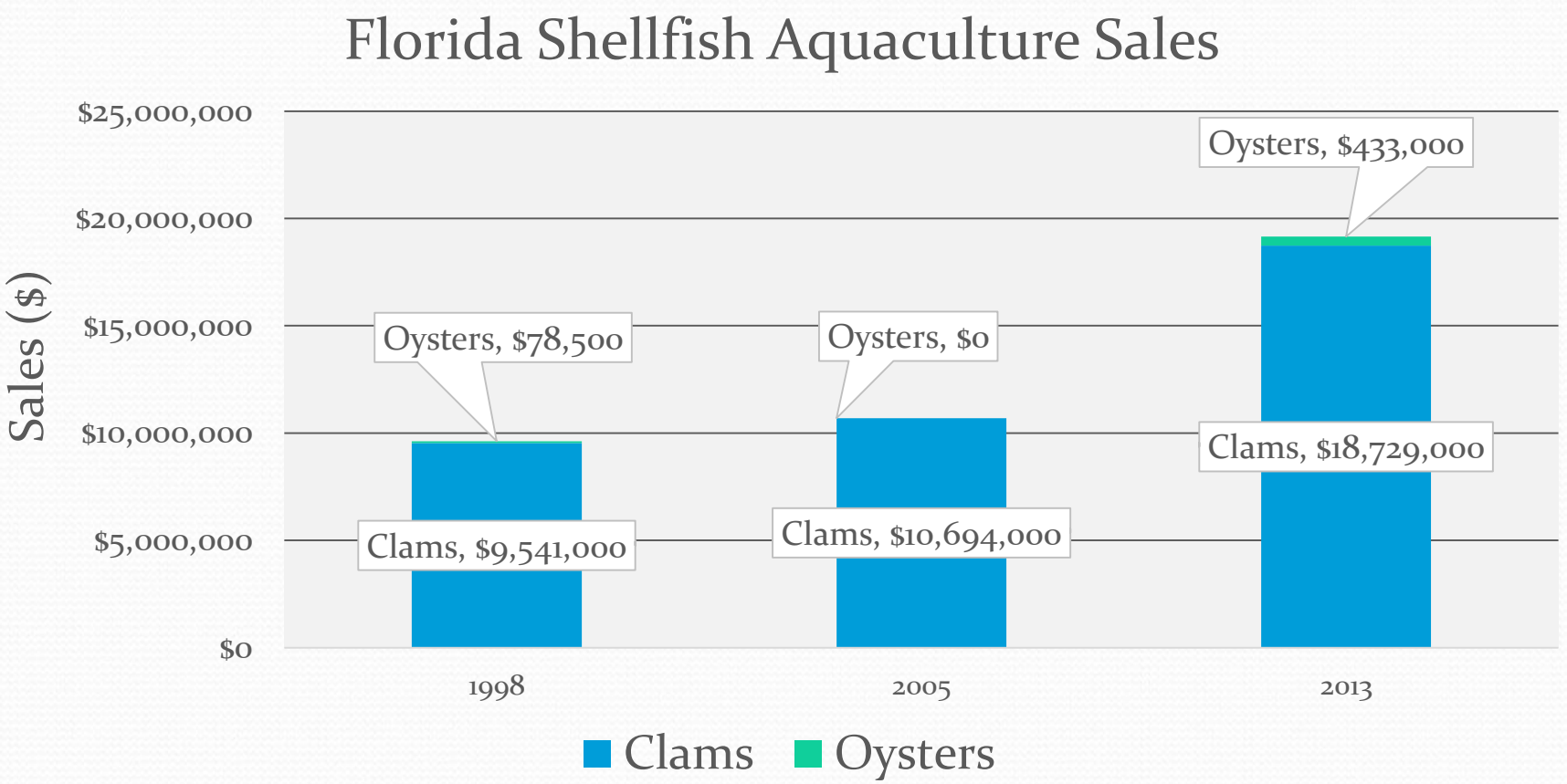
U.S. Mollusk Aquaculture Industry

Molluscan aquaculture in the U.S. increased 368% from 1998-2013, and continues to expand today!



Florida Bivalve Aquaculture Industry

- Shellfish aquaculture in Florida is dominated by hard clams (98% of sales in 2013).
- Oyster aquaculture, in response to declining wild-stocks and advancing culture technologies, is increasing annually.



Florida ranked first in hard clam production in U.S. in 1998 (USDA 2000).

Cedar Key named dominate production area in state (FASS 1998, 2000).

Cedar Key contributed over 85% to state's production (UF 2013).

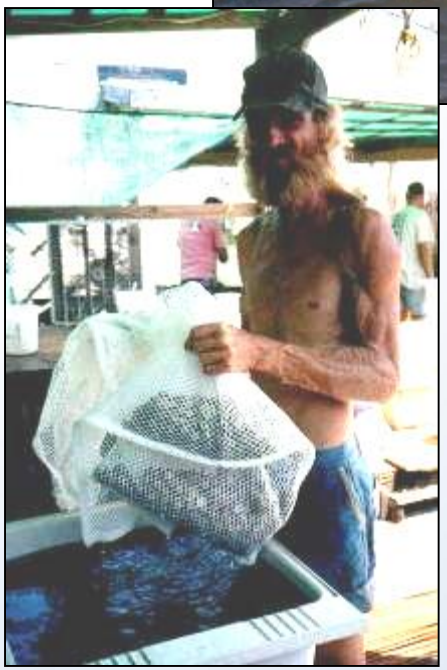
Industry Development on West Coast

In the 1990s due to:

- Successful job retraining programs for former fishermen
- Excellent leasing program and regulatory framework
- Year-round growing conditions

Florida Shellfish Aquaculture Retraining Programs

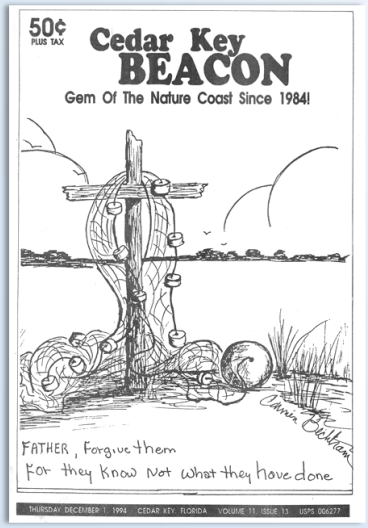
- Infrastructure provided to expand employment opportunities for Florida fishermen affected by increasing regulatory restrictions
  - "Hands-on" training
  - Classroom curriculum
  - Development of business plans, lease applications



A Way of Life Ends

- Oyster fishery reclassifications and closures in Suwannee Sound (1990-1)
- Statewide ban on gill and entanglement nets (1994)
- Affected counties economically depressed
- Limited alternative employment

Potent bacteria may change way of life for tomorrow's oystermen



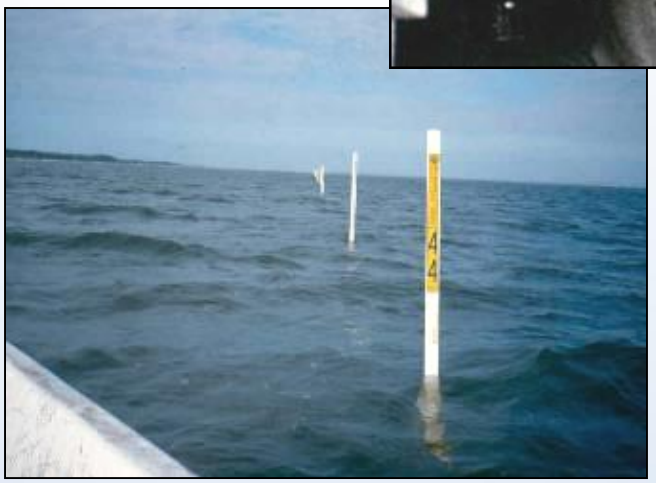
Retraining Programs in Cedar Key

Project OCEAN, 1991-3

Project WAVE, 1995-7

- Served 4 coastal counties
- Culture technology transferred
- Over 200 former fishermen placed into small businesses
- 948 acres of aquaculture leases established off Levy and Dixie Counties

Graduation, 1993

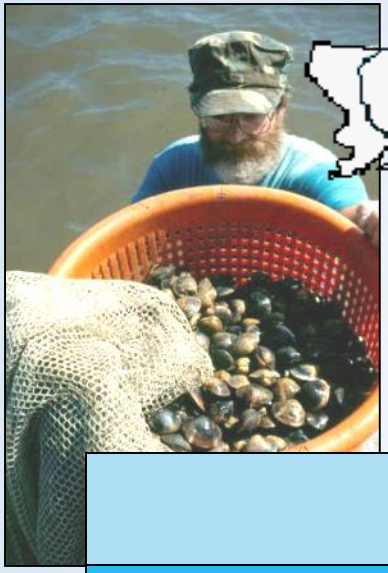


Current Status

- >300 certified clam growers in state
  - 150 in Cedar Key
- >2000 acres of sub-merged land leases in 12 coastal counties
- Profile dominated by small businesses

Fresh from Florida

Certified Clam Farmers*



1-5

6-10

11-20

21-40

41-150

Atlantic Ocean

Franklin County n=30

Dixie County n=15

Levy County n=150

St. John's County n=4

Volusia County n=9

Brevard County n=15

Indian River County, n=17

Manatee County, n=3

Charlotte County, n=7

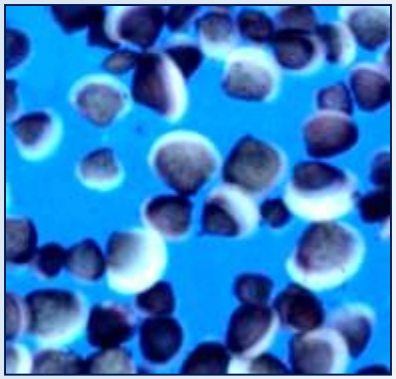
Lee County n=33

Collier County, n=4

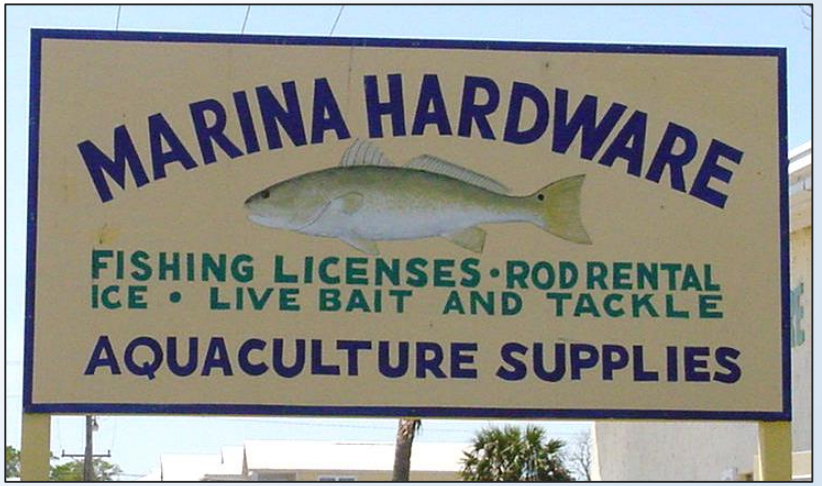
Gulf of Mexico

*FL Department of Agriculture and Consumer Services, 2014-15

Supporting Infrastructure



- Seed suppliers
- Bag suppliers
- Other suppliers
- Equipment manufacturers



- Boat builders
- Wholesalers

Economic Impact

- Surveyed wholesalers to determine number and value of clams handled in 1999, 2007, and **2012**
- Used input-output methodology to estimate direct, indirect, & induced impacts

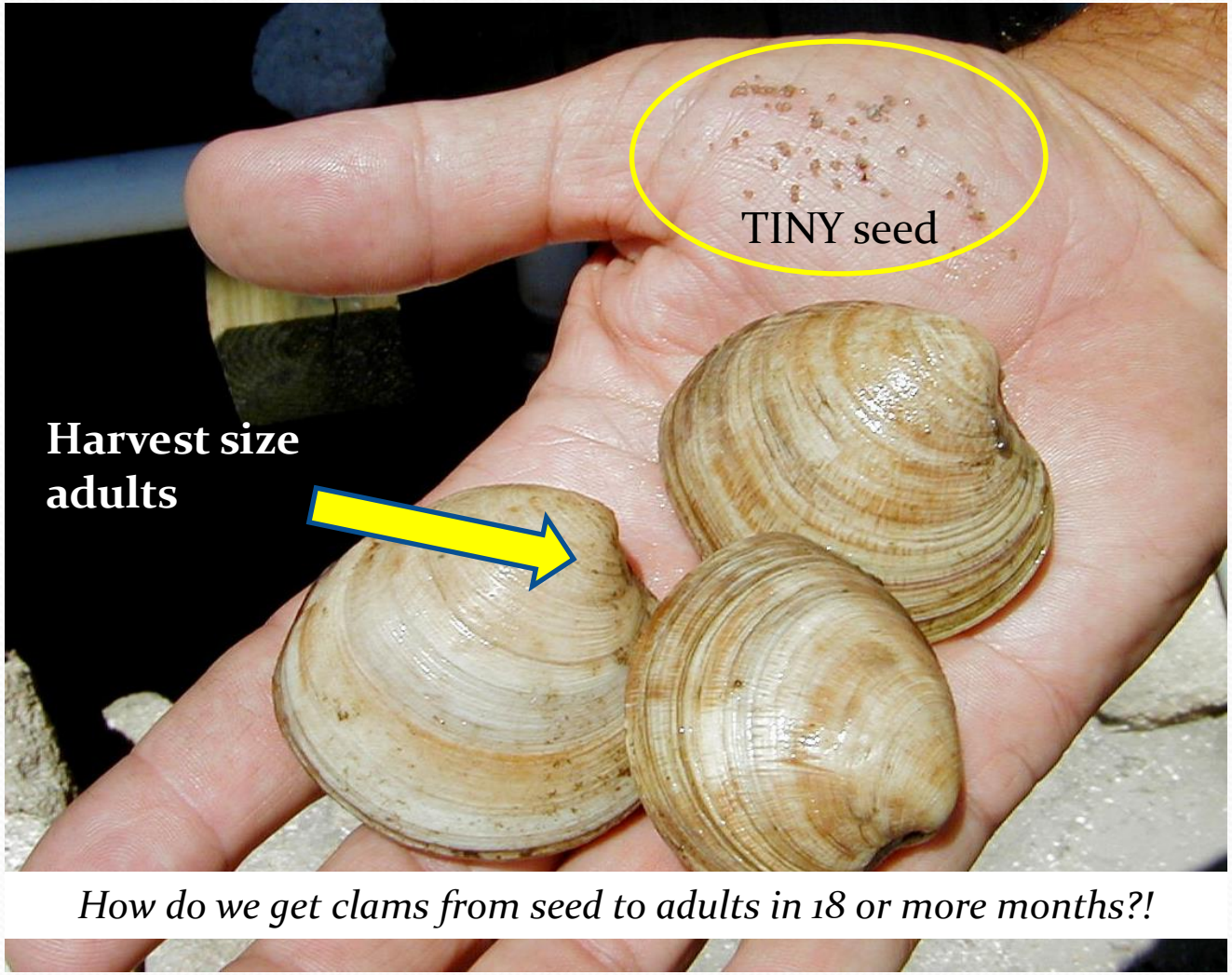
	Sales output	Value added	Labor income	Jobs
1999	33.9	12.1	9.0	-
2007	52.9	31.5	25.3	606
2012	38.7	21.9	14.7	543

Clam Biology

- Northern hard clam or quahog naturally occurs along Atlantic coast from Nova Scotia to Florida
- Bivalve mollusk, poikilothermic
- Occupies intertidal and subtidal habitats in estuarine environment
- Infaunal, burrows into substrate to various depths (<8”)
- Filter feeders, remove food particles, usually small phytoplankton (algae) from water
- Sexes separate, but externally indistinguishable

Northern hard clam *Mercenaria mercenaria, notata* strain

Shellfish Aquaculture Methods



How do we get clams from seed to adults in 18 or more months?!

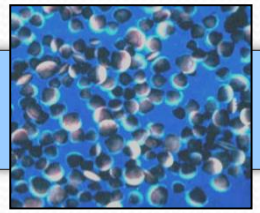
Shellfish Aquaculture Methods

Three main phases of production

Hatchery
- Spawning
- Larviculture
- Setting & post-set rearing
- Grown to 1 mm

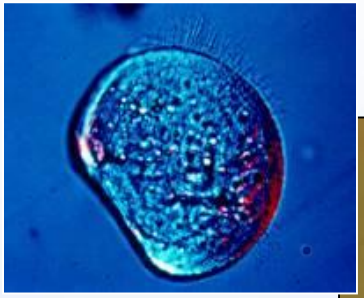
Nursery
- Shore-based raceways or upwellers
- Fed naturally occurring algae
- Grown to ~5-6mm

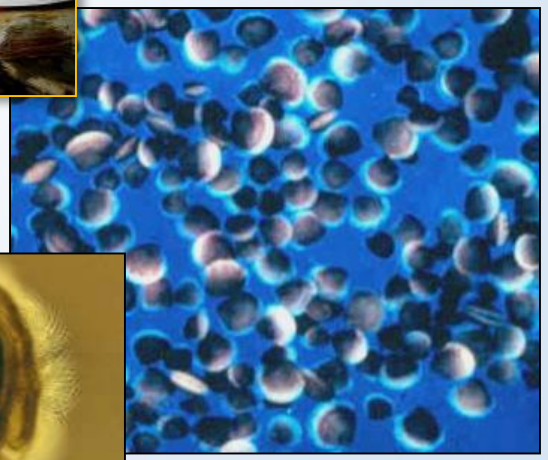
Growout
- Placed in open-water lease sites
- Grown to market size (~1")



Hatchery Production of Seed



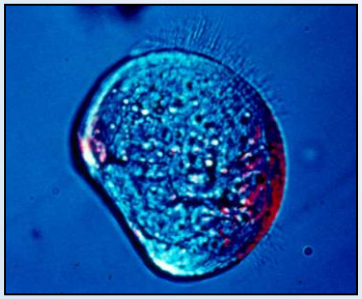


1 mm seed

About 10-12 commercial hatcheries in Florida produce 0.5 billion seed annually

Spawning and larval rearing

- Spawning of ripe adults or broodstock



- Rearing of micro-scopic larval stages under controlled conditions for 10-14 days

Algal production

- Production of several species of marine micro-algae to feed clam larvae

Post-set rearing

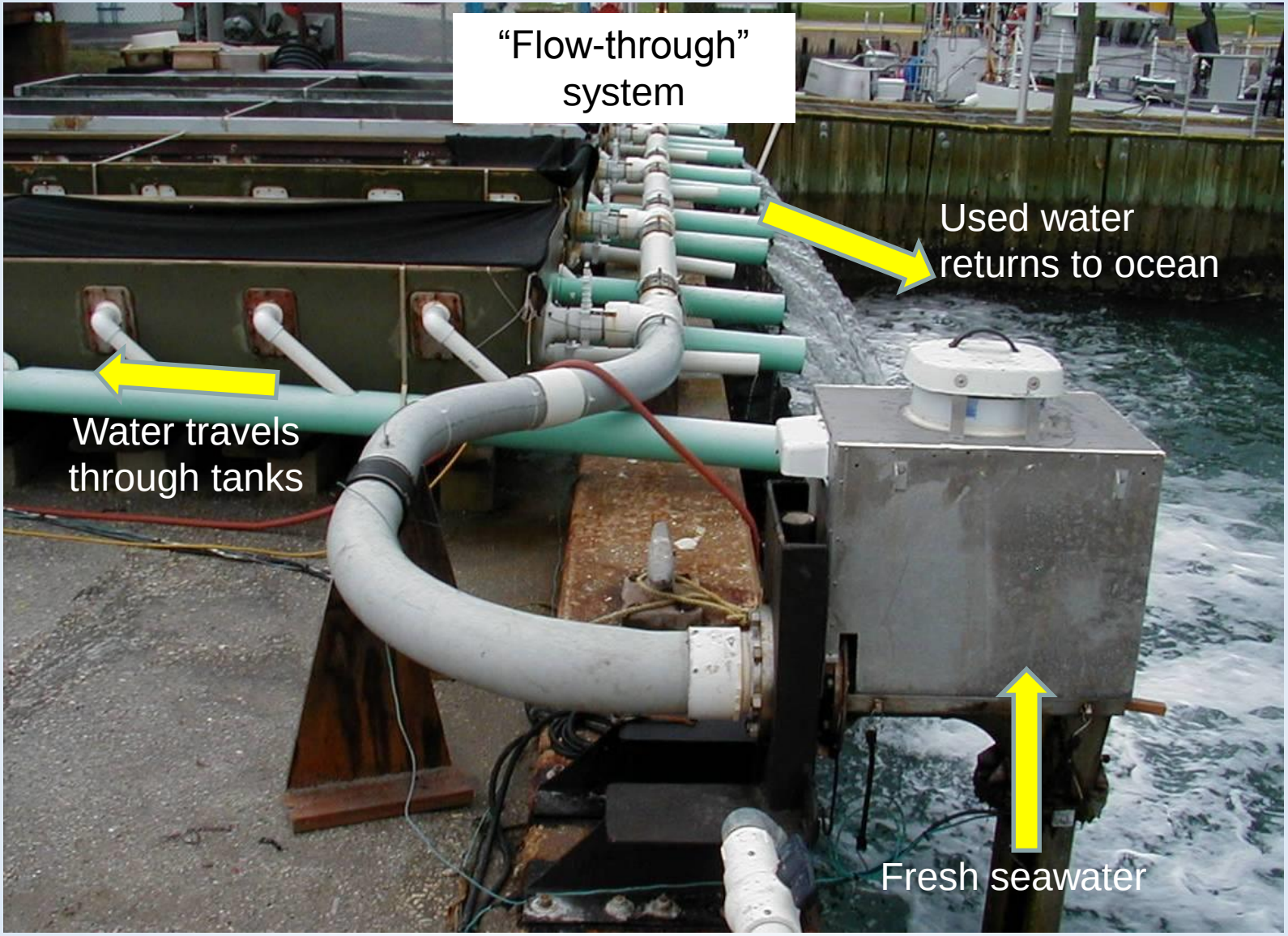
- Post-set rearing in downwellers at hatchery until 1-mm seed size

Land-based nurseries

- Serves as an intermediate step between hatchery and growout operation
- Creates a division of labor
- Provides small seed (1 mm) with adequate food supply and protection from predators until they reach a field plantable size (5-6 mm)

Land-based nurseries

- Systems (raceways, wellers) simple in design, operation, and maintenance
- Allows growers to purchase and rear inexpensive seed
- Provides for acclima-ion of seed to local growing conditions
- Many growers attracted to this option
- 75 of these facilities statewide
  - 35 in Cedar Key



The intake and flow-through of fresh seawater serves as a food source, allows for adequate oxygen, and removes waste.

Small seed at start of nursery phase

Large seed at end of nursery phase

Seed growth during the nursery phase

Clam Seed Sizes

Bag Mesh Size	Sieve Mesh Size (mm)	Seed Size (SL, mm)	Seed Count (number/ml)
Nursery (3 mm)	3.3	5.0	15-20
Nursery (4 mm)	4.0	6.0	9-12
Growout (8-9 mm)	7.5	12.0	1-2
Growout (12 mm)	12.0	15.0	0.5-0.9

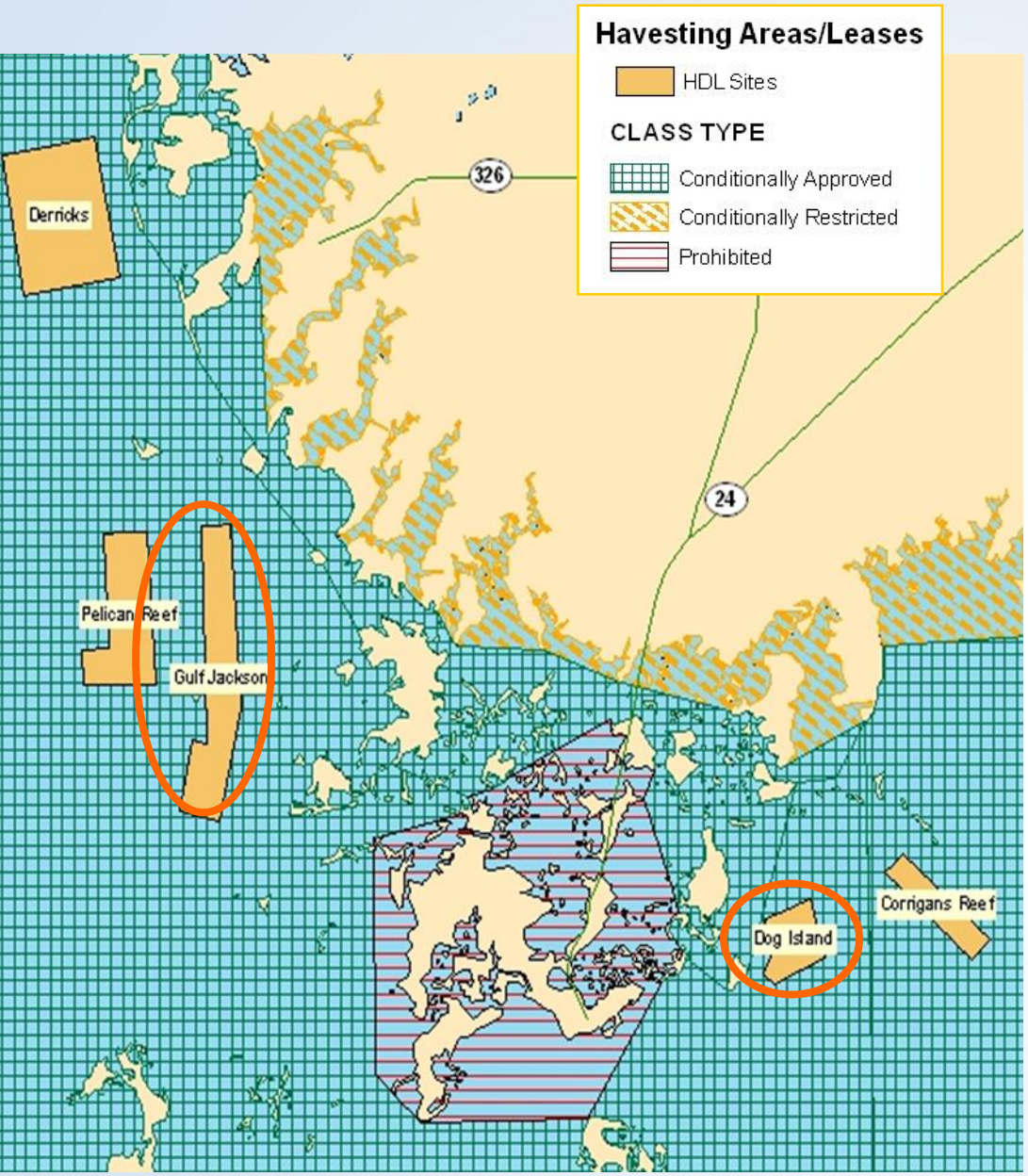
Clam Growout

- Open-water farming
- Lease state-owned submerged lands for farm sites
- Limited tidal range
- Subtidal cultivation
- Operating costs are low
- Food, oxygen and water exchange provided by environment

Leasing Program

- Established in state statute (Chapter 253, F.S.) in 1988
- Provides authority for leasing sovereign submerged lands
- Administered by FDACS Division of Aquaculture

- 10-year term, renewable and transferable
- Nominal application and annual rental fees
- Minimum effective cultivation requirement

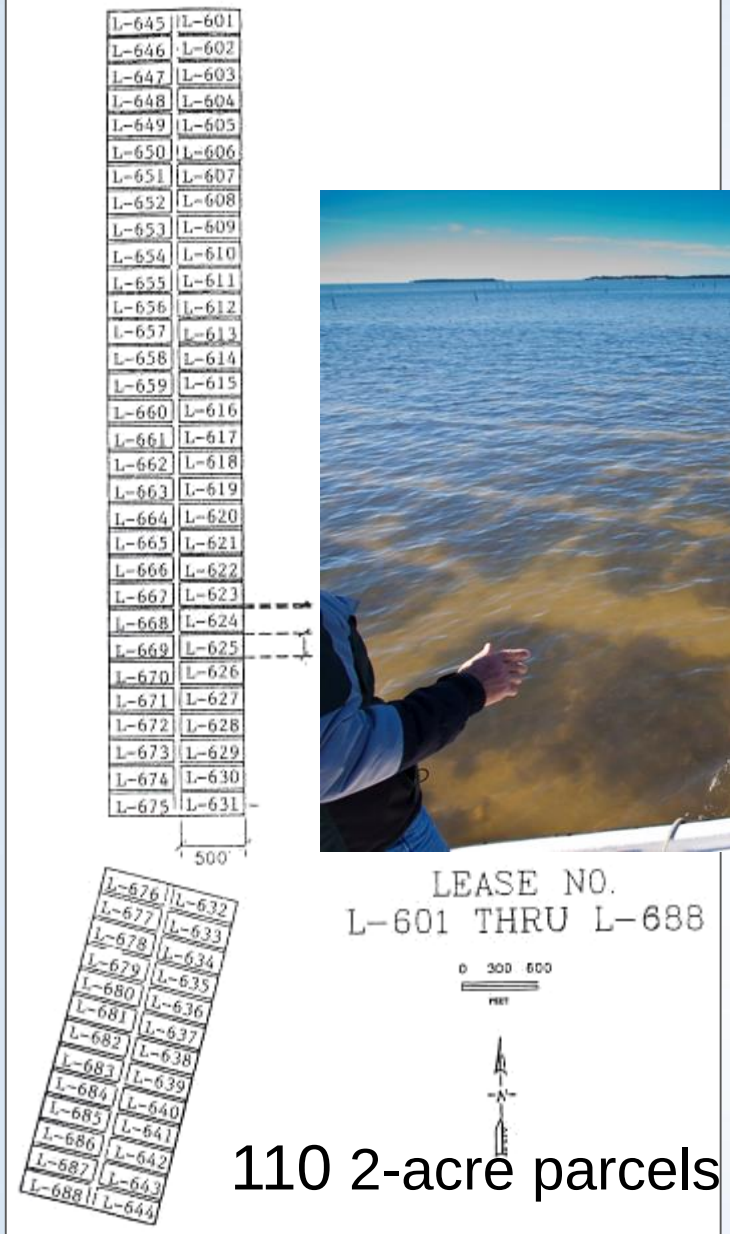


Cedar Key Aquaculture Use Zones

Shellfish Leases

- Potential sites must undergo resource survey
- Located on nonproductive “bare” bottom substrate
- Waters must be approved for shellfish harvesting
- Can not impede navigation or conflict with other uses
- Usually grouped in block areas called Aquaculture Use Zones (AUZs)

Cedar Key Leases



110 2-acre parcels

Gulf Jackson
High Density Lease Area

Photo courtesy of Pat Bonish

30 2-acre parcels

Dog Island
High Density Lease Area

Hard Clam Leases

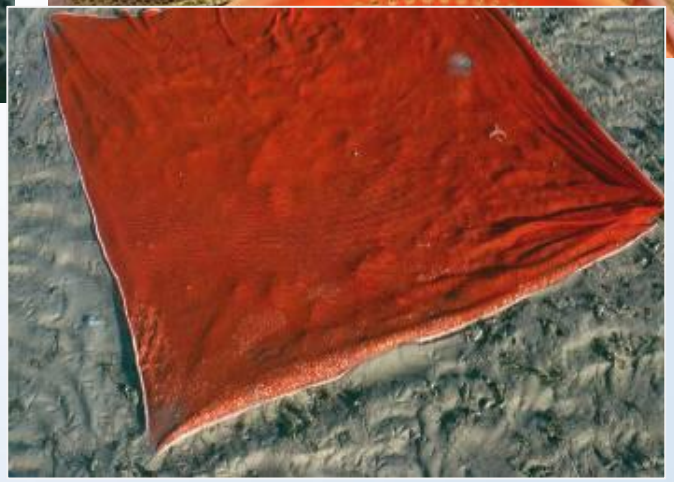
True or false?

You will get in trouble if you are <u>not</u> a leaseholder and you are caught in possession of cultured clams <u>or</u> harvesting clams from a specific lease site.

TRUE - It is against the law for anyone other than the lease holder to harvest cultured clams from lease areas.

Growout Technology

- Soft bag - Polyester mesh material sewn in the shape of a bag



- Two-step process – field nursery (3-4 mm mesh) and growout (9-10 mm mesh) bags
- Secured to bottom with stakes
- Planted in rows (bags usually “belted”)
- Sediments serve as substrate

- Predator protection
- Harvesting device
- Inexpensive and durable
- Used for several crop cycles

Photo courtesy of Carlton Ward, Jr., LINC Foundation

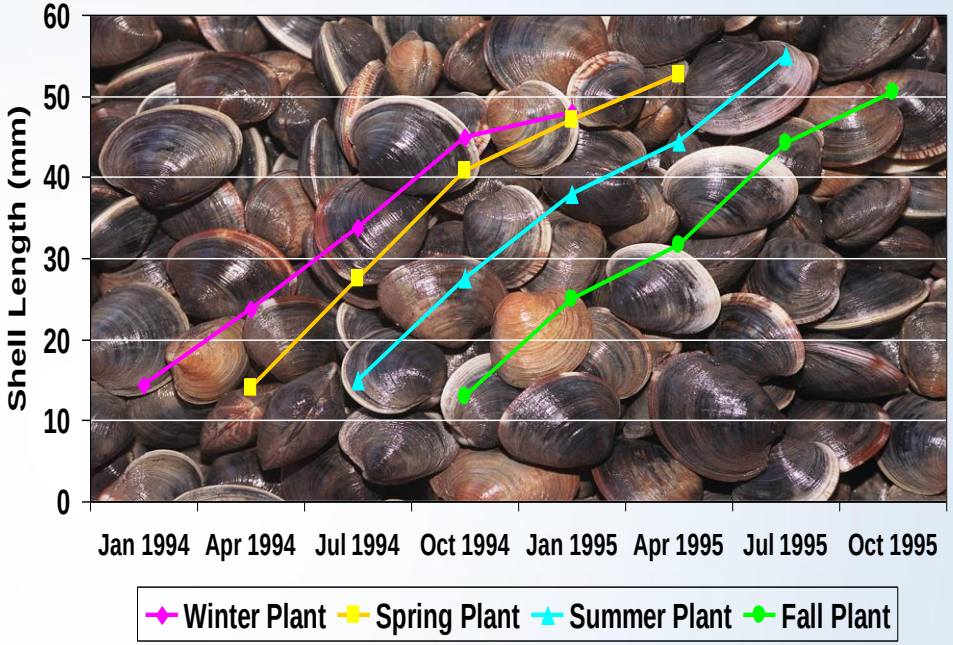
Clam Bag* Stocking Info

Bag Mesh Size	Stock Rate* (#/bag)	Stock Volume (ml/bag)	Stock Density (number/ft^2)
Nursery (3 mm)	10-20,000	650-1500	625-1250
Nursery (4 mm)	10-20,000	1000-2000	625-1250
Growout (8-9 mm)	800-1200	400-1200	50-75
Growout (12 mm)	800-1200	800-2400	50-75

* Assuming bag is 4’ by 4’ in dimensions or 16 square feet

Florida hard clams grow fast and are available year-round!

- 15-18 month growout
- One half to a third of crop times of other states
- Year-round growing conditions
- Subtropical water temperatures
- High natural productivity



Clam crop survival

- Environmental conditions associated with clam mortalities
  - Low salinity events
  - High water temperatures (>95 ^{o}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
- Evidence of predation – shells, bag
- Threats are dependent on clam size and seasons

Clam covering netting

- Need for additional predator protection
- Facilitates “belting” bags
- Helps manage fouling or encourages fouling
- Adds to cost of culture equipment
- Site specific in terms of which material to use

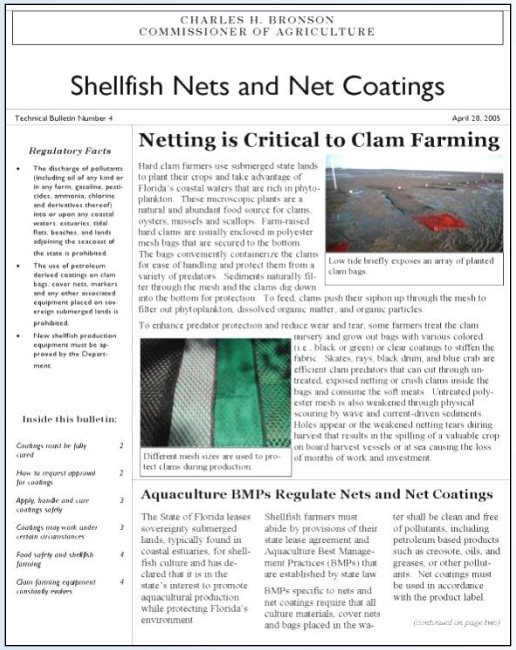
- Variety of materials used
  - Larger polyester mesh netting
  - Plastic “bird” netting
  - Chicken wire (1- 2” hex mesh)

Clam bag net coatings

- Need for additional predator protection
  - Losses associated with rays
- May eliminate need for cover netting
- May encourage fouling
- Site specific in terms of which net dip to use

Clam bag net coatings

- Requires DACS approval
- See DACS Technical Bulletin #4: *Shellfish Nets and Net Coatings*



CHARLES H. BRONSON
COMMISSIONER OF AGRICULTURE

Shellfish Nets and Net Coatings

Technical Bulletin Number 4 — April 28, 2005

Regulatory Facts

- The discharge of pollutants (including oil of any kind or in any form, gasoline, pesticides, ammonia, chlorine and derivatives thereof) into or upon any coastal waters, estuaries, tidal flats, beaches, and lands adjoining the seacoast of the state is prohibited.
- The use of petroleum derived coatings on clam bags, cover nets, markers and any other associated equipment placed on sovereign submerged lands is prohibited.
- New shellfish production equipment must be approved by the Department.

Inside this bulletin:

Netting is Critical to Clam Farming

Hard clam farmers use submerged state lands to plant their crops and take advantage of Florida's coastal waters that are rich in phytoplankton. These microscopic plants are a natural and abundant food source for clams, oysters, mussels and scallops. Farm-raised hard clams are usually enclosed in polyester mesh bags that are secured to the bottom. The bags conveniently containerize the clams for ease of handling and protect them from a variety of predators. Sediments naturally filter through the mesh and the clams dig down into the bottom for protection. To feed, clams push their siphon up through the mesh to filter out phytoplankton, dissolved organic matter, and organic particles.

Low tide briefly exposes an array of planted clam bags.

To enhance predator protection and reduce wear and tear, some farmers treat the clam nursery and grow out bags with various colored (i.e., black or green) or clear coatings to stiffen the fabric. Skates, rays, black drum, and blue crab are efficient clam predators that can cut through untreated, exposed netting or crush clams inside the bags and consume the soft meats. Untreated polyester mesh is also weakened through physical scouring by wave and current-driven sediments. Holes appear or the weakened netting tears during harvest that results in the spilling of a valuable crop on board harvest vessels or at sea causing the loss of months of work and investment.

Different mesh sizes are used to protect clams during production.

Aquaculture BMPs Regulate Nets and Net Coatings

The State of Florida leases sovereignty submerged lands, typically found in coastal estuaries, for shellfish culture and has declared that it is in the state's interest to promote aquacultural production while protecting Florida's environment. Shellfish farmers must abide by provisions of their state lease agreement and Aquaculture Best Management Practices (BMPs) that are established by state law.

BMPs specific to nets and net coatings require that all culture materials, cover nets and bags placed in the water shall be clean and free of pollutants, including petroleum based products such as creosote, oils, and greases, or other pollutants. Net coatings must be used in accordance with the product label.

(continued on page two)

- 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

Other clam culture considerations

Bottom net culture

- Developed for intertidal areas
- Primarily used in Northeast
- Method used initially on east coast of Florida
- Now being used in SW FL
- Consists of single layer of predator protection
- Clams allowed to bury deeper
- DACS now allows use of hand-held pump-driven harvesters

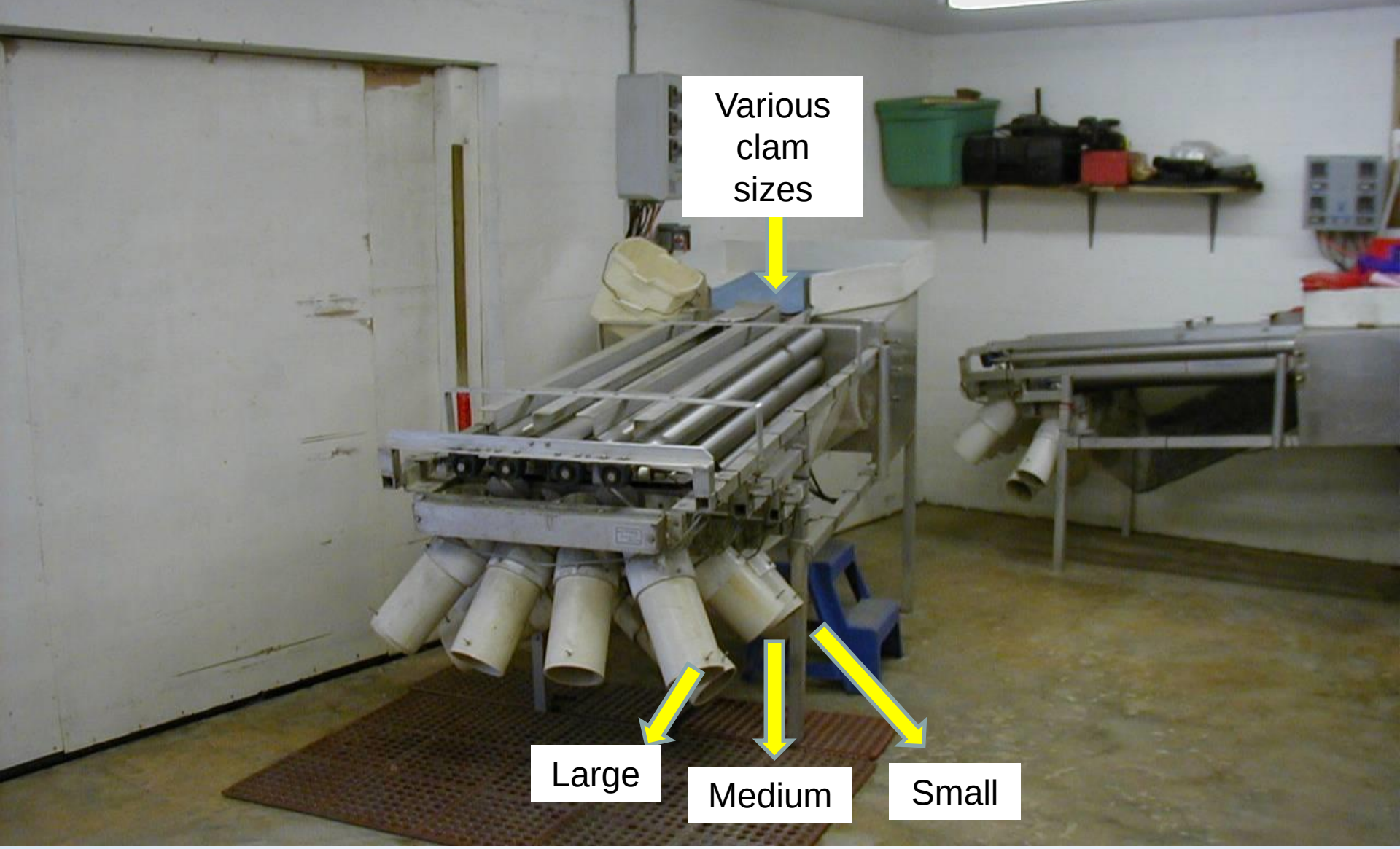
Clam Harvest

- Bags are pulled by hand using a winch or roller rig on the boat

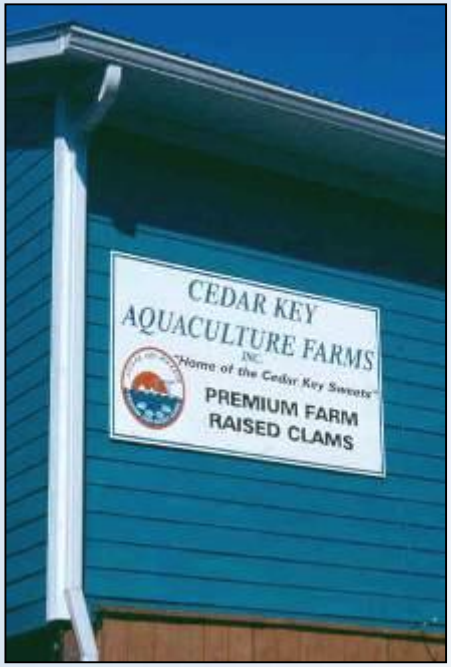
Clam Harvest & Processing

Once clams are harvested from lease sites they are loaded onto boats and taken directly to certified shellfish wholesaler facilities under the seasonal time-temperature matrix where they are processed for sale.

The first step in processing is to clean or wash the clams using a tumbler. The tumbling action breaks open dead clams and thoroughly rinses off the shellstock.

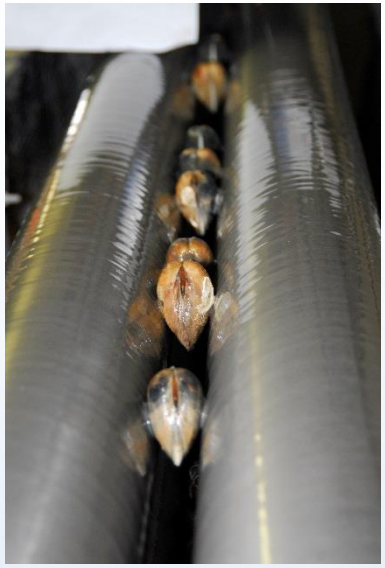


After tumbling, clams are graded by their various sizes using an opposed roller sorter. Mesh bags catch clams as they fall out.

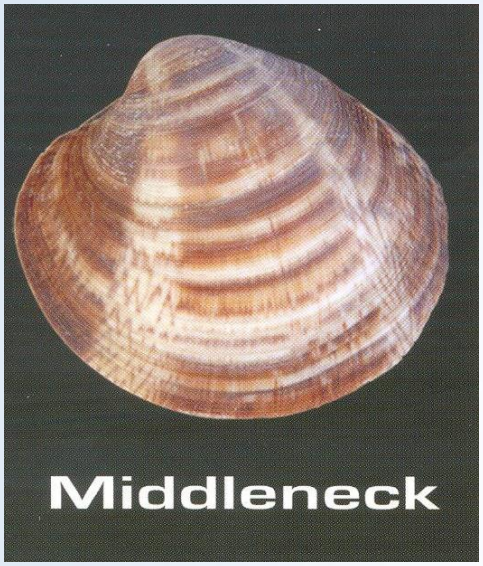


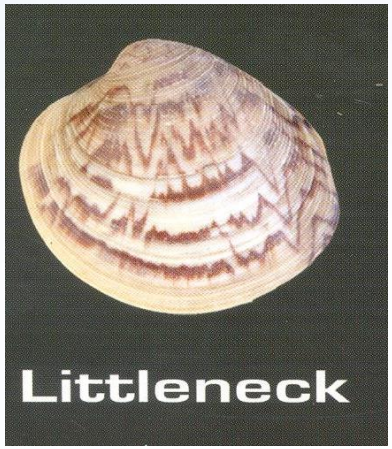
Clam Wholesalers

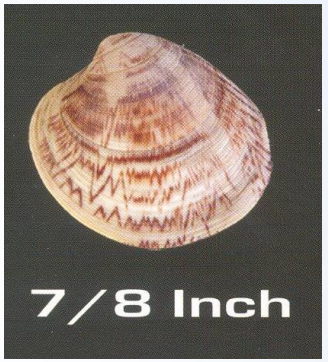
- About 50 certified clam wholesalers statewide
  - 21 firms in Levy County
- Clams sold as live shell stock

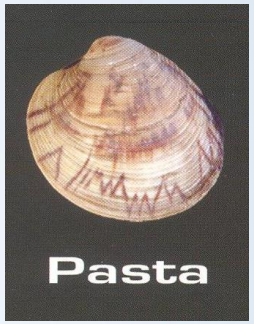


How to describe marketable clams?









Common Name	Number per Pound	Width / Hinge Size (inches)
Middleneck	7-9	1 1/4”
Littleneck	10-13	1”
7/8 inch	14-18	7/8”
Pasta	18-25	3/4”

Did you know?

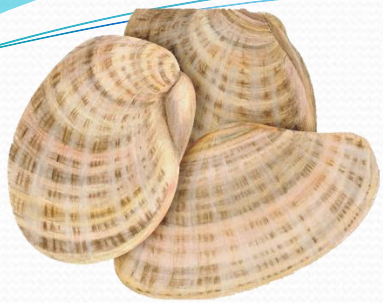
Shellfish Aquaculture is GOOD for the Environment!

Shellfish Farming is Sustainable

- Shellfish seed are hatchery produced, not sourced from wild populations
- Shellfish feed low on food chain
- No feeds, fertilizers, herbicides, drugs, chemicals, or antibiotics are used in their production

Information provided by the East Coast Shellfish Growers Association

East Coast Shellfish Growers Association



SUMMARY

- Florida is #4 in the nation for shellfish aquaculture!
- The state's shellfish industry has ~$ 20 million in sales annually!
- Hard clams are the main product in Florida, over 180 million produced annually.
- Oyster aquaculture farms are increasing in number each year.
- Shellfish aquaculture is sustainable, benefiting Florida's environment and the economy!