Evaluation of the Sunray Venus Clam *Macrocallista nimbosa* under Field Nursery and Growout Culture Conditions in Florida

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Sea Grant
Florida

Background

- Considerations for alternative species for aquaculture
  - Native molluscan species
  - Cultured and marketed similar to hard clam *Mercenaria mercenaria*
- Sea Grant-funded research has evaluated the suitability of several mollusks
  - Angel wing, 1990-1992
  - Bay scallop, 1996-2000
  - Ark clams, 2002-2004
- New species: Sunray Venus, *Macrocallista nimbosa*, 2006-10

Background

- Attractive large (up to 6”SL) clam distributed from South Carolina to Florida
- Targeted species for commercial harvest in 1960s along west coast
- Harvest halted due to spotty distribution, limited fishing grounds
- Natural growth rate experiments suggested fast grower
  - (3”, 40 g in 12 months)

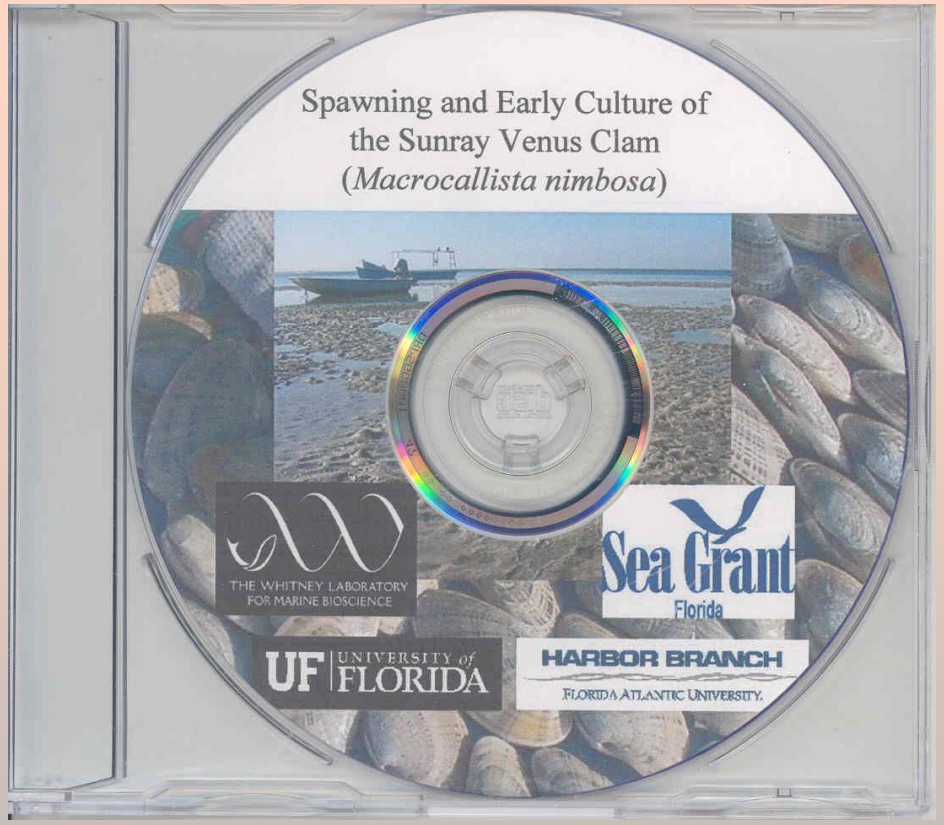
Shell pile at Apalachicola processing plant
Photo courtesy of Florida State Archives

Objectives

- Utilize current hard clam methods as a starting point to:

1) Identify spawning methods
2) Establish hatchery protocols
3) Examine nursery culture
4) Evaluate field nursery and growout methods
5) Test market acceptance

Presented by John Scarpa at the 2008 Clam Industry Workshop



DVD available:
Spawning and Early Culture of the Sunray Venus Clam

Broodstock Collection and Spawning

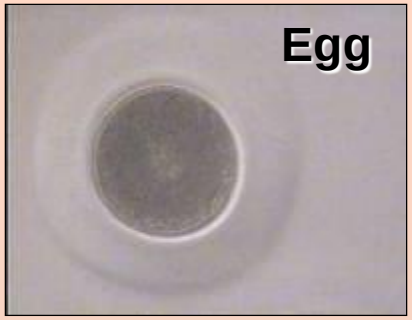
Adults collected from intertidal sandbars where natural populations noted

Held in trays with substrate - sand, aragonite

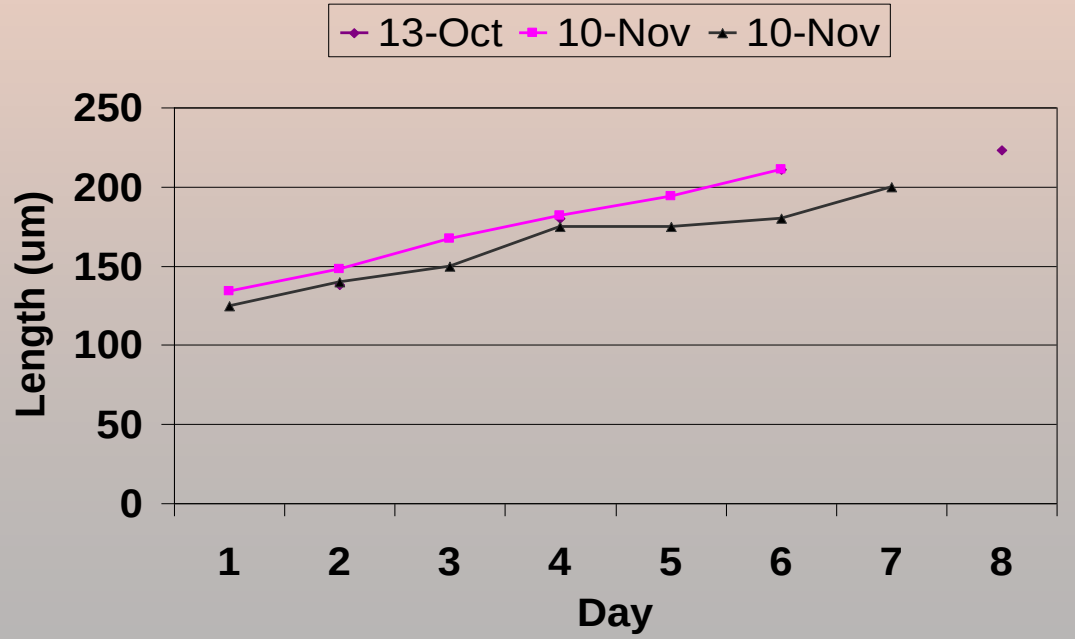
Conditioned at 28-30 ppt, 65-75^{o}F and fed adequate microalgae

Induced spawning by using thermal cycling, temperature increased 10-20^{o}F above ambient (70^{o}F), and addition of dissected sperm

Larval Culture

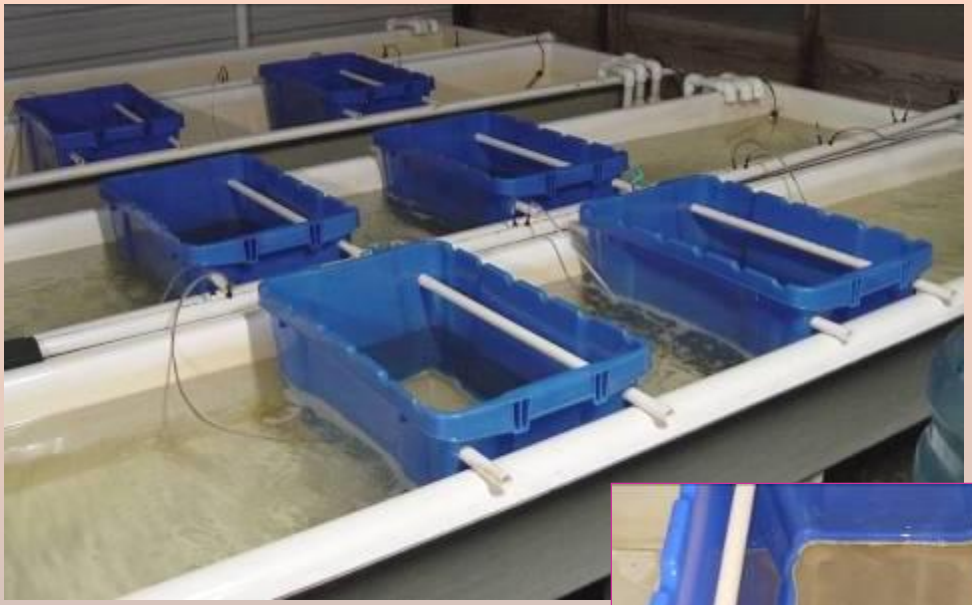


Embryological development documented, similar to most bivalves, except eggs have noticeable gelatinous membrane



Fertilized eggs placed in culture tanks at 1-2/mL. Larval culture rearing conditions were 28-35 ppt, 72-86^{o}F, daily water changes, fed 50-100K cells/mL of microalgae

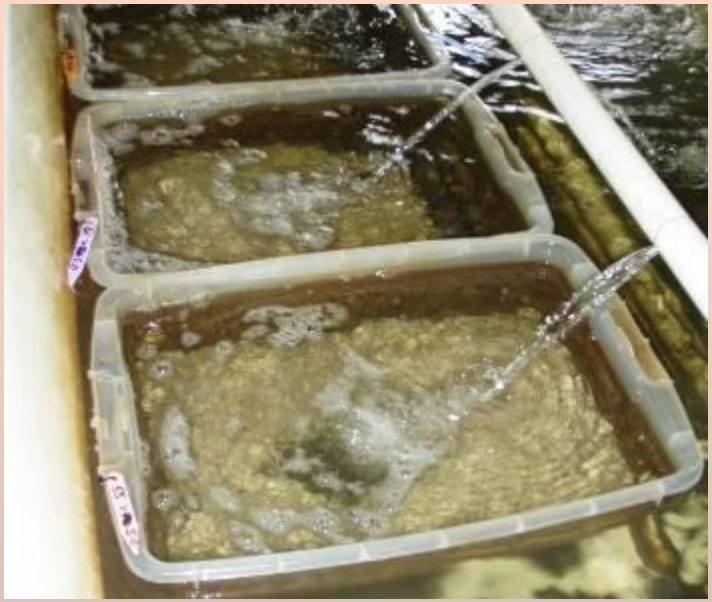
Setting and Post-set Culture



Pediveligers were noted by day 6-9 and moved to setting system

Pediveligers stocked at 2-3K/ft^2 of bottom area, fed microalgae, and rinsed with saltwater

Land-based Nursery Rearing



In 1-3 months, depending on feed and temperature, post-set sieved on 1.0-1.2 mm screens (275-500/mL) and moved to land-based nurseries. Reared in downwellers, upwellers, and FLUPSY

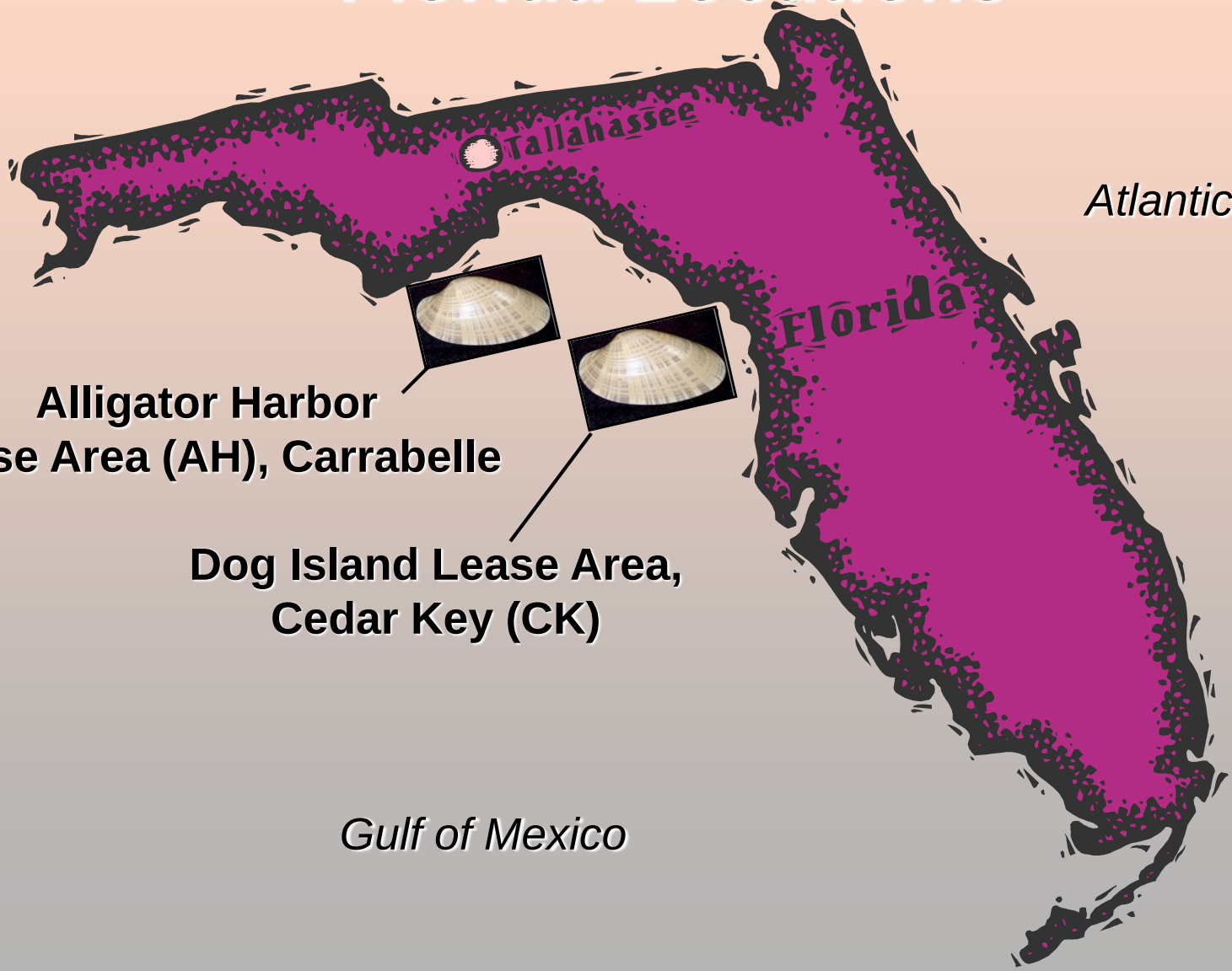
Addition of substrate was advantageous, but could be problematic if allowed to go anaerobic

Objectives

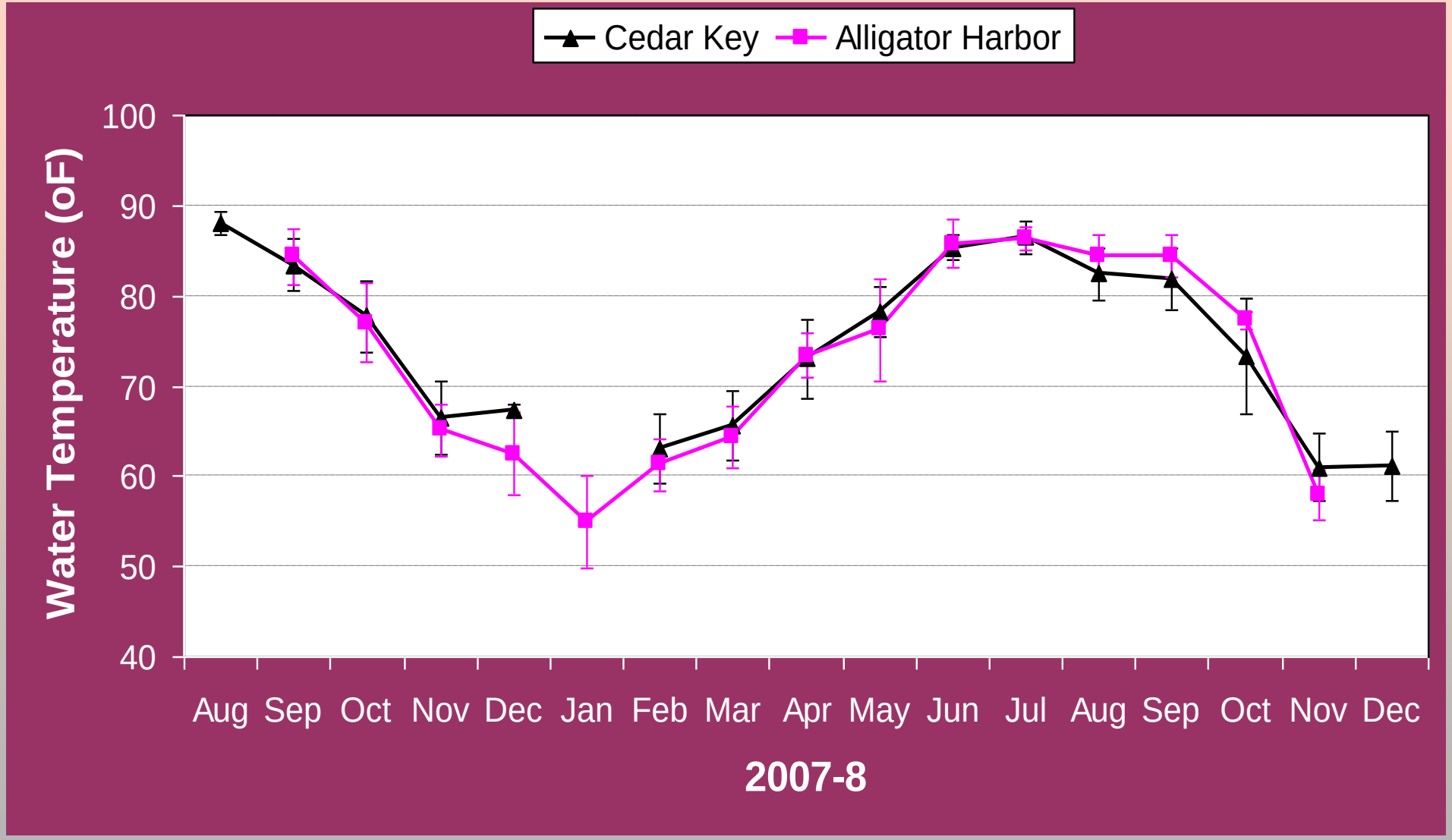
- Utilize current hard clam methods as a starting point to:

  1) Identify spawning methods
  2) Establish hatchery protocols
  3) Examine nursery culture
  4) Evaluate field nursery and growout methods
  5) Test market acceptance

Field Nursery and Growout Trials
Florida Locations

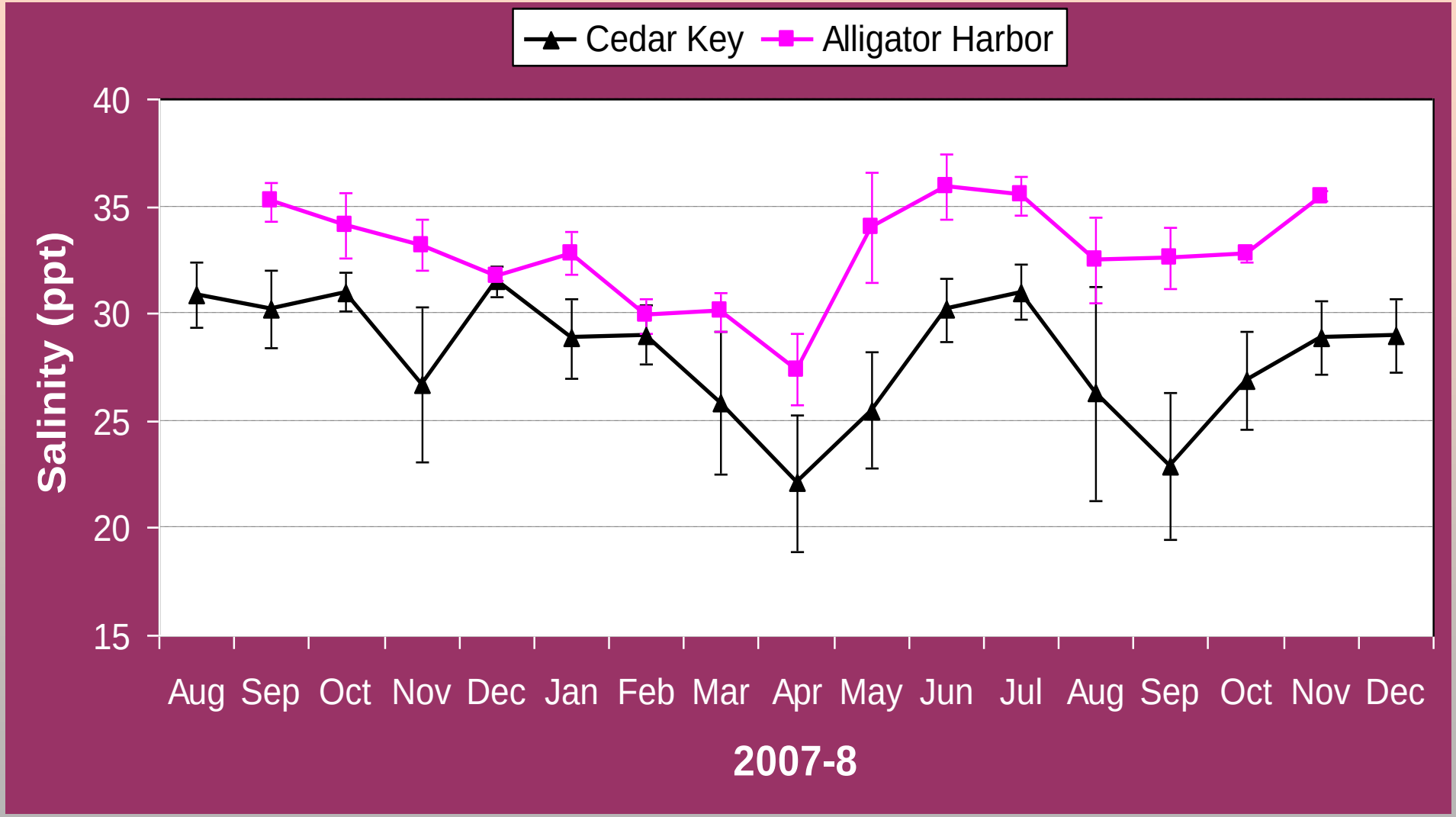


Temperature (ºF), Monthly Means ± SD



Water temperature measured every 30 minutes with YSI 6600 data sonde

Salinity (ppt), Monthly Means ± SD

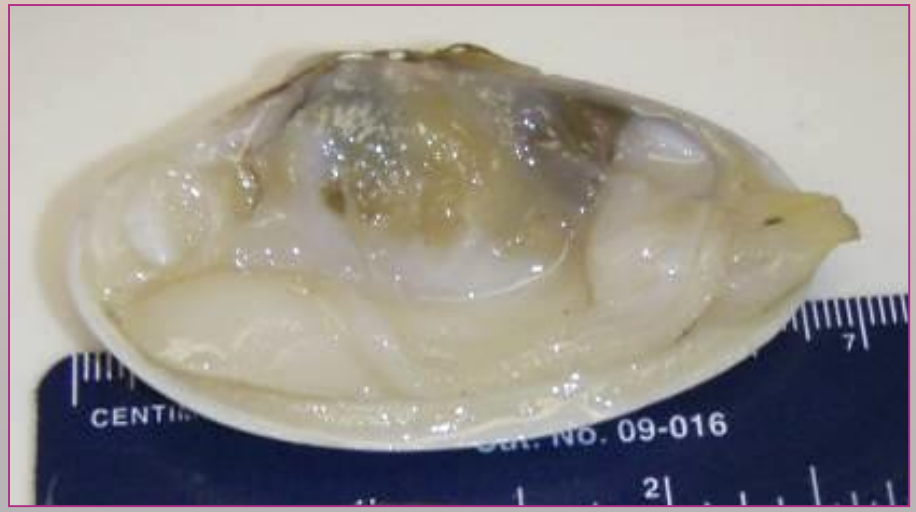


Salinity measured every 30 minutes with YSI 6600 data sonde

Sampling and Measurements

Following parameters measured:

- Survival
- Growth – SL, SW, SH
- Weight – total, meat, dry
- Condition index*
- Histology



*Ratio of dry meat:dry shell x 100 (Fernandez *et al.* 1999)

Field Nursery Trials – Bottom Cages

Bottom cages (3' x 1.5' x 6" deep) constructed of wire and lined with 4 mm polyester mesh material

- Stocking densities, 100-375/ft^2
- Seed sizes, 11.7-18.5 mm SL
- Duration, 42-106 days

Field Nursery Trials – Bottom Bags

Bottom bags (3' by 4' and 4' by 4') made of 4 mm polyester mesh material

- Stocking densities, 330-555/ft^2
- Seed sizes, 9.3-13.8 mm SL
- Duration, 78-113 days

Field Nursery Results – Alligator Harbor

Sieve (mm)	System	Density (#/ft^2)	# Days	Survival (%)	Shell Length (mm)	Growth (mm/day)
9.0	Cage	100	42	69.3 ± 28.7	26.8 ± 3.6	0.20
9.0	Cage	200	42	94.3 ± 4.3	27.6 ± 3.8	0.22
6.7	Cage	222	78	70.3 ± 0.1	27.5 ± 3.7	0.18
6.7	Bag	330	78	78.3 ± 3.0	22.8 ± 3.6	0.12
5.0	Bag	555	106	31.6 ± 11.8	26.9 ± 3.3	0.17

Field Nursery Results – Cedar Key

Sieve (mm)	System	Density (#/ft^2)	# Days	Survival (%)	Shell Length (mm)	Growth (mm/day)
6.0	Cage	375	106	81.8 ± 24.2	26.2 ± 1.2	0.14
4.0	Bag	440	113	90.1 ± 4.4	23.8 ± 0.7	0.13

Density used for stocking hard clams in a 4’ x 4’ (16ft^2) nursery bag is 625/ft^2

Field Nursery Results

Approximately 78,000 juveniles (22-28 mm SL) nursed during June – November 2007 and used for growout trials

Growout Trials Alligator Harbor

Bottom cages (3' x 3' x 6" deep) constructed of vinyl-coated wire

Bottom bags (4' x 4') made of 9 mm polyester mesh material

- Stocking densities, 38-70/ft^2
- Seed sizes, 26.9-27.1 mm SL
- Duration, 396-476 days (13-15 months)

Growout Results – Alligator Harbor

Gear	SD* (#/ft^2)	# Days	Survival (%)	Shell Length (mm)	Total Weight (g)	Dry Mt Weight (g)	CI
Cage	51	476	28.4 ± 6.0	64.7 ± 1.7	36.7 ± 3.4	1.82 ± 0.25	8.6 ± 0.7
Bag	38	476	24.2 ± 16.7	45.6 ± 3.6	14.5 ± 3.2	0.94 ± 0.26	9.9 ± 1.9
Bag	50	396	38.4 ± 14.0	56.2 ± 0.8	23.4 ± 1.0	1.18 ± 0.12	9.8 ± 0.4
Bag	70	412	58.3 ± 26.7	48.9 ± 3.0	19.6 ± .0	1.02 ± 0.07	10.3 ± 0.6

*Stocking Density. Note densities used for stocking hard clams in growout bags range from 50-75/ft^2

Growout Results – Alligator Harbor

- Mortalities attributed to predation – holes in bags, crushed shell in cages and bags, presence of stone crabs

Growout Results – Alligator Harbor

- Shell deformities or irregularities observed of clams in bags
  - Limited to ventral margin with one valve having excessive curvature resulting in a depression
- Ranged from 8 to 48% per bag

Growout Trials – Bottom Cages Cedar Key

- Stocking densities, 43 & 56/ft^2
- Replications, 3 cages per SD
- Seed size, 26.2 mm in SL
- Duration, 340 days (11.2 months)

Bottom Cage Results – Cedar Key 11.2 Months

SD* (#/ft^2)	Survival (%)	Shell Length (mm)	Shell Width (mm)	Total Weight (g)	Dry Mt Weight (g)	Cond Index
43	76.7 ± 9.1	64.5 ± 2.5	22.9 ± 0.6	33.9 ± 2.9	1.55 ± 0.14	8.8 ± 0.3
56	59.9 ± 13.4	62.9 ± 2.5	22.3 ± 0.1	32.4 ± 2.7	1.48 ± 0.15	8.2 ± 0.2

*Stocking Density. Note densities used for stocking hard clams in growout bags range from 50-75/ft^2

Growout Trials – Bottom Bags Cedar Key

- Bottom bag treatments
  - No frame
  - 1” PVC pipe frame
  - 1 ½” PVC pipe frame
- Replications, 3 bags per trt
- Stocking density, 44/ft^2
- Seed size, 26.4 mm in SL
- Duration, 377 days (12 months)

Bottom Bag Results – Cedar Key 12 Months

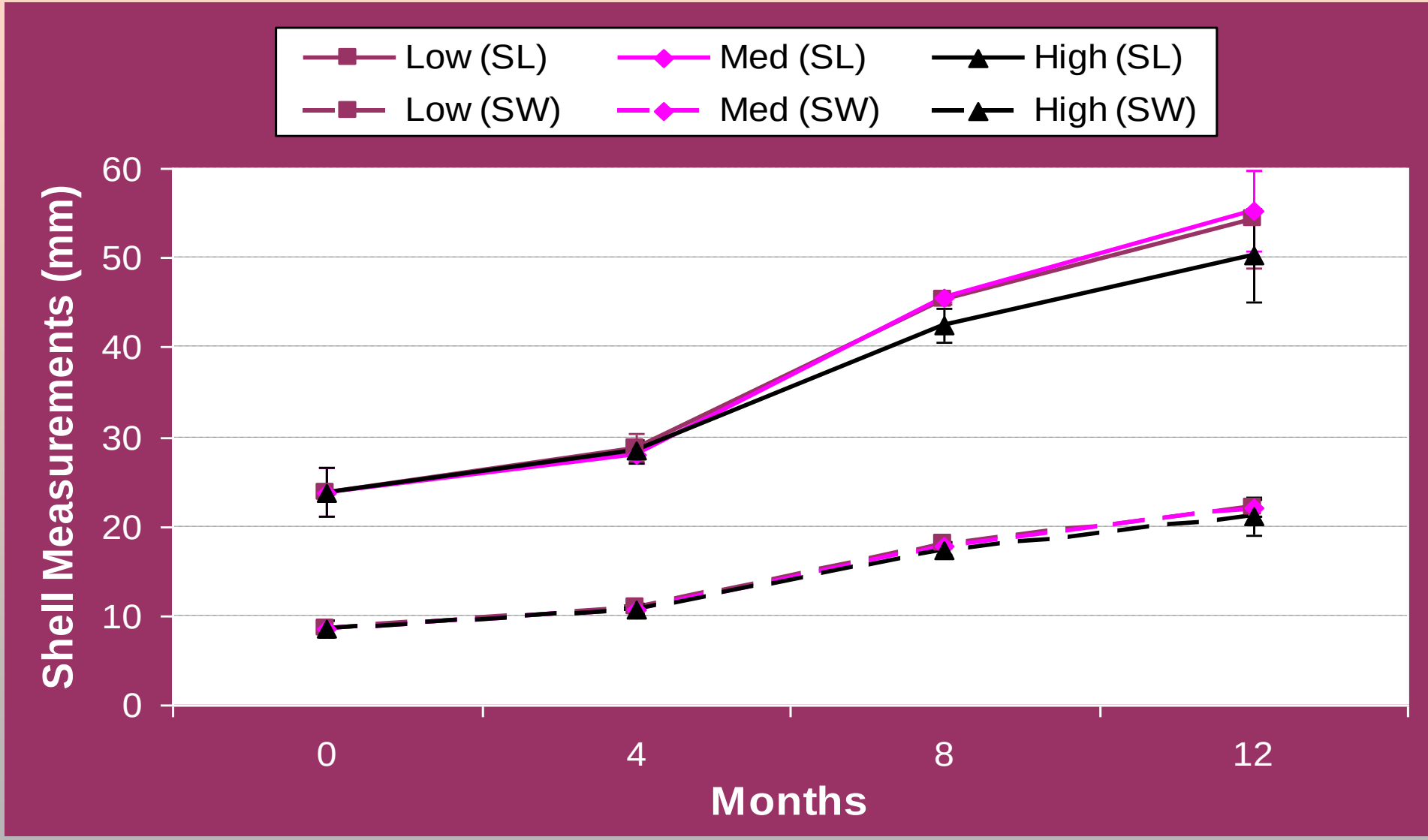
Bag	Survival (%)	Shell Length (mm)	Shell Width (mm)	Total Weight (g)	Dry Mt Weight (g)	Cond. Index
No frame	76.3 ± 9.1	56.1 ± 1.9	22.7 ± 0.4	26.9 ± 2.1	1.61 ± 0.30	11.2 ± 0.5
1” frame	64.7 ± 8.3	58.2 ± 2.5	22.3 ± 0.1	29.3 ± 1.8	1.72 ± 0.13	11.0 ± 0.5
1 ½” frame	75.1 ± 7.4	58.7 ± 0.7	22.1 ± 0.1	29.2 ± 0.7	1.61 ± 0.05	10.4 ± 0.2

Statistical analyses conducted with SAS using general linear model, statistical differences considered significant if P<0.05.

Stocking Density Trials Cedar Key

- Stocking density treatments
  - Low, 600/bag, 38/ft^2
  - Medium, 800/bag, 50/ft^2
  - High, 1000/bag, 63/ft^2
- Replications, 9 bags per trt
- Bottom bags, cover netting
- Seed size, 23.8 mm in SL
- Duration, 372 days (12 months)

Stocking Density Results – Cedar Key



Monthly Growth Rate (SL): Low-2.55 mm Med-2.62 mm High-2.21 mm

Stocking Density Results – Cedar Key 12 months

Density	Survival (%)	Total Weight (g)	Dry Meat Weight (g)	Condition Index
Low	73.1 ± 6.4	24.1 ± 4.9	1.35 ± 0.27	11.3 ± 0.7
Med	67.2 ± 22.2	24.9 ± 4.5	1.43 ± 0.25	11.1 ± 0.5
High	74.5 ± 14.2	19.9 ± 4.7	1.14 ± 0.14	10.8 ± 0.6

Statistical analyses conducted with SAS using general linear model, statistical differences considered significant if $P<0.05$.

Growout Results – Cedar Key

- Shell deformities were also noted and quantified
  - 19-22% from bags
  - 1-4% from bags with frames
  - None from cages
- Sunray venus harvested from AH and held in cages in CK for several months “grew out” of their shell irregularities

Summary

- Sunray venus clams were cultured through field nursery and growout using methods similar to hard clams
- Production results were site-specific
- At one site, commercially acceptable survival and growth rates were obtained
- Shell deformities were gear and substrate related
- Ongoing studies will determine suitability of other existing lease areas to assist in determining optimum site characteristics

Sunray Venus Clams

were harvested for market evaluations in October-December 2008

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What's next?

- Eliminate barriers to commercial production of sunray venus clams by:

1) Creating initial founder broodstock lines for Florida hatcheries;
2) Demonstrating proper development broodstock for seed production;
3) Determining production performance for field-based nursery and growout culture at multiple existing commercial high-density lease areas;
4) Establishing a relationship between soil (substrate) and productivity at multiple lease areas using a soils-based approach;
5) Defining a) salinity and b) soil preferences for selection of future lease sites;

What's next?

- Eliminate barriers to commercial production of sunray venus clams by:

6) Determining the sensory, microbial, and nutritional profiles of cultured sunray venus clams; and

7) Examining product attributes with respect to wholesale market and product distribution standards for molluscan shellfish.

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We are seeking industry partners to participate in these objectives.