



Evaluation of the Sunray Venus
Macrocallista nimbosa
for Diversification of the
Hard Clam Aquaculture Industry
in Florida

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HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY



Background

- Considerations for alternative species for aquaculture
 - Native molluscan species
 - Cultured and marketed similar to hard clam
Mercenaria mercenaria
- FL Sea Grant-funded research has explored culture potential of variety of marine mollusks
 - Angel wing, 1990-1992
 - Bay scallop, 1996-2000
 - Ark clams, 2002-2004
- New species: Sunray Venus,
Macrocallista nimbosa, 2006-12





Background



- Attractive large (up to 6" SL) clam distributed from South Carolina to Florida
- Targeted species for commercial harvest in 1960s along FL's 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

Results Presented at:

*Larval and early nursery culture of the sunray venus clam *Macrocallista nimbosa*.*

Scarpa, J., Sturmer, L.N., Nunez, J., Laramore, S. and Creswell, R.L.

Caribbean & Latin America Aquaculture 2007, San Juan, Puerto Rico, 6-9 Nov 2007.

*Evaluation of the sunray venus clam *Macrocallista nimbosa* for aquaculture in Florida.*

Scarpa, J., Sturmer, L., Nuñez, J. and Creswell, R.L.

National Shellfisheries Association 100th Annual Mtg, Providence, RI, 6-10 April 2008.

*Salinity tolerance of the sunray venus clam *Macrocallista nimbosa*.*

Scarpa, J., Laramore, S.E., Harangody, M. and Sturmer, L.N.

National Shellfisheries Association 101th Annual Mtg, Savannah, GA, 22-26 Mar 2009.

Funded by Florida Sea Grant R/LR-A-44, 2006-8

Broodstock Collection and Spawning



130 mm (5") SL

Adults collected from intertidal sandbars where natural populations noted



Held in trays with substrate - sand, aragonite

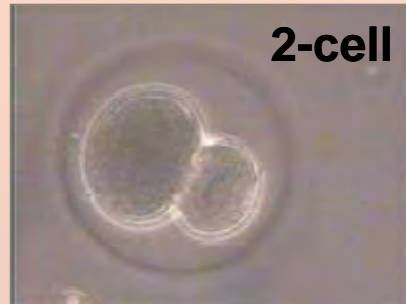
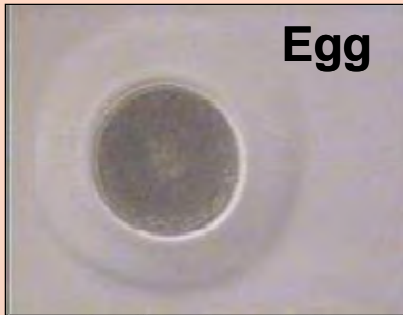


Conditioned at 28-30 ppt, 65-75°F and fed adequate microalgae

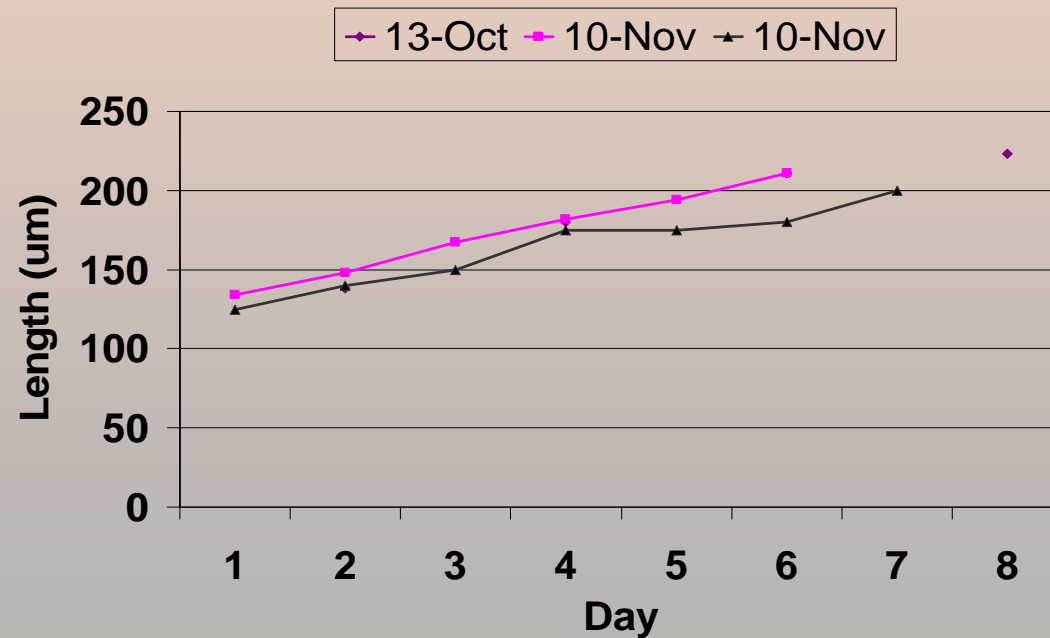


Induced spawning by using thermal cycling, temperature increased 10-20°F above ambient (70°F), and addition of dissected sperm

Larval Culture



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



Survival:
 13 Oct - 13% ?
 10 Nov HBOI - 88%
 10 Nov UF - 85%

Fertilized eggs placed in culture tanks at 1-2/mL. Larval culture rearing conditions were 28-35 ppt, 72-86°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/ft² of bottom area, fed microalgae, and rinsed with saltwater



Setting and Post-set Culture

- **Substrate Experiments**

- No Substrate
- Aragonite (0.5-1.0 mm)
- Sand (<0.5mm)
- Pediveligers to >1.0mm sieve

- **First Exp: (n=1)**

- Sand: 100%
- Aragonite: 71%
- No Substrate: 49%
- Total: 32K (63% return)

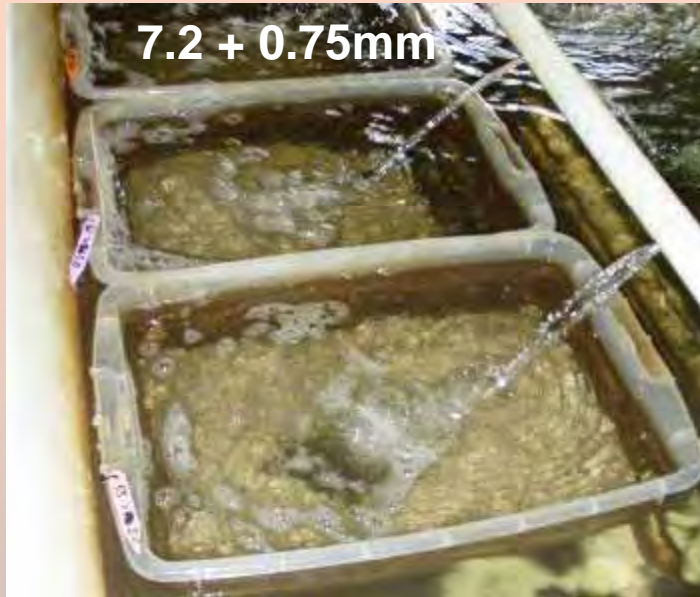
- **Second Exp: (n=3)**

- Sand: 58%
- No Substrate: 35%
- Total: 454K (46% return)



*In 1-3 months, depending on feed and temperature,
post-set sieved on 1.0-1.2 mm screens
Size: 275-500/mL, 1.2-1.5 mm shell width,
3.3-4.0 mm shell length*

Land-based Nursery Rearing



Juveniles (>1.6 mm sieved seed) moved to land-based nurseries. Reared in downwellers, upwellers, and FLUPSY at 17,200/m² (1600/ft²) for 3-4 months.



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





Land-based Nursery Rearing

Juveniles (>1.6 mm sieved seed) reared in laminar-flow raceways and trays at 10,760-27,000/m² (1000-2500/ft²) for 7-9 weeks.

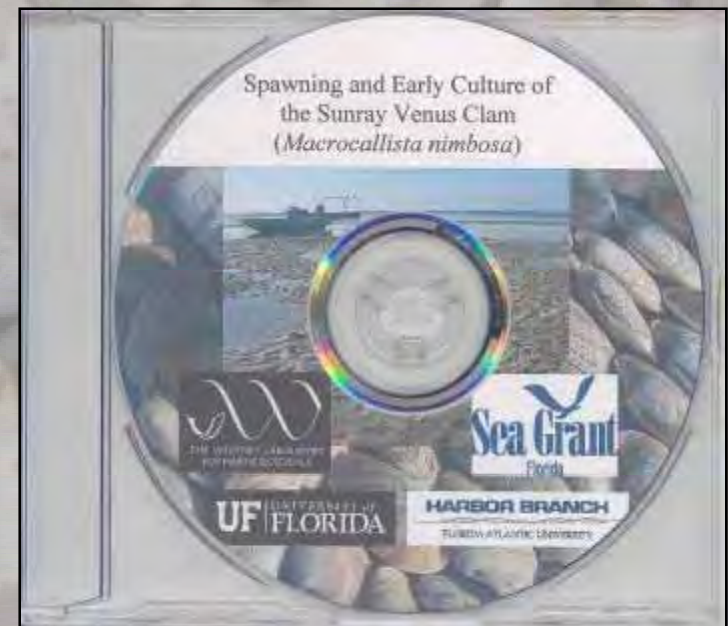
Results ranged from 7.4-8.9 mm SL, 85-91% survival.

System	Stocking Density (# / ft ²)	# Reps	Ave SL mm (±SD)	Ave Survival % (±SD)	Sieve >4.0 mm % (±SD)	Sieve >3.3 mm % (±SD)
Tank	1000	2	7.4 (0.4)	84.6 (1.2)	53.2 (1.7)	26.3 (2.7)
	2000	2	7.3 (0.1)	89.0 (2.0)	46.9 (6.3)	25.2 (1.8)
Tray	1000	3	8.9 (0.6)	88.9 (1.6)	79.1 (7.6)	14.1 (6.4)
	1500	3	8.4 (0.2)	91.0 (6.7)	75.0 (9.1)	15.4 (5.2)
	2000	3	8.3 (0.7)	87.8 (2.7)	74.7 (4.1)	15.3 (3.4)
	2500	3	8.1 (0.5)	88.3 (2.7)	69.9 (5.6)	17.5 (3.2)

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

Summary

- Sunray venus clams were successfully
 - Collected and transported
 - Spawned under controlled conditions
 - Cultured through setting and nursery
 - Methods similar to hard clam
- DVD summarizing seed production techniques and documentation of sunray venus development during hatchery phase is available





Objectives

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

4) Evaluate field nursery and growout methods

Results Presented at:

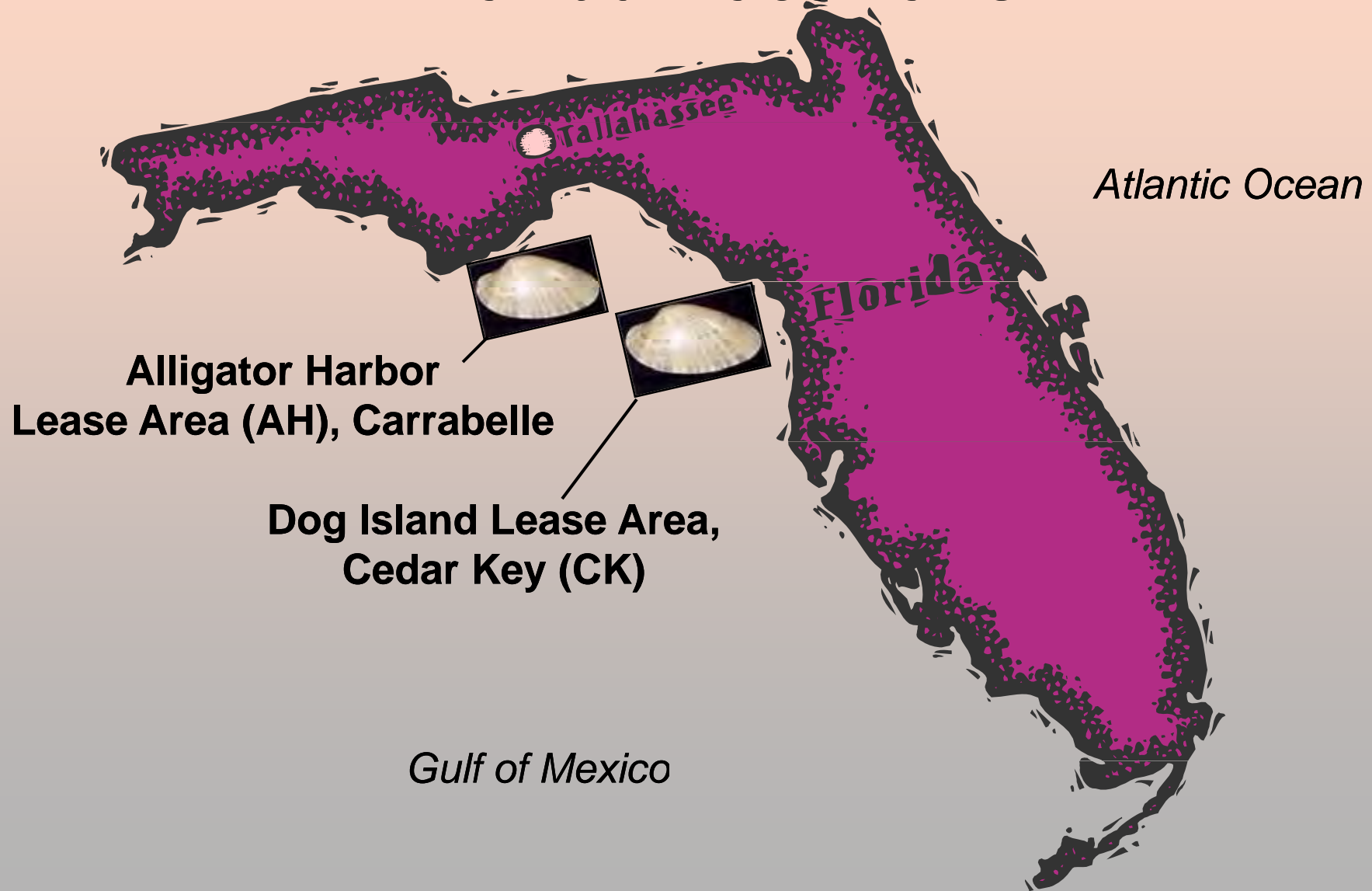
*Evaluation of the sunray venus clam *Macrocallista nimbosa* under field nursery and growout culture conditions in Florida.*

Sturmer, L.N., Scarpa, J. Laramore, S.E. and Creswell, L.

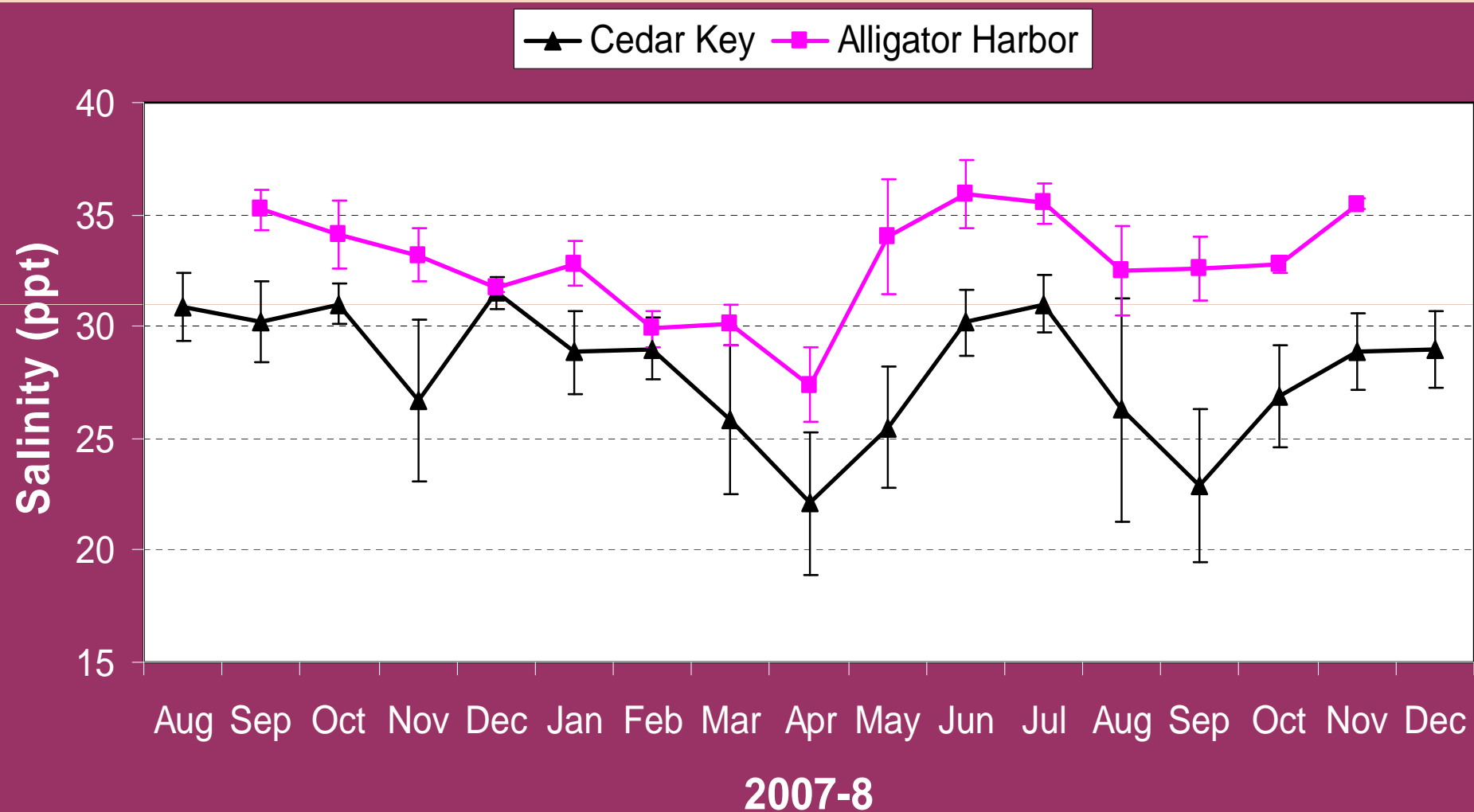
National Shellfisheries Association 101th Annual Mtg, Savannah, GA, 22-26 March 2009.

Funded by Florida Sea Grant R/LR-A-45, 2007-9

Field Nursery and Growout Trials Florida Locations



Salinity (ppt), Monthly Means \pm SD



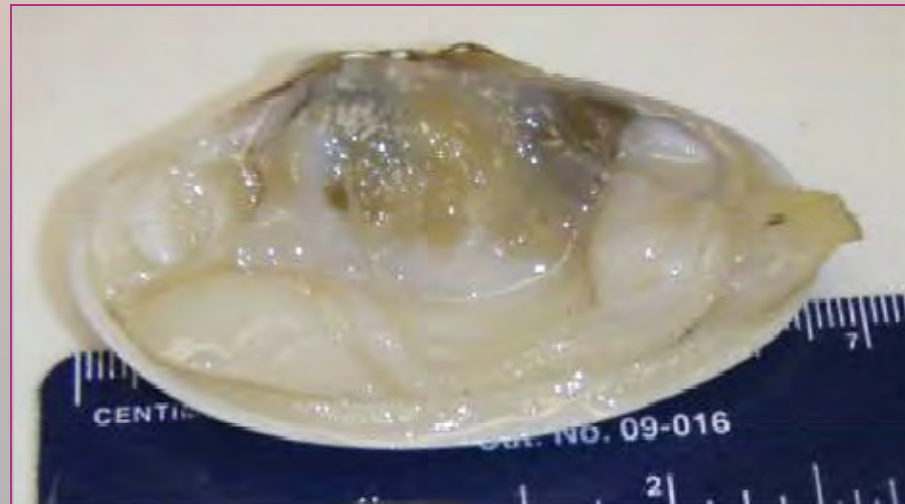
Salinity measured every 30 minutes with YSI 6600 data sonde

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/ft²
- Seed sizes, 12-18 mm SL
- Duration, 42-106 days





Field Nursery Results Bottom Cages

Site	Sieve (mm)	Density (#/ft ²)	# Days	Survival (% \pm SD)	Shell Length (mm \pm SD)	Growth (mm/day)
AH	9.0	100	42	69.3 \pm 28.7	26.8 \pm 3.6	0.20
AH	9.0	200	42	94.3 \pm 4.3	27.6 \pm 3.8	0.22
AH	6.7	222	78	70.3 \pm 0.1	27.5 \pm 3.7	0.18
CK	6.0	375	106	81.8 \pm 24.2	26.2 \pm 1.2	0.14

AH – Alligator Harbor CK – Cedar Key

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/ft²
- Seed sizes, 9-14 mm SL
- Duration, 78-113 days

Field Nursery Results Bottom Bags



Site	Sieve (mm)	Density (#/ft ²)	# Days	Survival (% \pm SD)	Shell Length (mm \pm SD)	Growth (mm/day)
AH	6.7	330	78	78.3 \pm 3.0	22.8 \pm 3.6	0.12
AH	5.0	555	106	31.6 \pm 11.8	26.9 \pm 3.3	0.17
CK	4.0	440	113	90.1 \pm 4.4	23.8 \pm 0.7	0.13

Density used for stocking hard clams in a 4' x 4' (16 ft²) nursery bottom bag is 625/ft²

Growout Trials – Bottom Cages

*Bottom cages (3' x 3' x 6" deep)
constructed of 1" vinyl-coated wire*



- Stocking densities, 43-56/ft²
- Seed sizes, 26-27 mm SL
- Duration, 340-476 days
(11.2-15 months)



Growout Results Bottom Cages

Site	SD* (#/ft ²)	# Reps	# Days	Survival (%)	SL (mm)	Total Wt (g)	Dry Mt Wt (g)	CI
AH	51	4	476	28.4 ± 6.0	64.7 ± 1.7	36.7 ± 3.4	1.82 ± 0.25	8.6 ± 0.7
CK	43	3	340	76.7 ± 9.1	64.5 ± 2.5	33.9 ± 2.9	1.55 ± 0.14	8.8 ± 0.3
CK	56	3	340	59.9 ± 13.4	62.9 ± 2.5	32.4 ± 2.7	1.48 ± 0.15	8.2 ± 0.2

Densities used for stocking hard clams in growout bottom bags (4'x4', 16ft²) range from 50-75/ft²

Growout Trials – Bottom Bags



- Alligator Harbor (AH)
- Stocking densities, 33-70/ft²
- Seed size, 27 mm SL
- Duration, 396-476 days (13-15.6 months)



Bottom bags (4' x 4', 16 ft²) made of 9 mm polyester mesh material

- Cedar Key (CK)
- Stocking density study (n=9)
 - Low, 600/bag, 38/ft²
 - Medium, 800/bag, 50/ft²
 - High, 1000/bag, 63/ft²
- Seed size, 24 mm in SL
- Duration, 372 days (12 months)

Growout Results – Bottom Bags

Site	SD* (#/ft ²)	# Reps	# Days	Survival (%)	SL (mm)	Total Wt (g)	Dry Mt Wt (g)	CI
AH	38	2	476	24.2 ± 16.7	45.6 ± 3.6	14.5 ± 3.2	0.94 ± 0.26	9.9 ± 1.9
AH	50	3	396	38.4 ± 14.0	56.2 ± 0.8	23.4 ± 1.0	1.18 ± 0.12	9.8 ± 0.4
AH	70	4	412	58.3 ± 26.7	48.9 ± 3.0	23.4 ± 1.0	1.02 ± 0.07	10.3 ± 0.6
CK	38	9	372	73.1 ± 6.4	54.4 ± 5.5	24.1 ± 4.9	1.35 ± 0.27	11.3 ± 0.7
CK	50	9	372	67.2 ± 22.2	55.3 ± 4.5	24.9 ± 4.5	1.43 ± 0.25	11.1 ± 0.5
CK	63	9	372	74.5 ± 14.2	50.3 ± 5.2	19.9 ± 4.7	1.14 ± 0.14	10.8 ± 0.6

Predation



Menippe mercenaria

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

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/ft²
- Seed size, 26 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 $P < 0.05$.

Shell Deformities



- Shell deformities or irregularities observed of clams in bags, not cages
 - Limited to ventral margin with one valve having excessive curvature resulting in a depression
- AH – 8 to 48% per bag
- CK – 19 to 22% per bag
 - 1-4% from bags with frames

- 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
 - Field nursery: 90% survival, 24 mm SL in 4 months
 - Growout: 65-76% survival, 50-59 mm SL, 20-29 g TW in 12 months
- Shell deformities were gear and substrate related

Acknowledgements



- University of Florida faculty
 - Don Sweat and John Stevely
- University of Florida staff
 - Eric Cassiano, Chuck Mulligan, Capt. Al Dinsmore
 - Reggie Markham, Barry Clayton, Russ Colson
- Harbor Branch Oceanographic Institute at FAU faculty and staff
 - Susan Laramore, Fredrico Prah
- Industry Partners
 - Van Lewis, St. Teresa Shellfish
 - Johnny Sheridan, Andy Arnold
 - Chris Taiani, Big “T” Clam Farm
 - Cedar Key Aquaculture Farms