

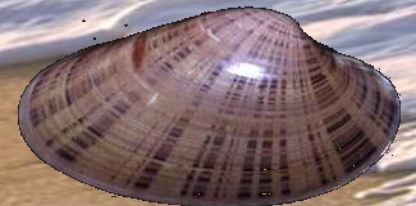
Sunray Venus Clam Growout Culture:

Results of Growout Field Trials in Florida
Evaluation of Bottom Plant Methods
Harvest Sizes & Comparison with Hard Clams



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Presented at Project VENUS Workshops, September 2014, Cedar Key, FL



Sunray Venus Growout Seed



- Shell length (SL), longest distance across shell
 - Measured in millimeters (mm)
 - 25 mm = 1 inch
- Seed size for growout bags (9 mm mesh opening)
 - Minimum ≥ 15 mm SL
 - In UF field trials, used seed size of ≥ 20 mm SL
 - Seed count, 0.5-1.2/ml

Species Diversification in FL Aquaculture: Nursery and Growout of the Sunray Venus Clam

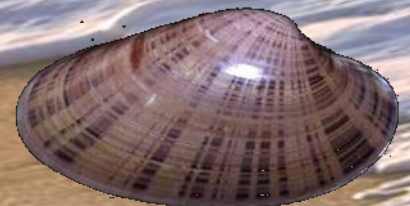
○ Objectives

- Used current hard clam methods as a starting point to:
 - Examine culture methods for growout
 - Document survival and growth in culture systems

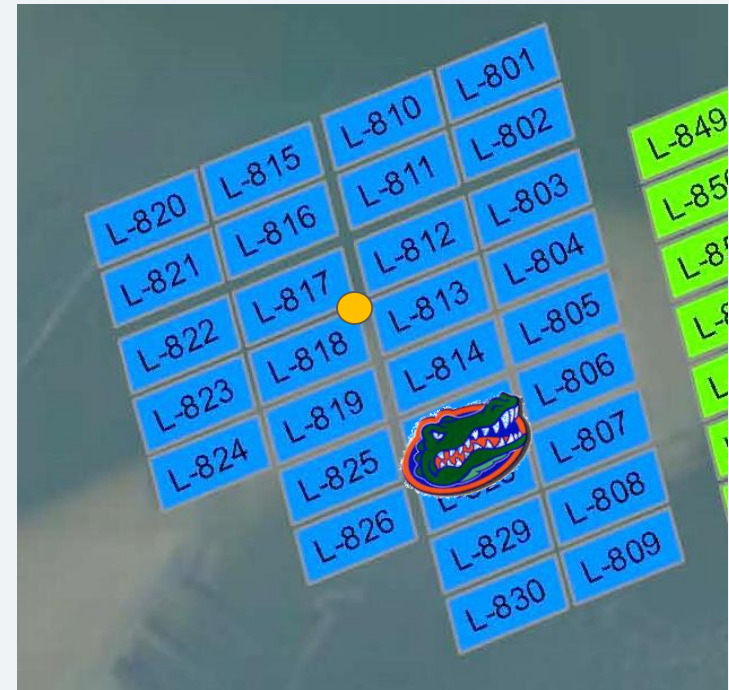
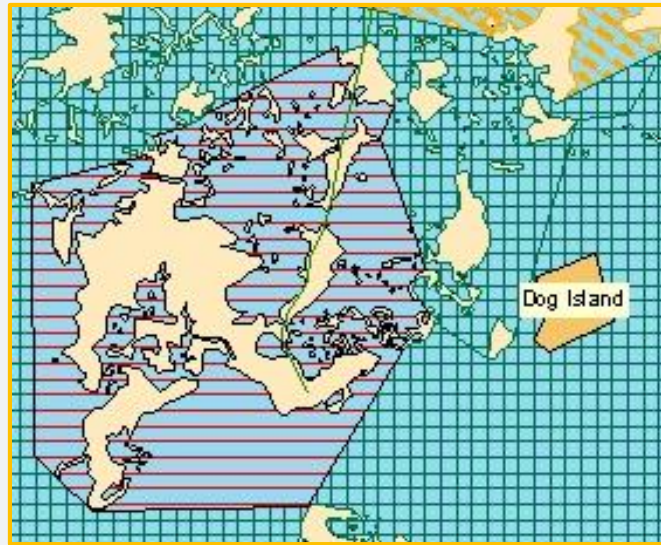
○ Funded by Florida Sea Grant, L/LR-A-45, 2007-09

Sturmer, L.N., Scarpa, J. Laramore, S.E. and Creswell, L. 2009. Evaluation of the sunray venus clam *Macocallista nimbosa* under field nursery and growout culture conditions in Florida. J. Shellfish Res., 28(3):734.

Scarpa, J., Laramore, S.E., Harangody, M. and Sturmer, L.N. 2009. Salinity tolerance of the sunray venus clam *Macrocallista nimbosa*. J. Shellfish Res., 28(3):727.

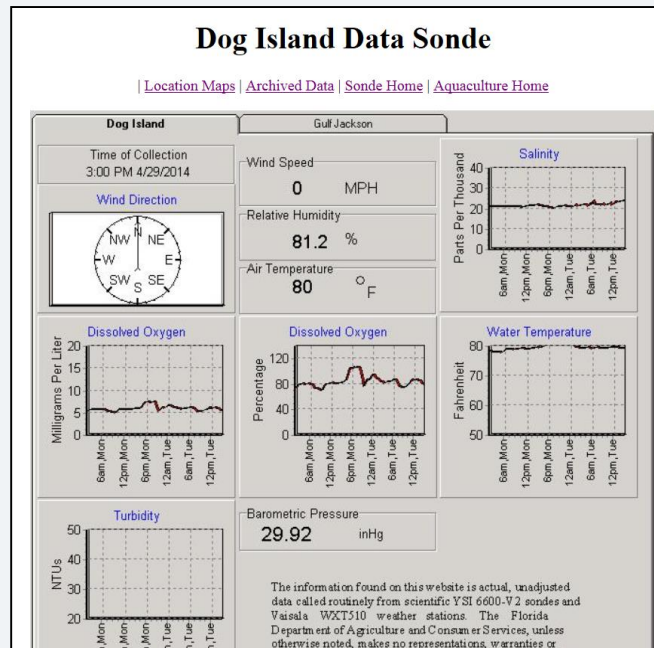


Growout Field Trials conducted at UF Experimental Lease, Dog Island HDLA



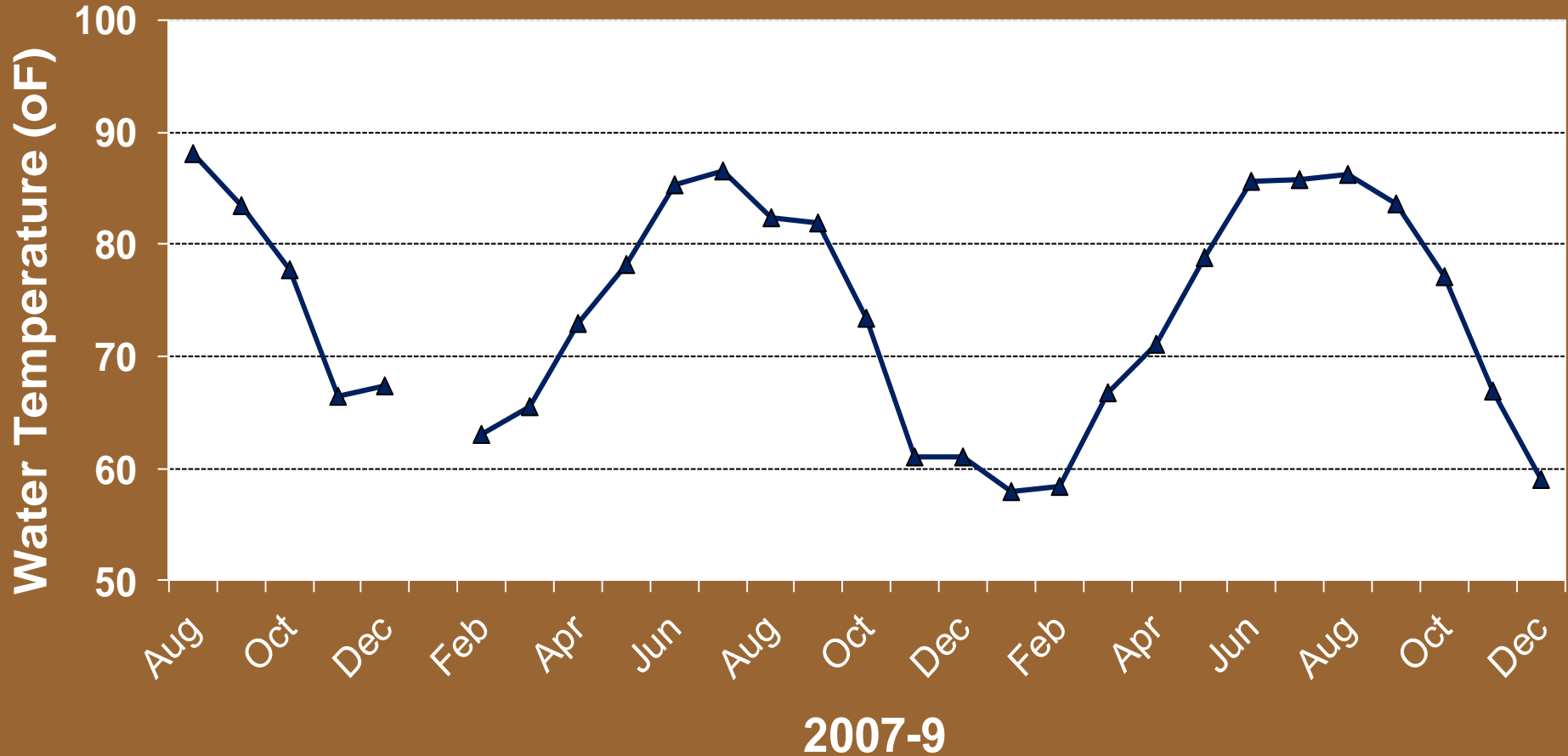
● Water Quality Monitoring Station

**Real-time
WATER QUALITY
information available at**
<http://sondes.floridaaquaculture.com/sondes/>



Temperature (°F), Monthly Averages

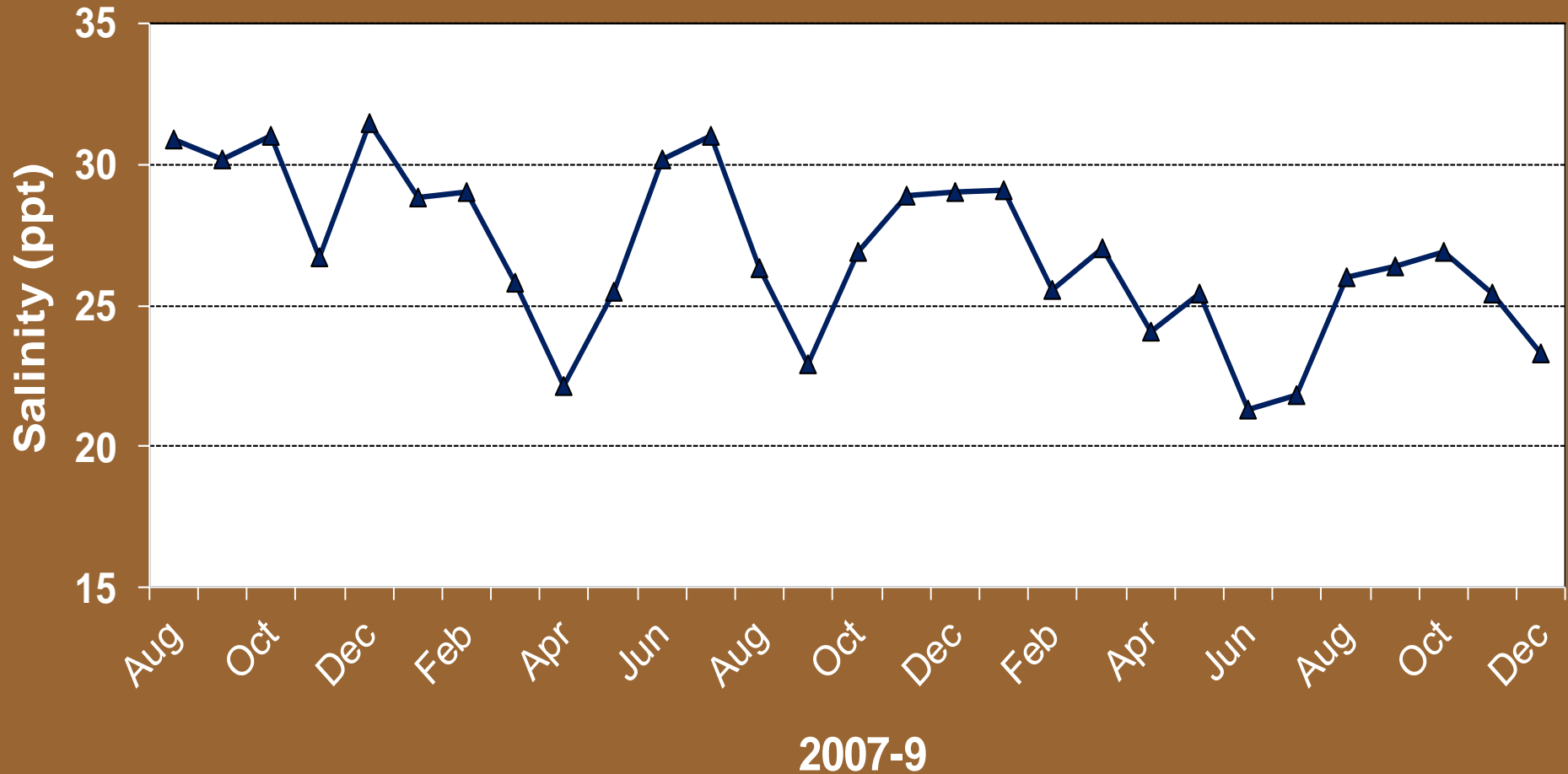
Dog Island High-density Lease Area, Cedar Key



Water temperature measured every 30 minutes with YSI 6600 data sonde

Salinity (ppt), Monthly Averages

Dog Island High-density Lease Area, Cedar Key

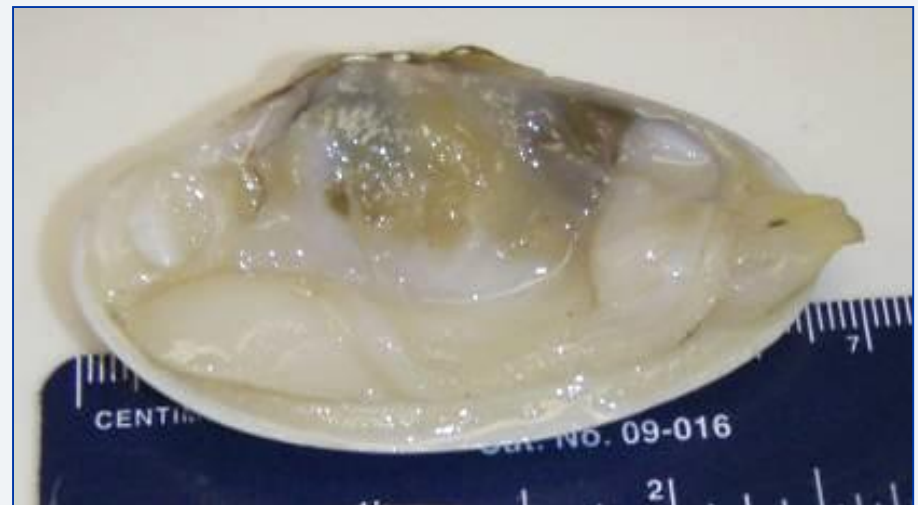


Salinity measured every 30 minutes with YSI 6600 data sonde

Sampling and Measurements

Production characteristics determined at harvest:

- Survival
- Growth – length, width, height
- Weight – total, meat (wet, dry)
- Condition index*



*Ratio of dry meat:dry shell x 100

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, 700/bag (44/ft²)
- Seed size, 26 mm (1") in SL
- Duration, 377 days (12 months)



Bottom Bag Results 2007-8, Cedar Key

Bag Type	Survival (%)	Shell Length, mm (inches)	Shell Width, mm (inches)	Total Weight, g (#/lb)	Dry Mt Weight, g
No frame	76	56 (2.2")	23 (0.9")	27 (17/lb)	1.6
1" frame	65	58 (2.3")	22 (0.9")	29 (15/lb)	1.7
1 1/2" frame	75	59 (2.3")	22 (0.9")	29 (15/lb)	1.6

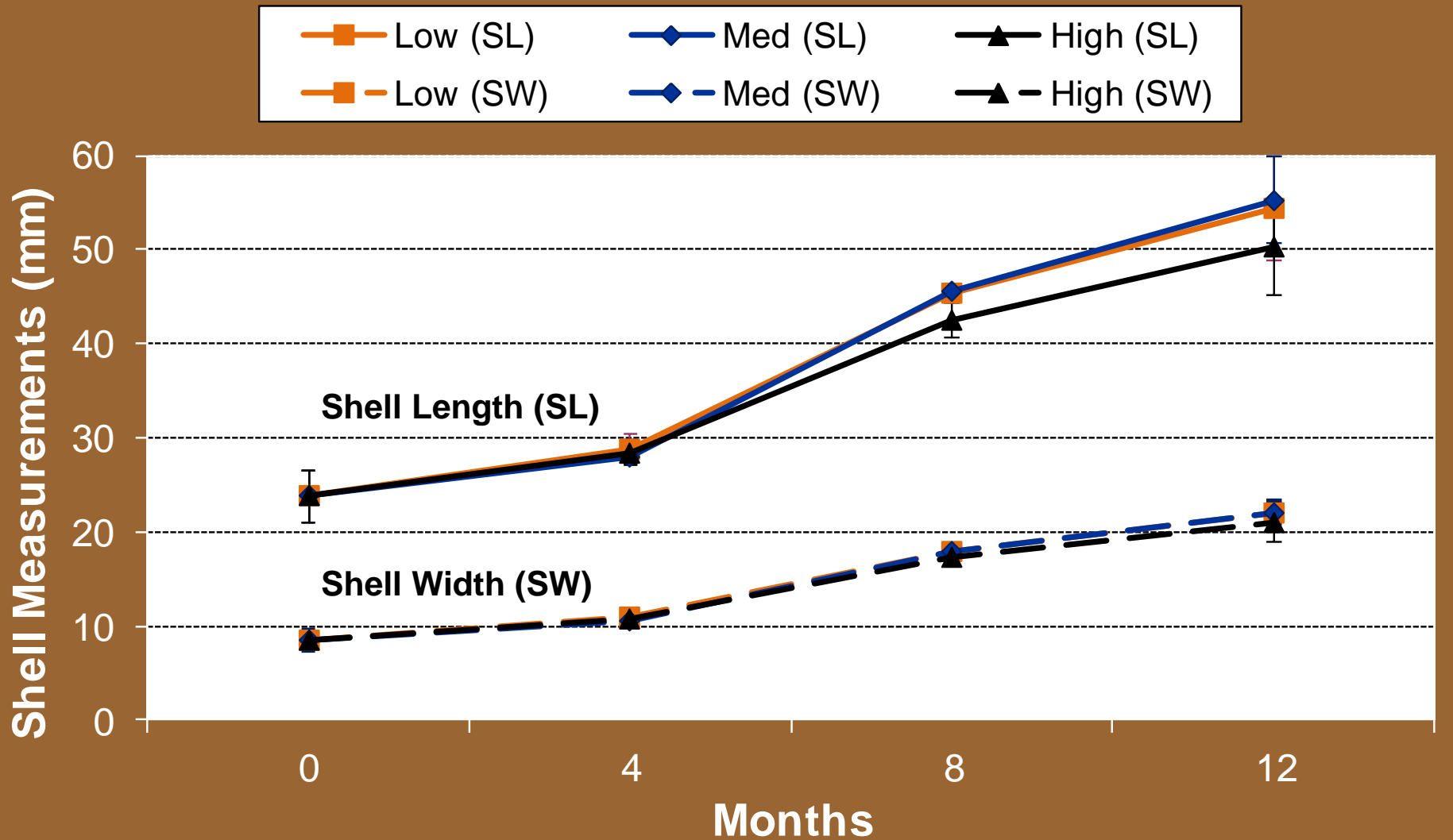
No statistical differences. Statistical analyses conducted with SAS using general linear model, statistical differences considered significant if $P < 0.05$.

Stocking Density Trials Cedar Key



- Stocking density treatments
 - Low, 600/bag (38/ft²)
 - Medium, 800/bag (50/ft²)
 - High, 1000/bag (63/ft²)
- Replications, 9 bags per trt
- Bottom bags, cover netting
- Seed size, 24 mm (1") in SL
- Duration, 372 days (12 months)

Stocking Density Results, Cedar Key



Monthly Growth Rate (SL): Low-2.6 mm Medium-2.6 mm High-2.2 mm



Stocking Density Results 2007-8, Cedar Key

Density	Survival, %	Weight, grams (#/lb)	Dry Meat Weight, grams	Condition Index
Low	73	24 (19/lb)	1.35	11.3
Med	67	25 (18/lb)	1.43	11.1
High	75	20 (23/lb)	1.14	10.8

No statistical differences. Statistical analyses conducted with SAS using general linear model, statistical differences considered significant if $P < 0.05$.

Bottom Plant 2008-9, Cedar Key

Seed broadcasted on bottom substrate, covered with 9 mm mesh polyester netting (4' by 8' plants) edged with lead line, and an additional layer of plastic netting staked with PVC pipe.



- Stocking information
 - Density, 52/ft²
 - Seed size, 26mm (1") length
- Growout duration, 12 months
- Harvest results
 - 53% survival
 - 63 mm (2.5") length
 - 23 mm (0.95") width
 - 33 grams total weight (14/lb)



Sunrays were hand dug at harvest using rakes

Growout Results



Deformities limited to bottom margin of shell with one shell having excessive curvature resulting in depression or hole

- Sunray venus cultured using methods similar to hard clams
- Production results site-specific
- Commercially acceptable survival and growth obtained at Dog Island HDLA
- Shell deformities (irregularities) noted
 - Ranged from 1-22%
 - Gear and substrate-related

Eliminating Barriers to Commercial Production of Sunray Venus Clams in Florida

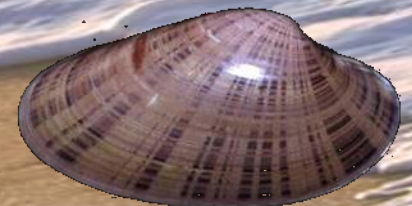
○ Objectives

- Determine production performance and site characteristics at existing leases
- Evaluate bottom sediments at each growout site to determine optimal soil properties
- Test submerged lands sites for potential “new” lease areas

○ Funded by Florida Sea Grant, L/LR-A-46, 2010-12

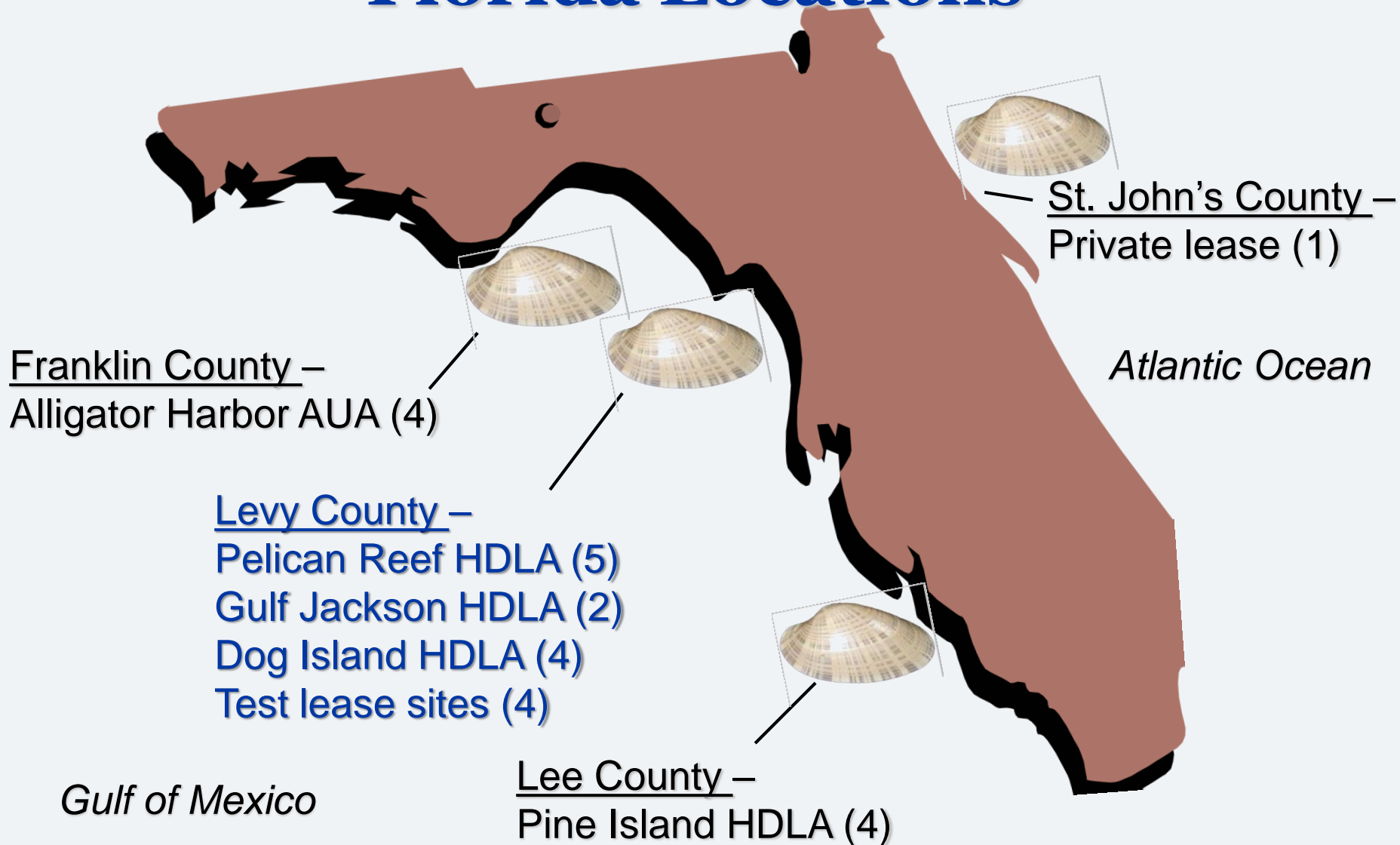
Sturmer, L.N., Scarpa, J., Adams, C., and Creswell, L. 2010. Evaluation of the sunray venus clam for diversification of the hard clam culture industry in Florida. Page 965, Book of Abstracts, Aquaculture 2010, San Diego, CA, 1-5 March 2010.

White, W., Sturmer, L.N., Ellis, L.R., and Osborne, T. 2012. Applying a soils-based approach to clam aquaculture in Florida. J. Shellfish Res., 31(1):360.



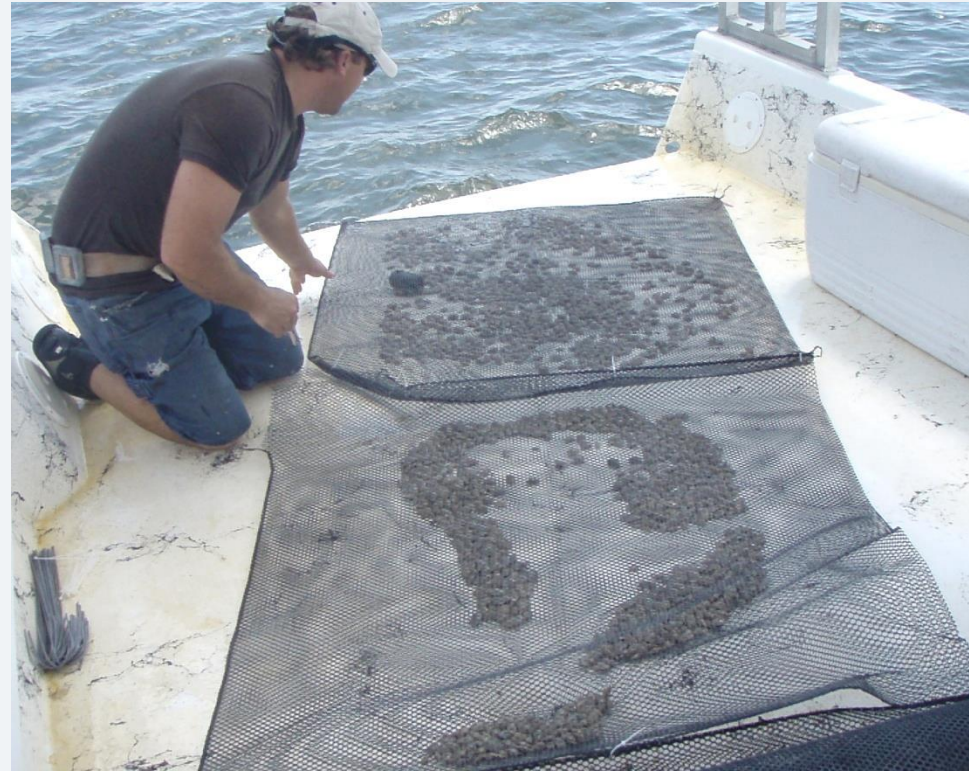
Growout Trials, 2010-12

Florida Locations



Production Performance at Commercial Lease Areas, 2010-11

- Provided 210,000 seed to 18 clam growers
- Evaluated 20 leases in 4 counties
- Plant, Jul-Aug 2010
- Harvest, Jul- Aug 2011
- Duration, about 12 months
- Growers allowed to “experiment” with seed

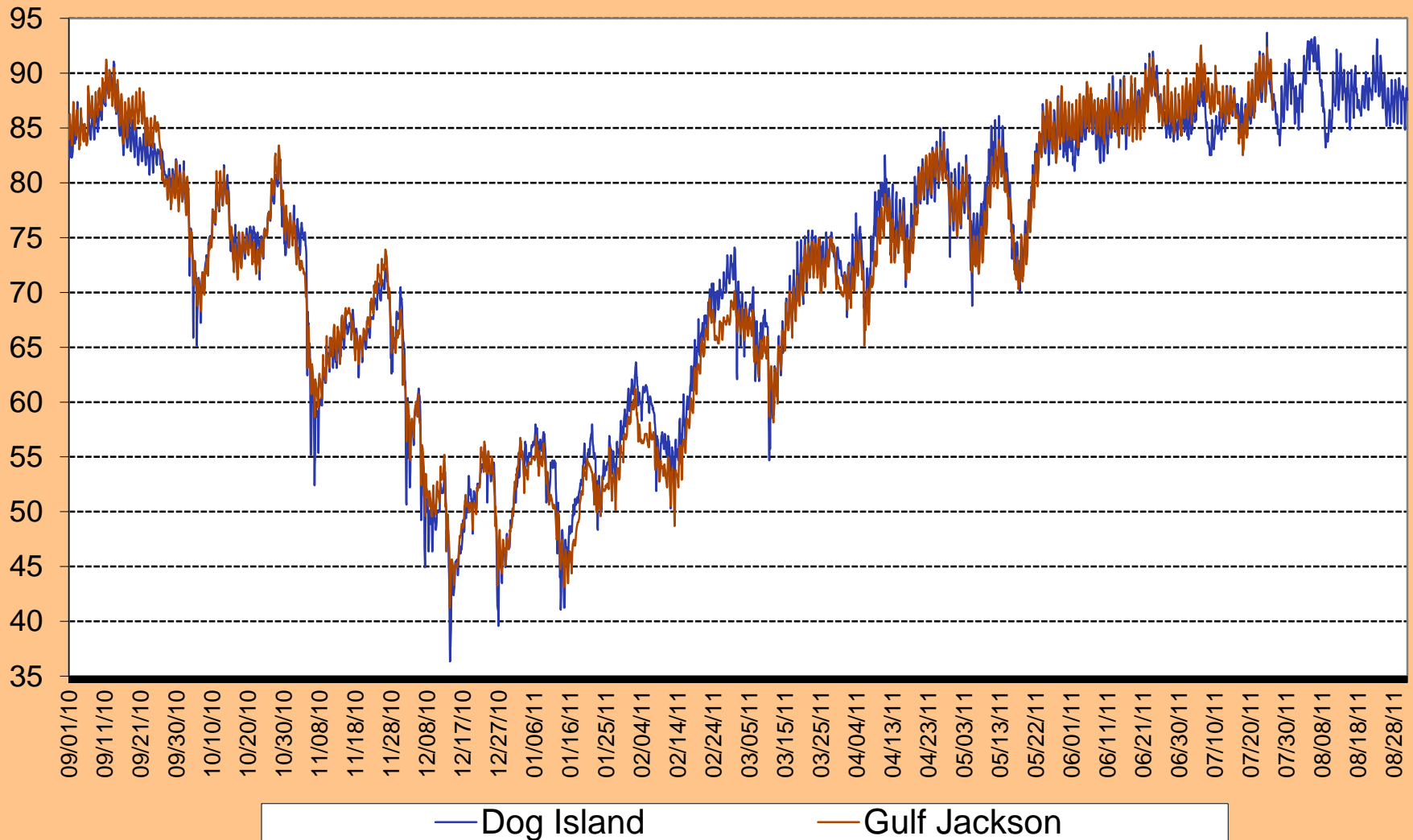


Standardized 3 bottom bags:

- 4' by 4', 9 mm mesh polyester material
- Some bags covered, some dipped
- Stocking density – 800/bag (50/ft²)
- Seed size at plant – 25mm (1”) shell length

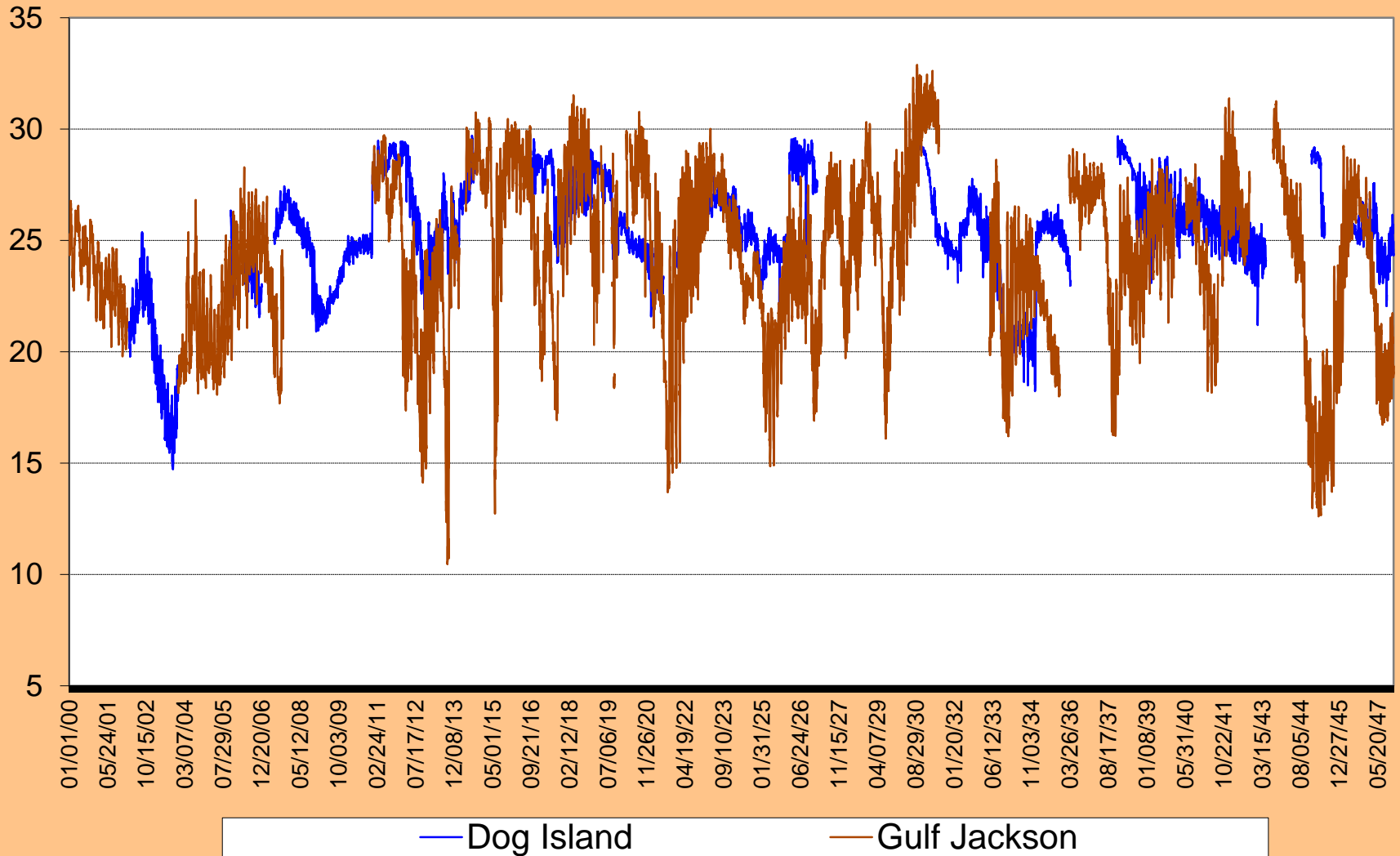
Water Temperature (°F), 2010-11

Levy County Growers' Sites



Salinity (ppt), 2010-11

Levy County Growers' Sites



2010-11 Growout Results – Pelican Reef

Lease Parcel #	Width, inches	Length, inches	Total Weight, g (#/lb)	Dry Meat Weight, g	Survival, %
905	0.8	2.1	21.0 (22/lb)	0.8	35
906	0.8	2.0	18.7 (24/lb)	0.6	4
998	0.8	1.9	17.2 (26/lb)	1.2	16

Comments: Good growth (7/8"SW); Lowest overall survival; Range of shell deformities from low to highest



Shell Deformities:
905 – 2.0%
906 – 5.3%
998 – 0.7%

Lease Site Study – Pelican Reef HDLA, L-906 - Bag 2

2010-11 Growout Results – Gulf Jackson

Lease Parcel #	Width, inches	Length, inches	Total Weight, g (#/lb)	Dry Meat Weight, g	Survival, %
631	0.8	2.1	21.6 (21/lb)	1.0	48
6022	0.8	2.1	21.9 (21/lb)	1.0	25

Comments: Similar growth as Pelican Reef (7/8"SW); Better survival than PR; Low shell deformities



Shell Deformities:
 631 – 0.7%
 6022 – 1.3%

Lease Site Study – Gulf Jackson HDLA, L-631 - Bag 2

2010-11 Growout Results – Dog Island

Lease Parcel #	Width, inches	Length, inches	Total Weight, g (#/lb)	Dry Meat Weight, g	Survival, %
818	0.8	2.1	23.0 (20/lb)	1.0	62
820	0.7	1.9	13.9 (33/lb)	0.6	11

Comments: Similar growth as other Levy County sites (7/8"SW); Highest survival, but also low survival



Shell Deformities:
 818 – 4.7%
 820 – 0.7%

Lease Site Study – Dog Island HDLA, L-818 - Bag 2

2010-11 Growout Results – Dog Island

Soil Properties at Planting:

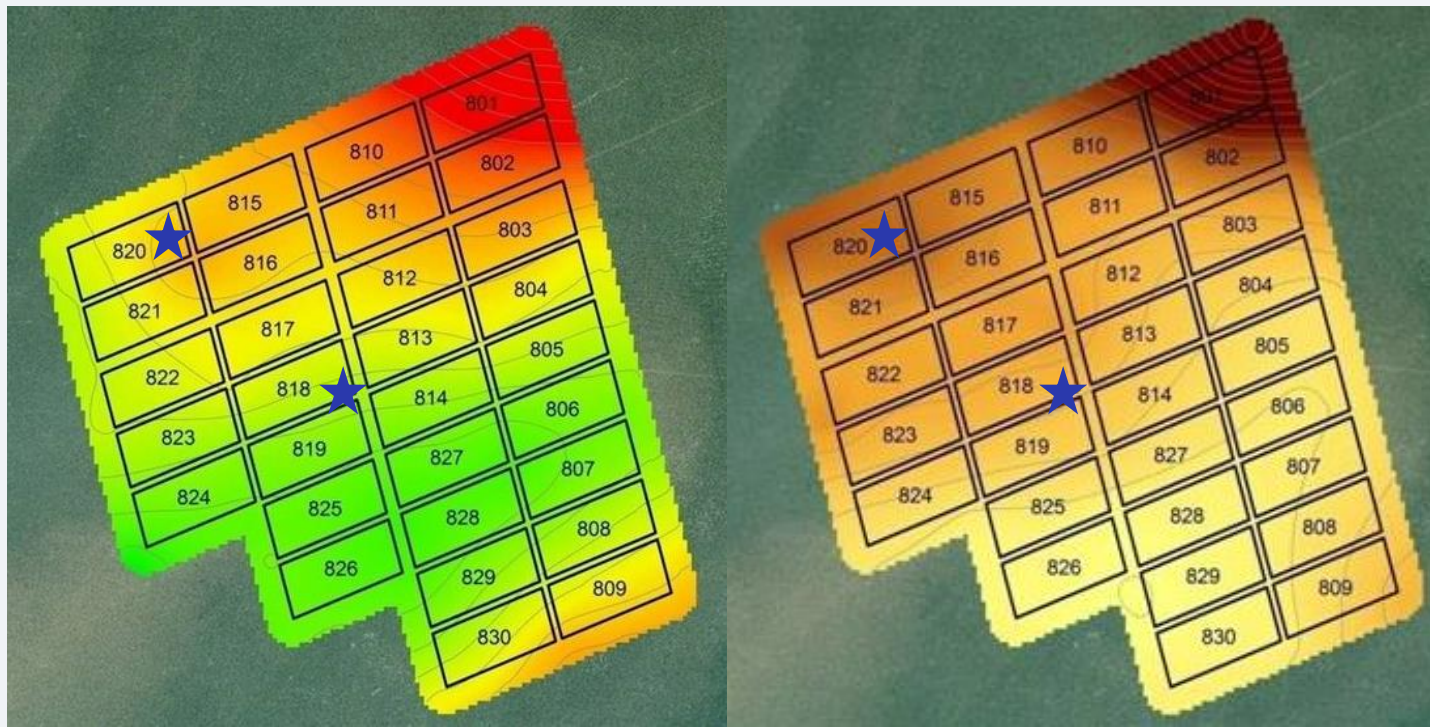
Lease Parcel #	Sand, %	Clay, %	Silt, %	Organic Matter, %	H ₂ S, mol
818	93	5.4	2.3	1.5	0.4
820	89	6.6	4.4	3.1	0.2

Organic Matter

High
(4%)



Low
(0.5%)



Clay Content

High
(5%)



Low
(1%)

Relationship between Bottom Substrate and Sunray Venus Productivity at Leases

- Aqueous soil properties measured during planting of seed at leases
 - Triplicate core samples
 - Particle size (sand, silt, clay)
 - Bulk density, Organic matter (OM)
 - Hydrogen sulfide (H₂S)



Acceptable Production ($\geq 50\%$, n=14) and Soils Relationships:

Values	Survival (%)	Sand (%)	Silt (%)	Clay (%)	Bulk Density (g/cm ³)	OM (%)	H ₂ S (mole)
Average	56	94	2.8	3.0	1.6	0.6	0.40
Range	50-71	88-98	0.1-8.6	1.0-5.3	1.5-1.6	0.2-1.3	0.04-1.2

Survival positively correlated with sand content and bulk density, while clay content and OM were negatively correlated with survival

2010-11 Growout Results

Levy County Test Sites: Dog Island Spit (DI-E, DI-W)



Production Characteristics at Harvest:

Test Site	Width, inches	Length, inches	Total Weight, g (#/lb)	Dry Meat Weight, g	Survival, %
DI-E	0.74	2.2	20.9 (21/lb)	-	57
DI-W	0.74	2.2	21.2 (21/lb)	-	49

Soil Properties at Planting:

Test Site	Sand, %	Clay, %	Silt, %	Organic Matter, %	H ₂ S, mol
DI-E	94	2.9	2.8	0.6	0.07
DI-W	95	2.1	2.5	0.5	0.08

Comments: Similar soil among test sites; % content fall within acceptable ranges for Sand, Clay, Silt, & OM

Recommendations for Bottom Bags



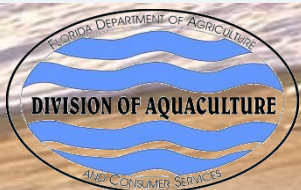
- Use dipped or undipped growout bags
 - Maybe only dip one side of bag
- If undipped bags are used, must use cover netting
 - Chicken wire is better, plastic netting is buoyant and prevents seed from burying
- Prior to planting, rake bottom to “fluff” sediments
- After planting, use pump with distributor pipe to fill bags with sediments
 - Only 2-4 passes depending on sand accumulated
 - Check often, do NOT bury bags



Advancement of Sunray Venus Culture through Evaluation of Alternative Growout and Harvesting Methods

○ Objectives

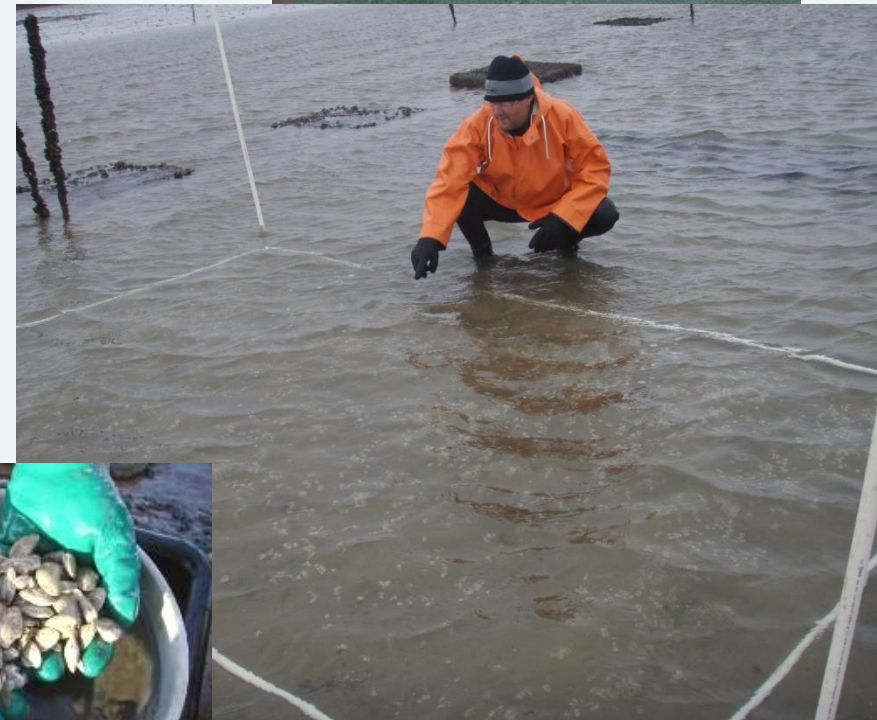
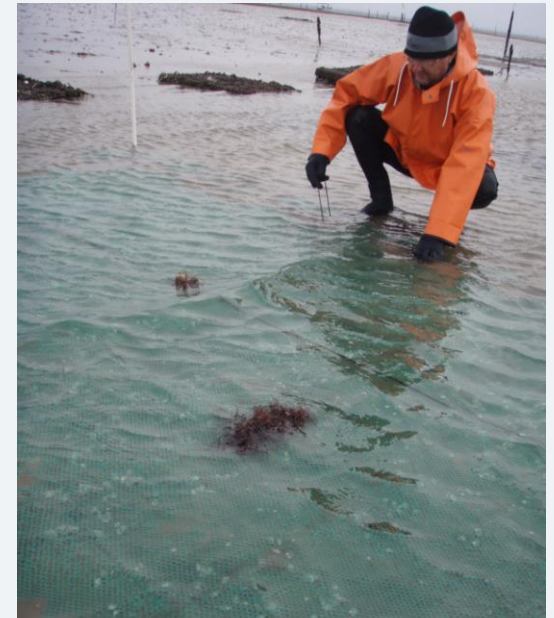
- Examine production characteristics of sunray venus clams using bottom net culture
- Determine effects on soil physiochemical properties resulting from the use of a pump-driven harvester to harvest bottom-planted sunray venus clams as compared to harvesting bottom bags
- Assess product quality of sunray venus clams harvested by these two methods
- **Funded by Florida Department of Agriculture and Consumer Services, 2013-14**



Growout Trials, 2013-14

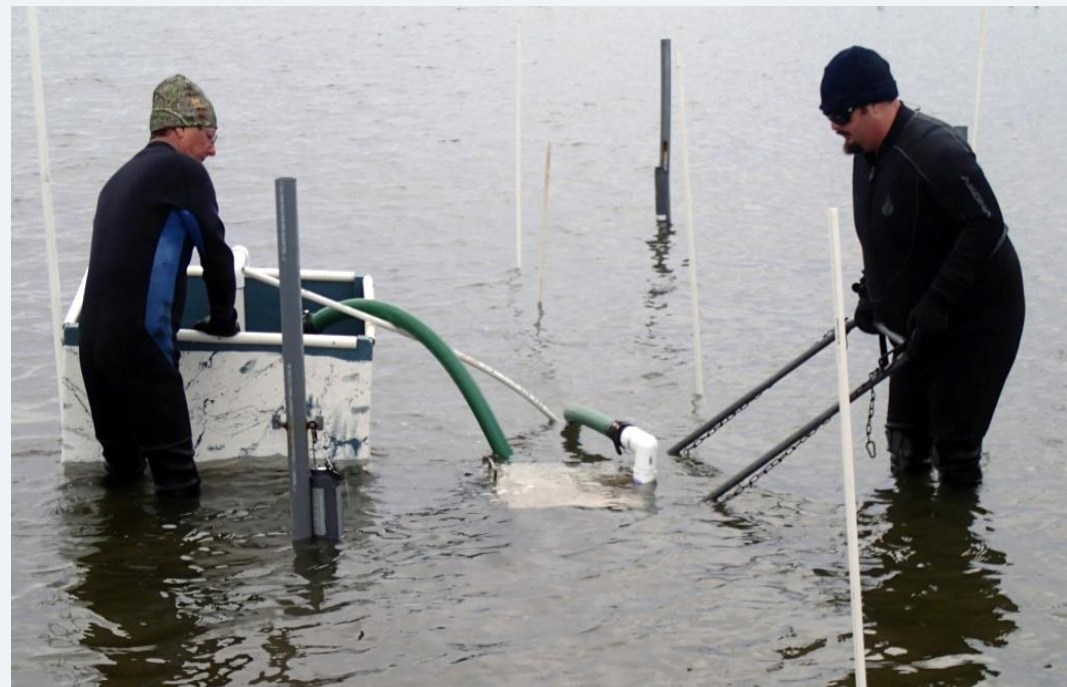
Bags versus Bottom Plants

- Treatments
 - **Bottom plants**, ½" mesh HDPE and polyester 9mm mesh cover netting, 8' x 10', 80 ft²
 - **Bottom bags**, belt of 5 bags, 80 ft² per row
- Replication, n=4
- Stocking density, 900/bag (56/ft²)
- Seed size, 15-20 mm SL
- Site, UF lease, Dog Island HDLA
- Plant, Fall 2012
- Harvest, Fall 2013
- Ave duration, 12 months



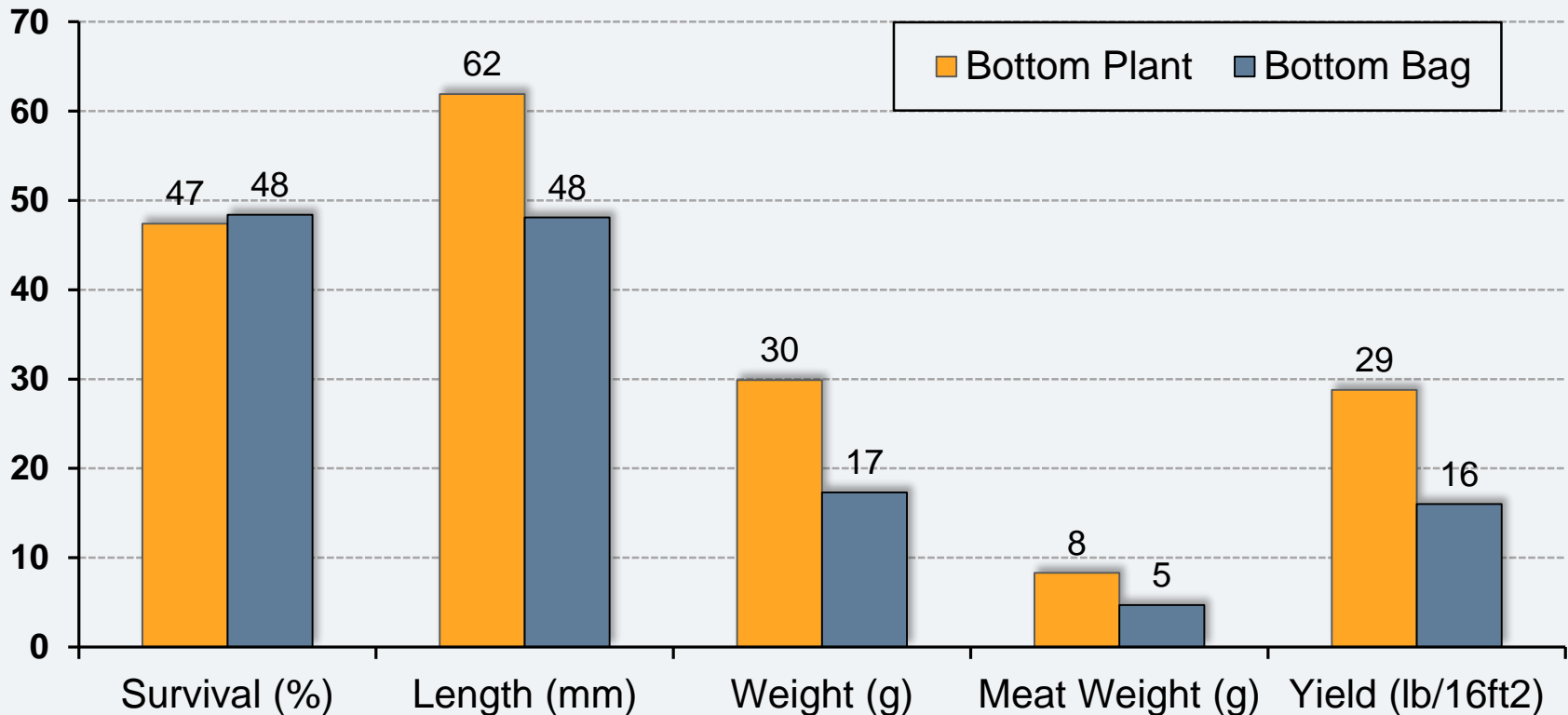
Pump-driven Harvester

- Mechanical harvesting device, “box” harvester used in Virginia
 - Stainless steel, box-shaped
 - No tines, angle of box digs into substrate
 - 5 Hp pump delivers pressurized water via 18 nozzles along spray bar
 - Wire basket collects clams



Bags vs Bottom Plants

- Survival same in both methods (47-48%)
- Bottom-planted sunray venus clams were
 - 29% larger in shell length
 - 76% heavier / 60% more meat weight (wet)
- Bottom-plant method increased yield by 80%

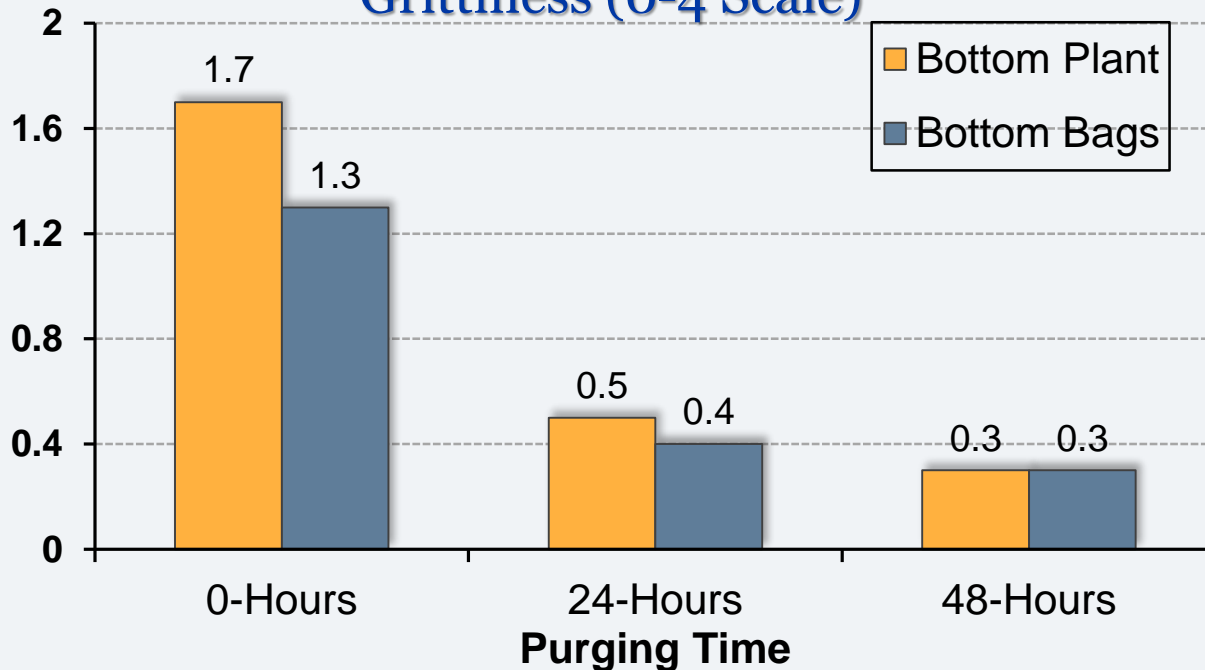


Product Quality

- In grittiness evaluation, using scale of 0 = no grit and 4 = extremely gritty
 - Sunray venus harvested from both methods were rated as “slightly to moderately” gritty
 - After 24 hours, 70% reduction in grittiness values for clams harvested by both methods
 - After 48 hours, values same for both methods

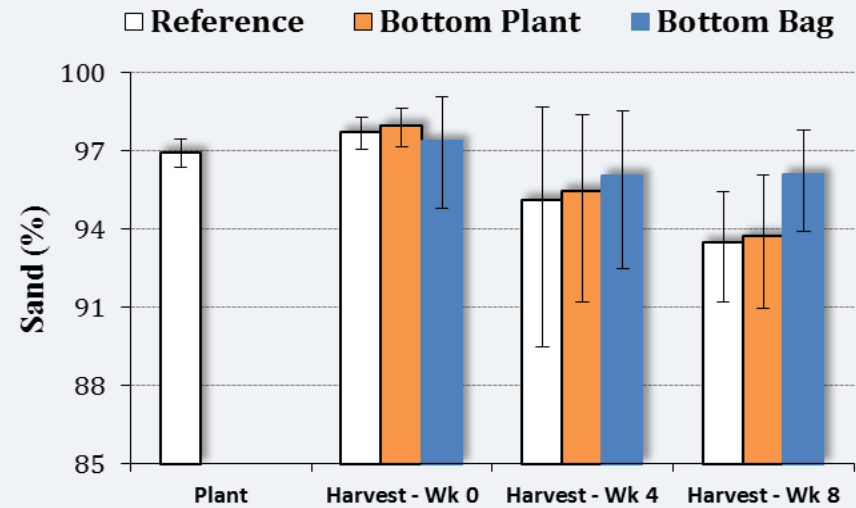


Grittiness (0-4 Scale)

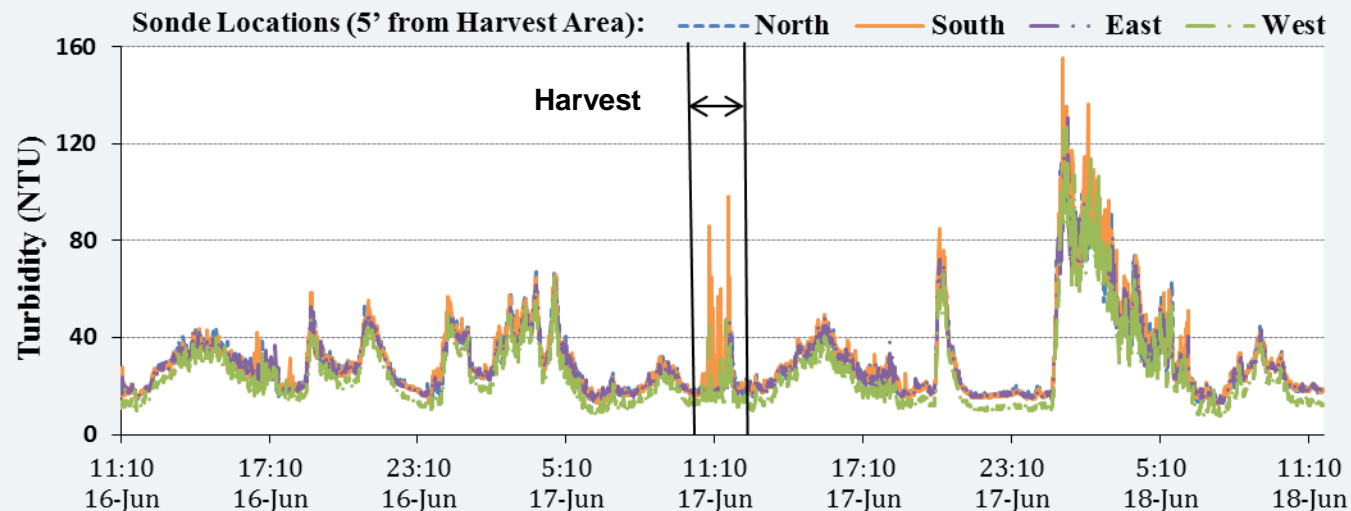


- Shell deformities
 - 0.5% for bottom plant
 - 3.1% for bottom bags
- Shell breakage
 - 2.9% for bottom plant
 - 0.5% for bottom bags
- Shell life, 10 days
 - 100% for both culture methods

Effects on Water Quality and Soils using a Pump-driven Harvester



- Short-lived, variable pulse events
- Weather events can produce effects comparable to or greater than those associated with harvesting



Bottom Planting Sunray Venus Clams

Following is how UF bottom planted sunray venus clams in field trials conducted in Cedar Key. These methods are modified from how Virginia growers culture hard clams. Florida growers in the Indian River and Pine Island Sound have also been bottom planting clams for years. They certainly may use different techniques and may share their experiences.

○ Materials

- Dipped polyester mesh (9mm) growout material, sewn together to width of bottom plant
- High-density polyethylene (HDPE) netting (1/2" mesh)*
 - 14' wide x 100' long, cut to desired length
 - 1" mesh does not deter predators (whelks)
- Tie-wrap polyester (bottom layer) and plastic netting (top layer) together
- Tie-wrap nets to 1/2" PVC pipes along the width to help deploy under water
- Rebar (5/8"-diameter) pieces, cut to cover the entire length and width of the plant
- Wire stakes to secure ends of cover netting and rebar



***HDPE Netting Supplier:**

Industrial Netting, Minneapolis, MN Item #OV1581-168X100

Phone: (800) 328-8456, Website: www.industrialnetting.com

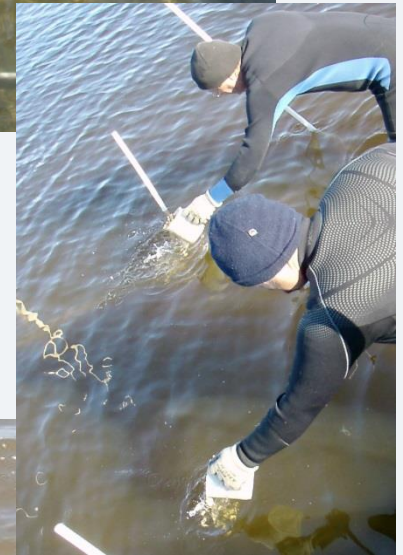
Bottom Planting

○ Materials (continued)

- PVC pipe frame connected with tees to allow frame to sink
 - Frame serves as a guide in planting seed
 - Frame should be 1' shorter around perimeter than bottom net size; if using 14' wide net, then plant area would be 12' wide

○ Methods

- Mark corners of plant area with PVC pipes
- Place PVC frame over plant area
- Broadcast seed, then remove frame
- Roll cover netting over plant area, secure ends with stakes
- Place rebar about 1 foot within the net perimeter
- Make sure rebar pieces butt up to each other to secure entire area
- Secure rebar with stakes, push rebar into the bottom sediments



Predators: Snails

○ Crown conchs

- Can be problematic with bags not covered
- In bottom plants, conchs get caught under netting



○ Whelks

- Can be problematic with bags not covered
- In bottom plants, 1/2" mesh deters predation, 1" mesh does not



○ Moon Snails – Biggest problem

- Can enter bag mesh at small size, grow quickly
- Can bury and move through sand easily
- In test bottom plants (80 ft²), found 11-15/plant



Large mucous-lined foot



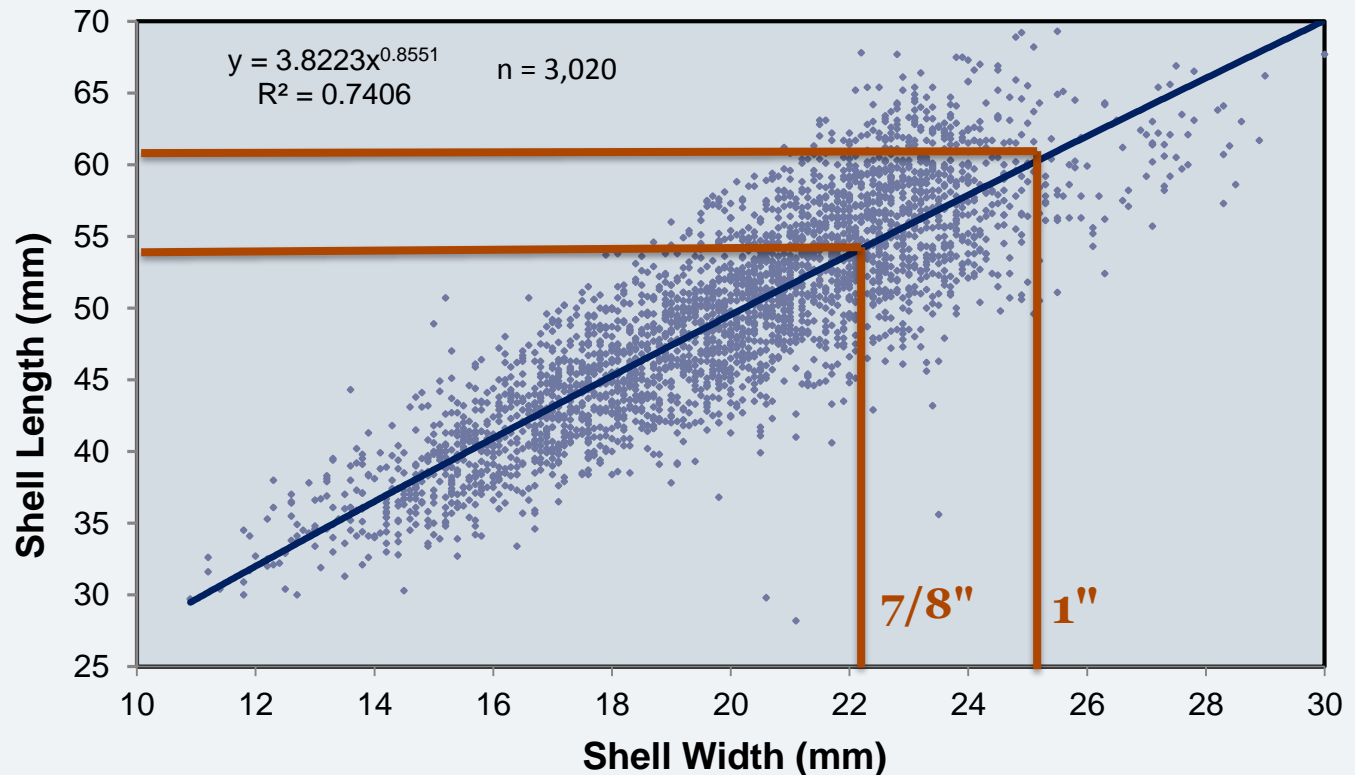
Sand collar contains eggs





Harvest Sizes

To determine sunray venus harvest sizes for 7/8" and 1" grades common to hard clams, lengths and widths of over 3,000 sunray venus were compared



Grade	7/8" (22 mm)	1" (25 mm)
Min. Shell Length	53 mm (2.1")	61 mm (2.5")

Harvest Sizes

Sunray venus harvest sizes differ from those typical for hard clams

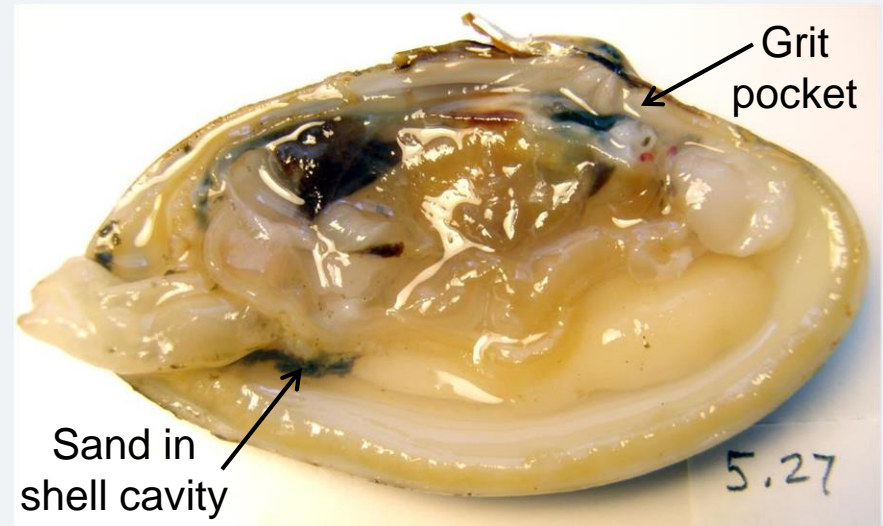
Grade Size	7/8" Width (22-25 mm SW)		1" Width (25-28 mm SW)	
	Sunray Venus	Hard Clam	Sunray Venus	Hard Clam
Shell Length	58 mm (2.3")	45 mm (1.8")	64 mm (2.6")	49 mm (2.0")
	Average and Range 46-65 mm (1.8-2.5")	Average and Range 38-50 mm (1.5-2.0")	Average and Range 52-72 mm (2.1-2.9")	Average and Range 43-58 mm (1.7- 2.3")
Total Weight	28 g (16/lb)	28 g (16/lb)	37 g (12/lb)	36 g (12.5/lb)
	Average and Range 18-42 g (11-25/lb)	Average and Range 20-36 g (13-23/lb)	Average and Range 23-49 g (9-20/lb)	Average and Range 28-49 g (9-16/lb)
Meat Weight	6.7 g	3.9 g	9.4 g	5.0 g
	Average and Range 3.6-11.2 g	Average and Range 2.7-5.7 g	Average and Range 5.4-13.4 g	Average and Range 2.9-7.9 g

For the same size clams in terms of shell width, meat of the sunray venus weighs 1.7-1.9 times more than the meat of a hard clam



Grit Pocket

- Sunray venus possess a grit pocket
 - Not the same as grit (sand) in shell cavity or gut
- Calcareous kidney stones
- Can not be purged
- At 24 mm (7/8") SW, grit pocket is
 - 40 mm² in size
 - Weighs (wet) 0.2 grams
 - 4% of wet meat weight (5.5 g)
- At this size, not apparent or distinct in sensory profile or consumer acceptance studies
- Grit pocket increases with size and age of sunray venus

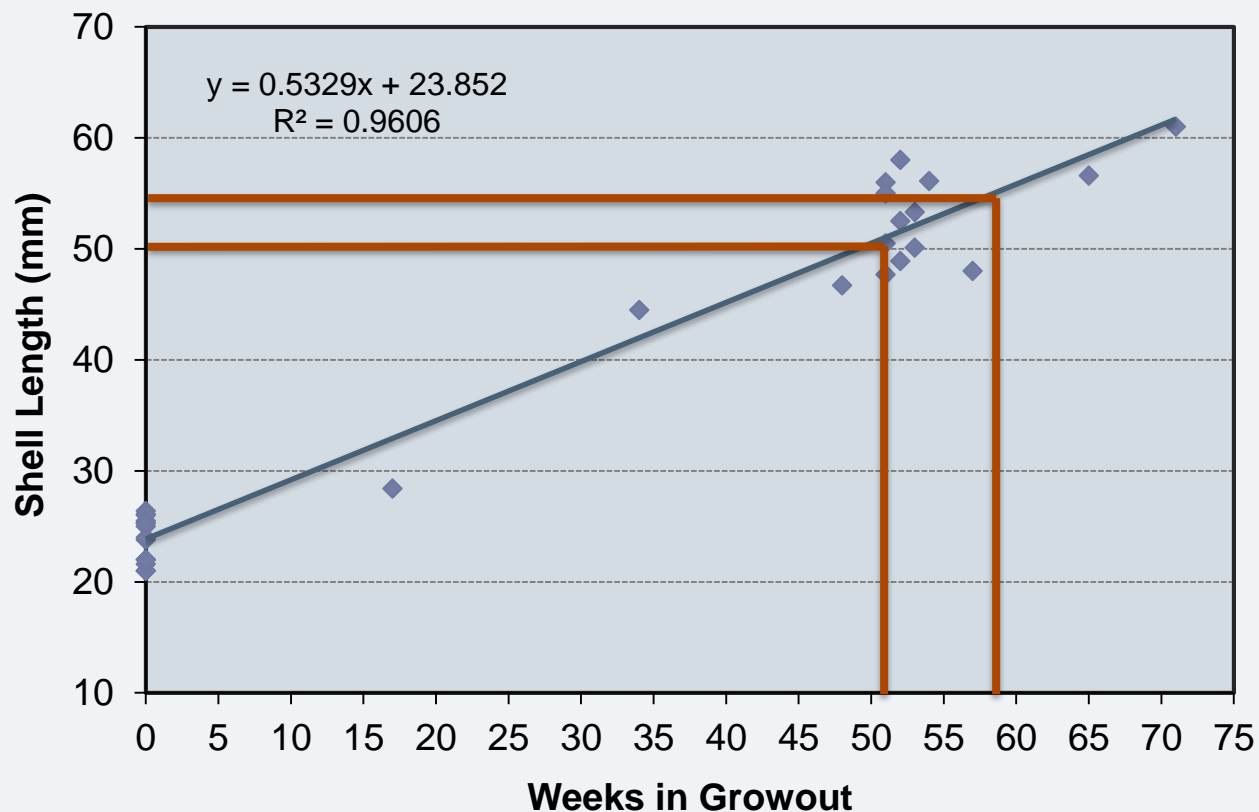


This will define maximum harvest size for sunray venus shellstock markets



Harvest Times

To reach a harvest size of 2.0-2.2" (50-55 mm) SL sunray venus, need 51-58 weeks (12-13 months) in growout using bottom bags and planting a 20-25 mm SL seed



Using the bottom plant culture method can potentially reduce cultured time by 2-3 months to reach the same harvest size



Project VENUS

- An integrated technology transfer project to assist the commercial development of sunray venus clam culture
- Brings together the following resources:
 - University of Florida IFAS
 - Harbor Branch Oceanographic Institute at FAU
 - FDACS Bureau of Seafood and Aquaculture Marketing
 - Cedar Key Aquaculture Association
- Funded through NOAA National Sea Grant Program

Project VENUS

Vocational Education Network Using Sunrays



○ Project Objectives, 2015

- Ensure adequate sunray venus seed availability for Florida growers by working with shellfish hatchery operators
- Educate current clam growers about culture and handling methods suitable for sunray venus clam production
- **Characterize sediments to determine compatibility of existing leases and siting new leases for sunray venus culture**
- **Evaluate protocols used by shellfish processors for freezing sunray venus clams to assess product quality**
- **Educate consumers and seafood buyers about availability and attributes of a new Florida aquaculture product**