

Florida Shellfish

Overview of Recent and Ongoing Applied Research Projects

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Shellfish Aquaculture Extension Program
Cedar Key, Florida





Applied Industry-driven Research and Extension Projects

- With faculty from UF IFAS and other institutions developing and implementing applied research and extension projects
- Over past seven years, federal and state funds have been invested in industry-driven projects
- These projects are focused on
 - 1) Genetic improvement of stocks
 - 2) Advancement of farming practices
 - 3) Species diversification

UF Project Partners



- Chuck Adams, *Food and Resource Economics*
- Jim Austin, Shirley Baker, Ed Philips, Ruth Francis-Floyd, Denise Petty, *SFRC Fisheries and Aquatic Sciences*
- Bill Pine, Peter Frederick, *Wildlife Ecology and Conservation*
- Todd Osborne, Mark Clark, Rex Ellis, *Soil and Water Science*
- Steve Otwell, Anita Wright, *Food Science and Human Nutrition*



Genetic Improvement of Stocks

- Evaluation of Clam Stock Hybridization, 2007-9
- Assessment of F1 Hybrids Backcrossed with Hard Clams, 2009-11
- Evaluation of Thermally Selected Multi-Parental Crosses with Hard Clams, 2010-12

Funded by USDA CSREES Special Research Grants

Supported by the Cedar Key Aquaculture Association
Former Congresswoman Ginny Brown-Waite
Former Senator Mel Martinez



Project Team, 2007-13

HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY



Dr. John Scarpa - HBOI
Shellfish breeder
- Production of
experimental stocks



Dr. Shirley Baker - UF
Invertebrate physiologist
- Laboratory challenges

UF UNIVERSITY of
FLORIDA
IFAS



Leslie Sturmer - UF
Shellfish extension agent
- Experimental field trials
- Industry liaison

- Both institutions involved in job retraining programs in the 1990s and in the development of sustainable aquatic organism production

Improvement of Cultured Clam Stocks through Hybridization

- Hybridization is a common breeding technique
- Hybrids have superior traits to either parent species
- The use of clam hybridization for “mariculture” potential was examined in the 1960-70s by Winston Menzel at Florida State University
 - Showed hybrids had improved growth, shelf life
 - Little data reported on merit of hybrids for improved survival
- **A rigorous examination of clam hybridization was conducted in 2007-9***
 - **To improve production**
 - **To assure product quality**



* Scarpa, J., Sturmer, L.N., Arnold, W., Geiger, S. and Baker, S.M. 2009. Culture of hard clam hybrids (*Mercenaria mercenaria*, *M. campechiensis*): Hatchery to field-nursery. *Journal of Shellfish Research* 28(3): 727-728.

Clam Species

- Northern hard clam
 - Gulf of St. Lawrence to Florida
 - Supports aquaculture and fishing industries
- Southern quahog
 - North Carolina to Caribbean
 - Supports recreational fishery
 - Traits for resisting environmental stressors
 - Gapes in refrigerated storage
- *Mercenaria* species normally separated by environmental tolerances
 - Hybridize where they do co-occur and under hatchery conditions



Northern hard clam
Mercenaria mercenaria
notata



Southern quahog
Mercenaria campechiensis



M x M



M x C

Single parent crosses utilized
Oct-Dec, 2007

Produced and tested 3 families (A,B,C)

- Parental stocks - ♀x♂: MxM, CxC
- Reciprocal hybrids - ♀x♂: **MxC**, **CxM**



C x M



C x C

Summary*

- Hybridization may offer improved clam production performance
 - **MxC**, ↑ SW and DryMtWt
- Genetic background played a significant role in responses
 - Family A, **MxC** ↑ SW, TW, DMtWt, Yield
 - Family C, **CxM** ↑ SW, TW, DMtWt, Yield
- Shelf life acceptable up to 8 days
 - At 10 days **MxC** (88%), **CxM** (70%), versus **MxM** (98%)
- Gaping in storage problematic
 - By day 8 for **MxC** (47%)
 - By day 4 for **CxM** (63%)

* Sturmer, L.N., Scarpa, J. and Baker, S.M. 2010. Culture of hard clam hybrids (*Mercenaria mercenaria*, *M. campechiensis*): Results of growout production trials. Page 966, Book of Abstracts, Aquaculture 2010, San Diego, CA.



Sunshine Clam (M x C)



TropiClam (C x M)

Backcrossing F1 Hybrids with Hard Clams

- Mating of a hybrid with its parental species
- F1 Hybrids (**MxC** and **CxM**) backcrossed to hard clams (**MxM**) as female or male
- Objectives:
 - Improve product quality
 - Maintain improved production

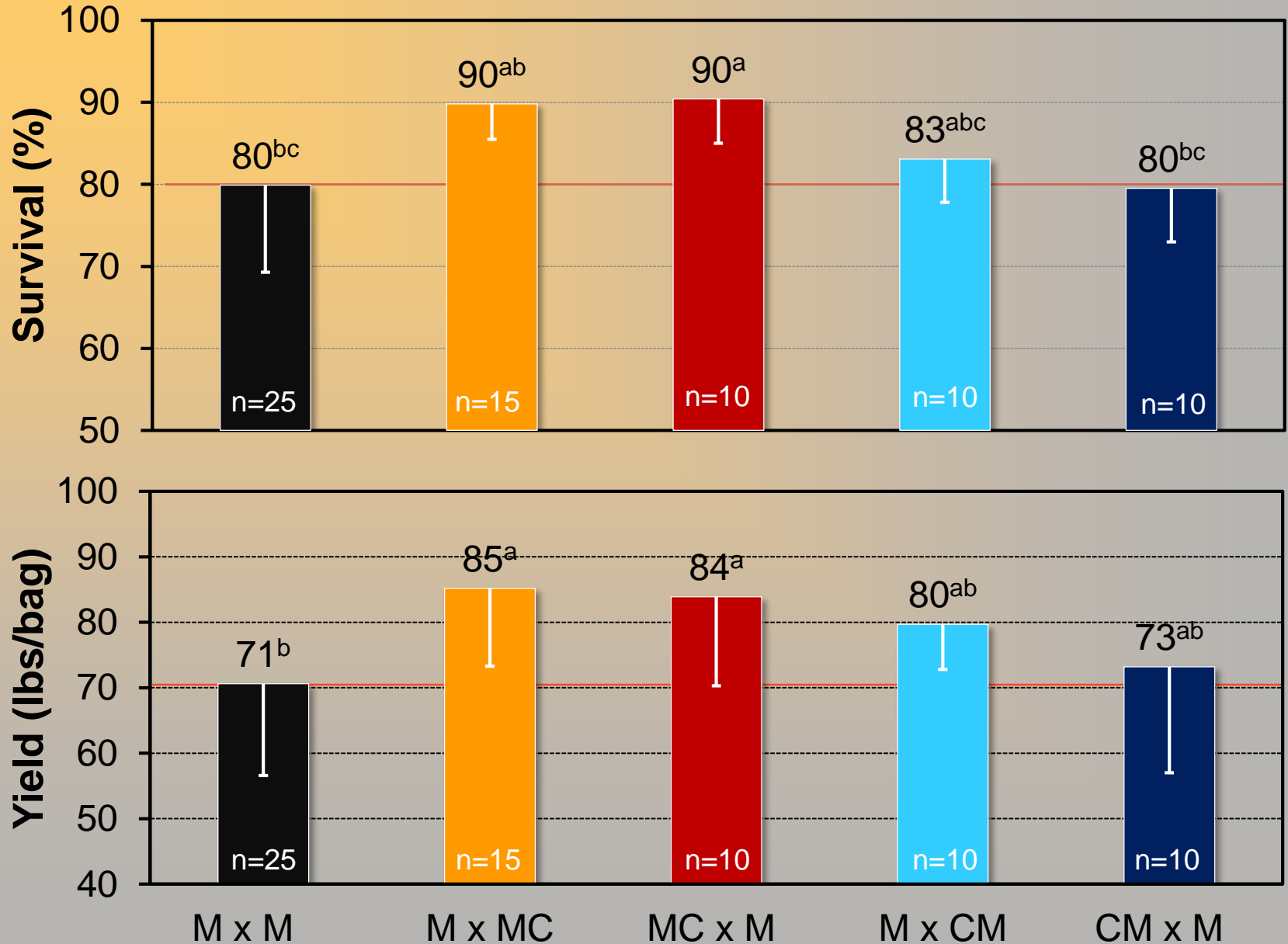


Backcross Parents

Backcross Families	Female ♀	Hybrid Family	X Male ♂	Hybrid Family	=	Stock
F G* H	M		M			M x M
	M		MxC	A		M x MC
	M		CxM	C		M x CM
D E	M		M			M x M
	MxC	A	M			MC x M
	CxM	C	M			CM x M

* M x CM replicate stock in Family G spawn was not viable

Production Results (13 months)



Note: ANOVA were performed using the PROC GLM procedure of SAS. Treatment means were considered significantly different when $p \leq 0.05$.

Summary

- Backcrossing F1 hybrids to hard clams offered improved survival and yield
 - MxMC and MCxM had ↑ survival, ↑ yield
- Genetic background (families) played a significant role in responses
 - For Family F, M x MC had ↑ survival, ↑ production
 - For Family D, MC x M had ↑ survival, ↑ production
- Shelf life commercially acceptable
 - At 10 days, 98-100% for all stocks
 - At 12 days, 92-96% for backcrosses vs 99% for hard clams
- Gaping in refrigerated storage acceptable
 - At 10 days, 3-11% for backcrosses vs 2% for hard clams
 - At 12 days, 7-14% for backcross stocks vs 3% for hard clams
- **This breeding approach can increase summer survival and productivity, while maintaining product quality standards**



Broodstock Made Available to Industry

- High performing broodstock lines provided to 90% of Florida hatcheries
 - Group 32, Family D: MC-A x M
 - Group 40, Family F: M x MC-A
 - Group 44, Family G: M x MC-A



"We spawn millions!"

Development of Clam Broodstock for Seed Production Workshop
Harbor Branch Oceanographic Institute at FAU
December 2011

Improvement by Thermal Selection and Addition of Wild Stocks, 2011-12

- Common breeding approach is selection of survivors of adverse environmental events
- In plant breeding programs, thermal challenges are artificially induced with progeny from surviving stocks produced
- Another common breeding approach is to out-cross domestic stocks with wild stocks
- FL cultured clams selected for “notata” strain
- Shell coloration not preferred in some markets and associated with inbreeding depression

- Objectives:

- Improve growth, survival, and genetic diversity
- Reduce color variant – “notata”





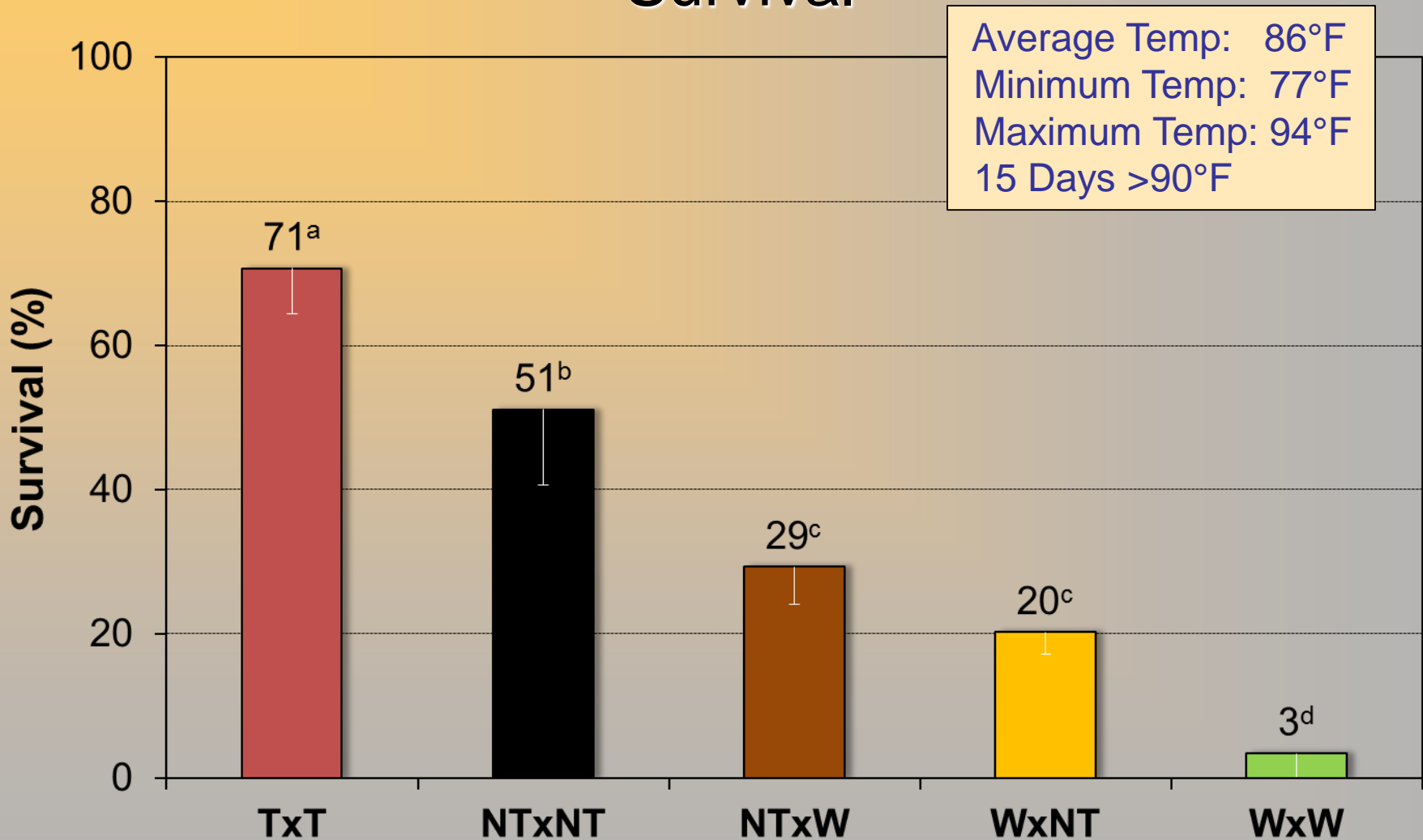
Breeding Scheme



- Thermally challenged hard clams
 - 2250 subjected to 95°F for 48 hours
 - Spawned 45 survivors, or 2%
 - Compared with non-thermally challenged hard clams (control)
- Incorporation of “wild” stocks
 - “Wild” clams obtained from natural populations near St. Augustine
 - Spawned with cultured clam stocks
 - Created reciprocals and controls

Female ♀	Male ♂	Stock
T	T	T x T
NT	NT	NT x NT
NT	W	NT x W
W	NT	W x NT
W	W	W x W

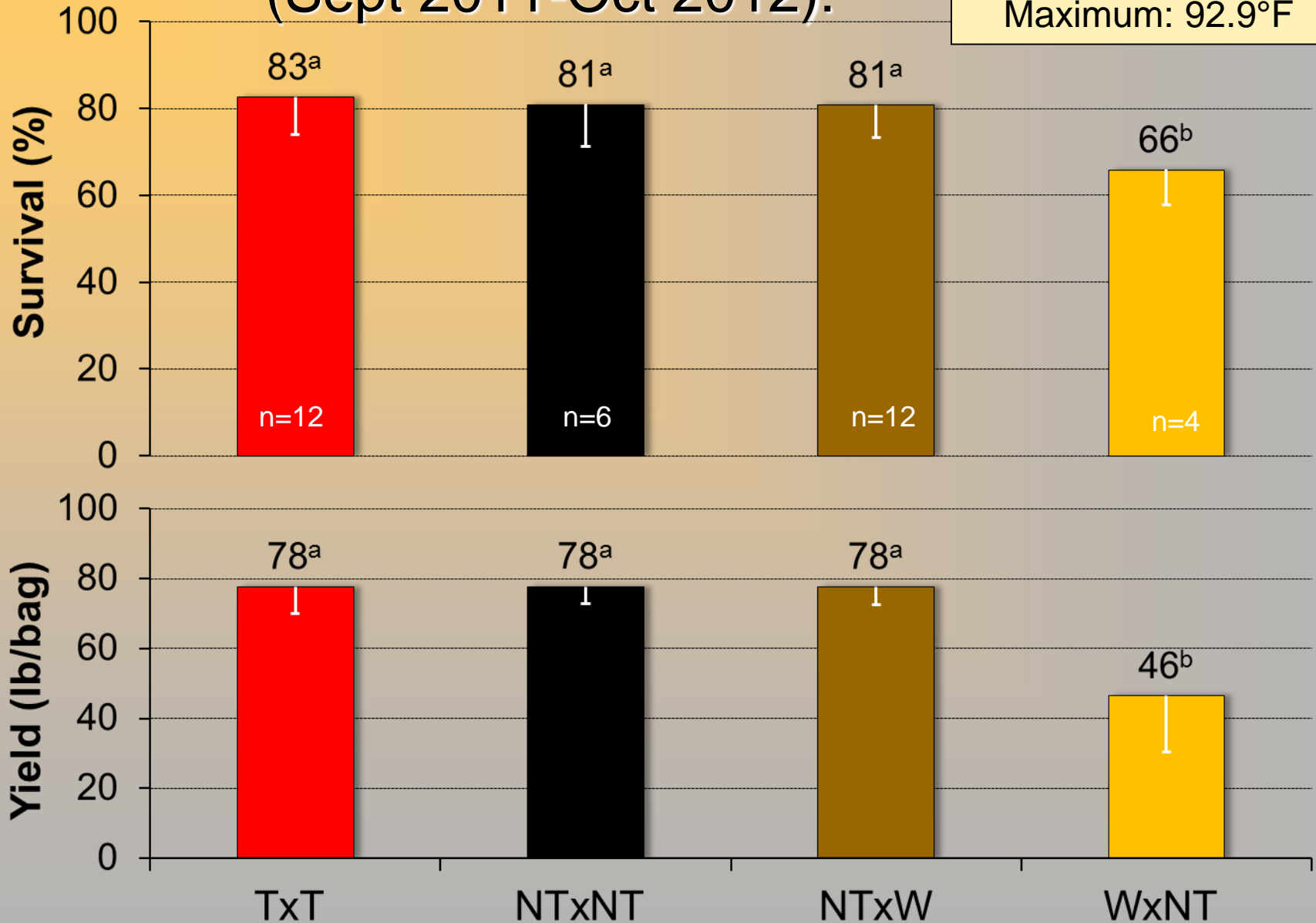
Field Nursery Results (July-Sept 2011): Survival



Note: ANOVA were performed using the PROC GLM procedure of SAS. Treatment means were considered significantly different when $p \leq 0.05$.

Growout Results (Sept 2011-Oct 2012):

Water Temperatures:
8 days > 90°F (32°C)
Maximum: 92.9°F



Note: ANOVA were performed using the PROC GLM procedure of SAS. Treatment means were considered significantly different when $p \leq 0.05$.

Shell Coloration of Clam Stocks, % Notata



NTxNT - 92%

- Rated on a scale of 1 to 5, where
1 = 0%
2 = 25%
3 = 50%
4 = 75%
5 = 100%
- Rated 150 clams per group



NTxW - 58%



WxNT - 39%

Improvement of Cultured Clams by Marker Assisted Selection in Stocks



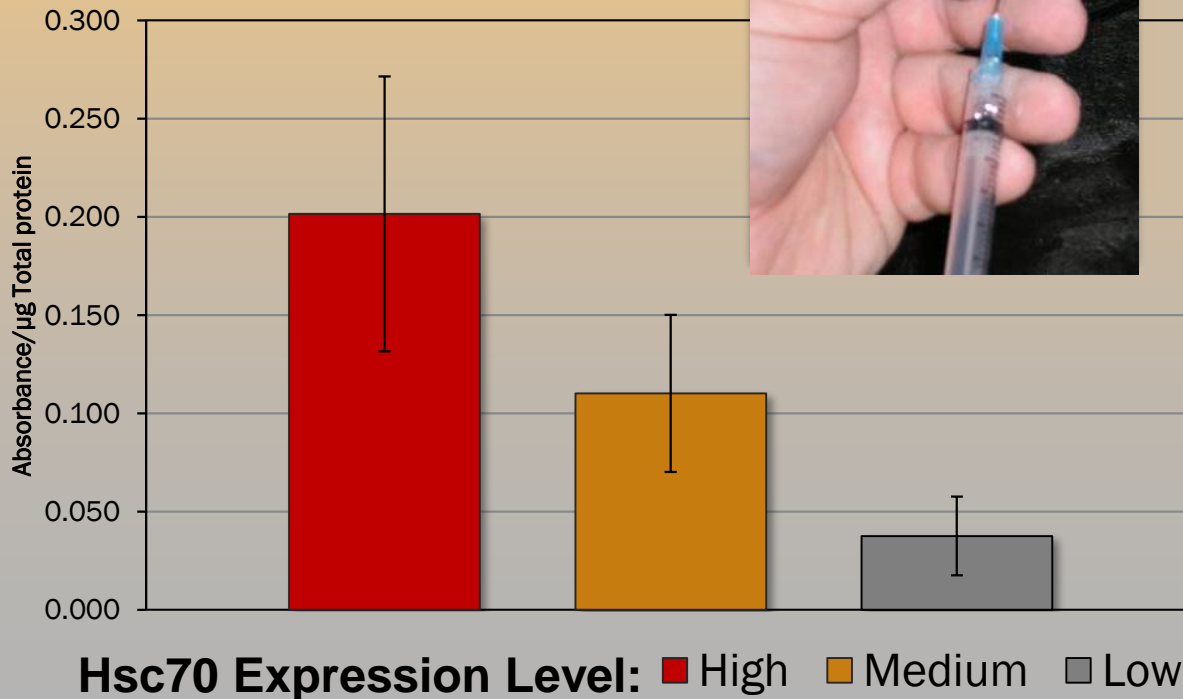
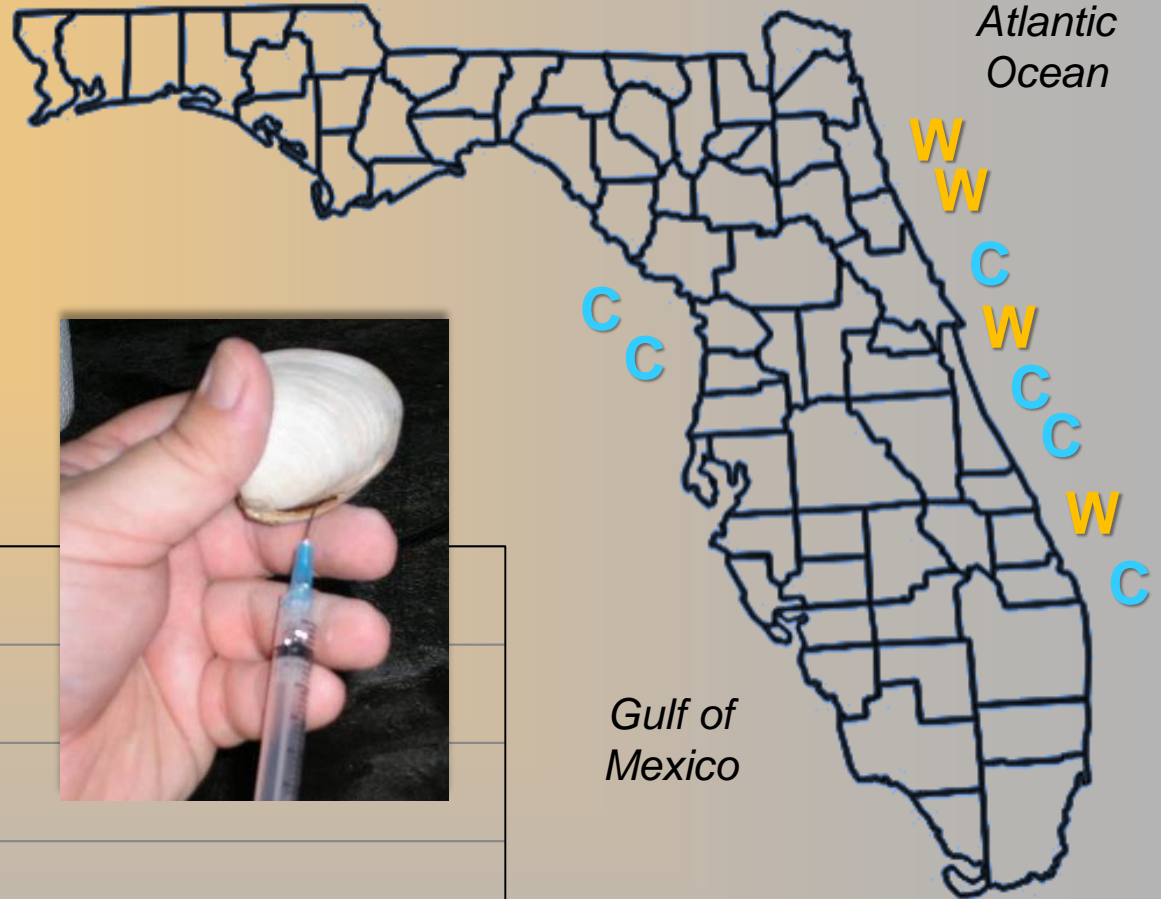
- Select stocks based on markers associated with trait of interest
- Potential marker: Heat shock proteins
 - Induced – In response to stressors, Hsp
 - Cognate – Cellular housekeeping, **Hsc70**
- In previous studies:
 - Hsc70 levels associated with clam survival in temperature challenges (El-Wazen 2008)
 - Hsc70 levels may be heritable

Funded by:



Florida Broodstock Survey

- Collected hard clams from 10 sources
 - Commercial stocks (C)
 - Natural populations (W)
- Extracted hemolymph from ~500 clams



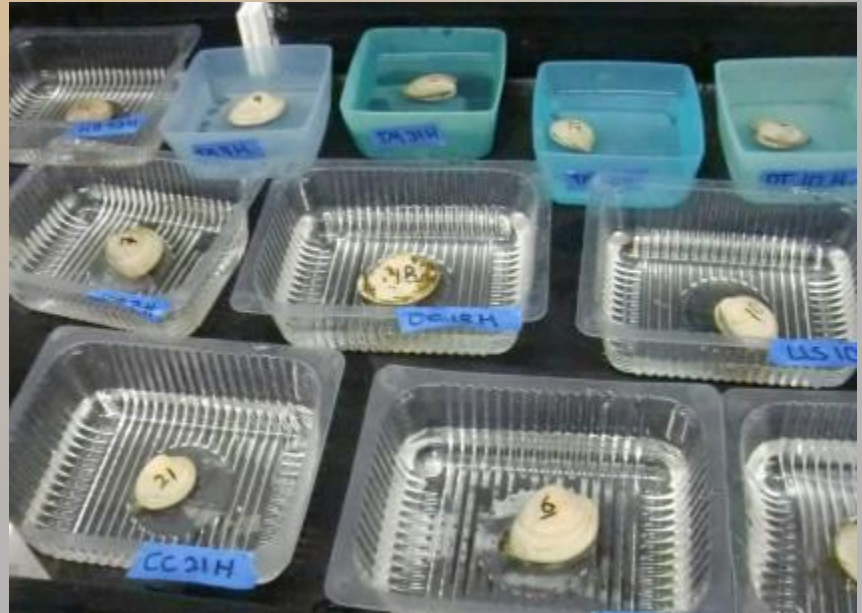
- Analyzed for levels of Hsc70
- Three expression levels of Hsc70

Hatchery Production*

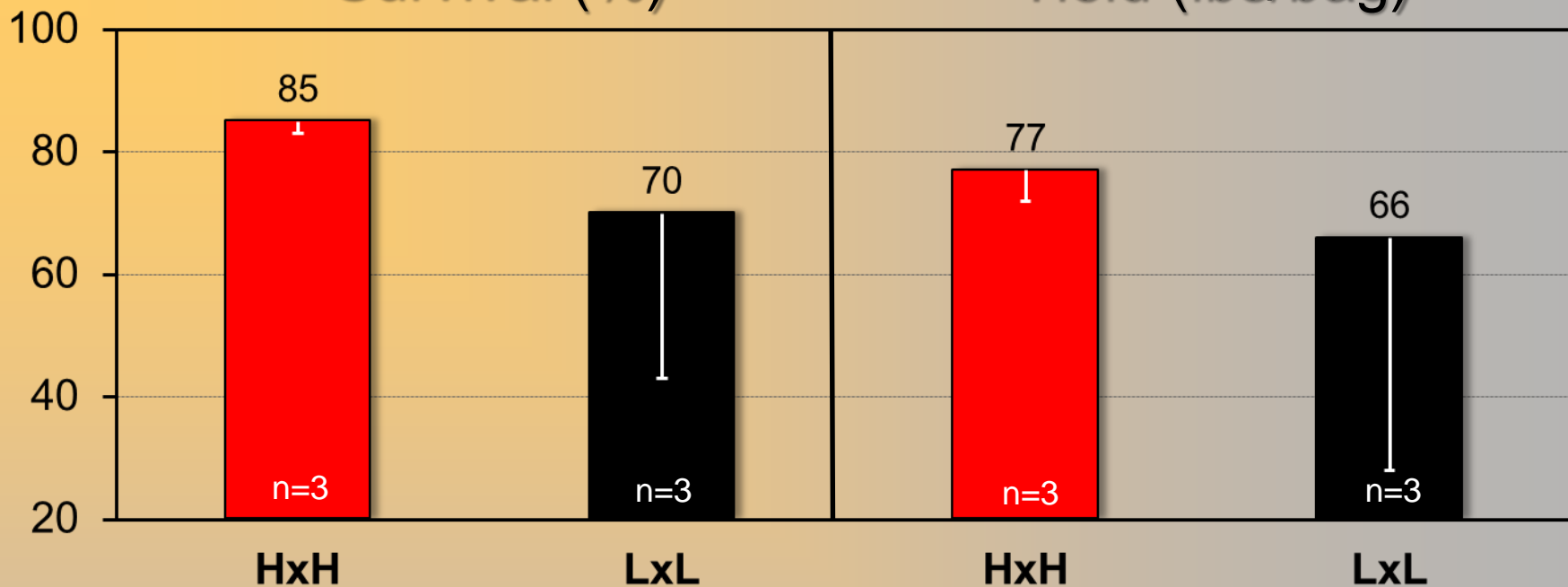


- Hatchery techniques modified for single parent crosses
- Produced six distinct families
 - High-expressing Hsc stocks (**HxH**)
 - Low-expressing Hsc stocks (**LxL**)
- Jan – Apr 2012

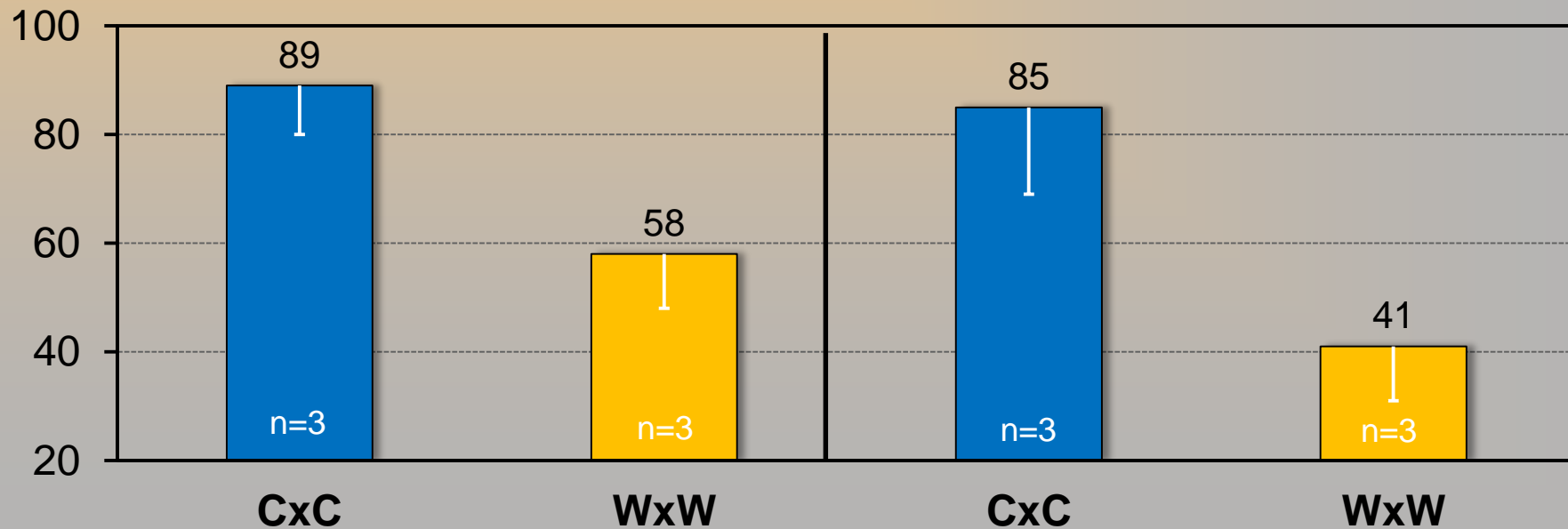
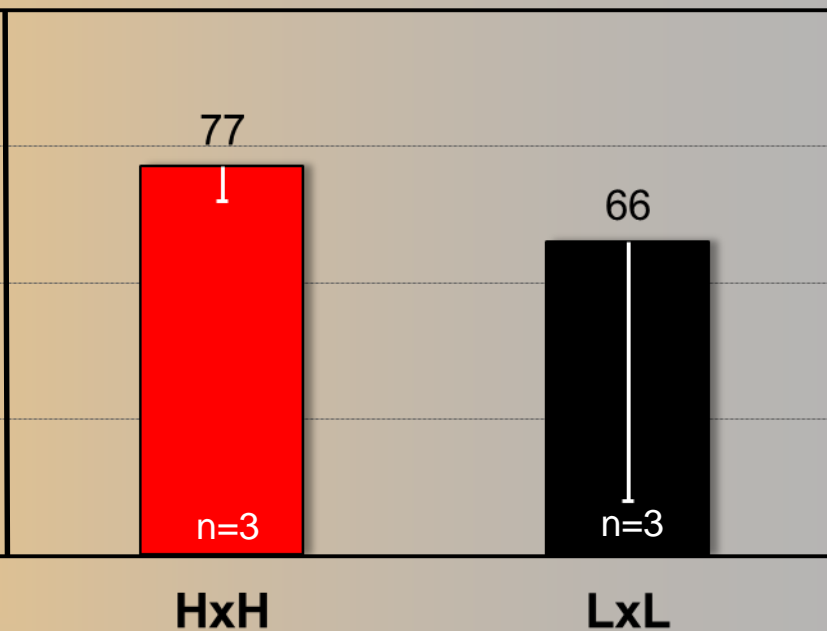
* Scarpa, J., Baker, S.M., Sturmer, L.N., and Krebs, W. 2013. Preparing for climate change: Increasing hard clam survival in Florida using biomarkers of thermal tolerance. Aquaculture 2013 Conference Proceedings: 185.



Survival (%)



Yield (lbs/bag)



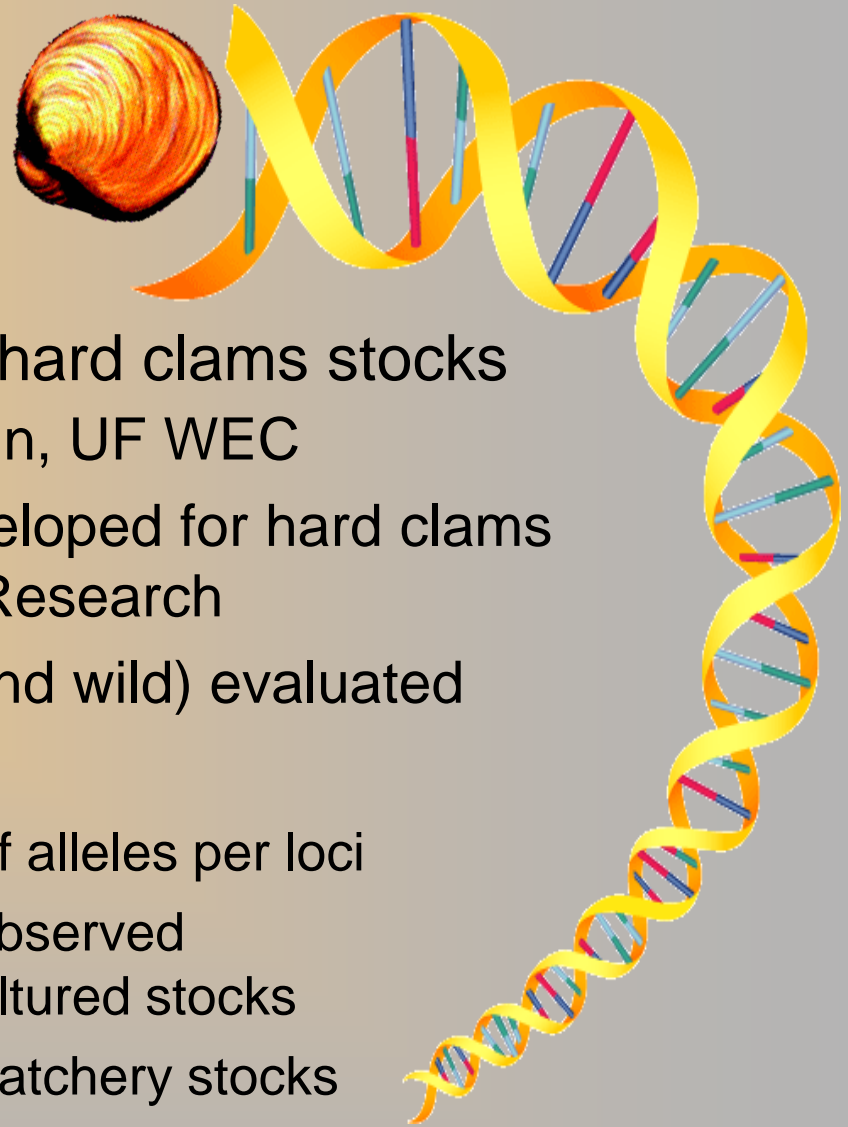
*PROC TTEST, SAS 9.4, treatment means significantly different when $p \leq 0.05$

Summary

- Broodstock selection methods may be useful in increasing hard clam survival and improving shell characteristics
 - ↑ Survival in **TxT** versus **NTxNT**
 - ↓ Notata coloration in **NTxW** versus **NTxNT**
- Hatcheries must ensure good record keeping for separate lines as reciprocal parental crosses played a role in responses
 - ↑ Survival and yield in **NTxW** versus **WxNT**
- Differing parental Hsc levels did not affect hard clam production
 - Survival and yield = in **HxH** versus **LxL**
- Wild stocks did not perform well
 - ↓ Survival and yield in **WxW** versus **CxC**
- **Commercial hard clam stocks are being selected for Florida conditions and some improvement can be gained from basic breeding practices**



What's New ?



- Determined **genetic diversity** of hard clams stocks
 - Study conducted by Dr. Jim Austin, UF WEC
 - Using microsatellite markers developed for hard clams by UF Center for Biotechnology Research
 - Eleven Florida stocks (cultured and wild) evaluated
 - Preliminary results
 - Wild stocks had higher number of alleles per loci
 - Wild stocks had equal levels of observed heterozygosity (heritability) as cultured stocks
 - Differentiation highest between hatchery stocks
 - Drift has occurred between wild and cultured stocks

Shellfish Farm Environment, Management and Other Projects



- Assessment of Farming Activities on Aqueous Soils
- Evaluation of Mechanical Harvesting
- Net Coatings for Biofouling Control
- Valuation of Ecosystem Services
- Sensory Profiling of Clams
- Industry Economic Impact



Assessment of Soil Landscapes in Clam Lease Areas*

- Clams are infaunal bivalves and spend majority of their lives buried
- Sediment characteristics affect clam production, but is a short coming in many studies
- Subaqueous soils at one high-density lease area were investigated using a soils-based approach, 2007-9

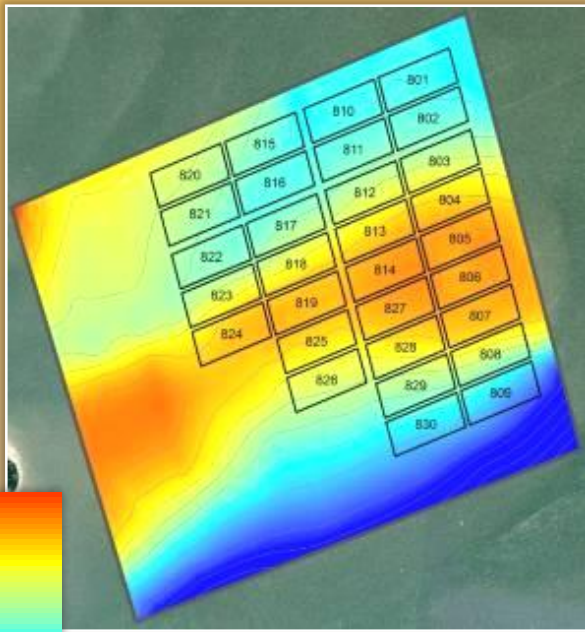
**Investigators:*

*Rex Ellis, Todd Osborne, and Mark Clark
University of Florida, Soil and Water
Science Department*

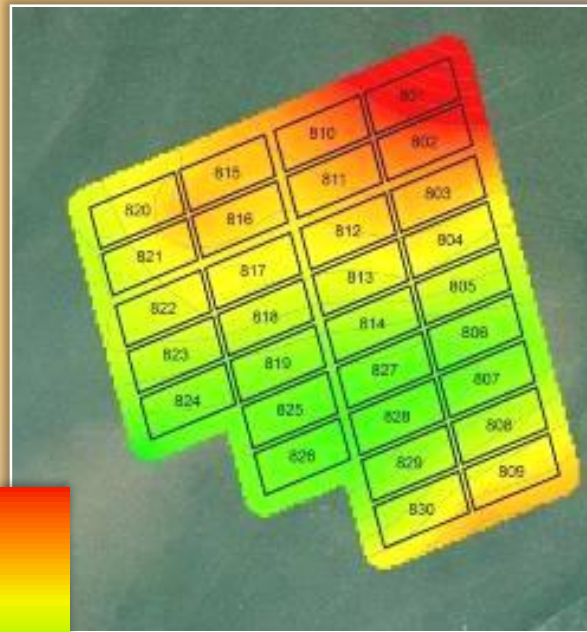


Dog Island High-density Lease Area

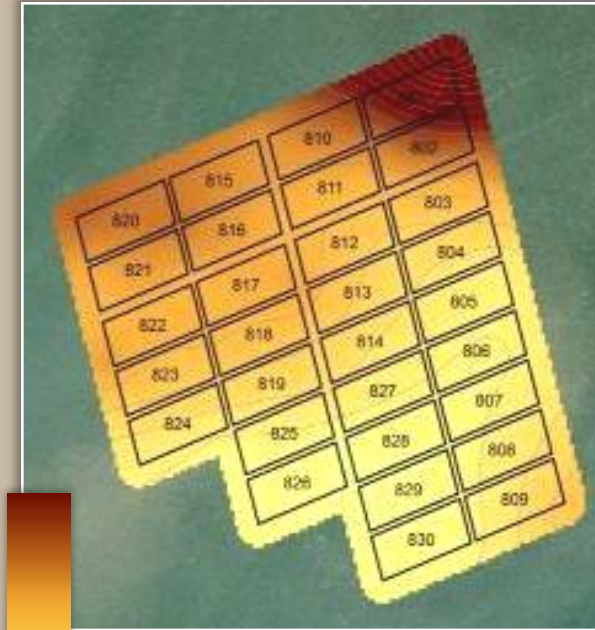
DOG ISLAND HDLA SOIL CHARACTERIZATION STUDY, 2009-10



Soil Elevation
Low (-6.5') to High (+1.5')



Organic Matter
Low (0.5%) to High (4%)



Clay Content
Low (1%) to High (5%)

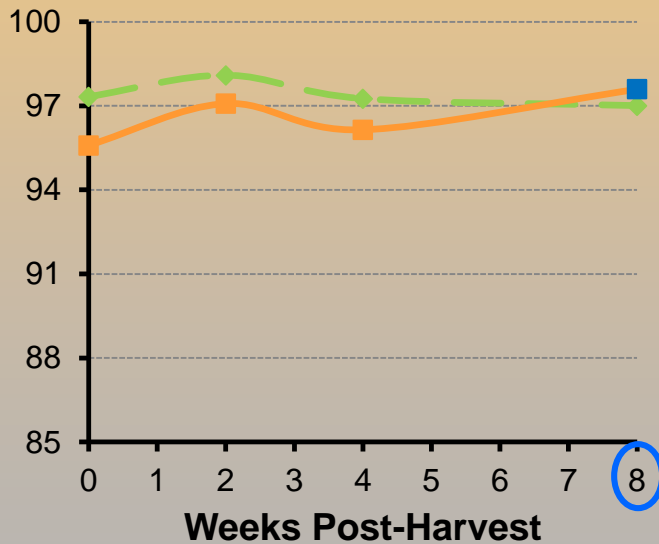
- Spatial relationships between soil properties and lease trends evident
 - OM and Clay are lowest in the shallowest areas (ie. sand bar)
 - Gulf side of the sand bar has depressed clay and OM
 - The protected side of the bar has elevated clay and OM
- Patterns likely drive critical biogeochemical reactions that affect clam production throughout the lease area

Soils-based Approach to Clam Farming

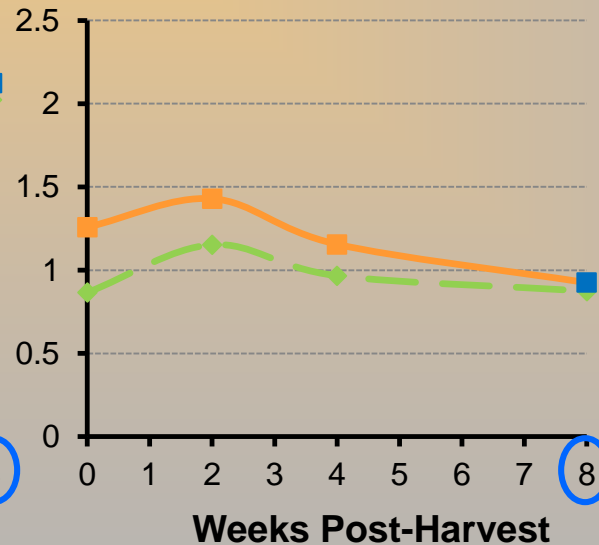
Is there an effect on soil properties due to clam harvesting methods?
If so, what is recovery time of soils?



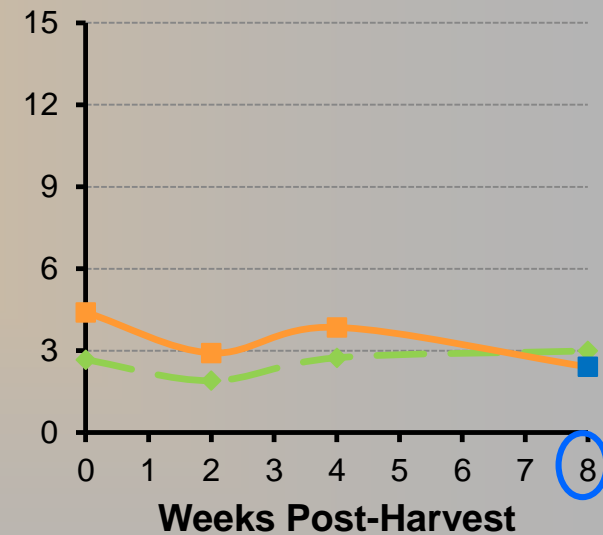
% Sand Content



% Organic Matter



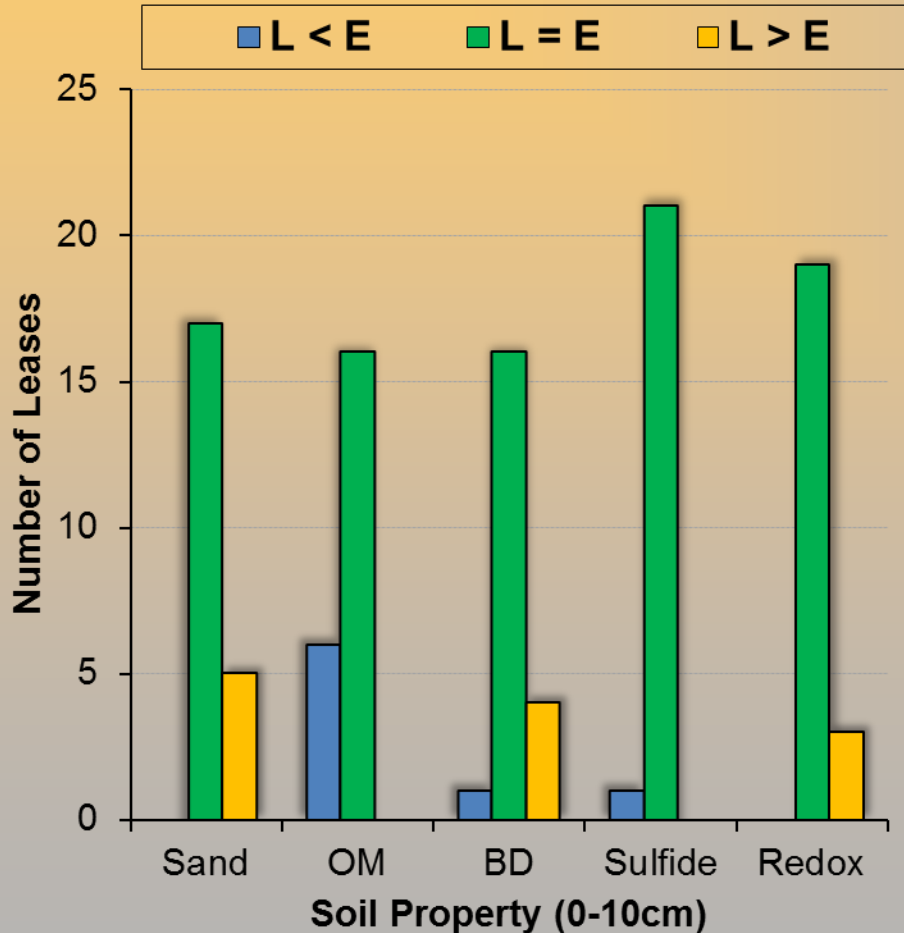
% Clay + Silt Content



- Recovery of soil properties after harvest in relation to reference site
- Recommend a 2-month fallow time before replanting bags

Soils-based Approach to Clam Farming

LEASE (L) VERSUS EASEMENTS (E)



Do soil properties differ in areas of intensively farmed leases versus adjacent unfarmed areas (e.g., easements, corridors)?

Soil Property	L < E	L = E	L > E
	(%)		
Sand	0	77	23
OM	27	73	0
BD	5	76	19
Sulfide	5	95	0
Redox	0	86	14

Note: T-tests were performed using SAS software. Treatment means were considered significantly different when $p \leq 0.10$.

Alternative Culture and Harvest Methods



- Interest in bottom planting
- Lease provisions limit use of mechanical harvesting
- Evaluated effects of a pump-driven harvester on water and soil physiochemical properties
 - Clams, FSG PD, 2013
 - Sunray Venus, DACS ARC, 2013-4
 - With Todd Osborne, UF SWS

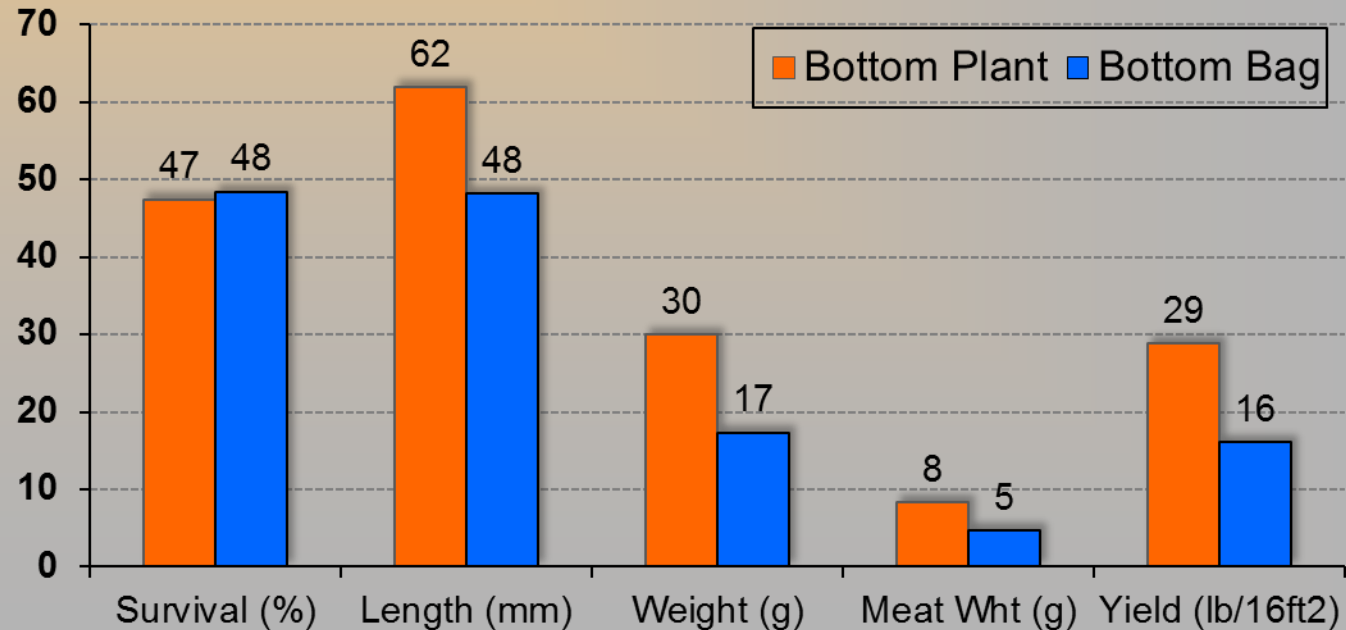
— Tested Virginia “box” harvester

- No tines, angle of box digs into substrate
- 5 Hp pump delivers pressurized water via 18 nozzles along spray bar



Bags versus Bottom-planted Sunray Venus

- **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
 - Four replications, 12 month growout
 - Stocking density, 56/ft²; Seed size, 15 mm SL
- Bottom-planted sunray venus were
 - 29% larger in shell length
 - 76% heavier / 60% more meat weight (wet)
 - 80% increase in yield (lb/16ft²)
 - Crop time could be reduced by 2-3 months

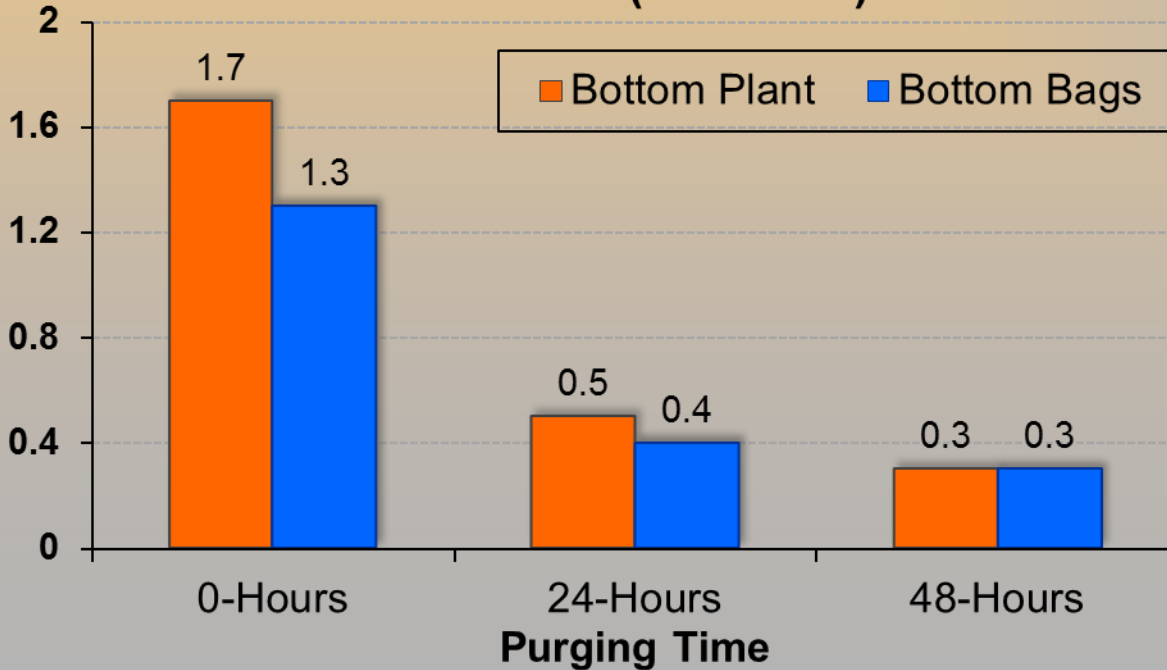


Product Quality of Sunray Venus

- Grittiness evaluation, 5-point scale where 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

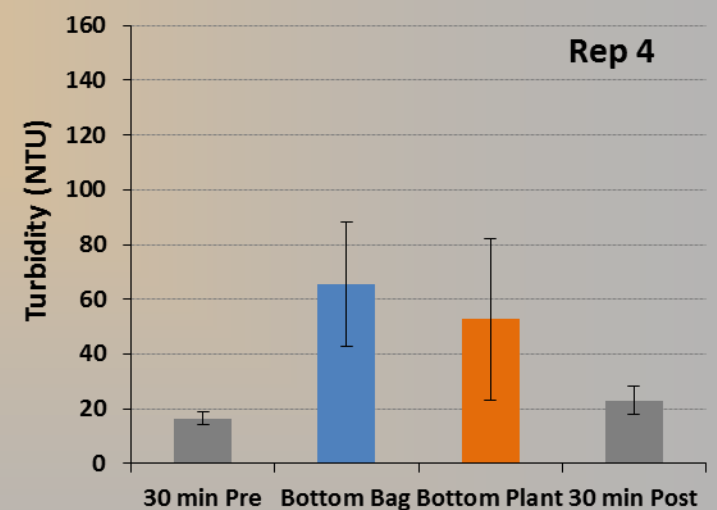
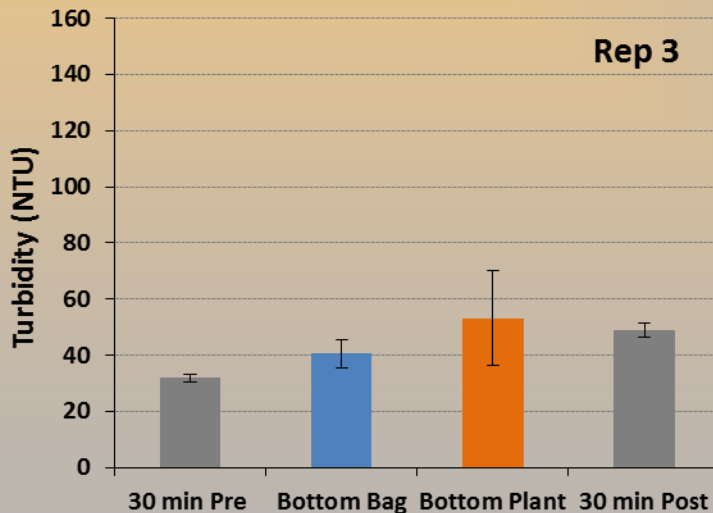
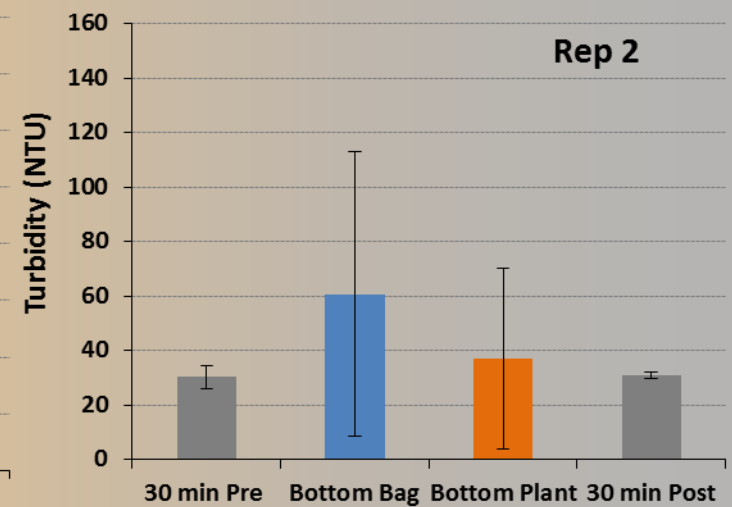
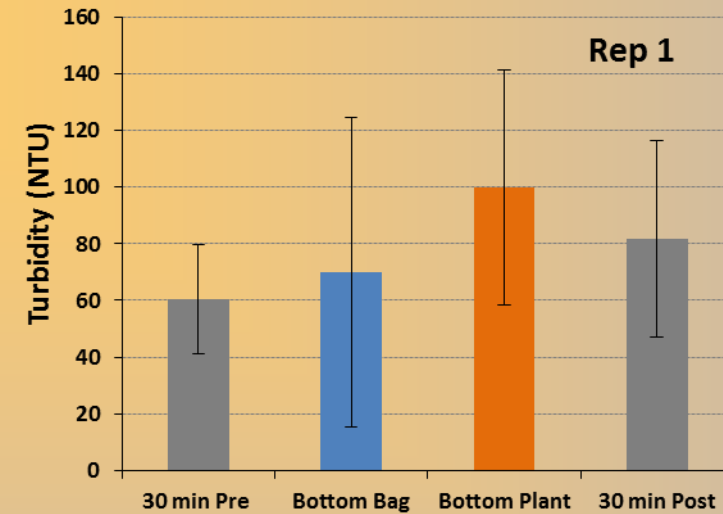
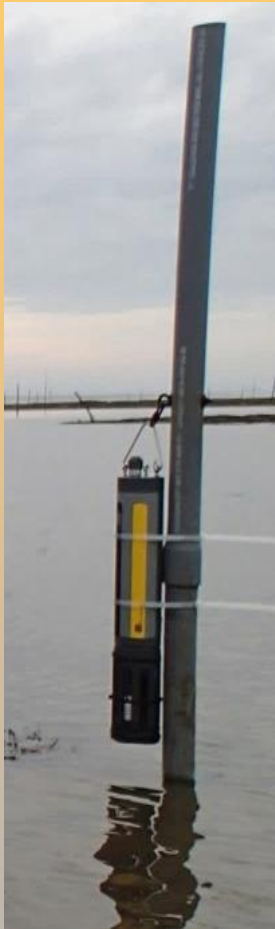


Grittiness (0-4 Scale)



- 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 using Harvester

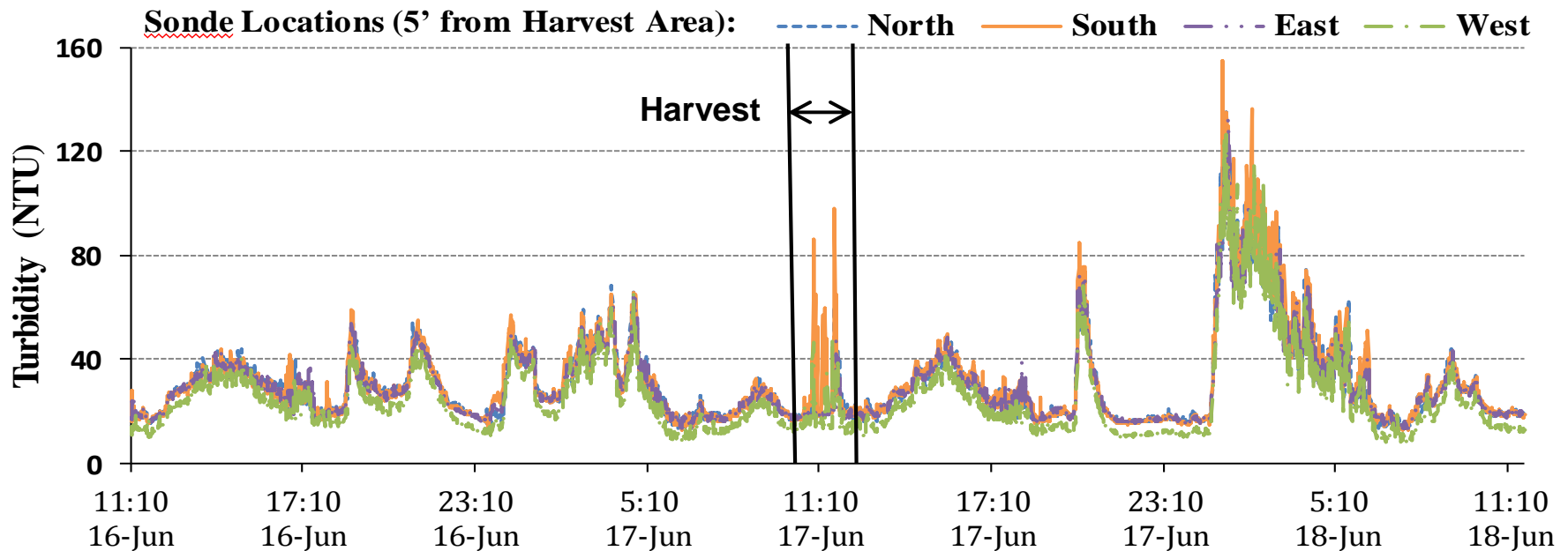


- **Turbidity (NTU)** measured continuously 48 hours pre-and post-harvest
- No significant difference observed in any replicate between mean turbidity values observed during the use of the pump-driven harvester or bag harvest

Effects on Water Quality using Harvester



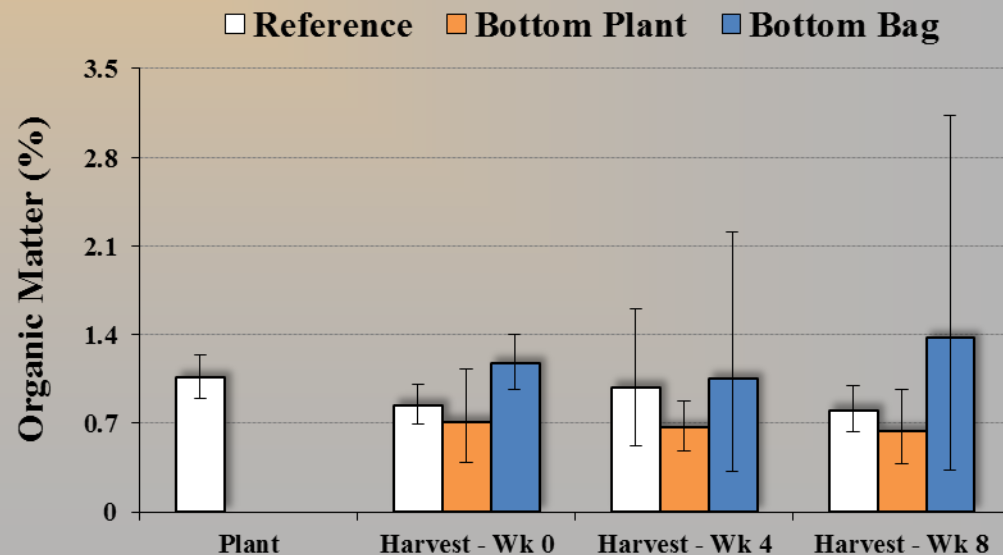
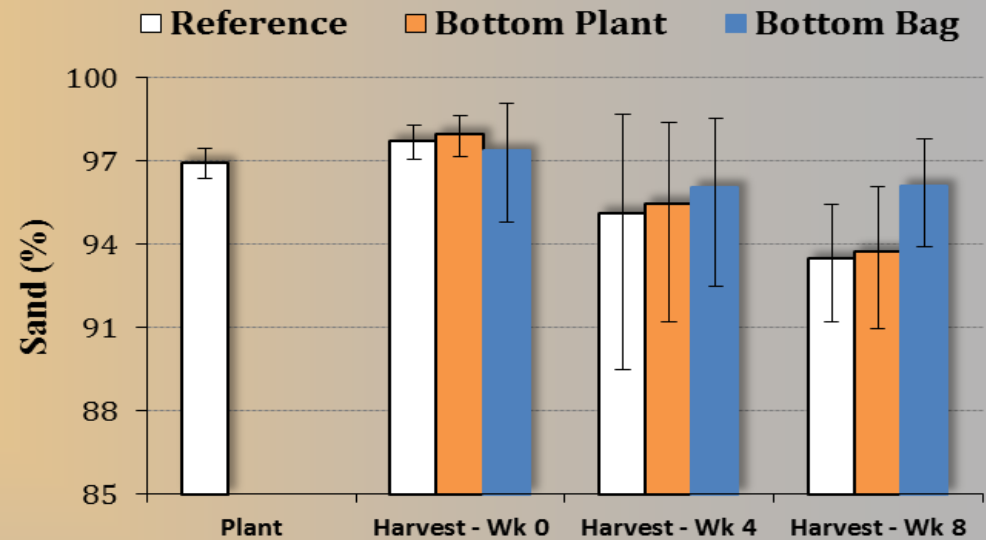
- Short-lived, variable pulse events
- Weather events can produce effects comparable to or greater than those associated with harvesting



Effects on Soil Properties using Harvester



- Soils measured at plant, harvest, and post-harvest (4 and 8 wks)
- Little effect observed in harvest-induced changes to soils PSD
- Science-based information provided to DACS to support proposed statute change in 2015 legislative session



Evaluating Biocide-free Net Coatings in Reducing Biofouling on Clam Culture Gear

- In preliminary study, two foul-release, biocide-free coatings were tested on clam bag material in Cedar Key, FL*
 - A. Photoactive release coating
 - B. Silicone-based release coating
 - C. Alkyd-based coating
 - D. Uncoated (control)
- After 3 months, Trts A and B had significantly less coverage and wet weight of biofouling than Trts C and D

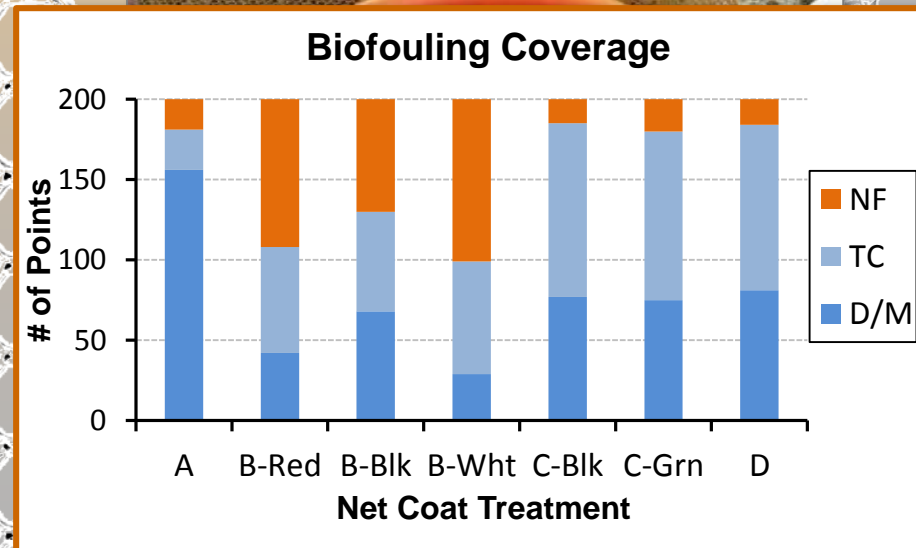


Reference: *Cassiano, E., A.Croteau, G. Smith, L.Sturmer, and S.Baker. 2012. Addressing biofouling in Florida's hard clam aquaculture industry: performance of two net coatings. *Journal of Shellfish Research* 31(1):268A.

Evaluating Biocide-free Net Coatings in Reducing Biofouling on Clam Culture Gear

- Field trials being conducted in 2014-15
- Biocide-free (non-toxic) antifouling coatings
 - Commercially available
 - Experimental formula
- Treated and untreated bags tested at 3 growing sites on Florida's west coast
- Assess biofouling coverage and weight, clam production, post-harvest maintenance of bags, and cost-benefit analysis

Funded by DACS Florida Aquaculture Program, 2014-15



"Green" Clams

Assessing and Quantifying the Value of Ecosystem Services Provided by Florida Clam Aquaculture

- Determine net removal and storage of nitrogen and carbon by harvest-size clams in Florida waters
 - Shirley Baker, UF SFRC
- Calculate range of valuation of ecosystem services (ES) provided by industry using replacement cost method
 - Sherry Larkin, Kelly Grogan UF FRED

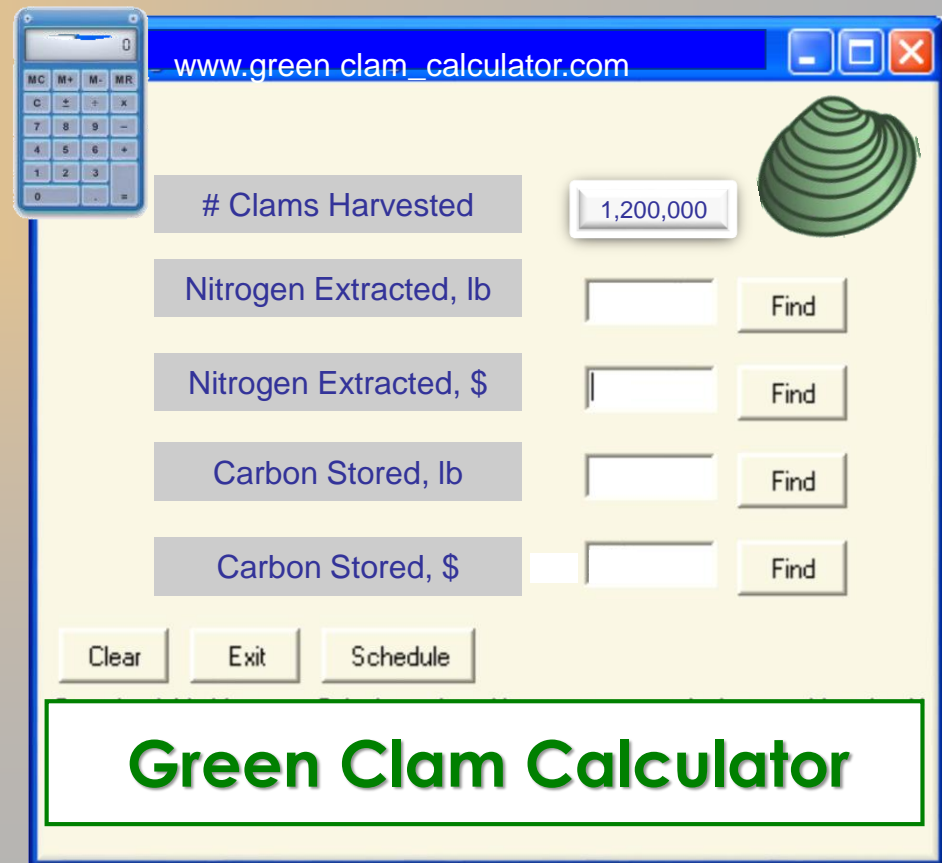


Funded by DACS Florida Aquaculture Program,
2014-15


"Green" Clams

*Promoting the Value of Ecosystem Services Provided
by the Hard Clam Aquaculture Industry in Florida*

- Information used to produce interactive, web-based tools
- On-line ES calculator
 - Growers enter annual production to determine ES values for their farms
- Industry could potentially seek certification of carbon and nutrient credits/offsets



The screenshot shows a web browser window with the URL www.green_clam_calculator.com. The interface includes a calculator icon on the left and a clam icon on the right. The main form has the following fields and buttons:

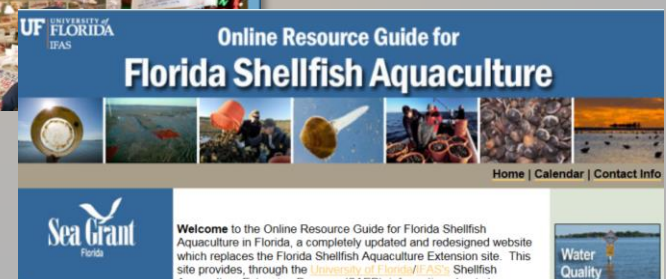
# Clams Harvested	<input type="text" value="1,200,000"/>	
Nitrogen Extracted, lb	<input type="text"/>	<input type="button" value="Find"/>
Nitrogen Extracted, \$	<input type="text"/>	<input type="button" value="Find"/>
Carbon Stored, lb	<input type="text"/>	<input type="button" value="Find"/>
Carbon Stored, \$	<input type="text"/>	<input type="button" value="Find"/>

At the bottom of the form are three buttons: , , and . Below the form is a green-bordered box containing the text **Green Clam Calculator**.

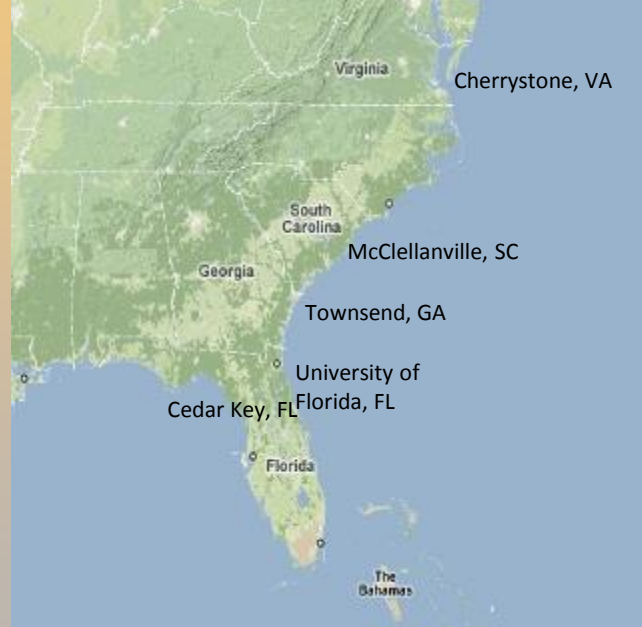
www.FlaClams.com

Promoting the Value of Ecosystem Services Provided by the Hard Clam Aquaculture Industry in Florida

- Website designed to showcase Florida industry
 - Informative resource tool and working platform to promote cultured clams as environmentally friendly and benign
 - Developing outline and need industry input from each growing area
 - Featuring: News Blog, Calendar, About our Industry, About our Farms and Farmers, About our Clams, Try Florida Clams, Where to Buy

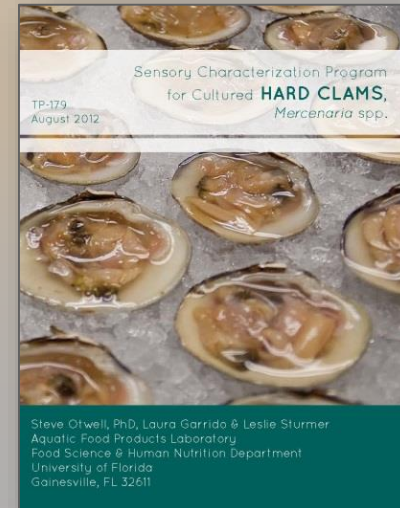


Sensory Profile of Hard Clams



- A science-based, non-biased tool developed
 - Describe and rate sensory attributes for hard clams
 - Appearance, Aroma, Taste, Texture, Flavor, Aftertaste
 - Lead to local product distinctions or “appellations”

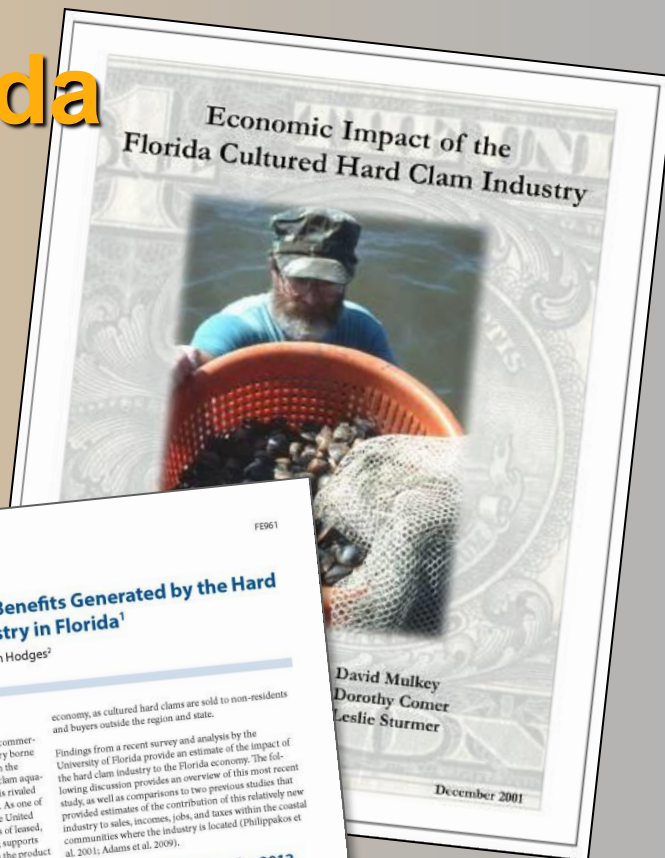
Cultured hard clams from MA to FL
evaluated in 2009-10 at the
UF Aquatic Food Products Lab



Economic Impact of Florida Clam Culture Industry

- Survey of certified shellfish wholesalers conducted by UF economists* to determine number and value of clams handled in 1999 and 2007... and **now 2012**
- Input-output methodology used to estimate direct, indirect and induced impacts
- IMPLAN PRO™ software

*Chuck Adams and Alan Hodges
UF Food and Resource Economics
Department



1. This is EDIS document FE961, a publication of the Food and Resource Economics Department, UF/IFAS Extension, Gainesville, FL; Leslie Sturmer, statewide shellfish extension agent IN UF/IFAS Extension, Gainesville, FL. The EDIS website at <http://edis.ifas.ufl.edu>.

2. Charles Adams, professor, Food and Resource Economics, UF/IFAS Extension, Gainesville, FL; Leslie Sturmer, statewide shellfish extension agent IN UF/IFAS Extension, Gainesville, FL; Alan Hodges, extension scientist, Food and Resource Economics Department, UF/IFAS Extension, Gainesville, FL.

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<http://Edis.ifas.ufl.edu>
EDIS Publication # FE961, Oct 2014



Economic Impact Assessment Findings ... 1999, 2007 & 2012



Wholesale Dealer Sales	1999	2007	2012
\$ of sales by dealers*	\$21.8 mill	\$26.7 mill	\$19.5 mill
Ave. price rec'd by dealer*	\$0.16	\$0.15	\$0.14
Disposition of sales (% by #) / ave price rec'd* (by <u>region</u> and <u>type of buyer</u>)			
In-State	49% / \$0.23	41% / \$0.13	50% / \$0.12
Out-of-State	51% / \$0.22	59% / \$0.15	50% / \$0.15
Wholesale buyer	77% / \$0.17	61% / \$0.12	64% / \$0.13
Restaurant	14% / \$0.15	6% / \$0.18	15% / \$0.14
Retail	7% / \$0.14	32% / \$0.18	20% / \$0.16
Consumer	1% / \$0.23	1% / \$0.19	1% / \$0.19



* Dollar values are nominal, not adjusted for inflation



Economic Impact Assessment Findings ... 1999, 2007 & 2012



Economic Impact (\$ million) *	1999	2007	2012
Region 1			
Economic Output	24.0	44.9	N/A
Incomes	6.5	23.0	
Value-Added	8.8	28.8	
Regions 2 & 3 (combined)			
Economic Output	9.9	8.1	N/A
Incomes	3.5	2.3	
Value-Added	3.3	2.7	
Total for Florida			
Economic Output	33.9	53.0	38.7
Incomes	9.0	25.3	14.7
Value-Added	12.1	31.5	21.9

* Dollar values are nominal, not adjusted for inflation

Species Diversification



- 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 a variety of marine mollusks

- Angel wing, 1992-1994
- Bay scallop, 1996-2000
- Ark clams, 2002-2004
- Sunray venus, 2006-12





Investigation of Ark Clam Culture and Marketability

PROJECT TEAM INVESTIGATORS:

Leslie Sturmer, Jose Nunez, LeRoy Creswell, Shirley Baker
University of Florida, Institute of Food & Agricultural Sciences

Robert Degner, Kimberly Morgan
University of Florida, Agricultural Market Research Center

Alan Power, Randal Walker
University of Georgia, Marine Extension Service

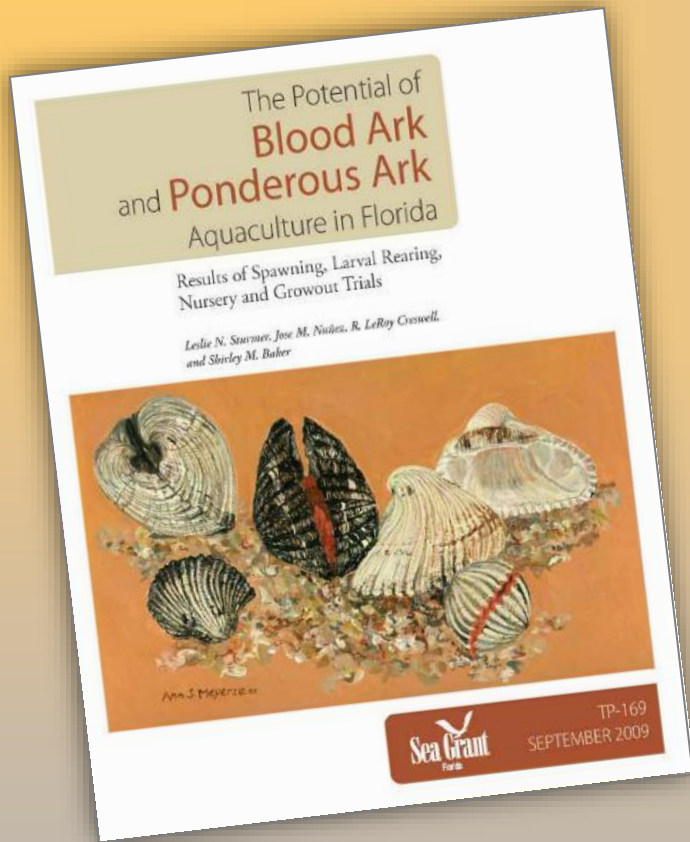
John Baldwin, Larry Nissmen
Florida Atlantic University, Dept. Biological Sciences

FUNDED BY:

USDA CSREES and Florida Sea Grant, 2002-6



Species Diversification: Ark Clams



- Nursing and growout can be conducted using gear and methods similar for hard clams
- Survival and growth documented
- Ethnic markets identified
- Unreliable setting and seed production



- Spawning protocols and cues for setting pediveligers developed
 - John Scarpa, HBOI-FAU
 - USDA NIFA, 2012-3

Renewed Interest in Oyster Culture

Commissioner Putnam, Cabinet Approve New Aquaculture Leases

Expansion of Water Column Leases Brings Opportunity to Apalachicola Bay, Other Areas of the State

Oct 10, 2013

Tallahassee, FL – Commissioner of Agriculture Adam H. Putnam and the Florida Cabinet today voted unanimously to approve additional aquaculture leases in several parts of the state, primarily in Apalachicola Bay.

The wild oyster industry in the Apalachicola Bay has declined substantially in recent years. Spring Creek Oyster Company recently began cultivating oysters in cages in the full water column, part of the water, which reduces the risk of disease and improves survival rates.



Florida Department of Agriculture
Benefiting commercial aquaculture,
Conserving natural resources

Navigational Marking of Off-Bottom Oyster Culture Leases

Off-bottom oyster culture that involve surface or subsurface oyster culture equipment may present a navigation hazard to boaters and a significant liability risk to leaseholders. This liability can be reduced if the leaseholder applies for and receives approval from the U.S. Coast Guard to appropriately mark lease boundaries as a navigation hazard. The U.S. Coast Guard communicates the potential hazard to the boating public via a notice to mariners and coastal navigation charts are amended to depict the hazard

density, types of vessels, or marine life considerations. These issues are just some of the many variables which the U.S. Coast Guard will consider and/or which may affect a Private Aids to Navigation marking determination.

U.S. Coast Guard
Florida is split into two U.S. Coast Guard districts. The Eighth District is headquartered in New Orleans and their eastern boundary ends at the Econfina River in Taylor County.

Division of Aquaculture

Kal Knickerbocker
1203 Governor's Square
Tallahassee, Florida 32301-2700

Tallahassee Office: 850-488-5471
Winter Haven Office: 863-297-3985
Email: Kal.Knickerbocker@FreshfromFlorida.com
Website: www.FreshfromFlorida.com

Application

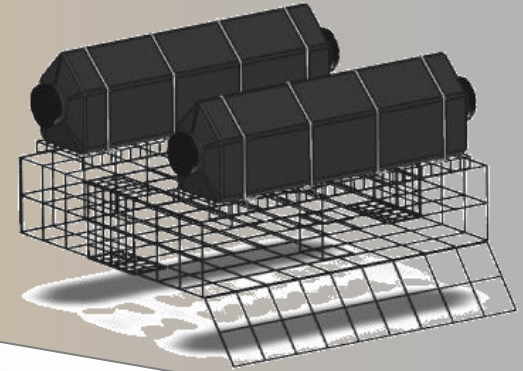
The U.S. Coast Guard offers a Private Aids to Navigation Application form (CG-2554). Information required for the form includes the contact information for the responsible party, the U.S. Army Corps of Engineer permit that approves structures in navigable waters of the United States, location in latitude and longitude for each proposed marker, and

- In past 12 months, over 35 clam leases modified for water column usage (Franklin, Levy, Manatee)
- New oyster aquaculture leases in Wakulla County
- Several clam hatcheries now producing oyster seed



Oyster Culture Workshops

- A series of workshops co-organized by UF and FDACS to inform interested clam growers and others about advancements in oyster culture gear and methods



An Introduction to Intensive Oyster Culture

Thursday
September 26, 2013
FSU Coastal and Marine Laboratory
3618 Coastal Hwy 98
St. Teresa, FL

Friday
September 27, 2013
FWC Senator George Kirkpatrick Marine Lab
11350 SW 153rd Ct
Cedar Key, FL

Both workshops are from 2:00 to 5:00 PM.

Workshops are FREE.

To ensure there are enough handouts available, please confirm your attendance with:
Portia Sapp, FDACS Division of Aquaculture, (850) 489-5471, Portia.Sapp@FreshFromFlorida.com
or
Leslie Sturmer, UF IFAS Shellfish Aquaculture Extension Program, (352) 543-5057, LNST@ufl.edu

TOPICS TO BE INTRODUCED:

- Overview of U.S. East Coast intensive oyster culture operations and Florida's experiences
- Rules of the Road: Conversion of shellfish aquaculture leases to water column usage, navigational marking requirements, other permits, BMPs pertaining to seed sources, and public health regulations for oyster harvesting and processing
- Development of off-bottom oyster farming gear and methods for the northern Gulf of Mexico

SPEAKERS INCLUDE:

- Leslie Sturmer, University of Florida IFAS and Florida Sea Grant, Shellfish Aquaculture Extension Program
- Chris Brooks and Portia Sapp, Florida Department of Agriculture and Consumer Services (FDACS), Division of Aquaculture
- William (Bill) Walton, PhD, Auburn University Shellfish Laboratory and Alabama Cooperative Extension Service

SUPPORTED BY:

An introduction to the Oyster Culture Industry in the Northeastern U.S.

Thursday
April 3, 2014
FSU Coastal and Marine Laboratory
3618 Coastal Hwy 98
St. Teresa, FL

Friday
April 4, 2014
FWC Senator George Kirkpatrick Marine Lab
11350 SW 153rd Ct
Cedar Key, FL

Both workshops are from 2:00 to 5:00 PM.

Workshops are FREE.

To ensure there are enough handouts available, please confirm your attendance with:
Portia Sapp, FDACS Division of Aquaculture, (850) 489-4033, Portia.Sapp@FreshFromFlorida.com
or
Leslie Sturmer, UF IFAS Shellfish Aquaculture Extension Program, (352) 543-5057, LNST@ufl.edu

TOPICS TO BE PRESENTED:

- Introduction to on-bottom oyster culture systems and methods used in small farming operations in the Northeastern U.S.
- Start-up of a private oyster culture initiative in Martha's Vineyard—from training and seed development to marketing and promotion
- Development of best management practices for the east coast shellfish aquaculture industry

SPEAKERS INCLUDE:

- Dale Leavitt, PhD, Associate Professor and Aquaculture Extension Specialist, Roger Williams University, Bristol, Rhode Island
Dale teaches a course on practical shellfish farming and conducts applied research for the advancement of shellfish aquaculture
- Rick Kamey, Director and Shellfish Biologist, Martha's Vineyard Shellfish Group, Oaks Bluff, Massachusetts
For over 30 years, Rick and his shellfish group have sought to expand their island's shellfisheries through innovative aquaculture technologies
- Sandy Macfarlane, Coastal Resources Specialist, Massachusetts
Sandy, a renowned Cape Cod author, has three decades of experience in coastal resource management, shellfish aquaculture and restoration

SUPPORTED BY:

An Introduction to Oyster Culture Gear & Suppliers

Wednesday
December 4, 2013
1:00-4:00 pm
FSU Coastal and Marine Laboratory
3618 Coastal Hwy 98
St. Teresa, FL

Thursday
December 5, 2013
1:00-3:00 pm
FWC Senator Kirkpatrick Marine Laboratory
11350 SW 153rd Ct
Cedar Key, FL

The workshops are FREE.

To ensure there are enough handouts available, please confirm your attendance with:
Portia Sapp, FDACS Division of Aquaculture, (850) 489-5471, Portia.Sapp@FreshFromFlorida.com
or
Leslie Sturmer, UF IFAS Shellfish Aquaculture Extension Program, (352) 543-5057, LNST@ufl.edu

TOPICS TO BE COVERED:

- "Hands-on" discussion of oyster culture gear types—advantages, disadvantages, costs, and considerations for siting, deployment, and operational management
- Where to buy culture gear? Information on equipment suppliers (only at the December 4th workshop)
- Where to buy oyster seed? Information on seed suppliers (only at the December 4th workshop)

SPEAKERS INCLUDE:

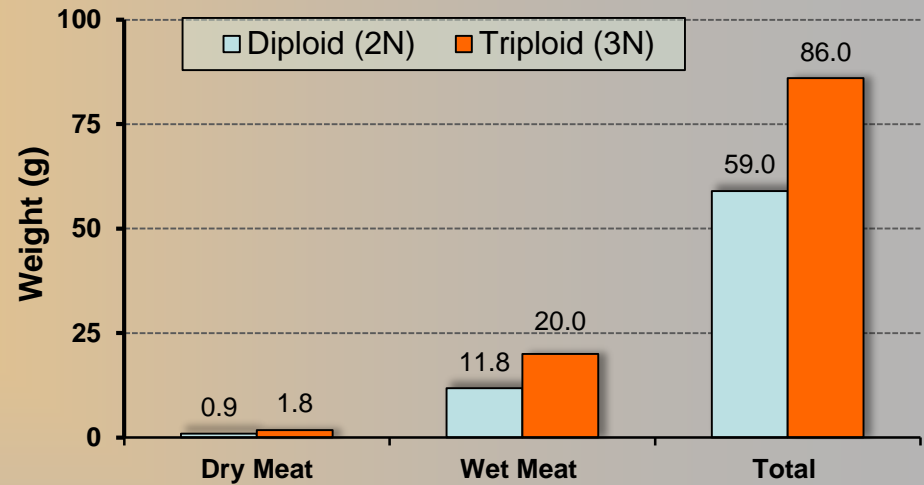
- William (Bill) Walton, PhD, Auburn University Shellfish Laboratory and Alabama Cooperative Extension Service
- John Supan, PhD, Louisiana State University and Sea Grant (only at the December 4th workshop)
- Time will be allotted for equipment and seed suppliers to present their products and services

SUPPORTED BY:

DVDs are available

Development of Triploid Oysters*

- Private-public partnership
 - 4Cs Breeding Technologies Inc.
 - Auburn University
 - University of Florida
- Develop naturally occurring triploids through tetraploid technology using west coast Florida oyster stocks
- Comply with FDACS rules pertaining to oyster genetic protection and disease prevention



*Sturmer, L., Vaughan, D., and Allen, S. 1993. The potential of triploidy in enhancing American oyster *Crassostrea virginica* cultivation in Florida. Book of Abstracts, 1993 annual meeting of the World Aquaculture Society, U.S. Chapter, Hilton Head, South Carolina.

Evaluation of the Sunray Venus Clam *Macrocallista nimbosa*

- Integrated project
 - Brood stock handling
 - UF Florida Sea Grant
 - Embryonic development
 - UF The Whitney Lab
 - Hatchery protocols
 - Harbor Branch at FAU
 - Nursery and growout culture
 - UF Florida Sea Grant
 - Market perception
 - UF Food & Resource Economics
- FL Sea Grant funding, 2006-10

Eliminate Barriers to Commercial Production of Sunray Venus



Sunray Venus Clams

Aquaculture Production Potential

THE SUNRAY VENUS CLAM (*Macrocallista nimbosa*) is a large, arc-shaped, native clam that dominated South Carolina's Florida and Gulf of Mexico coast. During the 1950-70s, two million pounds of these clams were harvested in the Pamlico region of Florida. However, significant natural stocks of sunray venus clams, as well as the small size of the fishing grounds, limited the development of the fishery. The price fishery market and potential growth rate make the sunray venus clam a highly desirable as a new candidate species to expand and diversify the local clam, *Mercenaria mercenaria*, aquaculture industry in Florida.

Over the past five years, research and extension faculty at the University of Florida and the Florida Institute of Oceanography, along with industry project partners, have developed, tested, and demonstrated technical methods to culture the sunray venus clam. The project team used culture methods similar to those employed by the Florida hard-shell clam industry as a starting point. Accomplishments for each major stage follow:

Spawning: Wild *Macrocallista* was cultured from the west coast of Florida, conditioned, and spawned by chemical

ALSO IN THIS SERIES

- Aquaculture Production Potential
- Sensory Profile
- Shelf Life Assessment
- Nutritional Profile

FLORIDA SEA GRANT COLLEGE PROGRAM



- Funded by FSG, 2010-12
- Objectives:
 - Created initial brood stock lines for seed suppliers
 - Determined production performance at existing lease areas
 - Established relationship between soils and productivity at lease areas
 - Defined salinity and soil preferences for selection of future lease sites
 - Determined sensory, microbial, and nutritional profiles
 - Examined product attributes with respect to wholesale market and product distribution standards

Sunray Venus Clams

CONSUMER ACCEPTANCE of Cooked and Raw Clams

SUNRAY VENUS CLAMS represent an interesting addition to the complement of soft-shell shellfish available through commercial culture and wild harvest in Florida. Sunray venus clams can be grown to similar environmental conditions and using similar culture techniques as farmed clams. The nutritional availability of sunray venus clams will likely enhance the viability of the cultured soft-shell clam and wholesale industries, which recently has shown to be a good economic investment opportunity of \$1.2 million.

Consumer studies have used consumer acceptance of both raw and cooked sunray venus clams. The number of consumer venus clams with defects are higher than those with defects in farmed clams. The number of defects in farmed clams was higher than those with defects in wild clams. The number of defects in wild clams was higher than those with defects in farmed clams.

ALSO IN THIS SERIES

- Aquaculture Production Potential
- Sensory Profile
- Shelf Life Assessment
- Nutritional Profile

FLORIDA SEA GRANT COLLEGE PROGRAM

Sunray Venus Clams

NUTRITIONAL PROFILE

SUNRAY VENUS CLAMS are a low fat source of protein. A single 2-ounce (56 g) serving of sunray venus clams (18 to 20 cooked clams) provides approximately 7 g of protein. The low fat content (2.96 mg compared to protein of 100 mg) is 0.03%, with 50% (average 3 fatty acids) and the remainder (52%) is saturated fat. The level of cholesterol in sunray venus clams was about 25 mg per 50 g serving. The level is low when compared to fish, shellfish, and other foods, such as pork, eggs, chicken, and cheese.

ALSO IN THIS SERIES

- Consumer Acceptance of Cooked and Raw Clams
- Sensory Profile
- Shelf Life Assessment
- Aquaculture Production Potential

FLORIDA SEA GRANT COLLEGE PROGRAM

Sunray Venus Clams

SENSORY PROFILE

THE TASTE: CONSUMERS received samples of the University of Florida Aquatic Food Products Lab conducted a sensory evaluation of the sunray venus clams to describe or profile the characteristics of this new aquacultural clam. The sensory attributes measured focus on the product's appearance, texture and cooking potential.

ALSO IN THIS SERIES

- Consumer Acceptance of Cooked and Raw Clams
- Aquaculture Production Potential
- Shelf Life Assessment
- Nutritional Profile

FLORIDA SEA GRANT COLLEGE PROGRAM

Sunray Venus Clam Culture in Florida



Eight Years of Research and Development



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 Objectives:

- 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 bottom 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 the availability and attributes of a new Florida aquaculture product



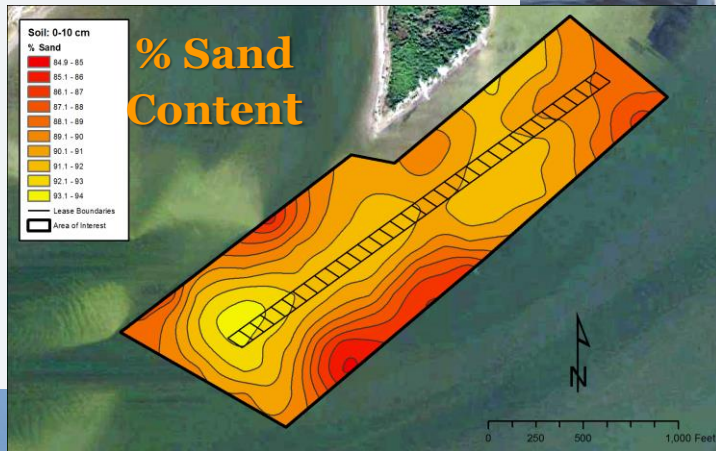
Demonstration Site

Dog Island Demonstration Site

Cedar Key



- 5-acre site established for education by FDACS and UF
- Allows growers to grow a crop without investment and commitment of a lease
- Site suitable for sunray venus culture
- 38 growers participating



34 0.15-acre plots



Addressing Sunray Venus Seed Production

- Examining **nutritional status** (fatty acids) of cultured and wild adults
 - HBOI-FAU and UF, Specialty License Plate funding, 2014-15
- Determining **reproductive patterns** of wild and cultured adults
 - HBOI-FAU and UF, DACS ARC proposed funding, 2015-16
- Evaluating **maturation protocols** for spawning wild adults
 - Bay Shellfish and Eckerd College, DACS ARC proposed funding, 2015-16



Clam Industry Meetings

- Present information on recent and ongoing projects
- Meet Dr. Huiping Yang and learn about her research experiences
- Provide direction in addressing research efforts to meet the needs of shellfish aquaculture industry

You are invited to participate!

Dialogue with SW Florida Shellfish Growers

Wednesday, September 17, 2014
3:00-5:00 PM

UF IFAS Charlotte County Extension Office
25550 Harbor View Road
Suite 3, Room B
Port Charlotte, Florida

Learn about recent and ongoing projects being conducted by the Shellfish Aquaculture Research Program:

Striving to meet the industry's needs!

The Cedar Key Aquaculture Association invites you to participate in a General Membership and Industry Planning Meeting

Thursday, August 21, 2014
Community Center, 809 6th Street
Cedar Key, Florida

From 6:00-7:00 PM:

- CKA members complete their annual business with the Association:
 - Renew your 2013-14 membership and Anchor Hole agreement
 - Pick up your parking decal and
 - Elect your Board of Directors for
- Get caught up on the various activities over the past year and plans for the

From 7:00-8:00 PM:

- Brief introductions/updates will be provided:
 - Marketing—Martin May, DACS B
 - Research—Dr. Huiping Yang and
 - Marine Debris—Paul Zajack, DAI
- Develop an ACTION PLAN and set priorities:
 - Break-out sessions will allow groups to discuss what is needed for the industry to
 - Then you will individually rate and provide guidance for your state agency

Pizza and refreshments

For more information, contact Rose Cartwell, Members, or Leslie Stummer, UF Shellfish Agent

You are invited to participate!

Dialogue with Indian River Shellfish Growers

Wednesday, October 29, 2014
2:00-4:00 PM

Captain Hiram's Restaurant
Downstairs Meeting Room
1606 Indian River Drive
Sebastian, Florida

Learn about ongoing projects being conducted by the Shellfish Aquaculture Research & Extension Program:

- Project VENUS: Vocational Education Network Using Sunrays
- Effects of a Pump-driven Harvester on Water & Soil Properties
- Performance of Biocide-free Coatings in Biofouling Control
- Valuation of Ecosystem Services provided by Clam Farms
- Development of Triploid Oysters for Florida Culture Stocks

Meet Dr. Huiping Yang, a new UF faculty member in molluscan shellfish aquaculture and restoration, and hear about her research experiences

Provide direction in addressing research efforts to meet the needs of the shellfish aquaculture industry

For more information, contact Leslie Stummer, UF IFAS Shellfish Aquaculture Extension Agent, at (352) 543-9057 or LNST@ufl.edu



Questions?

