UF IFAS

Sea Grant Florida

HARBOR BRANCH

FLORIDA ATLANTIC UNIVERSITY

SFRC

USDA

Wednesday, November 7, 2012
Community Center, Cedar Key

Clam Culture Industry Workshop

AGENDA

1:00—3:30 PM

Welcome and Introductions

Sue Colson, City of Cedar Key Commissioner
Karl Havens, Florida Sea Grant College Program
Tim White, UF School of Forest Resources and Conservation

Project Updates

Soil properties on clam leases under intensive culture efforts and recovery of harvesting activities

Rex Ellis and Todd Osborne, UF IFAS Soil and Water Science
Bill White, UF SFRC Fisheries and Aquatic Sciences

Selection for heat tolerance in cultured clams using biomarkers

Shirley Baker, UF SFRC Fisheries and Aquatic Sciences
John Scarpa, Harbor Branch Oceanographic Institute at FAU

Clam stock improvement projects: results of growout field trials

Leslie Sturmer, UF IFAS Cooperative Extension Service
John Scarpa, Harbor Branch Oceanographic Institute at FAU

Sunray Venus Culture and Marketability

Broodstock development for sunray venus clam seed production

John Scarpa, Harbor Branch Oceanographic Institute at FAU

Production evaluation at leases and relationship of soil properties

Leslie Sturmer, UF IFAS Cooperative Extension Service

Defining soil properties for sunray venus clam culture

Rex Ellis and Todd Osborne, UF IFAS Soil and Water Science

Examination of wholesale market attributes for sunray venus clams

Chuck Adams, UF IFAS Food and Resource Economics

Developing product standards or guidelines for sunray venus clams

Steve Otwell, UF Aquatic Food Products Lab

Industry Input / Where do we go from here?

FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
DIVISION OF AQUACULTURE

APPLYING A SOILS-BASED APPROACH TO CLAM AQUACULTURE IN FLORIDA

L. Rex Ellis, University of Florida (UF) IFAS Soil and Water Science Department
Todd Z. Osborne, UF IFAS Soil and Water Science Department
William R. White, UF IFAS School of Forest Resources and Conservation, Fisheries
Leslie Sturmer, UF IFAS Cooperative Extension Service

Sediment characteristics, such as sediment type, particle size distribution, and soil permeability, seem important for hard clam growth; however, characterization of sediment is a short coming in many studies. This ongoing project complements a prior USDA-funded project in which we conducted a survey of soil properties at the Dog Island High-density Lease Area (HDLA) near Cedar Key to determine spatial patterns within the lease area.

Introduction Florida's inshore coastal waters have limited intertidal areas, thus the majority of hard clam cultivation is subtidal. Given that clams spend a majority of their life buried in aquatic soil, it is expected that soil properties affect clam productivity. While determining what soil properties may be best for clam growth was a focus of prior soil-based clam research, there has been no focus on the mechanics of clam aquaculture. Pre- and post-harvesting soil conditions need to be quantified to determine the effect of harvesting. Most farmers believe the soil to be important for clam growth, but all cite a lack of organized knowledge on how it affects growth.

Goal and Objectives The goal of this project is to assess soil properties on intensively-farmed shellfish aquaculture leases, to determine the influence of clam harvest techniques on subaqueous soils, and to investigate if farming practices can be modified to maximize beneficial characteristics of soils on lease sites. The specific objectives are to: 1) Compare subaqueous soil properties at several shellfish aquaculture lease areas with adjacent unfarmed reference (control) sites, 2) Compare soils in farmed portions and in adjacent un-farmed portions seasonally to determine reference conditions and 3) Analyze soils immediately after harvesting clam bags and after varying fallow times to determine physical and chemical changes to soils due to harvesting. The efforts focused on Objectives 1 and 2 will be referred to as the **Spatial Study** while the efforts focused on Objective 3 will be referred to as the **Harvest Study**.

Experimental and Sampling Design: To better understand changes due to farming activity, leases with high farming intensity will be compared with control or reference sites nearby the leases (e.g., easements, navigational corridors). Soils were sampled at six leases in the Dog Island HDLA during the summer of 2011 and at three leases during the winter of 2012. Previous studies showed there to be a spatial pattern in soil OM at the Dog Island High Density Lease Area. Using this information, we selected from available leases, those which would provide a range of soil properties. Soils were sampled at six locations in the Gulf Jackson HDLA during the summer (2012) and will be sampled in the winter (2013) to determine if seasonality has any effect on lease soil quality. Second, soils from two leases at Dog Island HDLA and three leases at Gulf Jackson HDLA were analyzed immediately after harvesting and compared to adjacent reference sites to determine the effect of harvesting activity on the soil. The participating farmers did not replant in those areas to allow for sampling at varying fallow periods (e.g.,1 week, 2 weeks, 1 month, 2 months).

Outcomes: Spatial Study Soil properties measured at intensively-farmed leases and adjacent easements were not statistically different, indicating that effects of clam aquaculture may be nominal. Further, leases and easements are subjected to similar environmental conditions (e.g., tides, currents, winds), which may have more of an influence on soils than farming activities. This can be observed by comparing graphs of soil properties at parcels 819 and 816 (Figure 1).

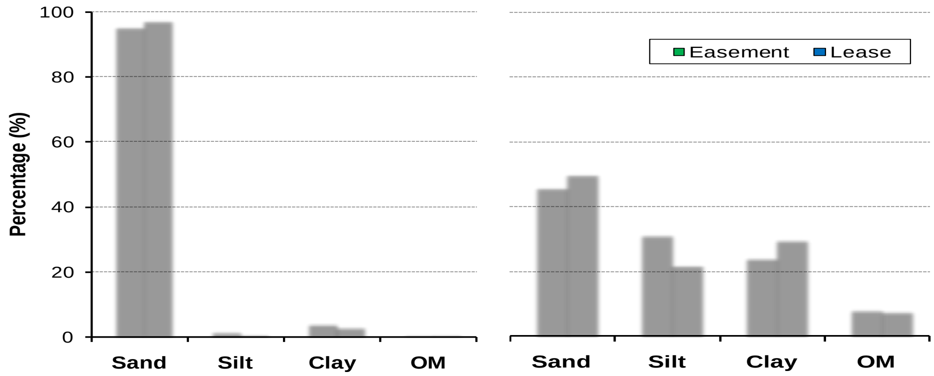


Figure 1. Physio-chemical characteristics of surface soils (0-4") occurring on two of the Dog Island High-density Lease Area parcels.

Outcomes: Harvest Study Soil properties of the harvest sites typically converged with the reference sites after a few weeks. An example of this is given for lease parcel 819 in the Dog Island HDLA (Figure 2). Each graph was qualitatively examined to determine the week of convergence (green circles, Figure 2). These weeks were then averaged across all sampled leases and soil properties at Dog Island HDLA and then Gulf Jackson HDLA. For harvest sites located at Dog Island HDLA, average recovery time of soil properties was 2.9 weeks, with a maximum of 4 weeks. At Gulf Jackson HDLA, average recovery time was 5.7 weeks, with a maximum of 8 weeks. Based on these findings, we recommend a fallow period of 2-8 weeks.

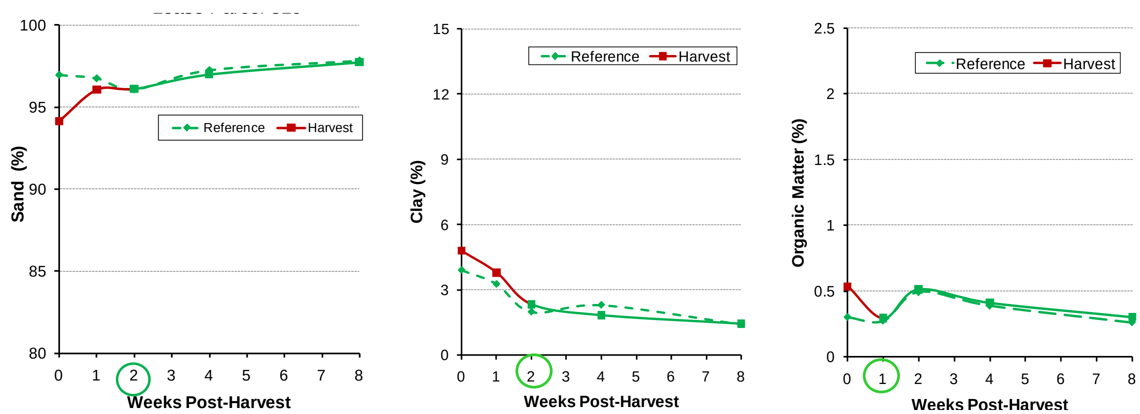


Figure 2. Examples of soil properties converging over time for a parcel on Dog Island HDLA.

Outcomes: Overall Long-term effects of intensive bottom planting seem to be small compared to the natural variability that exists in soils. However, detailed monitoring of soils suggest that bottom planting can temporarily change soil properties. Combining these findings, we feel that the long-term changes to soil properties would likely be avoided if a brief (e.g. 2-8 weeks) fallow period was periodically observed between plantings. This research provides science-based information to be used by clam farmers in their decision making. For instance, a farmer may choose to rotate farming to different portions of a lease to maintain high soil productivity if it is found that longer fallow times result in soil properties favorable for clam growth. This research is being funded through USDA National Institute of Food and Agriculture.

SELECTION FOR HEAT TOLERANCE IN CLAMS USING BIOMARKERS

Shirley M. Baker, University of Florida IFAS, Fisheries and Aquatic Sciences Program
John Scarpa, Harbor Branch Oceanographic Institute at Florida Atlantic University
Leslie N. Sturmer, University of Florida IFAS, Cooperative Extension Service

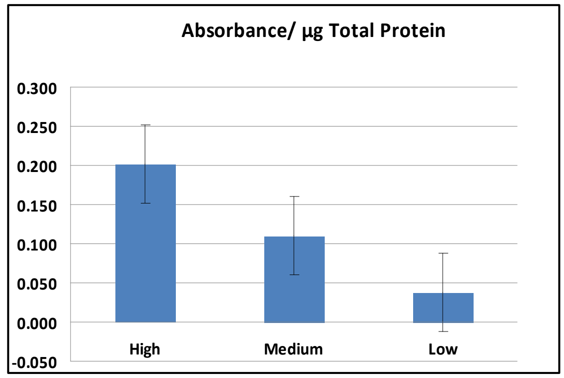
Florida represents the southernmost limit of the northern hard clam, *Mercenaria mercenaria*, where subtropical temperatures allow for a long growing season. Growers across the state of Florida have experienced chronic losses of market-size clams when summer water temperatures exceed 90^{o}F. Climate change will certainly have an effect on worldwide agriculture and crops that are currently near temperature thresholds, such as hard clams, are likely to suffer. Clearly there is a need for a heat-tolerant clam strain if the Florida industry is to reduce current summer mortalities and adapt to future climate change.

For the past several years we have examined the utility of two basic breeding techniques, triploidy and hybridization, for increasing survival and production in Florida waters. These studies indicated that thermal tolerance in clams may be under genetic control. In our projects we produced different families of clams from single-parent crosses; parents were selected at random from available broodstock. We found some families consistently performed better than others. As we further investigated the differences in the families, we found that heat-shock proteins may be indicative of thermal resistance.

Heat-shock proteins (Hsp) are involved in formation, transportation, and degradation of proteins. Some Hsp increase when cells are exposed to elevated temperatures or other stressors that damage proteins and are referred to as inducible. A second form of Hsp is produced regularly under non-stressful conditions for cellular housekeeping and is referred to as cognate. In our previous project, we found that a hard clam family having approximately twice as much cognate Hsp compared to two other families had significantly greater survival after heat challenge. These data suggest that using biomarkers of thermo-tolerance, such as Hsp, we can target particular genetically distinct groups for selective breeding, thus reducing the time and resources needed for strain development.

The overall goal of our project is to increase summer survival and productivity of cultured hard clams, while addressing thermal tolerance needs related to climate change. We are in the process of addressing three project objectives: A) examine levels of Hsp in hard clam broodstock and offspring families *to test if levels of Hsp are heritable*, B) measure Hsp levels in hard clam families and at life states *to test if family rankings are consistent over time*, and C) measure survival, production, shelf life, and laboratory thermo-tolerance of hard clam families *to test if Hsp levels are correlated with survival, production, and product quality.*

A survey of cultured and wild groups (n=11) of clams (total n=540) found that relative levels of hemolymph heat-shock protein 70 varied among individual adult clams and could be categorized as high, medium and low (Figure). It was noted that clams that were larger on average were in the low Hsp category, indicating that size and cognate Hsp may be related, but this needs further study. From these surveyed hard clams, we produced at two different times, three families from high-Hsp expressing parental stock and three families from low-Hsp expressing parental stock. One replicate set of clams (n=6 families) was planted on the east coast of Florida in the Indian River Lagoon and the second replicate set of clams was planted on the west coast of Florida in the Gulf of Mexico. During nursery and growout culture we will examine Hsp levels of the different groups. Hsp may be considered a biomarker for selective breeding of heat-tolerant hard clams if Hsp levels in progeny are correlated with parental Hsp levels and the high-Hsp families exhibit higher survival in the field and laboratory challenges.



Our research will provide the necessary data to assess if cognate Hsp may be useful as a biomarker, or indicator, for thermal tolerance in cultured hard clams, which then could be successfully used in selective breeding programs. Development of more robust clam strains would represent an important gain over the present reliance on unselected stocks and would have a positive impact on production of cultured clams in Florida, improving production and cash-flow for clam farmers and ancillary businesses.

Project support is recognized from USDA-NIFA, USDA-Egypt Science and Technology, and NOAA-Sea Grant (R/LR-A-47).

FLORIDA HARD CLAM BREEDING PROJECTS: RESULTS OF GROWOUT TRIALS

Leslie N. Sturmer, University of Florida (UF) IFAS Cooperative Extension Service
John Scarpa, Harbor Branch Oceanographic Institute at Florida Atlantic University
William White, UF IFAS School of Forest Resources and Conservation

The need for a hardier clam strain has become evident as shellfish growers in Florida report below average survivals or total losses during prolonged hot summers. The local southern quahog *Mercenaria campechiensis* may have suitable production characteristics for Florida environments and readily hybridizes with the northern hard clam *M. mercenaria*, but gapes during refrigerated storage. We previously reported on field trials conducted during 2008-9 with parental species and their hybrid crosses.

Backcrossing F1 Hybrids to Northern Hard Clams

Interspecific hybridization of the hard clam (M) with the local southern quahog (C) resulted in increased yield but reduced shelf life in refrigerated storage, which is typical for the southern quahog. Backcrosses of the F1 hybrids (MC, CM) with the hard clam were examined to minimize these product quality concerns. Five families of backcrossed hard clams were produced using multi-parent crosses from hybrid and parental stocks in 2009-10. The following families (♀x ♂): MxMC, MCxM, MxCM, CMxM were compared with hard clams (MxM). Larval and nursery methods did not differ from methods used by Florida hatcheries nor were noticeable differences among stocks observed. Seed (>750K) from 19 stocks were field nursed in the summer (2010, 3 months), transferred to replicated growout systems in the fall, and harvested the following fall (2011, 13 months). During the field nursery, survival of backcross stocks (71-82%) was greater than hard clam controls (65%). At harvest, 3 out of the 4 backcross stocks yielded higher survival (83-90%) and production (75-84 lb/bag), compared to hard clams (79%, 68 lb/bag) (Figure 1). After 10 days in refrigerated storage, survival of backcross stocks (97-99%) was similar to hard clams (100%). Although gaping was higher in the backcross stocks (3-11%) versus hard clams (2%), these results were commercially acceptable. This breeding approach can increase summer survival and productivity of cultured hard clams while maintaining product quality standards; however, it requires the maintenance of unique clam lines.

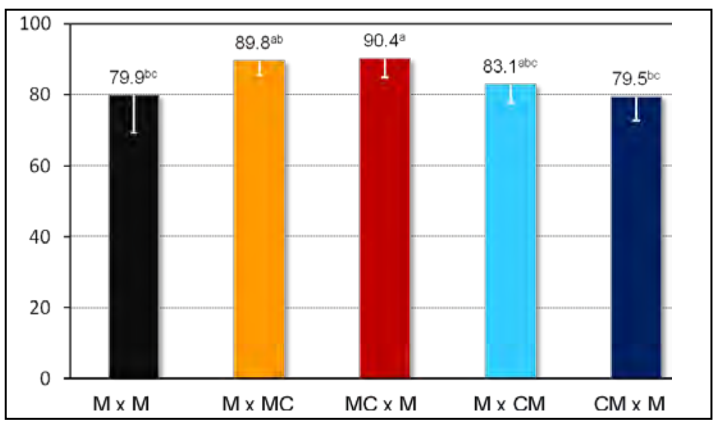


Figure 1. Average survival of backcross families (MxMC, MCxM, MxCM, CMxM) after 13 months in growout, compared with the hard clam control (MxM).

Evaluating Thermally Challenged and Wild Stocks

Another breeding approach is selection of survivors of an adverse environmental event, such as high water temperatures, for broodstock. In plant breeding programs, thermal challenges are artificially induced and several generations of progeny from surviving stocks are produced. In our study, multiple families of hard clams from commercial stocks were collected and half were thermally challenged for use as broodstock. Hard clams (n=2,250) were exposed to a thermal challenge (95°F, 48hrs) and survivors (n=45) were conditioned and spawned to produce progeny.

Another component of this study evaluated crossing hard clams collected from natural populations with cultured stocks for the purpose of increasing genetic diversity or "vigor." Further, the Florida hard clam culture industry is based primarily on the "notata" strain of the hard clam, which has been bred in cultured stocks to distinguish them from fisheries, or "wild," stocks. However, this shell coloration is not preferred in some markets and may be associated with inbreeding depression. We collected "wild" hard clams from the St. Augustine area, where "pure" *M. mercenaria* stocks are known to exist, to test if this color variant could be reduced while increasing genetic diversity.

Two spawns of thermally-challenged (T), non-thermally challenged (NT), and wild (W) broodstock produced the following groups (♀x ♂): NTxNT, TxT, NTxW, WxNT, WxW. There were no differences noted in performance of stocks during larval rearing, setting, and land-based nursing. Groups were land- and field-nursed, and recently harvested in replicated growout trials. In the field-nursery culture over the summer (2011, 4 months), there was a natural thermal event (water temperatures >90^{o}F for 22 days) and the TxT cohort was found to have 40% higher survival as compared to the NTxNT control (71 versus 51%). Offspring of the crosses (NTxW, WxNT) performed poorly (20-29%) as did the WxW control (3%). However, after 13 months in the field growout, there were no significant differences in survival of the NTxNT, TxT, and NTxW stocks (81-83%); survival of the WxNT cohort was significantly lower (66%) (Figure 2).

Results were similar for yield, which is a function of both survival and total weight. The NTxNT, TxT, and NTxW stocks averaged 78 lb/bag, whereas average yield of the WxNT stock was 46 lb/bag. The shell coloration of harvested stocks was rated on a scale of 1-5, where 1 was the least (0% notata) and 5 was the most (100% notata). The hard clam stock (NTxNT) had 92% notata coloration, while the NTxW cross had 58% notata coloration (Figure 3). Although the notata coloration of the WxNT cross was reduced to 39%, the poor production performance of this cross would negate any commercial advantage.

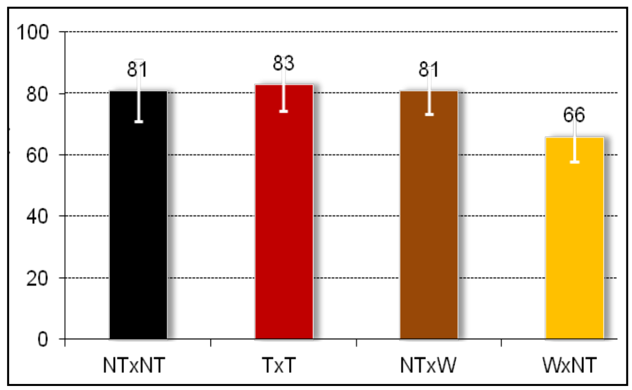


Figure 2. Average survival of a thermally challenged hard clam (TxT) stock and reciprocal wild crosses (NTxW, WxNT) after 13 months in growout, compared with the hard clam control (NTxNT).

Figure 3. Notata coloration of the hard clam stock (NTxNT) rated 92% on a scale of 0-100% (left), while the coloration in the NTxW cross was reduced to 58% (right).

Traditional breeding and selection methods are useful for increasing survival, yield, and changing coloration of hard clams for the Florida shellfish aquaculture industry; however, hatcheries must ensure good record keeping of production parameters for their separate lines.

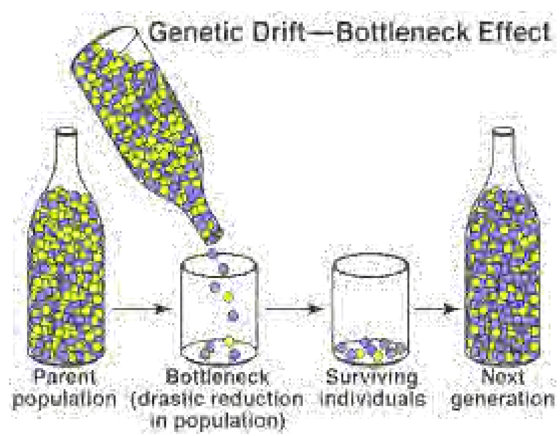
Support for this research came from the USDA NIFA Special Research Grant Program.

ENHANCED HATCHERY PRODUCTION OF SUNRAY VENUS CLAMS THROUGH BROODSTOCK DEVELOPMENT

John Scarpa, Harbor Branch Oceanographic Institute at Florida Atlantic University
Leslie Sturmer, University of Florida IFAS, Cooperative Extension Service

The Florida shellfish aquaculture industry primarily produces a single species, the hard clam *Mercenaria mercenaria*, which may be may be problematic if a new virulent clam disease emerges or price reductions occur from economic perturbations. The sunray venus clam (SRV), *Macrocallista nimbosa*, is a native species that was commercially fished in the Gulf of Mexico during the 1960s and 1970s and is being evaluated as a new aquaculture species to diversify the industry. In our previous research, we spawned SRV clams, cultured larvae, produced seed, and reared them through growout using techniques similar for commercial hard clam culture. The existence of a latent market was determined via a consumer acceptance study.

Our next goal is to assist Florida shellfish hatchery operators as there may be a reluctance to move forward developing sunray venus clam broodstock or producing seed until they are confident that growers have a marketable product for wholesale distribution. This "chicken and egg" scenario may be overcome by assisting the industry; as was done to head start the hard clam industry in Florida. Our previous projects utilized single- or double-parent crosses to produce replicate families for *scientific* culture of the species. However, commercialization requires multi-parent crosses to produce founder broodstock (G_0) that retain as much genetic diversity as possible from wild local populations for future selection efforts.



Retaining genetic diversity aids in future selection efforts and environmental adaptability of the organisms. We demonstrated to industry personnel the proper development of sunray venus clam broodstock for seed production through a workshop that introduced the concept of effective parental number (Ne) and factorial pair-wise matings. These concepts, if followed, will ensure that Florida clam hatchery operators do not initiate genetic bottlenecks, which may result in inbreeding depression, or limit genetic diversity in their product and future lines for selective breeding.

To date, two separate lines of broodstock were created using multiple parents to capture genetic diversity for future selection by commercial hatcheries. The parental broodstock were taken from natural stocks in two different regions along the coast of Florida on the Gulf of Mexico. SRV clams from these lines will be made available to Florida commercial hatchery operators in the near future. This research is supported by Florida Sea Grant College Program (Project R/LR-A-46).

DETERMINING COMPATIBILITY OF COMMERCIAL LEASES AND AQUEOUS SOIL PROPERTIES FOR SUNRAY VENUS CLAM CULTURE

Leslie Sturmer, University of Florida (UF) IFAS Cooperative Extension Service
Rex Ellis, UF IFAS Soil and Water Science Department
Todd Osborne, UF IFAS Soil and Water Science Department
William White, UF IFAS School of Forest Resources and Conservation, Fisheries

The objective of this project component is to determine the compatibility of shellfish aquaculture leases and potential future lease sites for the potential of sunray venus (SRV) clam culture. Production performance of SRV clams was evaluated at 20 existing commercial leases and 4 test sites by providing over 210,000 SRV seed to 18 growers in four counties (Franklin, Lee, Levy, and St. Johns). Growers were allowed to "experiment" with some of the seed, but were asked to standardize three bottom bags, each stocked at $50/ft^2$. The SRV clams were harvested after about 12 months. Production characteristics measured at harvest included survival, growth (shell length, shell width, total and meat weight), and shell deformities. To examine a relationship between aqueous soils (bottom sediment) and SRV clam productivity, soil properties were measured both at plant and harvest. Triplicate core samples were taken for analyses of sand, clay, silt, and organic matter content. Hydrogen sulfide values and bulk densities were also determined.

The 2010-11 growout studies yielded a range of results with SRV clam survivals of 4 to 71%. There was less variation in growth, with harvested SRV clams ranging from 0.6 to 0.8 inches in shell width and 1.6 to 2.1 inches in shell length. Results obtained for total weight ranged from 10.3 to 21.9 grams (21-44/lb). Shell deformities or irregularities were low, ranging from less than 1 to 5.3%. Survival was considered acceptable if values exceeded 50%. At those leases with ≥50% survival, soil characteristics consisted of an average of 93.% sand content (range, 92.7-97.0%), 3.3% clay content (range, 2.7-5.4%), 3.1% silt content (range, 0.4-8.5%), and 0.8% organic matter content (range, 0.4-1.5%) (Table 1). At those leases with <50% survival, soil characteristics consisted of an average of 89.0% sand content (range, 82.7-93.3%), 5.5% clay content (range, 3.6-6.8%), 5.2% silt content (range, 1.7-12.2%), and 2.1% organic matter content (range, 1.3-3.1%) (Table 2). These findings indicate that aqueous soils with higher sand content, lower silt content, and lower organic matter are more favorable for sunray venus clam culture.

Table 1. Acceptable production of ≥50% survival of sunray venus clams obtained at four leases in Franklin and Levy Counties during 2010-11 and soil characteristics measured at these leases.

Values	Survival (%)	Sand (%)	Clay (%)	Silt (%)	Organic Matter (%)
Average	62.8	93.2	3.93	3.05	0.82
Range	55 - 71	92.7 – 97.0	2.7 – 5.4	0.4 – 8.5	0.5 – 1.5

Table 2. Unacceptable production of <50% survival of sunray venus clams obtained at six leases in Franklin and Levy Counties during 2010-11and soil characteristics measured at these leases.

Values	Survival (%)	Sand (%)	Clay (%)	Silt (%)	Organic Matter (%)
Average	23.2	89.0	5.53	5.17	2.10
Range	4 - 48	82.7 – 93.3	3.6 – 6.8	1.7 – 12.2	1.3 – 3.1

The 2011-12 growout studies are ongoing. However, production results have been obtained from six sites. In southwest Florida, SRV clams reached shell widths of 0.73-0.83 inches, shell lengths of 1.9-2.2 inches, and total weights of 16.0-24.0 grams (19-28/lb) in 11 months. Survival ranged from 51 to 61%; there was some evidence of predation. Shell deformities were less than 5%. These results are commercially promising (Figure 1). Soil characteristics at these leases averaged 97% sand content (range, 97.1-97.5%), 1.3% clay content (range, 1.0-3.4%), 1.1% silt content (range, 0.1-2.0%), and 0.4% organic matter content (range, 0.26-0.46%). Three test sites were also evaluated for the potential of SRV clam culture leases in Levy County. After 12 months, SRV clams averaged 0.74 inches in shell width (SW), 2.2 inches in shell length (SL), 21 grams (22/lb) in total weight (TWT), 53% survival, and no shell deformities. The third test site yielded smaller clams (0.6” SW, 1.9” SL, 14 grams TWt) and survival of 52%. Soil characteristics at these test sites averaged 95% sand content (range, 94.0-95.4%), 2.4% clay content (range, 2.1-2.9%), 3.0% silt content (range, 2.5-3.7%), and 0.5% organic matter content (range, 0.44-0.63%).

Figure 1. Sunray venus clams harvested from a commercial lease in Southwest Florida after 11 months.

This project is yielding information that will aid in the characterization of soil types and chemistry for determining compatibility of existing shellfish culture leases and siting future leases for this promising aquaculture species.

This project component is supported by Florida Sea Grant College Program (R/LR-A-46).

DEFINING SOIL PREFERENCES FOR SUNRAY VENUS CLAM CULTURE

L. Rex Ellis, University of Florida (UF) IFAS Soil and Water Science Department
Todd Z. Osborne, UF IFAS Soil and Water Science Department
William R. White, UF IFAS School of Forest Resources and Conservation, Fisheries

Relationships between terrestrial agriculture and soils have been thoroughly investigated; yet links between shellfish aquaculture and subaqueous soils have only recently been examined. As infaunal (bottom-dwelling) bivalves spend a majority of their life buried, traditional soil characterization is being applied in Florida to a potential new aquaculture species, the sunray venus clam *Macrocallista nimbosa*. Soil type preferences, percent organic matter (OM) and percent sand for the sunray venus clam are being determined from *in situ* mesocosm studies that reveal variations in production characteristics.

In the first study, sunray venus clams were grown in three soil types: Sand (0.5% OM; 99 sand), Muddy Sand (1.5% OM; 97% sand), and Sandy Mud (9.2% OM; 80% sand). These soils were first placed into 3-gallon buckets. Forty juvenile clams (average size: 11 mm in shell width, SW; 30 mm in shell length, SL; 4 grams in total weight, TWt) were stocked in each bucket (Figure 1). Buckets were partially buried (with surface protection similar to grow-out bags) at the UF experimental lease within the Dog Island High-density Lease Area near Cedar Key. Each soil treatment was experimentally replicated six times for a total of 18 buckets; environmental variables on-site were controlled by placing all buckets together on one lease in a randomized design. The buckets were retrieved after six months and production characteristics of harvested Sunray Venus clams determined.

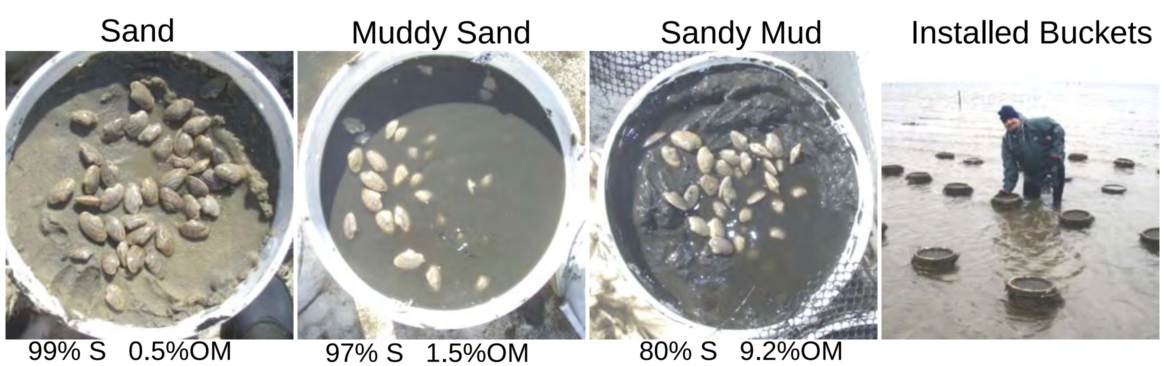


Figure 1. Photographs of three soil types in buckets with Sunray Venus clams placed on top.

Sunray venus clams grew to similar weight and deformiteis in the sandier soils: Sand (10.8 g TWt and 3% deformiteis), Muddy Sand (11.0 g TWt and 2% deformities). Clams in the Sandy Mud were smaller and had more deformities (9.6 g TWt and 19% deformities).

In an effort to better understand and differentiate the possible preferences of the Sunray Venus clam for substrate type, we devised an additional bucket experiment where we manipulated soil particle sizes. The engineered soils were created to enable both finer resolution determinations for soil preference while also mimicking the range of natural soils found in proximity to Dog Island leases such that suitability of farming Sunray Venus on existing leases could be determined. We engineered 6 different soils that ranged from 85-100% sand and 0-15% fine fraction (silt and clay) using clean beach sand for the sand fraction and salt marsh soils for the fine fraction (silt +clay) (Figure 2).

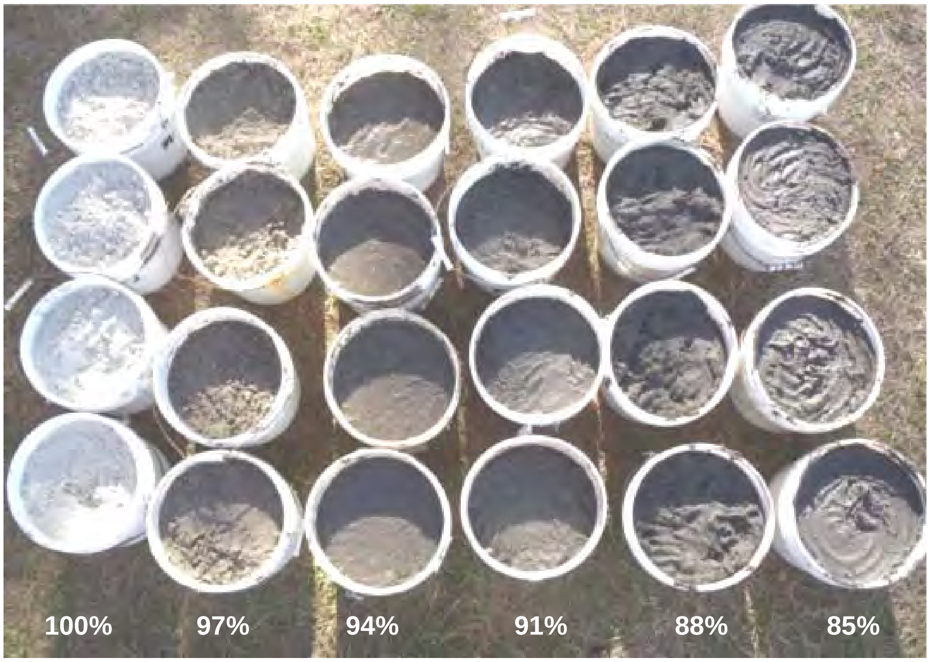


Figure 2. Collection of six engineered soil types ranging from 85 to 100% sand. Each column of buckets is a soil type. There are four replicates of each soil type.

This bucket study was conducted in much the same manner as the previous study, engineered soils (6 treatments were replicated 4 times for a total of 24 buckets) were planted with 40 individual SRV clams and the buckets deployed in November of 2011 for 6 month growout. In May of 2012, buckets were retrieved and clams sieved and measured. Results indicated there were no significant differences among the soil treatments in SRV length (mean range 34.7-37.5 mm), width (mean range 11.7-12.4mm), height (mean range 20.5-21.6mm) or weight (mean range 5.2-6.2 g). Similarly, there was no statistical difference between the survival among the soil types (mean range 87-97%) nor the rate of deformity observed (0.6-5.0%). These findings suggest that the range of soils tested is conducive to SRV farming and production. Hence, the soils on the Dog Island leases appear to be suitable for SRV farming. A particularly interesting observation was that the highest shell length, height, and meat weight were found in the 97% sand treatment, however, due to variability in the measurements, there were no statically relevant differences in clam survivorship or characteristics due to soil treatments. The combination of these two studies suggests soil with > 85% sand is suitable for Sunray Venus clam production.

Characterization of soil types and chemistry will aid in determining compatibility of existing shellfish culture leases and in siting future leases for this promising aquaculture species.

This project component was funded by Florida Sea Grant College Program (R/LR-A-46).

MARKETABILITY OF THE SUNRAY VENUS CLAM: RESULTS OF DEALER SURVEYS ADDRESSING PRODUCT ATTRIBUTES

Chuck Adams, University of Florida IFAS, Food and Resource Economics
Leslie [redacted] Sturmer, University of Florida IFAS, Cooperative Extension Service

The sunray venus clams *Macrocallista nimbosa* represents a potentially viable molluscan shellfish species for commercial culturists in Florida. Recent studies have demonstrated acceptance of both cooked and raw sunray venus clams by consumers, chefs, and restaurant mangers in local Florida markets. Follow-up studies assessed wholesale buyer perceptions of cultured sunray venus clams. Overall, this recent survey found that wholesale buyers rate sunray venus clams very highly as a potential addition to existing product lines and suggests market demand for this candidate species likely exists.

Wholesale Dealer Survey

Wholesale dealers were asked to assist in evaluating cultured sunray venus clams on the basis of product attributes and the requirements for product handling. Each dealer was asked to evaluate shell stock (live) sunray venus clams and then provide shell stock to their own "downstream" clients. Cultured sunray venus clams and a "survey kit" were sent to 33 dealers. Each of these survey kits contained: (1) up to two 100-count samples of cultured sunray venus clams, (2) information on the nutritional, microbial and sensory attributes of sunray venus clams, (3) a summary of the consumer acceptance studies recently conducted by UF (Adams et al. 2009), and (4) a product attribute survey instrument to be sent directly to the UF Food and Resource Economics Department. Via the survey instrument, each of the wholesale dealers and downstream clients were asked to provide suggestions/comments on product appearance, condition, shelf life, size, sensory attributes, handling methods, volume/frequency requirements pertaining to potential future orders, and other factors. A total of 29 dealers responded to the survey. The majority of survey respondents were distributors, located in the southeast United States, had total annual seafood sales exceeding $10 million, reported molluscan shellfish sales as being the greatest percentage of annual sales, carried a diversified product line of molluscan shellfish, and considered oysters and clams as the most important products offered.

Product Attributes

Dealers and clients were asked to rate the shellstock sunray venus clams across several attributes, using an 8-point Likert Scale, with 1 being a lower rating and 8 a higher rating. Most attributes received relatively high ratings, the lowest being given for the taste of raw product and texture.

Product Attribute Ratings of Shellstock Sunray Venus Clams by Dealers and Clients

	Likert Scale rating – 1 (poor) … 8 (excellent)
Shell Appearance	7.3
Meat Color	7.1
Taste - Raw	5.4
Taste - Cooked	6.6
Texture (tough vs soft)	5.1

Other Product Characteristics

Survey recipients were also asked to assess other product attributes, such as presence of grit, shell color, meat yield, shell thickness, and shelf life. Half of the survey respondents were not able to detect any grit in the product, while 46.7% detected ‘some grit’, while 3.3% detected ‘excessive grit’. Meat yield was suggested to be ‘About as expected’ or ‘More than expected’ by 56% and 44% of respondents, respectively. Approximately 70% of respondents indicated that shell thickness was ‘Just right’, while 90% found shelf life to be ‘Acceptable’. Most respondents indicated that the clam size received was acceptable. In addition, most respondents suggested few concerns regarding handling, storage, packaging or shipping of sunray venus clams.

Demand Assessment

Survey recipients were asked to provide perceptions on the potential demand for sunray venus clams. Approximately half the respondents (46%) indicated they ‘Could sell some’, while 42% suggested a ‘High market demand’ will exist. Respondents also suggested that of the key product attributes for sunray venus clams, the most attractive marketable attributes would be taste, shell appearance, and meat yield. Information provided by respondents regarding the likey peak season of demand, the quantity of clams that could be sold during this peak season, and the likely per unit price was too variable to provide clear findings; however, the responses suggested that the market may likely exist year-round, with potentially significant volume of sales being possible. The average price that respondents would be willing to pay was $0.183, though there was a considerable range in responses.

Boston Seafood Show

Cultured sunray venus clams were featured at the International Boston Seafood Show in 2011. Cooked clams were served to over 300 individuals who were then asked to provide comments about the clams via a brief survey. Approximately 240 surveys were completed, revealing an overwhelming, positive assessment of the product across a range of attributes and factors.

Summary

The overall assessment of sunray venus clams by dealer and client respondents was extremely favorable. The findings from this most recent dealer survey corroborates the findings from previous consumer acceptance surveys, in that sunray venus clams are highly rated as a potential new candidate aquaculture species. These findings suggest that a latent market exists for sunray venus clams.

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