Clam Industry Workshop

Wednesday, October 14, 2009
Community Center (old Lion's Club)
809 6th Street, Cedar Key

1:30-4:00 PM

Welcome and Introductions
- *Sue Colson, Mayor of Cedar Key*
- *Tim White, UF School of Forest Resources & Conservation*

Sensory Characteristics for Hard Clams from MA to FL
- *Laura Garrido & Steve Otwell, UF Aquatic Food Products Lab*

Clam Stock Improvement: Results of Hybrid Field Trials
- *John Scarpa, Harbor Branch Oceanographic Institute-FAU*
- *Leslie Sturmer, UF Cooperative Extension Service*

Clam Stock Improvement: Results of Hybrid Lab Challenges
- *Shirley Baker, UF SFRC Fisheries and Aquatic Sciences*

Water Quality, Temperature Variability, and Health Monitoring
- *Leslie Sturmer, UF Cooperative Extension Service*
- *Denise Petty, UF College of Veterinary Medicine*

Final Report on Ark Clam Culture Potential and Marketability
- *Leslie Sturmer, UF Cooperative Extension Service*

Species Diversification: Results of Sunray Venus Clam Field Nursery and Growout Trials and Future Efforts
- *Leslie Sturmer, UF Cooperative Extension Service*
- *John Scarpa, Harbor Branch Oceanographic Institute-FAU*

Consumer Acceptance Studies of Cultured Sunray Venus Clams
- *Chuck Adams, UF Food and Resource Economics*

4:00-4:30 PM

Industry feedback session / Discussion groups

4:30—5:30 PM Social Hour

Results of Hybrid Clam and Sunray Venus field trials will be served.

THE ROMANCE OF CLAMS: A NEW SENSORY CHARACTERIZATION PROGRAM FOR HARD CLAMS, *Mercenaria* spp.

Laura R. Garrido and W. Steven Otwell
University of Florida IFAS, Aquatic Food Products Lab

Summary

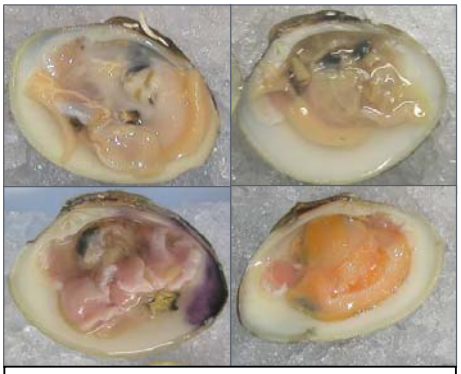
A new method has been developed to help judge and rate the romance of hard clams. This method is known as 'sensory profiling' which is simply a science-based approach to describing or characterizing the sensory attributes of raw hard clams. The attributes include standard measures for product appearance, aroma, flavor, tastes, texture and mouth-feel. The rating scales use such terms such as plumpness, briny, metallic, salty, umami, seaweed, earthy, firm, chewiness, grit, brittle shell and a rainbow of colors. The science is in the development of standards for reference and training for proper ratings while the romance is in the description much like consumers use to describe their wines and other foods. This method can be useful in directing commercial production and processing operations as well as consumer selection and enjoyment.

Methodology

The already trained sensory seafood panelists at the University of Florida's Aquatic Food Products Lab were used to conduct the evaluations. These panelists have been trained for several years on evaluations of raw oysters, shrimp and other seafoods. The panelists were first exposed to samples of hard clams from several growing areas of Cedar Key, Florida in order to identify appropriate and uniform descriptive terms for raw clams. Then, in series of sessions, the pre-trained panel was exposed to several samples of clams along the Atlantic coast as far as Massachusetts. For the purpose of this study, and to assure authenticity of the samples, all clam samples were obtained from different locations from Massachusetts to Florida and were shipped directly to University of Florida within hours after harvest. Raw clam product evaluations were conducted at a similar temperature (45^{o}F or less) as customarily used for serving raw clams in restaurants. Clams were shucked 30 minutes prior to each panel session and the half-shell product was stored on iced until consumed. Failure to maintain low temperature in the raw clams products altered the flavor and odor perception. Panelists had to consume at least five clams per sample and then report their average rating for the five. Panelists did not have more than 20 clams per sitting to prevent errors due to fatigue. Samples were presented utilizing blinding codes. The form or questionnaire was divided in 6 sections: appearance, aroma, basic tastes, flavor, aftertaste, textures and mouth-feels. The attributes listed on the form were rated on the basis of a 10 point intensity scale.

Results and Discussion

Most sensory attributes provided distinction by harvest locations and time relative to water salinity as influenced by seasons and weather. Outer shell color was the least variable, ranging from common grey-tones to more browns and some orange coloration associated with Florida hard clams. All shell colors are typically expected and should not necessarily influence product preference. In contrast, shell strength, described as brittleness, was more obvious and a potential commercial concern for the clams from Massachusetts through New Jersey. The edible meat color was more variable per location than shell color, yet the meat colors should not present a negative impression and there is no evidence



Color scales for clam meat ranging from white, tan, beige and gray (top) to pink, yellow, peach and orange (bottom).

that consumers would prefer meats with more white or pink tones. Interestingly, the clams from Florida and Georgia were amongst types that exhibited more obvious variability in meat colors per individual clams from the same harvest. Meat color could be used in marketing efforts to embellish or distinguish products, but there was no evidence that any one color indicated a better or inferior product. Likewise, edible meat plumpness and volume (fill in the half-shell) could be used to distinguish products since this was one of the more obvious variables, but additional work would be necessary to determine how these visual attributes vary per season. Presence of sand or grittiness in clams is an unpleasant and negative mouth-feel. Some samples were rated high in grit. In terms of taste, ratings for "salty" where by far the most distinguishing attribute. This result is not unexpected and remains consistent with commercial experiences. In fact the standard 10 point rating scale had to be expanded to account for some very strong salty taste. The salty flavor would not necessarily distinguish regions, but it could reflect seasons and local weather conditions. Although salty taste is a traditional and routine description used by many consumers, it would be interesting to develop a consumer preference scale for salty clam flavor. Also, there was an interesting range in ratings for umami taste which has not been previously described for hard clams. This could be another attractive term used in marketing to describe clams. In absence of such scales, let the romance flourish.

This work was supported by Florida Sea Grant and the Cedar Key Aquaculture Association.

Results of sensory profile for hard clams cultured from Massachusetts to Florida during the winter of 2009. A = average from all clam samples, H = above the average, L = below the average, D = depends on source or sample.

Ratings	MA	CT	NY	NJ	VA	SC	GA	FL
Appearance								
Volume of Flesh	H	H	H	A	H	D	H	L
Plumpness	H	H	H	A	H	D	H	L
Aroma								
Briny	D	H	A	L	L	L	H	H
Metallic	D	H	A	L	L	L	H	H
Basic Tastes								
Salty	H	L	H	A	L	D	A	D
Umami	H	L	H	A	L	D	A	L
Flavor								
Seaweed	L	H	A	H	L	D	A	D
Chick..liver	L	H	A	H	L	D	A	D
Earthy	L	H	A	H	L	D	A	D
Aftertaste								
Metallic	A	H	L	L	L	L	L	L
Astringent	A	H	L	L	L	L	L	L
Texture, Meat								
Firmness	A	A	H	L	A	L	A	A
Chewiness	A	A	H	L	A	L	A	A
Mouthfeel								
Detect Grit	D	D	A	L	D	D	D	L

CULTURE OF HARD CLAM HYBRIDS (*Mercenaria mercenaria, M. campechiensis*): RESULTS OF GROWOUT FIELD TRIALS

John Scarpa, Harbor Branch Oceanographic Institution at Florida Atlantic University
Leslie N. Sturmer, University of Florida IFAS, Shellfish Aquaculture Extension Program

The Florida hard clam aquaculture industry is a dramatic success story with over 350 small-scale businesses providing an economic impact of $49 million. Yet, it has expanded primarily through increased acreage and number of growers rather than increased productivity. Over the past decade, mortality events resulting from hurricanes, low salinities, and, potentially, high water temperatures have affected production. The industry is based primarily on the "notata" variety of the northern hard clam *Mecenaria mercenaria*, which may not be suited for some Florida environments. The local southern hard clam *M. campechiensis* may have improved production characteristics for Florida environments and readily hybridizes with *M. mercenaria*, but is known to gape during refrigerated storage. Therefore, a rigorous examination of production characteristics of these species and their hybrids has been undertaken.

Cultured *M. mercenaria notata* and wild *M. campechiensis* were used as broodstock and production of reciprocal hybrids was accomplished. Three families were reared under commercial conditions during 2008-9. Survival among families in land and field nurseries ranged from 73-82% and 73-86%, respectively. Differences at these stages were not evident. Approximately 248,000 seed (shell length 15-22 mm) were planted in the fall of 2008 for replicated comparison of stocks, densities (60, 72, and 85 per square foot), and gear (bottom bag versus bottom plant). Plants were sampled every four months with harvesting initiated a year latter. In addition, ten growers planted 190,000 seed on commercial leases in three counties for site comparison. At harvest, parental stocks and their hybrids were evaluated for survival, growth (shell length, shell width, total weight, meat weight), commercial grade, condition index, reproductive status, health, and shelf life in refrigerated storage. Market acceptance was documented via a consumer acceptance study and characterization of sensory attributes for appearance, texture, basic tastes, aroma, and flavors. Preliminary results of these production trials and implications for the hard clam aquaculture industry in Florida will be presented. This work was supported by USDA-CSREES.

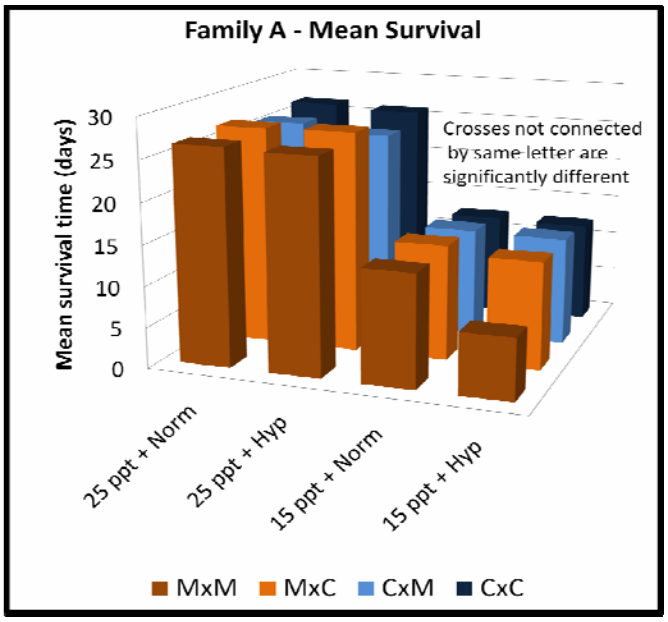
FIGURE 1. From left to right: samples after 8-months of growout of *Mercenaria mercenaria* (*Mm*), hybrid (♀*Mm* x ♂*Mc*), hybrid (♀*Mc* x ♂*Mm*), and *M. campechienis* (*Mc*).

EVALUATION OF HYBRID HARD CLAMS (*M. mercenaria, M. campechiensis*) FOR FLORIDA AQUACULTURE: RESULTS OF LABORATORY CHALLENGES

Shirley M. Baker, University of Florida IFAS, Fisheries and Aquatic Sciences Program

The northern hard clam, *Mercenaria mercenaria* (M x M), is an important aquaculture species in Florida. Over the past decade, mortality events resulting from hurricanes, low salinities, and, potentially, high water temperatures, have affected production. The local southern quahog *Mercenaria campechiensis* may offer improved production characteristics and hybridizes readily with the northern hard clam. Therefore, a rigorous examination of parental species and their crosses under laboratory (this study) and commercial conditions has been initiated.

Parental species and their crosses (4 months in growout, average 19 mm in shell length), representing two families, were exposed to salinities of 15 or 25 ppt and hypoxic (low) or normoxic (normal) dissolved oxygen levels with temperature held constant at 32°C (90°F) for 28 days. Observations of clam mortality were conducted at 24 hour intervals. Survival analyses indicate that *M. mercenaria* x *M. campechiensis* (M x C) crosses performed better under stressful conditions than did the parental species or the reciprocal cross. Treatment had a significant effect on survival as mean survival was shorter in 15 ppt, regardless of oxygen level. Family also had a significant effect on survival, as one family (Family B) performed better, overall, than did the other family (Family A). Among the parental species and crosses examined, the hybrid M x C was the least sensitive to stressors; whereas the hard clam (M x M) was the most sensitive, as indicated especially in response to 15 ppt + Hypoxia. Of the two families examined, Family B had a mean survival 2.6 days longer, under low salinity conditions, than did Family A. Although low salinity (15 ppt) conditions shortened mean survival time of all crosses and families, hypoxia (~2 mg/l) had relatively little impact on survival time.



This study showed that 1) the hybrid cross (M x C) may offer stress resistance, 2) genetic background may play a significant role in response to stressors, and 3) hard clams (M x M) are relatively insensitive to hypoxia. In June 2009 the laboratory challenges were repeated with larger sized clams (8 months old, 35 mm shell length). Preliminary results will be discussed. This research with both clam species and their hybrids yielded data that suggests stress tolerance is different and heritable. This project is supported by USDA CSREES.

MONITORING UPDATE: WATER QUALITY, WATER TEMPERATURES DURING SUMMER MONTHS, AND CLAM HEALTH

Leslie Sturmer, University of Florida IFAS, Shellfish Aquaculture Extension
B. Denise Petty, University of Florida IFAS, Fisheries and Aquatic Sciences

Water Quality Monitoring: A partnership developed by the Shellfish Aquaculture Extension Program (SAEP) with federal and state agriculture agencies allows for operation and maintenance of water quality and weather monitoring stations, which serve as a decision support tool for the clam industry. Currently, stations are located at five high-density lease areas in four coastal counties (Dixie, Franklin, Indian River and Levy). These stations provide timely information to clam growers, allowing them to make informed management decisions based on temperature, salinity and other measurements. Continuous "real-time" data are made available at the Department of Agriculture and Consumer Services, Division of Aquaculture's website http://www.FloridaAquaculture.com. Archived data are provided in monthly and annual graphic form at the SAEP's website http://shellfish.ifas.ufl.edu.

Water Temperature Monitoring: Water temperature plays an important role in biology and directly affects the bodily functions of aquatic organisms necessary for growth and survival. It also influences water quality parameters, such as dissolved oxygen and pH. An ongoing monitoring project is providing detailed and broad coverage of water temperatures by deploying inexpensive data loggers at multiple clam aquaculture leases to adequately describe variability possibly due to water depth, substrate characteristics, currents, and other parameters. The waterproof data loggers used for this project (pictured at right) are small, allowing them to be placed either inside of or attached to the outside of a clam bag on the lease site. In May 2008, 39 data loggers were deployed in the Cedar Key area providing 10% coverage of the Gulf Jackson and Pelican Reef lease areas and 25% coverage of the Dog Island and Corrigans Reef lease areas. Water temperature trends were different from those observed the previous year. In 2008, water temperatures were not as high with peak temperatures recorded in July and maximum values of 92.9°F reached on July 11. At that same time, temperatures ranged from 88.6°F to 92.7°F at the other lease sites. Water temperatures on the Gulf Jackson leases reached 88°F for 11 to 17 days during July 2008, while 90°F was exceeded on 1 to 10 of those days. Alternately, water temperatures on the Corrigan's Reef leases reached 88°F for 14 to 15 days during the same month, while 90°F was exceeded on 4 to 6 of those days. These values are important to clam production as clams cease growth processes at approximately 88°F and stop filtering around 90°F.

Clam Health Monitoring: Baseline health monitoring of cultured aquatic stocks has proven to be an important management tool. The UF Fisheries and Aquatic Sciences (FAS) Diagnostic Lab offers basic water quality parameter analysis; bacterial culture of water, algal stocks, and clam larvae; and histologic examination of clam larvae and adults (all for a modest fee). As soon as mortalities are observed, a sample of animals should be collected and submitted for analysis. Any delay makes disease identification more difficult. The FAS lab can provide specimen jars that contain chemical fixatives, and culture media.

FINAL REPORT ON CULTURE POTENTIAL AND MARKETABILITY OF THE BLOOD ARK *Anadara ovalis* AND PONDEROUS ARK *Noetia ponderous*

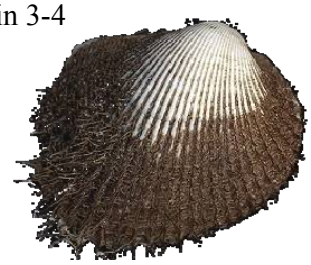
Leslie Sturmer, Jose Nunez, LeRoy Creswell, Robert Degner, and Shirley Baker
University of Florida, Institute of Food and Agricultural Sciences

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

The blood ark *Anadara ovalis* and ponderous ark *Noetia ponderous* are native bivalve species found to naturally set and grow in hard clam bottom bags. The project team assessed the culture and market potential of these ark clams to introduce new molluscan species to producers and provide a different revenue source to small-scale hard clam culture enterprises.

The annual reproductive pattern of the blood ark and ponderous ark off the east (Atlantic) and west (Gulf of Mexico) coasts of Florida, respectively, was histologically determined. In both arks, the sexes were separate, with a low incidence of hermaphrodites observed in the blood ark. Arks of both species were found to dribble spawn over most of the year, with peaks in gonadal development occurring during the late spring-early summer months for the blood ark and during the summer and fall months for the ponderous ark. Typical spawning techniques used in hard clam hatcheries were successful when applied to ripe ark clams and early developmental events of both were similar to those of the hard clam. Differences were found in the larval rearing period with time from fertilization to setting varying from 16 to 21 days in the blood ark and from 21 to 28 days in the ponderous ark as opposed to 10 to 14 days for the hard clam. Setting was problematic in that no visual cues were apparent to determine competency. Further, metamorphic induction experiments conducted to evaluate physical substrates and chemical cues on settlement were not successful. Rather, size determined when to transfer larvae to downwellers; setting percentages were low.

Post-set ark clams were reared using similar systems and methods as hard clams. Nursed in land-based wellers, blood arks increased from 1 mm in shell length to 14 mm in 3-4 months, whereas ponderous arks reached 19 mm in 6 months. Field-planted in polyethylene (hard) and polyester (soft) bottom bags, juvenile blood and ponderous arks reached market size (35-40 mm shell length, 23-27 mm shell width) in 11 and 18 months, respectively. Following post-set, mortality was negligible in the land-based nursery; survival exceeded 60% in the field nursery and growout. A nationwide survey of certified shellfish dealers was conducted to determine the current state of the market and sales for cultured ark clams. The consensus of responding firms was that both had limited appeal to traditional clam customers, but could be marketed to ethnic consumers. Product attributes, nutritional analyses and shelf life were also determined for both ark clams. A final report (Technical Publication 169, September 2009) is available through Florida Sea Grant. This document demonstrates that spawning, larval rearing, nursery and growout, harvest, marketing, and distribution of ark clams can be achieved. Specific areas requiring further research and/or development by commercial interests are identified.



Top: Ponderous ark
Bottom: Blood ark

EVALUATION OF THE SUNRAY VENUS CLAM *Macrocallista nimbosa*: RESULTS OF FIELD NURSERY AND GROWOUT TRIALS

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

The sunray venus clam *Macrocallista nimbosa* was commercially fished in Florida during the 1970s. Although natural growth rates were estimated to be high, its patchy distribution limited commercial exploitation. The sunray venus clam is now being evaluated as a potential new aquaculture species to diversify the hard clam aquaculture industry in Florida. Wild broodstock were collected, conditioned, spawned and larvae reared through setting: pediveligers (~220 μm) appeared at 7 days at 78-82^{o}F and 28-30 ppt. Land-based culture of juveniles occurred in downwellers with a 46-63% return. Sunray venus seed production techniques appear to be similar to those standard for hard clams. A DVD is available that illustrates the reproductive cycle and early development through a 1 mm seed size of the sunray venus clam.

Production performance of sunray venus clams under field nursery and growout conditions was examined during 2007-9 at two commercial clam lease areas in the Gulf of Mexico. Sunray venus clam seed (about 118,000; 9-18 mm shell length, SL) were field-planted in nursery systems (soft bags and hard cages) at densities of 100-550/ft^2. After 42-119 days, survival ranged from 32-94% and daily growth rate was 0.12-0.25 mm SL. Sunray venus juveniles (27 mm SL; 10 mm shell width, SW) were further cultured in hard cages at densities of 42-55/ft^2. After 11 months, sunray venus (61-67 mm SL, 22-23 mm SW, 30-37 grams total weight, 8.1-9.1 condition index) were harvested for market perception tests. Survival ranged from 50-82%. Production performance of sunray venus juveniles (26 mm SL) grown in soft bags and soft bags modified with internal PVC frames (both 1" and 1 ½") at densities of 44/ft^2 was also documented. After 12 months, no statistical differences were found among bag types for survival, which ranged from 65-76%, or growth (56-59 mm SL, 22 mm SW, 27-29 grams total weight, 10.4-11.2 condition index). However, 19-22% of the sunray venus harvested from bottom bags were deformed; whereas only 1-4% of those harvested from bags with frames were deformed. The shell irregularities were limited to the ventral margin with one valve having excessive curvature resulting in a depression. Another growout study evaluated stocking densities ranging from 38 to 63/ft^2 in bottom bags. To date, field nursery and growout culture methods for sunray venus clams are not prohibitive and exhibit little differences from hard clam methods. Although current trial production efforts appear successful, problems with shell deformities, which appear to be gear and substrate-related, must be resolved.

During 2010-11, the project team will work with industry sectors to eliminate barriers to commer-cialization of this new aquaculture species, facilitate technology transfer, and promulgate market development. This research is supported by Florida Sea Grant (Projects R/LR-A-44 and 45).

CONSUMER ACCEPTANCE OF CULTURED SUNRAY VENUS CLAMS *Macrocallista nimbosa* IN FLORIDA

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

The sunray venus clam *Macrocallista nimbosa* is being considered as an alternative species for commercial hard clam growers in Florida. Results from trial production efforts appear encouraging. Hatchery and growout costs appear to be similar to hard clams. However, the market acceptance of the cultured sunray clam needs to be demonstrated with the Florida market area. A group of four restaurants in north central Florida agreed to participate in a market acceptance study. Each restaurant received cultured sunray venus clams each week for a period of four weeks. The clams were delivered properly tagged, as live shellstock, in styrofoam boxes, with gel packs enclosed. The chefs in each restaurant were encouraged to serve the clams utilizing any preparation method they chose and to charge any price they wished. The wait staff were instructed to ask each patron who consumed sunray venus clams to complete a brief table side questionnaire. The questionnaire solicited the patron's perception of various attributes of the sunray venus clam they just consumed, as well as patron demographic information.

A total of 239 completed questionnaires were obtained from the four participating restaurants. Of the patrons who completed at least some portion of the questionnaire, 51.9% and 48.1% were male and female, respectively. Regarding respondent age, 21.3% were under the age of 30, while 39.1% were between the ages of 50 and 64. The majority of the respondents (80.7%) had resided in the southeast US for the longest portion of their lives. In addition, 92.8% of the respondents currently resided in Florida, while 87.4% of the respondents were Caucasian. Regarding product attributes, a majority (84%) of the respondents indicated the appearance was "Excellent", whereas 13% indicated that the product was "Very Good" and a total of 3% indicated that the product appearance was "Good" to "Poor". A similar ordinal pattern is seen for the other attributes, with the majority of respondents indicating that "Taste", "Texture", and "Tenderness" were either excellent or very good. The sunray venus clam possesses a grit pocket (actually kidney concretions or "stones"), which is located on the siphon end of the animal and is quite noticeable in wild animals. However, only 11% of the respondents indicated the presence of "grittiness" in the clams. An overwhelming majority (94%) of the respondents indicated they would order this product again at the price they paid for it. In addition, 97% of the respondents indicated they would recommend this product to others. The findings provide insight into the viability of sunray venus clams as an alternative candidate culture species. This research is supported by Florida Sea Grant (Projects R/LR-A-44 and 45).

CLAM WORKSHOP PRESENTERS AND CONTACT INFORMATION

Dr. Chuck Adams
University of Florida IFAS, Food and Resource Economics Department
P.O. Box 110240, Gainesville, FL 32611
Phone: (352) 392-1826, ext. 223 E-mail: cmadams@ufl.edu

Dr. Shirley Baker
University of Florida IFAS, School of Forest Resources and Conservation
Fisheries and Aquatic Sciences Program
P.O. Box 110600, Gainesville, FL 32653
Phone: (352) 273-3627 E-mail: sbaker25@ufl.edu

Laura Garrido
University of Florida IFAS, Food Science and Human Nutrition
Aquatic Food Products Lab
P.O. Box 110375, Gainesville, FL 32611
Phone: (352) 392-1991, ext. 308 E-mail: shrimp@ufl.edu

Dr. Steve Otwell
University of Florida IFAS, Food Science and Human Nutrition
Aquatic Food Products Lab
P.O. Box 110375, Gainesville, FL 32611
Phone: (352) 392-4221 E-mail: otwell@ufl.edu

Dr. Denise Petty
University of Florida IFAS, College of Veterinary Medicine
P.O. Box 100136, Gainesville, FL 32610
Fisheries and Aquatic Sciences Program
7922 NW 71st St., Gainesville, FL 32653
Phone: (352) 273-3612 or 273-3615 E-mail: pettyd@ufl.edu

Dr. John Scarpa
Harbor Branch Oceanographic Institute at Florida Atlantic University
5600 U.S. 1 North, Ft. Pierce, FL 34946
Phone: (772) 465-2400, ext. 404 E-mail: jscarpa1@hboi.fau.edu

Leslie Sturmer
University of Florida IFAS, Shellfish Aquaculture Extension Program
Senator George Kirkpatrick Marine Lab
11350 SW 153rd Court, Cedar Key, FL 32625
Phone: (352) 543-5057 E-mail: LNST@ufl.edu

Dr. Tim White
University of Florida IFAS, School of Forest Resources and Conservation
P.O. Box 110410, Gainesville, FL 32611
Phone: (352) 846-0850 E-mail: tlwhite@ufl.edu