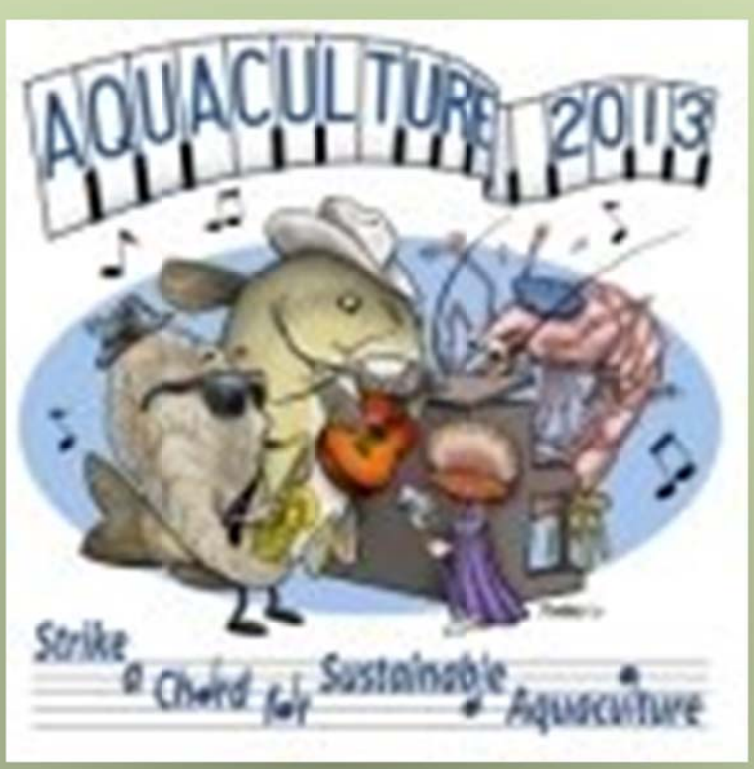

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Preparing for Climate Change: Increasing Hard Clam SURVIVAL in FLORIDA Using Biomarkers of Thermal Tolerance

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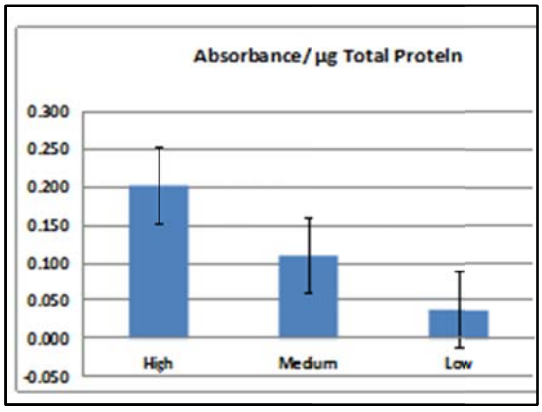
In light of recurring summer mortality events associated with high temperatures, as well as the prospect of increasing ocean temperatures, it is clear that the Florida clam aquaculture industry needs a heat-tolerant clam strain to reduce current summer mortalities, adapt to future climate change, and continue to contribute to national and global food security. Prior results indicate that oxidative-stress protection by heat shock proteins shows intra-specific variation and could be heritable. Previous studies show that clam families originating from single-parent crosses selected at random differed considerably in their response to thermal stress and expression of cognate Hsp70. In addition, other studies indicate that metabolic response to thermal stress may play a role in survival and could also be heritable. Together, these data suggest that, using biomarkers of thermo-tolerance, 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, *Mercenaria mercenaria*, in the Southeastern U.S., particularly Florida, while addressing thermal tolerance needs related to climate change. We are in the process of addressing three project objectives: A) examine levels of three putative biomarkers of thermal tolerance in hard clam broodstock, offspring, and among offspring families, B) measure putative biomarkers of thermal tolerance in hard clam families at different life stages, and C) measure survival, production, shelf life, and laboratory thermo-tolerance of hard clam families.

A survey of cultured and wild groups (n=11) of clams (total n=540) found that relative levels of hemolymph Hsp70 varied among individual adult clams and could be categorized as high, medium and low (Figure). At two different times, individual clams were spawned to produce three families from high-Hsp expressing parental stock and three families from low-Hsp expressing parental stock. One replicate set of clams 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. If Hsp levels in progeny are correlated with parental Hsp levels and high-Hsp families exhibit higher survival in the field and laboratory challenges, Hsp may be considered a biomarker for selective breeding of heat-tolerant hard clams. Project support from USDA-NIFA and NOAA-Sea Grant (R/LR-A-47).



CEDAR KEY EVERLASTING: AN EDUCATIONAL TOOL TO INSPIRE PUBLIC APPRECIATION FOR SHELLFISH AQUACULTURE

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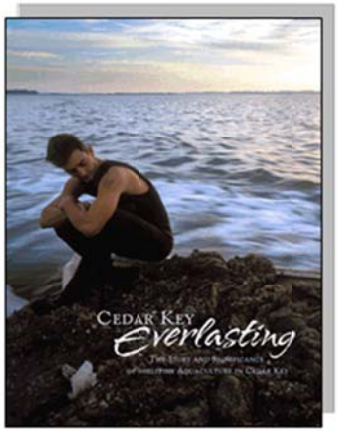
Located on a small island in the Gulf of Mexico, Cedar Key is a working waterfront community, rich in small town flavor with fewer than 800 residents. For most of the 20th century, Cedar Key remained a sleepy, ramshackle fishing village. However, during the 1990s, increasing regulations (oyster harvest closures, gear restrictions) affected the livelihoods of its fishing families. A transition to shellfish aquaculture as an alternative employment opportunity was facilitated through job retraining programs in the same decade. Today, clam farming adds an estimated $45 million a year into the areas economy and supports over 500 jobs.

Until recently, Cedar Key escaped the pull of developers despite its prime location. Over the past decade, word spread about this diverse, unspoiled region of Florida. Although several proposed developments are now on hold, Cedar Key has become a tourist destination. As harvesting of shellfish requires good water quality, future land use activities could affect the industrys continued viability. Therefore, with the local shellfish growers association, we decided to educate our visitors and new residents in an effort to inspire an appreciation for the communitys aquaculture and fishing industries, as well as what it takes to sustain them. We began by soliciting experts in their fields, who contributed to a series of essays about the environmental, economic, and sociological benefits of clam farming in Cedar Key. The 40-page magazine entitled *Cedar Key Everlasting* features 10 essays and the photography of several renowned Floridians. Their pictures capture the essence of the community in a way that engages readers and helps carry the science-based messages to the broader audiences. The publication ends with recommendations about what one can do to help keep the coastal environment clean.



To reach the intended audiences, community leaders and businesses were invited to a social and clam bake at which time the magazine was debuted. Following this, local real estate agencies, condominium management firms, hotels, chamber of commerce staff, and others were provided with additional copies and evaluation forms to capture public responses and determine if educational objectives had been met. Funds from the Florida Humanities Council through the National Endowment for the Humanities assisted in printing the publication. An interactive flipbook can be viewed at http://shellfish.ifas.ufl.edu.

Its true, its true; the climate must be perfect all the year. In short, theres simply not a more congenial spot for happily everlasting than here in Clamelot.

ELIMINATING BARRIERS TO COMMERCIAL PRODUCTION OF THE SUNRAY VENUS CLAM *Macrocallista nimbosa* IN FLORIDA

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The Florida shellfish aquaculture industry provides an estimated $53 million a year to the states economy and brings jobs to more than 900 people. However, the industry is built on a single clam species *Mercenaria mercenaria*. The sunray venus clam *Macrocallista nimbosa*, a native species commercially fished in Florida during the 1960-70s, is being evaluated as a new aquaculture species to diversify the industry and mitigate production and market risks. In our previous research, we successfully spawned sunray venus (SRV) clams, cultured the larvae, produced seed, and reared them through growout using techniques similar to those for commercial hard clam culture. The existence of a latent market was determined via a consumer acceptance study. The goal of this project was to demonstrate to the various industry sectors the culture and market potential of SRV clams through enhanced hatchery production and broodstock development, growout site selection, and determination of product attributes.

Three separate lines of broodstock (SRV) clams were created using multiple parents in a factorial mating scheme to capture genetic diversity for future selection by commercial hatcheries. Proper development of broodstock was also demonstrated to hatchery operators to assist in the initial production of seed for the industry. Production performance of SRV clams was evaluated at 18 existing commercial leases by providing SRV seed to growers and assessing growth and survival. In addition, a relationship between soil (sediment) and SRV productivity was established. Acceptable SRV clam survival ranged from 50.8-71.0% at lease sites where soil characteristics consisted of 92.7-97.5% sand, 0.3-1.5% organic matter, and bulk densities of 1.36-1.66 g/cm3. Soil preferences were further defined by culturing SRV clams in replicated containers of known soil types at one lease site. To help guide market development, shelf life and sensory and nutritional profiles of cultured SRV clams were determined. Product attributes were examined with respect to wholesale market and distribution standards for molluscan shellfish by providing samples of market-size SRV clams (51-62 mm length, 20-24 mm width, 20-33 g weight) and using a facilitated mail survey of primary wholesalers and their buyers.

FIGURE 1. Fact sheets on cultured sunray venus clams.

This project yielded data and materials (Figure 1) to fill voids in our previous SRV clam projects, thus eliminating or lowering barriers to commercialization of this new culture species, facilitating technology transfer to the Florida hard clam industry, and promulgating market development.
Supported by Florida Sea Grant (R/LR-A-46).