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AN UPDATED ASSESSMENT OF THE ECONOMIC IMPACT TO THE FLORIDA ECONOMY GENERATED BY THE COMMERCIAL HARD CLAM CULTURE INDUSTRY

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The commercial hard clam culture industry represents an important component of the overall Florida commercial aquaculture industry. The industry, which began in the very early 1990's, has now grown to include numerous hatcheries, hundreds of growers, and dozens of dealers. The industry is now an important source of non-local sales, incomes, jobs, and tax revenue in several key regions of Florida. Estimates of the economic contribution of the hard clam industry to local and the statewide economies provides important incentives for local, regional, and state decision-makers to ensure the industry is properly managed to encourage continued growth, stability, and sustainability. The University of Florida has conducted two previous assessments of the hard clam culture industry's economic impact to the Florida economy. A study done in 2000 found that the industry generated a statewide economic impact of $34 million. A follow-up study done in 2007 found that the industry generated an economic impact to the Florida economy of $52 million. The latter study also found that the industry generated $18.2 million in labor incomes, $22.4 million in value-added sales impacts, and over $1 million in local, indirect business taxes. A study intended to update these previous estimates is currently being conducted by the University of Florida. A mail-out survey targeting approximately 60 dealers who handled cultured hard clams during 2012 is being conducted. The findings will provide a current assessment of the economic benefits to the Florida economy as generated by this important sector of the Florida commercial aquaculture industry.

GENETICS OF HATCHERY AND WILD HARD CLAMS: WHAT, IF ANYTHING, CAN WE LEARN FROM MICROSATELLITE LOCI?

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The northern hard clam, *Mercenaria mercenaria,* is a commercially important bivalve species produced via aquaculture in the eastern United States, though little is understood about the effect of hatchery production on standing genetic variation in hard clam stocks. We used seven published microsatellite markers to compare levels of genetic diversity in six anonymous Florida hatchery and four wild stocks. Wild stocks of *M. mercenaria* displayed a greater number of alleles and higher levels of allelic richness relative to hatchery produced individuals. Differentiation was low in general, though highest among hatchery stocks (G_{ST} = 0.018, s.d. = 0.008; P < 0.001). In contrast, wild stocks were not differentiated (G_{ST} = -0.002, s.d. = 0.004; P = 0.58) and Bayesian model comparisons of panmixia (no structure), stepping stone, and full-migration gene flow models suggest that wild stocks are panmictic at the scale sampled. Together, these results suggest that genetic drift occurs as a result of brood clam, though the divergence between wild and hatchery stocks are not yet at the scale seen in some other aquaculture bivalve species. Null alleles were common and attempts to amplify a congeneric species, *M. campechiensis,* using the same suite of microsatellite markers were largely unsuccessful at five of the seven loci, likely due to the high polymorphism leading to null alleles in clams. These results suggest that published microsatellites may be unsuitable for future studies aimed at explaining patterns of variation, effects of aquaculture practice on genetic variation, and intraspecific hybridization.

BIOMARKERS FOR THERMAL TOLERANCE IN CLAMS: RESULTS OF LABORATORY CHALLENGES

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The Florida clam aquaculture industry needs a heat-tolerance clam strain to reduce current summer mortalities and adapt to future climate change. Previous studies show that clam families differed considerably in their response to thermal stress and expression of cognate heat shock protein 70 (Hsc 70). In addition, other studies indicate that metabolic response to thermal stress may play a role in survival and could also be heritable. We examined levels of three putative biomarkers of thermal tolerance (cognate Hsc 70, standard metabolic rate, and aerobic temperature threshold) in families produced from clam broodstock with high or low levels of Hsc 70, as well as their laboratory thermo-tolerance (see Sturmer et al. for report on field survival and production). Hsc 70 levels pf broodstock and progeny were measured using immunoblot analysis. Oxygen consumption rates of clams from each of the six families were measured as a proxy for standard metabolic rate. Aerobic temperature threshold was determined by measuring oxygen consumption rates at 25, 28, 31, and 34°C. Thermo-tolerance was determined in laboratory temperature challenge experiments. Despite differing parental Hsc levels, there were no differences in hemolymph Hsc 70 concentrations between the resulting progeny in putative high and low hsc groups. Nor did we find significant differences in metabolic markers or laboratory survival. We did, however, find differences between families, regardless of the level of Hsc in their parents. This represents an avenue to explore further in selection of hard clam strains for heat tolerance. This work was supported by NOAA-Sea Grant.

A STATE-BY-STATE STATUS REPORT ABOUT OFF-BOTTOM OYSTER FARMING IN THE US SOUTHEAST

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There has been a surge of interest in off-bottom oyster farming along the US southeast coast from North Carolina to Louisiana to take advantage of the premium branded half shell market. With similar challenges (heavy bio-fouling including oyster set, hurricanes, a commodity-focused industry, etc.) and opportunities (fast growth, rural coastline, etc.) throughout the region, these six states are all moving forward with processing applications, formation of regulations, and production from commercial oyster farms. In this session, we will provide a state-by-state synopsis of the current and short-term prospects for off-bottom oyster farming. We will review current production (acres, number of farms, harvest), pending applications, regulatory landscape, infrastructure and outreach/extension efforts. Significant challenges and opportunities in each state will be discussed.

SUCCESSFUL LARVAE SETTLEMENT AND HATCHERY CULTURE OF THE PONDEROUS ARK CLAM *NOETIA PONDEROSA*.

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The ponderous ark clam *Noetia ponderosa* has been considered a potential aquaculture species in Florida. Previous research indicated a bottleneck at metamorphosis when using traditional hard clam *Mercenaria* culture techniques. It was proposed that settlement cues might be necessary for this species. A series of trials were conducted in which *N. ponderosa* larvae (~220 um shell length) obtained from volitional spawns were exposed to different settlement conditions from that used in traditional hard clam culture. One trial used downwellers with combinations of sand substrate and flocculated algae. After 30 days, no larvae or metamorphosed juveniles were found, but differences noted in shell length of dead organisms indicated that flocculated microalgae might assist in setting. Further trials examined settlement on tank bottoms, as done with other bivalves. Size-competent ark clam larvae from three separate spawns were placed in rectangular tanks (400L) to which were added pieces of macroalgae *Ulva*, benthic diatom assemblage *Amphora*, or natural silt. No water changes were done, but microalgae were added intermittently. After 16-30 days, metamorphosed larvae were found attached to the *Ulva* and on tank bottoms in all treatments, suggesting that bare tanks bottoms were acceptable and no additions were needed. The settlement of ponderous arks from the first tank-bottom trial yielded about 100K juveniles (>1.2 mm), which was about a 36% return from the number of larvae added to the tanks. Seed ark clams were transferred to commercial culturists for continued culture. This work was supported by USDA-NIFA.

THERMAL SELECTION OF BROODSTOCK TO IMPROVE HARD CLAM *MERCENARIA MERCENARIA* PRODUCTION IN FLORIDA WATERS

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The need for a hardier clam *Mercenaria mercenaria* has become evident as shellfish growers in Florida report below average survival of crops during prolonged summers. A common agricultural breeding practice is selection of broodstock from survivors of adverse environmental events or artificially-induced challenges. In our study, multiple families of commercial hard clam stocks were collected and half were exposed to a thermal challenge (35°C, 48hrs). Survivors (45 of 2,250) were spawned to produce progeny (TxT). In field nursery culture over the summer, water temperatures exceeded 32°C for 22 days; the TxT cohort was found to have 61% higher survival than the non-thermal (NTxNT) control (71 versus 44%). However, there were no significant differences in survival or yield between TxT (83%, 35kg/bag) and NTxNT (88%, 35kg/bag) stocks after growout culture. In another study, biomarkers (cognate heat shock protein 70, Hsc) were evaluated for selection of thermal tolerance in hard clams. Three families each from high- and low-expressing Hsc parental stocks were produced. No significant differences between stocks were observed in either field nursery or growout culture. At harvest, survival of putative high-expressing Hsc families was 85±2%, while survival of putative low-expressing Hsc families was 70±27%. Results were similar for yield (35±2 versus 30±17kg/bag). Two of the putative low-expressing Hsc families were produced from clams collected from natural populations and did not perform well in culture (43-60% survival). These results indicate that commercial clam stocks have already been selected for Florida conditions and some improvement can be gained from basic breeding practices.

ASSESSING EFFECTS OF HARD CLAM FARMING ACTIVITIES ON BOTTOM SEDIMENTS USING A SOILS-BASED APPROACH

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Although infaunal bivalves spend a majority of their life buried in bottom sediments, relationships between sub-aqueous soils and hard clam *Mercenaria mercenaria* aquaculture have only recently been examined. We conducted studies during 2011-2013 to determine if bottom sediments were affected by clam farming activities. Surface soil properties (0-10cm) of 15 intensively farmed leases located near Cedar Key, Florida were compared with adjacent (unfarmed) areas. At a majority of the leases sampled, soil properties did not differ significantly from the unfarmed soils. Sand and organic matter content were similar at 83% and 65% of the leases, respectively, while bulk density (mass per unit volume) was the same at 83% of the leases sampled. At seven lease sites, we followed soils within the tracks of harvested culture bags and at adjacent (reference) sites by sampling immediately after harvest and at 1, 2, 4, and 8 weeks post-harvest. At 71% of the sites, soil properties converged with reference values in 3.2-8.9 weeks. Thus, a fallow period of 1-2 months is recommended for growers to allow soils to return to pre-farmed conditions. No time effect on soil properties was found at lease sites with higher organic matter and lower sand content (29% of sites); consequently, a fallow period may not be of benefit. Understanding relationships between clam farming activities and soil properties is important in increasing productivity and directing management practices. This work was supported by USDA NIFA.