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**Introduction**

- ❖ The hard clam (*Mercenaria mercenaria notata*) is the dominant molluscan species in Florida aquaculture (~\$10 million in 2005).
- ❖ Clam production in Florida has expanded primarily through increased acreage rather than increased productivity.
- ❖ Clam farmers in southern Florida have reported higher than expected mortality, which may be caused by high water temperatures, or other stressors (e.g., rapid salinity changes caused by excessive rain), during the prolonged hot summers of Florida.
- ❖ Southern hard clams, *Mercenaria campechiensis*, may have production traits for resisting these environmental stresses.
- ❖ Southern hard clams readily hybridize with northern had clams in the wild where the co-occur.
- ❖ Therefore, we are examining hybrid clams in laboratory and field-based experiments for enhanced survival, building upon earlier research by Menzel (1961) and Dalton and Menzel (1983).



Figure 1. Northern (a) and Southern (b - male, c - female) hard clams spawned by thermal shock

**Results**

- ❖ Spawning of both Northern and Southern hard clams species was accomplished by thermal stimulation.
- ❖ Southern hard clams seemed to spawn as water cooled from peak temperature.
- ❖ It was difficult to have spawns occur concurrently, but spawning usually occurred within 1 hour of each species.
- ❖ A total of five (5) different spawns were accomplished with different sets of parents on different days.
- ❖ Differences in fertilization between hybrid crosses were sometimes noticed, but have not been quantified.
- ❖ Relative DNA amount measured by flow-cytometry was approximately 5% greater for Southern hard clams *Mercenaria campechiensis* as compared to Northern hard clams *Mercenaria mercenaria notata*.
- ❖ Relative DNA amount of hybrid progeny resembled maternal parentage in some instances, rather than a true hybrid.
- ❖ Allozyme analysis (Fig 4) of parents indicated that two of the five spawns had parents that contained natural hybrids.

**Objective and Methods**

**Objective:**  
Produce replicate families of pure Northern hard clams (*Mercenaria mercenaria notata*), Southern hard clams (*M.campechiensis*.) and their reciprocal hybrids.

**Methods:**  
 ❖ Northern hard clam broodstock were obtained from a Florida hatchery.  
 ❖ Southern hard clam broodstock were obtained from the wild (Sarasota Bay, FL), where highly pure populations are known to exist.

- ❖ Clams were spawned by thermal stimulation (10°C increase) in separate spawning trays (Fig1).
- ❖ Single parent crosses were utilized. Eggs from each female were divided into two containers and inseminated with sperm from either Northern or Southern hard clams.
- ❖ Larvae culture was performed in 400L tanks using standard hard clam hatchery protocols: water changed daily, fed once daily at 50-100K cells T-ISO/mL, salinity 30 ppt, temp 24-28°C (Fig 2a).
- ❖ Setting occurred in 0.143 m<sup>2</sup> downwellers (Fig 2b).
- ❖ Post-set clams were fed twice daily a mixture of the flagellate T-ISO and the diatom *Chaetoceros* sp. and water changed every other day.
- ❖ Tissue (gill, mantle, and/or adductor muscle) from parents and whole post-set clams were analyzed for protein allozymes indicative of the species (Arnold et al., 2004) and relative DNA amount by flow-cytometry.



Figure 2. Larval culture tanks (a) and setting bins (b).

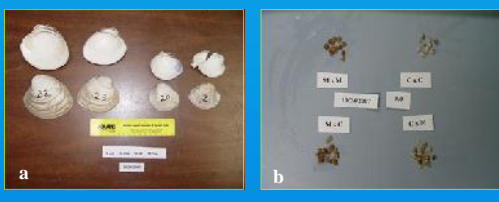


Figure 3. Parental shells (a) and resulting post-set juveniles from 24 Oct 2007 spawn (b). Crosses are listed female by male. Note color patterns seem to follow maternal parent.

**Conclusions**

- ❖ Production of hybrid hard clams (Northern, Southern) was successfully accomplished
- ❖ Genetic markers are necessary for hybridization studies to ensure purity of parents and resultant populations.

**References**

Arnold, W. et al., Influence of congeneric aquaculture on hard clam (*Mercenaria* sp.) population genetic structure. *Aquaculture International*, 12: 139-160.

Dalton, R. and Menzel, W. Seasonal gonadal development of young laboratory-spawned southern (*Mercenaria campechiensis*) and norther (*Mercenaria mercenaria*) quahogs and their reciprocal hybrids in northwest Florida. *J. Shellfish Res.*, 1: 11-17.

Menzel, W. 1961. Seasonal growth of the northern quahog, *Mercenaria mercenaria*, and the southern quahog, *M. campechiensis*, in Alligator Harbor, Florida. *Proc. Natl. Shellfish. Assco.*, 52: 37-46.



Figure 4. Starch gel of PGI exhibiting allozyme differences between Northern and Southern hard clams.

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