Seed for Hard Clam Farmers in Florida:

The Clam Hatchery at Harbor Branch Oceanographic Institution

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HBOI clam broodstock have been carefully selected. The special coloration pattern on the shells is called "notata."

Clam farming is the most rapidly growing segment of Florida's expanding aquaculture industry. Sales have increased from US$1.2 million in 1991 to $5.4 million in 1995, and in 1997 they reached $12.7 million. In response to the increasing demand for clam seed from Florida farmers, the clam hatchery at the Harbor Branch Oceanographic Institu-tion (HBOI), a leading marine sciences research organization, continued to increase production and expand the facilities. In 1998, a new state-of-the-art hatchery was completed at the Fort Pierce (Florida) facility. "We expect to produce half a billion clam seed this year in our new facility," says David Vaughan, Ph.D., Director of HBOI's Aquaculture Division.

HBOI's first clam hatchery started twelve years ago in a small greenhouse where algae production, broodstock maintenance, spawning and larval development all took place in the same area. Since then the Aquaculture Division has been conducting research to develop new broodstock strains of the hard clam (*Mercenaria mercenaria*), as well as hatchery, nursery and growout production technologies. "We made some important changes," states Hatchery Manager, Richard Baptiste. "We switched over to a saltwater well, and began raising massive volumes of microalgae on land, which greatly improved seed survival in early nursery. We also expanded the powered upwelling system in our field nursery," he explains.

Hatchery Location and Water Quality

The HBOI clam hatchery initially used water from the Indian River Lagoon, adjacent to the facility. This water supply came directly from the estuary through a pumping station and several thousand feet of PVC plumbing. The water was then filtered through sand and cartridge filters and sterilized with ultraviolet light (UV). Some of the problems with the water supply system included fouling of the pipes, contamination, fluctuating salinity (13-40 ppt), fluctuating temperature (12-36°C), and high maintenance costs. Installation of a saltwater well in 1995 took care of these problems. Presently, the water is vigorously aerated to remove hydrogen sulfide and is then pumped through a semi-fluidized shell and sand filter to remove any ammonia and iron. The saltwater is then recirculated through a sand filtration system in the holding tanks. The advantages of using the salt-water well include cleaner water, no fouling organisms, stable salinity of 25-35 ppt, stable temperature (24°C) and lower maintenance costs. The only disadvantage is that the water must be stored for times of increased consumption.

Genetic Selection

According to Dr. Vaughan, HBOI clam seed is the product of more than 12 years of meticulous genetic selection. During spawning, each female broodstock clam will release approximately one million eggs. "From every

Feeding baby clams with microalgae. Small clams are raised in downwelling units placed in fiberglass troughs. Two species of algae (Tahitian Isochrysis galbana *and* Chaetoceros gracilis*) are grown and mixed daily for feedings.*

million eggs produced we only select the top quality seed, around 10% of the spawn, for nursery production. Of those 100,000 seed, we keep a few for breeding and the rest are made available for sale to graduates of our educational programs," says Dr. Vaughan. When selecting broodstock, HBOI's Aquaculture Division scientists target uniform growth and a special coloration pattern called "notata," which is visually appealing and recognizable.

Larval and Microalgae Production

Hatchery and microalgae methodologies have not changed significantly

except for the increase in size of the culture vessels. The new 14,400 square foot clam hatchery has four 12,000-liter tanks, with a capacity of 200 million larvae per bi-weekly spawn. In land-based facilities a reliable mass microalgal culture system is necessary to keep up with the larger spawns and the large volumes and high survival of animals. The new hatchery facility has sixteen 12,000-liter tanks with 1500 watt, metal halide lamps to meet this need. It presently produces a large portion of the seed clams required by Florida's clam farmers. Many of these farmers were formerly commercial net fishermen who participated in retraining programs after the Florida's fishing net ban. HBOI's Aquaculture Division was contracted by the State of Florida to develop and implement these successful clam farming training programs.

Large amounts of microalgae are needed to feed clams. Mass production of microalgae is done in these 12,000 liter tanks.

Improvements to the Land-Based Nursery

HBOI's clam seed survival rates increased following improvements to the land-based nursery systems. In the early years, post-set clam seed were placed in upwelling units on land. These clams were fed natural phytoplankton from crudely filtered estuary water and were supplemented with cultured microalgae. This method introduced fouling organisms into the culture tanks, which affected the overall survival and growth. The new and improved method for raising post-set clams relies exclusively on the saltwater well source and the mass production of microalgae. This system consists of a series of fiberglass troughs filled with downwelling units. The troughs are linked together by a drainage system and a recirculation manifold. In this system food is batch-fed from the mass algal culture tanks during the day, and then left on a regulated trickle feed overnight. Two species of algae (Tahitian *Isochrysis galbana* and *Chaetoceros gracilis*) are grown and mixed together daily for feedings.

Improvements to the Field-Based Nursery

In the early 1980's the Aquaculture Division began developing a field-based nursery system, which allowed animals as small as one mm to be moved out of the land-based system to a field-based upwelling system. The original system consisted of floating upwellers with airlifts as a water movement source. "Due to expansion limitations, we went through many refining steps before we ended up with the system we're using now," says Baptiste. The improved nursery system consists of a series of fiberglass boxes that are tethered to a dock. Each box holds 18-60 cm diameter barrel upwelling units. A 20-cm PVC axial flow pump supplies 2,000 liters per minute to each box and the water is distributed to each of the upwelling units. The flow rates are exceptionally high, allowing each upwelling unit to be stocked with higher than normal clam densities. The field-based system uses natural phytoplankton to feed the seed clams, and is both labor and energy efficient. The system is also very simple to maintain. To empty the fiberglass box the retaining boards are removed and the pump flow is reversed. The box will then float on the surface, allowing staff to perform necessary maintenance or harvest the seed. The box is then refilled with water by returning the pump to the forward position.

The Future

The new generation of Florida's clam farmers has played an integral role in the growth of Florida's clam industry, and will continue to play a significant role in the future. HBOI's new clam hatchery has a future capacity of one to two billion seed clams per year to support these successful clam farmers.

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View of the land-based nursery with rows of fiberglass troughs, each containing several downwelling units.