Aquaculture-Farming the Waters

The state's history with aquaculture dates back to oyster culture operations in the early 19th Century and the establishment of a private trout hatchery in the 1860s. An extensive freshwater finfish hatchery program began in 1912 and has expanded several times since then. Operated by the Department of Environmental Protection and supported by user fees, these facilities provide a number of species, primarily rainbow, brook and brown trout to stock recreational streams and ponds.

New Jersey boasts a variety of aquatic farms producing clams, oysters, sport/game fish, baitfish, ornamental aquatic plants and fish, and food fish. As a result of the newly instituted Aquatic Farmer License Rule, 134 applications were received for clam and oyster farms, 14 for finfish, two for plants and two for a combination of fish and plants. This is well beyond the estimates of currently existing aquatic farms. These farms use a variety of systems including in-door recirculating systems, ponds, greenhouses, raceways and bottom leases in coastal areas.

Hard Clam Culture

The hard clam or northern quahog, *Mercenaria mercenaria*, has long been a mainstay of New Jersey's coastal communities. When the first Europeans came to New Jersey, they found piles of clamshells all along the coast where the local population feasted on shellfish. The newcomers were quick to follow in this culinary tradition and their recipes for chowders, bouillabaisses and cioppinos were put to good use.

The Native Americans not only used hard clams as a major staple in their diets but also used the purple portion of the clamshell to make beads. Originally the beads were used only for decoration, often to symbolize individual names, but then became a form of currency, which explains the origin of their scientific name, *Mercenaria mercenaria*. Because the purple beads were more valuable than plain white ones, a counterfeiting industry quickly sprang up. Needless to say, the Native Americans were much better at spotting counterfeits than the Europeans. To this day, hard clams are often called by the Algonquin name, quahogs (pronounced co-hogs).

Hard clam aquaculture became established in New Jersey in the middle 1970s and is the most important aquaculture industry within the state. There are seven hatcheries producing clam seed, and many other growers who rear these seed to market (little neck) size. New marketing efforts will be required to provide increased markets for the growing number of high quality clams available through aquaculture.

All current clam culture is conducted in the shallow lagoon systems behind the barrier islands and all successful hatcheries or nurseries have access to consistently high salinity (>26 ppt), good quality water. The areas potentially available are increasing as more waters are opened to shellfish because of improving water quality off our coast.

Pioneers in Clam Aquaculture

The New Jersey Department of Environmental Protection classifies any area supporting .2 shellfish per square foot as productive shellfish ground. That figure translates into back-breaking work for a commercial harvester dependent upon wild set. Because commercial seafood harvesters must have a good knowledge of biology and environmental science, some clammers began to think that there might be a way to actually farm the clams.

The history of hard clam culture begins with rudimentary attempts by traditional wild harvesters. They simply collected wild hard clam seed (very small clams) and broadcast it on leased bottom. Some individuals tried to enhance survival by placing seed in naturally occurring shell beds or by preparing the beds by the placement of shell on the bottom.

Other harvesters who did not own lease grounds would simply "hide" seed in rarely harvested areas. Some actually had good survival with this technique. They were placing seed in tidal creeks, and the size of the seed, greater than 20mm, made them immune to most of the smaller predators. The late Harold Haskin participated in a number of attempts to rear hatchery seed, obtained from the Milford Shellfish Laboratory in Connecticut during the mid-1950s. This work was done primarily on sites along the Delaware Bay shore. The Campbell Soup Company funded additional research at several sites on the Atlantic bay side of the state.

No history would be complete without mentioning the huge natural set in Little Egg Harbor Bay at an area known as the Goose Bar Sedges in the late-1960s and early-1970s. The incredible density inspired many shellfishermen to realize the potential for culture.

Some forward-thinking New Jersey clammers began to think that there were more productive techniques that could be used to farm clams. Doing their own research, well before the days of the Internet, they heard of studies on the culture of hard clams that were being conducted at the Virginia Institute of Marine Sciences (VIMS). Realizing the potential of New Jersey waters, they were the first students to enroll in a clam culture course at VIMS. These early students were so eager to learn, that they would get to the lab before dawn and do larval water changes before laboratory staff arrived for the day, just to practice. This initial work at VIMS began a long association with the New Jersey industry.

When they got back to New Jersey, they had to tweak the process to meet the exact environmental conditions in this state. They built a small greenhouse structure in the back yard and trucked seawater to it. These first attempts succeeded in spawning and setting several batches. Once there was proof of concept, the operation was expanded. All conditions seemed optimal. A borrowed refractometer had indicated the salinity at the new site was within the range of tolerance.

Then disaster struck. After having total mortality of several batches, it was determined that the salinity at the new site was too low. Another site was identified and a company called Breeder Shellfish was formed. This company had varying success in rearing and setting larvae. They then joined forces with an individual who was successfully rearing seed in North Carolina.

During the 1970s, companies successfully reared seed, but all attempts at effective grow-out were stymied. However, the intrepid clammers persisted**.**

The clammers tried making net pens out of a commercially available plastic mesh used to protect fruit trees from birds. This proved frustrating because the nets were fouled with algae and crabs. They tried using sheets of hardware cloth but had many of the same problems. Then they tried making screens of the hardware cloth to place over the clams. This single innovation was the beginning of the clam farming industry in New Jersey.

The Culturing Process

In nature, clams spawn in the spring. When coastal bays warm up, the shellfish release their eggs and sperm into the water. These eggs and sperm unite to form larvae, but in nature the recruitment/reproduction process is haphazard at best. Those larvae that result feed on the naturally occurring phytoplankton, or algae in the water.

After several weeks in a free-floating state, the clam larvae settle to the bottom, nestle into the sand or mud, and begin to grow to market size. The average littleneck clam in nature is probably 4 to 5 years old at harvest.

Hard clam aquaculture mimics this process, but the culturist takes control, and increases the speed at which the clams are produced. A large group of parents, or brood stock, is placed on a spawning table that looks like a very shallow bathtub. These 50 to 100 ripe clams are bathed with alternating doses of cool and warm salt water to simulate the springtime tides. Once the clams start to release their eggs and sperm, the spawners are removed from the table, the males and females are separated, and set in small bowls. The eggs and sperm (gametes) are collected separately, and eventually mixed together. Fertilization then occurs in a bucket. The resultant larvae are placed in a large tank containing filtered seawater. For the next one to two weeks, the larvae swim in the tank, feeding and growing on a diet of specially prepared unicellular algae grown previously by the culturist.

Once the larvae reach 200 microns, they begin to metamorphose or “set.” During this process they lose their ability to swim and settle to the bottom of the tank. (A micron or micrometer is one millionth of a meter, or one thousandth of a millimeter. In English units, it is equivalent to 1/25,000 of an inch.) These “post set” are collected and placed in up-welling tanks where they are fed ambient bay water, (filtered to remove larger particles and potential

competitors); and its naturally occurring algae. An up-weller, in its most simple design, looks like a 5-gallon bucket with screening on the bottom. The bucket has a hole on its side near the top. A group of up-wellers are placed in a tank, which is fed bay water. The hole in the side of the up-weller is connected through the side of the tank. Thus, the only way the water entering the tank can escape is to flow through the mass of clam seed in the up-weller, and exit through the side of the tank.

At about 1500 microns (1.5mm), the seed are taken from the up-wellers and placed on raceways. Raceways are made of 2-by-4s and plywood, or fiberglass, and are used to provide a surface on which to feed the clams by flowing bay water over them until they reach 8 to 15 millimeters, when they are ready for field planting. This part of the nursery process can also be done in the field in specially designed plastic mesh bags and boxes.

The field grow-out process occurs in the leases previously mentioned. The clam seed are planted in small plots, approximately 14 by 20 feet, and are covered by ¼-inch flexible plastic screening to protect them from numerous predators that typically feed on shellfish. Blue crabs, green crabs, mud crabs, drills, moon snails, knobbed and channeled whelks, rays, as well as waterfowl, can all damage the clam crop. The clams remain in these plots until they reach market size, which usually about 2 to 3 years after the spawn. During this time, the culturist manages the area as a farmer does his fields. Screens must be cleaned of fouling and checked for tears that might allow access by predators. Plots may be thinned and fast growers harvested for sale.

The Benefits of Hard Clam Farming

Clam aquaculture allows people the chance to continue as a working waterman, a profession that is dying out in many places. The culturist is able to supply safe, consistently high quality shellfish in its most readily accepted market form, in large volumes, at a fair price, on a year-round basis.

The hard clam aquaculture industry plays another significant role in preserving and enhancing the hard clam industry in New Jersey. Because the clams cannot be harvested until they reach a legal size of 1 1/2 inches, they have been able to spawn at lease once. These spawns release billions of gametes into the water, some of them fertilizing and setting in the areas, hopefully increasing the stocks of clams in the wild.

Also, every day the culturist spends working on his clam farm is one less day he is exerting pressure on the wild populations. This gives other commercial and recreational clammers a chance to participate in the fishery.

Recent Events

The last five years of the 1990s were hard on clam farming in New Jersey. A new shellfish disease named QPX appeared in the bays. Massive blooms of a brown tide and other algae inhibited seed survival and clam growth. There was little movement on acquiring new lease areas that would allow growers to practice good husbandry, avoid overcrowding and lessen the chances of mass mortalities from shellfish disease. Aside from these constraints, large numbers of cultured clams from Florida and Virginia began flooding the marketplace at cheap prices.

Clam culture in New Jersey is the major aquaculture industry and our biggest generator of revenues. However, this industry is currently facing major challenges in terms of the regulatory environment and major competition from other shellfish-producing areas. Much of that competition is from states that have moved rapidly to ensure the growth of their industries. New Jersey is making strides in that direction but there is still much to do.

The expertise at the Rutgers University Haskin Shellfish Research Laboratory can greatly assist the industry in improving hatchery technology, genetics, nursery, and field grow-out and overwintering of seed. Advances in all of these areas will be necessary if New Jersey culturists are to remain competitive with large-scale aquaculture of this species in other states. Since New Jersey is a major market for hard clams, appropriate legislative support, demonstration of new technology and increased marketing support could easily increase production by 10 percent per year throughout the next decade.