Pemaquid Oyster: Aquaculture, lifestyle blen

by Tim Harkins

NEWCASTLE, ME - Successful oyster farming on the Damariscotta River in midcoast Maine depends on several variables, such as water quality, good seed supply, dependable markets, and a lot of meticulous, manual work.

Pemaquid Oyster Company has figured out how to control as many of the variables as possible, and three of the partners in the company make up a willing workforce. That is, in fact, why they are in business: they believe in what they do and how it is done.

"Shellfish farming doesn't lend itself to big business," said Chris Davis, one of the company's principals. "Lifestyle has a lot to do with why people are in this, and I hope it stays that way."

The Pemaquid Oyster Company was started back in 1986. At the time, Carter Newell, another of the Pemaquid partners, was completing his graduate work at the University of Maine's Darling Center in Walpole, ME. Maine aquaculture pioneers Edward Myers of Abandoned Farm Inc. and university professor Herb Hidu had inspired Newell with their belief in the feasibility of culturing cold water marine species.

Davis and Newell, both Colby College graduates, joined with former Colby classmates including Jeff McKeen to form Pemaquid Oyster Company.

The nearby Damariscotta River was the obvious place to start. The 17-mile river, with its headwaters in inland Damariscotta Lake, flows to the ocean, where it mixes with the waters of the Atlantic in the areas of Pemaquid Neck. Bottom temperatures of the brackish river water range from a low of around 28°F in winter, beneath the ice that can fill the river's upper reaches, to about 65°-68° in summer.

The company grows the American oyster, *Crassostrea virginica,* exclusively for the half-shell trade, where premium prices can maximize the profit on each oyster. On average, they receive from 55-75 cents per oyster, Newell said, which can be as much as 10 times what the shucked industry gets for its product.

Pemaquid Oyster Company is obviously proud of its product quality. In fact, around 1988 it went so far as to trademark the name "Pemaquid" for its oyster. Although oysters from the Damariscotta region are frequently referred to as Pemaquids throughout the industry, only product from the Pemaquid Oyster Company can use the name.

Marketing their production has not been a significant challenge, Newell said. With strong demand along the Eastern Seaboard, Pemaquid sells 50% of its product in Maine, while the balance remains on the East Coast or goes to Canada.

Although there are three other oyster-farming operations within sight of Pemaquid Oyster, there appears to be camaraderie among growers.

"The market is huge," said Newell. "There is an untapped market of 40 million dollars in New York alone."

Hatchery

The farming process for Pemaquid Oyster begins at its Bremen, ME hatchery, which the company constructed back in 1997. Although the hatchery is not necessarily economically viable, it serves a key function: it is critical for the company to have mature seed for planting available during June and July because 70% of juvenile oyster growth occurs then.

The brackish waters of Damariscotta River in midcoast Maine provide Pemaquid Oyster Company with an ideal environment for oyster production. At left, one of the company's nursery sites, where juvenile oysters are held in floating mesh bags. Above, Pemaquid's American oysters are raised for the half-shell market. Center, Chris Davis, one of four company partners. At right, the operation's 24'x24' work barge, where oysters are cleaned, graded, and packed. All of the work is done by hand. The barge is powered by a small outboard, which allows it to be moved from site to site as needed among the company's five aquaculture lease sites.

Parent stock is brought in from the company's growout sites during February and is subject to a 4-6 week conditioning period where optimum spawning conditions are simulated in the water. Everything in this environment is controlled, from the water temperature to the food source. The water is even filtered to insure the removal of any disease or predators that could harm the tiny larvae.

Davis grows his own algae, using widely known species to feed the oysters. The water is slowly warmed to 75°-80°F. Once the oysters spawn, the eggs and sperm are collected and fertilized in 2,000 liter larval tanks.

When the larvae hatch, they are collected every other day through 200 micron sieves and placed in a settling tank. The larvae are mobile in the water until they are ready to metamorphose into the stationary form most commonly associated with oysters.

Once the oysters are ready to settle out, a micro cultch is prepared. The cultch consists of oyster shells ground up into almost a fine powder. The cultch gives each individual oyster its own tiny substrate to settle on — and by nature oysters prefer shell to any other hard surface.

Thousands of larvae can be grown on a single large shell. But as they increase in size they tend to grow into each other, causing deformities to the young oyster's newly forming shell. That appearance would not be conducive to Pemaquid's half-shell trade, where the shells need to be as uniform and unblemished as possible.

The tiny oysters remain in the settling tank for up to 6 weeks.

Upwellers

At 2-3 millimeters (mm), the oysters are moved to the upwellers for 2-4 weel The upwellers used by Pemaquid Oyste which are located off a dock on the rive in the town of Damariscotta, were designed and developed by Davis.

The purpose of the upwelling systen to ensure that the tiny shellfish are receiving an adequate supply of food ar oxygen.

Essentially, the upweller is a large, buoyant, fiberglass tank that floats clos to shore. Inside the tank are plastic cylinders, about the size of a barrel, tha

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are open on top and contain a fine mesh screen on the bottom. Plankton and oxygen rich water is pumped into the tank and through the cylinders via airlift pumps. The water flows at a specified rate that maximizes the growth of oysters stored in the cylinders. The water then drains out the bottom of the tank.

During a mid-August visit to Pemaquid, the tiny oysters had the appearance of a clump of wet sand when scooped up by the handful.

When the tiny shellfish reach the size of a fingernail, they are ready for the next production step and are transferred into mesh bags.

Nursery

The rectangular bags are constructed of a fine mesh that resembles window screen. The openings in the black mesh are 2 mm — just large enough to allow water to pass through, but not large enough to let tiny oysters escape.

Attached to the sides of each bag are long foam flotation units that keep the bags close to the surface. The bags are manufactured in Canada by ADPI, and seem to be the standard in the industry.

The company's vessel, Oyster Girl, is used both to disperse juvenile oysters on bottom for growout and for harvest. Below, partner Jeff McKeen with the dredge that is dragged on bottom to collect market-size oysters.

Tim Harkins photos

Each bag is loaded with approximately 7,000 seed oysters, which are measured out by volume.

Once the bags are filled they are put onto an open skiff for a boat ride out to the company's two-acre "nursery," a site leased from the state that is located just minutes from the dock but outside of the main channel of the river. The low tide reveals seaweed-covered ledges that lead right up to shore. A scattering of pricey homes peek through the pines and overlook the site.

When asked about the relationship with his neighbors, Davis replied that, "it couldn't be better." Once in a great while they experience an illegal harvest, and more often than not, it's the landowners that give them a call if they spy something unusual, he said.

At the nursery site, there are already two long rows of bags floating in the water. The bags are strung between two lines attached to buoys that are anchored on bottom. On this day, Davis snaps the newly filled bags into place. They sit for about 3 weeks while the tidal flow of the river supplies the young oysters with the food and nutrients they need to grow.

Every couple of days it's important that the bags are flipped over. This inhibits growth that would foul the mesh and restrict water flow to the oysters. Once turned, any existing growth tends to dry in the sun, which makes it easier to clean at a later time.

Grading

The oysters are transferred two more times before they are seeded on the bottom for growout. Between each transfer, the product is graded by hand. This is accomplished by shaking the oysters across different size mess screens — almost as if one were panning for gold.

"We spend a lot of time grading," said Davis, "but you end up with a better product and spend less time culling out in the fall."

The next holding bag or "tray" is constructed of 3/16" plastic mesh. It is approximately 32"x8"x5" and rectangular in shape. This time 3,000 oysters are placed in the tray, where they will remain for a month.

Tim Harkins photo

Tiny oysters spend a few weeks in the upweller system to get a nutritional boost before being moved to the nursery site.

Traditionally theses trays are 3" deep, but Davis has found the deeper tray allows accumulated growth to dry out better in the sun once it has been flipped. This makes things considerably easier to clean.

The final surface trays, where the oysters spend about 3 months, are constructed of 3/8" mesh and are filled with 1,000 oysters. The reason for reducing the amount of oysters in the trays is a function of the sheer volume they take up. Every time an oyster doubles in length it increases eight-fold in volume.

The plastic trays replaced wooden trays that were used early on in the company's history. Covered in mesh, the wooden trays weighed 15-20 pounds dry, but could become as heavy as 40-60 pounds while wet, plus the weight of the oysters. The change to the 2-3 pound plastic tray may seem like a small improvement, but, given that hundreds of trays are handled on any given day, it has made a huge difference.

The new trays, Davis said, "have created a much better growing system. They've revolutionized the nursery system."

Growout

Once the oysters reach 50 mm in size they are ready for bottom growout. Pemaquid Oyster has five different aquaculture leases that incorporate about 15 acres of river bottom.

Product is gathered from the trays, graded once more, and then put into plastic fish totes. The totes are loaded aboard the company's oyster boat, Oyster Girl. Jeff McKeen and Carter Newell usually operate Oyster Girl.

What occurs next can only be categorized as a leap of faith. After nearly a year of raising, monitoring, and handling the oysters, they are now dumped on a table located on the Oyster Girl's stern. While the boat is moving, the top of the table is tilted slightly, allowing the oysters to be dispersed about the bottom by the prop wash of the boat.

Some companies choose to conduct their final growout in the mesh trays. Although this offers a greater control of inventory, it requires an extremely large area and large number of trays to

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accommodate the every-increasing larger sized oysters. This method also involves a great deal of additional handling.

Pemaquid Oyster likes the bottom growout method primarily because of the labor savings. This method also reduces the visual impact the operation has on the surface of the river.

The river's flow patterns are vitally important to successful growout, and Newell, in particular, is adamant about where the oysters are sown.

"Some areas grow 30% faster than others," said Newell. "I can point out areas on the river that have growout in 8 months and others that have growout in 16 months — both within 100 yards of each other."

As the boat moves slowly through the water, Newell and McKeen try to regulate the dispersion of oysters to about 10 oysters/sq ft.

Each location where oysters have been placed is mapped out on the global positioning satellite (GPS) unit for easier retrieval. Primary oyster harvest is done by dragging a small dredge across the site bottom. Once an area is dragged, Newell or Davis also dives on the area during the slack tide to harvest the remaining shellfish by hand.

From April through New Year's, Pemaquid Oyster harvests once a week, averaging about 6,000 oysters per harvest. This is the result of sowing up to 2 million oysters on bottom.

Once harvested, the shellfish are sorted by size aboard the boat. Pemaquid Oysters are sold in three sizes: cocktails, selects, and jumbos.

After sorting, the oysters are loaded into yet another set of trays and moved to another part of the river to purge. At this new location the water tends to be saltier which enhances the taste of the oyster.

"When you eat an oyster, essentially you taste the water from the area where the oysters were grown," said McKeen. "And we have some of the sweetest water around."

Water quality and the health of the Damariscotta River are critical to the successful growth of oysters. Just this summer Davis received a grant from the US Department of Agriculture to determine the growing capacity of the river. These grants are known as Sustainable Agriculture and Research grants (SARE).

He will be examining factors such as the amount of food and oxygen that are transported by the river, and the amount of aquaculture this biomass can sustain.

The greatest setback faced by the company has been juvenile oyster disease (JOD). Although the cause of JOD is unknown, Davis said he suspects that it is somehow related to water temperature. This disease typically affects oysters at less than 1" in size and usually occurs in August. In one year Pemaquid Oyster lost 95% of its crop to this disease.

The other thing they have to watch out for is crab and oyster drill predation. An oyster drill is a small mollusk, slightly larger than a bottle cap, with a shell shaped like a drill bit.

By most all measures, the Pemaquid Oyster Company is a success. Withstanding the test of time, it produces a consistent, high-quality product and provides income and employment for at least three families. All the partners have a great deal invested in the company, much of which is sweat-equity, and a great commitment to preserving the health of the river.

"Essentially all we're doing is moving materials," said Davis with a grin. "That's what we're all about." ■

PEMAQUID OYSTER FESTIVAL - The Pemaquid Oyster Company and the Schooner Landing Restaurant and Marina teamed up to host the Pemaquid Oyster Festival on Sept. 28 in Damariscotta, ME. Proceeds of the event benefi the Edward Myers Marine Conservation Fund, which supports "efforts to conserve marine environments and maintain a sustainable working waterfront for future generations."

Systems Engineering

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must be trained in their particular trade or discipline. Even more importantly, the O&M staff must be trained based on appropriate O&M documentation delivered when the project is complete, training that should start for key individuals during the commission phase of the project.

Conclusion

So where are we? What's the message?

The basis of design is a road map, a written plan that should lead to a successful, cost-effective project. It requires us to review and apply appropriate codes and standards. It prompts us to build our project on the foundations of safety and reliability, thus assuring its suitability for the marine environment.

It establishes a design and construction "mission" to deliver and control key programmatic or process parameters, making it suitable for the intended biological, chemical, and physical processes.

And, finally, it establishes the analysis, evaluation, and execution that must be performed to lead the team through the design, construction, commissioning, and O&M phases of a project in a controlled, cost-effective manner.

Suggested reading

"Design and Operating Guide for Aquaculture Seawater Systems — Second Edition," by John E. Huguenin and John Colt (Elsevier);

"Development of a Seal Rehabilitation and Marine Science Facility's Seawater and Life Support System," *Aquacultural Engineering 27 (2003) 213 - 245,* by John E. Huguenin, John L. Chase, and Samuel R. Chapman (Elsevier).

This article is based on the full technical paper and presentation currently under development by Paul Hundley for the 2003 Aquacultural Engineering Society Issues Forum to be conducted in Seattle, WA on Nov. 3–5. Part 2 of this article will outline the specific details of a basis of design for a large seawater system.

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