



OYSTER FARMING IN LOUISIANA



Technology has provided our world with the tools to farm both its land and sea; farming in a sustainable manner is essential to feed the six billion people on earth.

People have found alternative ways to harvest marine organisms so as not to “overfish” our natural supply. One such method is sea “farming.” **Mariculture** is the process of farming organisms from the sea, and **aquaculture** is the general term for farming aquatic organisms; both processes have become economically and ecologically beneficial.

Oysters are grown by sea farming techniques. In Louisiana, half of the total oyster production comes from public seed grounds managed by the state, and half from oyster farmers’ private leases. Approximately 4,800 jobs in Louisiana are provided by oyster production and processing. Through science and research, we have improved the process of providing oysters to consumers in a sustainable manner.



WHAT IS THE OYSTER CULTURE CYCLE?

Hatchery Business

Stage 1 – Site Selection:

The most important stage in setting up an oyster hatchery is site location. The site must have good water quality. One must look at the watershed, gathering as much data as possible about salinity and water temperature, and talk with locals about any industrial impact on the targeted site.



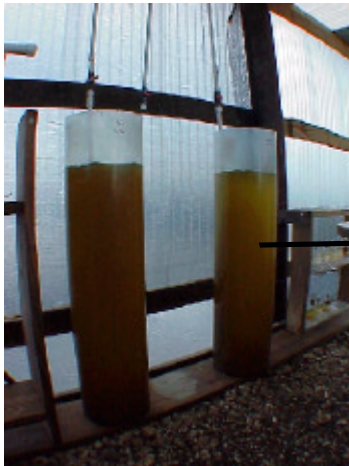
A consistent salinity range (25-31 ppt) is important for hatchery production (open ocean water is 35 ppt). When salinity drops dramatically—25 ppt to, say, 10 ppt—algae die, eliminating the food supply for oysters and many other organisms.

Water temperatures in the Gulf of Mexico remain relatively constant from season to season having no effect on oyster growth. Oysters at a hatchery can be raised or lowered in the water to maintain a constant temperature. However, hatchery owners prefer to keep oysters above ground to avoid predators like the oyster drill snail.



Hatchery Business

Stage 2 – Algae Culture:



Algae .
in
cylinders



Algae must be grown or made available throughout the next stages of the oyster hatchery cycle. The cultured algae used at the Grand Isle hatchery are *Isochrysis galbana* and *Chaetoceros muelleri*. *Isochrysis galbana* is a naked **flagellate** with cell walls that have scales on them called seta. *Chaetoceros muelleri* is a **diatom** that is high in lipids (fats), high energy food for larvae needed during metamorphosis. Algae are grown in large clear boxes, cylinders, or tanks and monitored for color and pH of the water. The darker green the algae get, the more algae are growing. The pH of the seawater is kept at eight during cell growth. Rapidly growing algal cultures are “starving for carbon,” so CO₂ concentrations need to be adjusted for proper algal growth and for photosynthesis to take place. Algal cultures should be kept in a filtered sunlit area because too much direct sunlight can kill the algae.

Stage 3 – Broodstock:

Preparing broodstock for production of the American oyster, *Crassostrea virginica*, occurs next in the cycle. This is the stage in which adult male and female oysters are fed algae to prepare them for spawning. The oysters are placed in tanks of shallow cold water at about 10°C for four weeks. The temperature is then raised two degrees per week to 24° C to mimic a springtime temperature increase. Previous to this step, broodstock are usually identified



Holding tanks of oysters to be spawned

and marked either male or female. Oysters in water that is 24°C take about four weeks to go from a non-reproducible “unripe” state to a reproducible, or “ripe”, state to spawn (or release eggs or sperm).



Hatchery Business

Stage 4 – Spawning:

The spawning stage begins after the oyster's gonads develop when the water temperature is raised to mimic springtime. Once "ripe," oysters can then be placed into a holding tank until they are needed. When an order for oyster larvae arrives at the hatchery, ripe oysters are then available for use. After the initial spawning, oysters in the gulf region can spawn again approximately every four weeks from April through October.

Scraping eggs from gonads



Knife pointing to gonads



Eggs and sperm from the oysters' gonads can be combined for fertilization by strip-spawning, or the oysters can release sperm and eggs naturally. Oysters reproduce by **external fertilization**. During natural spawning water temperature is increased. First, the males release their sperm into the water, which stimulates the females to release one to ten million eggs. When the water becomes cloudy, this is an indication that spawning has taken place. Male and female oysters should be close to each other for fertilization to take place. Strip-spawning is also done in the hatchery business. Eggs and sperm are scraped from the gonads of ripe oysters and then mixed in a beaker or container where fertilization takes place. Under the microscope, oyster eggs are relatively large (40 to 50 microns) and oval, while oyster sperm is very tiny and oblong (2 microns for the head and a 40-microns tail).

(Students may want to see "Oyster Anatomy" activity for more information on this.)

Scraping eggs from gonads



Filtering out gametes





Hatchery Business

Stage 5 – Larval Rearing:

Oyster larval stages



Beaker of Oyster Gametes



Embryological development occurs immediately after the egg is fertilized and the larval stage begins. During the first two days, **trochophore** larvae begin to swim using **cilia**, tiny hairlike structures. Larvae are filter feeders and eat **phytoplankton**. Any drastic change in salinity and temperature can kill the growing larvae. Then the larvae go through metamorphosis to become **veliger** larvae. The feature characteristic of a veliger larva is its **velum**, a swimming and feeding organ. Now cilia can be seen on the larva with the use of a microscope. Ten to twelve days after fertilization, the veliger larva develops a “foot” to become a **pediveliger larva**. Pediveliger larvae are now able to attach to a suitable substrate, cultch, with their “foot”.

Stage 6 – Setting:

Larvae poured into buckets to attach to substrate



Bag of substrate



The setting stage begins when the larva uses its foot to attach to a substrate. Various substrates or cultch may be used, such as, dolomite, oyster shells, shell fragments, graded chicken scratch, or any other suitable substance. Containers used to set oysters are located in a low-light environment because the larvae swim away from light. The larva searches for a suitable site, cements to the cultch, and goes through metamorphosis; the larval foot, velum, and eye spot disappear during this stage and the larvae become **spat**.



Hatchery Business

Stage 6 – Setting:

At first, spat are so small that they can only be felt and seen on the cultch as sandy bumps. At this stage of development, shell formation can be viewed under a microscope. Shell formation is the distinctive characteristic in the metamorphosis of a pediveliger larva into spat. Spat grow to a size visible to the naked eye within a week or two.



The spat growing on the cultch are visible under a Microscope.





Production Business

Remote Setting:

Remote setting is the process in which larvae are set in a location away from the hatchery to make seed (reproduce). This process starts before the larvae set. Pediveliger larvae are collected on a 225-micron screen to produce single oysters. Next, larvae are wrapped in paper toweling and kept moist and cool. Larval oysters can then be shipped express overnight to an oysterfarmer for use in business. This process allows the hatcheries to specialize in larval growth and the oysterfarmer to specialize in oyster growth, improving production volume, and decreasing cost of production. This division of labor between hatchery and nursery grow-out makes the oyster business economically feasible.

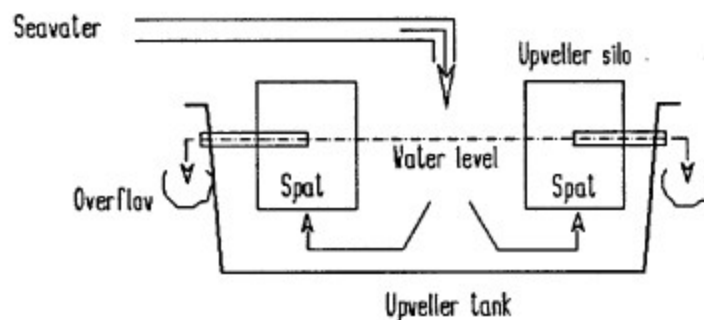


Putting saltwater through a 225 micron sieve to filter out larvae to be used in remote setting

Nursery:

Spat are reared in nursery systems using **ambient** seawater so that the spat will increase in size to produce seed oysters for grow-out and marketing. There are several kinds of nurseries. The most efficient are upwelling systems, silos that direct water through the seed mass to provide natural food for the growing seed oysters. It takes about four to six weeks to produce a 10-12 mm oyster in the gulf region during April through October.

Image of an Upwelling Nursery System



End View (not to scale)



Production Business

Grow-Out:

The oyster producer puts seed oysters into appropriately sized mesh bags. The bags are then placed in racks, rafts, lines, nets, or any other off-bottom system designed for oyster culture. Off-bottom culture allows the oyster to grow to market size (3") in twelve months in the gulf region, instead of two years when grown on-bottom.

Rafts for oyster farming



Some raft cultures can be rotated to reduce **biofouling** by air-drying



Close-up view of growing oysters

