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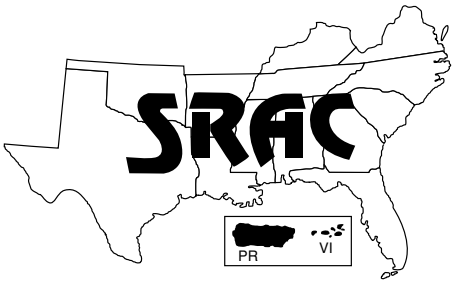

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Extensive Culture of *Crassostrea virginica* in the Gulf of Mexico Region

John Supan*

Oysters have been cultivated to improve their growth and flavor for many centuries. On-bottom, or extensive, oyster culture is the traditional method of farming oysters in the United States. With the rights to exclusive use of the water bottom, farmers have been able to cultivate oysters on oyster leases in many coastal states for more than 100 years. Such privatization is a highly successful fisheries management policy. Oyster leasing allows the farmer to speculate in the market and to choose when to harvest the crop for maximum economic return.

Seed production

Oyster seed for farming traditionally comes from wild oyster production on private leases or public oyster grounds. First, cultch is planted on the oyster grounds. Cultch is a hard substrate, usually consisting of shells, to which the planktonic oyster larvae will attach or set. Within months, the resulting small oyster spat (<1 inch) grow to seed size (>1 inch) and may be transplanted to private leases where they are grown to market-size (>3 inches). In Louisiana, much of the public oyster grounds are managed specifically for seed production. In other Gulf States, such as Florida, farmers are prohibited from obtaining seed oysters from public reefs and may plant cultch material only on their private leases.

The timing and location of cultch planting are important, so it is necessary to understand and monitor the oysters' life cycle (Fig. 1). Planting cultch when oysters are spawning and larvae are in the water column allows a natural biofilm to develop on the cultch and attract the pediveliger larvae to set before other fouling organisms (e.g., barnacles, algae, bryozoans, etc.) out-compete the spat for space and food.

Salinities less than 10 parts per thousand (ppt) throughout the spring and summer inhibit spawning and reduce larval survival, resulting in poor spatfall. When salinities are mostly greater than 15 ppt, spatfall may be abundant but survival may be poor because of increased fouling, predation and disease.

The water bottom should be firm to support the cultch and prevent the attached oysters from sinking and being smothered by sediment. Where there is no natural reef, cultch can be added. Cultch is primarily composed of oyster shells. They reportedly "float" on soft water bottoms because of their high surface-to-weight ratio and are generally available from oyster processing (i.e., shucking) facilities. *Rangia* clam shells are also used because their individual size and shape foster the attachment of single oysters. This reduces culling (i.e., separating oysters from extraneous shell) and other labor during harvest. Surf clam shells are used as cultch along some Atlantic coast states. Other cultch materials include crushed concrete, limestone, cement-fly ash mixture and other aggregates. High-pressure hoses or water cannons can be used to wash cultch overboard evenly, usually over existing oyster grounds, at 50 to 100 yd^3/acre.

Lease selection

Substrate type is the main criterion for selecting a lease site. The presence of naturally occurring oysters and shell indicates a good site. A cane or metal pole is the standard tool used by Gulf oyster growers to sound the bottom to determine firmness. Tapping the bottom repeatedly while traversing an area in a boat will tell the operator whether the bottom is mostly reef, scattered shell, sand, firm bottom or soft mud. Dragging a rope-drawn chain across the water bottom is another method used to feel for hard sub-

*Louisiana Sea Grant College Program, Louisiana State University

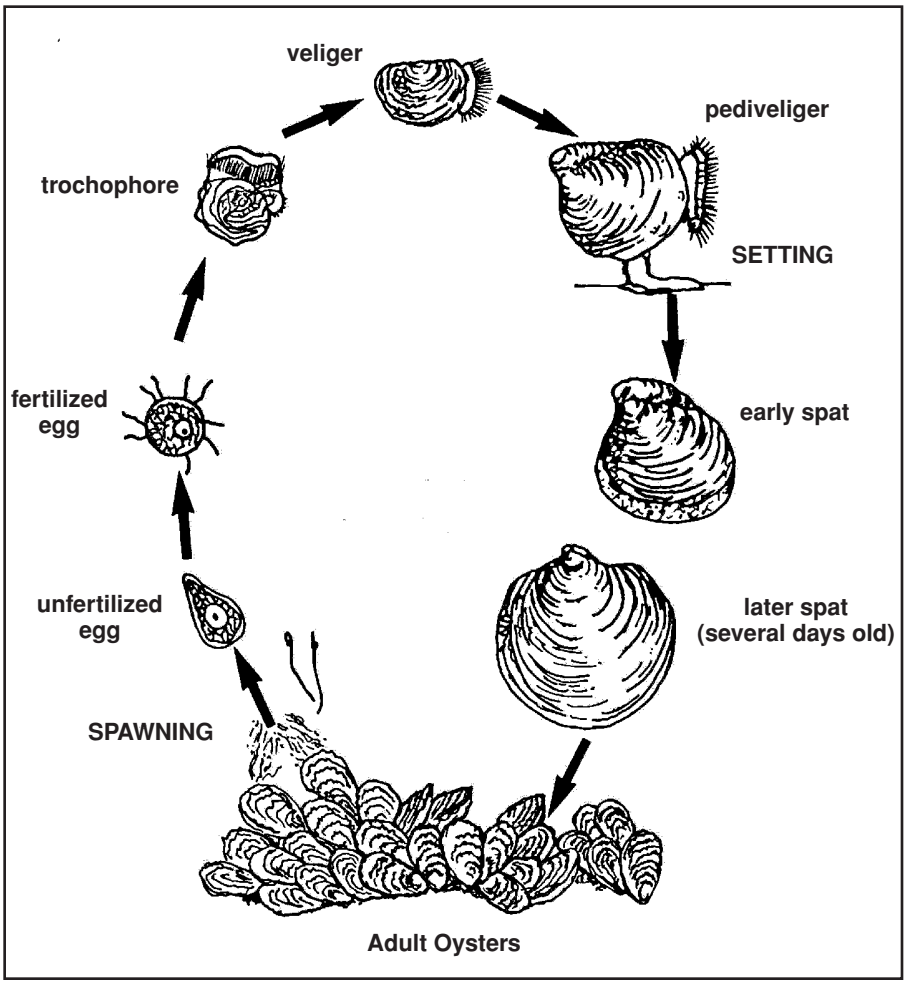

Figure 1. Life cycle of Crassostrea virginica from: The Oyster Fishery of the Gulf of Mexico, United States: A Regional Management Plan. Pub. No. 24, Gulf States Fisheries Commission, Ocean Springs, MS.)

strate. Hydroacoustics, or side-scan sonar, is a newer technology used mostly by state resource managers because of the cost. Some-times scuba divers visually assess the bottom.

While reef is the best substrate, it is not necessary; firm, sandy clay-mud can support oysters adequately. Hard sand should be avoided for extensive oyster farming because it can shift and smother a crop.

Salinity is another important criterion in site selection. Salty oysters are highly prized in the marketplace, but high salinities can lead to high oyster mortality from oyster drill and conch predation, and from diseases caused by parasitic protozoans such as Dermo (*Perkinsus marinus*) and, along the Atlantic coast, MSX (*Haplosporidium nelsoni*). However, salinities that are too low may foster infestations of hooked mussel (*Ishadium recurvum*). These mussels can smother a crop, reduce growth and meat yield, and increase labor and operating costs. Large schools of black drum (*Pogonias cromis*) and cow-nose rays can decimate a crop. Where they occur, growers may have to move the oyster crop to different areas.

Tidal current is important for producing quality oysters. Fast tidal current provides large amounts of algal food for fast oyster growth and high meat yield. Current, combined with salinity, helps to shape and flavor oysters, forming cupped and scalloped or lightly fluted shells. These attributes give oyster grounds name recognition in the marketplace.

The National Shellfish Sanitation Program (NSSP) addresses public health issues related to molluscan shellfish within the Interstate Shellfish Sanitation Conference (ISSC). Under this program, oyster growing waters are classified by state shellfish sanitation agencies (e.g., public health, resource management) as approved, restricted or prohibited for shellfishing. The classification is based on routine monitoring of fecal coliform bacteria and other water quality parameters, as well as shoreline point-source surveying. Areas that are conditionally approved are open for harvest during certain times of the year, depending on the rainfall and river discharge in a given watershed that may disperse pollutants and degrade bacterial water quality. State shellfish control authorities map these areas as open or closed to harvesting on a seasonal or annual basis. Growers must consult these maps before selecting a lease.

The distance from a lease to available seed is an important economic factor. If a lease is near wild seed grounds, transit costs (labor, maintenance and fuel) during seed planting and harvesting will be lower. The distance from the lease to the dock is becoming a greater factor with changing harvesting regulations. Site selection can affect management decisions and investment and operating costs.

Vessel and equipment

An oyster crop is left unprotected during extensive culture, so mortality can not be controlled. Large volumes of oyster seed must be planted to make an operation profitable, and this has influenced the types of vessels and equipment used.

In Louisiana, the leading oyster-producing state, the oyster "lugger" (Fig. 2) usually has a shallow-draft hull made of wood, steel or aluminum. The vessel is 50 to 60 feet long, 18 to 22 feet wide, is powered by a diesel engine, and is equipped with the latest navigation and communication instruments. A rear cabin

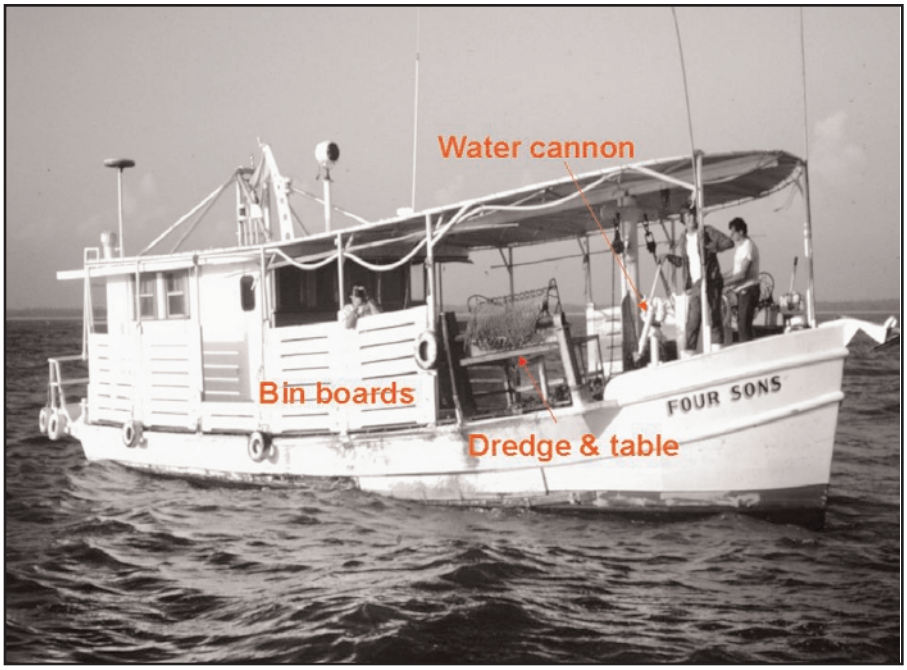

Figure 2. A Louisiana oyster "lugger."

comfortably boards a captain and two to four crew members, allowing some planting trips to last for weeks.

The gunwales are fitted with removable, stacked, bin-boards to hold large volumes of oysters on deck. A tarpaulin to shade the oysters from direct sunlight is required by health regulations. Many luggers are fitted with water cannons to spray the oysters overboard, and with two oyster dredges (e.g., 56-inch toothbar) (Fig. 3) that are fished simultaneously on each side of the vessel and alternately winched aboard and emptied. To reduce back strain during culling, the dredges may be emptied by hand onto a dredge table. The table is fitted with rollers to reduce friction and wear from the dredge chain on the hull and table. Some dredges have self-opening bags and are deployed and retrieved with hydraulic A-frames to reduce the need for deckhands. In some vessels, hydraulic (i.e., suction) dredges and on-board conveyors are used to harvest and move oysters. The type of harvesting and equipment used depends largely on what is permitted in each state.

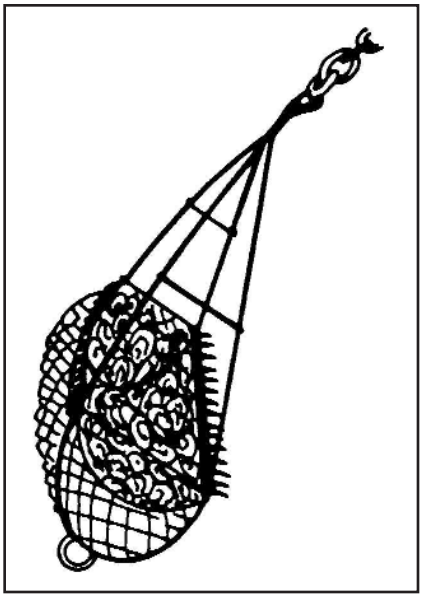

Figure 3. An oyster dredge. (From: The Oyster Fishery of the Gulf of Mexico, United States: A Regional Management Plan. Pub. No. 24, Gulf States Fisheries Commission, Ocean Springs, MS.)

Farming practices

Seed oysters may be harvested from public oyster reefs during a state's oyster season using gear permitted by the state. Or, seed can be harvested from farmers' own leases that naturally produce seed oysters. Planting usually occurs in the fall and early winter to reduce damage to the reefs during the summer, when oyster spawning and recruitment is greatest. The seed are planted by circling the lease while spraying the oysters overboard. The density of seed ranges from 42 to 110 oysters per square yard. It may take several weeks to transplant large amounts of seed—20 days or more to move 6,000 bushels.

Many farmers plant leases in several locations each year because the estuarine environment is unpredictable. If only one site is planted and estuarine conditions change substantially, the farmer may have to move his crop to another location with more favorable conditions.

When the oyster seed are moved to high saline leases, they grow rapidly and can reach market size within 6 to 9 months in the Gulf of Mexico region. While waiting for seed to grow to market size, farmers may harvest market-size oysters from the public oyster grounds or other leases. A return of 1.2 bushels of market oysters per 1 bushel of planted seed is a reasonable average return, yet returns of 0.4 to 4.0 bushels per bushel of seed have been reported.

The ideal oyster lease has enough cultch material to attract natural oyster production so that no seed planting is necessary. The farmer may use the lease as a source of seed for other leases and/or may harvest market-size oysters while the public oyster grounds are closed to harvesting.

Dockside prices are affected by a number of factors, including high and low oyster production cycles caused mainly by the opening and closing of states' public oyster grounds to harvesting. The more successful farmers are very attentive to market conditions and harvest their crops to meet specific market demands. Some leases may be left alone to grow larger oysters for processing (shucking), while others may be managed to produce smaller oysters for the half-shell trade. Good business

practices allow farmers to know and control their production costs, yet dockside price may or may not be high enough to produce a profit. Price is greatly affected by which market is being supplied. Farmers near large cities may receive high prices because consumer demand is great, but they may also have to contend with low water quality caused by point (e.g., sewage treatment facilities) and nonpoint (e.g., storm water runoff) discharges from such areas.

Permitting and licensing

Molluscan shellfish are the most regulated food in the United States. Public health controls are necessary to ensure that raw oysters, clams and mussels are harvested from estuarine waters uncontaminated by human pathogens. Shellfish sanitation programs in many states are funded by permit and license fees paid by oyster harvesters and processors. The management of the wild oyster fishery by individual states requires funding, usually obtained from the sale of licenses and other fees. Other costs growers may incur include annual lease rent and vessel licenses. In order to harvest from conditionally approved and restricted shellfish growing waters for depuration (i.e., purging shellfish of contaminants by exposing them to clean water), growers usually need special permits and performance or security bonds.

Regulations pertaining to the harvest of oysters and leasing of water bottoms differ from state to state. For more information, contact the appropriate state Marine Advisory/Extension agent or specialist through the National Sea Grant Office Web site: *(http://www.nsgo.seagrant.org/NationalSeaGrant.html).*

Suggested readings

The History, Present Condition, and Future of the Molluscan Fisheries of North and Central America and Europe, Volume 1: Atlantic and Gulf coasts. Edited by Clyde L. McKenzie, Jr., Victor G. Burrell, Jr., Aaron Rosenfield and Willis L. Hobart. U.S. Government Printing Office, 1997. 234 pp. (available at *http://bookstore.gpo.gov/cgi-bin/spcgate2001.cgi)*

Also see the Web sites of one of the five Regional Aquaculture Centers. The Southern Regional Aquaculture Center's Web site has direct links to them at: *http://www.msstate.edu/dept/srac/theracs.htm.*

SRAC fact sheets are reviewed annually by the Publications, Videos and Computer Software Steering Committee. Fact sheets are revised as new knowledge becomes available. Fact sheets that have not been revised are considered to reflect the current state of knowledge.

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