

Off-Bottom Culture of Oysters in the Gulf of Mexico

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Off-bottom oyster farming is the culture of oysters usually held in some type of mesh containers (basket, bag, cage, etc.) that are kept above the seafloor. Oysters grown this way are typically hatchery-reared single set oysters instead of clumps of oysters normally found in the wild. When properly operated, the containers provide protection from predators and eliminate burial in sediment, allowing oysters to be cultured in areas where oysters would not survive on the bottom (e.g., high salinity areas where predation rates are very high or where the substrate is too soft). Off-bottom oyster culture is distinct from public commercial and recreational fisheries on public oyster beds, traditional on-bottom oyster farming on private oyster grounds, oyster restoration efforts focused on establishing reefs for the various ecosystem services that they provide, and oyster gardening, which is non-commercial culturing of oysters, often to assist with restoration efforts.

While off-bottom culture of oysters is well established both globally and domestically on the Atlantic and Pacific coasts, this technique is relatively new to the Gulf of Mexico. In contrast, on-bottom culture is practiced throughout the region from Texas to Florida, and is the predominant method of production in Louisiana and Texas. On-bottom oyster farming in Gulf of Mexico typically relies on management of private oyster grounds, which includes putting cultch (oyster shell, limestone, etc.) down to harden the substrate and relies on recruitment of wild oysters via spat fall that attaches to the cultch. While on-bottom culture in the Gulf of Mexico



Figure 1. Oysters cultured along the Gulf coast using off-bottom methods (Photo by F. Scott Rikard).

allows for very high levels of production, production levels are also highly cyclical, subject, for example, to high levels of predation, dramatic salinity changes and/or years of poor recruitment. Because the oysters form irregular shapes, these oysters are primarily targeted for the shucked market.

We note that on-bottom culture using hatchery-reared spat on shell (often called remote set) supports very large industries in different regions (e.g., Washington, Virginia), including the production of oysters for the half-shell market. To date, this approach has not been adopted in the Gulf of Mexico. Given recent interest throughout the region, we focus here on off-bottom oyster farming.

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Why Culture Oysters Off-Bottom?

Off-bottom production systems take advantage of the availability of single cell algae called phytoplankton throughout the water column. Because farmers have more control over the farming practices, off-bottom production systems have the following potential advantages over other production methods like bottom culture:

- Promote faster growth by raising oysters in food-rich waters and controlling stocking density within a cage or bag;
- Increase survival by providing protection from predators and burial;
- Allow control of fouling (e.g., barnacles, overset oysters, mud worms);
- Improve shell shape and appearance, using various culture techniques; and
- Increase product consistency.

Oysters produced using off-bottom culture techniques are typically sold to the premium half-shell market by count. In contrast, traditional on-bottom production from either public oyster reefs or private oyster grounds yields very large quantities of oysters that tend to obtain lower prices. These oysters are sold by weight or volume, and are primarily intended for the shucked meat market. Off-bottom culture of oysters requires significant investments of time, labor and money, but has the potential to provide a consistent supply of premium quality oysters for the half-shell market.

Overcoming Barriers in the Gulf of Mexico

One of the primary barriers to success of off-bottom culture of oysters in the Gulf of Mexico has been the cost of manually cleaning oysters and culture gear of bio-fouling. Throughout the region, bio-fouling, including overset by wild oysters, can be extremely abundant and can occur throughout most of the year. Recently, several production methods using commercially available culture gear have been developed that allow for relatively easy and cost-effective control of fouling by allowing controlled exposure to air (forcing a simulated extended 'low tide') for various durations and frequencies. This technique has been demonstrated to minimize fouling on both oysters and gear.

Additionally, there was uncertainty about the willingness of regional consumers to pay higher prices for cultured oysters, in a marketplace where less expensive Gulf oysters are readily available. Efforts by pilot commercial operations in Alabama and Louisiana have demonstrated substantial market demand for branded, farm-raised Gulf



Figure 2. To control fouling, oysters and gear are flipped up onto the floats and allowed to air dry, before the oysters are returned to the water by flipping it back.

Coast oysters (where the oysters are tagged and marketed by the body of water where they were raised or the producer). These oysters have fetched prices competitive with oysters farmed in other regions of the US and substantially higher than generic 'Gulf oysters'. As a niche market, it will be critical to determine the degree of demand with the region, as well as in other regions.

The extended period of warm water in the region leads to a prolonged period of potentially poor condition of oysters as they go through their natural spawning cycle. Recent experiments with hatchery-produced native spawnless/sterile oysters (triploid oysters) have allowed the production of oysters with good meat quality during the summer months in the region. The availability of these spawnless oysters offer a distinct advantage to off-bottom oyster farming, given the routinely high survival. Alternatively, oyster farmers along the Gulf coast can opt to conduct seasonal harvests when condition is optimal, which is easier to accomplish than traditional methods because the oysters can be sorted by size prior to harvest.

Challenges and Considerations

There are numerous challenges and considerations for those considering off-bottom oyster farming along the Gulf coast.

Site Selection

Any oyster farm where oysters are harvested for market must be within waters that are, at a minimum, classified as "conditionally approved" for harvest (i.e., an area that is open for harvest except for specified circumstances, such as surpassing threshold rainfall levels) by the federal and local public health authorities working

together within each state. Furthermore, it is unlikely that permits will be obtained in areas where submerged aquatic vegetation (seagrass), natural oyster beds, or other protected natural resources are present. Based on the experience of commercial oyster farmers in Alabama and Louisiana, an ideal location should also provide conditions for 1) rapid oyster growth (e.g., salinities typically above 15 ppt), with most of the farmed oysters reaching market size within 12 to 15 months, and 2) high survival. These two requirements can be assessed before final site selection potentially by working with a local fisheries and aquaculture extension agent to assess typical growth and survival rates at sites under consideration.

In addition to average growth and survival, the risk of sporadic events that could slow growth, cause mortality or close harvest also need to be considered. This evaluation should be made based on long-term data for the sites under consideration.

Beyond these critical biological elements in site selection, logistical considerations should be taken into account, including protection from prevailing weather, travel distance, conflicts with other users, etc. In addition, the bottom type and the water depth should be considered because these will affect the choice of production gear and the security of the anchoring to hold the farm gear in place.

Finally, another recommended option for site selection is to choose a site near a successful farmer that is willing to share his or her experience.

Choice of Production Gear

The choice of production gear should be based on a combination of factors including investment and operating costs, profitability, desired farm layout, availability of equipment and replacement parts, ease of handling, durability, and likelihood of surviving severe weather. In waters along the Gulf Coast, gear that readily allows for the control of fouling by periodic air drying is highly recommended. Fouling has the potential to overwhelm an oyster farmer who would incur very high labor costs to control the fouling organisms. Gear choice should be based on realistic expectations of available labor. For example, some gear is best handled by at least two individuals.

Types of gear that have been or are being used in the Gulf of Mexico fall into the following categories: 1) Containers (cages, bags) resting on the bottom, usually elevated by short (3 inches to 12 inches) 'legs' or attached floats at the surface; 2) Suspended culture, including versions of the Australian long-line system where baskets are strung on a line that can be adjusted to different tidal

heights to control exposure time; and 3) Floating containers, (bags and cages arranged along anchored lines), including systems that can be a) flipped to lift the oysters and gear out of the water to allow air-drying to control fouling (Fig. 2) and b) sunk to avoid extreme weather and subsequently refloated. More detailed descriptions of gear types, including basic enterprise budgets, are included in the "Useful References" section of this document.

Permitting

Obtaining the proper state and federal permits is essential to establishing an oyster farm. Permitting is specific to each state and subject to change. State permitting agencies should be approached about current permitting requirements and guidelines, and may include marine fisheries, public health, environmental management, marine police, and the agency that regulates state submerged and tidal lands. At the federal level, permits will need to be obtained from the US Army Corps of Engineers and any other agencies as directed. We emphasize that permitting for this type of oyster culture will be substantially more complicated than the permitting for traditional bottom culture. The local fisheries and aquaculture extension agent can provide guidance on the necessary permits. In all cases, contacting permitting agencies early in the site selection process is advisable.

Security

Oyster farming requires an investment of time and money. Theft and vandalism could lead to significant losses of oysters and gear. By obtaining all necessary permits, oyster farmers should benefit from state enforcement of the farms' legal boundaries. Additional measures may be advisable, including security cameras or some sort of regular watch. Where oyster farms are located near other oyster farms or coastal businesses, there may be opportunities for business owners to assist each other with security.

Tropical Storm Preparedness

Any oyster farmer along the Gulf Coast must have a severe storms preparedness plan, triggered by specific levels of storm warning. Given the limited time for preparation and the difficulty in keeping oysters alive for lengthy durations out of the water, removing oysters and gear from the water is not a practical solution. Therefore, it is recommended that oysters and gear be well secured at or near the sea bottom prior to a storm's predicted arrival. Floating gear should be sunk to the bottom if possible and suspended gear should be lowered as close to the bottom as possible. As soon as practical after a storm event,

the farm site should be inspected for damage and gear returned to normal operating condition. Significant effort should be made to locate and remove any debris originating from the oyster farm.



Figure 3. To prepare for a tropical storm, these baskets could be lowered to the lowest clip and secured near the bottom.

Business Planning

It is strongly advised that anyone considering oyster farming put together a thorough business plan before investing significant time and/or money. Shellfish farming of any type involves significant risks that need to be understood and managed. Business planning allows:

- Determination of potential markets;
- Careful consideration and comparison of various options;
- Understanding of upfront and ongoing costs and the range of potential profits;
- Identifying risks and opportunities; and
- Obtaining loans or securing investment.

It is recommended that oyster farmers carefully track their costs, inventory, production and sales over time. A number of specialized software packages exist for this purpose. These records will also be useful for potential expansion and accounting purposes.

Marketing

Oyster harvesters must sell their product to a properly licensed wholesaler. Direct sales by harvesters are prohibited unless they have themselves become licensed wholesalers. Farmers should contact the state public health agency for current options and requirements. There are numerous federal requirements that are administered by state agencies.

Oyster farmers will likely want to sell by the piece, rather than by volume or weight. Note that each harvest unit will require a harvest tag with appropriate records kept of harvest (temperature, salinity, etc.), transport, and sales.

The primary market for off-bottom farm-raised oysters is the premium, half-shell market where oysters are sold live in their shells. This is a specialized, niche market and oyster farmers need to be aware that many oyster dealers may not have established customers for this product form. Though not able to sell directly unless specifically licensed, oyster farmers may want to encourage sales by speaking directly with restaurants and fish markets about their product. In other parts of the country, branding of oysters by location or farm name has worked well. These brands, or appellations, are like wines or specialized beers, and seem to appeal to a niche audience that is often willing to pay more for the product. Still, any oyster farmer on the Gulf Coast should recognize that this is a developing market in the southeastern U.S.

Conclusions

We have attempted to provide a very basic overview of the current status of off-bottom oyster farming within the Gulf of Mexico region, including consideration of potential, barriers and risks. While off-bottom oyster farming cannot replace traditional on-bottom culture within the region, it has shown promise as an additional source of oyster production for a niche market.

Useful Resources

Gear Descriptions

- Davis, J.E., B. Walton, G. Chaplin, F.S. Rikard, D.L. Swann and T. Hanson. 2012. Gulf Coast Off-Bottom Oyster Farming Gear Types: Adjustable Long-line System. Mississippi-Alabama Sea Grant Consortium Publication #12-013-01. 2 pp.
- Davis, J.E., B. Walton, G. Chaplin, F.S. Rikard, D.L. Swann and T. Hanson. 2012. Gulf Coast Off-Bottom Oyster Farming Gear Types: Floating Cage System. Mississippi-Alabama Sea Grant Consortium Publication #12-013-03. 2 pp.
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- Walton, B., J.E. Davis, G. Chaplin, F.S. Rikard, D.L. Swann and T. Hanson. 2012. Gulf Coast Off-Bottom Oyster

Farming Gear Types: Floating Bags. Mississippi-Alabama Sea Grant Consortium Publication #12-013-04. 2 pp.

Other Reading

Coddington-Ring, C. 2012. Evaluation of a Mechanical Grader for the Improvement of the Aquaculture Production of the Eastern Oyster, *Crassostrea virginica*, in the Northern Gulf of Mexico. Master's Thesis, Auburn University, Auburn, AL. 221 pp.

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Maxwell, V.J. and J.E. Supan 2010. Economic analysis of off-bottom oyster culture for triploid Eastern oyster, *Crassostrea virginica*, culture in Louisiana. *World Aquaculture Magazine* 41(1): 9-14.

Supan, J. 2002. Extensive culture of *Crassostrea virginica* in the Gulf of Mexico region. Southern Regional Aquaculture Center, SRAC Pub. No. 4300. 4 pp.

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