Eastern Oyster Production in Maine: A Basic Review

Sea Grant Maine

1865 THE UNIVERSITY OF MAINE Cooperative Extension

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Grading machine

Rack and bag culture

This presentation is principally concerned with production techniques and equipment, and oyster biology, and it is only a basic overview.

Issues such as site selection, permitting, marketing and business/educational resources are located elsewhere on the Maine Sea Grant website, and the reader is encouraged to review these other important topics.

Shellfish aquaculture is a complicated profession,
and a good deal of knowledge is needed in these other areas, to run a profitable and ecologically sustainable business.

A Rule of Thumb: Start! But Start Small…..

You have to start, because that's really the way to learn – through direct experience; watching your animals, knowing your site and market, and actually being a farmer.

However – you can learn as much from a small mistake
as you can from a big one…

Starter-sized oyster farm, with roughly 25 oyster bags: perhaps 5,000 oysters worth between $2500 and $3750. Investment for equipment, seed and permitting: approximately $700.

Maine has a great history of growing oysters, but the 'modern' age and techniques really took hold in the 70's, via programs run through the Univ. of Maine and the Darling Marine Center, by Dr. Herb Hidu.

Techniques have been refined since then, but the approach is generally the same: produce seed by hatcheries, move the young oysters ('spat' or 'seed') to nurseries, and then to growout sites, until the oysters are mature and ready for market.

The market is for premier-quality, half shell product, sold throughout the state, the region, the US and internationally.

Industry works closely with the research community, and the regulatory and management bodies, to address problems and to take advantage of opportunities.

In recent years, oyster culture has broadened throughout the state, and has attracted new entrants, many of whom come from marine trades, especially commercial fishermen. Income from aquaculture can supplement fishing, or can become a stand-alone business for those leaving the fishing industry.

Why the Eastern Oyster, *Crassostrea virginica*?

Eastern oysters are well accepted in the market, with prices to the Maine grower generally between $0.50 and $0.75 per piece. Maine has an exceptional reputation in the marketplace, for quality and taste.

Oysters are tolerant of a wide range of salinities and temperatures, and can tolerate a lot of handling; they are more 'forgiving' than many other shellfish species

The technology and husbandry techniques are well known, with help easily available for permitting and licenses, policy and regulation, extension, research and equipment supply.

The amount of investment needed to begin a farm is relatively small with this species, so fewer dollars can be spent on licensing, equipment and other needs.

On the Other Hand: Limitations and Considerations for Prospective Producers

As with any farming operation, there are limitations and issues that the prospective grower needs to keep in mind. These include:

- Correct siting for your farm has to meet the needs of the oysters: salinity, temperature, food availability, protection from predators, etc.

- The farm needs to be protected from damage by storms or other heavy weather.

- The farm should be in a place you can get to relatively easily, and you should be able to keep an eye on it from shore.

- The farm should have a minimal conflict with other users of the area, such as commercial fishing, boating, public facilities, or navigation, among others. It should also not interfere with the ability of the nearby landowners to get on and off their waterfront properties.

- Good water quality is a necessity, with minimal problems from harmful algal blooms.

- Above all, Aquaculture is Agriculture, which means that you will be a Farmer, and farming does carry risks.

Production Overview: What Will be Covered in this Presentation

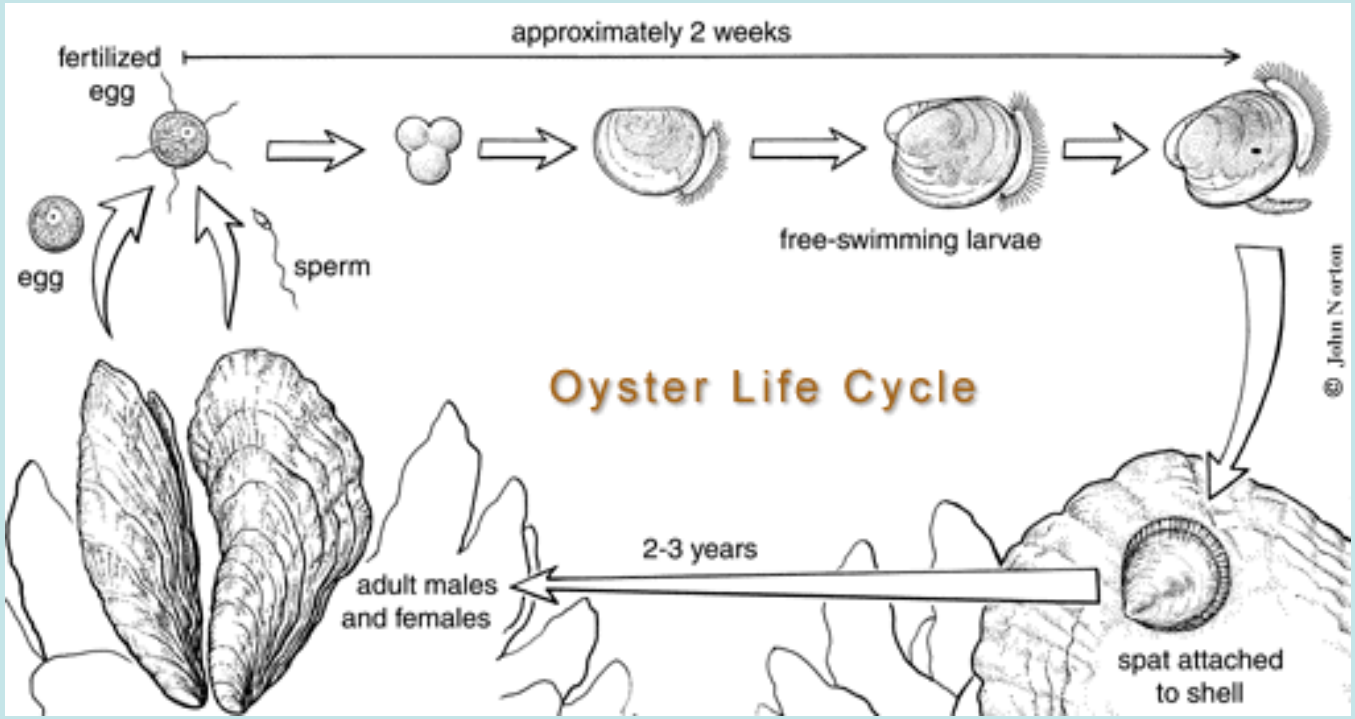
Life cycle and hatchery production of Eastern Oysters

Nursery operations
- Upwellers
- Floating trays

Growout production
- Bottom seeding
- Surface cages
- Bottom cages
- Rack and bag
- Longlines
- Raft system

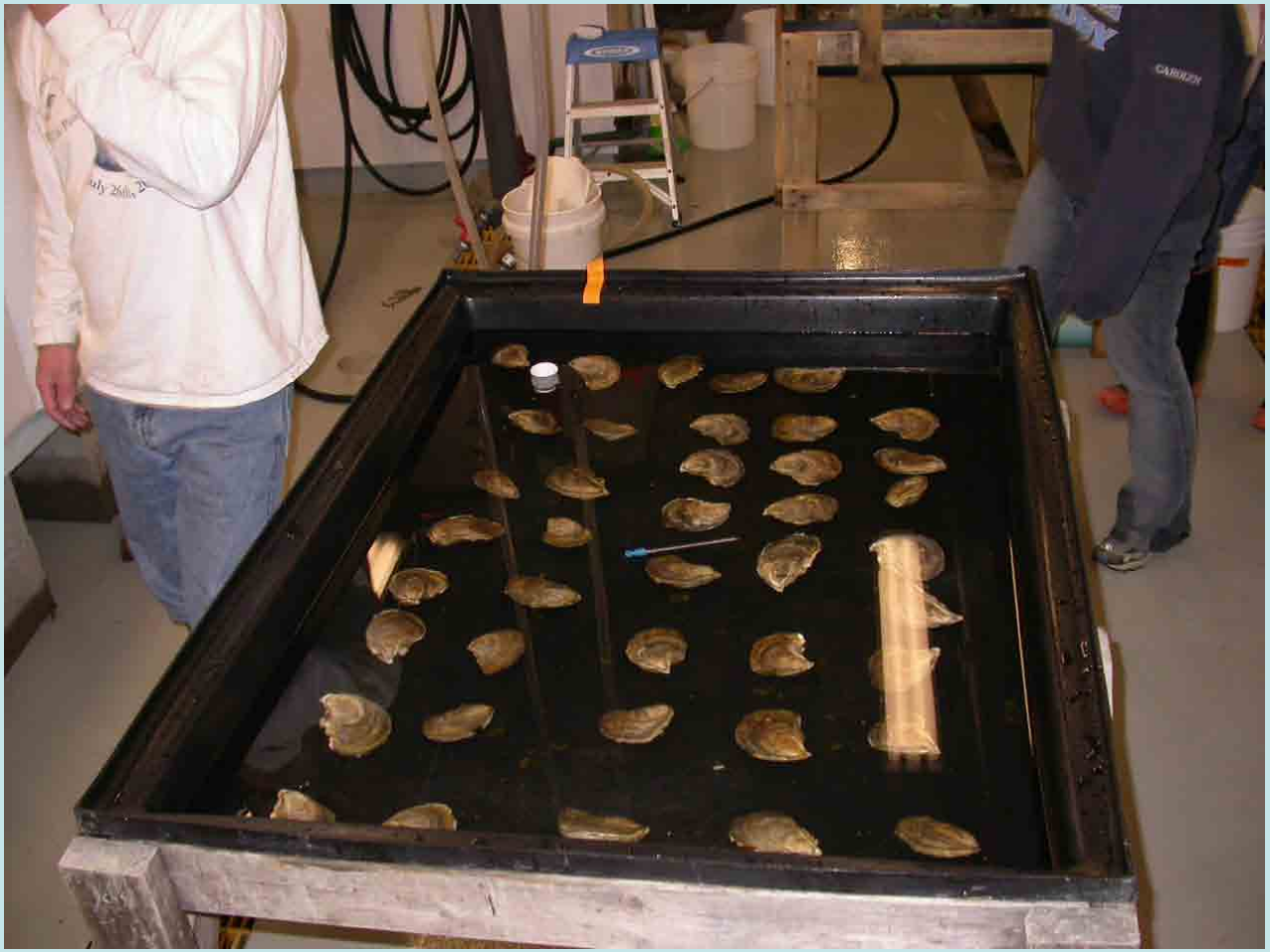
Harvesting
- Diving and Dragging
- Tongs and Rakes

Hatchery Production and the Oyster Life Cycle

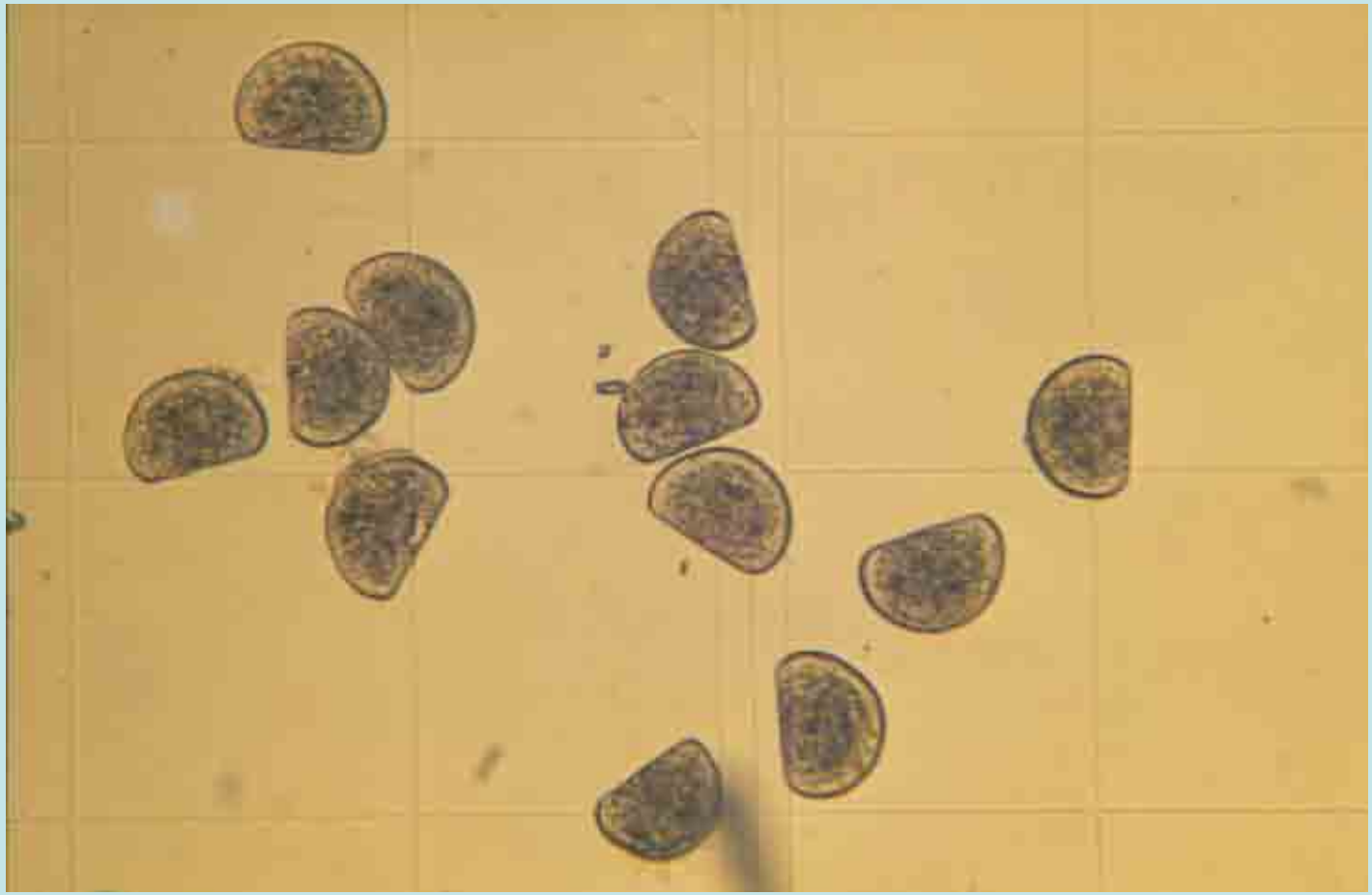


Sexes are separate in E. oysters, although they will switch from year to year. Most oysters start life off as males, then become females later on. Eggs and sperm are sent into the water column, where the fertilized egg goes through many stages of development. In 2-3 weeks, the oyster larva goes through a metamorphosis, and glues itself to a substrate. In the hatchery, the most common substrate is pulverized oyster shell, ground to about the size of one oyster larva (about 250microns, ¼ mm). The oyster cements itself to the small piece of oyster shell, and begins to grow. That way, the hatchery is able to produce 'single' oysters, for the half-shell trade.

In the hatchery, adult oysters are 'ripened' in mid-winter: kept at warm temperatures and fed plenty of algae, so that the gonads will develop and produce eggs and sperm.



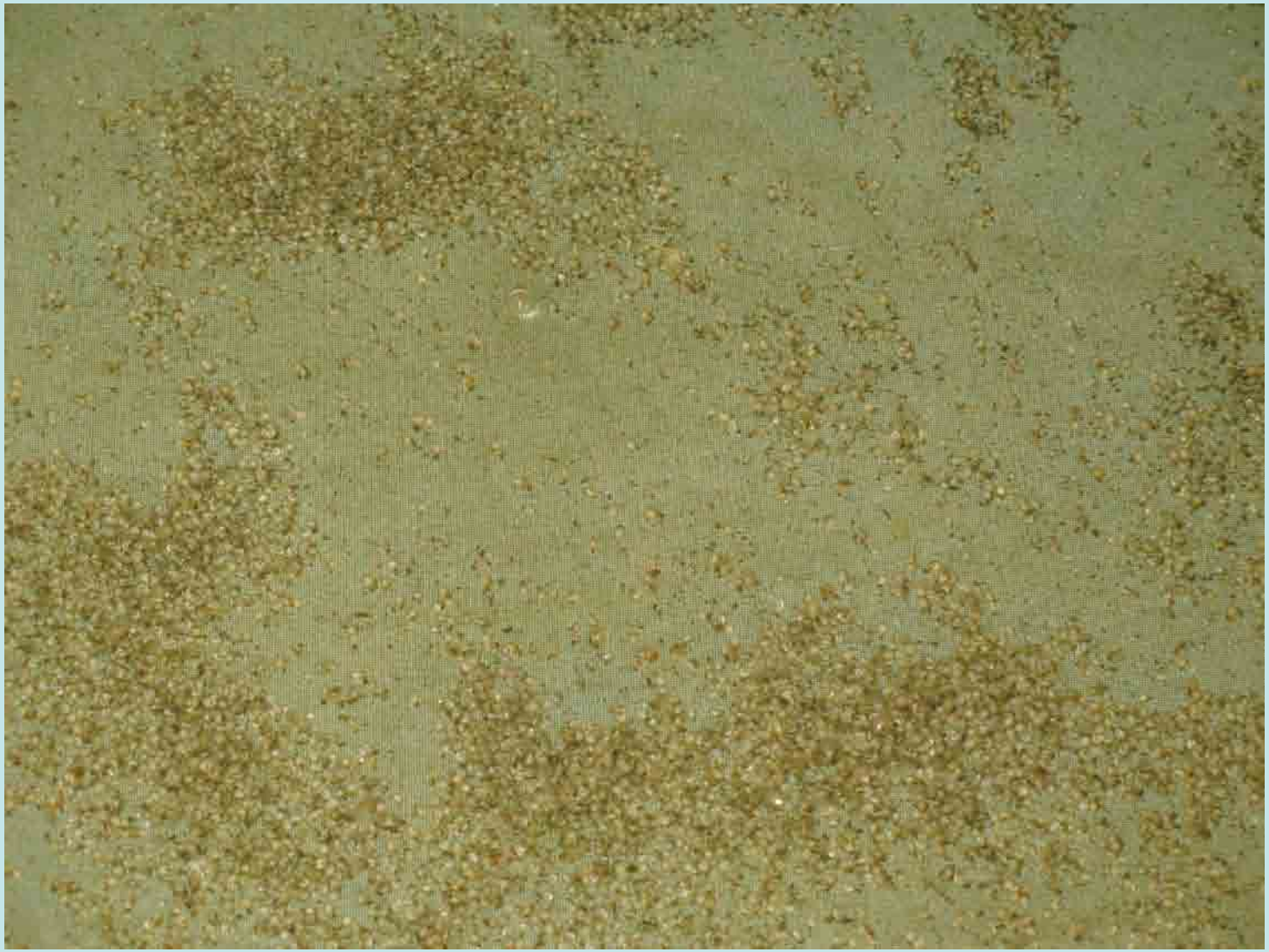
Hatchery operators usually induce the oysters to spawn by raising and lowering the water temperature. Spawning animals will be separated into individual containers, so that eggs and sperm can be mixed in the correct ratio; otherwise, over-fertilization can occur, resulting in deformed larvae.



A photo of 'D-hinge' larvae, approximately 125 microns (1/8th millimeter)

photo credit: Brixham Environmental Lab, UK

Oysters are filter feeders, and several species of marine algae are produced to feed the adults and young oysters. Hatcheries will grow several species of algae, so that the oysters get a balanced diet. Algal culture is very expensive in equipment and labor, and oysters eat a lot of algae, so hatcheries try hard to get their oysters out of the hatchery and into the natural environment as quickly as possible.



These look like grains of sand, but they are actually juvenile oysters, after they have gone through settlement and attached themselves to the shell chip.

The NURSERY:
Equipment and Husbandry

The goal of the nursery phase is to get your oysters to a size where they are easy to handle and can be brought into the growout phase. Like farmers anywhere, the oyster farmer should try for good growth, high survival, maximum quality, and maximum health of the crop.

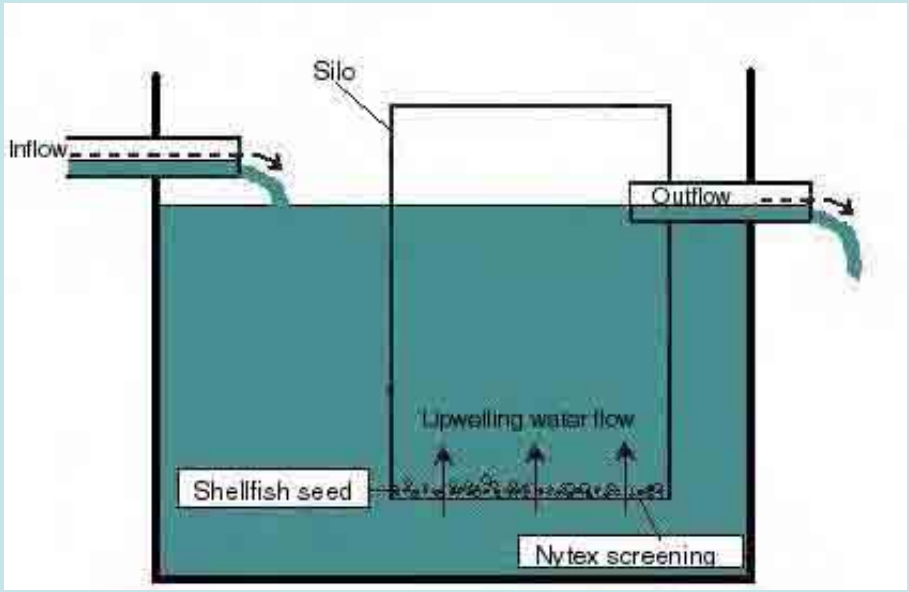
Good environmental conditions are critical – your crop and your livelihood depend on clean water.

Upwellers:

Upwellers are a common nursery approach, because they help the young oysters to grow quickly, and they are relatively easy to maintain, making them efficient and cost-effective.

The basic idea for an upweller is to build a container ('silo') having a mesh bottom; the oyster seed on the mesh, and water is directed up through the container. This allows each oyster to have access to a lot of food, and wastes are carried up and away.

Upwellers come in many shapes and sizes, but they should be placed in an area with good feed (algae) in the water, and they should be easily accessed for maintenance.



graphic: D. Leavitt

To learn more, several downloadable files for different upwellers are located on the Maine Sea Grant website: http://www.seagrant.umaine.edu/extension/shellfish-upweller

R. Curran photo

Upwellers: designed to move water and food past young shellfish, to foster rapid growth. An airlift upweller is at top right, and one driven by a de-icing pump at bottom right.

An example of a large upweller, driven by a paddle wheel. At bottom right, a silo shown upside down, with the mesh bottom.

Nursery Bags

Shellfish bags are also commonly used in the nursery phase. Floats are attached to keep them on the surface, where the water is warmest, and the food is abundant. Bags are flipped weekly for cleaning.

The bags are clipped to a longline on the surface – refer to the 'Building a Surface Longline' reference to see how to do this.

Important! Be careful that your oysters are at least twice as large as the mesh size of the bag – this will keep your oysters from falling through the mesh.

D. Andrews photos

Many times, oyster growers will purchase small seed (1.5 – 2.0 mm) and then grow them in the upweller until they are 10-15 mm or so. Then, they will be moved to a floating nursery, where they can be grown to a larger size.

Oysters can be grown to market size in floating bags, and producers should do a careful analysis of costs (equipment, labor, etc) vs. revenue to gauge the profitability of this approach.

Bottom Planting

Bottom planting is one method used by many oyster growers, mostly because of low cost, and higher efficiency.

However, the right site is essential (sediment, flow, temperature and feed, predators, fouling, etc.) and growers can expect to lose a significant portion of the crop to predation or other losses. Again, experimentation is useful, as is a careful economic analysis.

V. Steverlynck photo

Photos: Maine Oyster Farms

Oysters generally should be at least 1.5" in size before planting to the seabed. Stocking densities are usually between 8-15 oysters per square foot – this can be evaluated by diving after planting, and by estimating the number of oysters being planted vs. the area being covered. Use of GPS systems can be a great help in defining and recording the area being planted.

Bottom leases don't necessarily look like much, and have the benefit of low visual impact.

Harvesting:

Oysters are often harvested with a small drag, or by diver. Drags have the benefits of efficiency, but are harder on the oysters than diving. When harvesting, make sure that you check that your oysters are actually alive. Tap two oysters together – dead ones will make a hollow sound, and a little bit of a shake can tell you if the oyster meat is loose inside the shell.

Rakes and Tongs
Depending on your farm site, a bullrake or tongs might be a useful way to harvest your bottom-planted oysters

Ryan Curran photos

Other types of oyster growing equipment

There are MANY types of equipment designed to grow oysters and other shellfish. A few of these designs are included here, but the wise oyster farmer will review the options available, and consider which of them will work best. The approaches are offered as suggestions, not as official endorsements.

Bottom Cages:
These can come in many different designs and types. They cost more to build and maintain, but can support rapid growth and low mortality. This example is a 4-tier cage, one column wide, made of 1.5" coated wire mesh, but dimensions can vary.

The Oyster Gro System

This approach is new to Maine, and incorporates surface cage and bottom cage ideas. The units hold 6 shellfish bags usually, and can be set in the growing position (bags in the water) or the drying position (bags exposed to air), which helps control fouling.

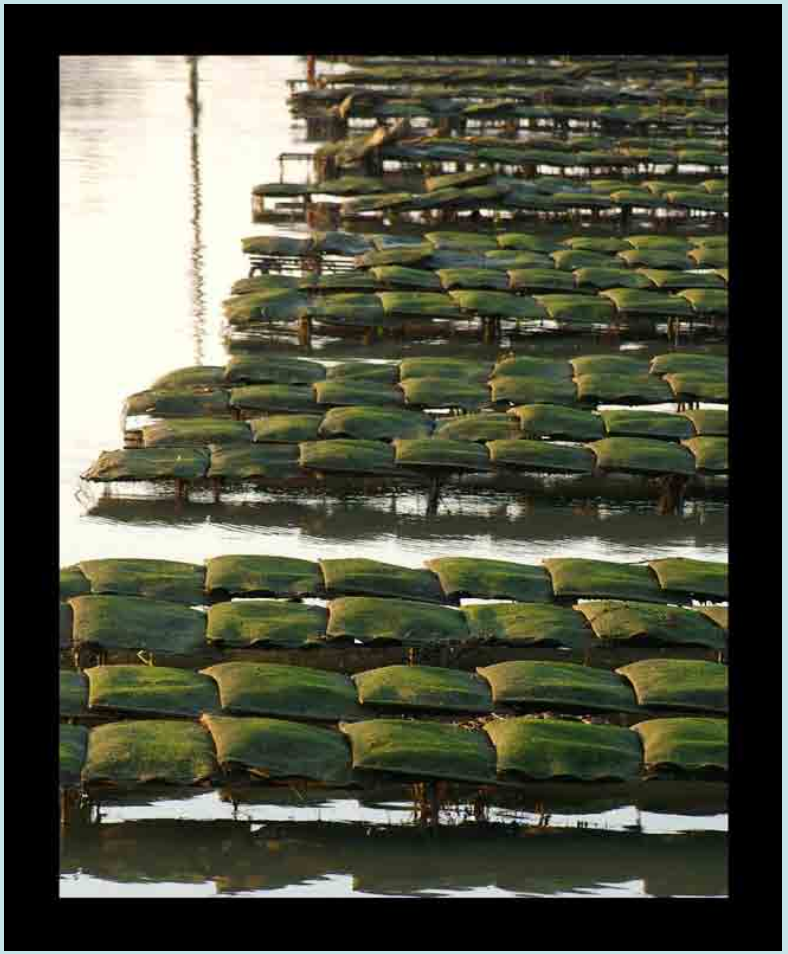
Caps in the floats can be removed, to sink the units to the seabed for overwintering.

The system is best for water depths up to about 20'.

A new system, the Oyster Ranch, is also on the market, operating on the same principles, but having only 4 bags in a cage, instead of 6.

Rack and Bag System – 'Oyster Tables'

The rack and bag system is broadly used in oyster culture in the US and elsewhere. Racks can be place in the intertidal zone or just below it, so the oyster bags get a regular air drying during each tide. The racks are usually pretty accessible too, so can be easy to service, and they are relatively low cost.



Longline Systems

These take advantage of posts that are set into the mud, with horizontal lines strung between them. Cages are then hung from the lines, so they move back and forth in the currents and waves. The lines can be raised and lowered, so that the cages spend more or less time out of water and exposed, to control fouling. Piers and pilings can be used in this way, and in some cases where winter ice is a problem, the whole farm can be pulled up and re-installed the next year.

Several versions of this approach are available.

photo: ronbuck.com

photo: Fukui N/A

Raft System

Using a floating structure such as a raft allows the producer to have a work platform as well as a means to suspend gear in the water column.

Depending on the growth and mortality rates for the oysters, and the market being filled, the extra costs for materials and maintenance may make this a profitable approach.

Cages of different types can be purchased, and some systems, such as pictured here, allow the producer to set the dimensions of the cages, and build each unit according to an individual specification.

Eastern oysters grown in a raft-based cage system

Remember: Start small….but Start!

For more information, please browse the other pages on the Maine Sea Grant website.

Other excellent resources for growing shellfish in Maine include:

Maine Dept. of Marine Resources
207.666.9500
http://www.maine.gov/dmr/aquaculture/index.htm

Maine Aquaculture Association
207.622.0136
www.maineaquaculture.com

Maine Aquaculture Innovation Center
207.581.2262
www.maineaquaculture.org

Downeast Institute for Applied Marine Science
(207) 497-5769
www.downeastinstitute.org