SEED OYSTERING

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INTRODUCTION

Oysters have been prized for their food and trade value since Native Americans harvested them in the rivers and bays of Long Island Sound (LIS). As colonials discovered that these tasty shellfish were a profitable resource and were relatively easy to harvest, overfishing soon led to the depletion of many of Connecticut's natural beds. In the mid-eighteenth century, conservation-minded legislators established the first regulations for oyster gathering. Volume limits (i.e. the "Two Bushel" Law) were set so that mature oysters would remain to replenish the beds and dredges were outlawed to decrease the fishing pressure. Oystermen were also prohibited from harvesting during the summer spawning months to allow young oysters time to grow (Kochiss 1974).

In order to stay in business after the depletion of many of the natural beds, Connecticut oystermen began experimenting with the cultivation of oysters. Artificial beds were prepared by laying out cultch (old oyster shells) or "shelling" to catch the set of free-swimming larvae. Because the natural beds did not produce market-size oysters anymore, some oystermen began to transplant smaller "seed" oysters to more productive grounds (Kochiss 1974). The oysters were collected and sold to seed buyers in Connecticut and other states, upon which they were distributed to private grounds and grown out to market size.

An essential ingredient in the success of Connecticut's oyster industry today is the practice of artificial cultivation of seed oysters. Seed oystermen are instrumental in maintaining healthy, productive oyster beds. Before the summer spawning season, oystermen must turn the shell over, removing the silt from the beds to keep the area open for consistent water and nutrient exchange (which allows for increased recruitment). After oyster larvae set onto cultch, oystermen begin to work the beds by thinning out crowded oysters and scattering the shells. This tends to expand the seedbeds (Brooks 1891). Oystermen also remove predators such as starfish, using mops which they drag over the beds to entangle the hungry predators. Seed oysters may be transplanted to different grounds several times to achieve optimum growth and quality.

A consistent supply of high-quality seed is vital to the industry. Three sources of oyster seed in Connecticut are: shellfish hatcheries (<10%), prepared (cultched) private beds (leases and grants) (~60%), and public natural beds– those areas harvested by the seed oystermen– (~30-40%).

Our state is now the third largest producer of oysters in the country, and the quality of Long Island Sound oysters is preferred worldwide. Connecticut has become the largest producer of seed oysters in the Northeast with approximately 200 seed oystermen involved in an industry worth $300,000-$700,000 annually (Connecticut Department of Agriculture, Bureau of Aquaculture).

ECOLOGY

The range of the Eastern or American oyster *(Crassostrea virginica)* includes the Atlantic coast of North America from the Gulf of Saint Lawrence to the Gulf of Mexico (Gosner 1978). In Connecticut, oysters are farmed in the Long Island Sound (LIS) estuary, a prime habitat for oysters. River and tidal currents meet in estuaries– creating conditions which are beneficial to the growth of oysters. The mixing of salt and fresh water (brackish water) produces a unique chemical environment which oysters prefer. The shifting of the tides disperses a variety of nutrients from rivers across the oyster beds. The shallow estuarine environment can also pose a threat to oyster populations at times. Extreme fluctuations in water temperature and salinity, as well as climate changes such as a drought, can adversely affect the health of oysters, increasing disease activity, starvation, and exposure.

Oysters are immobile bottom dwellers and must maintain a steady flow of water through their gills for respiration, feeding, and excretion. An adult oyster can circulate up to 30 quarts of water per hour (Kochiss 1974). In the process of filtering nutrients; however, oysters can be exposed to a variety of toxins such as pesticides, hydrocarbons,

heavy metals, and bacteria. These contaminants may have harmful effects on the shellfish as well as the consumer; however, since oysters have a tremendous filtering capability, they are able to cleanse themselves of toxins when transferred or "relayed" to clean water. Seed oystermen should always be aware of the possibility of contaminants entering their seedbeds. Local watersheds, marshes, and estuaries in close proximity to shellfish grounds may be a possible source of impurities and/or poor water quality.

LIFE HISTORY

Eastern oysters reach sexual maturity at a shell length of approximately 2.5 cm and reproduce every year thereafter. The average female can produce up to 100 million eggs per year (Gosner 1978). Eastern oysters spawn when water temperatures rise above 20°C (68°F). They do not incubate eggs, but instead extrude millions of eggs and sperm into the open water. The presence of reproductive cells in the water stimulates spawning by other oysters in close proximity, consequently improving the chances of fertilization.

Generally, the first or second oyster sets of the season are the most abundant and successful. Within a few hours of fertilization, the eggs develop into tiny free-swimming larvae, which undergo several stages of development (Figure 1). After developing a shell covering, the larvae form a very small circular organ called the velum. These larvae, now called veligers, grow cilia or hair around the velum, which permit them to swim vertically in the water column and also function to carry food particles to the mouth. Veligers only move horizontally as a result of drifting with the tides and wind-generated surface currents.

Dispersal, environmental conditions, and predation are the principle factors controlling survival of these veliger larvae. It may take two to three weeks for the larvae to settle to the bottom. They are vulnerable at this time to a number of planktonic predators. The survivors undergo a settling and fixation process called "spatfall" and as they set on a hard substrate, they are considered spat or seed. Seed oysters grow out for four to five years before attaining a marketable size.

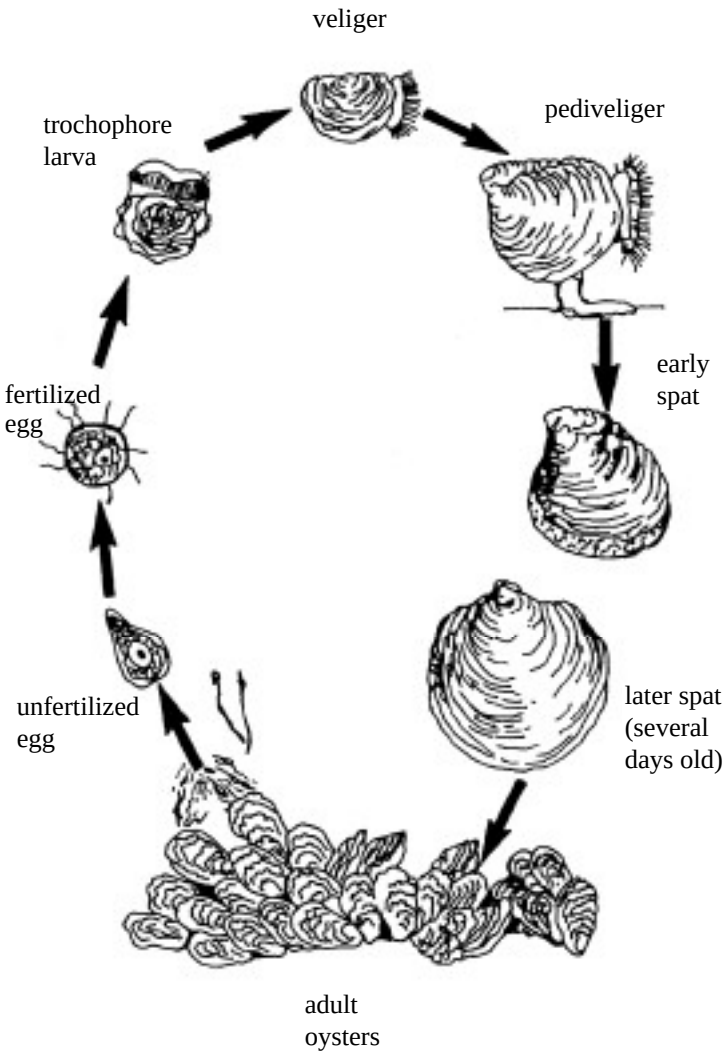

Figure 1. Life cycle of the Eastern oyster, *Crassostra virginica.* (SRAC 1994)

AQUACULTURE

Oyster culture, practiced earliest by the Chinese, Italians, and French, is one of the oldest types of mollusk culture (Kochiss 1974). The Romans collected spat on bunches of twigs suspended in the water column over their spawning beds (Brooks 1891). The French further developed this method by building elaborate rough board floors raised off the sea bottom which were covered with small twigs for collecting spat. This technique proved to be successful but extremely labor-intensive. As the years progressed, aquaculture methods became more sophisticated. Oyster culture developed out of necessity as the natural beds were rapidly depleted due to overfishing in

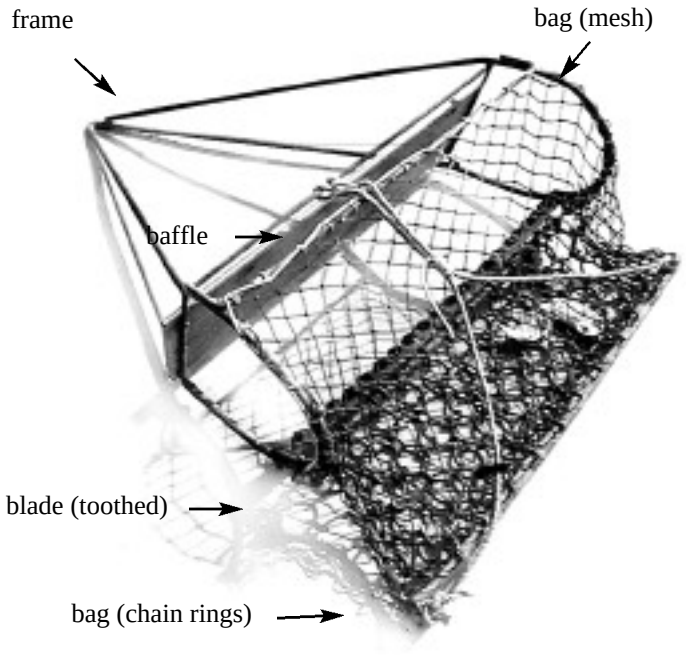

Figure 2. Seed oystering dredge.

the United States.

The first attempts at propagating oysters on the East Coast involved moving oysters from unproductive grounds to nutrient-rich waters that were beneficial to growth. When natural beds ceased to produce market-size oysters, oystermen began planting cultch to improve their grounds in order to catch spat. Seed oysters were dredged from the natural beds and transplanted to leased lots and grown to market size. For decades, this practice continued along the coast. In 1986, the Connecticut state legislature established a program to purchase cultch for distribution on the state-owned natural beds to promote oyster spawning. The program allowed oystermen to harvest seed from the beds and pay a 10% tax which entered into a revolving fund to purchase additional cultch (Connecticut Department of Agriculture, Bureau of Aquaculture). The program was so successful that it has been renewed every year since and many states have followed Connecticut's example.

Seed growers are able to purchase either wild seed (collected by seed oystermen) or hatchery-produced seed. Adult oysters can be induced to spawn in the laboratory using temperature cues, and two-week-old eyed larvae can be sold immediately to nursery growers. In a process called "remote setting", cultch is laid in a tank with aerated seawater and the larvae are distributed over the shells for settlement. The oysters remain in the tank for a few days after attaching to the cultch before they are transferred to a nursery area. In remote setting, the cultivator controls the settlement process; however, the larvae must be handled very carefully. The advantage to purchasing eyed-larvae is that they are sold at a cheaper price than seed because shipping costs are dramatically decreased without any shell to transport. Alternatively, hatchery oysters can be grown out to ?" to 1" in size on cultch and then are sold immediately for planting. Small seed can be grown in cages on the sediment (bottom culture), in trays (suspension culture) or in floating upwellers for weeks or even months before transplanting to leased grounds.

EQUIPMENT AND TECHNIQUES

The most important tool for seed oystermen is the dredge. A seed oystering dredge is similar to a large curved metal rake with a basket on the end, which is used to collect oysters (Figure 2). The basic seed dredge is constructed with a blade that is placed at a fixed angle (usually 80° to 100°) from the run of the bottom frame. The blade acts to gather the oysters from the bottom.

Basic blade design falls into two styles, *scrapers* ("no teeth"), or *toothed* blades. Scraper blades are constructed with ?" steel (2"-2 ?" wide) with a small bevel or taper cut on the bottom face. These types of blades are rather aggressive accumulators of bottom materials; however, it is desirable to scrape just the surface of the beds. Care should be taken when installing a straight blade in a dredge. If the blade is placed at too sharp an angle forward, the dredge will tend to fish "dirty" with the blade biting into the bottom too aggressively. Both blades have some similar fishing characteristics, but the toothed blade will almost always catch cleaner than a scraper blade. A toothed blade is installed so that as the angle of the frame relative to the bottom is changed, there will be an optimum angle at which the teeth will penetrate the bottom (Figure 3a). As the angle of the frame relative to the bottom decreases, the teeth can fall past a positive forward facing angle. If

too much line is let out, the teeth will actually be facing backward, not forward (Figure 3b). The dredge will probably just bounce or "chatter" on the bottom. A toothed blade creates a vertical space between the frame of the dredge and the bottom, and reduces the total contact area horizontally. This has the effect of keeping finer materials from being drafted into the bag.

Another feature of the dredge is the "cutting board" or baffle. It is rectangular in shape and made from either plywood or sheet metal. The baffle is positioned 10"-12" in front of the blade, at a slight backward angle relative to the bottom. This device has two functions: one is to exert downward pressure on the dredge, giving the dredge additional weight. This will help keep the dredge steady and allow it to fish on the bottom easier. Because of their light weight, seed dredges will tend to lift or "float" while being towed. The flow of water up and over a baffle will exert additional downward pressure. As the bag starts to fill with material, the balance of the dredge is changed. The baffle helps to keep the blade down. Without a baffle to counterweight the contents of the bag, the dredge may fill a little, lift the blade out of the bottom and stop fishing. The second function of the baffle is to create what is known as "draft". As the dredge is towed, a vacuum is created behind the board. This "draft" can lift material in front of the blade so that it is carried into the bag.

The dredge bag is composed of interlocking chain rings at least ?" in diameter. The size of the bag varies but it cannot exceed a capacity of 1 ? bushels. The weight of the seed dredges on the natural beds is restricted to 30 pounds or less. This law was enacted years ago by the State as a conservation measure. Because seed dredges are restricted by weight, care must be taken when making the chain bag– too long and the dredge blade will lift, causing the dredge to chatter or bounce, possibly damaging oysters. The balanced dredge should have a chain bag that is no longer than half the width of the blade. Keeping the bag within these parameters will allow the dredge to fish easier.

Before making any commitment as to how to fish the dredge, it is necessary to determine the nature of the bottom material. Seed dredges usually fish soft-mud or sand/shell bottoms, although there are many other bottom types such as shell-impacted mud, surface shell over mud, surface shell over sand, or gravel, clay, cobblestone, sandy mud, mud with stones, or gravel. A few trial tows, with experience, usually are enough to tell you what you are dealing with.

The speed and duration of the tow depends upon the bottom type. When dredging over soft sediments to collect seed, the boat must proceed at a slow rate heading into the current in order to avoid stirring up silt and particles which will smother the seed bed. Mud will fill the dredge quickly, especially if the dredge is towed too slowly or with too much "scope" of line. Tow speed over soft bottoms should be 2-3 knots. Shelled or hard bottoms can be fished slower (1-2 knots), but care should always be taken to make sure the dredge is fishing and not just plowing into the sediment. Tow patterns can vary considerably depending on the area. In the Housatonic River, currents usually dictate long straight tows into the current. However, there are many areas with weaker currents that allow for oval or circular tows to be made. This is an easier way to work a boat single-handedly when an individual has to haul the dredge, cull, shovel, and bag oysters.

When operating a dredge, a short, light drag is preferred. A full dredge when lifted can leave a pile of oysters on the bottom, which, if not harvested or distributed over the bed, will cause death by asphyxiation or a reduction in shell and meat quality for the oysters in the middle of the pile. The dredge should be dragged for a short amount of time until the bag is 2/3 full. If the bag is too full, it will damage the bottom and may crush the oysters. It takes practice to determine how full the bag is, especially in strong currents and deep water.

Care should be given as to how much line or "scope" is used when fishing the dredge. Generally the dredge should be let out with enough line so the bag can almost fill. A dredge that is fished too heavily will often cut through the surface layer of oysters. Typically, tow line is 3/8" or 3/4" (Dacron® rope), which has high tensile strength and is resistant to stretching when wet. The strength and design of the line holding the dredge is another important factor.

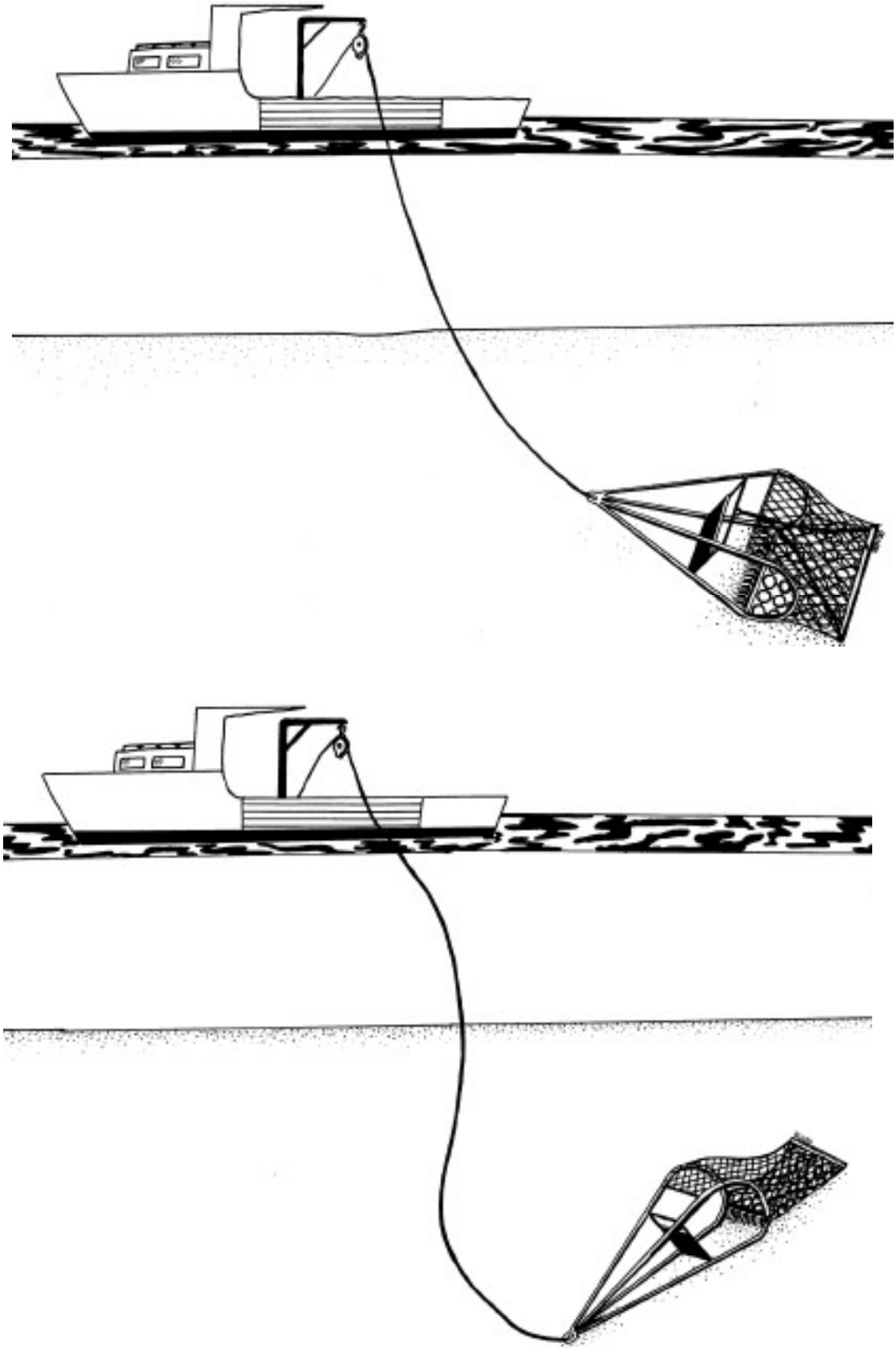

Figure 3. (a) Correct positioning of the dredge (teeth are facing forward at a positive angle) and (b) incorrect positioning of the seed dredge (teeth are facing backward).

The line must be strong enough for the capacity of the dredge and bag when hauling but also easy to work with. A variety of ropes may be utilized, but some types of rope may bend, forming a kite, in strong currents or with heavy loads. This will negatively effect the tow, creating drag. A 3/8" diameter rope is typical, but the line may have to be modified when working in deeper water or in stronger currents.

Typical seed oyster boats are 18-26 feet in length, flat-bottomed, and most are simply scow boats, (Figure 4) which are easy to operate in the shallow areas where seedbeds are located. Large amounts of seed and/or cultch can be transported on large scows. Outboard motors range 40-90 horsepower on average.

Dredges are usually situated so that the boat doesn't run over the tow line. This sometimes requires placement of an additional cleat along the midline of the boat. Vessels should be equipped with a working surface to protect the deck. Galvanized sheet metal is preferred, as it is inexpensive and long lasting. Sheet stainless steel is sometimes used as a shoveling surface; however, it is more expensive and very slippery when wet. Large #8 or #10 shovels are extremely useful, as they hold approximately $^1/_2$ bushels. Many boats are now equipped with lobster-pot haulers to aid in hauling seed dredges. These "wimpy winders" are extremely helpful when hauling dredges in deep water, since the sheaves (grooves on the pulley) of the hauler replaces hands on the lines. The haulers have a handle attached across the face of the sheave to crank in the line (Figure 3) usually $^3/_8$" or $^1/_2$" poly-blend line (Poly Plus® rope). This type of line is designed to work well on pot haulers.

The dredge is hauled up by hand, emptied on the deck, and thrown over again. As the beds are harvested, it is wise to cull (sort) the dead, deformed, or damaged oysters and remove them from the seed bed. Cultch should be removed from the beds and given to the local seed distributor. After the seed has been collected, it is moved to different lots or sold to licensed seed buyers who distribute the seed onto their grounds. The oysters are transplanted as needed so that a market-size product (Figure 5) with the desired shape, texture, and flavor results.

Figure 4. Seed oystering boat (scow).

Figure 5. Market-size oyster.

SHELLING

Cultch is spread either with water hoses on larger boats, or with a shovel on small boats. Shelling from a scow can be quite rewarding, the shell being planted in areas known to set with oysters. Often shallow water flats are most-effectively done this way. Dried shell is preferred, but often the only shell that gets planted is that which is culled from oystering. If large quantities are available, amounts of more than 1,000 bushels per acre are planted. It is not necessary to plant shell this heavily to get a good set, however. Often there is considerably less material which later produces many bushels of seed. Care should be taken when planting shell. If the area has a history of siltation, or if the bottom is too soft, then shelling in these areas may be less effective since the silt may smother young oysters, or the shell may simply sink out of sight in the mud. Generally, harder and more stable bottoms are preferred for shelling.

Seed dredges are also an effective means of silt removal from the beds. The dredging activity will kick up soft, fine material and put it into suspension in the water column. This is beneficial especially prior to shelling. If silt is present on the shells, settlement will be unsuccessful.

SHELLFISH SANITATION

The State of Connecticut Department of Agriculture, Bureau of Aquaculture, administers the *Connecticut Shellfish Program,* which was designed to: (1) assure safe shellfishing areas for commercial and recreational harvesting, (2) protect public health, and (3) maintain certification and compliance with the United States Food and Drug Administration's (FDA) National Shellfish Sanitation Program (NSSP). The Bureau performs coastal sanitary surveys and monitors shellfish growing areas in Long Island Sound.

Shellfish are classified in compliance with the NSSP, as determined by these surveys. Classifications are listed as *approved, conditional/approved, restricted, conditionally restricted, and prohibited* for shellfishing (Connecticut General Statutes Sec. 26-192e). Classifications can change over time and are dependent on environmental conditions. For instance, an *approved* area may become a *closed* area due to a seasonal restriction or storm event, which could result in contamination of the shellfish beds (Sec. 26-192e). Classifications and/or closures are determined by the State.

PUBLIC HEALTH ISSUES

The Connecticut shellfish industry prides itself in providing a quality product to the consumer. Although eating contaminated oysters can cause typhoid, hepatitis, and gastroenteritis, safety measures are taken in every part of the cultivation process to ensure safe shellfish production and prevent foodborne illnesses. The Connecticut Department of Agriculture, Bureau of Aquaculture, is responsible for the sanitary inspection and licensing of anyone involved in harvesting, processing, or shipping shellfish. Since seed oyster beds are located predominantly in areas closed to shellfishing– meaning that these oysters are not ready for human consumption– seed oystermen face certain health risks when working on the beds. Wearing gloves and heavy

rubber boots will protect the body from possible cuts and wounds. Proper hygiene, such as washing with an antibacterial soap after handling shellfish and gear, as well as treating any cut as a serious injury, will prevent the possibility of *Vibrio* bacterial infections. Get into the habit of keeping the boat and gear clean and washed down and sanitized after each harvest. Harvested seed oysters should be sold and transferred immediately to licensed buyers in order to prevent a health hazard.

STATE GUIDELINES

Seed oyster harvesting may be permitted (by the Connecticut Department of Agriculture) in areas classified as *conditional, restricted,* and *pro - hibited* as long as the licensee notifies the local enforcement agency of the intended start date, duration, and termination of the harvesting practice, and follows the quantity limits which may be established by the local shellfish commission (Sec. 26-192h). Harvesters must apply for the specific permits and/or licenses necessary for seed oyster harvesting to their local shellfish commission (some towns require a per bushel fee). Town licenses are available at the respective town halls. State license applications and record forms may be obtained from the Department of Agriculture, Bureau of Aquaculture, in Milford. The licensee must obtain the signatures of seed oyster buyers or companies they are selling to as part of the application. In addition, for seed oystermen working on state-owned natural beds that are seeded (cultch has been added), a license must be obtained. As part of this license, an accurate record of the harvested shellfish must be kept for a period of three years. A quarterly return accompanied by a tax payment equal to 10% of the retail value of the harvested oysters shall be made to the Commissioner of Revenue Services.

ETIQUETTE

Seed beds are located predominantly in areas close to shoreline communities. With increased boating traffic from commercial and recreational fishing, the noise level in these areas can be excessive, especially in the early hours at which fishermen are accustomed to working. Most people recognize the value of the commercial (shell) fishing industry, but some may oppose shellfishing activity if they feel that they are continually bothered by excessive operational noise. The bottom line is to respect the rights and property of others. Water is a shared resource that we should all enjoy!

PERMITS

Oystering Personal License.
($10.00 per individual)

This license allows the harvesting of seed oysters in State and Town natural beds. The person shall apply to the Commissioner of Agriculture (Sec 26-213).

Oyster Boat License.
($15.00 per boat)

This license is required for any boat involved in commercial shellfishing from any natural bed. A written application is required by the Commissioner of Agriculture (Sec. 26-212). Boats used for commercial purposes must also apply for a United States Coast Guard Boat Registration Permit. Some areas are harvested by handpicking along the shore at low tide and the proper permit is required.

Please note that license fees were valid upon pub - lication of this document, but are subject to change.

REGULATIONS

- ☐ Harvest season for the state natural beds is September 20 through July 20between sunrise and sunset.
- ☐ Certain areas may be classified off-limits due to contamination.
- ☐ A seed oystering license does not include the harvesting of clams, mussels, or scallops.

- ☐ Oyster seed may only be sold to individuals or companies with a license to purchase seed for specified relay or transplant.

- ☐ Out-of-state sales are restricted to oysters three inches or greater in length to individuals or companies licensed by the receiving state to relay or transplant that product.

- ☐ Chain bags must have rings more than ?" in diameter, and net bags must have mesh more than two inches from knot to knot (Sec. 26-217).

- ☐ Only hand power is to be used for hoisting or operating dredges or other implements for gathering oysters on natural beds. Hydraulics are prohibited. A dredge or contrivance shall not weigh more than 30 pounds, exclusive of net or bag, or with a bag capacity of more than one and one-half bushels (Sec. 26-215).

- ☐ Each bag or container must be marked with a *yellow tag* indicating that they were harvested from restricted-relay areas or better. The tag must include the license number, and the oysters must be relayed for a minimum of 14 consecutive days in water temperatures of 50°F (10°C) or greater. (*In areas designated as restricted-relay or better, no size restriction applies*).

- ☐ Each bag or container must be marked with a *red tag* indicating that they were harvested from prohibited areas or better; the tag must include the license number, and the oysters must be transplanted for a minimum of six months. (*In areas designated as prohibited, harvested seed oysters must be* 2 ? *inches or smaller*).

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FURTHER READING

The text in this fact sheet is a compilation of research and information from the following publications:

Bohn, R.E., D.W. Webster and D.W. Merritt. 1995. "Producing Oyster Seed by Remote Setting." Northeastern Regional Aquaculture Center Bulletin No. 220.

Brooks, W.K. 1891. *The Oyster*. The Johns Hopkins University Press, Baltimore, MD.

Burrell, V.G., Jr. 1985. "Oyster Culture." Pp. 235-273.In: *Crustacean and Mollusk Culture in the United States*. J.V. Huner and E.E. Brown, Eds. AVI Publishing Company Inc., Westport, CT.

Kochiss, J.M. 1974. *Oystering from New York to Boston*. Wesleyan University Press. Middletown, CT.

Gosner, K.L. 1978. *A Field Guide to the Atlantic Seashore*. Houghton Mifflin Company. Boston, MA.

Perkins, B.E. 1995. "Aquacultured Oyster Products." Southeastern Regional Aquaculture Publication No. 434.

Lorio, W.J. and S. Malone. 1994. "The cultivation of American oysters (*Crassostrea virginica*)." Southeastern Regional Aquaculture Center Publication No. 432.

Webster, D. and D. Merritt. 1985. "Purchasing Seed Oysters." Oyster Aquaculture Work book Series. Maryland Sea Grant Extension Publication No. UM-SG-MAP-85-02.

Webster, D. and D. Merritt. 1988. "Stabilizing Oyster Ground." Oyster Aquaculture Workbook Series. Maryland Sea Grant Extension Publication No. UM-SG-MAP-88-04.