



## Stabilizing Oyster Ground

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### Background

Oystermen have been planting and harvesting oysters in the Chesapeake Bay for nearly a century. Compared with public watermen who harvest oysters from the state's 295,000 acres of chartered public grounds, oyster planters currently lease some 10,000 acres of private Bay bottom, though several hundred thousand more acres have been designated by state surveys as barren. According to state law, these public leaseholds are limited to barren, or marginal bottom that does not produce oysters naturally. Consequently, planters must cultivate these grounds, usually by first laying down a "foundation," a firm substrate of cultch material to support the planting of spat, or small oysters.

Leased grounds must be laid with cultch to provide a surface that will prevent planted seed oysters from sinking into muddy bottoms or from being covered and suffocated by shifting sediments.

Since the 1970s the University of Maryland Sea Grant Extension Program has been assisting in development of the private oyster fishery in the Bay. Early efforts used hatchery-produced oyster spat in test plots in cooperation with private planters in order to evaluate growing success.

More recently, adaptation of the remote setting technology, first developed in the Pacific Northwest, has been a priority. Remote setting gives planters the opportunity to grow their own seed from hatchery-produced oyster larvae, thus giving them greater control while significantly reducing seed costs.

During these field tests, it has become clear that very little documentation is available on the types and success rates of using materials other than oyster shells for cultch. Nor has there been any concerted effort to assess the bearing strengths of different types of Bay bottom in order to document the volume of cultch required in particular regions.

While such studies still need to be done, "Stabilizing Oyster Ground" will familiarize you with options you must consider in choosing cultch, the amounts you must consider laying down and the maintenance of planted areas.

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### Cultch Materials

In Maryland, the primary cultch material has been oyster shell, though in other regions planters have used a variety of other cultch, including shells from the surf clam, soft clam and scallop. Of oyster shell, there are two types, “green” and “dredge.”

#### Green Shell

Packing house or “green shell” — the oyster shell left after the shucking process — is perfectly suited for stabilizing oyster bottom, and, after weathering, as cultch material for setting spat as well. However, with natural oyster production down in Maryland and with a great deal of the product shipped out of state for shucking, green shell has become increasingly scarce in recent years.

If you have a source of green shell for remote setting, you should contract for it early in the year — even to the extent of paying for it ahead of the time you plan on using it. Make no mistake, however: even if it is given to you, green shell will be expensive because of the transportation charges. Shell is not that heavy, but it is bulky. That bulk fills up a truck fast, and over-the-road trucking charges are high. The farther from the plant you are, the more cultch is going to cost.

#### Dredge Shell

Dredge shell is usually not as expensive to move because it is transported in large bulk loads. In fact, if you can get it at the same time that the State of Maryland is moving shell into your area for the public repletion program, you may be able to cut your costs significantly. It is always easier for the dredge contractor to add one more barge to the tow rather than to run a separate unit down the Bay towing one barge loaded for a planter.

The one factor that will increase the expense of dredge shell is the distance for some of the growers from the contractor's site on Kent Island. The price of shell is usually quoted by the cubic yard. Bear in mind that it takes about 16.7 Maryland oyster bushels per cubic yard of shell.

#### Alternative Types of Cultch

Other materials can be used for cultch and may be useful depending upon availability, price and ease of movement. You can consider gravel, slag or aggregate as well as the shells of the surf clam, quahog, soft clam, or scallop for use as cultch. Remember, price is the prime factor in their consideration.

### Bottom Types

It should be noted that many areas are good for oyster survival and growth but have bottom types that are poor for supporting oysters. Preliminary examination might lead one to believe that such areas are unsuitable for oyster farming. This may not be the case. Bottom stabilization is usually not done annually or even between every crop, although it may be advisable to reevaluate the condition of the bottom prior to reseeding and to add a small amount of cultch material if necessary. In most areas it is the initial placement of cultch that comprises the largest expense in stabilization. This initial application may provide an adequate growing bottom for many years with little or no additional shelling necessary. In such areas the costs associated with this initial stabilization could then be spread out over many successive crops.



*Oyster shell is placed overboard to stabilize bottom grounds and provide a firm substrate for planting oyster seed.*

Several factors should be considered when assessing potential oyster planting areas. The type of bottom material, the profile of those materials, their bearing strength, and the physical nature of the area should all be taken into account. Let's look at each of these.

### ***Fine Clay***

Many bottom sediments are composed of fine clay particles which produce substrates unsuitable for oyster farming. Very fine particle sizes will fail to support the oysters and cause them to smother and die.

### ***Mud***

Much of the area not classified as natural oyster bars in Chesapeake Bay has a mud bottom. The type and amount of mud on the planting area must be determined in order to calculate the volume of shell needed. Some types of mud are very suitable as substrate for oyster planting and some are not. Deep deposits of soft, soupy mud should be avoided because the amount of shell needed for stabilization and for growing oysters would be excessive and, very likely, not cost effective. Some muds are firm enough so that a smaller amount of shell is required for stabilization. These areas may be very useful for growing oysters.

### ***Buried Hard Substrate***

Shell, clay or stone overlaid with small amounts of soft sediment may be transformed into productive oyster ground with the addition of appropriate amounts of bottom preparation material.

### ***Sand***

Contrary to what one might imagine, sand makes a very poor oyster growing area unless it is bound together with some clay particles. The shifting nature of sand, especially where it is exposed to heavy wave or current action, may cause the spat to move or, in many cases, may quickly bury the animals and kill them. In most cases sandy areas should be avoided.

### ***Stone or Rock***

There are areas in the Bay which have stone or rocky bottom types. These are often very good areas in which to plant and grow oysters. They often produce very clean product which is in demand for the half-shell market. One factor to keep in mind is the amount of material which will have to be moved and culled through for the market product. Stones are heavy to move and will also tend to wear out harvest equipment rapidly. These costs may be insignificant, however, compared to the return for the product and in the minimal amounts of stabilization material necessary to maintain proper growing conditions.

### ***How Much Shell to Plant***

It is important to try to estimate how much cultch material you need to stabilize your grounds. Bottom sediments differ in the same river, let alone from river to river. You should consult with others in your area who have had experience in placing cultch overboard. They can be an important source of information for working out planting rates.

To begin with, use a sounding pole to poke and prod the bottom to determine what you have. Examining the bottom directly by SCUBA diving is not usually helpful, since visibility in the Bay is so poor throughout most of the year, though you might try it if you can find a time in the early spring when visibility may be greater.

The sounding pole will tell you how much mud is overlying the bottom, if there are any shells and how deep they are, what types of bottom materials are down there (sand, clay, mud, etc.) and where they run on your grounds. Make up a little plan of the bottom if you find different types of bottom sediment so that you can figure out which areas will be better than others to plant.

Talking to other planters in the area may help you to estimate out how much shell per acre to plant to stabilize the bottom. Some planters have placed as much as sixteen thousand bushels of shell to the acre to stabilize soft mud bottoms; others have

Table 1. Cost of stabilizing one acre of oyster ground (using Maryland oyster bushels\*)

| Depth (inches) | Cost per bushel emplaced (cents) |       |       |       |        |        |        |        |        |        |        |
|----------------|----------------------------------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|
|                | 25                               | 30    | 35    | 40    | 45     | 50     | 55     | 60     | 65     | 70     | 75     |
| 1              | 560                              | 672   | 784   | 896   | 1,008  | 1,120  | 1,232  | 1,344  | 1,456  | 1,568  | 1,680  |
| 2              | 1,120                            | 1,344 | 1,568 | 1,792 | 2,016  | 2,240  | 2,464  | 2,688  | 2,912  | 3,136  | 3,360  |
| 3              | 1,680                            | 2,016 | 2,352 | 2,688 | 3,024  | 3,360  | 3,696  | 4,032  | 4,368  | 4,704  | 5,040  |
| 4              | 2,240                            | 2,688 | 3,136 | 3,584 | 4,032  | 4,480  | 4,928  | 5,376  | 5,824  | 6,272  | 6,720  |
| 5              | 2,800                            | 3,360 | 3,920 | 4,480 | 5,040  | 5,600  | 6,160  | 6,720  | 7,280  | 7,840  | 8,400  |
| 6              | 3,360                            | 4,032 | 4,704 | 5,376 | 6,048  | 6,720  | 7,392  | 8,064  | 8,736  | 9,408  | 10,080 |
| 7              | 3,920                            | 4,704 | 5,488 | 6,272 | 7,056  | 7,840  | 8,624  | 9,408  | 10,192 | 10,976 | 11,760 |
| 8              | 4,480                            | 5,376 | 6,272 | 7,168 | 8,064  | 8,960  | 9,856  | 10,752 | 11,648 | 12,544 | 13,440 |
| 9              | 5,040                            | 6,048 | 7,056 | 8,064 | 9,072  | 10,080 | 11,088 | 12,096 | 13,104 | 14,112 | 15,120 |
| 10             | 5,600                            | 6,720 | 7,840 | 8,960 | 10,080 | 11,200 | 12,320 | 13,440 | 14,560 | 15,680 | 16,800 |

\*To convert US Standard bushel, multiply values in table by 1.019; for conversion to Virginia oyster bushel, multiply by .933.

used far less to make firmer bottoms productive. The expenditures for preparing the ground can be extremely high and may make the venture economically unsound. And remember, once having prepared the ground you still must pay to lay seed. As in any business, you need to have a financial plan before starting — more ventures fail because of poor financial work than any other cause.

Table 1 will give you an idea of the cost involved for stabilizing one acre of bottom with various depths of shell at delivered prices ranging between \$.25 to \$.75 per bushel. For instance, to calculate the cost of planting one acre with 4 inches of oyster shell costing \$.50 per bushel delivered, find the depth of shell and follow across the column until you get to the correct price. In this case the cost would be \$4,480 per acre. Multiply the number of acres to be planted by the cost per acre to obtain the figure for the cost of the project. If the price per bushel falls between the listed figures you can interpolate between them.

The table gives you the cost per acre of some number of inches of shell laid; it does not tell you the number of bushels to buy to achieve a particular number of inches. To find how many bushels of oysters to lay on one acre of ground to be covered with one inch of cultch, for example, use the conversion factors in Table 2.

It should be obvious from the tables that bottom stabilization may be an expensive component of any oyster

Table 2. Calculating Cultch Needs

There are 43,560 square feet in an acre. At 1 inch in depth this equals 6,272,640 cubic inches in an acre. Different bushels contain varying amounts of volume.

According to the US Bureau of Standards there are:

- 2,748 cubic inches in a standard bushel,
- 2,801 cubic inches in a Maryland oyster bushel, or
- 3,002 cubic inches in a Virginia oyster bushel.

Therefore an acre-inch of material, or one acre covered one inch deep is equal to:

- 2,283 US Standard bushels,
- 2,240 MD oyster bushels, or
- 2,089 VA oyster bushels.

If you were covering one acre of ground with five inches of cultch, for example, you would multiply one of these values by 5 to determine the total number of bushels needed. Using Maryland oyster bushels, you would multiply 2,240 by 5 to get 11,200 bushels. This is the number of bushels needed to stabilize one acre of ground requiring 5 inches of cultch. Multiply this number by the total number of acres to determine the total number of bushels needed for all your ground. Your calculations may be more complicated than this if, as is likely, some portions of your leasehold require more cultch than others.



culture operation. Based on potential return of harvested oysters, areas that require large amounts of shell may be uneconomical to convert into productive bottom. In addition, the cost of deploying shell on the bottom is highly variable. The prospective oyster planter must take these variables into consideration before attempting to convert any barren bottom into a successful oyster farm.

An important factor to consider is that the actual cost of shell stabilization is spread over the life of the project, that is, shell will not need to be deposited as deeply as the initial application each time planting is begun. Additionally, if funds for the project are borrowed from a lending institution, the interest over the growout period will have a definite effect on the overall cost. It may be possible for you to repay interest only during the growout cycle, such as a farmer or orchardist would do during the growout of their farm products. You would have to discuss this with your banker when negotiating financing for the project.

Please note that the costs in Table I are for shell stabilization rates only and do not include the cost of planting seed oysters.

### Maintaining Oyster Bottom

Grounds do not need to be spread with cultch each year. This expense is incurred only at the beginning of the initial planting process or in rehabilitating older grounds that have become overburdened with sediment or where the shells have sunk into the bottom. Over time, grounds that are not maintained will be covered with sediment, which can smother oysters and prevent a natural “strike” of spat.

In some areas rehabilitation need only occur infrequently since the bottom will be worked by planting and harvesting and the old cultch will remain fairly clean due to the dredging action. There are several methods you can consider in maintaining oyster bottom. The first, and most traditional method, is “overshelling” where a light volume of shell is deposited over the grounds after oysters are harvested. If the cultch material is located a far distance from your site, transportation costs may make this one of the most expensive options.

Another method is to use certain agricultural equipment to turn the shell over and clean it off. In some regions of the country, agricultural harrows have been used and are highly regarded. Harrows come in various sizes. They are dragged by boat over the grounds when the tidal velocity is highest; the sediments suspended are thus carried away. This is usually done over several tidal cycles. This method is similar to “bagless dredging” which has been used for many years. Harrowing, however, is thought superior to bagless dredging for maintaining oyster bottom.

In bagless dredging a towed dredge is used without the chain and mesh bag attached. In essence, the dredge serves as a rake with the teeth picking up shell on the bottom and allowing the sediment to be carried away with the tide. Dredges are not very wide, however, and the amount of bottom covered is limited. The gear is worked in a circular pattern.

### Limitations on Shell Planting Methods

Traditionally, planters have maintained their grounds by taking shell from a shucking house out to their lease on their boats. This would be done over time and slowly the leased grounds would build up a solid foundation. Later, as the business grew, larger boats such as skipjacks and buy boats were used to move large volumes of shell for planters. Nowadays, large barges can be seen moving up and down the Bay in the spring and summer loaded with dredged shell for placement on bars in the Chesapeake area.

While it is cheaper to move large amounts of shell at the same time, especially over long distances, many leases in Maryland are in waters less than ten feet deep, and sometimes less than six. These shallow waters are less accessible to vessels such as tugs and large barges which move heavy amounts of shell: they generally draw too much water. Unloading large barges onto smaller lighters is usually cost prohibitive. Until equipment designed to operate in these shallow areas is developed and constructed, obtaining inexpensive dredged shell could be a problem.

### Conclusion

Newly leased Bay bottom must be stabilized with cultch before seeding operations can begin. Judging which kind of cultch to use depends mainly on its cost, which is largely a function of the cost of transporting it to the leasehold. Once the leasehold is stabilized, cultch may also be needed occasionally for maintenance. How much cultch is needed for stabilization depends on characteristics of the bottom — its composition and firmness. Some bottom types may be uneconomical to plant. A careful plan should be undertaken in advance of cultch planting to estimate the amount of cultch needed and its cost.

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