*Oyster Spat Set on Cultch — 2015**

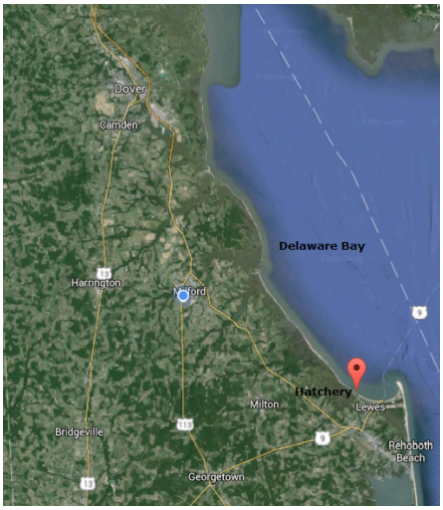
# Evaluation of Gear Type Used in Small Scale Remote Set Spat-on-Shell Production

## for Delaware's Oyster Gardening Program

Delaware State University SINCE 1891 | College of Agriculture, Science and Technology

# WHAT IS A REMOTE SET?

Remote setting is a technique used to produce oyster spat, and consists of two phases: (1) setting, where larvae attach to a setting material (cultch) such as oyster shell; and (2) a nursery period where newly set oysters (spat) are grown in protected areas until they are ready for planting (Bohn et al. 1995). This remote set study was conducted at the University of Delaware (UD) oyster hatchery, located in Lewes, DE at the mouth of the Broadkill River near Delaware Bay.




*Location of UD Oyster Hatchery in Lewes, DE*

## Why Do Remote Sets?

A remote set was performed once every two years in order to supply oysters for the Delaware Oyster Gardening Program. Once spat reached a size range of 5-10mm, the spat on shell were transferred to Taylor floats that were deployed at volunteers' docks throughout the Delaware Inland Bays.

Oyster gardening is the growing of oyster spat on shell to a larger size. These juvenile oysters are then planted into the riprap areas of the Delaware Inland Bays to help with oyster restoration of the bays, and to improve water quality.

For more information on the DE Oyster Gardening Program, visit https://www.inlandbays.org/projects-and-issues/all/oyster-gardening/.

# HOW TO GET STARTED

## Tank Preparation

Weathered shipping pallets are first placed in the bottom of the tank to act as a spacer between the bottom of the gear and the tank bottom, in order to better control sedimentation. A manifold of 1" PVC was used as a framework for the aeration system. Soaker hose was then attached to the framework with cable ties, and connected to a piston-based aerator. Cinder blocks were placed on top of the pallets throughout the tank to provide flat surfaces on which the oyster gear would be stacked.

*Aeration Design and Tank Preparation**

*Aeration Design**

## Cultch Preparation

Cultch preparation, containerization, and handling are labor- and time-intensive components of a remote set operation. In order to prepare the cultch we used in this study, sun bleached whole shucked oyster and clam shell and shell fragments were aged for one year, and then power washed to remove grit. The removal of grit is important, because it can prevent larvae from setting on the cultch.

*Power Washing Cultch to Remove Grit+*

## Cultch Containerization

Cultch is containerized in order to ease the transport of shell into and out of the tank, and to allow for sufficient water circulation in the tank which allows larvae to penetrate into all shell crevices (Bohn et al. 1995, Congrove et al. 2009). When adding cultch to a container, it is important that the shells are never deeper than 15 cm, as larvae are able to penetrate only the top 7.5cm-15cm layer of shell (Webster and Meritt 2011, Congrove et al. 2009). This avoids dead space and nonproductive areas in the tank. A tank with uniformly distributed shell should yield greater numbers of spat settlement. Containerization also aids in keeping the shells from compacting, and with the ability to clean the cultch. The type of container used will determine the labor-intensiveness of filling, handling, cleaning, and transporting. In this study, nylon bags, vinyl-coated wire baskets, and plastic aquaculture trays were used.




*1. Containerization of Cultch using Bags+*

*2. Containerization of Cultch using Trays**

*3. Cultch in Trays**

# HOW TO GET STARTED

## Placing Cultch in the Tank

Containerized cultch was placed into a 5,678 L (1,500 gal) tank in the setting tank. Water was pumped directly from the Broadkill River (near Roosevelt Inlet in Lewes, DE) at an approximate rate of 3,000 gallons/hour. Several days of water circulation allowed a biofilm (layers of bacterial colonies) to develop on cultch prior to larvae being added to the tank. Biofilm are thought to attract the larvae and lead to better attachment to the cultch (Weiner et al, 1989).




*1. Water Supply for System**

*2. Remote Set Tank System**

*3. Remote Set Tank with Oyster Gear+*

## Addition of Larvae

'Haskins NEH' disease resistant eyed oyster larvae (approximately 2 weeks old) were obtained from The Rutgers University Haskins Shellfish Research Laboratory (Port Norris, NJ), and added to an aerated culture tank (1.056M larvae were stocked in 2009, and 1M in 2011, 2013, and 2015). A dark tarp was placed over the tank to reduce sunlight, as it has been found in previous studies that the setting of *Crassostrea virginica* larvae is partially inhibited by light, and encouraged by darkness (Shaw et al, 1970).

Algae contained in inflowing water exclusively served as a food source for the larvae/spat. Larvae usually attach to the cultch and metamorphose into spat within 24 hours of being added to the tank. After a settlement period of 72 hours, water circulation to the tank was resumed.



*1. Addition of Oyster Larvae to Tank+*

*2. Oyster Larvae+*

# REMOTE SET DESIGNS

Remote sets were performed in 2009, 2011, 2013, and 2015.
Three different gear types were compared over the course of these remote set times.

*Cultch in Bags*[+]

## 2009

In 2009, shell was contained in vinyl diamond braided mesh bags (oyster netting) shell and placed on the bottom of the tank.

***Bags Containing Cultch in Tank***[+]

## 2011

In 2011, vinyl-mesh bags and 19 vinyl-coated wire baskets (14-gauge 25 mm square wire, 35.6 cm x 35.6 cm x 15.2 cm) were used to hold shell. The baskets were utilized to test their performance for use in a remote set.

***Cultch in Baskets and Bags***[+]

## 2013

In 2013, cultch was placed in stacked plastic aquaculture trays (Dark Sea Stackable Trays, 68.5cm x 68.5cm x 8.9cm) that were stacked on a center pole.

***Aquaculture Trays***[*]

## 2015

In 2015, instead of stacking trays on top of each other, a spacer was engineered by cutting 4 PVC tubes to 2.5 inches, then placed between trays at each of the four corners of each tray. Shell was placed into aquaculture trays with 2.5 inch PVC spacers placed between the trays. The 2015 design was established based on the success of the 2013 aquaculture tray set. Cultch was also placed into stacked baskets (35.6cm x35.6cm x 15.2cm). These baskets were stacked three high, and were placed in open areas in the tank between the side of the tank and the stacks of trays in order to maximize the amount of cultch available.

***Cultch in Aquaculture Trays with Spacers***[*]

***Aquaculture Tray Set-up***[*]

***Cultch in Baskets***[*]

# NURSERY PERIOD

After setting occurs, the spat go through a 4 week nursery period, where they are allowed to grow to 15mm in size before being distributed to oyster gardeners. During this time, the spat-on-shell are cleaned, and counted in order to determine the setting efficiency of the set.

## Cleaning the Tank

Weekly, the remote set tank was drained, and accumulated mud was rinsed from the cultch and the tank. This is important, as oysters can become covered with sediment, which hinders their ability to filter feed and obtain oxygen.

## Counting the Spat

In order to determine the success of the remote set, the number of spat settled on shell, dead spat, and scars (remains of once living spat) were counted from a uniform volume of oyster shells. After a nursery period of three weeks in the remote set tank, the spat were counted. Samples consisted of enough haphazardly selected shell to displace 2L of water to provide a normalized shell amount by volume (average number of shell was 149).

Samples of shell were collected from diverse locations within the tank to insure cultch would not come from one clustered location. Shells were inspected for the presence of live spat, dead spat, and scars (the remains of once live spat). Initially, shell was examined under a dissecting microscope (100x) to count spat. By the fifth week of the nursery period, the spat were large enough to be easily recognizable by the naked eye.



*1. Collecting Oyster Shells with Spats in the Basket**

*2. Measuring Cultch by Volumetric Displacement**

*Counting Spat with Dissecting Microscope**


*Counting Spat with the Naked Eye**

# WHAT WE LEARNED

Due to different uncontrolled variables that occurred for each remote set year (food availability, temperature, salinity, etc.), only differences in the number of spat settled for different gear types used during a single year can be compared. In 2011, cultch in mesh bags contained on average more spat than in the baskets. The use of baskets allowed greater side access to the cultch material it contained for larvae for settlement. When comparing the bags to the baskets in 2011, the settlement of the larvae was most probably affected by setting away from the light near the surface (where the baskets were located) and toward the darker areas of the tank (where the bags were located).

In 2013, the alternating design of filled and empty trays may have limited the access that larvae had to the cultch in the filled trays. In 2015, the use of stacked trays with PVC spacers allowed ample water flow between all shells, and is thought to have allowed larvae access to any shell in the trays. These trays had almost 18% more spat settlement than baskets also used in 2015. The surface area for each tray is 2.9 times greater than that of each basket, which may result in larvae finding cultch with greater ease to settle upon.

The setting efficiency for this study ranged from 17% to 28%, which is consistent with other remote set efficiency studies performed at Virginia Institute of Marine Science (VIMS) ranged from 0% to 24% (Congrove 2009) and 5% to 30% in (Parker et al. 2011). It was also over the 5% minimum amount that Congrove (2009) determined would provide economical remote set production of spat-on-shell.

It cannot be determined if the different gear utilized in this remote set study affected the estimated number of spat settled or setting efficiency. Because of this, the practicality of each gear type was examined. The criteria for this focused on labor intensiveness of the gear used (the input) in relation to the number of spat settled and the setting efficiency (the output). Bohn et al (1995) found that limiting the labor and effort put into the handling of cultch during a remote set is all-important to not negatively affecting profitability for the oyster grower.

***Spat on Shell — 2015**[*]*

Bags were determined to be very labor intensive to fill and handle. Because of the shape and diameter, they had a reduced surface area for larvae settlement. They were hard to keep clean (from mud deposition), and the shell became packed tight within the bags from stacking, which reduced the flow of water into them. It was not practical to remove them from the tank for cleaning.

Baskets were used in 2011 to elevate shell off the bottom, and were found to be easier to clean than the nylon bags. Baskets were used in 2015 to fill in "empty spaces" between the aquaculture trays. Rinsing the cultch in the baskets was labor intensive, as the baskets needed to be removed from the tank with a book hook, rinsed, and replaced.

In 2013, aquaculture trays were purchased and their ease of use in the remote set process evaluated. The trays were stacked one on top of another on a center pole. Seven poles were used, and each held up to 14 trays. In between each cultch-filled tray was an empty tray that was used as a spacer. Trays were able to be "fit" more easily into the tank than baskets, and were easier to handle. When PVC spacers were used between the trays in 2015, more trays of shell were able to be used. This design also better facilitated washing the shell to prevent the settlement of mud on the shell.

It was determined that stacked trays with PVC spacers worked best with this small scale set-up and will be used for future remote sets because they: 1) require less handling time than mesh bags and baskets, 2) distribute shell more uniformly within the tank, 3) are more environmentally friendly (used multiple sets/years), 4) made washing sediments off of the shells easier, and 5) yielded a high setting efficiency and average of spat set when compared to the other gear types.

## Further Information

**For more information on the Remote Set process, please refer to the following resources:**

- **Remote Setting Systems — University of Maryland Extension Oyster Aquaculture Technology Series AGNR-AO-11-05** (Don Webster and Don Meritt)
  https://extension.umd.edu/sites/default/files/_docs/programs/aquaculture/Remote%20Setting%20Systems.pdf

- **A Practical Manual for Remote Setting in Virginia — Virginia Fishery Resource Grant Program** (Michael S. Congrove, James A. Wesson, and Standish K. Allen, Jr.)
  http://web.vims.edu/adv/frg/FinalSpatonShell%20Project.pdf?svr=www

- **Producing Oyster Seed by Remote Setting — University of Maryland Cooperative Extension Service, Maryland Sea Grant Extension Program Oyster Aquaculture Factsheet UM-SG-MAP-95-03, and the Northeastern Regional Aquaculture Center, University of Massachusetts Dartmouth. NARC Bulletin No. 220** (Richard E. Bohn, Donald W. Webster, and Donald W. Meritt).
  http://www.mdsg.umd.edu/sites/default/files/files/95-03-RemoteSetting-2.pdf

**For detailed research results, please check out the following journal article:**

- **Ozbay G, Reckenbeil B, Phalen, L. 2020. Remote Set of Oyster (*Crassostrea virginica*) in Various Aquaculture Gear. ELSEVIER *Egyptian Journal of Aquatic Research* 46(4):397-403.**
  https://doi.org/10.1016/j.ejar.2020.09.004
  https://www.sciencedirect.com/science/article/pii/S1687428520300790

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