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Record Keeping for Shellfish Aquaculture

Gef Flimlin, Ocean County Marine Extension Agent

Shellfish Farming and Record Keeping

Since man first began eating clams and oysters, he has relied primarily on the harvest of wild resources. While the demand for shellfish has continued to grow, natural harvests have declined. In many areas, environmental conditions for growing shellfish remain favorable, but often recruitment or new sets in these areas are inadequate. Other shellfish grounds have been closed to harvest because of bacterial problems. For these reasons, many people who have traditionally depended on wild harvested shellfish have turned to aquaculture. Commercial baymen are particularly good candidates for shellfish farming because of their vast knowledge of water conditions. Shellfish farmers can purchase clam and oyster seed from a hatchery and plant it in areas where environmental conditions are favorable for growth and survival.

Like agricultural land farmers, successful shellfish culturists must record and maintain detailed records that will serve as guides to predict and review fluctuations on the farmed shellfish beds. Accurate record keeping goes beyond writing down observations and data. Culturists must analyze this information periodically and modify their operation appropriately to increase their profitability. Improved management practices translate into increased production and lower operating costs.

This fact sheet will provide the culturist with the tools to gather and collect the information needed to make improvements in culture operations.

Weather, Water and Site

Environmental factors, which affect the growth and survival rates of shellfish, can be categorized as weather, water and site. Recorded measurements of these changeable factors are the foundation of accurate record keeping. The more detailed the records, the more beneficial they become, and the greater chance for success.

Since shellfish are filter feeders, they depend on food and oxygen from the water for survival. Rainfall can affect salinity, and rapid air or water temperature fluctuations in a coastal area can have an immediate effect on the availability of phytoplankton (microscopic aquatic plants) in the water, which may directly or indirectly affect the shellfish.

Temperature variations can easily be measured with a thermometer. Salinity changes are measured with a refractometer or hydrometer. These can be purchased from a scientific or aquaculture supplier. Salinity can vary with depth, so samples should be collected from the depth where the shellfish are grown and not from surface water. Different species have preferred salinities, and extreme and rapid changes may cause problems.

Major storms and other significant weather events are also important. Certain precautions may be needed when one is predicted. Increased winds from a specific direction may affect tidal levels. Changes at the site should be monitored closely and recorded. Knowledge of tides and winds that might cause a lease site to become exposed to freezing during cold winter months is important. Precise wind speeds may not be necessary data, but records of strong variations and directions may prove to be valuable.

If a site is shallow and prone to freezing, the effects of ice-cover should be noted. Record its occurrence and effect on the shellfish, predator control devices and the site itself.

Water flow is fairly constant, and it must be understood. Since the water supplies shellfish with food and oxygen,

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it is important to understand the flow rate and the relative abundance of phytoplankton being delivered to the site. For instance, growth rates may become diminished in specific areas of a lease because of insufficient feed or flow, and adjustments in planting techniques or densities should be made. Areas with reduced flow should be planted lighter than sites where water flow provides an adequate supply. If crop growth is particularly poor, the site should be abandoned.

Availability and quality of food in the water can be difficult to measure. Seasonal color variation may indicate different species or quantity and type of algae present in the water. These observations should be recorded and compared against years when shellfish growth was especially good.

The Shellfish Crop: Seed to Harvest

Environmental records will have limited value unless kept in conjunction with shellfish growth. Growth and environmental data should be set up to allow quick comparisons through time. The goal is to correlate growth data with environmental information so production can be optimized. The condition of the shellfish should be noted and measured periodically. The most obvious biological parameters to note are growth and survival. Other important observations include predation, planting densities, differences in conditions of shellfish groups, and equipment failures or successes.

Observations, measurements, or counts should be recorded in writing as soon as possible. Do not trust your memory! Always keep a note pad, two soft lead (#2) pencils (pens are useless), and a clipboard covered with a clear sheet of plastic with you. Sheets provided in this publication can be photocopied on waterproof paper, or modified as needed and printed. Summarize important information obtained from the field into a computer or ledger later. A two ledger system has the benefit of providing a back-up version, which will be neater and easier to read in the future. Keep field data sheets and permanent records in separate locations. Precise and accurate facts recorded in a timely fashion yield better information for future decisions and action.

Counting the Crop

The number of clams or oysters in the system is particularly important to the grower. Numbers at initial planting, confirming purchases from a hatchery, sizing and grading, and inventory control are significant items for monitoring for increasing production. Growers must evaluate growth rates, mortality, numbers available for market, and total system production.

To facilitate inventory and management of the culture site, each bottom screen, mesh bag or stack of boxes should be identified with a small plastic tag. These plastic tags are available from livestock or aquaculture suppliers. The tags should contain spawn or batch information, the planting date and any other data which the grower feels necessary. An overall site plan kept at home with an additional field copy showing the location of each container or screen is essential.

Counting in the Nursery Phase

Since counting the total number of shellfish in a culture system is impractical, count small representative samples of the population. These sub-samples counts are then related to the total. To do this, the total volume occupied by the shellfish group must be determined. Any container can be used to do this but metric devices will make the calculations easier (1000 milliliters or ml = 1 liter). Several sizes of graduated cylinders should be purchased for use by the grower.

Examples:

1) Estimating the numbers of seed is more accurate if all are close to the same size. Therefore it is best to grade the seed before counting. Following a session of sieving shellfish seed, it is determined that the total volume of the largest seed in a small nursery system is 25 liters. The grower now wishes to know how many seed are in that group. A sub-sample of a specific number of seed is collected randomly from the total volume. It should be large enough to be representative of the whole population but small enough to be easily counted (50-150 shellfish). It is prudent to collect multiple samples of the same number (two to three) and average the results to arrive at a more reliable number.

Example: You count three groups of 125 seed. When the volume of each sample is measured in a graduated cylinder, they represent 25, 30, and 35 mls.

25 + 30 + 35 mls/sample ÷ 3 = average of 30 mls/125 seed

2) To determine the total count of seed, you divide the volume determined in the sub-sample into the total volume and multiply that value by the number of seed in the sub-sample. For instance, if the total volume of seed is 25 liters (25,000 ml), and 125 seed were counted in 30 ml., our calculations would be as follows:

25,000 ml. ÷ 30 ml. = 833.3

Daily Environment

Month of ________________

DATE	AIR TEMP	WATER TEMP	SALINITY	WIND SPEED/DIR	RAIN	OBSERVATIONS

Daily Field Sheet

Date ____________

Air Temperature ________ **Water Temperature** _________ **Salinity** __________

Growth and Survival Sheet

Date______________________

Location_________________________ **Tag/Plot ID**__________________
Planted (month/year) ____________ **Plot Size (l x w)** ___________________
Original Number Planted in Plot ____________________________________
Sampling Area (1ft² square box or ½m² ring __________________________
Last Sampled ____

# in Sample	# Live	# Dead	% Survival
1)			
2)			
3)			
4)			
Total			

Plot % Survival = (Plot size ÷ Sampling Area) x (Total % Survival)
Plot % Survival = __________________ **x** _______________
Plot % Survival = __________________**%**

Number Surviving = Plot % Survival x Original Number Planted in Plot
Number Surviving = ______________ **x** _________________
Number Surviving = ______________

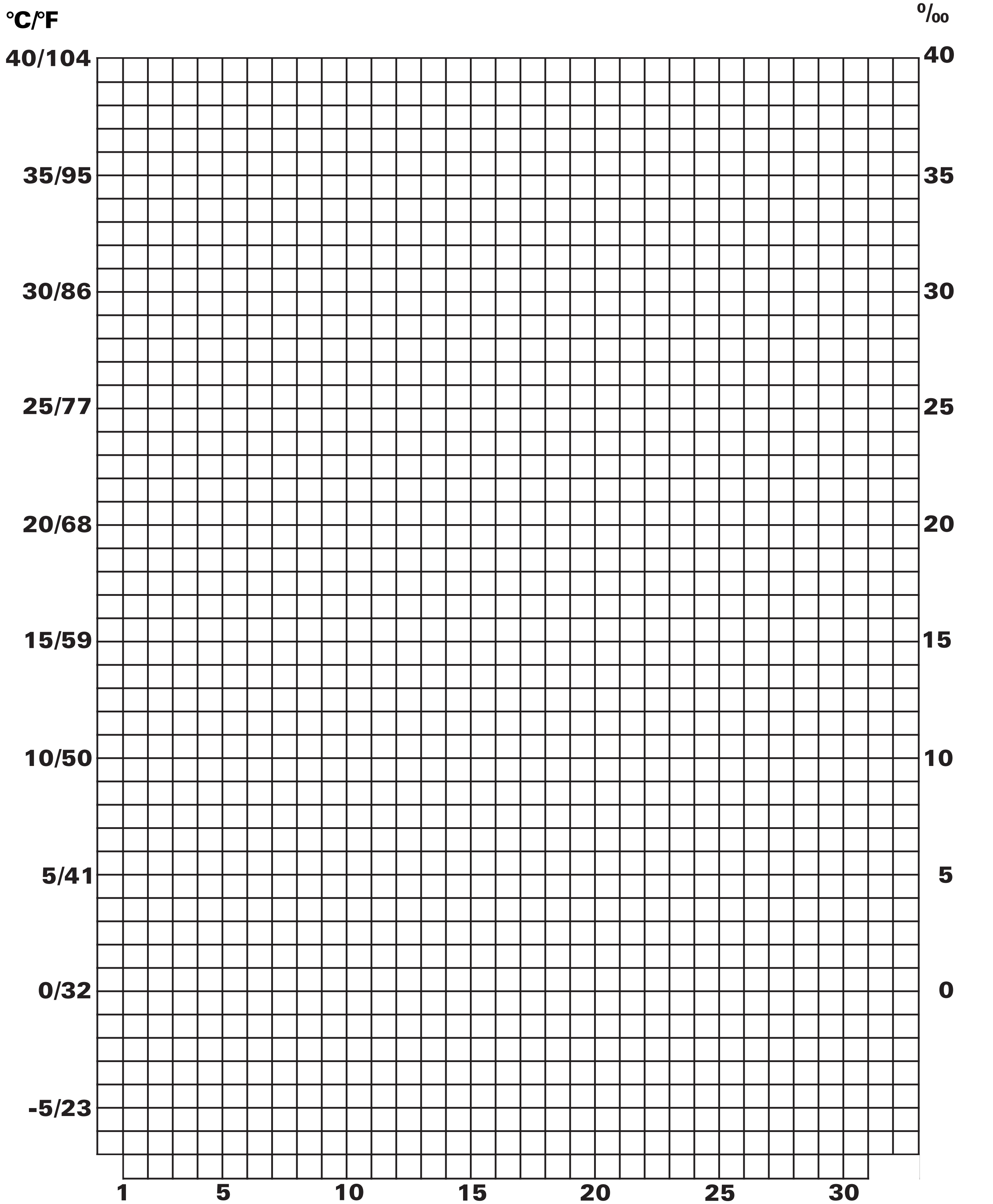
	Shellfish Length Measurements (mm)					
1)						
2)						
3)						
4)						

To determine average size of shellfish in plot, add all length measurments together and divide by total number of shellfish measured.

Average Size of Shellfish in Plot ___________________**mm**

Summary Chart

H_2O Temp. **Month ____________** **Salinity**



833.3 x 125 = 104,162 seed/25 liters

These numbers should be recorded in a journal or in a spread sheet so that they can be referred to at a later time to determine the success of your nursery system.

Counting in the Growout Phase

Large bottom plots can be measured in square yards, feet or meters.

1) Pick a small area for a sub-sample (e.g. one square foot or ½ square meter ring).

2) Remove all of the shellfish from that area, and count them. Record both live and dead.

3) Take several sub-samples from different areas of your planting, since shellfish will not be evenly distributed, and one sample may not be representative of the entire group. Both the sides and the middle of the plot should be sampled.

EXAMPLE: You have an average count of 46 shellfish/ft^2 from several samples obtained from a plot that is 20 x 14 feet.

1. An average of 46 seed/ft^2 is computed from sampling three individual spots.

2. Total Plot area is 20 x 14 = 280 sq. ft.

3. Therefore 46 seed/ft^2 x 280 ft^2 = approximately 12,880 seed in the plot.

Percent Survival/Percent Mortality

Survival can be determined by relating past or original counts to the present count. By using the formula shown on the Growth and Survival Sheet, the number of shellfish alive since the previous sampling can be determined. Percent survival from the initial planting to the present can be derived by comparing initial stocking numbers with those just obtained. Any marked decrease in survival indicates a problem which needs immediate attention. Although absolute survival cannot be determined until final harvest, periodic estimates based on a sample count will facilitate management decisions.

Percent Survival can be calculated by taking random samples (scoop a cup through a portion of the plot, or use the square foot method) and count the number of live shellfish in the sample and compare against the total to get a percent survival. Divide the total number by the number dead in the sample to get the percent mortality.

Example 1: 125 seed were taken in a sample. 10 were dead (therefore 115 were alive).

125 ÷ 10 = 12.5% mortality (or conversely 87.5% survival).

Several samples should be collected to get an average.

Example 2: Referring to the example for counting in the field growout. An average of 46 clams was calculated per ft^2. Initial stocking was 15,000 seed per plot (280 ft^2) or about 54/ft^2. Therefore...

46 ÷ 54 = 85% survival (15% mortality)

Growth and Maintenance

The growth rate of shellfish between sampling periods is very important. When taking measurements (volumes, length, thickness, etc.), it is important to be consistent and to record all units. Notation of growth lines should be recorded to assess overall health and vigor of the crop. The average size of the shellfish in growout can be noted periodically by sampling and measuring with a ruler or caliper. Similar comparisons can be done in the nursery by recording changes in count per volume over time. Comparing these rates for different sites, years, or seed source can optimize future decisions.

Since maximizing growth is the ultimate goal, it is important to take advantage of the best growing conditions. Proper cleaning, maintenance, or sorting of shellfish, removal of fouling organisms, or elimination of predators are essential practices. Dead shellfish should be carefully inspected for signs of predation (e.g.. drill holes, crab or starfish damage) and removed from the group immediately so as to reduce the potential for infection of the rest of the crop. Recording differential counts and making observations on the presence of potential predators is an essential management practice. The less the shellfish are disturbed, the better. However, this should not be interpreted as a hands-off approach to shellfish culture. More shellfish culturists have gone out of business from lack of care, than from too much!

Forms and Charts

The following formats and forms are provided for recording your data.

(1) The Daily Environment Chart (insert 1) is used to record important weather data. Severe weather changes are especially important to note, and can be recorded even if you are not working on your site. Be sure to record the time of day and as much detail as possible when recording information for your shellfish plot.

(2) The Field Sheet (insert 2). Data from different shellfish groups can be recorded on this one sheet (e.g.. plot #3, nursery boxes, product storage area, etc.). Segregation and identification of different groups is absolutely necessary for this operation. The aforementioned plastic inventory tags are most helpful here.

The top portion of the sheet is for environmental data that should be taken first and also transcribed onto the Environmental Chart. Record each group as noted on the tag, the activity being done (cleaning, sieving, sampling, harvesting, etc.), and conditions of the shellfish and equipment (e.g.. white lips, heavy algae cover, ripped screen, etc). The miscellaneous section is for any other important observations. Since these sheets are used in the field, the use of waterproof paper is a plus.

(3) The Growth and Survival Sheet (insert 3) can be completed while the field work is being done or after. Use one sheet for each bottom plot examined.

The most important initial piece of data here is the tag or plot number. This must be recorded to keep continuity. If new shellfish groups are made by combining two or more size groups, containers or plots, note it, so that past data information will be readily available for the next sample period.

Include plot size for growout areas so that extrapolations can be made from samplings. The sampler size refers to the unit from which the sample is taken, e.g.. 1 ft^2 or ½m^2, etc. This should correspond to the units used for noting plot size. Sometimes a ½m^2 ring is used for sampling, and so the plot size should be recorded in square meters.

Sample in various plots so that the averages from different plots will be representative of the site and the planting. Length measurements could also be done and recorded. From these measurements, information about growth rates and timing of harvest can be considered.

(4) The Summary Sheet (insert 4) is used to identify and characterize trends. It can be used as both an observation sheet and graph. Water temperature and salinity data can be plotted on a graph in two different colors for easy comparison. Both salinity and temperature numbers are entered from left to right. Indicate the month at the top of the page and plot the information on the vertical line, indicating the appropriate date shown at the bottom.

Feel free to photocopy or modify these sheets for your individual situation.

More Information

A computer software program called "CLAMFARM" which was designed for recordkeeping for clam culturists is a good tool to bring all this information together. It can be ordered from Rutgers Cooperative Extension of Ocean County.

Additional information about these techniques for measuring, sources of equipment or the software program can be received from:

Gef Flimlin
Marine Extension Agent
Rutgers Cooperative Extension of Ocean County
1623 Whitesville Road
Toms River, New Jersey 08755
Phone: (732)349-1152, Fax: (732)505-8941
flimlin@aesop.rutgers.edu

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