Handbook of Mussel Farm Site Monitoring
Enhancing Seed Production

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Introduction

An important part of operating any mussel farm is careful site monitoring. Each site is unique with ever changing oceanographic and environmental conditions. Regular monitoring of site conditions and their impact on the mussel lifecycle can aid the grower significantly in running farm activities. This handbook is a guide to site monitoring methods related to mussel seed collection, a critical step in the mussel production cycle. Without a reliable seed source, annual farm production may fluctuate and/or make it difficult for expansion. Through regular meat yield and larval/spatfall analysis, a grower can better predict mussel spawning, larval growth and timing of settlement, optimum collector locations and deployment times, plus many other benefits, such as those shown below.

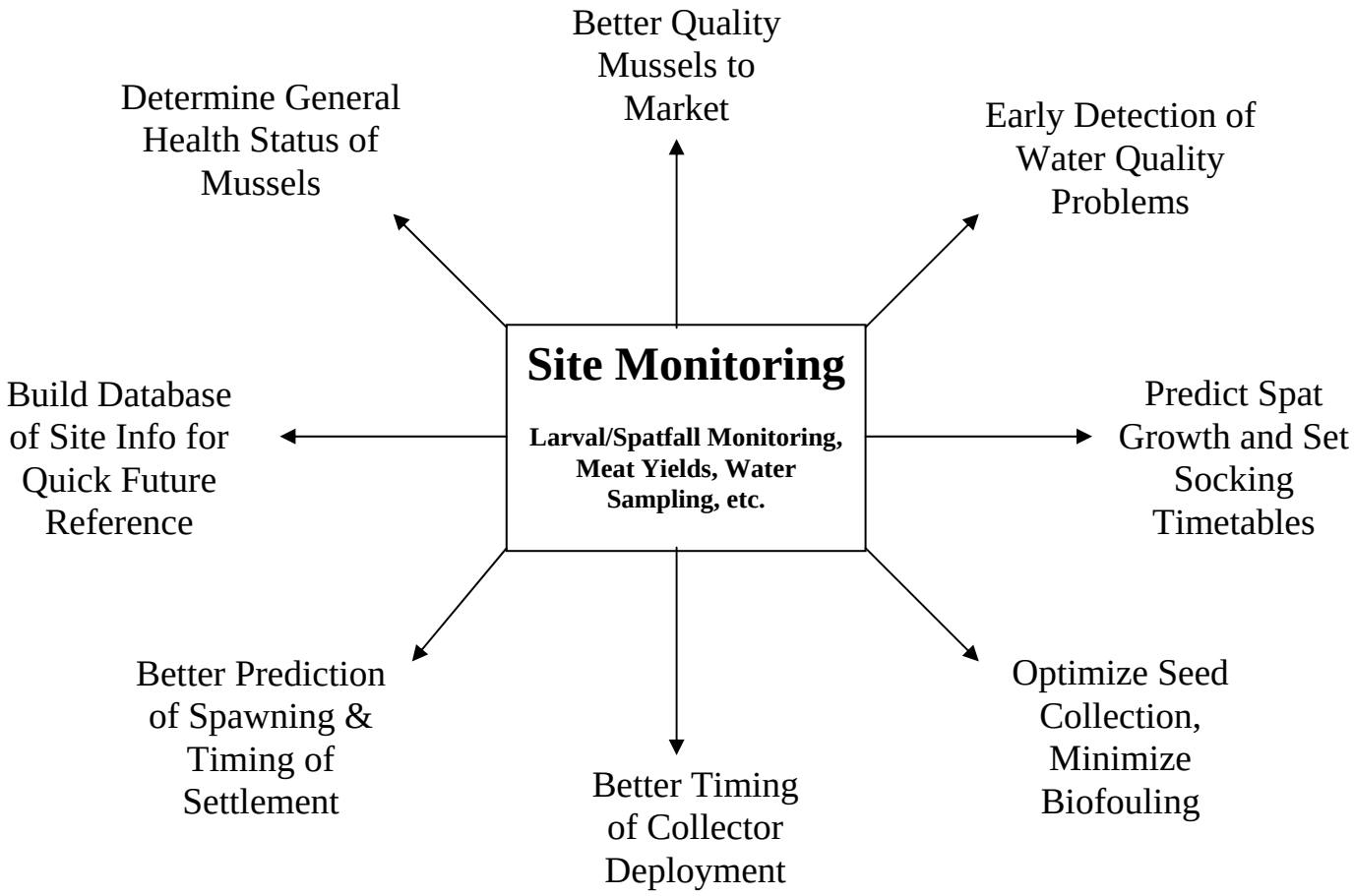


Figure 1. Some advantages of site monitoring.

Organizing and Record Keeping

An organized farm is a successful farm. It is vital for predicting mussel spawning and larval settlement that site conditions be monitored and most important, to write things down in a well organized fashion. Mental notes of deployment dates, collector locations, periods of algal blooms and other important site information written on scraps of paper **simply will NOT do**. By writing things in a well organized daily log book, a grower can look back at data from previous seasons as a comparison to current site conditions. This may help significantly in site operation decision making.

A log book may be as simple as an exercise book or binder for each season. Have sections for site names and physical layout, weekly meat yield calculations, results of weekly larval monitoring, collector deployment information, fall and spring spat collection summaries, water quality, plus a section for daily entries of site observations. Sometimes, even the subtle observations may prove useful. Also include a section on phone numbers, contacts for equipment, etc. With everything at your fingertips, running the farm will be more efficient.

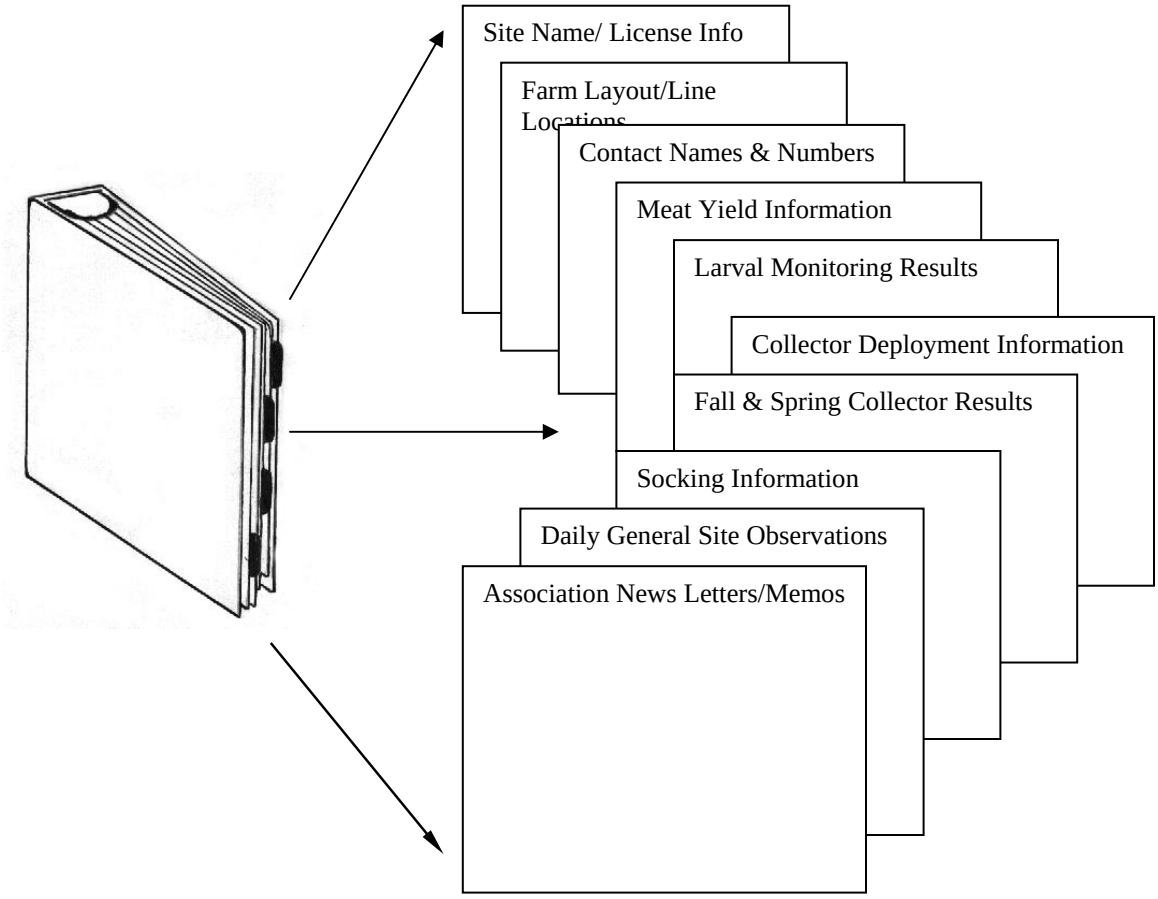


Figure 2. Examples of site information to be kept organized in a binder.

Mussel Meat Yields

It is essential to maintain a healthy supply of high quality product year round in order for the mussel industry to prosper. Because poor quality products will only lead to future losses in sales and farm production, it is important that they not be sold to market. Methods have been developed to analyze the condition of existing shellfish populations, the most frequently of which is the mussel steamed meat yield. This meat yield is also an indicator of quality, since it gives the relationship of meat to shell, with higher values generally indicating better quality. There are other indicators of mussel quality, including mussel size, shell shape and appearance, and growers should be aware of these.

Figure 3. Soft tissues (meats) of adult mussels – female top, male – bottom (*Sean Macneill photo*)

Mussel meat yields are also used to provide an indication of the general condition of the soft tissues (Figure 3). They can be used to examine the overall health status of the animals, as well as provide an indication of poor growth conditions due to such things as over-stocking, low food levels, etc. There may even be differences in mussel meat yields from different places on the farm.

Consistent monitoring of meat yields can also give an estimate of the seasonal variation in mussel weights in relation to reproductive events such as spawning in a population of mussels on a site: a rapid loss in meat yield following high levels usually indicates spawning has occurred. It is **important** that meat yields be recorded on about a weekly basis, if possible, after the winter ice is gone to ensure that an accurate pattern of mussel development is being determined.

Methods of Determining Meat Yields

Need for Consistency in Sampling Techniques

It is very important to ensure that the correct meat yield procedure is followed each time a sample is taken. Otherwise, yields can vary greatly, which misrepresents the true condition of the mussel and a leads to poor understanding of the mussel spawning/recovery cycle at the farm site. Any farmer, whether on land or in the sea, should want to know how well his or her animals are doing, not only for themselves, but for their customers as well.

Steamed Meat Yield vs. European Meat Yield

There are two common methods of determining meat yields. In Canada, the most common of these is the **Steamed Mussel Meat Yield**, which is calculated using mussel meats that have been steamed. In Europe and Asia, the meat yield most often used is the **European Meat Yield**, which is the ratio of the weight of cooked meats to the live weight of the mussel before cooking. Both methods of meat yield can be very easily determined from the same sample of mussels, and it is probably a good practice to calculate both each time (refer to page 6). This will allow the grower or processor to compare their values among themselves, and with other mussel producing regions of Atlantic Canada and Europe.

Wild vs. Cultured Mussels

Some growers believe that the mussel seed they collect each year originated from 'wild' mussel beds near, but not on, their sites. This indeed may be the case, as mussel larvae can drift long distances. If you can identify a bed of mussels close by, then perform occasional meat yields on them as well. Although not documented, these 'wild' mussels may spawn before cultured mussels because those in the intertidal zone are exposed to warmer water or air for part of the day, which may play a role in triggering spawning. Growers often find meat yields from wild mussels consistently lower than those of cultured mussels, even though the meats look full. This is due to the thicker shell of the wild mussel affecting the meat yield calculation.

Procedures

The procedure below has been adapted from recent reports (Bernard, T. 1997. PEI Mussel Monitoring Program, PEI Dept. of Fisheries Technical Report #218, Charlottetown, PEI. 29p. and Ibarra, D. 1998. Factors Influencing Cultured Mussel Meat Yield and Recommendations for a Standard Method. Independent Research Option Final Report, Marine Institute, St. John's, NF. 68p.). A sample meat yield data sheet follows the procedures. Record all weights, lengths and calculated meat yields in the spaces provided on the data sheet.

(1) Obtain approximately 1 kg of adult mussels, sized approximately 55 mm or greater in length, randomly from the site (at least 2 or 3 socks). Clean mussels of any dirt or slub. Rinse in clean water.

(2) Weigh and record the sample of whole, live mussels (g) using a balance or any other scale capable of reading 1 g increments. The weight should be about 1 kg.

(3) Using the calipers, measure and record the lengths of 20 adult mussels from your sample (mm) on the data sheet.

(4) Steaming:

- Preheat a pot on the high setting (electric Wok with a vent is ideal) with just a small amount of water, enough only to cover the bottom. Pot should be big enough so that the mussels do not take up more than about one third of the space (about 5 liters).
- When the water boils and emits steam, put all the mussels in the pot and cover. Allow the water begin boiling again on high heat. Begin timing the cooking process. Loosen lid a little to allow steam to escape and prevent boiling over.
- **Steam** mussels for **10 minutes**.

(5) After steaming, shuck the meats from the shells and obtain separate weights of the total shucked steamed meats and the total empty shells using a balance or any other scale capable of reading 1 gram increments.

(6) Calculate both steamed meat and European meat yields using the formulas shown on the sample data sheet.

(7) Keep data sheets in a safe place (e.g., binder) that you can easily access. Over time, you'll have a database of information on meat yields at your fingertips. You may wish to plot your values for each sampling on graph paper to quickly identify trends in meat yield levels throughout the year, such as the sample one below.

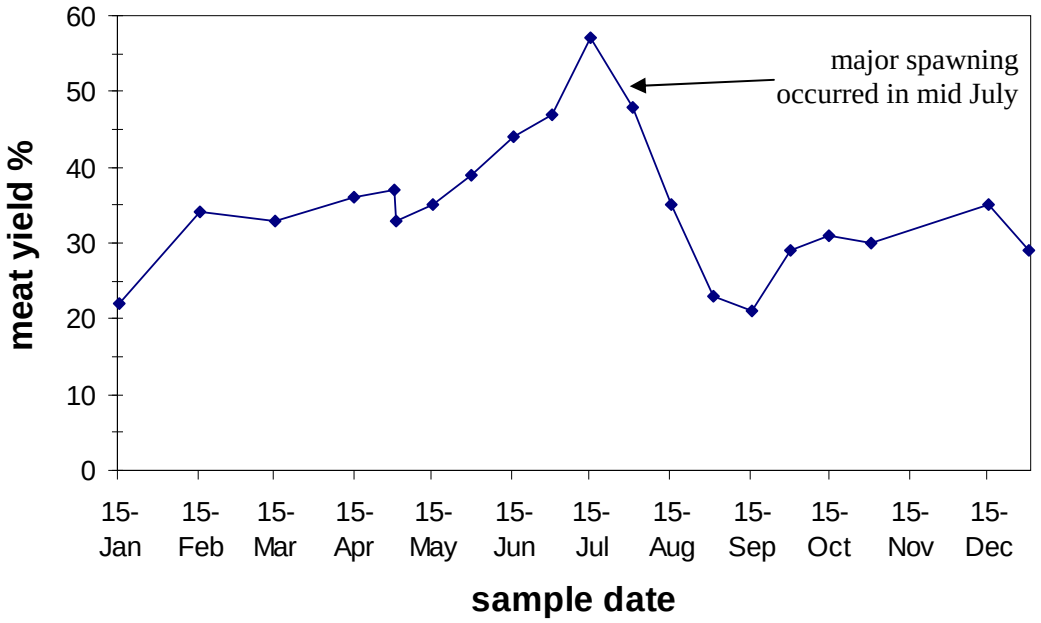


Figure 4. Example plot of meat yields.

Blue Mussel Larval/Spatfall Monitoring Program 1998

Meat Yield Data Sheet

Grower: _____
Site:_____
Date/Time: _____
Water Temperature: _____ (^{o}C)
Salinity (if possible): _____ (ppt)

Mussel Lengths (mm):

1.	6.	11.	16.
2.	7.	12.	17.
3.	8.	13.	18.
4.	9.	14.	19.
5.	10.	15.	20.

Mussel Weights (g)

Total Un-Cooked Mussel Weight	g
Steamed Meat (Shucked) Weight	g
Steamed Shell (Empty) Weight	g

Steamed Meat Yield (%):

$$\frac{\text{Shucked Steamed Meat Weight (g) X 100}}{\text{Empty Shell Weight (g) + Shucked Steamed Meat Weight (g)}} = \_\_\_\_\_ \%$$

European Meat Yield (%):

$$\frac{\text{Shucked Steamed Meat Weight (g) X 100}}{\text{Total Live Weight of Uncooked Sample (g)}} = \_\_\_\_\_ \%$$

Other Notes and Observations:

Larval Monitoring

Through regular meat yield analysis, a grower can determine when mussel spawning has occurred by a large drop in the percentage yield over several weeks (Figure 4). Mussels will lose weight as eggs and sperm are released from the gonadal tissue. Visual evidence of a major spawning event is a rise in flotation along the main lines (Figure 5). Growers are urged to begin larval monitoring as soon as they see evidence of spawning (drop in meat yields or rise in flotation), or by mid May in many regions of the island.

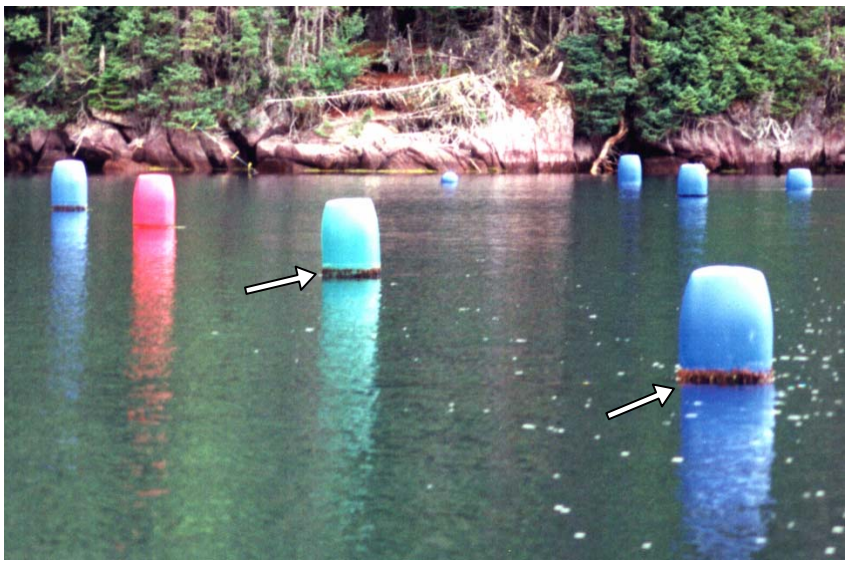
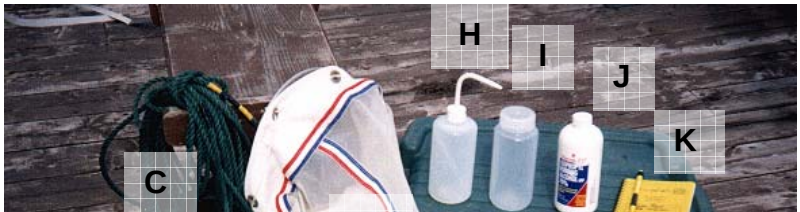


Figure 5. Rise in floatation (arrows) is often an indication that spawning has occurred (*Sean Macneill – photo*).

The timing of collector deployment is important to maximize seed collection while minimizing fouling of ropes. Through larval monitoring, a grower can determine the optimum time to deploy collectors. That is, when mussel larvae are most abundant and the majority are of settling size. Collectors deployed too early will result in slubbing of collectors; too late and the major settlement period will be missed.

Larval monitoring has become routine for many mussel farmers each year through a mussel larval & spatfall monitoring program. The program, offered to members of the Newfoundland Aquaculture Industry Association (NAIA), has been very successful in helping growers secure an annual seed supply. Participants are trained in the techniques of plankton tow sampling, microscopy and larval invertebrate identification as well as being assisted with site specific seed collection issues. Larval monitoring kits, such as the one shown in Figure 6, were developed and purchased by many mussel farmers. Below lists the components of the kit followed by procedures for plankton tow sampling – the first step in larval monitoring. There are two types of plankton tow techniques that will be discussed – 1) Vertical Tow and 2) Horizontal Tow.

Components of the Larval Monitoring Kit



A. Bucket

B. Plankton net – 100 μm mesh size

C. 20 m of rope with 1 & 5 m increments

D. Plastic funnel

E. Thermometer with float attached

F. 80 μm mesh screen

G. 500 μm mesh screen

H. Wash bottle

I. Sample Jars (250 mL or 500mL)

J. Waterproof field notebook

K. Rubbing Alcohol (70% isopropyl)

L. Plastic rough tote carry container

Figure 6. Larval monitoring kit. An inexpensive necessity to secure a reliable seed supply *(Miranda Pryor – photo*).

Procedures for Plankton Tow Sampling

Vertical Tow

1. Place the plankton net over the side of the boat and remove the air from the net and bottle. A small rock inside the jar will help the net sink better.

2. Lower the net to about 2 meters from the bottom, or 20 meters, which ever is less. Whatever depth you choose, make a note of it and continue to use that depth for each sampling.

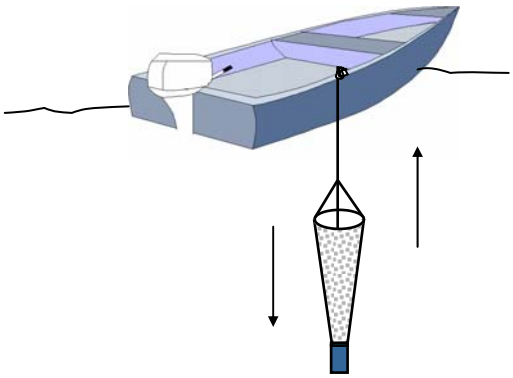


Figure 7. Vertical plankton tow.

***Tip** Don't forget to tie the end of the rope attached to the net to the boat!**

3. Slowly pull net back up (about 0.5 m/sec). Try to keep boat from drifting.

4. Hold the net up outside the boat and rinse the net with a scoop or wash bottle (Figure 8A).

5. Unscrew bottle on net and pour contents into 20 L bucket (Figure 8B). Rinse bottle and inside net using wash bottle (Figure 8C).

6. Repeat steps 2 - 5 at two more chosen sampling areas of the site. Combine the contents of **all three samples** in the 20 L bucket upon completion. Your chosen sites for sampling should be sampled each week.

6. Hold the screens on top of one another so that the **larger mesh (500 µm)** screen is on top. Pour the contents of the bucket slowly through the screens (Figure 8D). Rinse the bucket and pour onto screens to make sure all material is screened (Figure 8E).

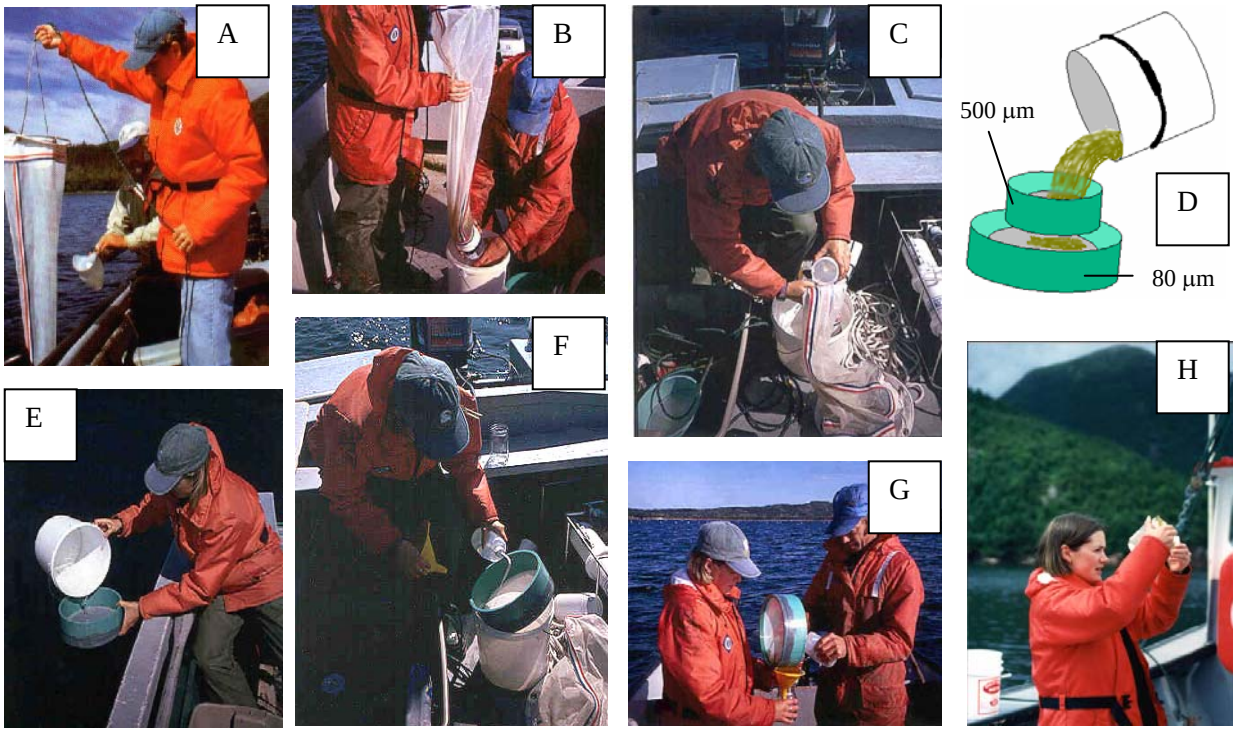


Figure 8A-H. Step by step procedure for plankton tow sampling. Each plankton takes 10 minutes or less to complete (*Cyr Couturier and Miranda Pryor – photos*).

7. Using a wash bottle, gather plankton to one section of the 80 µm screen. Make sure any grooves in the screen are rinsed thoroughly (Figure 8F).

8. Using a funnel and wash bottle, carefully direct the plankton into a sample jar. Rinse the funnel with seawater and ensure sample jar is 2/3 full (Figure 8G).

9. To check for starfish larvae, repeat steps 7-8, washing the contents of the **500 µm mesh screen** into another sample jar and fill to an appropriate level.

10. Top off sample jar with rubbing alcohol (Figure 8H). For the **STARFISH** sample, **DO NOT ADD ALCOHOL**. Alcohol will dissolve the starfish larvae. Keep sample cool and examine promptly!

11. To label the samples, use a strip of masking tape and a pen/waterproof marker, label the cover of sample jar, or write the information in your field notebook. Include the information listed below. For the sample with starfish larvae, label the same but indicate 'starfish'. Ensure cover is on tightly and put in a safe place.

Site Name:	Grower:	
Sample Date:		
Horizontal or Vertical Tow:	Tow Depth (m):	Length of Tow (m):
Tide Conditions:		Time of Tow (min):
Water Temperature:		
Wind Direction and Strength:		
Comments:		

Figure 9. Plankton tow information to record on sample jar and/or field notebook.

12. Samples are now ready for microscopic analysis. See next sections for use of microscope, sample preparation and analysis. After use, screens and plankton net should be rinsed with **fresh** water and put somewhere to dry for until the next tow.

Horizontal Tow

Equipment Required

- Larval monitoring kit
- Watch or timepiece to keep time
- 1 meter of rope with heavy weight attached (~8 kg)

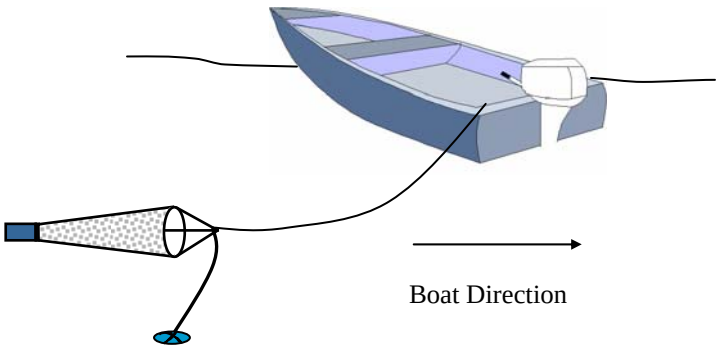


Figure 10. Horizontal plankton tow.

Procedure

1. Fix approximately 8 kg weight to the bridle of the net with about 1 meter of rope. Ensure collector bottle is properly attached. Attach one end of the 20 m rope to the bridle and the other to the boat.

2. Place net over the side of the boat and remove air from the net and sample jar.

3. Slowly pay out the rope and increase speed of the boat so that the net is approx. 1 meter under the surface. Many growers find it easier to idle the motor in reverse while towing net.

4. Using a time piece, tow at a steady slow speed until 3 minutes or 100 meters is up.

Note: From Step 5 onward, the procedure is the same as the vertical tow. Refer to Figure 8A-H.

5. Pull net up to boat and hold outside to rinse with scoop. Rinse contents of the net **from the outside** starting at the top and moving toward the bottom.

6. Empty the collector bottle into the 20 L bucket and rinse off the bottom of the net using the wash bottle.

7. Stack the filter screens on top of one another so that the **larger mesh (500 μm**) screen is on top. Pour the contents of the bucket slowly though the screens. Rinse the bucket and pour on screens.

8. Using a wash bottle, gather plankton to one section of a screen and using the funnel, direct the plankton into a sample jar. Rinse the funnel with seawater and ensure sample jar is 2/3 full. To check for starfish larvae, wash the contents of the **500 μm mesh screen** into another sample jar and fill to an appropriate level.

9. Top off bottle with rubbing alcohol. For the **STARFISH** sample, **DO NOT ADD ALCOHOL**. Alcohol will dissolve the starfish larvae. Keep sample cool and examine promptly!

10. To label the samples, use a strip of masking tape and a pen/waterproof marker, label the cover of sample jar or write the information in your field notebook. Include the information listed in Figure 9. For the sample with starfish larvae, label the same but indicate 'starfish'. Ensure cover is on tightly and put in a safe place.

11. Samples are now ready for microscopic analysis. Make sure net and screens are washed with **fresh** water, dried and stored properly until next use.

Comments on the Horizontal Tow vs. Vertical Tow

In a practical sense, the horizontal tow is no more difficult to perform than a vertical tow, and both tow types are easier to carry out when more than one person is available. However, through experience, a horizontal tow performed at, say, 1 meter depth for 100 meters is rarely accurately carried out at those conditions. Often, the 100 meters or 3 minutes are estimated, and the depth varies considerably throughout the tow (e.g., the boat motor shuts off & net sinks to bottom or boat goes too fast and net comes to surface, etc). When the tow ***is*** carried out close to one depth, the majority of larvae ***may*** be missed due to uneven larval distribution in the water column. Mussel larvae of different size classes (e.g., d-stage <200 μm & eyed larvae >250 μm) have been found at different depths, so a vertical tow is the best way to find out the true size distribution of larvae, as it samples the entire water column. In addition, from a vertical tow, the depth is known and the amount of water filtered through the plankton net can be more accurately calculated. This gives a clearer estimate of the number of mussel larvae ***per liter*** of original seawater, rather than the number of larvae in a 500 mL sample jar. The best approach to take when deciding on a tow type is to do the vertical tow always, and carry out the horizontal tow second, as a comparison. Too much information is better than not enough.

Mussel Larval Sample Preparation and Analysis

Plankton tow samples must be examined using a microscope to determine size and abundance of mussel larvae present in the water. Below is a brief overview of the compound light microscope and its use, followed by procedures for analyzing larval samples.

Use of the Compound Light Microscope

Below is a compound light microscope similar to that used in the analysis of the larval samples.

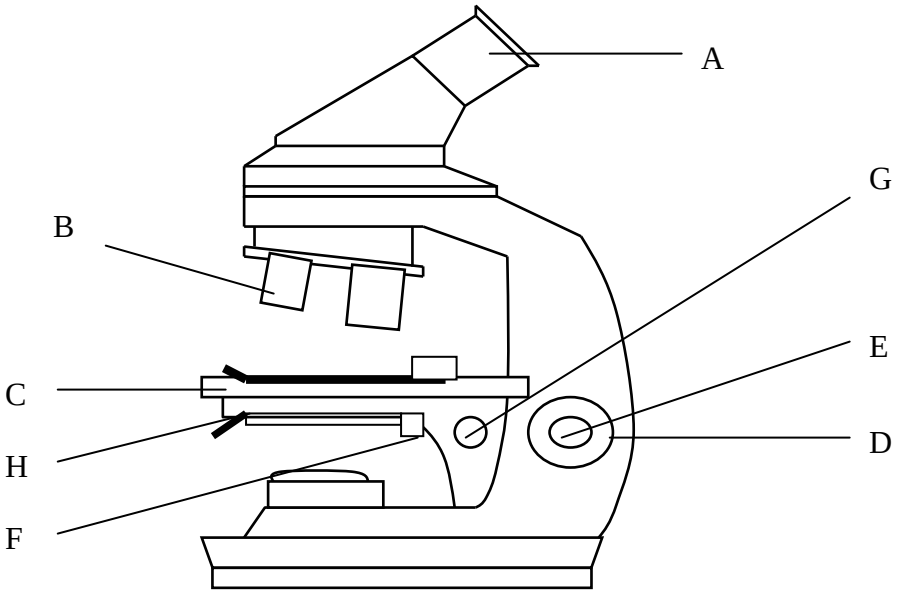


Figure 11.The compound light microscope.

Table 1. Major parts of the microscope and their functions.

Major Part	Function
A. Ocular (eyepiece)	Magnifies image 10X
B. Objective lens	Revolving magnifying lens low power (4X) medium (10X) high.(40X)
C. Stage	Holds slides
D. Coarse adjustment	Rapidly brings sample into focus
E. Fine adjustment	Slowly brings sample into focus
F. Substage adjustment knob	Raises and lowers condenser
G. Mechanical stage control	Moves slide about on stage
H. Diaphragm lever	Controls amount of light reaching specimen

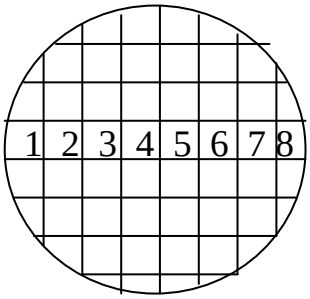
Tip **Growers should contact grade schools and local colleges to borrow/rent microscopes for a few months during the monitoring period. A few growers already do this and in return, they provided mussels for use in biology labs/science classes.**

Calibration for Size Measurement

Microscopes allow for precise measurement of microorganisms. Some microscopes have an ocular micrometer, a circular disk of glass which has graduations engraved on one surface. You can see the ocular micrometer by looking though the microscope. It appears as a tiny ruler. If you don't see it, try closing one eye. If that doesn't work, there may not be one. You can add an ocular micrometer by replacing the ocular lens with a lens equipped with one. At different magnifications, each unit of the ocular micrometer represents a different length, thus it is necessary to calibrate the ocular micrometer. This is done by using a stage micrometer. If the microscope doesn't have an ocular micrometer and one isn't available, sizes of the mussel larvae under each power of magnification can be done using the field of view method. Both procedures are described below.

Field of View Method to Size Mussel Larvae

Under the desired power, place a piece of graph paper (mm^2) on the stage of the microscope. Focus the grid on the paper and count the number of squares that fit across your viewing area, or field of view. Below is an example.



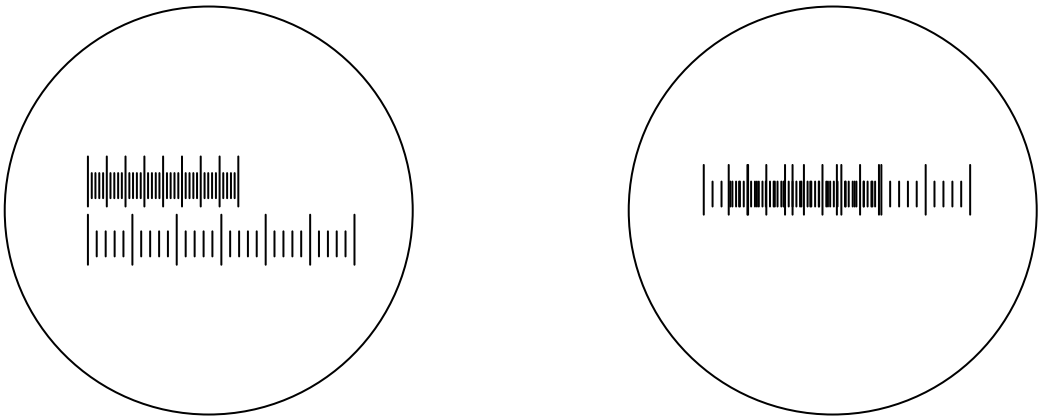
In this example, 8 squares fit across the field of view, so the diameter is 8 mm or 8000 μm. To determine the size of individual larvae, estimate how many of these will fit across the field of view if they were lined up end to end. If approximately 32 could fit across, then each larvae is 8000÷32 = 250 μm. Note that each time you change to a different power of magnification, you must determine the field of view.

Using the Ocular Micrometer to Size Mussel Larvae

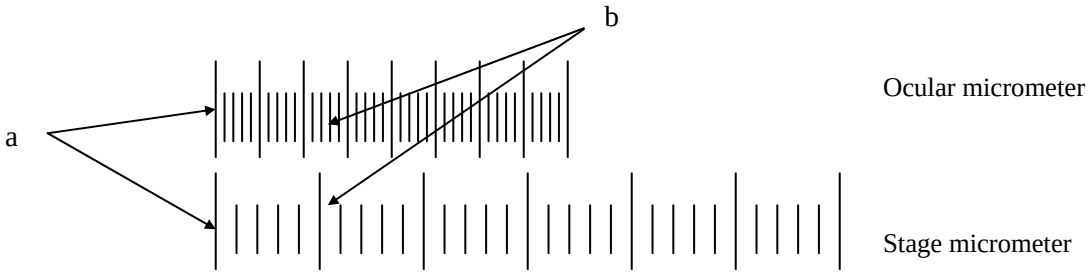
People often find this method most confusing and frustrating, but it is simple and more accurate than the field of view method. The confusion arises in that to determine larval size under each power of magnification, you must first determine the distance between each unit (bar or line) of the ocular micrometer. To do this, the ocular micrometer is calibrated using a special slide called a stage micrometer. The stage micrometer also has a tiny ruler on it, but its units are

exactly 0.01 mm or 10 μm apart. Below is the step by step procedure with an example, at **low power (4X objective lens)**.

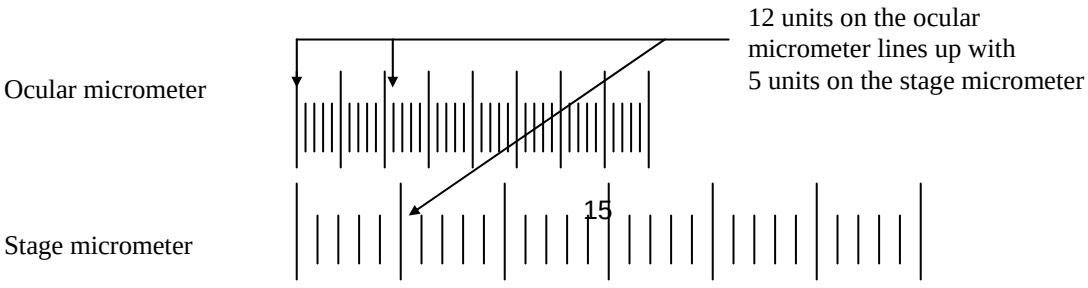
1. Place the stage micrometer on the stage of the microscope and focus. You will see either separate 'rulers' or they will overlap into a mass of lines as below.



2. Move the stage micrometer until one line of the stage micrometer coincides with a line of the ocular micrometer (a). Then look for another line along the stage micrometer that coincides with a line on the ocular micrometer (b).



3. Count the number of units (lines) between each of the coinciding lines.



4. Divide the number of ocular micrometer lines by the number of stage micrometer lines (a).
Multiply the resulting value by 0.01 mm to get the distance of each ocular division (b). Finally,
multiply by 1000 to get measurement in micrometers (1 mm = 1000 μm) (c).

a) $$\frac{\text{12 units ocular}}{\text{5 units stage}} = 2.4$$

b) $$2.4 \text{ X } 0.01 \text{ mm} = 0.024 \text{ mm}$$

c) $$0.024 \text{ mm X } 1000 \text{ μm/mm} = 24 \text{ μm /ocular unit}$$

Note that the procedure must be repeated when you change magnification and some microscopes have calibrations written on the side of the microscope.

Preparation of Sample and Analysis

Equipment Required:

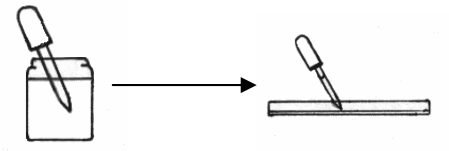
- microscope with total magnification of 100X and preferably with an ocular micrometer (ruler in eyepiece)

- small plastic petri dish or glass depression slide
- water dropper that can measure 1 mL
- notebook or data sheet/pencil to record measurements

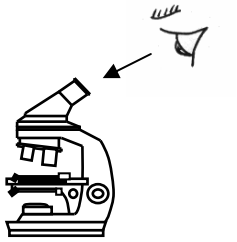
Procedure

1. Take sample jar from plankton tow, shake to create homogeneous (larvae scattered throughout) solution. Do not swirl jar as this causes large larvae to concentrate at the bottom center of the bottle.

2. Remove 1 mL with water dropper or pipette and place in petri dish or slide.



3. Place slide or petri dish on microscope stage and scan for mussel larvae



4. Count the larvae and measure the lengths of a representative sample. Record data and comments on data sheets or in notebook*.

5. Repeat steps 1 - 4 so that 3 - 1mL samples are analyzed.

6. Grower should deploy collectors if results indicate that >50% of larvae sampled were >200 μm in length.* +

*To assist growers in how to distinguish mussel larvae from other bivalve larvae and plant material, a colour key is being created from plankton tow samples of last season. Work completed thus far is included in this handbook at the end as well as a sample larval data sheet.

How to Identify Site Trends from Larval Tow Data

If you are new to larval monitoring, just identifying mussel larvae and doing counts often seems a chore by itself. But how do you get to identify site trends? What can you do with the larval abundance numbers you've come up with? Unfortunately, for a new farm, a trend will be hard to establish with only one years' worth of data. However, after several seasons of larval monitoring, you may begin to see a trend in appearance of mussel larvae and relative abundance. **It is easier than you think.**

Each time you determine larval abundance from a plankton tow, record the number and date in an exercise book. For visual affect, plot out the abundance on graph paper, adding the new number each time a tow is done. After a few seasons, your graph may look similar to the one shown below. This one clearly shows a trend in larval abundance. Similar graphs can be plotted for meat yield data as well.

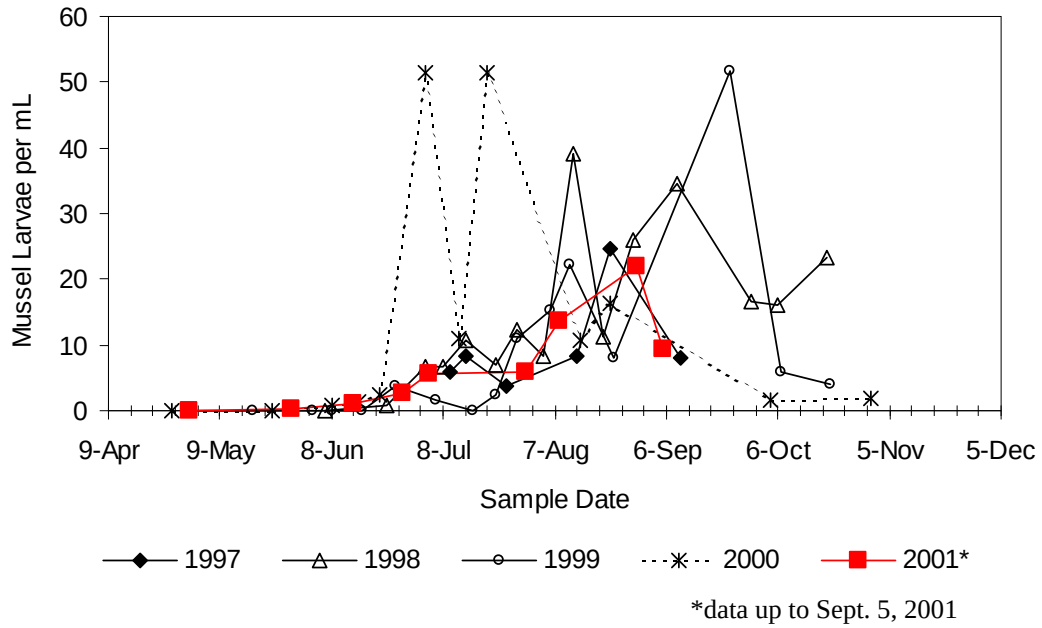


Figure 12. Mussel larval abundance (per mL) for a mussel farm site on the South Coast of Newfoundland, 1997-2001. Note that for 1997-99 and 2001, the trend is similar (i.e. larvae are most abundant during August/early September). For year 2000, abundance peaked about a month earlier.

+Collector Deployment Decisions

Based on meat yields and larval monitoring a grower can better predict the timing of mussel spawning and settlement. **Its best to wait until larval monitoring shows a majority of mussel larvae of settling size before deploying collectors**, **but here are some other considerations:**

- Number of collectors to be deployed and how long it will take
- Manpower available to do the job
- Bad weather
- Is the site prepared?

Growers must have equipment prepared beforehand and not be making collectors when the optimum time to deploy collectors is upon them. Use common sense and good judgement.

As an example, lets say you have 30,000 collectors to deploy. Your plankton tow results indicate that larval abundance is rising each week and their size is increasing from previous tows. When you calculate the percentage of larvae >200 um, you find there is only 45%, but there are some eyed larvae (setting) in the sample. If you anticipate several weeks to deploy your collectors, you are best advised to start deploying, even though only 45% are >200um. Stagger your deployments by a few days so that by the time they are all out, a majority of mussel larvae are >200 um in length. The following are some observations made by growers involved in larval monitoring on a regular basis:

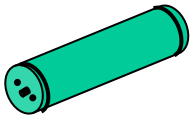
- It's always best to deploy collectors when larval abundance is on the increase rather than when they are dropping. When larvae begin to settle out, abundance can drop very quickly and collection drops with it.
- A plankton tow that shows LOTS of larvae from 'd'-stage to eyed stages generally means a good collection if collectors are deployed on time.
- Sometimes doing plankton tows at different tide levels (high and low) or in different areas of the farm can show huge differences in the amount of mussel larvae observed.

Water Monitoring (Temperature and Salinity)

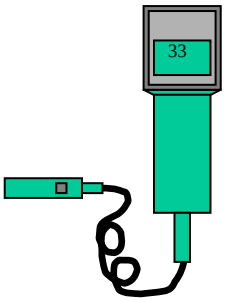
Fluctuating temperature and salinity can each directly affect the animal being cultured, most notably newly settled mussel spat and scallops. For example, heavy rains that lower the

salinity near the surface can cause a loss of newly settled spat, as freshwater tends to weaken their byssal attachment. High water temperatures have a similar effect. Sudden lowering of salinity can be fatal to scallops. High water temperature can also lead to healthy blooms of phytoplankton, providing food and quick growth opportunity for newly settled mussel spat.

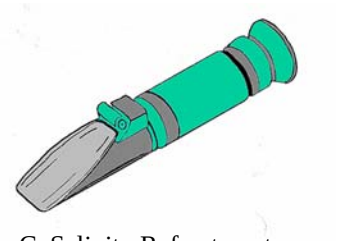
There are a number of instruments used to monitor temperature and salinity. In the larval monitoring kit, a thermometer is used to measure surface temperatures. Over time, one can see the trends in temperature. Another simpler way to keep track of temperature is to deploy a thermograph, such as the one shown below (Figure 13A). A thermograph (brand name examples – Vemco Minilog or Onset StowAway^{TM}) is programmable to take temperature readings at a specified time interval for up to a year or more at a time. Information is downloaded through computer software and the device is reset and deployed again.



A. Vemco Minilog Thermograph



B. YSI temperature/Salinity Meter



C. Salinity Refractometer

Figure 13. Examples of the many simple water monitoring devices available to growers.

A YSI meter (Figure 13B) measures both salinity and temperature through a sensitive probe on the end of a long cord. The unit is battery operated and different length cords can be purchased. Finally, a device that requires no computers or batteries is the salinity refractometer (Figure 13C). A few drops of water on its glass slide and you get an instant reading of salinity.

Spatfall Monitoring

As part of the larval & spatfall monitoring program, during the fall and spring of each season, a random sample of 3 collectors from each site is retrieved and analyzed for spat numbers, density, weight, average spat size and biofouling. This gives an indication of how

timely collectors were deployed, spat growth over the winter period etc., and can help in setting time tables for collector stripping and socking.

At each site, 1 collector is retrieved from the front, middle and back of the spat collection area for a total of 3 sample collectors. Spat on each collector are removed and stored frozen, until analysis is carried out by monitoring staff.

An on-site approach to spat monitoring can easily be done by the growers themselves. By monitoring the progress of spat growth, one can get a better understanding of how site conditions influences the life cycle of the mussel and better planning of farm activities such as socking schedules can take place.

Equipment Required

- Set of measuring calipers
- A weigh scale (digital or analog – accurate as possible)
- A good field notebook

Procedure

1. After settlement has occurred and spat are visible on collectors, ***carefully****** obtain a small sample and measure lengths of a few dozen. Record information in your notebook.

***If water is particularly warm, or if there was a sudden rainstorm, DON'T lift up collector lines. Newly settled spat are very poorly attached and disturbing the lines may cause a heavy loss in seed. It's best to wait a few weeks (months) until you are sure the collection period is over and conditions are more favorable.**

2. By sampling every few weeks, one can get an idea of their growth. If you want to get more involved, you can choose different locations on your farm site and sample as a comparison (e.g., inside site and outside site).

3. You can also measure the increase in weight of your collectors over time using the weigh scale. Record the weights in your notebook.

Summary/Conclusion

Site monitoring is very important to ensure farm success. It is especially important for seed collection, a critical step in the mussel production cycle. By carrying out meat yields and

larval monitoring, a grower can more accurately determine the timing of mussel spawning and settlement. Collectors can be deployed at the optimum time of settlement to maximize seed collection while minimizing biofouling of equipment. Spatfall monitoring in the fall and spring can help determine how timely collectors were deployed, amount and types of fouling, spat growth over the first season and can help set timetables for collector stripping and socking. Monitoring water conditions can be very important for the health of your animals and gain a better understanding of how environmental conditions affects production on the farm. Regular monitoring and record keeping will result in smoother, more efficient farm activities and allow growers to prepare for events in advance.

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Appendix

Colour Keys of Bivalve Larvae and Spat
Sketches of Various Bivalve Larvae
Common Phytoplankton
Sample Larval Data Sheet