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Aquaculture in Shared Waters Fact Sheet: Getting to Know Your Water

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Aquaculture businesses must operate on sound environmental principles, most especially because marine aquaculture occurs in an open system: the ocean. While all farming activities, on land or at sea, have some degree of environmental interaction, farmers should understand these processes, with best management practices to minimize negative impacts. Successful farms must cope effectively with any changes to the marine system, and an organized system of monitoring and recordkeeping will improve your chances of business success, while maintaining a healthy environment.

This fact sheet provides a summary of direct and indirect environmental factors that may affect your marine aquaculture business; more detail on equipment and methods is covered in the companion fact sheets on Site Selection, and Husbandry.

Routine assessment of water quality is a good practice for any agriculturist. Here, water temperature is being collected. >
Photo: Chris Bartlett

Water Quality

Good water quality is essential for a sustainable and profitable aquaculture enterprise. Basic factors such as temperature and salinity are critical variables to understand, and they are useful parameters to track over time. Besides temperature and salinity, other parameters are often helpful to understand, such as dissolved oxygen, levels of primary productivity (phytoplankton), or turbidity. Note that it's important not just to know the average values, it is important to understand the trends over time and the maximum or minimum values likely to be encountered. For example, a particular location might have good temperature on average to grow mussels, but if the water temperature goes too low, the whole crop can be lost.

Overall, water quality monitoring provides a central tool in understanding the conditions your crop is growing in, and to inform your husbandry practices and site management.

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How to Evaluate Water Quality:

Some water quality characteristics can be measured with basic tools, easily available to the aquaculture producer. Below are some essential parameters, and ways to begin evaluating them. As always, a notebook and pencil are indispensable tools for the farmer; your memory will change, but your notes will not - write it down!!

Temperature:

Temps are easily taken by a simple alcohol thermometer. If you are using a thermometer, be sure to create a way to guard against drops or slips: tie a piece of line around the thermometer, or insert the thermometer through a small piece of foam, so that it will float. Electronic meters are also valuable, though more expensive; they often have long cords to allow you to measure temperature at depth, and this type of unit will also often record salinity as well. In the event that you don't have an electronic meter but want to measure down below the surface, a sampling bottle allows the user to drop the bottle to a specific depth, and then to pull a cord to close the bottle up. This way, the water at the right depth is retained, and can be measured at the surface.

Logging meters (aka 'data loggers') can remain in the water for weeks or months, recording at specific times. This way, the readings can be downloaded to a computer, and examined in detail at leisure. Data loggers are in common use for such things as temperature and salinity, and individual units are often around $100, though some additional equipment may be necessary.

A refractometer is an easy-to-use, affordable and effective piece of equipment to measure salinity levels
Photo: Kathlyn Tenga-Gonzalez, Maine Sea Grant

Salinity:

Salinity can be measured by basic tools such as a hydrometer (about $10), or something more expensive, such as a refractometer ($100-$300). These items are available through aquarium supply stores, or scientific supply vendors.

Dissolved Oxygen:

D.O. is a somewhat tricky measurement to make. Electronic meters are available starting at under $200, and can run much higher than that. Test kits which use a method called titration to determine oxygen level are also available. A specific reagent is added to a sample of water, and a color change in the sample indicates the level of oxygen present. Titration kits are available for less than $100, and these might have enough material to perform 50 measurements or so.

Water Clarity:

Phytoplankton are a critical part of food supply for bivalve shellfish, and new science also indicates that detritus may also play a strong role. For the purposes of evaluating phytoplankton, chlorophyll is frequently measured. This is usually done with a fluorometer; check with your local marine extension agent about available equipment, since fluorometers are relatively expensive. *Turbidity* describes the cloudiness or haziness of water; usually an indicator of how much material is suspended in the water column, and is often helpful in understanding how much food (phytoplankton, detritus) or silt is present. The easiest way to measure turbidity is with a Secchi Disk; this is a black-and-white circle that is lowered with a rope that has been marked off in feet or meters. The disk is lowered into the water until it becomes invisible, and that measurement (the 'Secchi depth') is a useful comparison over time, even though each reading is somewhat inexact.

Species of common interest for Maine sea farms

WARMER WATER

	Temperature	Salinity	Notes
Razor Clam	Warm, 60˚F to 85˚F	Salty, above 28 ppt (parts per thousand)	Razor clam culture is still developing, though likely will be best under netting. Strong preference for suitable habitat, razor clams have a patchy distribution, and prefer muddy sand, hard sand, shell hash - not too soft nor too hard.
Softshell Clam	Warm is good - 60˚F to 80˚F	Fairly salty, 20 ppt and above, similar to mussels	Clams are best grown under plastic netting on mud flats, though soft mud likely not the best - look for harder mud, shell hash or muddy sand. Nets will need cleaning and if ice will be present, will need to be removed before ice arrives and immediately after ice-out.
Hard Clam	Warmer than softshell, 65˚F and above	Brackish to full seawater, 15 ppt and above	Also usually grown under netting, though they will prefer harder substrate than softshell clams.
Eastern Oysters	Generally warm; estuaries, rivers, coves or bays that might warm up (60˚F and above)	Brackish to full seawater, 15-34 ppt	Oysters like warm temperatures for best growth, and can withstand wide swings in salinity. Most good sites in Maine will be in estuaries, or protected locations that will warm up a bit; heads of bays, coves, etc.
European Oyster	Cool, below 75˚F, and above 32˚F in winter	Salty, above 25 ppt	European (or flat) oysters like moderate conditions, not too hot in summer nor too cold in winter. Sourcing seed can be difficult, market can be valuable, but also variable.
Sea Scallop	Cool, below 70˚F	Salty, above 25 ppt	Scallops do not like to be crowded, and will require lots of space if grown in cages. Hot or very cold weather should be avoided when handling, to limit stress and mortality. Still in development as a Maine aquaculture crop.
Blue Mussels	Colder than oysters, maximum of 70˚F	Fairly salty, 20 ppt and above	Blue mussels can feed and grow year round, but in very warm temperatures, they can lose their byssal attachment and fall off growout ropes. A protected site is helpful, especially when growing under rafts, to limit damage from heavy weather. Generally requires more capital than oyster farming, for growing and processing equipment.
Kelp	Cool, below 68˚F	Salty, above 25 ppt	Kelps grow best about 7-10 feet below the surface, but can be grown in both protected and exposed sites. Kelps are a wintertime crop with seeding in October/November and harvests possibly in February, more fully from then on into May. Kelp blades will become fouled and unmarketable as food if left unharvested too long.

COOLER WATER

Climate Change

Aquaculturists have to deal with change all the time on the farm, whether it be by tide, season or changes from one year to the next. Changes in climate may have real impacts on an individual farm site, perhaps through higher precipitation and reduced salinity, higher average water temperatures, increased toxic algal blooms, or reduced pH. In dealing with these changes, observation is key: create a farm log and be sure to maintain useful and regular notes. Over time, farm logs can be indispensable in describing changes, and to help keep track of what works vs. what doesn't. Remember, recollections can change over time (including being forgotten), so write it down!

Resources

Aquaculture in Shared Waters fact sheet series:
http://www.seagrant.umaine.edu/Resources-and-news

Ocean Acidification
http://medsea-project.eu/wp-content/uploads/2013/10/ebook-ECONOMICS-OF-OCEAN-ACIDIFICATION.pdf
2015 Maine OA Report: http://www.maine.gov/legis/opla/Oceanacidificationreport.pdf
MOCA: http://www.seagrant.umaine.edu/extension/maine-ocean-and-coastal-acidification-partnership

A field guide to phytoplankton in the Gulf of Maine
http://www.seagrant.umaine.edu/files/pdf-global/MSG-E_03-06-phytoplankton.pdf

A Guide to Bivalve Diseases for Aquaculturists in the Northeastern US
http://www.seagrant.umaine.edu/files/pdf-global/99Ext_BivalveDiseases.pdf

Best Management Practices for the East Coast Shellfish Aquaculture Industry
http://agresearch.umd.edu/sites/default/files/_docs/ECSGA_BMP_Manual_NRAC-NOAA.pdf

Northeastern US Aquaculture Management Guide:
https://agresearch.umd.edu/sites/default/files/_docs/NE_Aquaculture_Management_Guide_2014.pdf

The goal of these fact sheets is to inform readers about the possibilities of integrating aquaculture with current fishing and seafood businesses, and to diversify incomes along Maine's working waterfront.

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