Water Quality in Bivalve Hatcheries

Revised and updated by Dr. Susan Laramore on March 2015
from Dr. Ralph Elston, Florida Clam Industry Workshop, Cedar Key, FL, September 2008

Water quality in hatcheries is often determined empirically or by experience, based on qualitative assessment of local conditions and experience or history in regard to required water treatment.

Water quality parameters significantly out of the expected or "normal" ranges, are associated with poor performance in the hatchery. Direct effects may include poor shell formation due to low alkalinity, poor growth due to salinity or temperature being outside the optimal range or indirect effects such as that of temperature and nutrients that supports the growth of pathogenic bacteria.

Daily or more frequent measurements can be implemented fairly easily for pH, salinity/conductivity, temperature, oxidation-reduction potential and dissolved oxygen using various instrumentation; including continuous automated monitoring systems that send an alarm signal if they go out of range.

Based on the needs and the budget of the hatchery it is recommended that monitoring can be accomplished in descending order depending based on importance:

1. Incoming temperature, then pH, conductivity/salinity, DO, ORP; easily accomplished with instruments/meters purchased from Pentair/Aquatic Eco-systems, YSI, Cole Parmer, even Amazon or E-Bay!

2. Add to the above testing capability for nitrogenous compounds (ammonia, nitrite, nitrate), and hypochlorite (chlorine). There are many readily available choices ranging from color wheels, test strips, drop tests to more expensive test kits (e.g. LaMotte and Hach).

3. Add to the above testing capability for alkalinity, hardness or calcium, at this point it's worth questioning test frequency and looking at getting a multi-parameter colorimeter (e.g. Hach).

4. Add to the above testing a saturometer (for total gas pressure – super saturation), and UV kill ability (plates!). Add to the above testing capability for H_2S, SO_4, PO_4 and you definitely will need a colorimeter, unless you can get a contract with a local university to do water testing.

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Possible choices for instruments and kits:

1. For salinity, D.O., pH, temperature - YSI meters and probes nice, but expensive. Other options include a large selection of separate meters by Pinpoint, Hanna, etc. and an "old fashioned" refractometer.

2. Nitrogenous evaluation – Portable and table top Hach meters are nice, but expensive. However, they can measure a variety of ions as well. LaMotte kits are very usable.

3. Why ORP? It's more an indicator that something otherwise not readily detectible is off in the redox cycle. By itself, it doesn't say much (unless you use ozone or your sensor is right downstream from the UV unit), but it is almost as good an indicator of overall system function as pH is. So if it starts dropping, rising, or fluctuating, it's time to start looking at the other non-routinely tested factors. Natural ORPs can occur in a huge range; it's the change that's significant.

4. We recommend that if water quality is a potential issue at your site that you take ~500 mL of incoming water weekly, label it unambiguously, freeze it, then forget about it entirely, so it's possible to reconstruct a baseline reference in the event of later problems. This would work for everything except dissolved gases, which means that you don't need to be able to predict which elements may go out of whack in the future.

5. Comments on ranges and importance of some marine water quality parameters as they pertain to shellfish hatcheries are shown in the following table.

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MEASURED PARAMETER	RECOMMENDED RANGES	COMMENTS
Rearing water temperature	Depends on species reared.	Should be monitored on continuous basis
pH	7.8 to 8.4	Range may vary with species.
Salinity	Depends on species reared	Monitoring based on local variability
Dissolved oxygen	> 5.0 mg/L, < 5% over saturation	Range may vary greatly with species; range varies depending upon temperature
Oxidation reduction potential (ORP)	150-250	Although range is highly variable, maintenance of stability is more important than exact values
Nitrogenous compounds	*Ammonia:* 0.1ppm generally safe. *Nitrite:* 0.2 ppm should generally be safe. *Nitrate:* 16 ppm in SW	Adults are hardier than larvae. Toxicity is increased by higher pH. Ammonia is generally most toxic, with nitrite being 10-100 times less toxic, and nitrate being another 10-100x less toxic than nitrite. Ammonia toxicity is a function of the amount of unionized ammonia, which varies with temperature, salinity, and pH.
Hypochlorite	None detectible	Any detectible hypochlorite can cause death.
Alkalinity	110-140; few adverse consequences if higher than 200 ppm$CaCO_3$. Also measured as dKh (norm 6-7; tolerable to 11) and meq/l (2.1-2.5)	Varies with calcium, magnesium, and pH; can be altered by several other common solutes
Total dissolved gas saturation	< 5% greater than saturation	