Water Quality in Shellfish Hatcheries and Nurseries:

Temperature, Salinity, Dissolved Oxygen
Ammonia, NO2, No3

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Water Quality

- **Temperature**– Measure of hotness or coldness
  - Either Fahrenheit (°F) or Celsius (°C)

- **Dissolved Oxygen (O_2)**– Amount of oxygen dissolved in water
  - Higher temps mean lower DO capacity
  - Inversely related to temperature

- **Salinity** – Degree of salt dissolved in water

Variation

- **Temperature**
  - Seasonal air and water temperature changes

- **Dissolved Oxygen (O_2)**
  - Higher amounts in colder waters than warmer waters
  - Organism usage

- **Salinity**
  - Fresh water influence, precipitation
  - High temperature can lead to evaporation, increase in salinity

Equipment

- **Temperature** – Weekly and continuous
    - **Temperature HOBO Data Logger**

- **Dissolved Oxygen (O_2)** – Weekly and continuous
    - **PINPOINT® II Oxygen Monitor**
    - **Dissolved Oxygen HOBO Data Logger**

- **Salinity** – Weekly and continuous
    - **Handheld Salinity Refractometer**
    - **Conductivity /Temperature HOBO Data Logger**

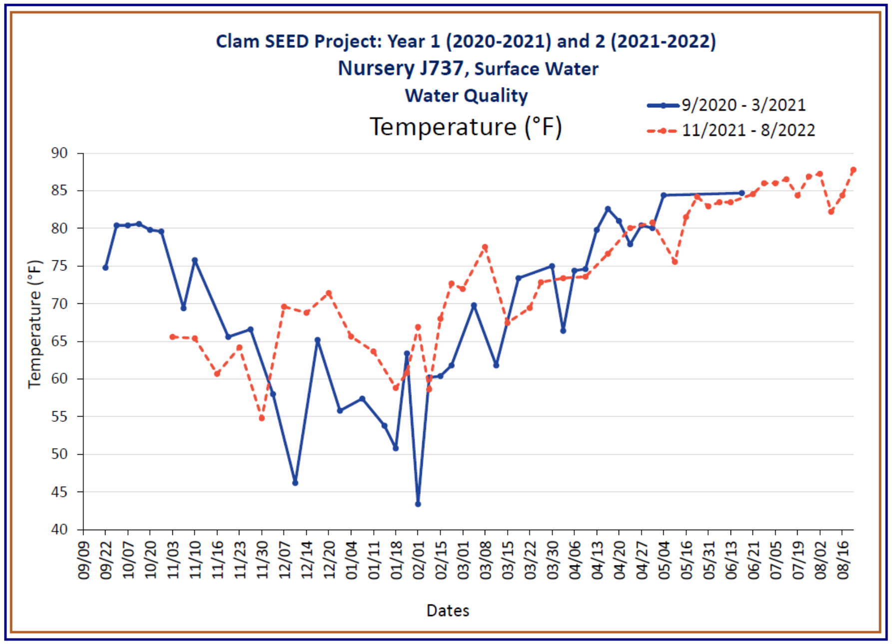
Recommendations for Shellfish Hatcheries

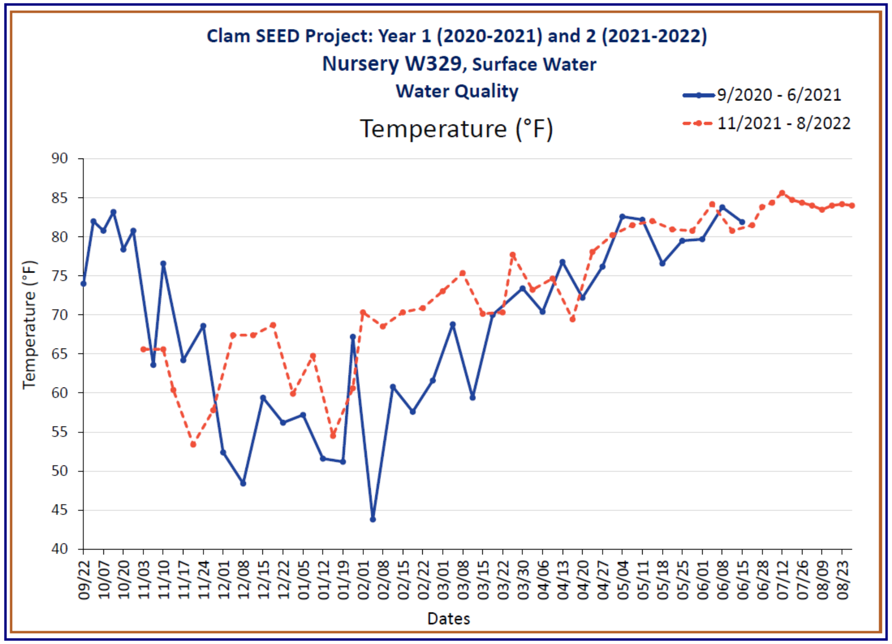
- **Temperature**
    - 75-82 °F optimal
    - 68-86 °F for larvae and post-set rearing
    - 64-68 °F for conditioning
    - 72-73 °F for rapid conditioning and prespawn priming
- **Dissolved Oxygen (O_2)**
    - >5.0 mg/L
- **Salinity**
    - 20-35 ppt
    - Range varies with life stage, monitor for variation

Importance of these Parameters

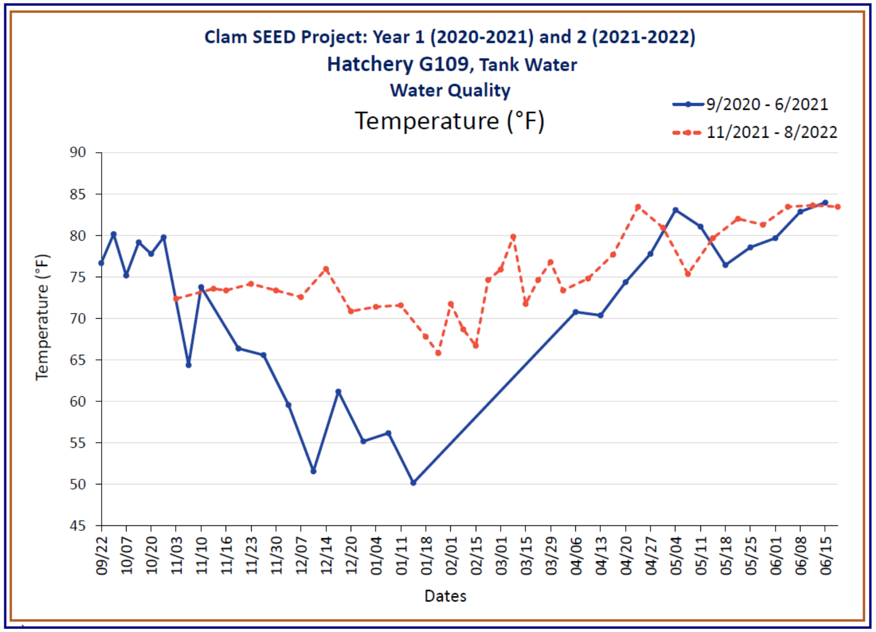
- **Temperature**
  - Quick changes can cause stress
- **Dissolved Oxygen (O_2)**
  - Required for respiration
- **Salinity**
  - Quick changes can cause stress

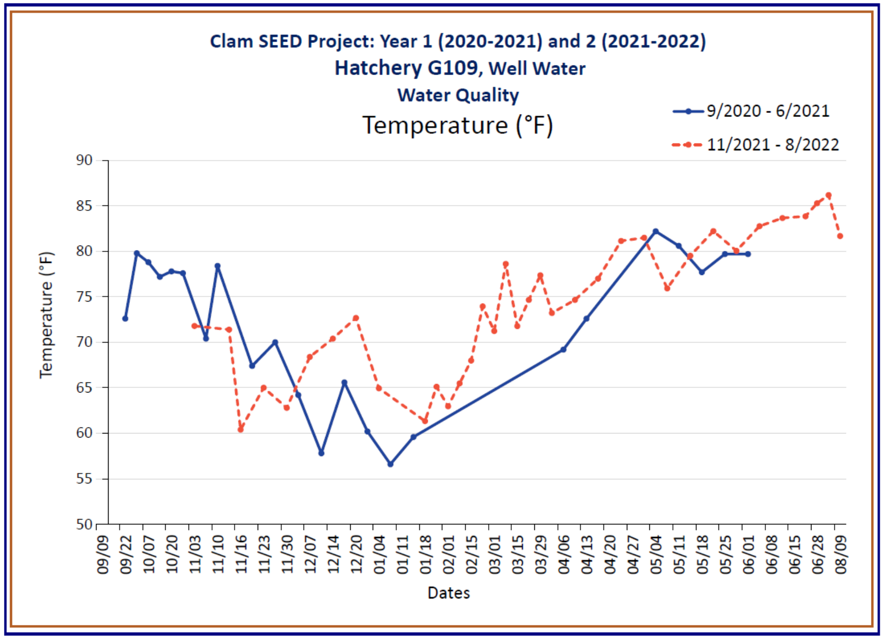
Temperature (°F)



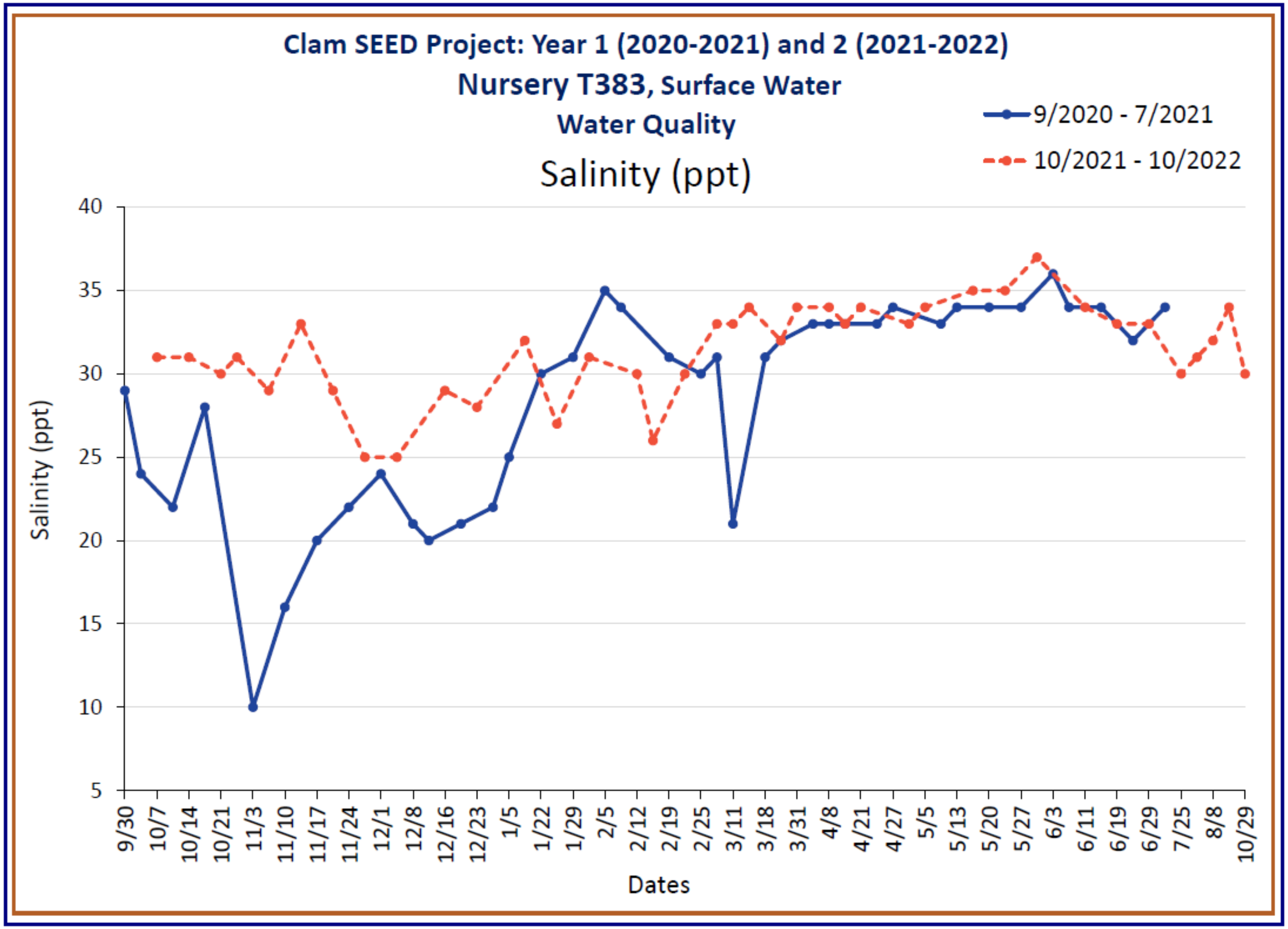


Temperature (°F)

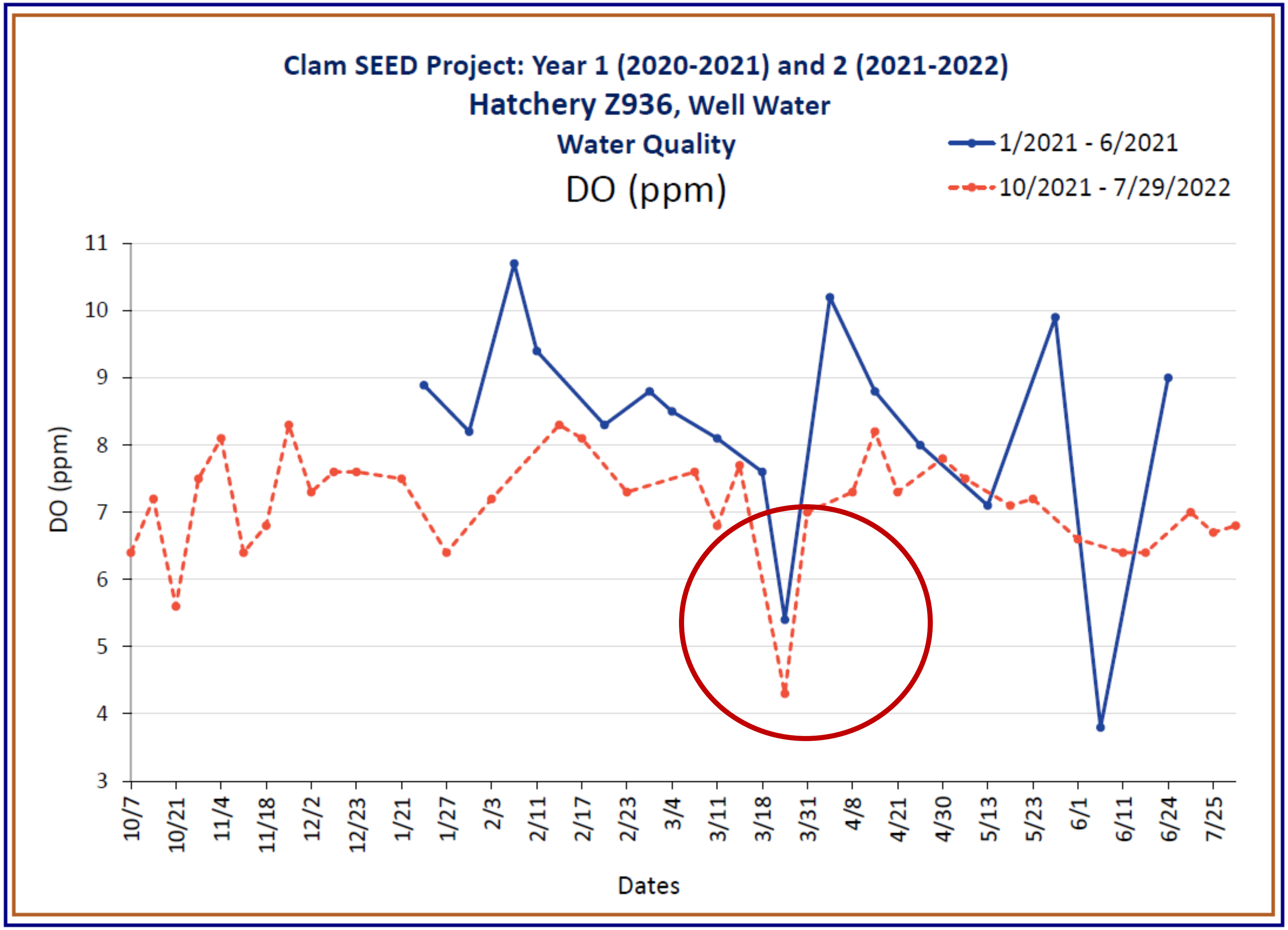




Salinity (ppt)



Dissolved Oxygen (mg/l)



Nitrogenous Compounds

- **Ammonia (NH_3)-** By-product of metabolic process (i.e., food digestion and decomposition of uneaten food and organic matter)
    - Most toxic of nitrogenous compounds; varies with salinity, pH, and temperature

- **Nitrite (NO_2)-** Formed by the oxidation of wastes containing ammonia, converted by Nitrosomonas bacteria
    - Toxicity increased by higher pH, 10-100 times less toxic than ammonia

- **Nitrate (NO_{3-})**-Final product of conversion in N cycle; converted by nitrifying bacteria
    - 10-100 times less toxic than ammonia

Equipment

- **Hach spectrophotometer**
- **Biweekly**

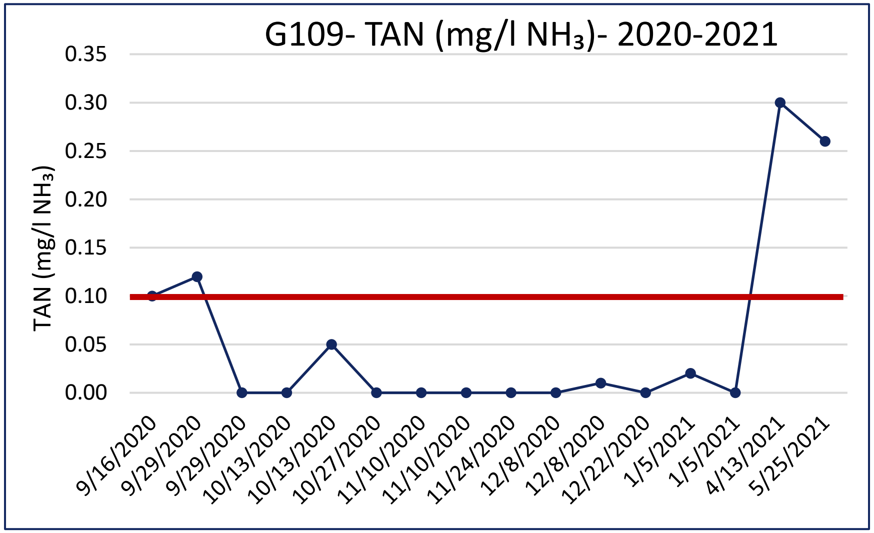
Recommendations for Shellfish Hatcheries

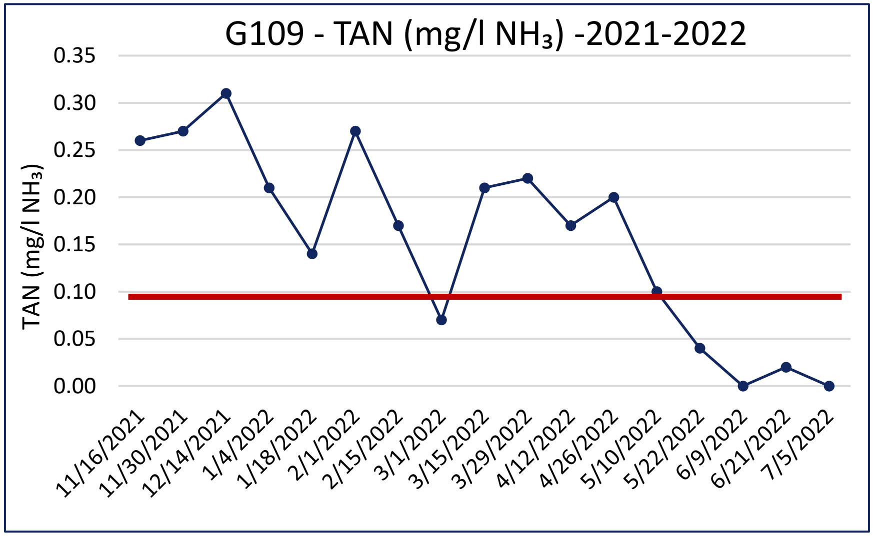
- **Ammonia (NH_3)**
  - <0.1 ppm

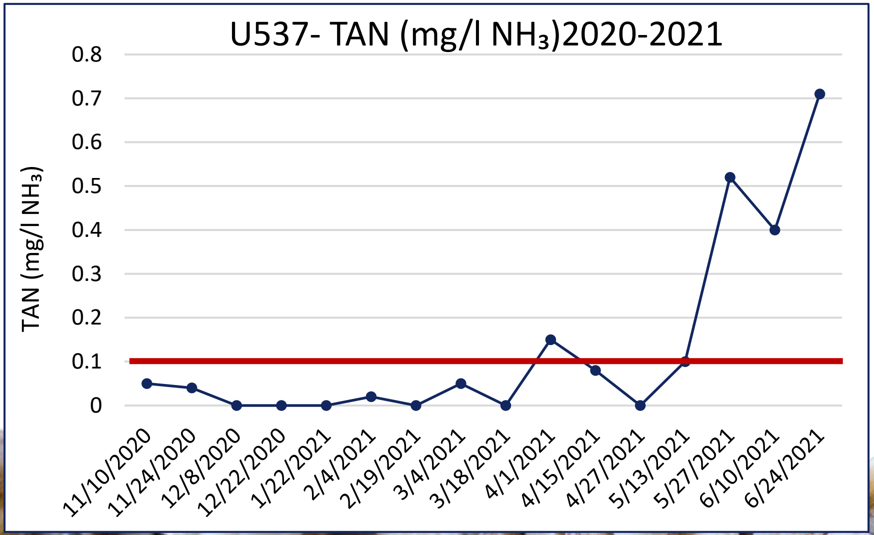
- **Nitrite (NO_2)**
  - <0.2 ppm should generally be safe

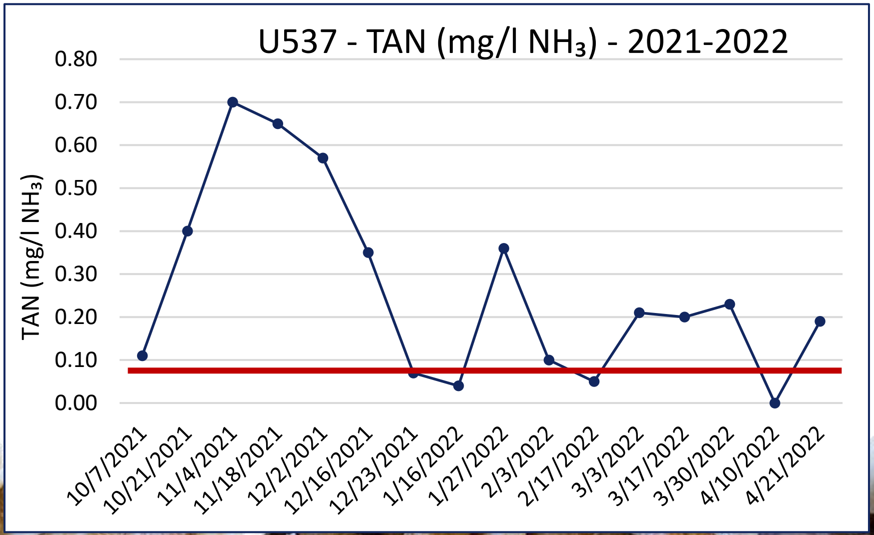
- **Nitrate (NO_3)**
  - <16 ppm in salt water

Ammonia (NH_3) - <0.1 ppm

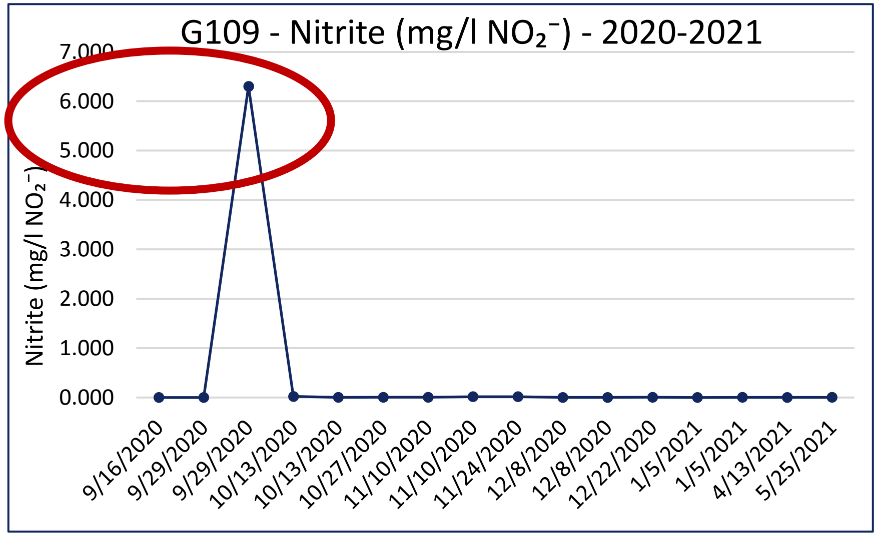


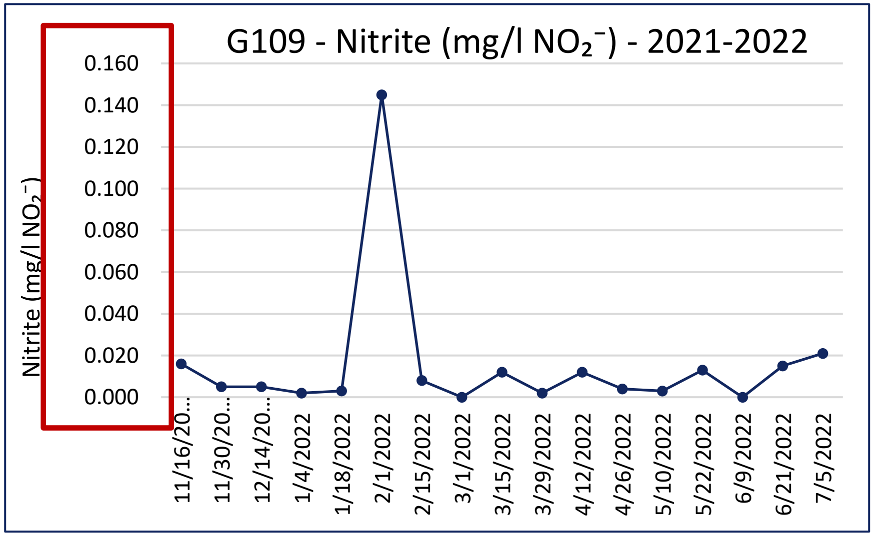






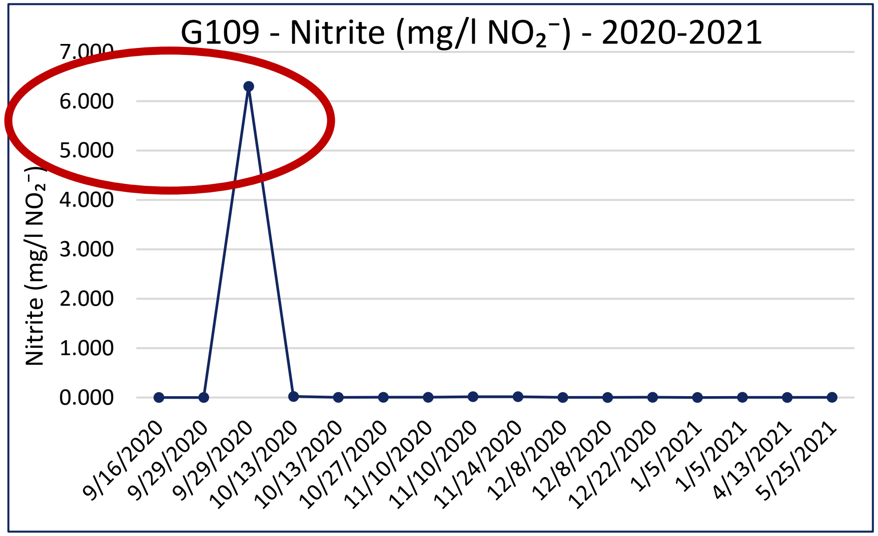
Nitrite (NO_2) - <0.2 ppm

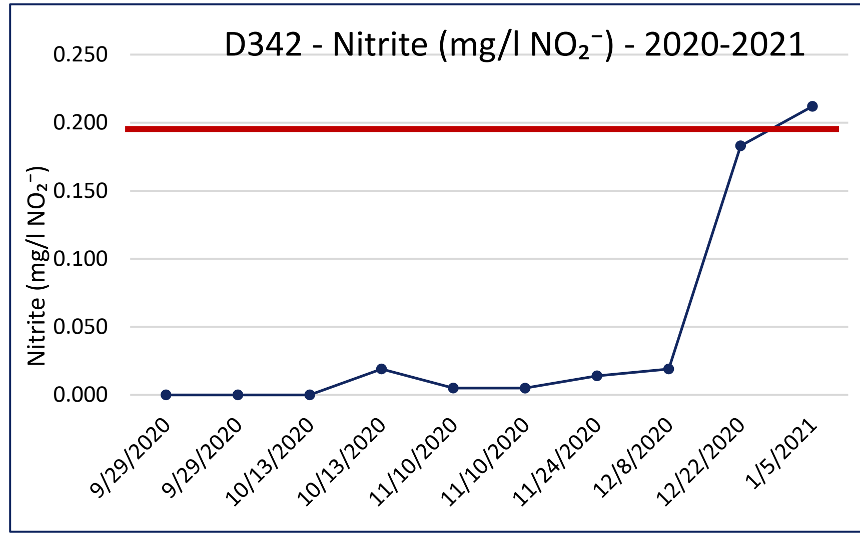


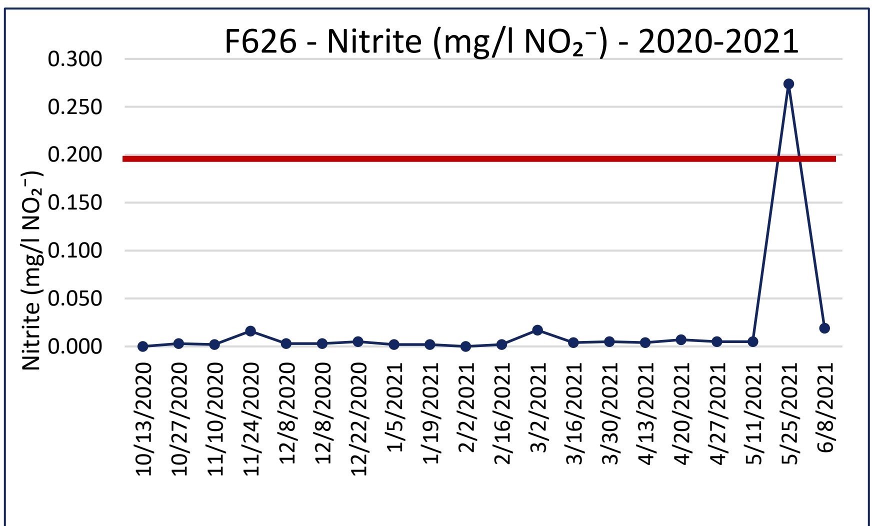


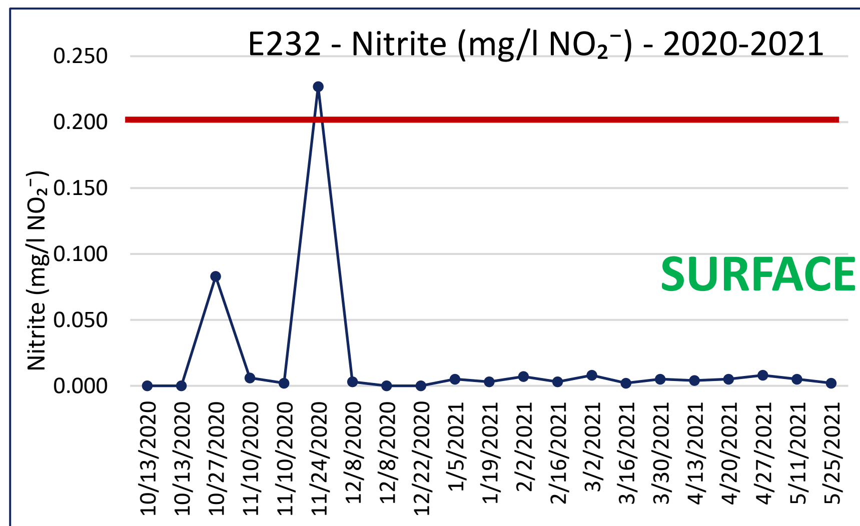
Nitrite (NO_2) - <0.2 ppm

WELL



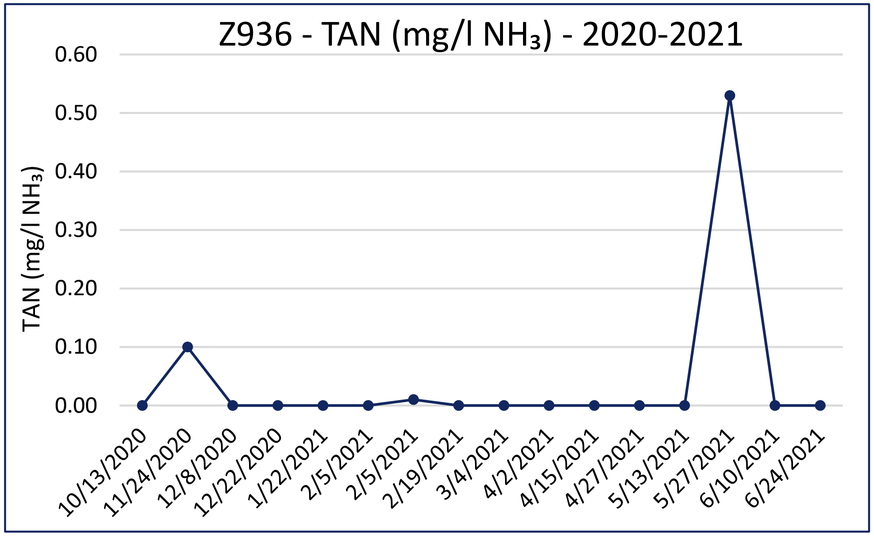


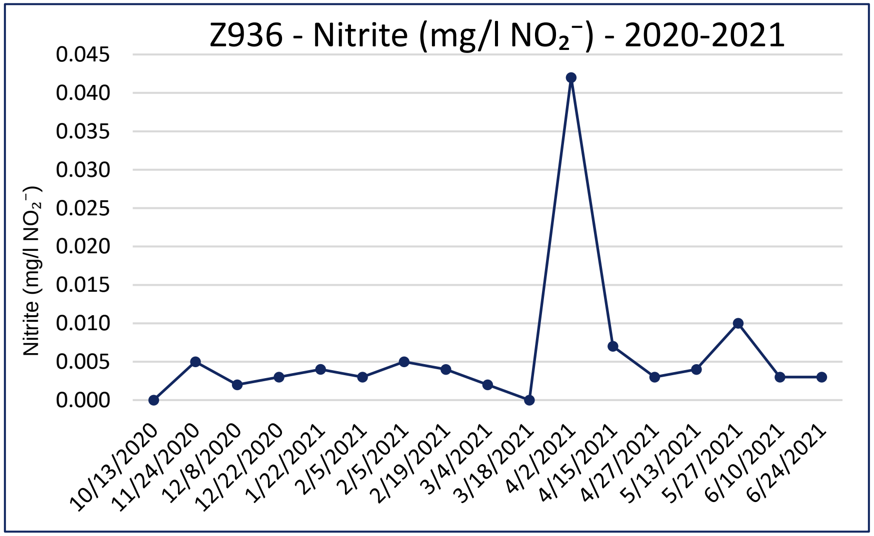


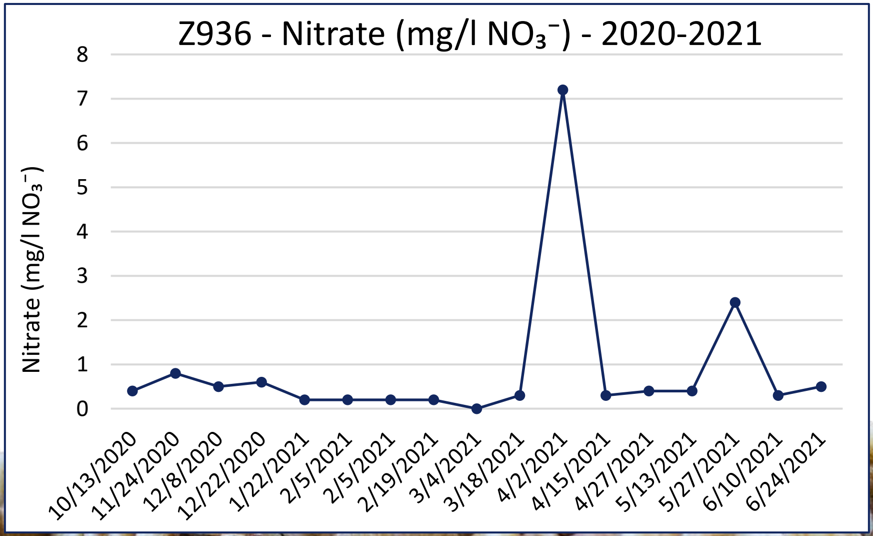


SURFACE

Hatchery, Well Source Water





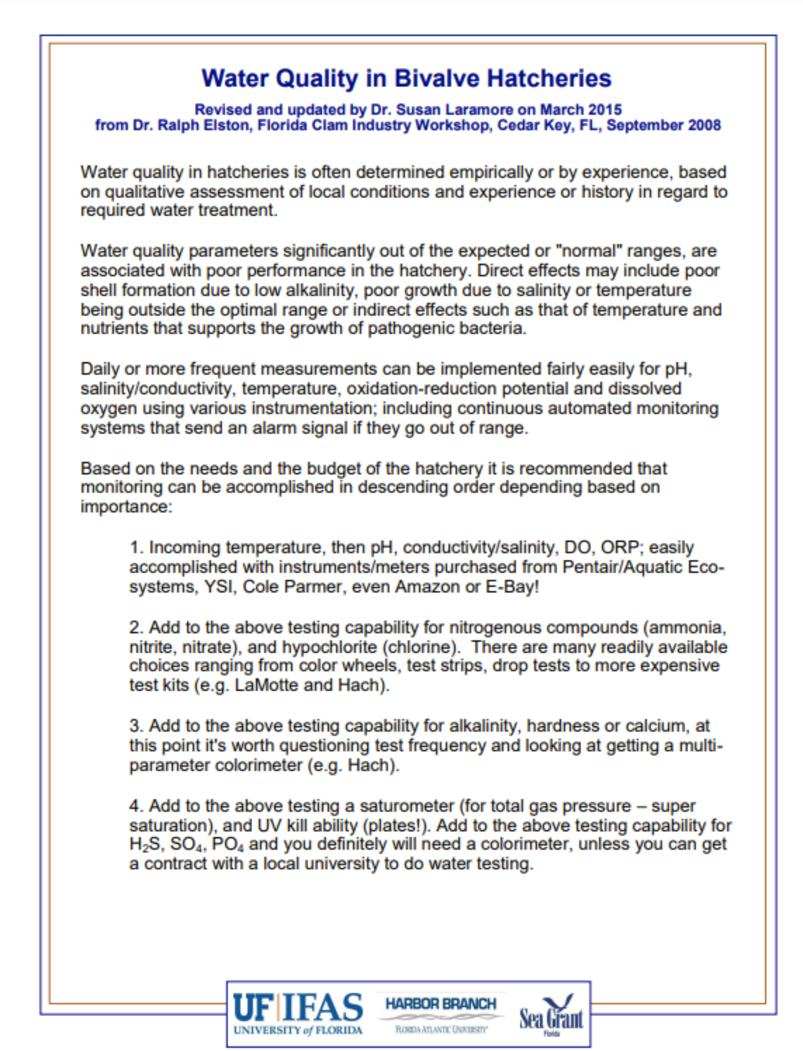


Additional Information

BASIC WATER QUALITY PARAMETERS FOR AQUACULTURE						
Measured Parameter	**Definition**	**Recommendations**	**Problem**	**Solution**	**Comments**	**References**
Alkalinity ($CaCO_3$)	Water property that resists or buffers against changes in pH upon addition of acid or base	110-140 [1] or <140 mg/l [2]; >200 ppm, few adverse consequences [1]; Also measured as dKh (norm 6-7, tolerable to 11) and meq/l (2.1-2.5) [1]	Too low	Addition of alkaline buffers used to adjust pH usually provides adequate alkalinity; if buffers contain calcium, adds to hardness	Varies with calcium, magnesium, and pH; can be altered by several common solutes (i.e., soda ash dissolved in water)	[1] Shellfish [2] Shrimp
Calcium Hardness ($CaCO_3$)	Calcium and magnesium ions in water; expressed as mg/L $CaCO_3$ equivalent	>20 ppm as $CaCo_3$ [3] 20 – 200 ppm [4]	Too low	Addition of calcium chloride to water supply	Important aspect of water chemistry in saltwater systems; closely related to pH	[3] Catfish [4] Finfish
Carbon dioxide (CO_2)	Clear gas; end product of cellular respiration	<20 mg/l (ppm) [2] <10 ppm [3] 1.5-3 ppm [4] normal range 1-10 mg/l [2]	Too high	Vigorous aeration (degassing) of incoming water; supplemental aeration in tanks	Primary greenhouse gas	[2] Shrimp [3] Catfish [4] Finfish
Dissolved Oxygen (O_2)	Amount of oxygen dissolved in water; higher amounts in colder waters than warmer waters	>5.0 mg/L [1] <5% over saturation [2] 5 ppm to 90% of saturation level [3]	Too low	Vigorous aeration of incoming water; supplemental aeration in tanks	Range may vary with species and life stage; varies depending upon temperature	[1] Shellfish [2] Shrimp [3] Catfish
Hydrogen Sulfide (H_2S)	Colorless gas with strong odor of rotten eggs, exists as ionized and unionized	<0.005 ppm [3] <0.002 ppm [4] <0.1 mg/l [2]	Too high	Vigorous aeration (degassing) of incoming water	Unionized form toxic to aquatic organisms; dependent on pH, temperature, salinity	[2] Shrimp [3] Catfish [4] Finfish
Hypochlorite ($Ca(ClO)_2$)	Chemical compound widely used for water treatment and as a bleaching agent	Non detectable [1]	Detectable	Commercial sodium thiosulfate used as a neutralizer; 1.5 grams required to neutralize each liter of 200 ppm chlorine solution	Disinfectant used in cleaning tanks; any detectible level can cause mortality to shellfish	[1] Shellfish
Iron (Fe)	Chemical element, a metal; by mass, the most common element on Earth	<0.5 ppm total iron [3]	Too high	Aeration (oxidation) followed by filtration (i.e., activated carbon) and/or precipitation	Saltwater from wells often contains high levels of iron and other minerals	[3] Catfish [4] Finfish

Fact sheet and website page
https://shellfish.ifas.ufl.edu/clam-seed-project-2020-22/

Additional Information



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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Handheld Salinity Refractometer
2022

PINPOINT® II
Oxygen Monitor
2022

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