Water Quality BMP's
The Key to Good Fish Husbandry

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Aquaculture Realism

- "A Severely or Chronically Stressed Fish is a Dead Fish"
  - Severe stress is typically caused by a sudden event, causing death within minutes or up to a day.
  - Chronic stress is longer term exposure to poor living conditions, causing impairment to the immune system.
    - "A chronically stressed fish is a diseased fish and then eventually a dead fish"

An Interesting Insight

- "A Successful Fish Culturist is not successful because he or she is a successful biologist, physiologist etc";
- "No, he or she is successful in large part because he or she is a successful water quality and aquatic waste management specialist".
- "If you successfully degrade generated fish wastes and uneaten food safely and therefore maintain excellent water quality, the fish will take care of themselves".

Water Quality BMP I

- Set Realistic Production Goals!
  - In aerated Midwest ponds, a realistic production goal is 3000 pounds of fish per acre. Above that requires increasing the pond's ability to digest additional wastes.
  - In RAS systems, production is based on gallons of water (living space) and the size of the filtration systems. ½ lb. per gallon of water.
  - In flow-through systems, production is essentially based on gallons of water and exchange rate. Flushing of wastes.

Water Quality BMP II

- Monitor the Right Parameters & Know Why!
  - Water temperature
  - Dissolved oxygen
  - pH
  - Nitrogen compounds
    - Nitrite
    - Ammonia
    - Un-ionized ammonia
  - Alkalinity
  - Carbon dioxide

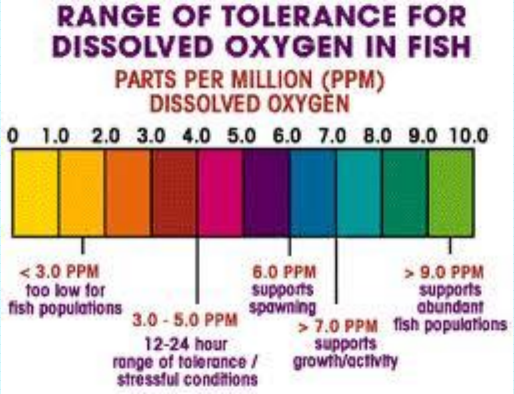
SRAC has fantastic factsheets on water quality!

Water Temperature

- Each fish species has upper lethal thermal limits. Ex. Rainbow trout will start dying once water temps exceed 68 F.
- Elevated water temps can cause stress, leading to health issues.
- High water temps also negatively impact biological degradation of wastes. Bacteria less efficient!
- Needed to calculate un-ionized ammonia levels!

Dissolved Oxygen

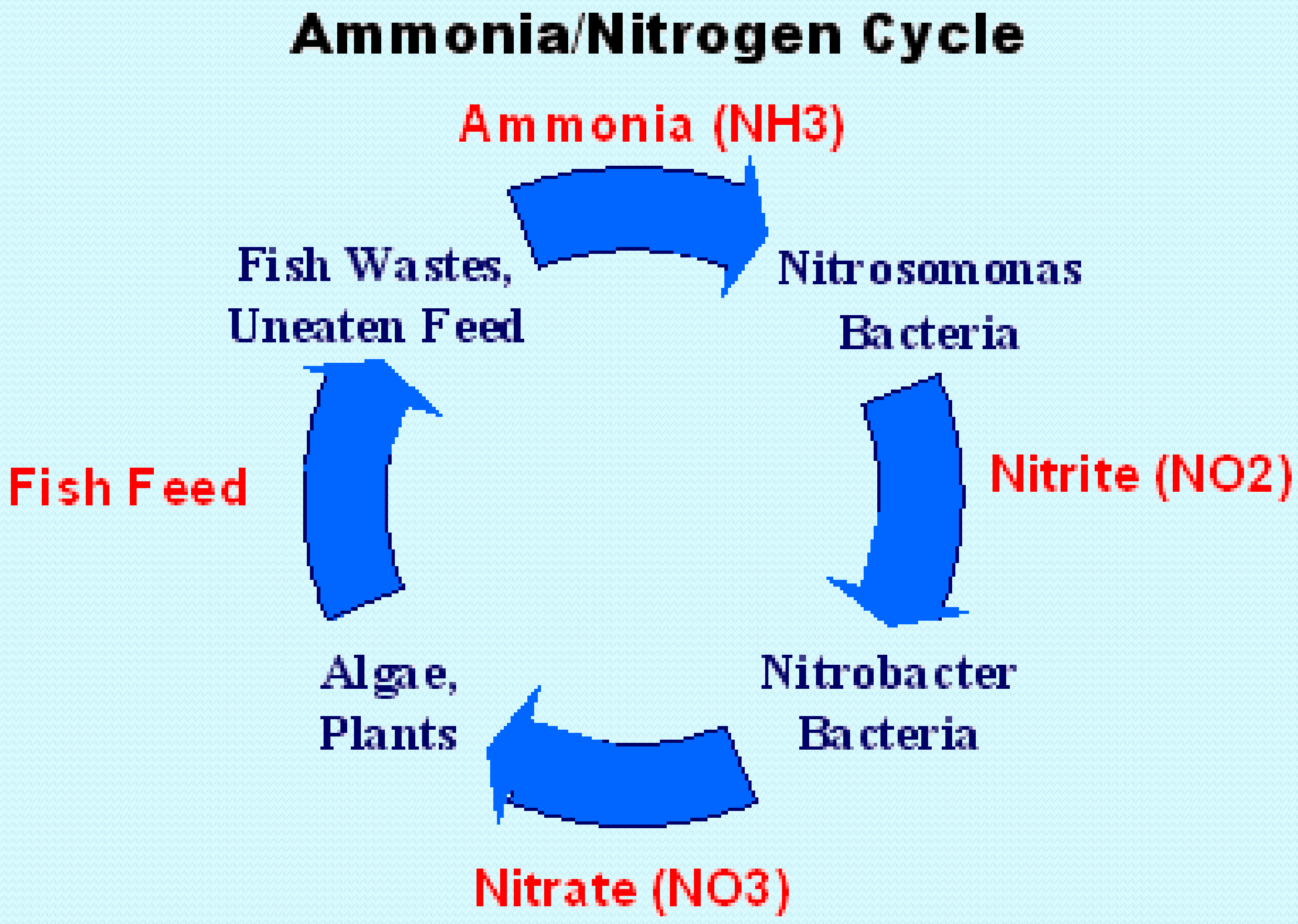
- Less than 4 ppm can lead to chronic fish stress, less than 3 ppm can lead to fish deaths.
- Dissolved oxygen utilized by fish, plants, and bacteria.
- Bacteria most efficient in degrading wastes need oxygen! Aerobic bacteria.
- Strong pattern of daily and seasonal variation.



pH

- Most fish species tolerate 6.5 – 9.0 well, chronic exposure to lower & higher can become problematic. Avoid sudden changes!
- Bacteria critical to waste degradation function best at levels between 7.0 and 8.5.
- Needed to calculate un-ionized ammonia levels!
- Can be done with a meter! Easy!
- Higher pH in glaciated Ohio, 7.5 -9.0 common. 7.0 – 8.0 in Eastern Ohio.
- Strong daily variation due to carbon dioxide levels, which is related to plant & algae density.

Nitrogen Compounds



Nitrogen Compounds

- Nitrate (NO_3)
  - Non-toxic up 200 ppm. Aquatic plants / algae quickly uptake nitrates.
- Nitrite (NO_2)
  - Very toxic to fish at very low levels, causes brown blood disease.
  - Fortunately, quickly converted to nitrates by bacteria.
  - Rare in ponds, a real concern in tank culture.
- Total Ammonia (TAN)
  - Ionized ammonia (NH_4^+)
    - Not toxic at typical pond levels, be careful in RAS!
  - Un-ionized ammonia (NH_3)
    - Reduced feeding at 0.06 ppm, mortality above 0.6 ppm.
    - Levels increase with higher pH and water temperatures.

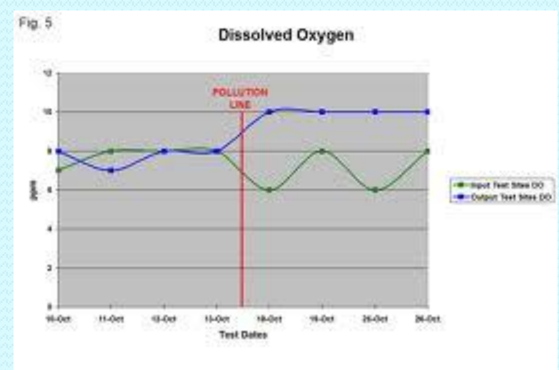
Water Quality BMP III

- Regularly monitor water quality parameters!
  - Oxygen / Temperature (AM)
    - Daily in ponds during warm weather and periods of heavy feeding. Once every 2-3 days otherwise.
    - Twice a day (12 hrs. apart) in RAS systems.
  - pH, nitrites, ammonia
    - Once every 2-3 days in ponds during warm weather and periods of heavy feeding. Weekly otherwise.
    - Twice a day in RAS systems.
  - Carbon Dioxide, Alkalinity
    - Weekly in ponds.
    - Daily in RAS systems.

Conditions can degrade very quickly in RAS systems, requires daily monitoring & attention.

Water Quality BMP IV

- Religiously record water quality data and set parameter goals!
  - Allows one to monitor trends, can be proactive in preventing a potential problem.
  - Provides a written historical record to look back over when similar concerns arise.
  - A fish health specialist / veterinarian will always ask to look at recent water quality data when problems arise.



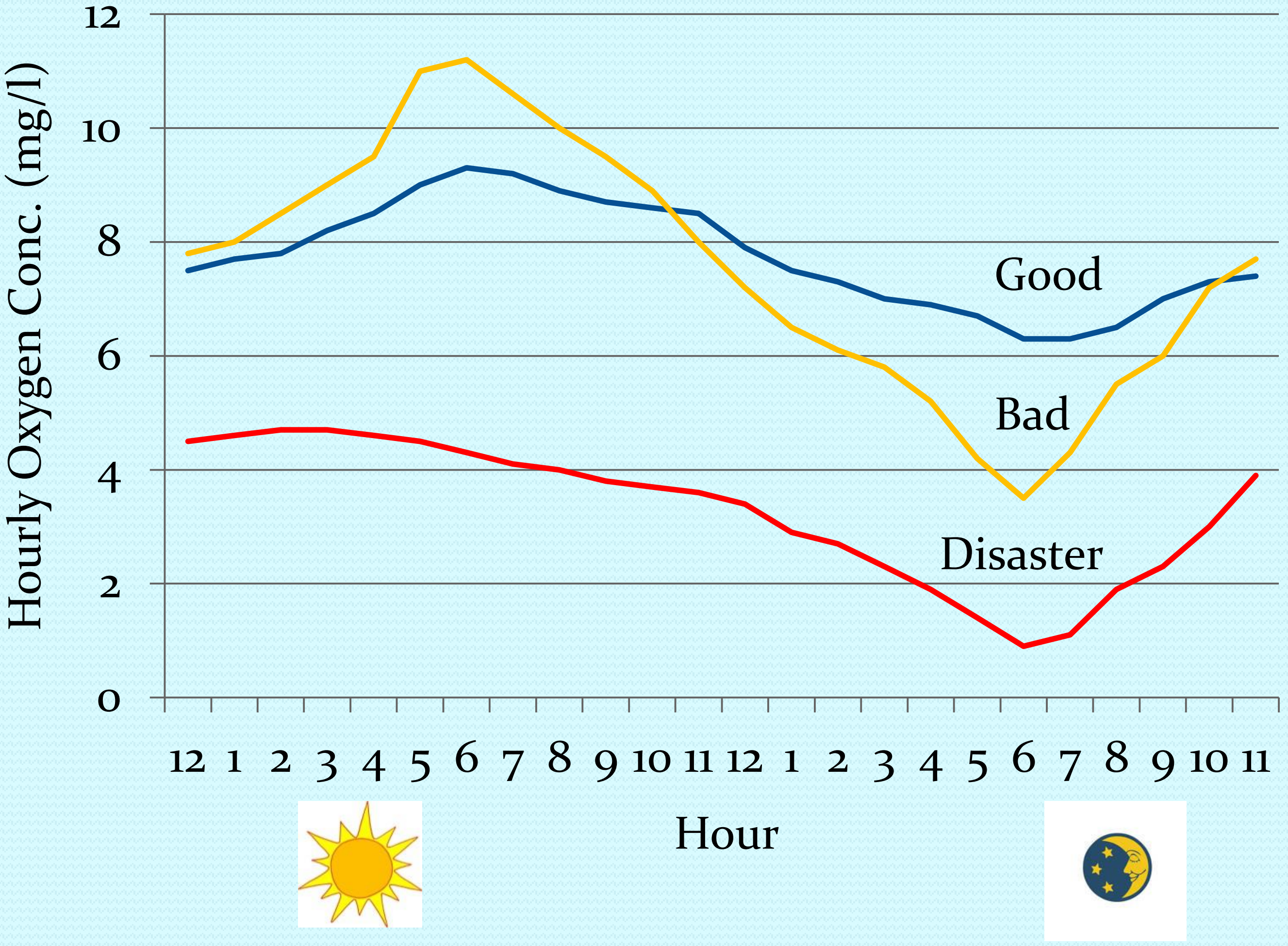
Water Quality Goals (0.5 m)

- Typical Published
  - AM Oxygen > 4 ppm
  - pH 6.5 -9.0
  - Hardness > 20 ppm
  - Alkalinity > 90 ppm
  - Nitrites < 0.05 ppm
  - Carbon dioxide < 20 ppm
  - Ammonia < 1 ppm
  - Un-ionized ammonia < 0.06 ppm
- Millcreek Perch Farm's
  - AM Oxygen > 5 ppm
  - pH 7.5 – 8.5
  - Hardness > 80 ppm
  - Alkalinity > 150 ppm
  - Nitrites < 0.02 ppm
  - Carbon dioxide < 5 ppm
  - Ammonia < 0.5 ppm
  - Un-ionized ammonia = 0.02 ppm

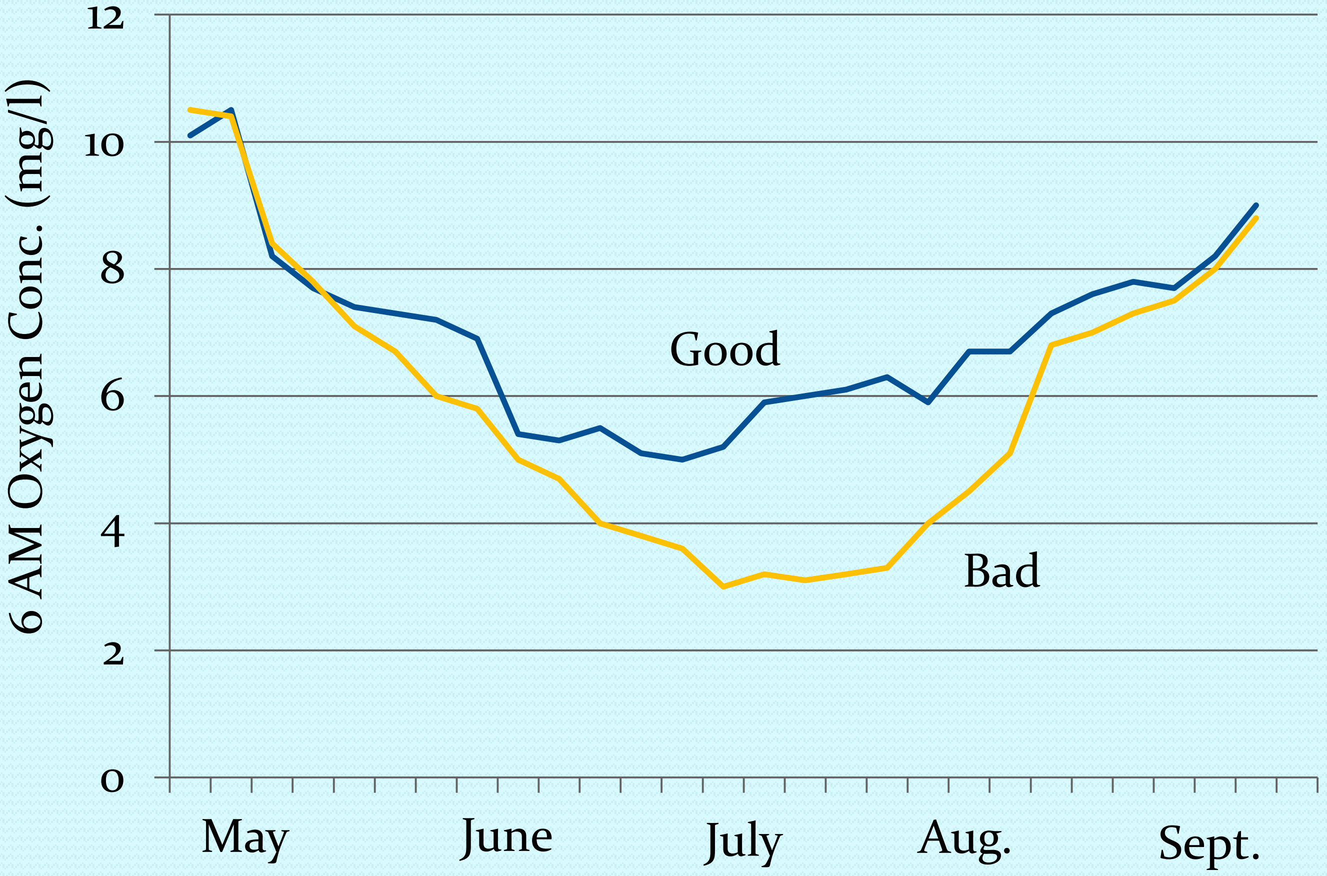
Water Quality BMP V

- Monitor Water Quality Trends
  - Trend monitoring allows assessment of how the production unit is functioning, whether it is a pond or a recirculating aquaculture system (RAS).
  - Allows assessing impacts of changes to the unit, such as increased feeding.
  - Can alert culturist to impending problems, thereby allowing a corrective action(s) to be instituted early.
  - Water quality must be monitored regularly to allow development and evaluation of trends.

Oxygen: Daily Variation
(do monthly in ponds / weekly in RAS)



Oxygen: Growing Season Variation



pH: Daily Variation
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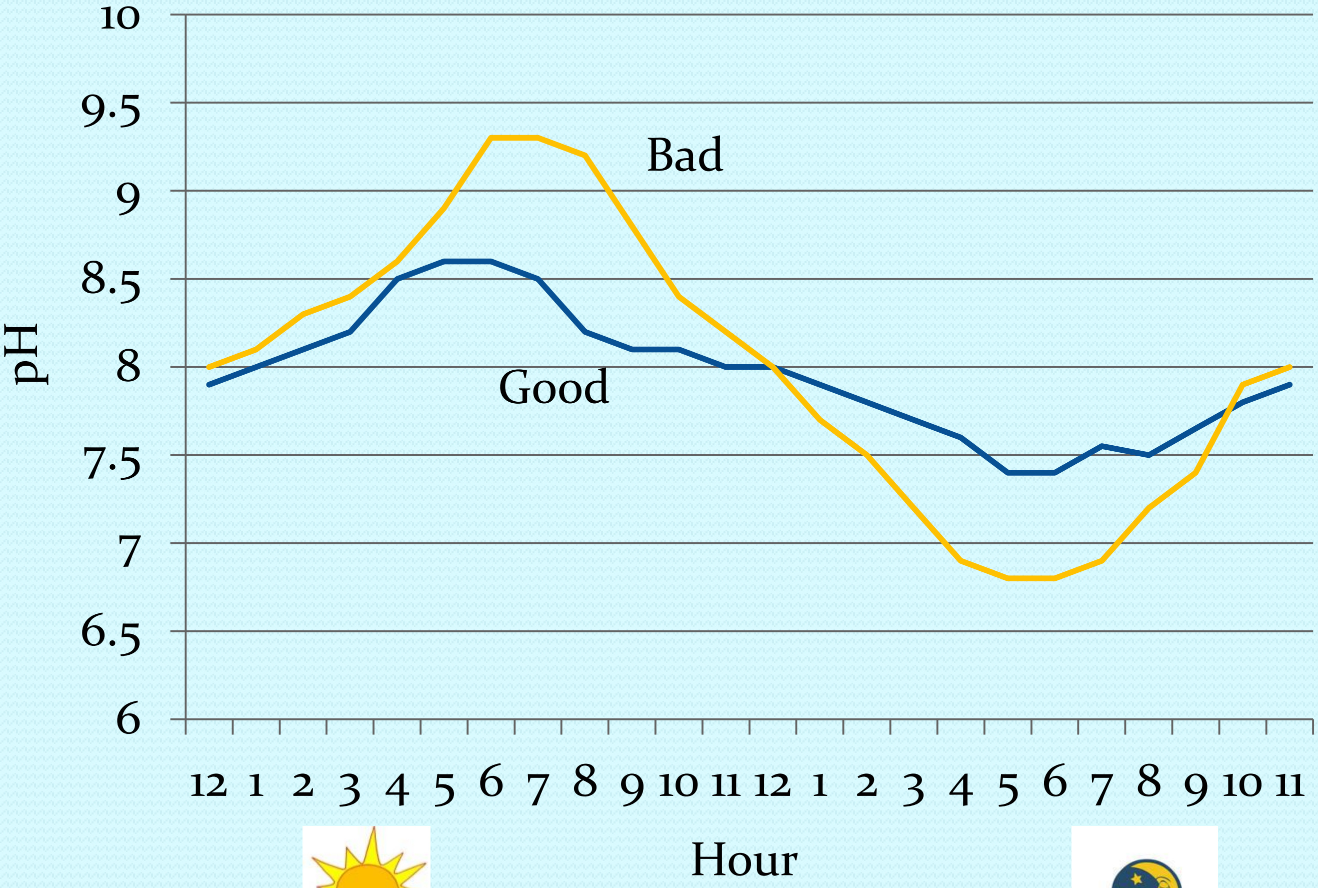
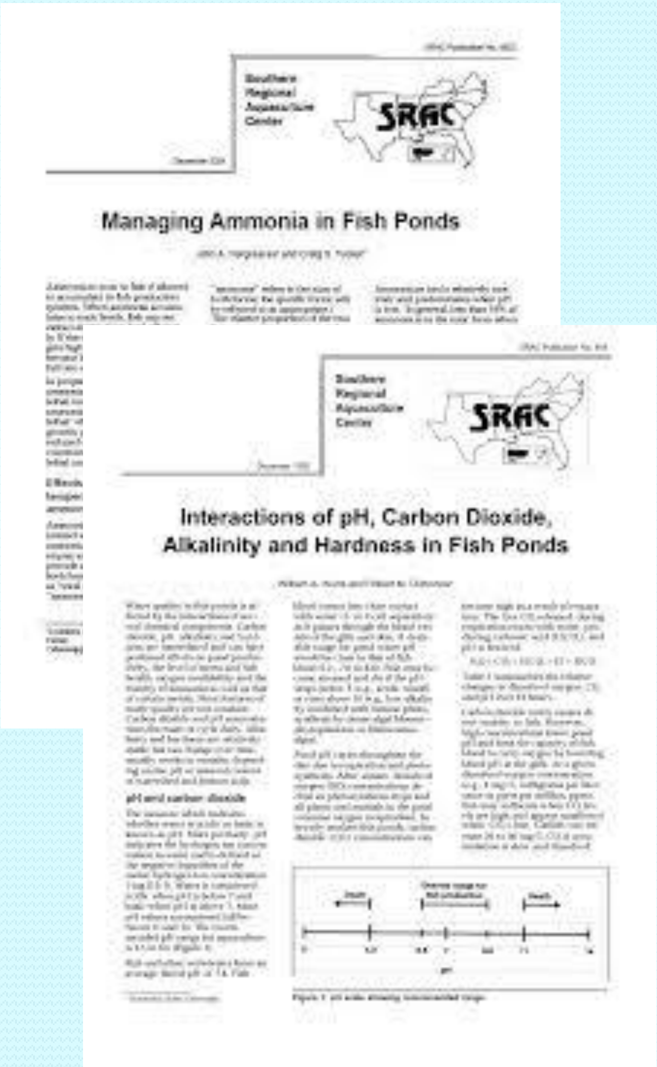


Water Quality BMP VI

- Understand Factors that Influence Water Quality Parameters
  - Sunlight / Photosynthesis
  - Seasonal
  - Water temperature
  - Amount of aquatic plants / algae / planktonic algae
  - Bacteria
  - Interactions between monitored water quality parameters as well as above factors.



Education! Education!

- Be a life-long learner!
- Use all sources of information on water quality, fish health, and fish husbandry.
  - State extension programs
  - Factsheets, bulletins, published articles, websites (SRAC)
  - Workshops
  - Other culturists!
- Create, review and re-work your own Water Quality & Fish Husbandry BMP – it is a living document.