1.7) DIURNAL AND SEASONAL POND DYNAMICS

Objective: This field exercise will allow you to record and evaluate the complex interrelationship between weather, daylight hours, temperature, and oxygen levels in a hypereutrophic pond.

Introduction: Even though aquaculture has been practiced for at least 3,000 years, its role has increased dramatically in the last few decades due to recent declines in wild fisheries. Most countries practice some form of "semi-intensive" aquaculture whereby natural productivity from the ponds provide more than half the nutritional needs of the animals that are being raised. Natural productivity is facilitated by adding fertilizer to the water to stimulate algal growth. This also increases the levels of zooplankton and benthic invertebrates that serve as food for the target species.

Turbidity readings provide a rough estimate for the density of phytoplankton. In semi-intensive aquacultural facilities, turbidity readings are usually taken every afternoon and by rule of thumb, visibilities of less than 30 cm require corrective measures. At these lower levels of visibility, the increased risk of an algae die-off outweighs the nutritional benefit of the plankton because it leads to dangerously low levels of dissolved oxygen. This situation is usually remediated by means of water exchanges.

Surface waters near large human populations often have very high algae densities due to nutrients released by human wastes and agricultural runoff. This often results in "dead zones" during the warmer months due to the inability to remediate during low oxygen events.

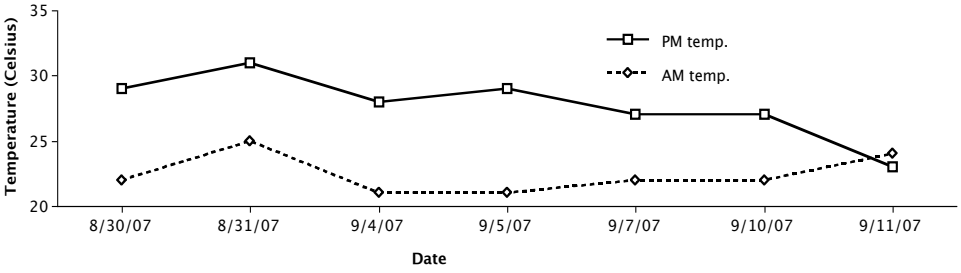
Procedure:

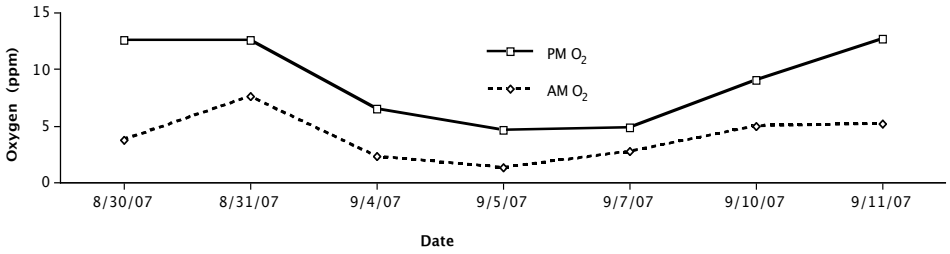
1) Choose a hypereutrophic pond and take the following measurements daily:
    a. Dissolved oxygen (morning and afternoon)
    b. Temperature (morning and afternoon)
    c. pH (optional)
    d. Turbidity (afternoon)

2) Record your data in a table, and enter oxygen and temperature into a spreadsheet program in order to generate the following six graphs:
    a. Line graph 1: x-axis = date, y-axis = AM temperature and PM temperature (2 lines)
    b. Line graph 2: x-axis = date, y-axis = AM oxygen and PM oxygen (2 lines)
    c. Line graph 3: x-axis = date, y-axis = AM oxygen and AM temperature (2 lines)
    d. Line graph 4: x-axis = date, y-axis = PM oxygen and PM temperature (2 lines)
    e. Scatter plot 1: x-axis = AM temperature, y-axis = AM oxygen
    f. Scatter plot 2: x-axis = PM temperature, y-axis = PM oxygen

Below are sample graphs 1 and 2 based on an actual data set taken in the Fall of 2007. The gaps between August 31 and September 4 and September 7 to 11 represent weekends and holidays. Note that this graph represents only two weeks of data. Your graph should span a period of 2 to 3 months:

Date	AM temp (°C)	PM temp (°C)	AM O_2 (ppm)	PM O_2 (ppm)
30-Aug	22	29	3.8	12.6
31-Aug	25	31	7.6	12.6
4-Sep	21	28	2.3	6.5
5-Sep	21	29	1.3	4.6
7-Sep	22	27	2.7	4.8
10-Sep	22	27	5	9
11-Sep	24	23	5.2	12.7





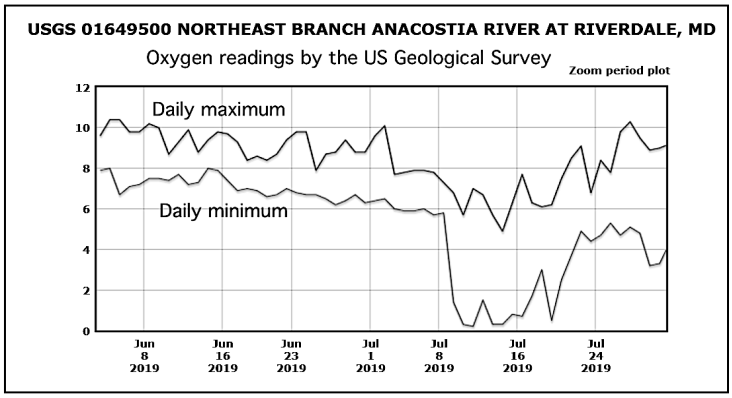
Questions:

1. What is the effect of time of day on dissolved oxygen? What is the reason for this?

2. Based on your scatter plots, is there a significant correlation between oxygen and temperature? Which correlation between oxygen and temperature is stronger, AM or PM? What is responsible for this difference?

3. What organisms contribute the most to turbidity in hypereutrophic ponds?

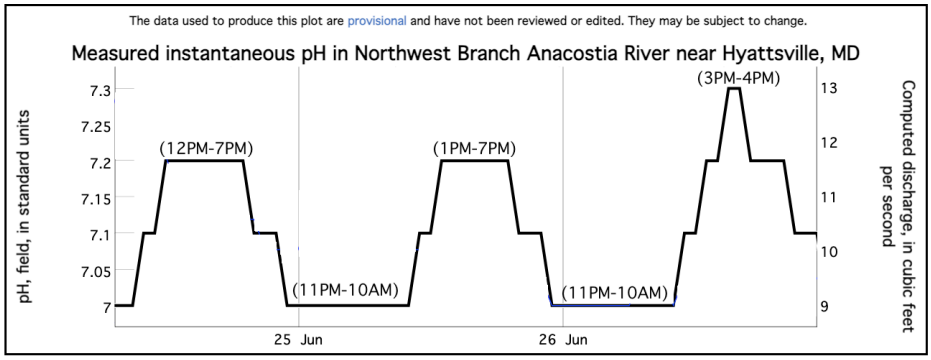
4. The graph below is based on data provided by the US Geological Survey in 2019. Based on the data you collected, what portion of the day is responsible for the "daily maximum" readings for dissolved oxygen?



5. What happened in the second week of July? What is responsible for this event? *Hint: Re-read the introduction*.

6. Based on what you learned in other labs, what dissolved gas plays a major role in diurnal variations of pH in natural waters?

7. The graph below is based on data provided by the US Geological Survey in 2010. Based on the diurnal variations in pH shown in this graph, what process is responsible for the minimum readings? Explain:



8. What process is responsible for maximum pH readings represented in the graph? Explain:

Assignment Checklist:

1. Did you completely answer all the questions?
2. Did you generate the six graphs indicated in the instructions?