Day #4– Phytoplankton Growth and Dissolved Oxygen

Student Information and Activity:

The California Current Ecosystem **LTER** *(Long Term Ecological Research)* is studying the California Current coastal pelagic ecosystem, with special interest in the long-term forcing by the **ocean warming processes** of the Pacific Decadal Oscillation, and El Niño, and how they are changing the structure and dynamics of the entire ecosystem. These two major phenomena result in changes in oceanic surface temperatures, which in turn can greatly affect the oceanic ecosystems and coastal climate patterns.

The California Current ecosystem is important for many reasons such as it sustains active fisheries for a variety of fish species and marine invertebrates, helps to control weather patterns and the water cycle for much of the western United States, and plays a vital role in the economy of many coastal communities. Dr. Mike wants to know where in the region the phytoplankton are growing the best and *why*. This is important to him because phytoplankton are at the base of the oceanic food web so are directly important to the health of the ecosystem but also for the fact that **phytoplankton produce oxygen** during *photosynthesis*, and the oxygen concentrations in the ocean are *important to keep the ocean healthy.* Dr. Mike has chosen two stations to take the research ship, The Melville, and collect water samples to study the phytoplankton in the area.

The two stations are labeled- Station #1, which is close to shore *(inshore station)*, and Station #2, which is further offshore *(offshore station)*.

At each station, Dr. Mike and his graduate students lowered the rosette *(the sampling instrument)* to collect water from different depths. *See video of rosette being lowered* (http://youtu.be/f_SHCc5Ton4). The rosette allows water samples to be collected at various depths along the way back up- opening and closing values to allow water to be trapped from specific depths along the way. The students measured the phytoplankton concentration by measuring the

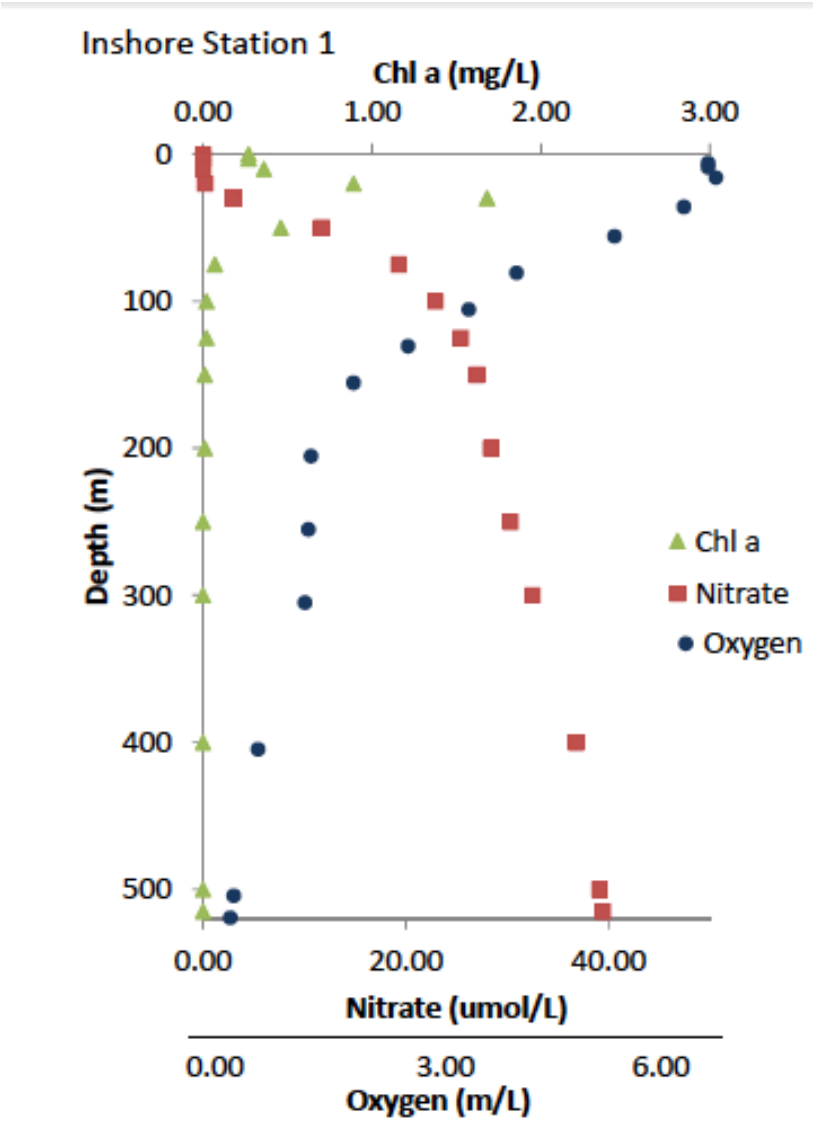
concentration of chlorophyll *a* **(Chla)**, which is a direct product of photosynthesis and they also measured the concentration of the important nutrient, **Nitrate**, and the concentrations of **Oxygen** at each depth. The oxygen levels can be directly correlated to productivity (mostly phytoplankton) in the ecosystem. Thus, by monitoring these different nutrients and products of productivity, scientists can see how healthy the ecosystem is as a whole. *The values they measured are shown in the two tables below for each station.*

Student Instructions:

Use the table to make a line graph of *each variable* as related to depth from surface down **(Chla, Nitrate and Oxygen)**. Create one for EACH STATION. *(See example graph on next page)*

Fill in the graphs provided on the separate sheet by plotting each variable on a different x-axis but the same y-axis (depth). *Use a different color* for each variable and make sure to label each variable with the corresponding color in a **LEGEND or KEY. Then answer the following questions using your graphs.**

Example Graph- Station #1



Inshore Station 1				Offshore Station 2			
Depth (m)	**Oxygen (ml/L)**	**Nitrate (µmol/L)**	**Chl a (mg/m³)**	**Depth (m)**	**Oxygen (ml/L)**	**Nitrate (µmol/L)**	**Chl a (mg/m³)**
0	5.83	0.00	0.27	0	5.82	0.00	0.13
3	5.83	0.00	0.27	3	5.82	0.00	0.13
10	5.92	0.00	0.36	10	5.82	0.00	0.13
20	6.03	0.20	0.89	16	5.82	0.00	0.13
30	5.55	3.00	1.68	20	5.82	0.00	0.13
50	4.75	11.70	0.46	30	5.81	0.00	0.13
75	3.62	19.30	0.07	45	5.8	0.00	0.14
100	3.07	22.90	0.02	50	5.88	0.00	0.22
125	2.37	25.40	0.02	75	5.39	3.80	0.66
150	1.74	27.00	0.01	100	4.82	11.20	0.17
200	1.25	28.40	0.01	125	4.03	17.30	0.08
250	1.22	30.30	0.00	150	3.28	21.90	0.00
300	1.18	32.50	0.00	200	2.58	26.50	0.00
400	0.64	36.80	0.00	250	2.22	29.30	0.00
500	0.36	39.10	0.00	300	1.56	31.60	0.00
515	0.32	39.40	0.00	400	0.98	37.40	0.00
				500	0.49	40.20	0.00
				515	0.41	40.60	0.00

Data Analysis and Conclusion: *What do your oceanography data mean?*

1. Before you look at the tables or the data, make a prediction of what might be different between these two areas of the ocean *(the "inshore" station versus the "offshore" station)*, based on how close to shore they are? *For example*, do you think there are more fish at one station than another? More nutrients? *(Hint: Think about where most of the nutrients come from)* **Explain your answer.**

2. Make two graphs, one for the inshore station and one for the offshore station. Look at the graphs you have made and circle the depths at each station where there is the **highest chlorophyll level.**

3. *Use your graphs to answer the following question*. At <u>what depth</u> at each station does the **nitrate** start to increase? *(Hint: Choose the depth where the nitrate begins to be higher in concentration than the preceding depths.*

4. Use your graphs and tables to answer the following question. <u>At what depth</u> (s) for each station are there the *highest oxygen concentrations*?

5. What do you notice about the depth where there is a maximum in chlorophyll and where the nitrate starts to increase? *Why do you think there is a maximum in chlorophyll at this depth and not right at the surface closest to the sun?*

6. *What have you learned* about **where phytoplankton prefer to live**?

7. Which station do you think supports a healthier food web? ***Explain your answer including prior food web knowledge.*** *(See Day #1)*