HARMFUL ALGAL BLOOMS OF PSEUDO-NITZSCHIA IN THE SANTA BARBARA CHANNEL

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Abstract:

The specific study of the diatom known as *Pseudo-nitzschia* is conducted here to provide quantitative data of algal blooms and insight on why predictions based purely on environmental factors may not accurately determine the number of *Pseudo-nitzschia* in a body of water. Some *Pseudo-nitzschia* are known to produce a neurotoxin known as domoic acid. Domoic acid is responsible for amnesic shellfish poisoning. Bait fish that feed on phytoplankton such as *Pseudo-nitzschia* become carriers of this toxin affecting the neurosystems of their predators (sea mammals, and birds) often resulting in death. Harmful Algal Blooms (HABs) are periods of time when there is a high concentration of harmful phytoplankton in the water column causing negative impacts on organisms higher in the food web. A HAB of *Pseudo-nitzschia* occurs when there are over 10,000 cells found per liter of seawater. The objective of my project is to test the California-Harmful Algal Risk Mapping Model provided by CenCOOS (Central and Northern California Ocean Observing System) against the data I collected off the Goleta beach pier. Predictions and models given by sites similar to CenCOOS sometimes give over-generalized information to shellfish farmers who avoid harvesting during predicted HABs. Farmers want to avoid harvesting shellfish that may be carriers of amnesic shellfish poisoning. HABs have the potential to disturb both our coastal ecosystem and economy through bloom toxicity so further and continued research is essential.

1. Introduction:

Partnering with the lab of Dr. Miller at the UCSB Marine Science Institute, using their pre-existing collection procedure, I collected water samples for two weeks on Monday, Wednesday, and Friday. I counted the *Pseudo-nitzschia* and extrapolated for the total volume of sample. I concluded that the CenCOOS map is accurate in predicting the probability that a HAB will occur in a location at a specific time. The predictive map was more generalized than the numbers I collected, and the numbers I collected have a large margin of error (that the prediction map is trying to account for) due to the uneven distribution of phytoplankton throughout my sample. I then took my research a step further and looked at the weather forecasts for the days that I collected samples and analyzed the wind, air pressure, and temperature readings in relation to the data I collected and that on the predictive model. Stated in a case study of our West Coast, “An apparent link

between upwelling-related physical signatures, macronutrients, and HABs in the various 'hotspots' throughout California has motivated attempts to forecast HABs as a function of select environmental variables" (Kudela).

2. Background:

Santa Barbara's fishing industry heavily relies on shellfish, as the rock crab holds one of the longest seasons. Without accurate predictions of when and where these HABs will occur, fishermen are taking risks that could detrimentally affect their crop. As these blooms increase in magnitude and duration, there is a need for a synoptic monitoring network (Kudela). Researchers have created models that identify the weather conditions associated with high-toxicity blooms, and have used these models to predict when the next bloom will occur in proximity to the forecasted conditions. But, there are two problems: we do not have enough temporal analysis to identify the optimal observation frequency necessary to monitor and forecast HABs, and second, we don't have enough observations to parameterize these models (Kudela). My project is one set of data being added to the books so that we can accumulate the amount of information necessary to parameterize the models. But, the data I have collected is only an attempt to capture the dynamics of HABs. The benefit of my collection is that setting up collection points along the West Coast, specifically in areas that wouldn't necessarily be detected by the already in-place prediction marks, will help identify trends in hot spots. I am extremely interested in agriculture and ag-tech, and I am a part of the Science Research Program (SRP) at Laguna Blanca School. My SRP class went on a field trip to Dr. Miller's lab where we learned about giant kelp and the environmental factors contributing to its production rate. I was really interested in the idea and reached out to Dr. Miller in search of a lab project to learn more about our marine ecosystem and pick up a plethora of basic lab techniques on the way, and he prompted me with this project. My project is addressing the clarity of information between the HARM Model and data collected off of the Goleta beach pier.

2. Question and Hypothesis:

How do the numbers of Pseudo Nitzschia collected from the Goleta beach pier compare to those on the CenCOOS prediction chart of Harmful Algal Blooms in the Santa Barbara channel? I believe that the prediction maps provided by CenCOOS will be predominately accurate, but will be quite standardized in their counts. So, I think that the CenCOOS counts will be over-generalized and have greater values predicted than the actual numbers of Pseudo-Nitzschia in our channel because it is better for them to over-predict than under-predict. I also think that the numbers I collect will be smaller than the actual numbers of Pseudo-Nitzschia because there is no way for me to control how the Pseudo-Nitzschia distribute themselves among the sample I collect and it is impractical for me to count the entire sample because of the size of the Pseudo-Nitzschia

and how long it takes to count the number of Pseudo-Nitzschia in a 2mL sample.

3. Materials and Methods:

First, I lowered a 9L bucket off pier and filled it with approximately 7.5L of ocean water. Then I detached the rope from the bucket and reattached it to the plankton net. Then, I lowered the plankton net around 7m into the water, giving it a slight tug to eliminate air bubbles and keep the net full. Set timer for 5 minutes. Next, drag the plankton net along the edge of the pier for 5 minutes at a rate where the total distance adds up to about 120m. Retrieve plankton net and detach the bottom compartment. With the sea water collected in the bucket, backwash the filters on the collection compartment and then pour excess plankton/debris mixture into a collection jar. Consistently mix sample with syringe 5x in each direction to evenly distribute the phytoplankton and debris. Use the syringe to collect 50mL of the sample and then press out 2 mL of the sample in a 5mL petri dish. On a larger, clear piece of plastic, draw a 1cm x 1cm grid to provide a counting parameter. Use the dissecting microscope to count Pseudo-Nitzschia in each square of the grid. Then, record the data and repeat until 5mL of the sample has been tested. Lastly, take the total tally and record final numbers. To calculate the volume of the sample, first, measure the radius of the plankton net. Then, measure the length of the distance travelled during collection. Finally, plug the numbers into the equation: $V=\pi r^2 \times L$, where V: Volume (m^3); r: Radius of net (in m); L: distance (in m).

4. Results:

February 15: 45,864
February 21: 6,370
February 23: 13,165
February 26: 3,185
February 28: 5,308

I had tried to collect a sample on February 13th, but my procedure was unsuccessful. I refined my procedure, and on the 15th, I counted the most amount of Pseudo-Nitzschia, by a large margin, out of all of my collections. Wind: 5mph W. On February 21, I collected my sample in the morning. The water was a shade of grey/brown. I suspect that the distribution of Pseudo-Nitzschia is not in my favor for this sample because to have such a dramatic decrease in the count is peculiar. Wind: 8mph W. On February 23, the current was flowing in the opposite direction to which it normally flows. This meant I had to take my collection from the opposite side of the pier so my net wouldn't get stuck under the pier. The current shift could account for the high numbers of Pseudo-Nitzschia collected. Wind: 11mph NNW This wind speed and direction could also be a contributing factor to the bloom. On February 26, I collected my sample early in the morning to avoid the currents/wind. Wind: 8 mph W. On February 28, I collected the sample from the opposite side of the pier, again. And it was shaded. Sample had less debris, which could be a contributing factor to the amount of Pseudo-Nitzschia counted. In the samples with more debris, I found less Pseudo-Nitzschia. Wind: 4mph SE.

5. Conclusion:

My hypothesis was supported by the data I collected. The CenCOOS HARM Model is able to determine the probability that a bloom will occur. However, this prediction does not tell us how substantial that bloom will be. Researchers are using data, like that of which I collected, to identify trends in the bloom apparency and weather conditions. Currently, the HARM model is effective in providing researchers information of when they should conduct counts, but it is the numbers collected by the researchers that are supplied to the shellfish farmers to help them determine whether or not they should be harvesting product. The developers of the HARM Model are trying to better their prediction by substantiating their forecast with data collected by researchers, but many times, the data collected by researchers is high in error. The HARM Model relies heavily on the wind direction, current, water temperature, and salinity. It predicted blooms to increase after a major weather shift has occurred. Further research includes discovering how to identify how much domoic acid is produced by each cell of Pseudo-Nitzschia to determine the magnitude of the bloom. This is something that hasn't yet been discovered and would be detrimental to providing a completely accurate representation of the bloom's effect on our ecosystem.

References:

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