

Industrial Influence on Water Chemistry: pH and Nitrate Levels in Bellingham Bay

Jennie H, Gabby Lindley, Clay Burghart
Oceanography 101



Research Question

How does human industrial activity affect the pH and Nitrate levels in Bellingham Bay?

Introduction & Hypothesis

Our group joined together with a common interest in learning more about how the health of coastal ecosystems is impacted by human activities, particularly near industrial sites. We immediately thought about the Cherry Point oil refinery up north in Blaine and how this could be a good site to test for water quality.

For our chosen water quality indicators, we wanted to first select nitrates because we were wondering how high the levels would be in our area and how this compares to average acceptable levels for marine life at 16 mg/L (CWQG,2007). We were also curious how nitrate runoff near industrial areas could be affecting our local marine ecosystems because according to an article we found from USGS, “Nutrient over-enrichment of coastal ecosystems generally triggers ecological changes that decrease the biological diversity of bays and estuaries”(Howarth, 2000). Our other water quality parameter we chose was pH. The EPA states that the average ocean pH today is 8.1 and that prior to the industrial revolution, the average was 8.2, which means the water is becoming more acidic (EPA, 2024). They also explain that as seawater becomes more acidic, carbonate is less available for animals to build shells and skeletons and under severe acidification those shells can dissolve (EPA, 2024). This was unsettling information and made us even more curious about our local water chemistry.

These findings led us to come up with our hypothesis. Which is, if we test the pH and Nitrate levels at Zuanich Park, Squalicum Park and Cherry Point, then we believe that the Cherry Point samples will contain the highest nitrates levels and lowest pH levels because it is at a location that is highly influenced by humans with a big refinery nearby, whereas Squalicum park will have the lowest nitrates and highest pH due to a lower industrial impact.

Methods

Materials and Location

We used glass mason jars to obtain the water samples at each of the locations. Once we had all the samples gathered, we tested each sample using a nitrate electrode probe, and a digital pH meter.

Three different locations in Whatcom County were used for our study. The first beach we gathered samples at was Zuanich Park, the second location was Squalicum beach and finally the third location was Cherry Point. At each of these locations we gathered four samples totaling 12 across all three locations. We gathered all the samples on Thursday Feb. 27th from 9:00am-10:00am.

Average pH Levels

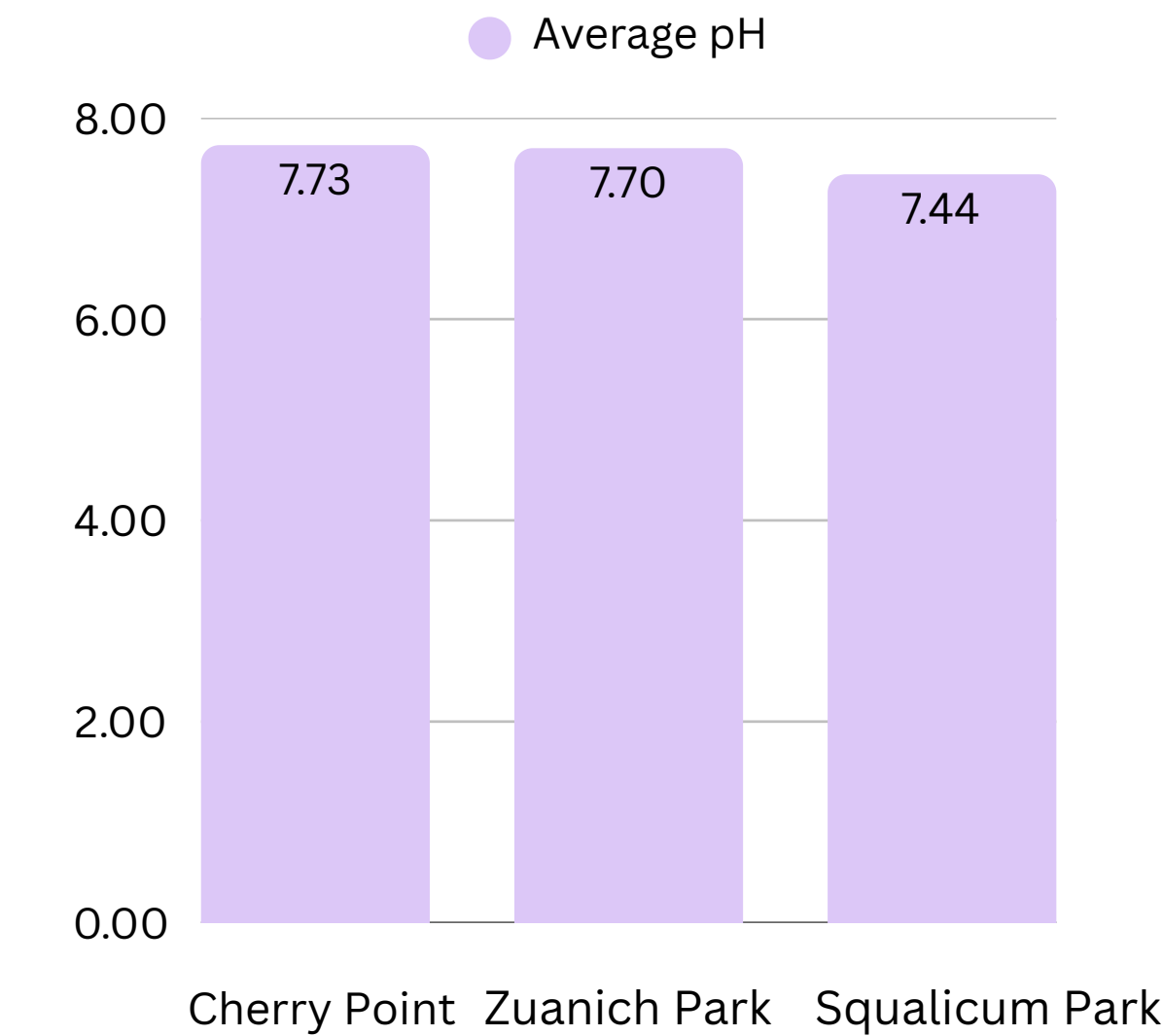


Table 1. Describes the average pH levels that were tested at all three locations. We used 4 samples, which were then used to calculate the average. pH is on a scale from 0-14, with 7 being neutral.

Average Nitrate Levels

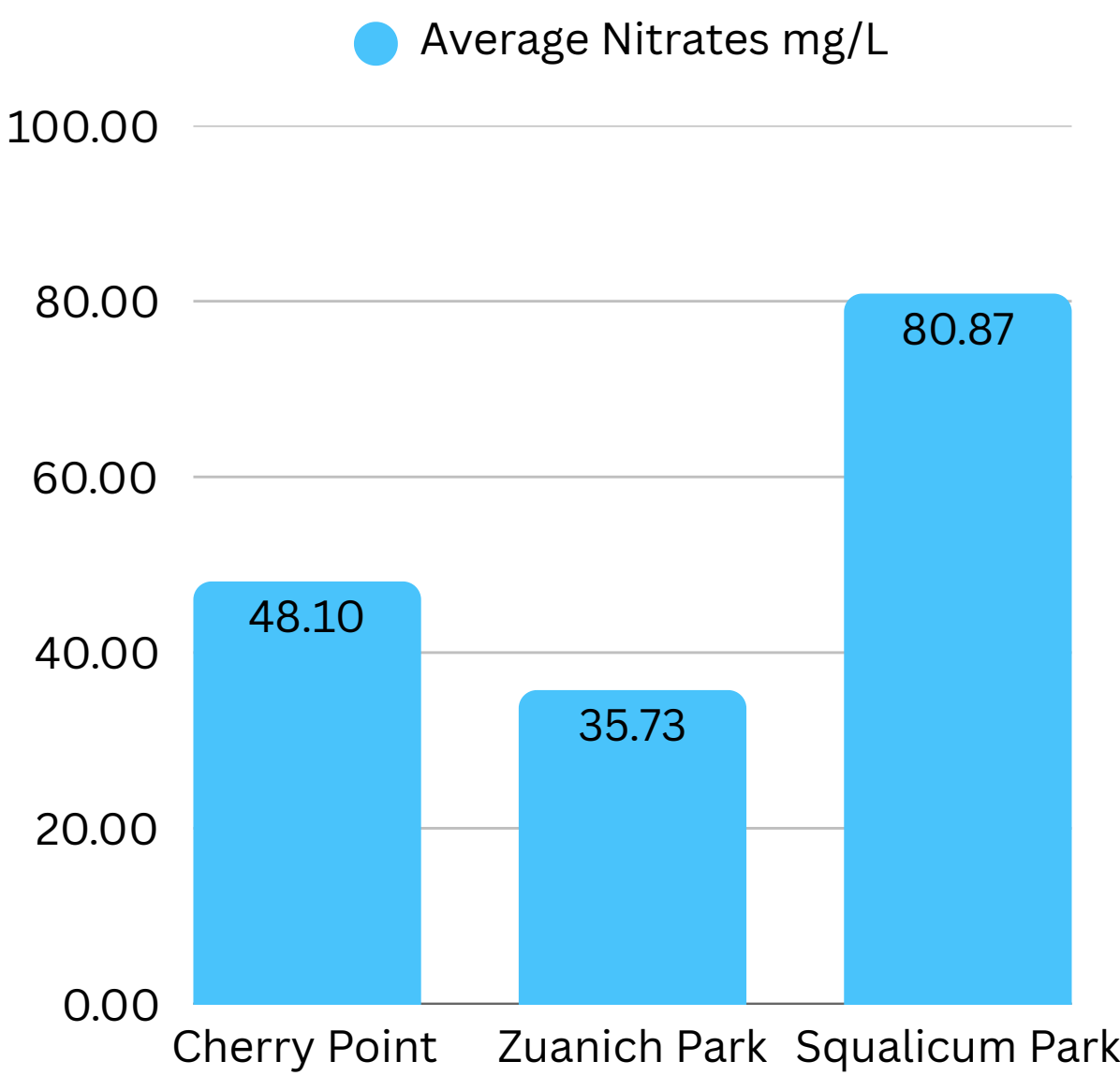


Figure 2. Describes the average Nitrate levels that were tested at all three locations. We used 4 samples, which were then used to calculate the average.

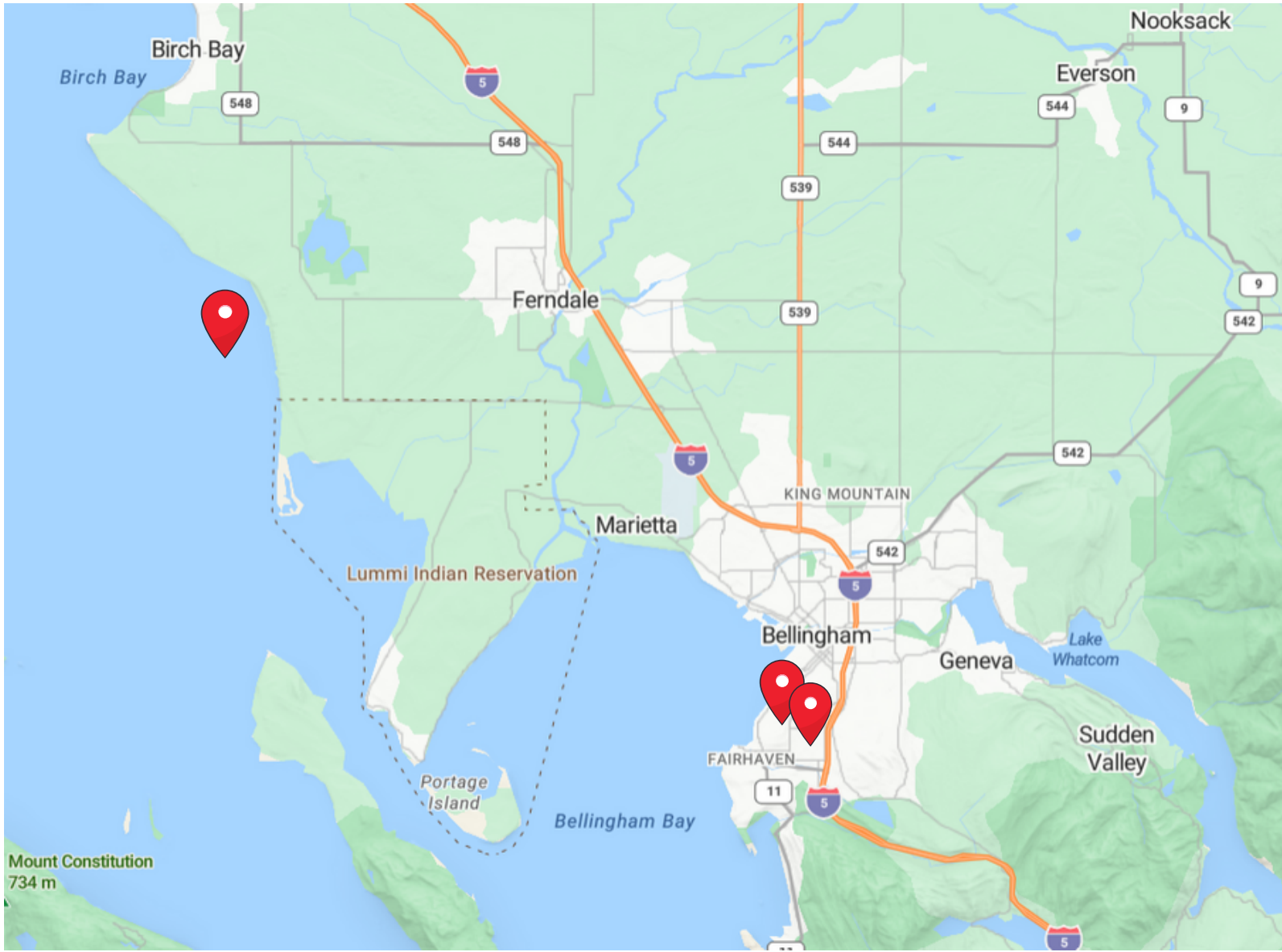


Figure 3. The data locations from left to right are Cherry point, Squalicum beach, and Zuanich park

Work Cited

EPA. (2024). *Understanding the Science of Ocean and Coastal Acidification*. <https://www.epa.gov/ocean-acidification/understanding-science-ocean-and-coastal-acidification#:~:text=The%20lower%20the%20pH%20value,ocean%20pH%20is%20about%208.1.>

CWQG. (2007). *Canadian Water Quality Guidelines*. <https://ccme.ca/en/res/protocol-for-the-derivation-of-water-quality-guidelines-for-the-protection-of-aquatic-life-2007-en.pdf>

Howarth, Robert. (2000). Nutrient Pollution of Coastal Rivers, Bays, and Seas. USGS Publications Warehouse. https://www.usgs.gov/publications/nutrient-pollution-coastal-rivers-bays-and-seas?utm_source=chatgpt.com.

Sinay Maritime Data Solution. (2021). *What are the main indicators of water quality?*. <https://sinay.ai/en/what-are-the-main-indicators-of-water-quality.>

Stanley, Roger. *Bellingham Bay Water Quality Survey*. Department of Ecology, June 22, 1979. <https://apps.ecology.wa.gov/publications/documents/2209075.pdf>.

Procedure

We used a nitrate electrode probe to gather nitrate levels of each of our samples, which were poured into 50 mL beakers. For every sample, we waited one minute for a proper reading to record and then rinsed our probe with distilled water before testing the next sample.

To record pH, we used a digital pH meter and repeated the same process of setting a timer for 1 minute until a settled recording number was reached and rinsed the meter with distilled water between testings.

Limitations

During our initial discussion about which locations to include in our research, we originally had a remote beach (Teddy Bear Cove), a partially industrialized location (Zaunich Park), and an fully industrialized location (Cherry Point). However, due to sample collection limitations we had to change one of our locations.

Ultimately we chose to take samples from Squalicum Park instead of Teddy Bear Cove. Due to this change, we did not anticipate how highly industrialized this area was and how impacted it is by multiple sources of human activity. This drastically changed our results, making our hypothesis incorrect.

Discussion/Interpretations

According to our data, Squalicum park had the highest concentration of nitrates, while Zuanich had the lowest. Squalicum park’s water quality was most affected by industrialization because it was in very close proximity to a manufacturing facility, and the beach had recently been under construction. Zuanich Park had the lowest amount of nitrates because there was not as much industrial interference, given the fact that the sample was collected in the winter, when there is seldom boat activity in comparison to the summer time. Cherry point also had a high amount of nitrates, likely because of the runoff from the refinery. The pH however, was relatively similar for each location and within a fairly healthy range.

Acknowledgements

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