Comparing pH and Nitrate levels in Coastal Seawater Throughout Puget Sound

By Makayla Huisman, Justin Boggs, and Cedar Champol
Oceanography 101

Research Question

How do pH and Nitrate levels in Bellingham Bay's seawater compare to pH and Nitrate levels in coastal seawater throughout Puget Sound?

Background

Over the last century, human activity has impacted the health of our coastal waters. We wanted to understand how our local water quality is being affected. For our research project, we chose several locations throughout the Puget Sound to test two very important indicators of seawater health; pH and nitrate levels.

Nitrate is a form of nitrogen that is an essential nutrient for many different species of flora and fauna. However, an over-abundance can be harmful, and can even cause hypoxia. Nitrate pollution is typically a result of runoff from fertilizer, water waste, or sewage. In their Methods Manual for Volunteer Stream Monitoring, the EPA states that nitrate levels in surface water can vary from less than 1mg/L to 30mg/L. Nitrate levels over 10mg/L can become toxic to certain warm-blooded animals (EPA, 2012).

pH is a system used to measure the acidity of a solution. A solution's pH levels are directly impacted by the amount of dissolved carbon dioxide from the atmosphere. pH levels average 8.1 to 8.2 in the open ocean. However, according to a University of Washington article by Hannah Hickey, the Puget Sound has an average pH level of about 7.8. Hickey suggests that the high acidity is partially due to burning of fossil fuels, and partially due to the ocean currents leaving the Puget sound rich in nutrients and low in oxygen (Hickey, 2015). Ocean acidification is particularly harmful for shellfish. Acidic seawater can eat away at the minerals that their shell and skeletons are made of. In a delicate ecosystem such as that of the Puget Sound, this could cause a disruption in the food web.

Our hypothesis is that the areas with higher levels of human activity will have poorer water quality, indicated by lower pH and higher Nitrate levels.

Methods

Materials & Location

In this experiment, we collected water samples from various locations around Bellingham and the northern Puget Sound, A total of nine water samples were collected. The water samples were brought to WCC's lab, where their pH and Nitrate levels were tested.

Procedure

Water samples were collected between 2/17/24 and 2/21/24. They were analyzed on 2/21/24. We inserted a pH meter into each sample, waited for the reading to stabilize, and recorded our results. After testing the pH of each sample twice, we used a nitrate probe to gather nitrate levels. The nitrate probe was inserted into each water sample for seven minutes to give the meter time to stabilize before we recorded our results.

Puget Sound pH and Nitrate Levels

Location	pH	Nitrate
Coupeville Ferry Terminal	7.8 & 7.7	27 mg/L
Penn Cove Mussel Farm	7.6 & 7.5	17 mg/L
Deception Pass	7.7 & 7.6	22 mg/L
Semiahmoo Spit	7.3 & 7.3	17.5 mg/L
Birch Bay	7.4 & 7.5	17.5 mg/L
Drayton Harbor	7.5 & 7.6	19 mg/L
Squalicum	7.8 & 7.8	17.5 mg/L
Seaglass Beach	7.7 & 7.6	15.5 mg/L
Marine Park	7.8 & 7.7	21.5 mg/L

Figure 1. Tested pH and nitrate levels of the seawater samples we collected from the Puget Sound.

Map of Seawater Sample Locations

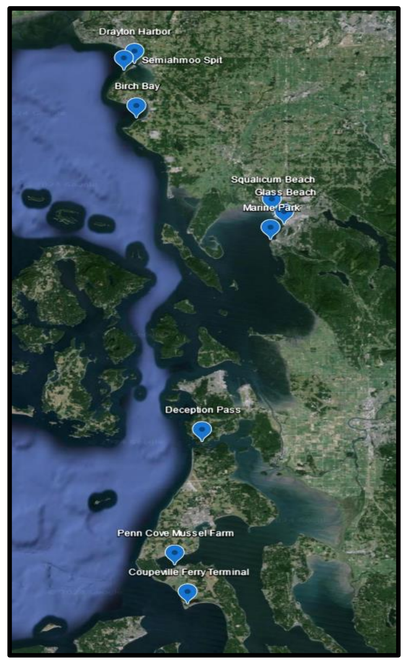

Figure 2. A map showing the locations at which our samples were collected.

Discussion

In this experiment we tested two major indicators of seawater health, pH and nitrate levels, throughout Puget Sound. Our preliminary research suggested a correlation between lower pH and higher nitrate levels (Willis, 2020). We hypothesized that seawater samples taken from more remote beaches would be healthier, with lower levels of nitrates and a higher pH than samples taken from urban areas or sites of industry.

Our results showed nearly the opposite. Our samples from urban beaches in Bellingham showed some of the healthiest pH and nitrate levels. Strangely, we found that samples with lower pH had lower nitrate levels, and samples with higher pH had higher nitrate levels. Nitrate levels were notably high in every sample, reaching potentially toxic levels (EPA, 2012). This could be explained by the precipitation that occurred throughout our sampling window and the resulting runoff. Also, it should be noted that the study was conducted during the winter, when nitrate levels tend to blossom due to a lack of algal growth in surface water (Khangaonkar et al. 2018).

Our results did not resolve our hypothesis. One obvious limitation of our research is the fact that this was a one-time experiment, giving only a snapshot of seawater health. For more accurate results a long-term study should be conducted, including results from the spring and summer months when algal blooms are in full effect. Another limitation is the fact that we only tested 9 samples. They don't represent the full area of the Puget Sound.

In conclusion, we were not able to clearly identify patterns in the data recorded. Generally elevated nitrate levels could indicate potential risks to marine life, so a study of broader scope should be conducted to gain more understanding of the varying health of Puget Sound's seawater

Sources

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