Joao's data collection:

Nooksack riverbed

Latitude/ Longitude: 48.787013, -122.581282 Ph: Visually described at 6.5

The area has a small park named Marietta Veteran's Park , there was a child at the time and the park did not seem very popular. There is a small house around the area but it seemed like a business/park management house that was closed. Besides that, there was very little human activity around the area, with few trailers and what seemed like a small plantation. Also, on the side of the plantation, it seemed like there was a small storage of car wrecks. On the other side of the river, it seemed like the area was never touched by humans whatsoever. I was there on the november 7th and the last time it rained was on the november 4th, however, the area was still very wet and the river seemed very muddy as well, which may have influenced the acidity of the river at the time.

Cornwall Park:

Latitude/Longitude: 48.775448, -122.482859 Ph: Visually described at 7.5

Cornwall park is a decently sized park with a lot of green areas, the park is well known and has a decent amount of visitors and some with animals as well. However, there is a lot of urban activity around the park, mainly commercial ones, but there is also residential activity around it. Although the urban area, it did not seem so strong to the point it would affect ph. I did the testing on the 10th and it rained on the 10th and on the 9th, before that only on the 4th. The result was expected as the water measured was around a green area with not so many factors that would have influenced the results.

Ben's data collection. November 10 & 12.

Skagit River Boat launch: Burlington

latitude/longitude: 48.468131, -122.308272

pH: best described at 7

This boat launch is the access point from NW Burlington to the skagit river. The river is separated by evergreen trees and A large, long spanning dike to the surrounding community and parks. The area to the north of the river is mostly housing with what I think is a water treatment plant close by. I'll double check on that. There was soft mud surrounding the river's sides. Over all the surrounding area of parks and community did not seem to have any effect on the river's pH balance. It had rained the day prior to testing.

Skagit River: SE Mt Vernon

Latitude/Longitude: 48.383159, -122.384405 pH: Best described as 6.5

This part of the river, SE of Mt Vernon, was surrounded by agriculture, lots of farms and small homes scattered around the river banks. The river was once again divided by a large dike and evergreen trees and the banks were made of soft wet mud. when testing the water the pH balance balance, like the last test, was fairly nutertal but seemed to be a bit more yellow in color leading me to believe it had a slightly less pH balance than the area

surrounded by housing. My guess to this would be because of the surrounding agriculture or the more urban areas the river had to pass through to get the the second location closer to the exit point of the river.

Kian's Data - Collected Nov 10 2020

North Fork Nooksack River: Horseshoe Bend Trailhead

Latitude/Longitude: 48.9020871, -121.9107996 pH: 6.5-7

This site was up closer to the source of the North Fork of the Nooksack River on Mt. Baker. The river here is near a campground and a foot trail and also goes underneath an overpass of the highway a little downstream from where I took the sample. The pH balance test showed that the water here was very close to a 7, maybe a little less based on it's light green/yellow color. The river here was surrounded by a dense forest and seemed mostly untouched by man.

North Fork Nooksack River

Latitude/Longitude: 48.8196409, -122.1788193 pH: 7

This site was located about a 10 minute walk from the road going up to the mountain but was a lot further downstream than the other site I went to. It was a very wild spot on the river with no human land use in sight. The water here tested at a 7 for pH which indicates that it is very healthy water. There was a big beach with silt, rocks, and sand around the river. There were trees on both sides of the river.

Script:

Ben Intro: Hello welcome back to the pHilosophers podcast where we talk about all things pH I'm your host Benjamin Pralle. Today we are gonna talk about PH balances. After last week's episode, an interview with the band Phish, it had me thinking what does pH mean in the realm of actual fish. Here in the PNW we have a large salmon population. I wanted to know: how does pH vary as a function of surrounding land use and in the end how does this affect local salmon populations? With me today are my pH experts Joao and Kian. Let's start with Joao giving us a background of what affects pH balances and what are the best conditions for salmon. (45 Seconds)

Joao Background: Thank you Ben, you're such a great host. Well pH testing was developed to indicate the acidity or alkalinity of the water. The results range from a scale that goes from 0-14, with 7 being neutral, numbers greater than 7 being alkaline and lower than 7 being acidic. Factors like Carbon dioxide, chlorine, air pollution, rain and human factors like urbanization, pollution and rural activity may vary the results of pH depending on the types of chemicals in the area. For example wastewater that contains detergent or soap can make water more basic and acid runoff from mining operations or acidic rain can make water more acidic. Although we are talking about salmon today, fish in general

struggle to live as the water pH approaches 5, as the pH approaches 9 salmon life is also in jeopardy. Maybe the word alkaline does not sound as scary as acidic for us but have in mind that high pH may increase the toxicity of substances in the water. A good example is the toxicity of ammonia, which is increased ten times at a pH of 8 than it is at pH 7. (1:05)

Kian Methods:

So for our experiment each of us individually went to different sites in order to test the pH of these areas and see if we could find any correlation between the pH and how the land around these areas is being used. Initially we hypothesized that areas that had more immediate human land use would potentially have an affected pH balance compared to areas that had less human land use. I went to two sites along the North Bend Nooksack river in order to test an area with little to no land use while Joao and Ben both tested areas with more human land use. The tests were simple - you fill up a plastic Falcon tube with 10mL of water from the water you are testing, then put a pH testing tablet into the tube and invert the tube and wait for the tablet to dissolve. Once the tablet has fully dissolved the water will have changed color. You then visually determine which color on the pH chart best matches the sample that you collected. (50 sec)

Ben Promo: We just like to take a quick moment to thank our sponsors to the pHilosopher podcast in today's sponsor food for thought go to foodforthought.com/philosophers for a 15% discount on all nootropic products (15 seconds)

Roundtable Results:



1. (Ben) So I decided to do this experiment myself trying two different locations, first being a Skagit riverboat launch in Burlington Wa and the other being southeast into Mount Vernon still on the Skagit River. Both locations had a different land use around them the Burlington location was a boat launch near a City Park and surrounded by residential living while the Mount Vernon location was surrounded by local agriculture and farms. Not much varied between the two locations the results yielded a pH balance is right around 7 with slightly lower pH for my Mount Vernon location maybe a 6.5. (40 sec)

2. (joao) Well I stayed around the Bellingham area. I had the opportunity to visit 2 different streams, the first one was the Nooksack riverbed in which I visited a small park named Marietta Veteran's Park. The human activity was very low around that area with parts probably never touched by humans before. Althoughlt, it rained 3 days before, the area was still very wet. The second stream I visited was Cornwall Park that has a lot of green area, however, the park is surrounded by urban activities, with houses and commercial stores around it. Also, It rained that day and on the day before. That way, my data results indicated that the Noosack riverbed had a pH around 6.5 while the cornwall park had a pH of 7. Now let's hear from Kian. (40 se c)

3. (Kian) Like I said earlier, I tested two sites along the North Bend Nooksack River. One sight was at the Horseshoe Bend Trailhead which has a trail and campsite nearby, however it didn't seem like there were many people hiking or camping when I was there. This site had little human land use except for the nearby highway (which was not heavily trafficked at the time). This site tested a perfectly neutral 7pH which indicated to me that this was a healthy river in terms of pH and would be a suitable habitat for salmon. The other site I went to was also along the North Bend Nooksack River, however this site was farther downstream. This site had even less human land use and was a good example of an all natural river system. This site also tested at 7pH which showed me that thus far the pH had not been affected in any significant way. (40 sec)

Round table Interpretations: (1.5min)

1. (Ben) Now, what do you two think these results mean for the Ph balances as a function of land use in our area?

(Kian) To me, it doesn't seem as though we found conclusive evidence that pH balance varies one way or the other as a function surrounding land use. This could be for a number a reasons...

(Ben) In our area we did have significant rainfall which could have affected the data we received. Rain tends to balance pH levels in water tables.

(Kian) It's also possible that the locations where we got our samples didn't have a high enough level of pollutants or other substances in order to make a difference in the pH balances.

(Joao) Which is good for what we want, right? An area that is safe for proliferation of salmons.

(Ben) Seems to me the factors that affect the pH balances in our area tend to be very neutral. It would be interesting to further this test in a more metropolitan area.

(Kian) Even though we weren't able to find evidence that variability of land use has an effect on the pH of local water systems, we can't rule out that land use COULD affect pH balance in areas where there is more human land use.

(Ben) Why this matters: (Joao) one of the main reasons we wanted to do this experiment was to find out if how humans are using the lands can impact the pH level of water which could make these water uninhabitable for salmon and other local species of fish. We have a responsibility to the ecosystems around us because what we do on land affects not just salmon populations but the greater ecosystems as a whole.

Conclusion: (Ben) Well that's our time today hope it was an educational process for all you listening today, I know it was for me. Thank you again to our experts Joao and kian. Make sure to tune in next time for the philosophers podcast. (12 seconds)

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Katie Parks (photos and research partner) Audrey & Captain Pralle (Research team), Katie Rae (Photos and driver).

Point source pollution is a common cause that can increase or decrease pH depending on the chemicals involved ¹⁸. These chemicals can come from agricultural runoff, wastewater discharge or industrial runoff. Mining operations (particularly coal) produce acid runoff and acidic

groundwater seepage if the surrounding soil is poorly buffered ²². Wastewater discharge that contains detergents and soap-based products can cause a water source to become too basic.

- Fondriest Environmental Learning Center