An Examination of Possible Relationships between pH and Calcium Levels in Soil and the Quantity of Terrestrial Mollusks Found

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Abstract

One soil sample was taken from each of thirteen wooded areas using a core sampler (15cm deep). Each sample was taken in a somewhat different area- some from a monoculture area of jewelweed, some from a riparian zone, some from an area beneath a dam. In each of the thirteen areas from which samples were taken, snail bait was placed on the soil, covered with cheesecloth and left to attract mollusks for roughly 60 hours at which time we returned to the sites and counted the amount of mollusks (including snails and slugs) at each site. Meanwhile, the soil samples were each tested for both calcium (ppm) and pH levels. We hypothesized that there would be a positive correlation between pH level, calcium amount, and population density of mollusks. Analysis showed that there was a positive correlation between pH level and amount of mollusks; as the level of pH increases, the number of mollusks present increases. However, we found that there was no correlation between amount of calcium and levels of pH. Also, there was no correlation shown between pH levels and population density of mollusks. Thus, our experiment was inconclusive.

Introduction

Mollusks can be found in both freshwater and soil. At least 35,000 species are present in soil and are normally found in the upper or litter layer of soil. The population density of mollusks is affected by precipitation rates, soil structure, and chemical distribution in the soil. For our experiment we decided to look at the amounts of calcium along with the population density of mollusks and pH levels. Mollusks require a higher amount of calcium in order to provide the nutrients needed for their shells. We predicted that there would be a positive correlation between pH and calcium levels.

Our group decided to focus the experiment on mollusks because of their presence in site two[1] interested us, and we wanted to find out how their population density compared in different environments. Before we could begin our experiment we had to do an initial survey. This included finding out the population density and biodiversity of arthropods, plants and the population density of worms, bacteria, protozoa, algae, and fungi along with soil texture, pH and salts. The survey did not show a positive correlation between pH level and calcium. Traditionally, as the pH increases the calcium level should increase (a correlation should be present)[2]. This fact led us to our hypothesis; there will be a positive correlation between levels of calcium and pH and therefore a higher population density of mollusks

Procedure

After deciding what our experiment was we went into the field and collected soil samples in various kinds of soil. We made sure that our soil samples were random by taking soil samples in various types of environments. We also took two soil samples right next to dead trees. We took 13 samples and took soil down to the first mark, using a core sampler. The first mark was 15.5 centimeters long. The core sampler is 15.5 centimeters wide. At each location we used inflated latex gloves tied to sticks in the surrounding area, to mark the spot. We labeled the gloves numerically so we would be able to retrace our steps and so we would be sure that we wouldn't mess up the data. To label we used a black sharpie marker.

Then we put 20 grams of "Ortho Bug-Geta Snail and Slug Killer" onto the ground next to where we took the soil sample. We put enough gauze to cover it and watered it all down, in order to attract the mollusks to their death. The water was distilled water and we put 33 ml on them. Then we let it sit over the weekend.

The weekend was sunny and sometimes cloudy but mostly sunny. It never rained. Temperatures ranged from the 70's to the 80's. Then we went back three days later and counted the mollusks. We also reapplied water if the poison was dried out. We put enough water to wet it thoroughly.

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[1] This site contains an urban stream located directly below a dam with soil that is consistently moist. It contains higher algae and arthropod populations than most sites. Also Site Two contained more plant species, a high level of calcium, low potassium levels, average salt levels, predominately loamy sand and pH of 6.4, which is slightly acidic.

[2] Dr. Peter Groffman PhD, Conversation at E.S.S.R.E meeting, July 2001.

To count the mollusks we fingered through the poison (with latex gloves) and also looked on the soil of a 1-foot radius around the poison. We looked for snails and slugs. For slugs we counted live and dried up ones as well as slime. Then we went back out the next day and then cleaned up. We also used latex gloves when dealing with the poison since it could kill us, or make us very ill.

While this was going on we also took all the soil samples that we took and tested them for both calcium and Ph. For both tests we used the LaMotte STH Series for professional soil tests. For Ph we took a titration of Soil Flocculating Reagent. The Soil Flocculating Reagent contained .008% polyacrylamide. This mixed with the soil gave us our test sample. When we added the Duplex indicator to a sample of the soil solution we were able to attain a approximate Ph. Then depending on the Ph we added a different chemical to a separate sample, to get a precise Ph. These chemicals were the following: Bromcresol Green, Chlorphenol Red, Bromthymol Blue, Phenol Red and Thymol Blue. For Calcium we took a titration using the Calcium test solution. This test solution had 4% sodium oxalate. This gave us an approximate amount of calcium. Then we recorded all the data and analyzed it.

Results & Analysis

PH Data

Sample	Duplex Indicator	Specific Indicator
1	8	7.2
2	7	6.4
3	8	7.2
4	5	4.2
5	7	6.4
6	7	7.2
7	8	7.2
8	7	6.4
9	7	7.2
10	8	7.2
11	8	7
12	6	5.4
13	8	7.2

Calcium Data

Sample	
1	1400 ppm
2	150 ppm
3	1400 ppm
4	0 ppm
5	150 ppm
6	1000 ppm
7	700 ppm
8	0 ppm
9	1000 ppm
10	70 ppm
11	7700 ppm
12	150 ppm
13	2300 ppm

Mollusks Data

Sample	Day 1		
	Both	Snails	Slugs
1	3	3	0
2	2	0	2
3	0	0	0
4	4	2	2
5	6	0	6
6	3	0	3
7	24	0	24
8	1	0	1
9	15	0	15
10	1	1	0
11	0	0	0
12	0	0	0
13	4	0	4

Statistics

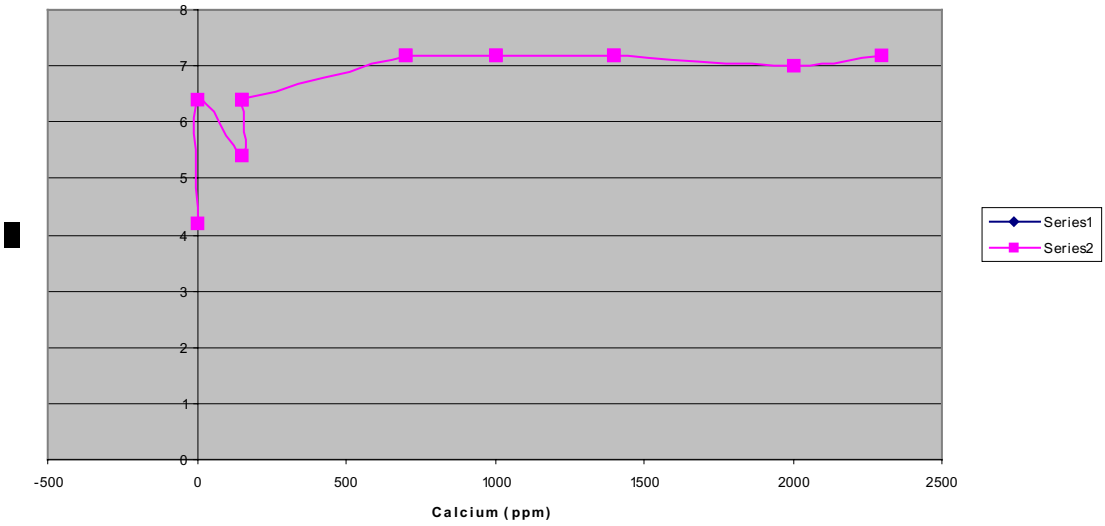
	PH	Calcium		Mollusks	
mean	N/A	842.307		4.846	
median	7.2	700		3	
mode	7.2	150		0	
maximum	7.2	2300		24	
minimum	4.2	0		0	
range	3	2300		24	
std. Deviation	N/A	735.591		6.724	
std. Error	N/A	1286.858	397.756	8.91	0.782
variable	N/A	541049.1		45.212	

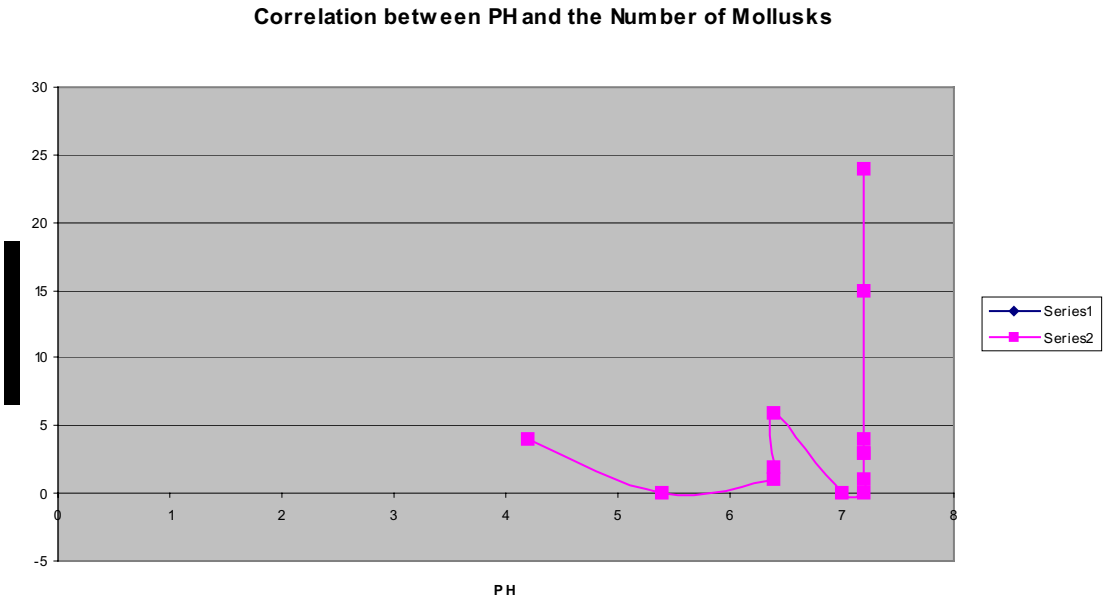
T-Tests

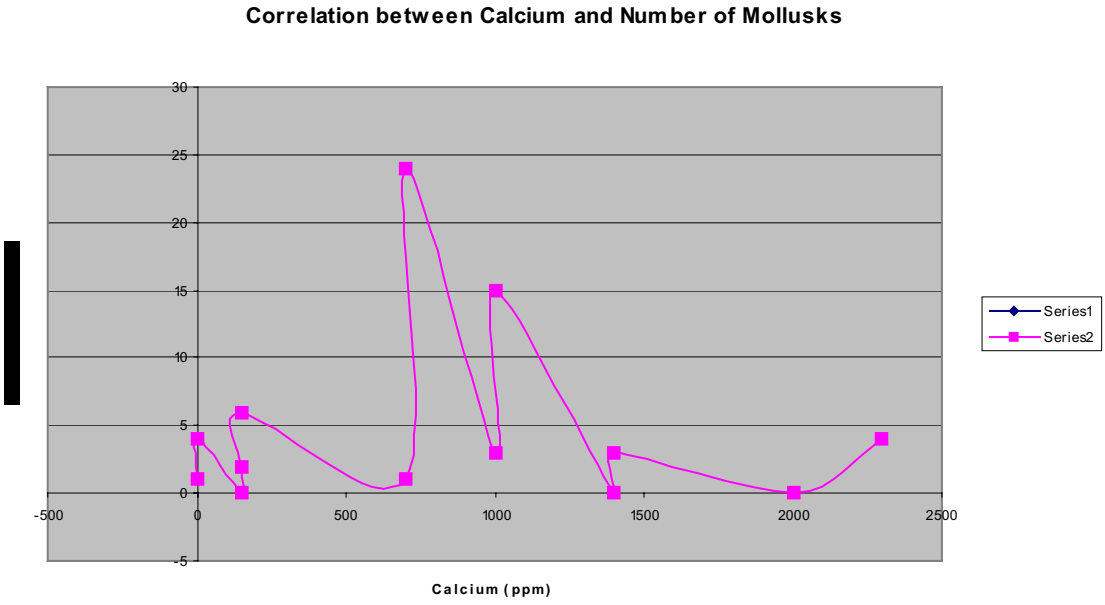
t = 2.179 according to the sampling distribution chart

	Calcium vs PH	PH vs mollusks	Calcium vs mollusks
t_s	1.969	1.003	0.152

Correlation between Calcium and PH







According to the mollusks vs. PH graph, as the amount of PH increases, the amount of mollusks in the soil increases. We used liner/exponential regression to determine which was then plugged into the t-test equation. T=1.003 which was less than 2.179 the number given by the Sampling Distribution chart. This showed that there was no correlation between pH and mollusks. According to the pH and calcium graph, there was not an obvious correlation. From 0 to approximately 700 ppm the ph increases from 4.2 to 7.2. After the calcium reaches approximately 700 ppm the ph remains constant around 7.2. t= 1.969 which is less than 2.179, again showing no correlation between calcium and pH. The graph for calcium and mollusks has no consistent pattern. From 0

to 500 ppm the average number of mollusks is about 5. From 500 to 1500 ppm the number of mollusks jumps to a high of 24 and quickly drops to 4 mollusks. From 1500 to 2300 the number of mollusks remains below 5. For further analysis, t= .152 which is less that 2.179, which showed that there was no correlation between mollusks and calcium.

Conclusion

While we cannot conclude any correlations between the data, we can hypothesize about potential correlations. The reason why there may be correlations that our statistics did not verify is because our sample size was thirteen, which may not be large enough. If we had more time we would try to increase our sample size.

One thing that might have correlation is the relationship between pH and calcium. Our graph shows an obvious positive correlation. It was the statistics that failed to verify it, thought it was 90% accurate which does suggest something. In our research however, we found many sources, which claimed that there was a direct correlation between the two. So it is likely that our graph is more accurate then the statistics. Since we can prove that one graph was more accurate then the statistics that leaves room for the possibility that there is more then one instance where this is relevant.

Another graph that looked like it was going to prove a correlation was the graph between pH and Mollusks. The graph looked like it had an exponential positive correlation. However the t-test was less 80% accurate so we would have to take more samples to be sure. There is definitely no correlation between the calcium and number mollusks. This is strange because you'd think that if calcium and pH had a correlation, and pH and mollusks had a correlation, then it would follow logically that calcium would correlate with mollusks. This lends itself to the probability means that there was a 2^{nd} or even 3^{rd} variable that we were not aware would cause a problem.

One possibility is the fact that there were different water saturations in each soil sample. In our research we found several sources that mentioned that water saturation levels could affect calcium. Another possibility is that the soil textures varied in each soil sample. This was also found in some research to have potential to affect the soil nutrients. If we were to do this experiment again we would have more samples and we would try to have similar water saturation levels and similar soil textures.

Another problem we had was the fact we let the sample sit over the weekend before we took the count of mollusks. In those three days, calcium levels could have easily changed as well as pH. If we did this experiment again we would have taken calcium and pH tests the day we counted the mollusks. Even though we didn't prove anything statistically, from the graphs there is still a potential future for this experiment.