How the Ballona Drainage Creeks Adversely Affects Water Quality and Local Fauna

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Introduction

In the summer of 2025, I set out to research the pollution in Ballona Creek in Los Angeles (LA), California. Ballona is an EPA 303(d) impaired waterway; this means it does not meet the state pollution standards that it must meet. This idea came from a personal connection with the nearby Venice Beach, where I surf every week with my friends. A major thing we deal with during the wet season in LA is that whenever it rains, waters often appear contaminated after rainfall, likely due to urban runoff carrying pollutants. Urban runoff occurs when water flows over the ground instead of being absorbed by it, which picks up oil, chemicals, and fertilizers. The Ballona Creek and others like it are responsible for transmitting this runoff to the ocean as they are mainly made of concrete and are prime examples of this phenomenon. This research can have serious connotations not only for my close friends, but for the 10 million people who visit Venice Beach each year as well as the surrounding bay area.

Given past studies done during the wet and dry season, I wanted to measure what the pollution was like in the dry season specifically to see whether there were any danger of pollutants and their effects with minimal rain (Bhandaram, et al., 2010). The focus of my study is how drainage creeks such as the Ballona Creek negatively affect ocean water quality (nitrates, nitrites, pH, ammonia) near where it lets out and how this impacts local fauna such as crabs. These specific parameters are important because they can have direct effects on local flora and fauna as well as increase eutrophication levels which can dangerously decrease oxygen levels.

I am using the striped shore crab (*Pachygrapsus crassipes*) as an indicator species because its red hue that stands out and its relatively static nature make it ideal for counting. The striped shore crab also has a previous study which helped me to set my parameters and determine whether it is dangerous for them (de la Haye et al., 2013). In addition, crabs are used regularly as bioindicators because they are susceptible to nitrogenous compounds and shifts in pH levels. My hypothesis is that while there may not be a typically stressful level of pollution, there is likely to be a link between higher pollution levels and less crabs. This would mean the more pollutants measured, the lower the crab count will be. If the measured pollution levels are higher towards the outlet of the creek that would suggest that there is a high likelihood that the bay is getting polluted.

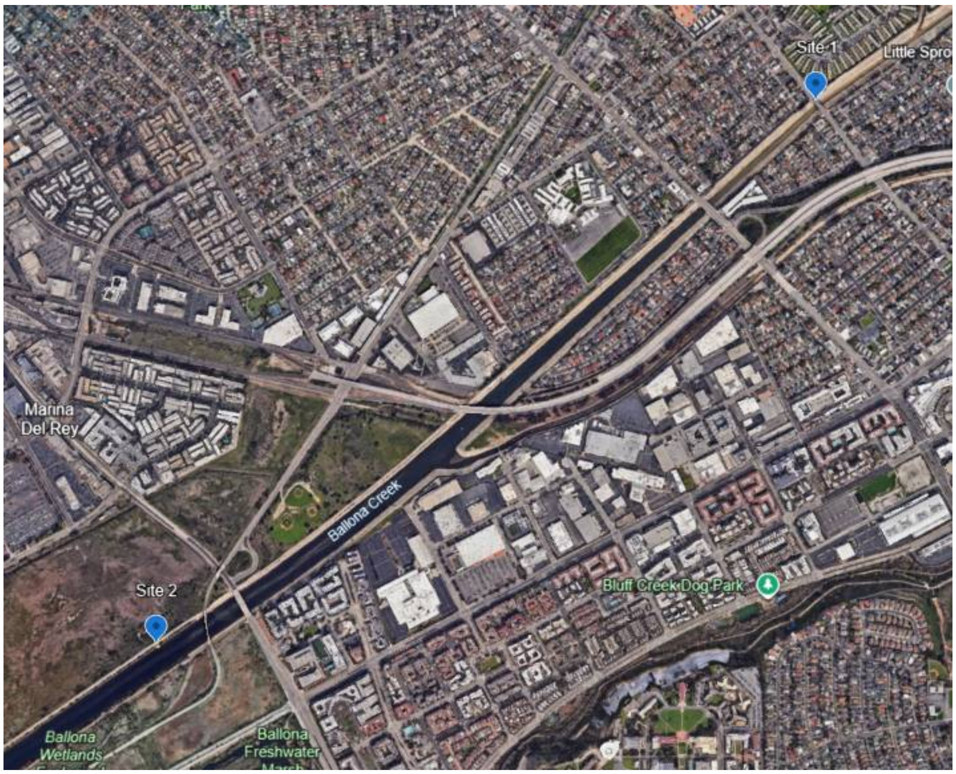
Beyond Ballona Creek my results could be meaningful because of their specificity with the striped shore crab and could be used for later studies on this species. This could also be used to show how easy it is to gather important data and spark movements to monitor our drainage outlets better. I have a lot of hopes for this project, and through it I hope to raise awareness about the dangers of urban runoff and encourage more community participation in environmental monitoring.

Methods

I used two sites for this study, sites 1 and 2. Site 1 was used for water sampling and is located along the creek directly under where Inglewood Boulevard goes over the creek. Here, the creek has an almost completely concrete bottom and is about 2 feet at its deepest and 30 feet wide making it a perfect channel for harmful runoff because there is no substrate to absorb contaminants. It is devoid of any vegetation and like much of the creek; it is mere feet away from dense residential neighborhoods. The reason I included this site was for water samples only. Site 2 differs in many ways; it is located farther down the creek exactly 611 feet after Culver Boulevard passes over and can be further identified by the yellow line on the concrete that I believe is used by the UCLA rowing team to mark a start line. Site 2 is about 1.7 miles downstream of Site 1 and there are many smaller creeks that join in between making the two sets excellent for tracking pollutant dilution.

Figure 1

Google earth image of Sites 1 and 2



The differences between them are immediately apparent; Site 2 is about 100 feet across and about 6 feet at the deepest and has a lot more plants. The most notable thing is that there is a thin layer of mud, gravel, and rocks above the concrete bottom which allows for a lot of life. This makes it optimal for searching for crabs because *P. crassipes* need rocks to hide in and ample biomass to feed off.

Samples were collected twice a week maximum, from 3-5 on a Sunday or Saturday from August 12 to September 20, 2025. The tide range is from 3.28 ft to 3.72 ft, and the air temperature range is from 69-76 °F. There was one tide outlier, but it doesn't affect the crab's ability to feed and survive.

The samples were collected using the API Saltwater Master Test Kit. There are four measures in the test kit and four corresponding test tubes, which I filled and tested on site. At Site 1, I filled the test tube to the required amount by dipping it into the water until full and once they were all capped and full, I took out the test kits and using the instructions, went one by one until I had results for all of them. This step is done on-site, meaning finding a surface to perform the tests was a challenge. Once they were completed, I'd empty the tubes and rinse them out. Then I take a fresh rag to swab the insides clean, making sure to use a different side of the rag each time. After I'm done cleaning, I head to site 2 where I repeat much of the same for sampling the water although because this site had more of an incline and was dirtier, a flat surface was even more desired.

Crab searches were conducted in the exact same area along the bank of the creek. And the markings for the boundaries were renewed and checked each time with a measuring tape. The area is

10 meters across in a straight line, and I count by looking down into the shallow rocky edge of the creek where the crabs are sighted. I use visual estimates which means the true count may vary based on visibility and tide. I give myself 10 minutes, which is more than enough time to walk up and down a few times to really get a good look. To have absolute clarity, I use polarized sunglasses which help to pierce the water and see more easily, and I do this every time to be consistent. To avoid recounting, I note the exact crevice or rock the crab is in/on, and because these crabs move so little, I can completely avoid this issue.

As mentioned before, I used solutions to test the levels of pollution at the sites. This introduces dangers as many of these solutions contain acids and other harmful chemicals. To negate this, I use disposable latex gloves and use caution when handling. This is the only necessary precaution when considering my procedure, but it should also be noted that I biked to and from my sites and used a bike helmet during this.

Data was analyzed by giving crabs a threshold based on data from other sources to determine if they are affected on paper and then to see if there is a correlation when we count the actual number in the research (de la Haye et al., 2013). By using a threshold, there is no need for a control group, especially because there is no exact environment like this one. For the descriptive statistics, I used mean, median, range, and standard deviation for the parameters and crab count. This allows me to examine the center and spread of the data. Correlation was used to link the relationship present. Using r-values I could calculate the strength of the relationships which would help my confidence in declaring them linked or not. This was all possible because I used Google sheets with the XLMiner Toolpak, an extension that enables you to do descriptive statistics while in Google sheets.

Results

The primary finding from my study was a correlation between the water quality parameters and the crab population. I use this comparison to suggest that there is a connection between how polluted the water is to the survival of the native species. I used site 2 for the correlations as it best reflects the water quality nearest to the crabs. As seen in Table 1, the water quality parameters widely varied on different days. pH was the most stable with a small range and SD as seen in Table 2.

Table 1
Measurements for pH, ammonia, nitrates, and nitrites found at Site 2

Date	Time	pH	Nitrates (ppm)	Ammonia (ppm)	Nitrites (ppm)
8/14	5:00 pm	8.00	5.00	0.00	0.00
8/17	3:40	8.00	5.00	0.25	0.25
8/31	4:10	8.10	5.00	0.00	0.00
9/1	4:05	8.10	5.00	0.00	0.00
9/20	4:10	7.80	10.00	0.5	0.25

Table 2

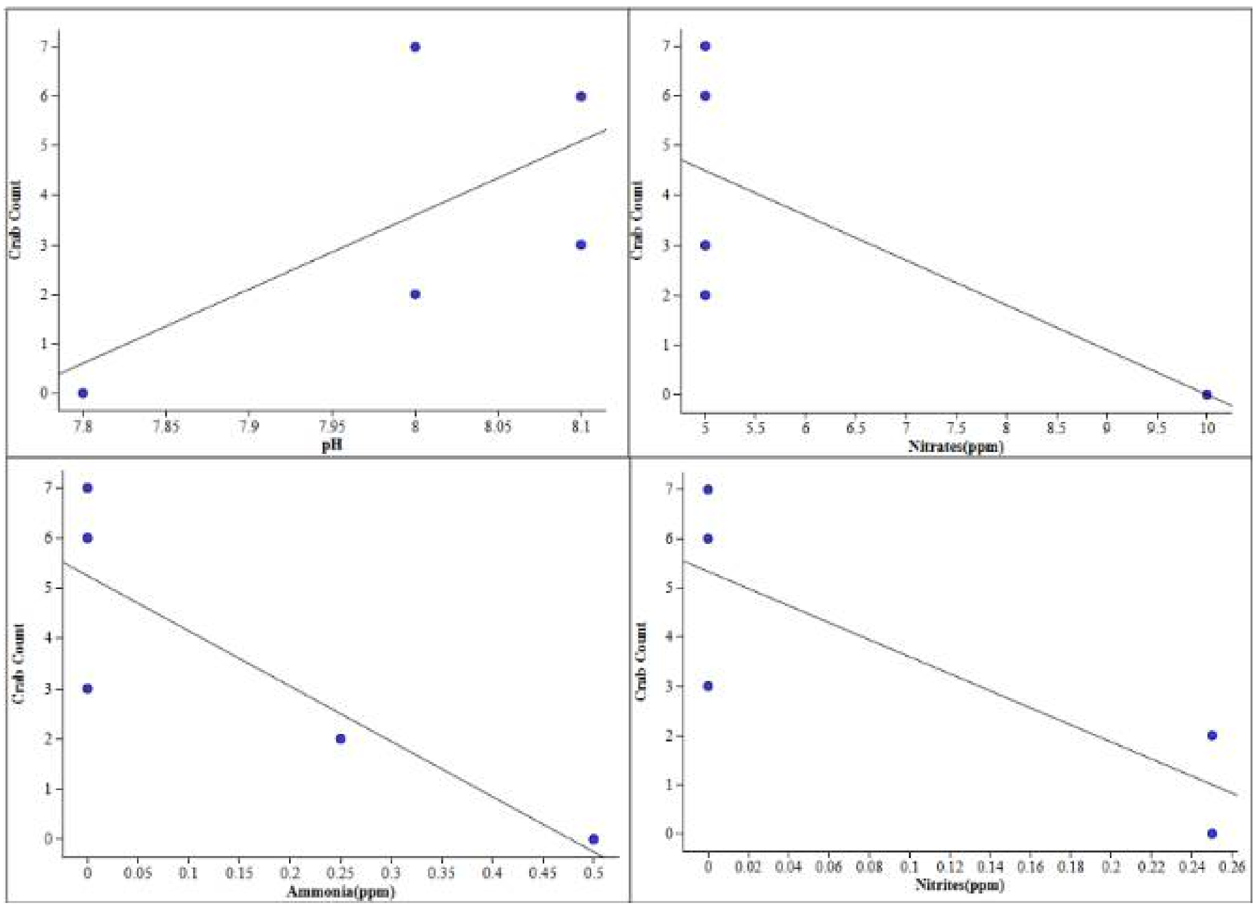
Descriptive statistics for water quality at Site 2 including pH, ammonia, nitrates, and nitrites

	pH	Nitrates (ppm)	Ammonia (ppm)	Nitrites (ppm)
Mean	8.00	6.00	0.15	0.10
Median	8.00	5.00	0.00	0.00
Standard Deviation	0.12	2.24	0.22	0.14
Range	0.30	5.00	0.50	0.25

Another finding was the correlation between the water quality parameters and their corresponding crab counts. For pH, there was a medium strength positive correlation of r=0.638 meaning that the lower pH there is the less crabs there were. For nitrates, there was a medium strength negative correlation of r=-0.699 with the crab population meaning that the higher the nitrate levels the lower the crab population. Another finding was the ammonia which had a strong negative correlation of r=-0.854 which means that the higher the ammonia levels the lower the crab count is. The final correlation is nitrites, which had a strong negative correlation of r=-0.824 which means the higher the nitrite levels the lower the crab count is.

Figure 2

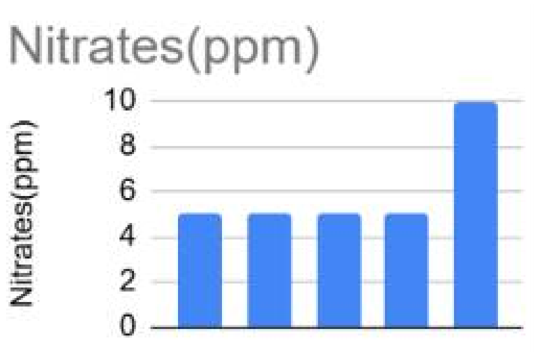
Correlations of pH, ammonia, nitrates, and nitrites compared to crab count



The last important result was the link to weather conditions found when there was a rain event right before 9/20. The pollution for that day greatly increased as seen by the graph for nitrates where the last bar was 9/20. The strong increase can be tied to a phenomenon called “first flush” (need citation). On 9/20 I also observed a mortality event where all observed crabs were deceased.

Figure 3

Nitrate levels for each observation day at Site 2



Discussion

Although I used a small sample size for this study (n=5), because of the strong correlations like nitrites at -0.824 and ammonia at -0.854, there is a potential statistical association between these two variables. pH and nitrates are not as strong, so I am not comfortable asserting them but instead acknowledge that there appears to be a correlation and that further studying needs to be done to prove it. Another reason I defend my claim is that ammonia, nitrates, and nitrites are known to have a host of negative effects on crabs such as leading to Molt Death Syndrome (MDS), Osmoregulatory stress, and damage to the gills (Romano & Zeng 2012). Even though *P. crassipes* was not specifically included in the experiment, they tested many animals from the entire order of Decapoda and found ubiquitous results. This agrees strongly with my hypothesis that ammonia, nitrates, and nitrites would cause the crab population to decrease. What about pH? Acidic conditions of less than or equal to 6.8 pH are proven to cause harm by impacting the calcification of decapod's exoskeletons (de la Haye, et al., 2013). Even though the tested levels never reach the proven threshold, there is nothing disproving that the threshold could be higher (more basic). This gives me even more confidence that pH is causing death in crabs in the Ballona creek.

But there is also value in understanding where and how these pollutants came to the creek. Ballona Creek at Site 2 has a gravelly and muddy bottom which affects the ways chemicals travel through it (Jurries, 2003)   This is good to note as a contrast to Site 1. In my hypothesis I posit that I will be observing in the dry season only, however there was a rain event on 9/20 which caused such a big spike in many parameters. This brings into question the role of weather conditions. I know that rain has a distinct correlation to pollution levels because of past studies (Bhandaram, et al., 2011). Even light rainfall can cause a massive increase in pollution. It should also be remembered that this was the first instance of rainfall in many months, which could explain why there was such an extreme increase in pollutants. This is called the "First Flush" phenomenon and happens when there is a buildup of pollutants on non-absorbing surfaces like concrete or asphalt because of a lack of rain. The pollutants aren't adversely affecting anything in this state but once it rains for the first time in a long time, this buildup is washed to places where it can do a lot of harm. This is notable for future case studies in this area. My hypothesis is supported by my results as I predicted that my researched parameters wouldn't be met, which they weren't, but that there would still be a noticeable correlation between the explanatory and response, which there was. It can be argued that it is only partially supported because I stated that my control water testing site would have explicitly lower or higher parameters, but it turns out there are completely different levels which most likely indicates different sources of pollution.

All these local effects have larger implications for the surrounding area and even the scientific community. The pollution of proven hazardous chemicals like ammonia and nitrates on marine life can destabilize not just species but shake the foundations of food webs as well. Humans tie into this as well because there is a massive fishing industry in the Santa Monica Bay that will be affected by pollution like this. In 2010 the total commercial landings in the bay were 817,907 pounds of fish and invertebrates' worth ~$208,674 (Los Angeles Department of Water and Power, 2016). This study is also a great example of how citizens can help monitor wildlife and environmental changes. If this becomes a regular thing, it could benefit science and the environment extremely.

References

1. Bhandaram, U., Guerra A., Robertson B., Slattery H.,Tran K. (2011). *Effect of urban runoff on water quality indicators in Ballona Creek, CA*. Institute of the Environment and Sustainability at UCLA. https://www.ioes.ucla.edu/project/effect-of-urban-runoff-on-water-quality-indicators-in-ballona-creek-ca/

2. de la Haye, K. L., Spicer, J. I., Widdicombe, S., & Briffa, M. (2012). Reduced pH sea water disrupts chemo-responsive behaviour in an intertidal Crustacean. *Journal of Experimental Marine Biology and Ecology, 412, 134–140.* https://doi.org/10.1016/j.jembe.2011.11.013.

3. Jurries, D. (2003). *Biofilters (bioswales, vegetative buffers, & constructed wetlands) for storm water discharge pollution removal*. Oregon Department of Environmental Quality. Biofilters (Bioswales, Vegetative Buffers, & Constructed Wetlands) for Storm Water Discharge Pollution Removal - February 2003

4. Los Angeles Department of Water and Power. (2016). *Sylmar Ground Return System Replacement Project (Draft EIR, Vol. 1).* https://www.ladwp.com/sites/default/files/2024-12/SGRS_Draft%20EIR_Vol%201_MARCH%202016.pdf?utm_source=chatgpt.com.

5. Romano, N., & Zeng, C. (2013). Toxic effects of ammonia, nitrite, and nitrate to decapod crustaceans: A review on factors influencing their toxicity, physiological consequences, and coping mechanisms. *Reviews in Aquaculture, 5(1), 1–24.*https://www.researchgate.net/publication/258248010_Toxic_Effects_of_Ammonia_Nitrite_and_Nitrate_to_Decapod_Crustaceans_A_Review_on_Factors_Influencing_their_Toxicity_Physiological_Consequences_and_Coping_Mechanisms

Appendix

A.1

Water quality parameter measurements for each site and observation day.

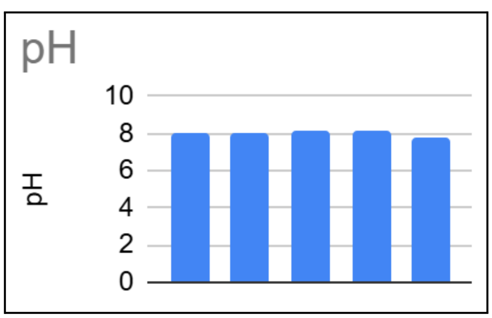
Date	Site	Site Description	Time of day	pH	Nitrates (ppm)	Ammonia(ppm)	Nitrites(ppm)	Notes
8/12	Pre-lim site 1		16:30	8	0	0	0	Site too deep, expected control levels
8/12	Pre-lim site 2		3:20	8.1	0	0	0.25	Very clear water, after foliage
8/12	3		4:20	8.4	10	0	0.25	very shallow
8/14	3		4:20	8.2	20	0	0.25	
8/14	4		5:00	8	5	0	0	Deeper water, more affected by wind
8/17	3		2:41	8.2	10	0	0.25	Same high winds
8/17	4		3:40	8	5	0.25	0.25	
8/31	3		3:30	8.3	5	0	0.25	
8/31	4		4:10	8.1	5	0	0	
9/1	3		3:20	8.2	0	0	1	
9/1	4		4:05	8.1	5	0	0	
9/20	3		3:40	8.1	5	0.25	0	
9/20	4		4:10	7.8	10	0.5	0.25	

Note: Explain pre-lim sites were not used in data analysis.

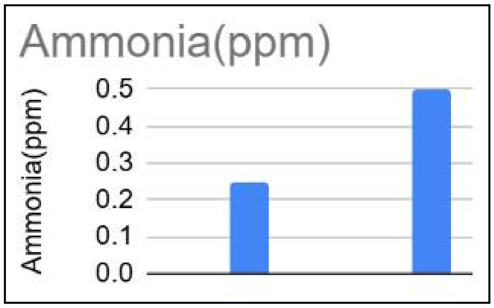
A. 2

Aerial visualization of Site 2 showing the physical characteristics of the site.

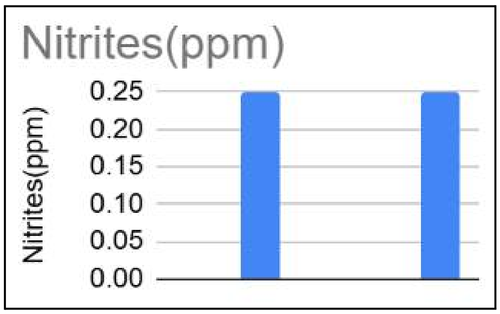
A. 3



A. 4


Ammonia(ppm)
Ammonia(ppm)
0.5
0.4
0.3
0.2
0.1
0.0

A. 5


Nitrites(ppm)
Nitrites(ppm)
0.25
0.20
0.15
0.10
0.05
0.00