

Evaluation of Agricultural Impacts upon the Water Quality in a University Campus Stream

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INTRODUCTION

For 8 weeks I lived and worked in EARTH University in Limón, Costa Rica. For my first two weeks in the country, I took a course called "Engaging Rural Communities" where I learned about agricultural practices in Costa Rica and the challenges that local farmers face. This course was a great introduction to my project, as it gave me time to familiarize myself with the country, the language and the university itself. After the course I met my professor Alex Gilman who helped me develop specific objectives for my time there.

Objectives for the internship:

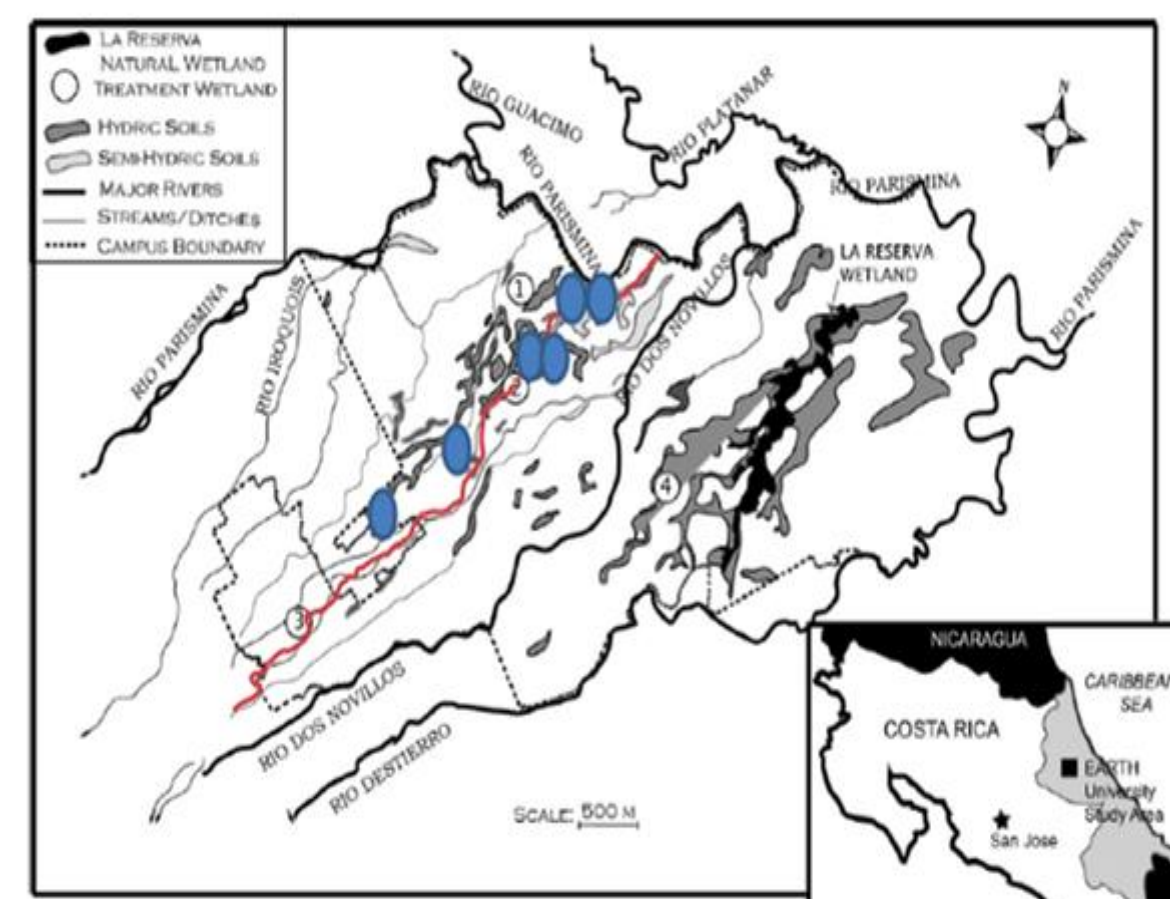
- Develop writing skills, particularly regarding formal science work (Quality over quantity)
- Have time and feedback for my research paper
- Learn how to correctly collect and analyze data sets, while also using historical data
- Increase Spanish skills (incluye palabras específicas de ciencia, naturaleza, etc)
- Understand how Costa Rica (and Costa Ricans) views environmental protection
- Meet and talk with professors and students studying the environment to help determine whether this is an educational path I want to take
- Learn how to take water samples effectively
- Learn about water ecosystems/macro-invertebrates
- Work on something that I find personally engaging
- Analyze impact of agricultural activities on local environment



METHOD

A third-year class of Applied Ecology students and myself evaluated the water quality in the Quebrada Henry stream which is a branch off of the river Rio Dos Novillos and runs through the university campus to the Rio Parismina. For the study, a total of six sites were sampled (shown right). Each site was selected to evaluate the effect of nearby agricultural activities.

- Sites 1 and 2 have frequent plowing, seed and harvest short-term crop production such as yucca, malanga, ñampie, and maize
- Site 3 is where the water treatment plant from the banana packing plant releases its wastewater into the stream
- Site 4 has two large concrete tanks of wastewater from agrochemical equipment washdown that works to degrade biodegradable chemicals.
- Site 5 and 6 are within the pastures of the Integrated Animal Production Farm, and potential contamination comes from soil, sediment and animal wastes being washed into the stream during periods of high rain.



BMWP ⁺ -CR	NIVEL DE CALIDAD
>120	Aguas de calidad excelente
101-120	Aguas de calidad buena, no contaminadas o no alteradas de manera sensible
61-100	Aguas de calidad regular, contaminación moderada
36-60	Aguas de calidad mala, contaminadas
16-35	Aguas de calidad mala, muy contaminadas
<15	Aguas de calidad muy mala extremadamente contaminadas

Macroinvertebrate samples were taken to determine water quality for this study. Different species of macroinvertebrates found in Costa Rican streams correspond to a government-approved water quality index (shown left), where different indicators species add varying levels of "points" to the water quality

Higher Point Total = Higher Water Quality

Analysis was done in the Water and Soil lab at EARTH, where stereoscopes were used to determine key characteristics of different macroinvertebrate species so that they could be grouped and tallied.

Data was then analyzed both from current water conditions (as of July 2018) but also from March of this year, as to have both a dry season measurement (March) and a wet season measurement (July) incorporated in the study.

Lastly, a survey was conducted to assess the environmental views of EARTH students. Both first-year EARTH students who had yet to experience much of EARTH's curriculum or see Costa Rica's environmental conditions firsthand, as well as third-year students who had had significant exposure, took the survey. For example, many of the third-year students who participated in the survey also completed the aforementioned Applied Ecology class where much of this project took place.

THE PROCESS IN PICTURES



CONCLUSIONS

For the water contamination data gathered, weather, and in particular rainfall, can be an influencing factor. Large rainfall events do effect physicochemical analysis more than bioindicator macroinvertebrate analysis such as the BMWP⁺ CR index, but variation in rainfall conditions can influence what species are present. Initially, it was believed that high rainfall events during the rainy season would lead to many macroinvertebrates washing downstream or digging deeper into the riverbed to prevent being washed downstream. However, this effect is not directly evident. The most contaminated sites overall (sites 3 and 4) were less contaminated during the rainy season, suggesting that high rainfall events may help clean the water in some instances. In general, long-term analysis with a variety of weather conditions would yield even more reliable and accurate results.

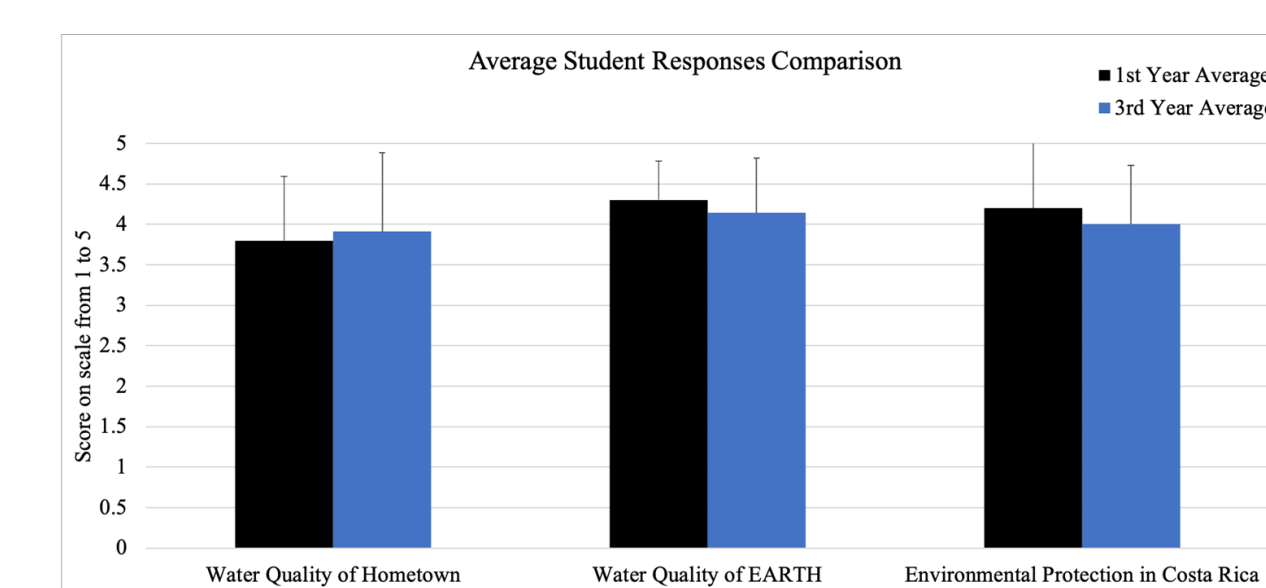
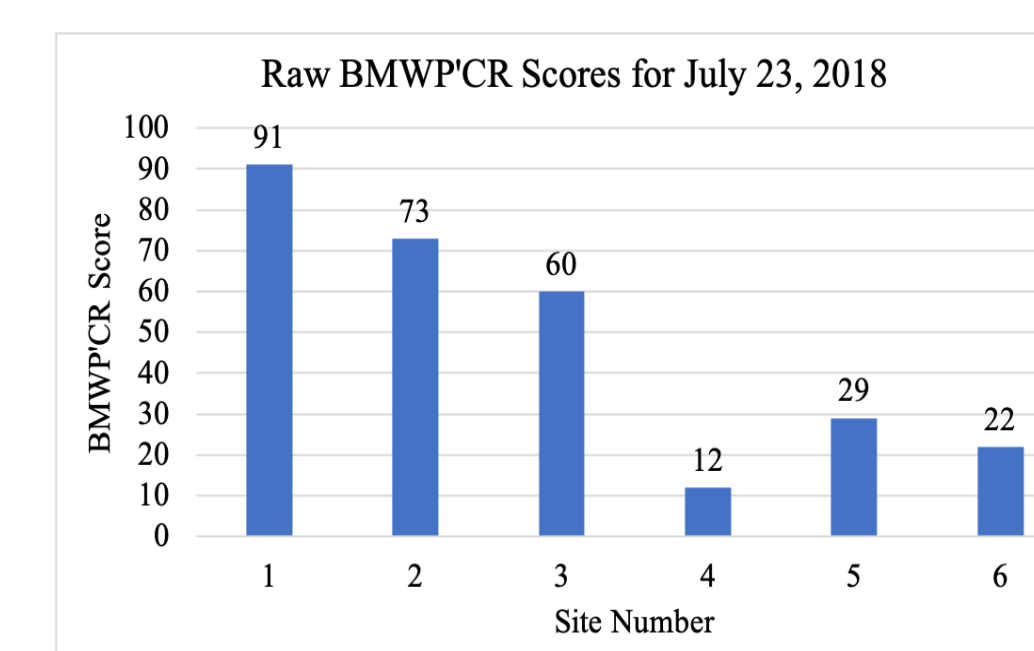
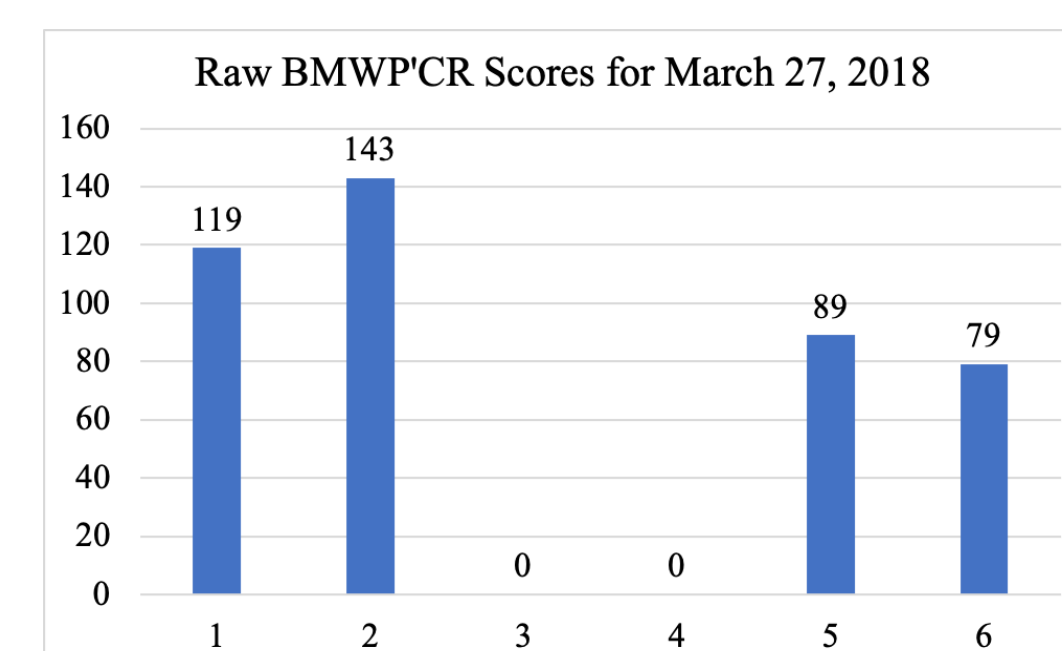
Evidence collected in this study supports the claim that the banana packing plant and/or other agricultural activities at EARTH are contaminating the local stream and are affecting the viability of water life such as indicator macroinvertebrate species. It is imperative that institutions like EARTH continue to advocate and demonstrate sustainability and organic practices. In addition, EARTH has a large population of talented professors and students dedicated to sustainability. The best solutions for EARTH could come from discussions and open-mindedness between farm managers and EARTH faculty and students. Specific practices by the banana plantation and potentially other EARTH farms need to be addressed with relatively simple solutions like the aforementioned water guards. Sustainable practices will need to become the norm if humans wish to avoid severe global warming and global catastrophes but these practices will only be viable if they are enacted on their own merit. Sustainability only for the sake of business does not work. There must be a balance struck between protecting the planet and remaining financially stable for the sake of sustainability. Environmental protection must first and foremost be motivated by a core belief in preserving and protecting delicate and increasingly threatened natural systems.

One of my biggest takeaways from my project is that science is never definitive. My project did not yield definite results to prove any one agricultural area of EARTH to be the main source of contamination. However, it did help show that there are problems with water contamination on EARTH campus that need to be addressed. My biggest address to EARTH would be to be careful that economic interests don't outweigh environmental interests. Investing in the environment can seem daunting, but generally sustainable places like EARTH show how valuable it can be.

RESULTS

In general, when water was tested downstream from the packing plant, a significant drop occurred at site 3 and 4. In the case of the March analysis, water before the packing plant for sites 1 and 2 was measured as good quality and excellent quality respectively, while sites three and four received a zero, indicating extremely contaminated water ("extremadamente contaminados") in that area. Meanwhile, sites 5 and 6 had regular quality.

Results from the test in July differ from the March results. Measured water quality was regular for sites 1, 2 and 3, and then dropped to extremely contaminated at site 4. Sites 5 and 6 were only slightly higher quality and were still rated as very contaminated.



First-year students did, on average, rate environmental practices and protection in Costa Rica higher than third-year students. However, standard deviation calculations represented by error bars in the figure show that this difference is not significant. P values for the three questions were generated as 0.5470, 0.6422 and 0.2469 respectively. For a significant difference to be present, values would need to be less than 0.05.

Overall, students view Costa Rica's environmental practices favorably, often citing the strict legislation that the Costa Rican government has put in place. Many also referenced the fact that this legislation is not always followed or enforced, which shows that many EARTH students are in fact aware of the issue of environmental perceptions not matching realities.

OVERALL EXPERIENCE

When I first arrived at EARTH as a Bortlaug-Ruan intern in the middle of rural Costa Rica, I had no idea what to expect. I knew very little about Costa Rica as a country, not to mention the Spanish language itself. However, in just eight weeks, I learned an incredible amount about Costa Rica, its people, and its environment. I was given the opportunity to take an initial two-week course about rural communities and rural development in the country, which allowed me to travel around the country and meet inspiring people who are making change. Not knowing much Spanish ultimately made my time at EARTH even more valuable, as I had constant exposure to native Spanish speakers as well as a formal three-week Spanish class to learn some of the complex aspects of the language. Similar to my past experiences with living/traveling abroad, flexibility was key. I was required to completely do away with my preconceptions of what I would be doing at EARTH from the moment I stepped foot on campus, but doing so was a valuable experience in independence and communication, in terms of initiating my project. Lastly, my time at EARTH has been a useful introduction to college life, as I was due to start college in the fall. I had quite a lot of independent time on campus to do personal research and writing, learning how to manage my time effectively so that I could complete my work and still have social time.



The friends I made and relationships I built over the span of 8-weeks I plan to keep, and I look forward to going back to Costa Rica soon (or Ecuador or New York or Belgium to see specific people!)

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