CLAG Field Report 2018

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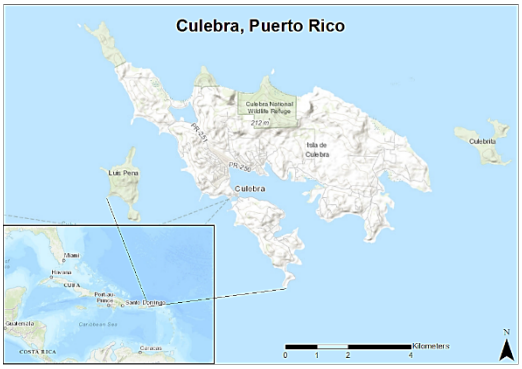
Introduction and Study Area

Terrigenous sediment delivery into tropical coastal waters from land development is a key stressor influencing the global decline of coral reef ecosystems, and Caribbean reefs are amongst the most affected. Higher turbidity of coastal waters from sediment loading rates can result in smothering, bleaching, reduced photosynthetic activity, and increased risk of disease for coral colonies. For small coastal watersheds in the northeast Caribbean, roads have been shown to be the main contributor of sediment that reaches the coast. The small Puerto Rican municipality of Isla de Culebra has experienced significant rates of development since the 1990's, which has been correlated with the continuous decline in health of coral reefs surrounding the island.



Based on the quality and diversity of coral, as well as the multiple endangered species of marine life that reside on the island, Culebra has been selected as one of only 4 priority coral reef management sites in Puerto Rico. However, long-term monitoring efforts at Culebra's Canal Luis Peña Natural Reserve have discovered a 50-80% reduction in live coral cover since 1997.

The health of Culebra's marine ecosystems are crucial, both environmentally and economically. Its economy relies almost entirely on income from tourism. If Culebra's surrounding corals continue to die off at its current rate, marine life will also deteriorate, which may potentially lead to a decrease in tourism revenue.

Research Overview

My research focuses on quantifying sediment production rates that occur from unpaved roads after large storm events. In addition, I am attempting to spatially locate segments of unpaved road that are eroding at the fastest rate using GIS analysis. While these are the main objectives of my current research, I have decided to include a qualitative component to my work in Culebra. Geography is uniquely characteristic in the sense that it is a field of study that observes the deeply connected relationship between humans and the natural landscape. In order to follow the general principles of geographic study, I wanted to employ a mixed methodological framework that takes both the local environment and the people inhabiting that environment into account. Twelve interviews with key figures involved with the erosion mitigation projects taking place in Culebra were conducted. These interviews were included in my project so I could acquire a general sense of how significant the quantitative data we are collecting actually is in their decision-making processes associated with these types of projects.

Framework and Methods

My initial research began in the summer of 2017. While I was able to complete a significant portion of the fieldwork required for my analysis that year, I was unable to finish every test and

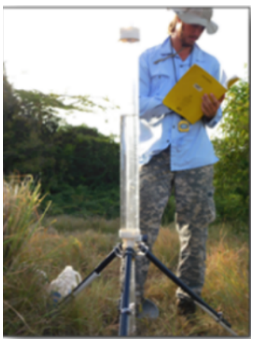
simulation necessary to produce accurate results. The CLAG field study award provided me with the additional funds needed to complete the remaining fieldwork at my study sites during the next summer.

Rainfall simulations and Guelph Permeameter tests were the two main field methods my advisor and I used to gather data on runoff rates and suspended sediment production rates from undisturbed hillslope surfaces and unpaved road segments. We grouped our road segments into 3 slope angle categories. 1-10% slope was considered low, 11-19% slope was moderate, and any road segment with a slope greater than 20% was considered high. We also further categorized the unpaved roads based off of when they were last graded (filled and smoothed). Recently graded roads had been graded within 1 year of our simulations, and ungraded roads were roads that have not been graded in over 1 year. Undisturbed, vegetated hillslopes were also analyzed in order to compare and contrast runoff and sediment production rates between different land surface types.

We ran 5 separate, 1 hour long, rainfall simulations on top of a 3 km^2 plot for each surface and slope type. We conducted 45 rainfall simulations in total. With this data, we can determine how quickly overland runoff is generated, how much total runoff is produced, and how much suspended sediment is created. Guelph Permeameter tests determine the water infiltration capacity for different surface types. A 30 cm deep borehole was dug into the ground using an auger. Water was then added into the hole at a constant rate for 30 minutes, and the change in water depth over time was measured. Over 50 tests were conducted during the two summers we were in Culebra. As we hypothesized, preliminary unpaved roads that are orders of magnitude greater than undisturbed, vegetated surfaces. Soil samples were collected for each rainfall simulation and Guelph Permeameter location in order to be further analyzed in the lab.

Rainfall Simulation on unpaved road

Rainfall Simulation on Undisturbed Surface



Guelph Permeameter test

Lastly, I had the opportunity of interviewing 12 individuals while I was in Puerto Rico. There were 4 main focus groups I interviewed who dealt with erosion mitigation projects taking place on the island. The groups were broken down into academic researchers, government officials, homeowners in Culebra, and private-sector organizations. I asked the same 10 questions to each person, and evaluated their responses. All interviews were recorded to transcribe and code at a later time. I intend to find any type of connection between responses of people within each group, and among all groups. These interviews are meant to compliment the research mentioned above, and indicate the level of validity this quantitative analysis has for local policy makers.

Conclusion

All the data that I was able to collect with assistance from CLAG's field study award will be further analyzed at the University of Texas at Austin. With this grant I was able to complete all the field analysis necessary to write my master's thesis. I hope to return to Culebra after graduation so I can share the information derived from the final product with the local residents and government officials. I believe that the distribution of knowledge to non-academic audiences is equally as valuable as providing that same information to academic researchers. The information I intend to share would not have been possible without CLAG's generosity, and I am very grateful for having the opportunity to finalize the research portion of my project this summer.