Science in Puerto Rico: For the people, by the people

Nick Carleson, PhD Candidate
Dept. Botany and Plant Pathology.
This poster is on Kalapuyan land.

Resilient wetlands

Partner Scientists: Edgardo Gonzalez, MS and Dr. Ricardo J. Colón-Rivera

Project: We worked in a wetland stand that was clearcut decades ago and used for agriculture. While the land was abandoned from its agricultural use, by itself it will not become the robust, diverse wetland it once was. The wetland needs assistance to jumpstart the rehabilitation process, so about five years ago they led teams to plant about 30 species of diverse flora. While the species they planted are growing, they are not thriving because kudzu vines have overgrown them (Fig. 1). I coordinated with two other students to lead a team of 25 students that cut vines about four feet off the ground, severing them from their nutrient source, and pruned low-hanging branches from trees to reduce the vines' ability to climb into the canopy. It was hot, humid, and hard work.

Impacts: Specialists have observed over time the connection between a resilient ecosystem and tourism; Ricardo said expanding the area of rehabilitated wetland expands the economic opportunity. To quantitatively estimate our impact, Ricardo performed drone flights one month and four months after our work, and measured how many vines died. While the delay of the drone flights has delayed the satisfaction of the work we did, our labor was immediately satisfying. Every tree that we freed from vines was one tree whose growth may have been stunted, unable to reach the top of the canopy for enough sun to thrive.

Figure 1. Dr. Ricardo J. Colón-Rivera explains to our group of 25 students where to trim vines. We performed stand improvements to the mixed Pterocarpus/Amphitecna/Anona area.

Challenges and Lessons: It was challenging to organize this work because on "island time," Ricardo and Edgardo's responsiveness was not what we were used to back on the mainland. However, if I had let Eurocentric values dictate my view of their competence or commitment to their work, we would have missed the oportunity to learn from their expertise. Once we were there, we connected deeply and the passion they had for their work inspired me. We finished our work in half the time they expected. I have immense pride for how we worked, and they said they would be happy to return any time.

Community-Engaged Science

1. Western scientific approaches often prioritize individuals over communities and narrow, abstracted portions of problems, while losing sight of the larger picture.

During my PhD, my research has at times felt disconnected from the needs of my community. As a computational forest pathologist, I spend most of my time analyzing genomic data and not much time in the field. The impact of my research is also not immediate, since I do not study "cures" for the disease, or efficacy of the treatments our stakeholders perform.

2. The insights and experiences of individuals who have lived in the ecosystems they study are invaluable to building and maintaining resilient ecosystems.

Knowing what issues are local involves keeping an open eye. Once, there was a major breakthrough in our research program at OSU, when a forester was driving with their family to the coast, pulled over when they noticed a dying tree, sampled it, and found the pathogen we study whose next-closest infection was 100 miles away. Local knowledge can help identify problems that visiting scientists may never have seen.

3. Anyone can perform science, and even a small scientific community can make a large impact in understanding and developing healthy communities of plants & people.

Working in the forest, spending time in the trees and in the streams, inspired me to always think about what local impact my research can have. Not only because my labor and reagents are paid from federal dollars, but because my time is valuable and can make an impact when used in the right way. Although our work is in a temperate forest and all our forest work areas in Puerto Rico were tropical, there's a common thread among us. It is a care and passion for the community that brings energy, and how we find outlets for that energy is problem-solving our environment.

Madeline the Red Mangrove

Our last project was planting mangrove saplings in a mangrove forest that experienced 100% mortality after Hurricane Maria. Dr. Robert Mayer, faculty at University of Puerto Rico at Aguadilla, runs a lab that performs experiments to find mangroves that can robustly grow in the face of drought, flooding, extreme heat, and extreme salinity. The mangroves they choose are based on thorough lab experiments subjecting saplings to those conditions.

There are three species of mangroves, red, white, and black, and the species they plant in an area are based on careful observations of where each species is most adapted to survive in relation to each other. They hire workers and lead volunteer teams to plant the survivors in a structure that they invented to protect the saplings while the trees can grow large and healthy. We filled the structures with sand and soil, and each had the opportunity to plant one.

I have a great feeling that Madeline, the mangrove sapling I planted (Figure 2), will grow up to be a strong and healthy red mangrove tree, planted near the outside of the stand and evolved to withstand flooding that protects mangroves toward the center. While the structures are designed for the planting of eight mangroves, the researchers expect only 3-4 to survive. It's possible that Madeline doesn't make it, but that will be because her siblings planted in the same structure grew instead. They all play their own role in re-building the ecosystem, and personally that helped illuminate my importance in my own community.

Figure 2 (right). Volunteer mangroves (left) do not succeed, so a team led by Dr. Robert Meyer is building structures to plant saplings in (right). One OSU student is seen picking their way through the mud. The mud of the mangrove basin was so thick that one student lost the sole of their shoe.

"Health is central to everything. Surging sea and salt water damages everything—health, water, land, infrastructure, community dynamics, family connections to traditional practices and the ability to feel that you are part of a community that can bounce back."

Dr. Maria Moreno, collaborator with Dr. Mayer on a $600k grant to restore four mangrove basins. Our team of 20 are among 500 volunteers to work on the project.

Resilient Waterways

Scientific Partners: Steve Tamar (Surfrider)

Background & Project: Steve Tamar co-founded a chapter for Surfrider and led the initiative to ban plastic bags in Puerto Rico several years ago. The chapter was powered by surfers and divers who noticed that plastic bags frequently got tangled in coral reefs, eventually killing them. Surfrider was successful in banning plastic bags in Rincón, and the initiative later spread to the whole island. Despite the ban, we frequently observed plastic bags on the beach. We split into two teams of six and picked up trash from two directions leading North and South along the beach. Together, we cleared 12.5 pounds of candy wrappers, plastic and glass bottles, soda can tabs, cigarette butts, and other garbage left behind on the beach (Figure 4). Later, I would be rewarded for this effort when I was snorkeling on a different beach. I was fortunate enough to see elkhorn coral and a leatherback turtle swimming in the water, two targets of Surfrider's conservation efforts!

Impacts: Surfrider efforts go beyond trash, they also monitor water quality. Steve has been testing water for Escherecia coli and Enterococci faecalis, two indicator species for the impact of a water source on human health, for seven years. Steve set up a lab on a shoestring budget, including a spectrophotometer, incubator, and small autoclave to sterilize equipment and reduce scientific waste (Figure 3). Surfrider volunteers collect water samples from frequently-traveled sources, including the beach where we performed the cleanup. Steve learned how to perform the experiments, perform calculations, and adhere close to EPA standards from reading literature and talking with faculty at the University of Puerto Rico at Aguadilla. Days earlier, we heard Dr. Miriam Salgado Herrera, PhD, with the USDA Forest Service International Institute for Tropical Forestry who tested water from a swimming spot nearby and found dangerous levels of Enterococci spp.

Figure 3. Steve Tamar describes how to read the assay revealing quantities of bacteria that make water unsafe for recreation. Steve gave me a "tour" of the Surfrider Rincón lab, which was one room with a mini-fridge and two working instruments. They had a third working instrument after winning a mini-grant from a scientific equipment manufacturer, but the small autoclave was recently disabled by a brownout, which frequently impact the area.

While Dr. Herrera is credentialed and earned her PhD, Steve has no formal training and performs science that will benefit the community. It was powerful to see how this science is inspired by and performed for local issues, by someone with passion to lead.

Figure 4. Two teams picked up 12.5 pounds of garbage from a beach, and recorded tallies of commonly found items such as bottlecaps and cigarette buts. The data was returned to Surfrider for longitudinal analysis. A leatherback turtle nesting site is cordoned off with caution tape. Based on the volume of garbage nearby, beachgoers respect the areas.

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