

Brenna Sweetman
Department of Geography
University of Alabama
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CLAG Report

A baseline analysis of water quality of the Port Honduras Marine Reserve, Belize

Overview

The objectives of my research were to analyze spatial and temporal trends in water quality of the Port Honduras Marine Reserve (PHMR), Belize from 1998 to 2015 and to determine the efficacy of the marine protected area for improved conservation management. This study was completed using a mixed-methods approach to gain a broad understanding of human impacts on water resources associated with land use change and population growth. PHMR represents a unique link between upland watersheds and coastal wetlands, mangroves, coral reefs, and seagrass beds. The local community and economy rely heavily on species from PHMR and the degradation of water quality could have both ecological and economic consequences. Primary threats to coastal water quality in the region have been identified as watershed-based pollution from nutrient fertilizer runoff and sediment from erosion. To address this issue, I analyzed land use land cover of the seven watersheds that drain into PHMR as well as data from Belize census reports to determine population dynamics during the study period. In addition to quantitative data collection, I also collected qualitative data through interviews with local stakeholders regarding their perception of threats to water quality of PHMR and its surrounding watersheds.

Description of activities

CLAG's support enabled me to live in Punta Gorda, Belize for two months and volunteer with the Toledo Institute for Development and Environment (TIDE) by paying for my housing and *per diem* expenses. TIDE, the NGO responsible for co-managing PHMR, conducted water quality monitoring with varying continuity from 1998 to 2015. The monitoring program ended in 2015 as a result of inadequate funding. Although TIDE had collected extensive data over the years, the organization lacked the resources to perform analyses and form conclusions. I organized and compiled the existing data into a cohesive database and analyzed the variables of temperature, pH, salinity and dissolved oxygen of ten sites throughout PHMR during the 17-year study period to determine spatial and temporal variability in water quality.

During my time in Belize I also interviewed various community members about their perceptions of PHMR and potential threats to water quality. These interviews were conducted with Mayan villagers located upland of PHMR, marine tour guides and park rangers of PHMR. My conversations with local community members also afforded me several unique opportunities to get involved with and serve the local community. As a volunteer with TIDE, I assisted with their biological monitoring surveys in PHMR of lobster and conch and attended a fisherman's forum. I also assisted with a reforestation project of the Rio Grande riparian buffer zone in the Mayan village of San Pedro. This was a project hosted by the Xucaneb group, a Mayan group focused on reforestation efforts along the river. In addition to these opportunities, I was able to present my research and discuss the importance of water quality on the Punta Gorda local TV station, the most popular media outlet in the region.

Results and discussion

Overall, the results of my spatial and temporal analyses yielded statistically insignificant results, suggesting little variation in water quality. The results of my spatial analysis indicated no difference in the water quality variables between the ten monitoring sites of the reserve regardless of receiving freshwater from watersheds of varying land uses. The results of my temporal analysis indicated significant differences in temperature, salinity, pH and dissolved oxygen between the wet and dry season, with the wet season defined as June through September and the dry season as October through May. However, I determined no significant long-term trends in these variables between 1998 and 2015.

The results of my land use land cover change in the watersheds of the region indicate a 344% increase in urban and cleared land and a 7% increase in agricultural land during the study period. The substantial increase in urban land use is likely a result of the upgrading of the Southern highway in the early 2000s, which facilitated development in the Toledo district. Toledo's population also increased 62% from 1998 to 2017, with the town of Punta Gorda's population increasing by 23%.

The qualitative data collected through interviews with local stakeholders identified conversion to agricultural plantations in the Monkey River and Rio Grande watersheds, the two dominant watersheds, as potential threats to water quality of PHMR. Another specific area of concern noted by community members is the dump site, an unregulated municipal trash site located within 1km of the Rio Grande river.

Conclusion

The results of my research indicate the water quality of the coastal marine ecosystem of PHMR has been effectively protected with minimal impacts from anthropogenic stressors and climate change thus far. These results are likely associated with the absence of beaches, limited coastal development and low population density of the region relative to the rest of Belize. However, the recent increase in population and land use change have the potential to impact water quality of PHMR in the future if these factors continue at their current rates. Improving municipal waste management should be a priority for local authorities in Punta Gorda. If unchecked, the dump site could have catastrophic consequences for water resources.

Long-term data collection of the marine environment is important to preserve marine water quality for aquatic species, human health and the economy. There is a clear need for more funding for TIDE and local government authorities to continue their monitoring efforts to meet conservation objectives. This study provides a baseline analysis of water quality but continued water quality monitoring in the region is critical for future conservation efforts.

The opportunity afforded to me by CLAG's support to travel to Belize and conduct this research study for my Master's thesis was an incredibly valuable learning experience for me and an important step forward in my professional career. Being involved in the work of an international NGO allowed me to gain valuable insight on management issues and conservation objectives in Latin America, an area that I anticipate working in in the future. I plan to finish my analyses, publish the results of this study in a peer-reviewed journal and share the findings with TIDE members and local authorities of Belize.



Discussing threats to regional water quality on Punta Gorda TV with Wil Maheia.



Sign at PHMR's ranger station showing the different designated use zones of the reserve.



Learning about TIDE's water quality monitoring procedures with marine biologist Tanya Barona and community research assistant Fernando Rabateau.