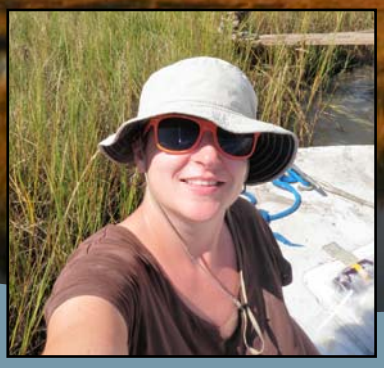
The Coastal Waters Consortium Presents:

Project Spotlight



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What is the topic of your research within the CWC?

Coastal habitats like salt marshes are vulnerable to disturbances due to global climate change. Because climate change has been occurring now for several decades, it is possible that coastal ecosystems have been changing more rapidly than was previously recognized. My research focuses on combining microbial diversity and ecology data with biological, physical, and geochemical observations made across temporal and spatial scales in the southern Louisiana salt marshes. Since the oil spill, we have sampled dozens of marshes. We have evaluated changes at the microbial level and see that there is potential for these changes to cascade through the entire marsh ecosystem. Triggers for microbial change are linked to changes in oiling that occurred during the Deepwater Horizon oil spill, as well as from flooding of the marshes with freshwater, which have lower salinity and lower pH. Freshwater flooding is due to river diversions. Changes in the microbial communities have the potential to affect carbon, nitrogen, and sulfur cycling, and may not have positive outcomes to the ecosystem. We have also become concerned about marsh soil stability and shoreline erosion, and how changes at the microbial level, be them related to abundance, distribution, or functional capacity, affect the delicate balance of marsh ecology, sedimentology, hydrology, and climate

What methods are you using to answer your questions?

After getting to the marshes in small boats, we use basic field geochemistry methods to measure water pH, temperature, and salinity, as well as collect sediment cores from the marshes. Back in the laboratory, we extract the DNA from the sediments at different depths, and then sequence specific genes from the samples. Genes of interest include the 16S rRNA gene, which is used for identification, and genes that are present in organisms with specific metabolisms, such as alkane degradation, methane oxidation, or sulfur oxidation.

What results have you gotten thus far? And did any of these results surprise you?

We have been surprised by how much marsh microbial diversity has changed over such a short period of time. Pre-oil spill data from 2010 showed highly similar compositions. But through time and depending on what happened to the marsh (higher concentrations of contaminating oil or more frequent flooding from freshwater), microbial changes followed distinct patterns depending on the disturbance. Now, microbial communities at different marshes are dissimilar to each other, and the differences correlate to changes in flooding history, salinity effects, and dominant vegetation type.

What are the next steps in your research?

We have a nearly continuous record of sediment collected from offshore at many marshes since May 2010 and of marsh inland soil since 2011 at some locations. Collectively, these geochemical and microbial data represent the most intense microbiological sampling of salt marshes in Louisiana. The physical, geochemical, and genetic datasets are huge, and we depend on advanced data analytics methods to process and interpret the findings. We are looking for more ways to maximize our computing power while maintaining dataset size and scope. We are also incorporating long-term public datasets, such as from state and Federal monitoring programs, to begin to integrate our work into large analyses related to marsh erosion histories due to sea-level rise and climate change.

What are the "big picture" implications of your study?

Microbes play fundamental roles in the biogeochemical cycling of important nutrients, like carbon, nitrogen, and sulfur that are essential for plants and animals. Our research, which is uncovering how natural and anthropogenic processes and disturbances affect functional and taxonomic diversity at the microbial level, also provides important information about how marsh ecology, diversity, sedimentology, and hydrology are delicately balanced. Consequently, we think that conservation of these systems needs to start at the base of the ecosystem, and our work helps to achieve this goal.

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