I recently spent two weeks aboard the R/V Nancy Foster, a 197 foot research vessel operated by the National Oceanic and Atmospheric Administration (NOAA) to conduct oceanographic research in U.S. coastal waters. NOAA is a federal science agency that supports the public with daily weather forecasts, severe storm warnings, climate monitoring, fisheries management, coastal restoration and marine commerce. As part of my internship with NOAA’s Marine Spatial Ecology Division (MSE), I assisted a team of scientists conducting ship-based research in coastal waters of Puerto Rico from June 26th to July 9th. NOAA operates 16 “ocean-class” vessels throughout the Pacific and Atlantic Oceans, but the Nancy Foster is one of the most operationally diverse platforms in the NOAA fleet in its ability to conduct fish habitat and population studies, seafloor mapping surveys, oceanographic studies, and maritime heritage surveys.

This two-week mission, or “cruise”, as we call it, was the 14th annual trip that the MSE division has conducted in the U.S. Caribbean since 2004. This area is filled with healthy coral reef ecosystems which are both economically and ecologically critical to the surrounding communities of Puerto Rico and the U.S. Virgin Islands. However, not enough is known about the diversity, health, and abundance of these corals and the marine communities dependent on them (e.g. fish, turtles, and marine animals). These cruises have helped collect information on
these areas for both scientists and the public to use and as well as to help with conservation measures.

Our project area for the cruise was a 30 kilometer section of central, southern Puerto Rico roughly between the municipalities of Guanica and Ponce in coastal waters with depths of between 10 and 1,500 meters. This area of Puerto Rico is a mixed collection of coastal land ranging from beautiful undeveloped coastlines on the west to large industrialized and developed cities on the east. Small islands, coastal communities, and inland bays are spread throughout making for an intricate and diverse coastline. I found it ironic however, that one moment I would be watching the live ROV feed and seeing such a healthy coral reef, and then then the next minute I would walk out to the ship’s main deck and see large oil and gas storage tanks and refineries just a mile away. It was striking to see such a vibrant and thriving undersea community so close to industries that could impact the coral ecosystem. I hope that this cruise helps people better understand the health of coral in Puerto Rico and the threats they face from human activities.

During our cruise, the scientists used a number of advanced technologies in order to characterize the resources in this location. Firstly, multibeam sonars mounted to the hull of the ship (Kongsberg EM710 and EM2040) were used to create highly detailed maps of the water depth, shape, and topography of the seafloor. In addition, the scientists also used Remotely Operated Vehicle (ROV) from the University of North Carolina, Wilmington (UNCW) Undersea Vehicle Program and fish acoustic sonars to characterize the conditions.

I mainly worked to help with the acquisition and processing of the multibeam data; however, was also involved in the other two portions of the mission. The multibeam sonar sends out a swath of sound to the seafloor, which bounces back and allows scientists to gain necessary information on critical areas such as the depth and type of the seafloor. We are able to create a variety of maps and charts of the seafloor exemplifying the changes, such as the one shown below (Figure 2). We use Geographic Information System (GIS) technology in order to create these sets of data related to positions on Earth.
Besides creating detailed maps of the ocean floor, we were able to find and track individual & groups of fish under the water using a single beam sonar system. This data characterized fish abundance, patterns, biomass, and spawning aggregations. This information is critical to scientists who manage popular fish areas and add restrictions to fisheries.

Based in the wet lab, which looks more like a classic laboratory setting, were the scientists focused on the ROV work. As opposed to us, who ran the sonar from 1600 to 0800, they ran the ROV dives from 0800 to 1600, usually fitting in about 4 or 5 dives a day (Figure 3). These dives were planned transects approximately 2 hours in length in order to capture data to help better understand the information collected from the sonar data.
Figure 3: Scientists directing the UNCW Mohawk 2 ROV into the water.

During the ROV dives, a ROV technician from UNCW Undersea Vehicle Program was responsible for driving and tracking the ROV as well as directing the ship; and the scientists were responsible for taking notes of observations, capturing photos from the live video feed to the surface, and tracking what exactly they see underwater (Figure 3). The ROV video and photos allowed a glimpse into what the actual seafloor looked like, as well as the environment of coral, sponges, fish, and other features (Figure 4 and 5). The ROV dives are extremely interesting and I was actually allowed to drive it one day (Figure 6).
Figure 4: Shallow-water soft and hard corals image captured by the ROV.
Figure 5: Coral (gorgonian) image captured by the ROV.
Overall, life on the ship was very rewarding and eventful. It was also extremely different from an ordinary day on land, particularly because of the fact that everyone was living with their coworkers. Although they were tight quarters and the Foster in particular tends to get a bit rocky, I thoroughly enjoyed the unique experience. I was able to get to know all of the other scientists, crew members, and officers on board, and even got the chance to interview a few of them. The scientists came from all over the country, with most living in either Maryland, Charleston, or Seattle, all large NOAA bases. All of the officers on the ship were NOAA Corps officers (Figure 7). The NOAA Corps are one of the seven uniformed services of the United States, consisting of all commissioned officers who have a scientific and technical background. They all were extremely interested in the work we were doing and would come down to the labs.
just to watch us work and to talk.

Figure 7: NOAA Corps officers driving the ship.

To continue into more detail about life on the ship, I will describe an ordinary day for me. I would wake up late because I worked a late shift, would work out (the ship has an awesome gym), and then would have some time to relax. I could take advantage of the hundreds of movies down in the lounge or go read a book on the “steel beach” (Figure 7).
I would eat a big, early dinner and get ready for my shift! My shift was the earlier of the two for the two sonar shifts. My shift was from 1600-2400 so it required plenty of coffee and snacks for everyone to stay alert and focused. During this time, there were four stations set up throughout the lab with plenty of computers at each. Each of these areas had the purpose of one specific task – acquisition, processing to create a swath bathymetry map, processing in arcGIS creating an acoustical backscatter map, and fish acoustics. I was able to work at all of these throughout my time on the ship, learning and eventually taking over that task. Acquisition involved controlling the multibeam sonar through a hydrographic surveying system called which includes real-time targeting, imaging, and editing, communicating with the bridge about what lines to next
run and what was going on at our end, and logging and transferring the files (Figure 8).

Figure 8: Me conducting multibeam acquisition.

It was the most involved and demanding piece of the process, and definitely the most stress inducing. Many issues tended to arise that had to be corrected on the spot, but I still loved being front and center and in charge of everything. The processing to create the bathymetry map would clean the sonar data, which would often have issues in areas such as sudden ledges or drops in the seafloor (Figure 9). It would eventually create a beautiful, colorful bathy map of the seafloor that would be sent back to acquisition and to ROV to use. The bathymetry dataset ensonified the entire seafloor of our operating area. It provides information on the depth of the seafloor by using the time it takes for the sound to return to the ship.
Processing in arcGIS creates a backscatter product that helps determine the type of seafloor, as different bottom types “scatter” the sound energy differently. A softer bottom, such as sand, would have a weaker signal than a rock bottom.

Those two weeks on the ship allowed me to further develop my skills in these areas of hydrography, geography, cartography, and oceanography. Getting the chance to work with professionals on a project that will be used in many ways for protection and management was incredible. I was able to get a glimpse into this specific career path, which I am extremely interested in. I, as well as everyone else aboard the Nancy Foster, have developed a passion for conserving the beautiful and critical reefs around U.S. waters. Coral reefs are a clear indicator of the health of our waters, and demonstrate the true diversity of coastal waters. Projects like this help to protect the reefs, which are such an integral part to our economy and to communities around the world. They help everyone from coastal resource managers and coastal industry companies to federal and state management efforts. You can follow the Nancy Foster and their range of projects on their Facebook page.