

Our World-Underwater Scholarship
Society® American Academy of
Underwater Sciences Mitchell Scientific
Diving Research Intern



Host: Joshua Manning, PhD Candidate
Florida State University
Bonaire, Caribbean Netherlands



Krista Laforest
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“It’s the not the destination, it’s the journey”

— Ralph Waldo Emerson

After months of being landlocked, itching for the world to reopen and longing to return to the sea, I was shocked to receive a call from the Our World Underwater Scholarship Society and overjoyed to hear that I had been selected as the AAUS Mitchell Scientific Diving Research Intern! Despite COVID-19 restrictions, I would be part of a research group from Florida State University (FSU) spending the summer conducting field research on coral reefs in Bonaire. There were countless unknown variables about how we would accomplish international travel, but there was no doubt that I was ready to begin this adventure!

Before departing in May, I would need to travel to Tallahassee to complete the onboarding process as a scientific diver for FSU. After meeting Chris Peters, the FSU Academic Diving Program’s Dive Safety Officer, for a swim test, I joined his scientific diving class for a day of checkout dives at Cherokee Sink, a freshwater spring near campus. For someone who spent most of their early career as a Divemaster in quarries, I was right at home in the chilly murky waters. During that weekend, I was able to meet Lena, an undergraduate student who would be joining the team in Bonaire. As we emerged from the water into a crisp 50-degree day, we smiled, knowing we were headed for warmer, crystal-clear waters!

I met the rest of the team as most people do lately – via Zoom. After countless calls to plan our flights, review travel requirements for entering Bonaire, and discuss what we hoped to accomplish over the summer, we were finally a week away from starting to conduct research! There was just one hiccup – our flight had been canceled and all flights from the US to Bonaire were suspended for another month. It was back to the drawing board, and back to Zoom, as we rallied to find another route to Bonaire. There were still flights from Florida to Curacao, and from Curacao to Bonaire on a small local airline. We

determined that we could take a COVID-19 PCR test three days before our arrival in Curacao, then take a rapid test during our layover to meet the requirement of getting an antigen test within four hours of our departure to Bonaire on a small twin engine “island hopper.” Once we had finalized our new itineraries, we packed our bags and prepared for our trip.

After a flight from Boston to Miami, I finally met Josh, Ethan, and Allie – graduate students at FSU – in person, before getting on the flight to Curacao. We waited in anticipation for our negative COVID-19 test results at Hato Airport in Curacao, before finally boarding our 20-person plane to Bonaire. As we approached the island, reality finally sank in: this was our home for the summer, and I could not be luckier to do research underwater for a living!

"Study nature, not books."

— Louis Agassiz

Upon arrival, we made the most of our self-imposed week-long quarantine before we could start working underwater by practicing our Caribbean fish and coral identification. Since Josh’s research focuses on how parrotfish territoriality affects spatial patterns of grazing on coral reefs, we mainly focused on the five species we would be observing:

stoplight parrotfish (*Sparisoma viride*),



queen parrotfish (*Scarus vetula*),



princess parrotfish (*Scarus taeniopterus*),



striped parrotfish (*Scarus iseri*),



photo credit: Joshua Manning

and the redband parrotfish (*sparisoma aurofrenatum*).



Parrotfishes are protogynous hermaphrodites that transition from an initial female phase to a terminal male phase based on social cues. These phases can have incredibly distinct colorations (see the above *S. viride* and *S. vetula*), so it is important to be able to differentiate when fishes are the opposite sex, or an entirely different species!

After several field seasons on the reefs of Bonaire, Josh found that males of some species, particularly the stoplight parrotfish, swim within well-defined territories and will chase off other males that enter these areas. So, for the first portion of Josh's research, we dove at Invisibles to record the behaviors and movement patterns of all terminal phase fish present on the reef for the five species of parrotfish. During these dives, Josh identified a fish to observe for 30 minutes, while I counted the number of initial phase fishes present within its territory. Josh would then signal to Lena, who was snorkeling at the surface with a handheld GPS receiver, to begin tracking the movements of the fish. At first, it was really difficult to determine how many initial phase fish were in each territory – if only they would just stay still! This became easier with time, and soon I was able to enjoy watching the fish from afar as they were grazing the reef substrate, visiting cleaning stations, and defending their territories from intruders. As the summer progressed, I was able to easily find the next fish's territory, which

allowed us to start tracking soon after finishing the previous track. Every second counts when a dive is two hours long!

We also tracked fishes at a second dive site, Aquarius. This time, I was in charge of GPS tracking as the top-side snorkeler. Viewing these fish from above made it much easier to discern the boundaries of each territory and when intruding fish were attempting to sneak into the territories. While it is tricky to keep up with a fish that is chasing another male out of its territory, especially when swimming against the winds on top of a flotation device, it soon became my favorite part of tracking! Overall, we were able to track 175 parrotfishes this summer; we were even lucky enough to track a rainbow parrotfish (*Scarus guacamaia*) despite being less common at the study sites!



Photo credit: Lena Kury



“Keep your friends close; keep your enemies closer.”

— Sun Tzu

One of Josh’s goals for the summer was to get a better idea about how terminal phase stoplight parrotfish interact with other conspecific males to defend their territory on the reef. During multiple dives, Josh and I followed male stoplight parrotfish and categorized the type and the duration of interactions with both terminal and initial phase fish. While males regularly chase smaller “floater” males (i.e., fish that do not possess a territory) out of their territory, it appears that males of similar size that share territory boundaries interact less often and less aggressively. This “dear enemy” effect has been observed in several other species, but never documented in parrotfishes! Males will often interact with females in their territories. These interactions are usually brief and appear to be over feeding spots. However, on occasion, we would see males chase females completely out of their territories, suggesting that maybe these females were not part of their harem. This was some of my favorite work of the summer; throughout these dives I truly felt that I was where I was meant to be. Despite fatigue from diving nearly every day, I was eager to get back in the water to see what the fish would do the next day!



Photo credit: Joshua Manning

By the end of summer, I was amazed how attuned I was to their behaviors – often I could tell in the moments leading up to a male entering a territory that the chase was afoot! However, not all fish behaved the same. While striped parrotfish pay little attention to other males and do not defend their space on the reef regularly, other species, like the redband parrotfish, interact with conspecific males by flaring their dorsal fins as if to say, “this is my area, stay out!”

Josh hopes that the data collected this summer will help us to better understand the drivers behind territory maintenance and space use in parrotfishes, which may have implications for the makeup of the underlying benthic community. In turn, this could provide important insights into coral reef management to restore and maintain a healthy ecosystem.

“In chambers deep, Where waters sleep, What unknown treasures pave the floor.”
– Edward Young

For the next portion of Josh’s research, we conducted benthic surveys to determine the composition of substrate on the sea floor. Parrotfishes influence the makeup of the benthos as they use their beak-like teeth to scrape at the substrate, which helps to keep algae in check and creates bare space for juvenile corals to settle and grow. During these dives, I would lay out a 30-meter reference transect, ensuring it was in the correct location by taking a compass heading at the beginning and end of the transect line. Josh would then lay four 10-meter transects perpendicular to mine, and we would get to work! While Josh classified, measured, and photographed the algae along the transect, I was responsible for classifying and measuring coral composition along the transect. Additionally, I measured relief every two meters, by taking the depth at the height of hard coral and again in the sand below. I was surprised to find how difficult this task became at depth – it seemed that my ability to do basic subtraction quickly was impaired as the swell of the sea rocked me back and forth! This, like many other

skills I gained over the summer, became easier as I developed muscle memory and became used to quickly identifying coral species.



photo credit: Joshua Manning

Finally, we concluded Josh's work for the summer by doing fish surveys. Similar to the benthic surveys, Josh would lay out a 30-meter transect, and we would slowly swim that distance, noting fish diversity, abundance, and sizes. It was overwhelming considering just how many fishes were in such a small space of the reef, but we were up for the challenge! We shared both our frustrations when we did not get the same fish counts and triumphs as we spotted rarer species like the queen angelfish. When the time came that we finished the last transect, there were mixed emotions as I was sad that our time was coming to an end, but proud of all we did in such a short amount of time!



“We delight in the beauty of the butterfly, but rarely admit the changes it has gone through to achieve that beauty.” – Maya Angelou

During the summer, Josh, Lena and I were fortunate enough to witness grooved brain coral, *Diploria labyrinthiformes*, spawning in May. As we hovered over these colonies, waiting for them to release their gametes into the water column to create the next generation of corals to settle onto the reef, we noticed something equally interesting. Four-eye butterflyfish (*Chaetodon capistratus*) which are thought to swim in monogamous pairs and defend a territory in a similar way as parrotfish, were swimming in groups of 20 or more, and racing from each brain coral colony around the reef, in hopes to eat the gametes released upon spawning as a quick snack before heading to their resting place at night! After seeing this, Lena and I decided to make a personal project out of this observation. For the remainder of May we poured through academic journals, hoping to learn more about butterflyfish territoriality, diet, and movement patterns before conducting our research in July when the grooved brain corals were predicted to spawn again.



For the week prior to spawning, Lena and I conducted behavioral observations of pairs of butterflyfish at The Lake, a popular dive site within walking distance of our house. While we initially followed the same methods that we used for the parrotfish – with a diver underwater and a snorkeler at the surface – we quickly realized that the fish were too shy and we would be able to collect a more robust dataset if we conducted the work via snorkel. During this time, we recorded videos of the fish's behavior and noted whenever they visited a coral colony, all while getting GPS tracks to determine their territory size. We were very surprised to find that they rarely visited the grooved brain corals, instead they appeared to prefer grazing on soft corals! Lena and I would swim to the shore and walk home with all our gear in tow- chatting excitedly about the day's findings and waiting in anticipation for the week of spawning. Sure enough, during the time when the corals were expected to spawn the butterflyfish pairs would join large groups and swim across the entire reef site to wherever a grooved brain coral was present, nipping at the surface in anticipation of a tasty treat!



Before starting a fish follow, I would signal to Lena to start the GPS track at the surface.

photo credit: Joshua Manning

After collecting these data, it was time to analyze the video footage using Behavioral Observation Research Interactive Software (BORIS). After creating the coding for an ethogram – an inventory of all the types of behaviors we witnessed – we uploaded videos and categorized each time the fish visited a coral colony, with the sounds of rapid keyboard clicking filling the living room. During the live observations, we were so focused on the behaviors of butterflyfish that we missed the other marine animals on the reef, but watching the videos back gave us the opportunity to see it all again! At one point during my fish follow, I completely missed a green moray swimming on the reef as a southern stingray stirred up the sand as it fed on invertebrates!

We also got a chance to learn how to use R – a statistical analysis software. Like learning a new language, it was frustrating as we learned to complete basic tasks, such as viewing our data. But with Josh’s help we were able to run statistical tests and create graphs of our data to summarize our findings about butterflyfish diet shifts during coral spawning!

“Find a job you enjoy doing, and you will never have to work a day in your life.”

—Mark Twain

The opportunity to be the 2021 Our World Underwater Scholarship Society AAUS Mitchell Scientific Diving Research Intern has been a whirlwind adventure! I am incredibly grateful that I was selected to represent OWUSS and AAUS along with the other 2021 interns. I was able to witness a thriving reef community for the first time this summer and learned more about fishes than I thought possible in such a short period of time. I have learned valuable lessons and skills – both above and below the surface – met incredible people, and advanced my career in marine ecology. While I am sad that my time as the OWUSS AAUS intern has come to a close, I am excited to continue my journey in coral reef ecology as I begin my master’s in marine biology at Nova Southeastern University this fall and work with Florida SeaGrant as the Coral Health Communications Intern! I believe that the experiences I gained this summer will allow me to provide a unique perspective at the ecosystem level that can be used to restore the Florida Reef Tract.

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