



2020 BIOS REU Mentors and Potential Research Projects

Dr. Julius Christopher Barsi is a molecular biologist whose research aims to explain the mechanism by which genomic information is translated into anatomical structure. At its core, he studies transcriptional control mechanisms. His experiments are directed at all levels of biological organization, ranging from transcription-factor DNA interactions that control spatial and temporal gene expression, up to a systems-level analysis of large gene regulatory networks. For his studies, his lab employs local echinoderms, in conjunction with third-generation sequencing, to decipher the transcriptional cis-regulatory code. REU's accepted into the Barsi lab shall be tasked with the following:

- Get acquainted with collecting, handling and caring for echinoderms
- Harvest gametes from live sea urchins without inflicting harm on the specimen
- Perform in vitro fertilization
- Culture embryos across developmental time
- Perform nucleic acid extraction/purification

In addition to the above, individuals who are proficient at Fusion PCR, Primer-Design and Gibson Assembly, can expect to work on elucidating embryonic gene expression patterns. *Alternatively*, bioinformaticians (in particular those familiar with Oxford Nanopore) and software engineers or data scientists, are strongly encouraged to apply. A separate set of tasks, more compatible with their skillset would be explored. Please visit [<https://barsi-leidenfrost.org>]. In this manner, students will learn the significance of their work as it relates to the lab's overarching research goal: To determine the mechanism by which genomic information is translated into anatomical structure.

Dr. Leocadio Blanco-Bercial is a biological oceanographer and zooplankton ecologist whose research focuses on population connectivity using traditional morphological and distributional studies paired with cutting-edge molecular tools and image analyses and recognition using artificial intelligence. His recent studies include global and local population genetics and connectivity of marine species in relation to present-day and past circulation patterns and the geological history of the oceans. Potential REU projects include:

- Image analysis and machine learning efficiency analysis, scaling measurements of zooplankton contribution to biogeochemistry, and metabarcoding analyses.
- Zooplankton-mediated Carbon Flux in the mesopelagic environment
- Bermuda Atlantic Time Series zooplankton community analysis linking morphological counts and next-generation sequencing protocols

Ruth Curry is an observational physical oceanographer at WHOI and an Adjunct Scientist at BIOS who works on general circulation and basin-scale ocean property distributions to assess their role in Earth's evolving climate system. At BIOS, she runs the Mid Atlantic Glider Initiative and Collaboration (MAGIC) Program which provides opportunities for undergraduates to participate in research using autonomous underwater gliders to address topical scientific objectives. She is also a PI on the Oleander Project, a 25+ year time-series of bi-weekly velocity and temperature measurements between NJ and Bermuda. Potential REU projects include:

- Quantifying the physical underpinnings of nutrient and carbon cycling using glider-based physical and biogeochemical observations
- Assessing the magnitude and impacts of turbulent mixing with respect to nitrate delivery and carbon export in the oligotrophic Sargasso Sea
- Measuring upper ocean heat content for applications to tropical cyclone forecasting
- Exploring time varying upper ocean structure and heat transport using the Oleander time series data

Dr. Samantha de Putron is a marine biologist and ecologist with a focus on coral ecophysiology and resilience. Current research includes: documenting the physiological differences of corals inhabiting various reef zones in Bermuda to determine the effects of the environment on coral performance; understanding the role of thermal stress in driving acclimatization in corals; and identifying the primary processes involved in coral growth. Potential REU projects include:

- Assessing how repeat exposure to thermal stress alters the productivity and respiration of corals from different habitats
- Investigating the roles of heterotrophic feeding, light and temperature on coral growth

Dr. Damian Grundle is a biogeochemical oceanographer whose research focuses on nitrogen cycling in the ocean and air/sea gas exchange. Much of his research uses stable isotope techniques (both natural abundance and tracer) to investigate the factors that regulate a range of nitrogen cycling pathways and the rates of microbially mediated nitrogen transformations. Most recently, his research has focused on 1) how decreasing oxygen concentrations in the ocean impact the production pathways and rates of production of the greenhouse gas nitrous oxide, 2) how environmental conditions in oceanic surface waters regulate nitrous oxide fluxes to the atmosphere, and 3) using novel glider-based techniques to better quantify oceanic export production. Potential REU projects include:

- Quantifying export production in the Sargasso Sea using a suite of ship-based biological and chemical sampling data in conjunction with glider-based measurements

Dr. Eric Hochberg is a biological oceanographer with main interests in the benthic ecology, oceanography, and biogeochemistry of coral reefs. His research centers on the use of optics to study reefs: bio-optics of reef organisms and communities; water column optical properties, including radiative transfer modeling; and remote sensing of reefs. Most recently he has been leading the NASA-funded COral Reef Airborne Laboratory (CORAL) mission to find the relationship between reef condition and biogeophysical forcings. Potential REU projects include:

- Environmental drivers of daily to seasonal changes in coral pigmentation
- Characterizing water clarity for coral reef ecology and remote sensing
- Functional ecology of coral communities in the lab and on the reef
- Coral reef mapping using high-resolution satellite imagery
- Automatic analysis of underwater photographs for coral reef communities

Dr. Amy Maas is a marine biologist whose research interests lie at the junction of physiology, ecology and biological oceanography. She studies how marine zooplankton function at the extremes of environmental variables such as oxygen, carbon dioxide and temperature. Her research directly addresses the hypothesis that global change is significantly affecting the physiological function and geographic distribution of important marine animal species. Potential REU projects include:

- Exploration of the response of open ocean animals to physiological stressors
- Investigation of changes in pelagic community composition and calcification over time
- Bioinformatically assessing and comparing the transcriptomes of marine invertebrates

Tim Noyes is a marine ecologist and fisheries biologist focusing on reef fish habitat utilization patterns, benthic ecology, resource availability for invasive species and the deep reef refugia hypothesis. Current research includes quantifying mesophotic coral ecosystem (MCE) ichthyofauna community structure and determining connectivity between shallow reef systems. Greater knowledge on these topics is required for more effective marine spatial management. Potential REU projects include:

- Employing environmental DNA (eDNA) to monitor biodiversity responses to natural and anthropogenic change
- The refugia hypothesis, determining vertical connectivity between shallow reef and mesophotic fish assemblages and revisiting recorded depth ranges for Western Atlantic reef fish species
- Establishing resource availability for the invasive lionfish *Pterois* spp.

Dr. Andrew Peters is an environmental chemist. His research includes the BIOS Environmental Quality Program, focused on environmental issues from the perspective of a highly developed and densely populated small island nation, and the BIOS Marine Atmospheric Observatory at Tudor Hill. Activities include: monitoring local ambient air quality; conducting local environmental impact assessments; and undertaking research on atmospheric and marine biogeochemical cycles. Potential REU projects include:

- Assessment of microplastic contamination in the marine environment
- Short-term and episodic behavior of contaminants in rainwater harvesting tanks and groundwater reserves

Dr. Yvonne Sawall is a marine biologist and coral reef ecologist with a special interest in coral ecophysiology and metabolism. Currently, Yvonne focuses on two lines of research: (i) Investigating the drivers of coral photosynthesis and calcification using a suite of different lab-based and *in-situ* technologies (incubations, oxygen stable isotopes, gradient flux approach); (ii) Investigating novel coral reef interventions (specifically artificial upwelling) with respect to their efficiency to mitigate coral bleaching during thermal stress using manipulation experiments. Potential REU projects include:

- Assessing energy and carbon budgets of corals (and seagrass) using advanced *in-situ* incubation chambers
- Testing and adapting the oxygen stable isotope approach to measure coral gross production *in-situ*
- Testing the efficiency of pulsed artificial upwelling of deep water in preventing coral bleaching during times of thermal stress