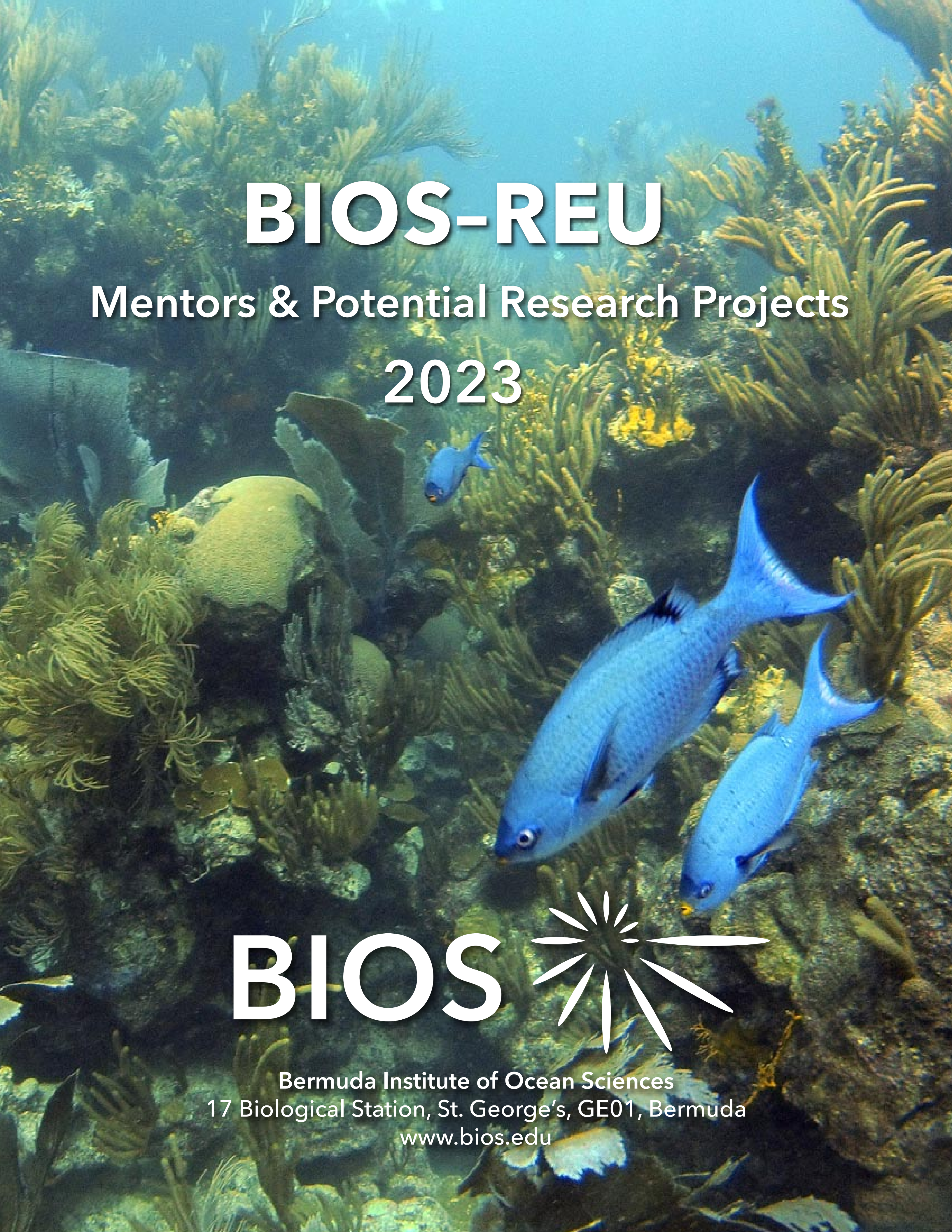

BIOS-REU

Mentors & Potential Research Projects

2023

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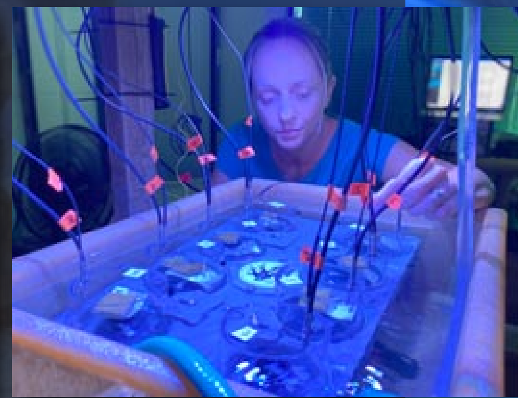
Research Theme 1



Coral Reef Function and Resilience

Eric Hochberg, Samantha de Putron, Yvonne Sawall

Coral reefs are home to innumerable species, form natural barriers to protect shorelines and are valued on the order of hundreds of billions of dollars annually for the goods and services they provide. The immense productivity of coral reefs is primarily based on the symbiotic relationship between the coral host and its photosynthetic endosymbiotic algae, enabling this partnership to engineer the carbonate reef foundation. The interacting metabolic processes of photosynthesis, respiration and calcification are therefore important drivers of coral and coral reef function. With ever increasing threats from local impacts and environmental change, it is important to understand these processes and how they are affected by environmental parameters, such as light availability, temperature, nutrients and water flow, and how they may change under future climate change scenarios.

Potential project areas are listed below, each using a combination of boat work and laboratory activities:

- Assessing coral response to natural and simulated thermal fluctuations and determining any interspecies variability in the measured physiological parameters
- Assessment of coral reef function by investigating the environmental drivers of organism and community photosynthesis, respiration and calcification.
- Mapping reef benthic communities using airborne and satellite remote sensing data and relating prevailing environmental divers to reef community structure
- Exploring machine learning methods for automatic analysis of underwater photographs for coral reef communities.

Research Theme 2

Planktonic Life: Size, abundance and community structure

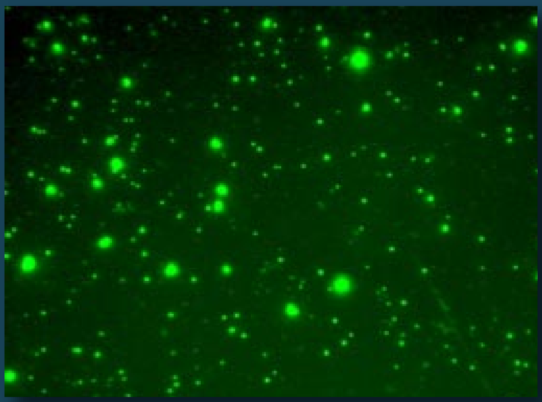
Amy Maas and Hannah Gossner

The planktonic realm – the space between the ocean's surface and the bottom- makes up about 98% of the habitable environment on Earth. Animals that live in the plankton can move up and down in the water, but are largely moved about by ocean currents that allow them to drift around the globe. The animals, called zooplankton, are the important link between ocean primary producers (the phytoplankton) and higher trophic levels like fish, whales and seabirds. Their metabolic processes move nutrients like carbon and nitrogen from the surface of the ocean into the darker depths or sometimes directly into the bottom sediments. New technologies that allow us to image these organisms in unprecedented detail are changing the way we study these ecosystems by measuring the size and taxonomy of each individual and simultaneously giving us quantitative abundances of the whole community. The purpose of this project is to apply image-based technologies, such as Zooscan and UVP, to explore life in the plankton and how they interact with their environment.

Potential projects for the fall REU program include a combination of field work and laboratory activities including:

- Studying the impact of changing environmental parameters on zooplankton physiology by conducting respiration experiments using in-situ oxygen meters
- Determining changes in daytime and nighttime distribution of zooplankton using plankton tows and high throughput imaging techniques to explore how community composition and diel vertical migration impact biogeochemical cycling in inshore systems
- Validating dry weight and image-based measurements for important taxa in order to improve allometric calculations of zooplankton-mediated carbon cycling, potentially contributing to a NASA project
- Exploring the relationship between seasonal changes to zooplankton community composition, functional groups, and environmental forcing in order to model potential future changes in ecosystem services in a changing ocean

Research Theme 3



Marine Microbial Oceanography

Rachel Parsons

Marine microbes comprise a remarkably diverse community in the ocean and account for more than 90% of the ocean's total biomass. The collective metabolism of this microbial community governs the massive biogeochemical cycles in the global ocean; and, as such, microbes fundamentally influence the ocean's ability to sustain life on Earth. Integrated scientific approaches that combine genomic data with field measurements have been a powerful platform for exploring microbial plankton and advancing knowledge about the oceanic cycling of nutrients, energy and carbon. Microbial Oceanography involves a broad suite of genomic, ecological, oceanographic and biogeochemical approaches to evaluate microbial process, structure and function on various scales. These scales can range from organism-compound and organism-organism interactions to large biogeochemical patterns on the ecosystem scale.

Potential projects for the fall REU program include:

- Ocean Deoxygenation and Oxygen Minimum Zones: Investigating the microbial community change over time using sequencing data and microscopy methods; Determining the genetic potential for carbon fixation, methanogenesis and ammonia oxidation within an oxygen minimum zone using quantitative PCR.
- Studying nitrification at The Bermuda Atlantic Time-series Study (BATS) site by investigating how mesopelagic microbial communities respond to additions of ammonium.
- Assessing the microbial colonization of marine microplastics to determine what specific microbes colonize specific plastic polymers and whether these microbes can grow on the plastic polymers.

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