Microbiome Implications of Climate Change-Induced Dormancy Loss in the Temperate Coral *Astrangia poculata*

Mentor(s)
Koty Sharp (Marine Biology, RWU)
Mia Sarris (Environmental Science, RWU)
Sean Grace (Biology, Southern Connecticut State University)
Anya Brown (Evolution & Ecology, University of California-Davis)

Location
Roger Williams University

Abstract
Over the past ten years, students in our laboratory have studied the microbiome diversity and dynamics in the local population of the temperate coral *Astrangia poculata* here in Narragansett Bay. Our studies suggest that its microbiome exhibits a level of stability and predictability that is much greater than that documented in tropical coral microbiomes (Sharp et al. 2017). In winter months, *A. poculata* undergoes quiescence, a dormancy induced by winter temperatures, typically in December-March, when temperatures go below 5°C (Grace 2017). The microbiome composition shifts across seasons: it repeatedly recovers from a winter dormancy period, retains a signature "core" group of microbes throughout all seasons, and exhibits a predictable pattern of microbiome reassembly/succession following quiescence that can be replicated via laboratory-induced quiescence (Sharp et al. 2017; Brown et al. 2022; Brown et al. *in prep*). This regular microbiome reshuffling is thought to be an important source of stability and maintenance of the coral's beneficial microbial associates (Brown et al. 2022). In winters of 2022-2023 and 2023-2024, our collaborators documented a lack of *A. poculata* dormancy, which is likely due in part to elevated sea surface temperature (SST). It is not yet known whether that lack of dormancy has implications on the microbiome assembly, and, ultimately, on the animal host. As part of an ongoing research collaboration with Dr. Sean Grace and Dr. Anya Brown, our lab is using high-throughput gene sequencing to characterize microbiomes in A. poculata across seasons, detailing the *A. poculata* microbiomes in specimens collected in a time series spanning the two non-quiescence winters. The aim of the proposed project is to characterize the microbiomes in *A. poculata* colonies across a time series in which the corals do not undergo quiescence. Comparative analyses with previously documented microbiomes in *A. poculata* during "typical" quiescent winters will inform new models of how A. poculata's microbiome, and more broadly, how animal microbiomes shift in response to climate change in Narragansett Bay, and lead to new methods for monitoring coastal ecosystem change.

Project Objectives
The proposed work is part of an ongoing, funded collaboration, in which undergraduate students in the Sharp Lab (RWU) will work to process collected specimens for DNA extraction, PCR, and high-throughput 16S amplicon sequencing. SURF student(s) working on the project in Summer 2024 will process the remaining samples that need to be extracted (DNA extraction, specific PCR reaction prep and analysis) and submit the resulting products for sequencing. Students will spend much of their time learning and performing bioinformatics analysis of the sequencing results. The aims of the labwork include the following:

> ***Aim 1:*** Process previously collected and summer collections of *A. poculata* specimens: complete DNA extraction, PCR amplification, and preparation/cleanup of amplification

products for submission to URI Genomics & Sequencing Center for high-throughput sequencing.

Aim 2: Use bioinformatics to characterize the taxonomic composition of the microbiome of *A. poculata*, along a high-resolution time series surrounding two winter periods (Dec 2023-March 2024; Dec 2024-March 2025), using QIIME pipelines and protocols previously developed and customized in the Sharp Lab (Brown et al. 2022). Perform comparative analysis with previously documented datasets from *A. poculata* specimens that have exhibited quiescence.

Student(s) working on these aims will gain transferable skills in molecular biology, microbiology, and bioinformatics. Another major component of this experience is student-led field collections, in which students will be able to gain training in scientific collection in the marine environment. Together, these skill sets are broadly applicable across a variety of careers, especially including the region's rapidly growing fields of applied marine research and life sciences. Information gained from this summer's research can serve as a platform for a public awareness campaign about climate change in Narragansett Bay and can provide a touchstone for future scientific communication initiatives. The student(s) on this project will be charged with not only presenting the data, but practicing communication of the results in a way that is digestible to the public and relates relevance back to land use and policies that can impact climate change.

This project is part of an ongoing collaboration among Drs. Sharp, Grace, and Brown. The bulk of the benchwork and sequence analysis will be led by the undergraduate students. Sharp will train the students in all benchwork and analysis in intensive meetings at the start of the summer, and progressively throughout the summer, as the student(s) gain more experience and independence, the students will lead the project. Sharp will mentor the student(s) using an approach that she has been employing for nearly ten years at RWU. Student mentoring includes not only regular time together at the benchwork demonstrating and teaching laboratory techniques, but also requires regular in-person meetings, both in person with Sharp and via Zoom with our collaborators. At weekly meetings, the student(s) will review goals set in the previous week, share findings/progress of the previous week, and set goals with Sharp for the week to come. The discussions will evolve from informal at the start of the summer to more formal, structured presentation by the end of the summer, so that the student(s) will be prepared to present a short talk/poster describing their research progress by the end of the 10-week period. Such presentations provide students with the opportunity to present the results of their research to a familiar group of investigators, while receiving feedback that will enable them to make research progress and to prepare successful formal presentations.

References

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