Our NSF and NURC projects are directed at understanding the role of marine sponges in the carbon and nitrogen cycles of coral reef ecosystems. Sponges are an important part of these endangered ecosystems, yet surprisingly little is known about their role in the transformations and cycling of key nutrient elements, particularly nitrogen. The funded projects resulted from initial measurements of the stable isotopic composition of sponges along natural environmental gradients in the Florida Keys, from nearshore (including Florida Bay) to the offshore outer reef tract. Stable C and N isotope measurements revealed significant spatial gradients in tissue $^{13}C/^{12}C$ ratios ($\delta^{13}C$ values) related to organic carbon sources and systematic differences in ^{15}N /^{14}N ratios ($\delta^{15}N$ values) between two distinct groups of sponges distinguished largely by differences in their associations with heterotrophic bacteria and other microbial populations. Sponges filter massive amounts of water to extract bacteria and other fine particles for food, however, recent discoveries have shown that the large bacterial populations hosted by some species, generally low $\delta^{15}N$ value sponges, are responsible for major N transformations including nitrification of ammonium and possibly N2 fixation. The hypoxic conditions frequently found in these "bacteriosponge" tissues also suggest the possibility of denitrification. The consequences of these different processes for the overall nutrient budget of the reef system are potentially large and we are developing collaborative experiments with a Stanford-based research group working on water column transport processes in order to obtain quantitative N flux results. The sponges may be recycling organic N to DIN, supplying new nitrogen or they may helping to rid the reef of an excess nitrogen supply that can lead to algal growth and other undesireable ecosystem changes via denitrification. Our current research team of scientists led by Profs. Chris Martens and Niels Lindquist, a team of experienced UNC PhD and undergraduate studentresearchers plus guest investigators from OceanOptics Inc., is conducting shore-based and Aquarius habitat missions to evaluate the importance of each of these different processes.

Recent technological advances by our group have allowed us to measure rates of sponge respiration (oxygen consumption) and nitrogen uptake and release right out on the reef without disrupting the sponges under study- that is we are able to directly measure the rates at which individual sponges are consuming oxygen and taking up or releasing various dissolved N species during Aquanaut diving operations and for shorter periods during dayboat operations. The experiments during our mission are designed to allow us to expand this work to whole sections of the reef.

There are three potentially important and exciting discoveries that could result from our experiments. First, if nitrogen gas that is dissolved in seawater is being converted to forms of nitrogen that are useful to other organisms on the reef, for example seaweeds, Dr. Martens and his team will have discovered a new and potentially important source of nitrogen affecting the biology and ecology of coral reefs. Second, if sponges and their bacterial colonists are able to capture and store dissolved nutrients, such as dissolved organic nitrogen, nitrate and ammonium, then the recently discovered pulses of nutrients that frequently occur throughout the Keys from upwelling (see previous Leichter missions for details) become even more important. Thirdly, if sponge-hosted bacteria can convert nitrate and ammonium to nitrogen gas for export back to the atmosphere an important pathway for removing excess nitrogen from the reef will have been discovered. Together, results from these experiments have the potential to fundamentally reshape how scientists and managers think about nutrient dynamics on coral reefs as well as how to study these processes.

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