Sponge Studies: Assessing the Effects of Environmental Impacts on Marine Sponge Detritus Production, and Use as a Natural Deep Sea eDNA Sampler

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Coral reefs, containing over 25% of marine species, are vital ecosystems that support a diverse array of life and provide crucial resources for sustenance, supplying food for over 1 billion people globally. Despite constituting a significant portion of all cryptic biomass on coral reefs, marine sponges remain one of the most understudied organisms. This research sought to highlight both the ecological and scientific applications of sponges. The first experiment emphasized a phenomenon known as the Sponge Loop, a critical process by which sponges recycle nutrients and provide a basal food source of detritus to the reef. This experiment tested the effects of various pollutants and global warming on the Sponge Loop, to understand how this essential process is affected by environmental impacts. Significantly reduced detritus production was observed when Mycale grandis was exposed to microplastic pollution (-591.7%, $p<0.018$), sunscreen pollution (-492.5%, $p<0.021$), and increased temperatures (no detritus). The second experiment focused on a scientific application of sponges, exploring their use as a natural eDNA sampler. eDNA is a modern technique used to assess the biodiversity of an ecosystem in a non-invasive way, fueling research in ecosystems such as the deep sea. Due to the filter-feeding nature of sponges, it was hypothesized that they may be able to concentrate eDNA and serve as natural samplers. DNA from deep-sea sponges collected near Kingman and Palmyra Atoll was extracted, amplified, and sequenced, resulting in the identification of species including Antedon bifida and Actinernus elongatus. This research underscores the dual importance of sponges, serving as ecological keystones in nutrient cycling and potential tools for non-invasive biodiversity monitoring.