Visualizing the Invisible: Using Microscopy to Observe Marine Microbial Communities Over Time

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Microorganisms cycle carbon and other nutrients to produce key compounds necessary for all life; thus, it is important to understand how these processes work. While existing techniques have made critical insights, they can be laborious, limited in scope, and costly. We aim to develop high-throughput microscopy workflows which are accurate and holistic. These approaches were applied to understand how different sources of organic matter structure microbial community composition in the Neuse River Estuary of NC. Water was incubated under one of three light regimes (visible light, UV, and dark) for 30 days to examine microbial responses to different sources of organic matter (autochthonous, high organic matter degradation, and allochthonous). SYBR-stained and autofluorescent cells were imaged in z-stacks at multiple magnifications and in both DIC and fluorescent channels. Abundances and cell properties were determined using automated AI techniques with supervised training. Automated methods were moderately successful in reproducing trends in counts for single cells and chains (>1 μm) but underestimated counts compared to manual methods. Methods were less successful at counting cells within aggregates. By combing these high-throughput microscopy methods with other analyses, this research is establishing a holistic understanding of microbial community structure and biogeochemical cycling in the estuarine environment.