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Microalgal blooms in a changing ocean

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Microalgae, i.e. oxygen-evolving photosynthetic protists, are ubiquitous in aquatic environments. Together with cyanobacteria, these microorganisms respond for most of the primary production in the oceans. In coastal waters, microalgae form massive blooms that can be harmful both to humans and to marine life. Contamination of shellfish with phycotoxins that rend them unsafe for human consumption and massive fish kills are among the unwanted, direct effects of algal blooms in coastal areas. Human-driven changes in marine ecosystems, especially eutrophication and climate-induced changes that result in increased temperature and alterations in precipitation patterns are increasing the frequency and intensity of algal blooms in coastal environments worldwide. Moreover, a shift in microalgae community composition from autotrophic towards mixotrophic species, mainly flagellated forms, is expected to occur in this changing environment. Blooming microalgae interact in many ways with other components of the aquatic microbiota. During massive blooms, exudates from microalgal cells fuel bacterial secondary production. The rich microenvironment created during algal blooms is known to promote the growth of pathogenic bacteria such as vibrios. Associations of bacteria with algal cells can provide refuge from predation, conferring these bacteria competitive advantage to proliferate during algal blooms. On the other hand, several bacteria have been shown to elicit pathogenic effects against marine microalgae, acting as an important loss factor for algal populations and a potential mechanism of bloom control. Likewise, microalgae can display allelopathic effects on bacteria. Such diversity of interactions among microalgae and bacteria can be species-specific and are influenced by environmental factors. Thus, detailed studies are needed to elucidate algal bloom dynamics and their associate microbial communities for particular marine environments.