

Arctic - Ecosystem Perspectives

The Use of 'Omic' Technologies to Study Microbial Response to North Slope Crude Oil in Alaska

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Microbes are vital to marine ecosystems constituting the base of the food web and performing essential processes such as oxygen generation, nitrogen fixation, and nutrient recycling. In addition, microbes serve to remove pollutants through the process of biodegradation. Specifically, the timelines and biological processes of petroleum biodegradation in marine ecosystems are yet to be fully appreciated. Previous studies from our laboratory have demonstrated that hydrocarbon-degrading bacteria and related functional genes exist in several distinct global locations. This investigation serves to evaluate the impact on microbial communities in sediment samples exposed to North Slope crude oil. To achieve this goal, baseline microbial populations in marine sediment samples collected in the vicinity of Barrow, Alaska were characterized through metagenomic, metatranscriptomic, and metaproteomic approaches. These techniques involve the study of the genetic sequence profile (metagenomics), genetic expression profile (metatranscriptomics), and protein function profile (metaproteomics) of entire microbial communities. The microbial response to North Slope crude oil exposure was measured using these three 'omic' techniques to determine perturbations in microbial diversity, gene expression, and protein functional content. Results of this study demonstrate the utility of 'omic' technologies to characterize microbial diversity and function in response to exposure to hydrocarbons. These findings can be applied to future investigations and predictions of recovery from hydrocarbon exposure to determine the potential for petroleum biodegradation as well as the timelines associated with return to microbial baseline diversity and function.