ABSTRACT

THESIS: Biogeochemistry of microbial biofilms in Devils Hole, Nevada

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Little is known about the role of microbial biofilms in nutrient cycling and ecosystem processes within desert springs. Furthermore, the difference between nutrient limitation of biofilms in desert springs and other ecosystems is unknown. Biofilms produce micro-scale physicochemical variation important to ecosystem function. We measured the variation in micro-scale physicochemical heterogeneity in biofilms of Devils Hole, Nevada. Microelectrodes were used to measure micro-scale chemical gradients of temperature, pH, O_2, and H_2S in addition to water column and pore water nutrient measurements in *Spirogyra*, cyanobacteria, and *Beggiatoa* biofilms over one year. Biofilm physicochemical gradients were used to calculate diffusion and metabolic rates. The rate of O_2 and H_2S diffusion ranged over two orders of magnitude. Biofilm production and respiration were influenced by biofilm type, light exposure, and sample month. Maximum O_2 production occurred in spring and summer during direct light exposure. Oxygen production and consumption varied with light exposure and season. The H_2S production and consumption varied with biofilm type. Higher concentrations of SO_4 in *Beggiatoa* suggested that H_2S production in *Beggiatoa* was quickly oxidized in the ecosystem. *Spirogyra* and cyanobacteria followed similar physicochemical trends; however, *Spirogyra* had more pronounced diurnal and seasonal variation. The differences between cyanobacteria and *Spirogyra* have implications on the ecosystem function of Devils Hole as well as other

ecosystems with diverse biofilm communities. The heterogeneous physicochemistry of microbial biofilms and the differences in biofilm nutrient limitation suggests that a change in microbial biofilms or nutrient concentrations could alter ecosystem biogeochemical dynamics. Additionally, we assessed the nutrient limitation of two desert springs in comparison with a temperate stream. A nutrient diffusing substrata experiment was used to measure chlorophyll *a*, respiration, and biomass with phosphorus, nitrogen, and sulfide treatments. Autotrophic and heterotrophic biofilms responded differently to treatments and the temperate stream had higher chlorophyll *a* biofilm accrual but lower respiration relative to the desert springs.