Young Scientist Special Session

Bottom-up establishment and application of synthetic periphyton community

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Phototrophic biofilms, also known as periphyton, are microbial freshwater communities that drive crucial ecological processes in streams. A multitude of biotic and abiotic factors influence natural periphyton, leading to changes in its composition and functions. Therefore, understanding species dynamics in natural periphyton is very challenging, yet fundamental to reveal causative and mechanistic insights into the impacts of different environmental and anthropogenic stressors.

To overcome this challenge, we established a workflow to obtain a fully defined but diverse, and highly reproducible synthetic periphyton, consisting of an assemblage of at least 22 phototrophic species (13 diatoms, at least 5 green algae, 4 cyanobacteria). We examined the single and combined effects of increased temperature (17°C vs 20°C) and widely used herbicide terbuthylazine (0, 1, 10 and 100 µM) on the 3D-structure, function and microbial composition of the synthetic periphyton. Our results show that both increased temperature (20°C) and exposure to high terbuthylazine concentration (100 nM) strongly impacted community composition and microbial succession. On the other hand, the photosynthetic function of the entire community remained intact, suggesting functional redundancy of synthetic periphyton. Importantly, we were able to follow single species dynamics and examine precisely how each species within the community responded over time to the tested stressors, singly and in combination. Species-level resolution within the community provided an accurate understanding of how single species and their interactions affect the community properties at the functional and structural levels when multiple stressors occur.

Overall, our synthetic periphyton is a powerful tool to perform mechanistic studies on periphyton structural and functional responses, as well as on species propagation, potentially to any biotic and abiotic stressor and their combinations. Indeed, such a synthetic periphyton, grown under controlled conditions, enables to overcome the complexity of its natural counterpart, to follow community response at the single species level and to test for various mechanistic hypotheses via targeted manipulation.