HYDRAULIC CONTROL OF BIOFILM DIVERSITY AND FUNCTION IN STREAMS

Abstract type
Oral presentation
Session type
General Session - G2 - Processes
Author Speaker
ANLANGER Christine
Affiliation
(Helmholtz Centre for Environmental Research, Germany)
Co-authors

GUTBROD Martin, (PreSens Precision Sensing GmbH, Germany)KALLIES Rene, (Helmholtz Centre for Environmental Research, Germany)NOSS Christian, (University of Koblenz-Landau, Germany)RISSE-BUHL Ute, (Helmholtz Centre for Environmental Research, Germany)VON SCHILLER Daniel, (University of Barcelona, Spain)WEITERE Markus, (Helmholtz Centre for Environmental Research, Germany)LORKE Andreas, (University of Koblenz-Landau, Germany)

Abstract

Biofilms are an important component of aquatic ecosystems. They integrate key primary and secondary producers and represent a main food source for higher trophic levels. Ecosystem functions, such as nutrient uptake, are mainly driven by epibenthic biofilms in smaller stream systems. The functional significance of stream biofilms depends on biofilm attributes – e.g. community composition and morphology as well as on nutrient supply from the water column. In field studies, biofilm attributes have shown to be affected by the spatio-temporal heterogeneity of near-bed hydraulics. However, due to the complexity of natural aquatic systems and the variability of environmental conditions, it is difficult to separate the effects of hydraulics on biofilm attributes. We conducted experiments in MOBICOS, a new research infrastructure consisting of streamside mobile mesocosms equipped with hydraulic flumes designed and constructed for investigating interactions of near-natural flow conditions and biofilm diversity and functioning. Biofilms were cultivated for several weeks under constant conditions on unglazed ceramic tiles before measuring near-bed flow velocity, oxygen fluxes and biofilm thickness, diversity and nitrogen uptake rates. Our results show that the nitrogen uptake rates were directly controlled by local flow conditions as well as biofilm biomass and thickness. There were also indications that mean (temporarily averaged) flow velocity U was more important for determining biofilm biomass than velocity fluctuations. Furthermore, flow velocity affected biofilm diversity. For example, U explained the richness of SAR (Stramenopiles, Alveolates and Rhizaria) operational taxonomic units (OTUs, dominated by diatom OTUs) and cyanobacteria OTUs by 27% and 26 %, respectively. Interestingly, cyanobacteria richness was positively correlated with U and nitrogen uptake efficiency (i.e. biomass normalized uptake rate) whereas SAR richness showed the opposite trend to U and no correlation to nitrogen uptake efficiency. Taken together, local flow conditions affect biofilm attributes and mass transfer processes, whereas nitrogen uptake is selectively dependent on stream biofilm diversity.

Keywords
hydraulics, fluxes, biofilms, nitrogen uptake, flume