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Stream Biofilms' Ecology and Biogeochemistry

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Editorial

Microbiology has altered dramatically in recent decades as a result of the view that most microbes live in complex communities connected to surfaces. Biofilms are communities of cells encased in a porous extracellular matrix that most, if not all, bacteria can create. Biofilms include dental plaque, germs that cause chronic infections on catheters and implants, and fouling of ship hulls and pipes, all of which have significant consequences for public health and industrial operations. The majority of current biofilm research is based on Maurice Lock, Gill Geesey, and Bill Costerton's discovery of more than 35 years ago: bacteria adhering to surfaces dominate microbial life in streams. These microbiologists were the first to investigate stream biofilms, also known as periphyton or epilithon, which are complex formations of bacteria, algae, protozoa, fungus, and meiobenthos.

The importance of interactions between microbial phototrophs and heterotrophs for energy flows was also highlighted early on in the study of stream biofilms, as was the function of the biofilm matrix as a location of extracellular enzyme activity and adsorption of dissolved organic matter. Since then, research on the ecology and biogeochemistry of stream biofilms has progressed slowly in the wake of burgeoning research on bacterial biofilms — which often consist of only a single strain and are of interest to medical microbiology rather than the polymicrobial communities found in stream biofilms — and the microbial ecology of marine and lake planktonic communities. Biofilms in streams, unlike those generated in the lab, are constantly exposed to a varied inoculum that includes bacteria, archaea, algae, fungus, protozoa, and even metazoa. When these many biological 'building blocks' are joined with the dynamic flow of streamwater, biofilms with intrinsically complex and variable physical structures are formed, which has ramifications for microbial activity and ecosystem processes.

Biofilms are important locations for enzymatic activity in streams, such as organic matter cycling, ecosystem respiration, and primary production, and hence serve as the foundation of the food web. Why should we care about stream biofilms' ecology and biogeochemistry? Streams carve the surface of the continent, creating thick and visible channel networks that might be regarded of as ecological arteries that run across the terrain. Streams are linked to their catchments through a variety of surface and subsurface flow channels, most notably the hyporheic zone in the streambed at the groundwater-streamwater boundary. Microbial cells, solutes, and particles enter streams along these flow pathways, where they may interact with biofilms that populate the huge surface area offered by the streambed as a 'microbial skin' enroute to downstream habitats and finally to the seas. As a result, biogeochemical fluxes are aided by the streambed and its biofilm microbiota. Indeed, stream biofilms are now acknowledged as significant contributors to global carbon fluxes, digesting organic matter and eventually spewing a surprising quantity of carbon dioxide into the atmosphere.

Microorganisms in streams are also major components of the nitrogen cycle as they denitrify nitrate that they receive from the catchment and emit the resulting nitrous oxide or nitrogen gas into the atmosphere. Furthermore, stream biofilms can be viewed as a crucial component of the catchment microbiome that also includes the microbial communities of the phyllosphere and soil. Water, microorganisms, and solutes are intercepted by the phyllosphere and soil crust as they enter the catchment, whereas stream biofilms govern the export of microbes and solutes out of the catchment. As a result, stream biofilms connect the land surface, groundwater, seas, and atmosphere, putting them at the centre of global biogeochemistry, biodiversity, and climate change. We cover the ecology and biogeochemistry of stream biofilms at various sizes in this review, as well as how the biodiversity and functions of these biofilms may affect and be influenced by environmental processes [1-5].

Conflict of Interest

None.

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