Identifying sources of toxics using biofilms

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Introduction

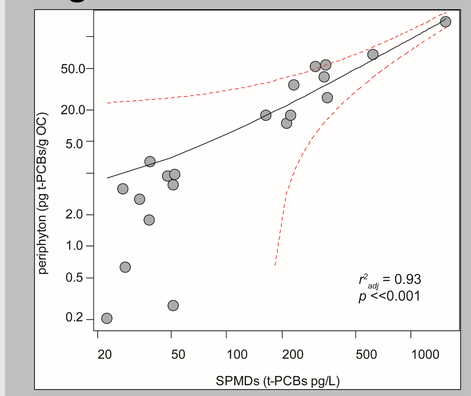
Biofilms (algae, microbial biomass, and organic detritus) growing on rocks contribute to the base of the food web in rivers and streams. In contaminated waterbodies, biofilms take up and bind contaminants from the water. Over the last few years, we have been using the contaminant concentrations of biofilms to assess the spatial distribution of metals and organic contaminants. We have also been measuring the bioconcentration of toxics from the water to assess the accumulation in higher trophic levels.

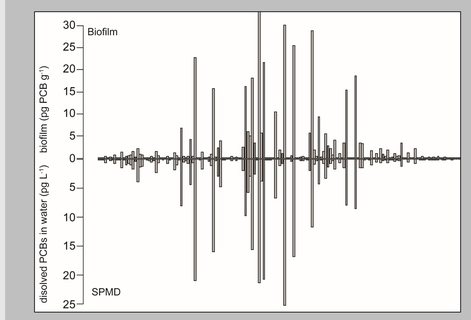
Methods and Findings

Concentrations of organics in the water column were measured using passive samplers (semi-permeable membrane devices) during various flow regimes. Our results show a strong, statistically significant relationship between dissolved concentrations of PCBs and DDT in the water column and the concentrations bound in and on biofilms. We find metal concentrations in biofilms to be (1) correlated with changes in periphyton community structure and (2) a more sensitive sample media of metal contamination than water and sediment. Lastly, because biofilms represent an entry into the food web, we are able to relate the contaminant source to the accumulation of organics in resident fish.

Sampling methods: Opportunistic scraping and artificial substrates

Organics



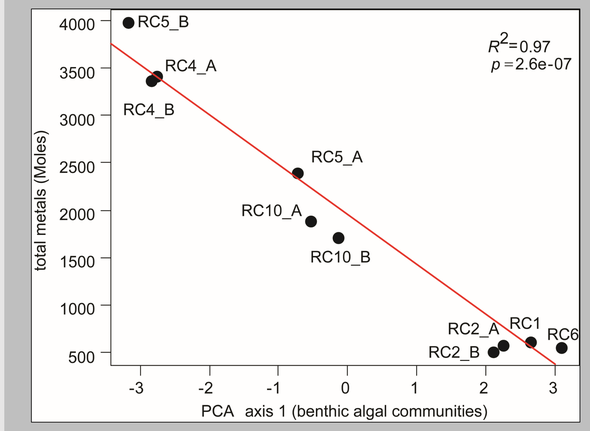


(**upper left**) Significant relationship between total PCBs in biofilms and water; measured using passive SPMD samplers over one month. (**lower left**) Very similar PCB congener distribution between biofilm and water at each site = representative bioconcentration.

(**lower right**) PCB source identification using biofilms, where red dots are concentrations (pg PCBs / g OC) elevated above upstream background (yellow dots).

Report:
Hobbs, W. and M. Friese. 2016. Wenatchee River PCB and DDT Source Assessment. Washington State Department of Ecology. Olympia, WA. Publication No. 16-03-029.

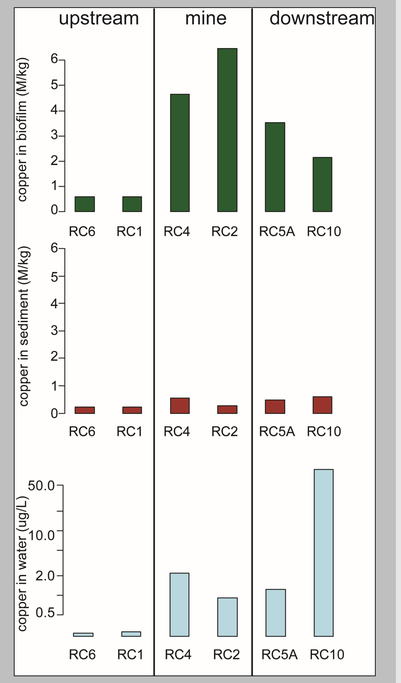
Metals



Report:
Collyard, S.A. and Larson, C., 2015. A Long-Term Monitoring Plan to Assess Aquatic Life Uses on Railroad Creek Using Biological Assessment. Washington State Department of Ecology, Olympia, WA. Publication No. 15-03-116.

(**upper left**) Holden Mine Site, Chelan Co, Washington. (**lower left**) Total metals (M) in biofilm tissues against diatom community structure (PCA axis 1) – sampled in 2013; highly significant relationship implies that metals have an influence on community structure.

(**right**) Copper concentrations in biofilms, sediments, and water – sampled in 2015; biofilms provide a temporally-integrated sample that clearly shows the main inputs from the mine site. Sediments lack spatial differences, and water is temporally variable.



Take-Home

The use of biofilms in source identification studies has proven to be highly effective under a number of hydrologic conditions and for various toxic contaminants.