Stream ecosystem responses and biomass and organism transport from cryoconites, stream microbial mats to lakes - Diane McKnight

Microbial mats in Dry Valley streams persist through winter and are revived with summer streamflow (Fig. 1A). Tyler Kohler, PhD student, evaluated controls on mat biomass of 3 mat types (orange, black, and green) to changing hydrology over 20 years by creating smoothed trends from generalized additive mixed models (Fig. 1B) and comparing trends with Pearson Correlation Coefficients. Mat biomass collectively decreased during the middle of the record coinciding with a period of low flows and a "flood" summer (Fig. 1C). In-channel mats (orange and green) were more strongly correlated with hydrologic variables, such as zero days, than marginal mats (black) (Fig. 2). Season length and total discharge were important variables for all mat biomass models ranked by model selection using Akaike's Information Criterion. We hypothesize that mats will be resilient to expected changes in hydrology in the MDV.
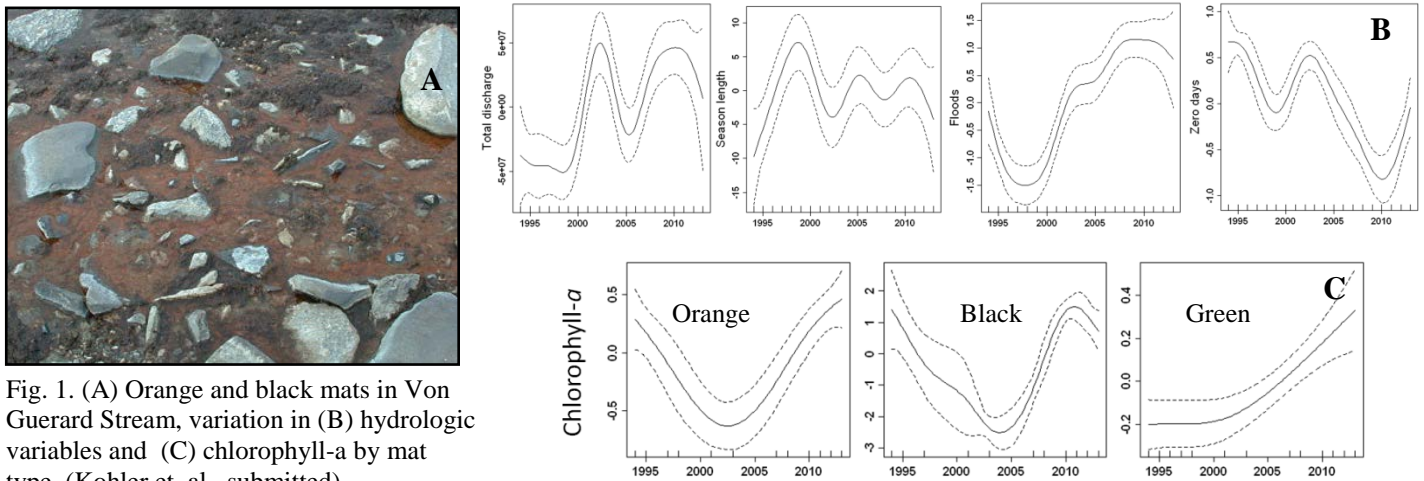

Fig. 1. (A) Orange and black mats in Von Guerard Stream, variation in (B) hydrologic variables and (C) chlorophyll-a by mat type. (Kohler et. al., submitted)

These microbial mats are sources of organic material to the lakes. James Cullis, PhD student, studied transport of particulate organic matter (POM) during diel flow peaks and observed clockwise hysteresis effects, indicating that POM transport is supply limited (Fig. 3). Hysteresis effects were simulated using a model based on sediment transport in streams. Large variations in POM transport dynamics among diel flood pulses were found to be related to time since a resetting flood and regrowth of potentially mobile biomass.
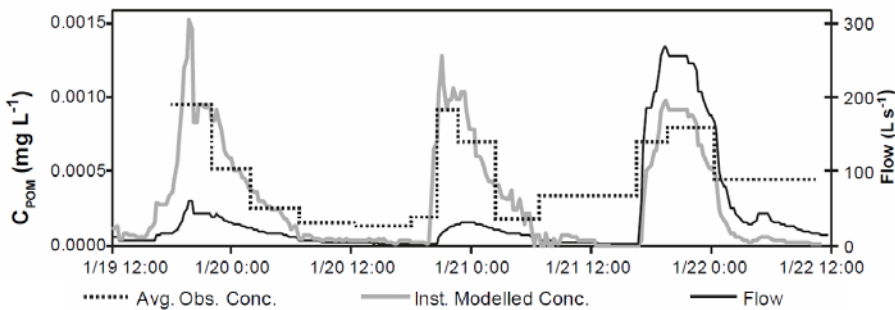

Fig. 3. POM concentration in Von Guerard Stream compared with flow and simulated POM. (Cullis et. al. 2013)

Fig. 2. Pearson Correlation Coefficients for chlorophyll-a and biomass with different hydrologic variables (Kohler et. al., submitted)

Lee Stanish, former PhD student, used the diatom distribution in POM to identify habitats which provide POM to lakes and streams (Fig. 4; Stanish et.al. submitted). She also documented strong co-occurrence patterns among diatoms and cyanobacteria and heterotrophic bacteria in these mats (Stanish et. al., 2013).
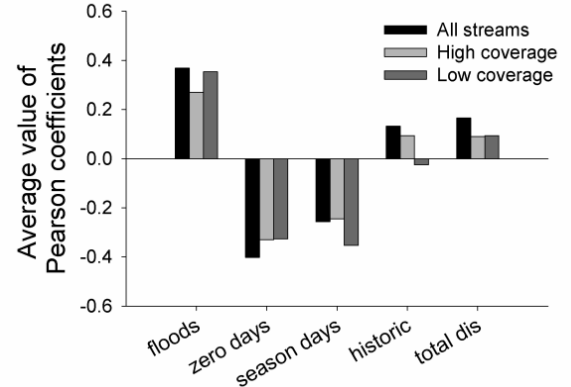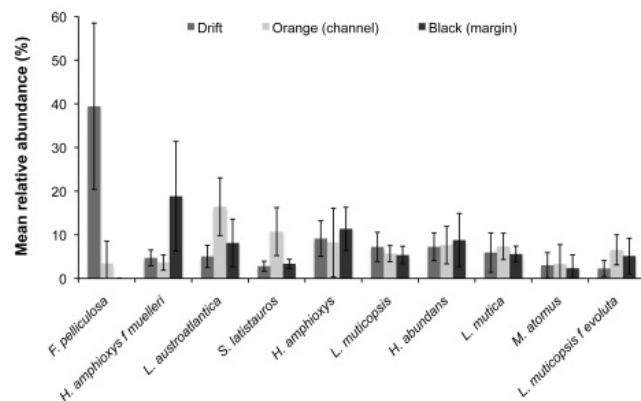

Fig. 4. Relative abundances of diatoms transported with POM (drift) compared to diatoms in orange and black mats