Geophysical Research Abstracts
Vol. 19, EGU2017-3390-1, 2017
EGU General Assembly 2017

Filling Gaps in Biogeochemical Understanding of Wildfire Effects on Watersheds and Water Quality

Charles Rhoades (1), Timothy Covino (2), and Alex Chow (3)

(1) US Forest Service, Rocky Mountain Research Station, Fort Collins, USA (crhoades@fs.fed.us), (2) Department of Ecosystem Science and Sustainability, Colorado State University, Fort Collins, USA (Tim.Covino@colostate.edu), (3) Department of Forestry and Environmental Conservation, Clemson University, Georgetown, USA (achow@clemson.edu)

Large, high-severity wildfires alter the biogeochemical conditions that determine how watersheds retain and release nutrients and influence stream water quality. These effects are commonly expected to abate within a few years, but recent studies show that post-fire watershed changes can have persistent, but poorly-understood biogeochemical consequences. Owing to the increased frequency and extent of high-severity wildfires predicted for western North America, and the growing awareness of the links between wildfire and clean water supply, there is a need to address these knowledge gaps. For the past 15 years we have tracked stream nutrients, chemistry, temperature, and sediment after the 2002 Hayman Fire, the largest wildfire in Colorado history. Our earlier work showed that headwater catchments that experienced extensive, high-severity forest fires had elevated stream nitrate, temperature, and turbidity for five post-fire years. Recent sampling, conducted 13 and 14 years after the fire, found that turbidity had largely returned to pretreatment levels, but that stream nitrate remained an order of magnitude above pre-fire levels in catchments with extensive high-severity wildfire. Stream temperature and total dissolved nitrogen concentration also remained higher in those catchments compared to unburned streams.

Decreased plant demand is the mechanism commonly credited for post-fire nutrient losses, though our current work is evaluating the implications of soil and stream nutrient uptake and supply on persistent nitrogen (N) export from severely-burned catchments. For example, we have measured higher total soil N and higher net N mineralization in severely-burned portions of the Hayman Fire compared to moderately or unburned areas, indicating that higher soil N supply may contribute to N losses from upland soils. Conversely, using a nutrient tracer approach we found reduced N uptake in burned streams, which suggests a switch from the N-limited conditions typical of pristine catchments. Low stream dissolved organic carbon (DOC) in severely-burned catchments suggests greater carbon limitation on in-stream biological activity. This is the likely result of organic matter losses during the wildfire compounded by low allochthonous inputs from uplands or riparian zones. We also find that catchments with severely-burned headwater reaches and sparse riparian vegetation have high stream nitrate. Our findings regarding soil N supply and in-stream N retention coupled with the persistent N losses from burned headwaters and exposed riparian zones help prioritize restoration efforts aimed at mitigating long-term water quality effects of severe wildfires.