Poster #21-55

Mechanistic and Predictive Understanding of Needle Litter Decay in Semi-Arid Mountain Ecosystems Experiencing Unprecedented Vegetation Mortality

J.O. Sharp[1]*, L. Leonard[1], K. Mikkelson[1,] E.L. Brodie[2], Z. Hao[2], K.H. Williams[2,] C. Gable[3], E. Coon[3] and A. Atchley[3]

[1]Colorado School of Mines, Golden, CO
[2]Lawrence Berkeley National Laboratory, Berkeley, CA
[3]Los Alamos National Laboratory, Los Alamos, NM

Contact: jsharp@mines.edu

BER Program: SBR
Project: University Award

Montane ecosystems within North America are experiencing a prolonged period of ecological stress resulting from large-scale insect infestation that has affected tens of millions of acres of forest. Repercussions are a concern for the local economy, ecological stability, and biogeochemical processes that can influence water resources, ecosystem function, and human health. The goal of this exploratory project is to isolate relative biogeochemical contributions of needle decay from rhizospheric processes in a perturbed forest ecosystem. To query potential mechanistic drivers, fallen needles under lodgepole and spruce trees from the Rocky Mountains of Colorado were harvested from the forest floor and transported to a montane ecosystem in Crested Butte during the Fall of 2016. The collection enabled a focus on needle chemistry variables of beetle-impacted spruce, non-impacted spruce, and non-impacted lodgepole pine. Defined masses of the needles were deployed in quadruplicate at three distinct elevations to observe the effects of temperature, accelerated snowmelt, and needle chemistry on carbon and nitrogen export into the atmosphere and hydrosphere. Over this past year the needles and underlying soil decay horizons were monitored with a focus on gas flux and soil water chemistry. Initial findings suggest that needle chemistry and seasonality influence gas flux with an observed peak in CO_2 production and CH_4 consumption during high moisture summer events. Gas flux above all three needle types was typically more pronounced than the needle-free controls with lodgepole needle deployments displaying the most significant shift. In contrast, aqueous pore water constituents in proximal soil horizons have shown few shifts based on needle chemistry. However, increased concentrations of DOC, TN, and SUVA were observed after induced snowmelt at 10,400' when contrasted with a proximal natural snowmelt plot. These observations support prior work studying enhanced carbon and nitrogen export into adjacent water bodies after snowmelt. Ongoing work focuses on characterizing the needle composition after decay, microbial ecology shifts associated with variables of elevation and needle chemistry and increased resolution of gaseous and pore water measurements during high moisture summer events. This research has implications for carbon and nutrient export that could aid in the prediction of and preparation for shifts of ecosystem function in montane watersheds with respect to water quality, gaseous export, and forest recovery.