Poster #1-30

Shrub Expansion Alters Root Traits in the Arctic

Jennifer Fraterrigo[1,2*], Weile Chen[1], Ken Tape[4], and Eugénie Euskirchen[5]

[1] Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL;
[2] Program in Ecology, Evolution, and Conservation Biology, University of Illinois, Urbana, IL;
[4] Institute of Northern Engineering, Water and Environmental Research Center, University of Alaska, Fairbanks; Fairbanks, AK
[5] Institute of Arctic Biology, University of Alaska, Fairbanks, Fairbanks, AK

Contact: jmf@illinois.edu

BER Program: TES
Project: University Award

Deciduous shrub encroachment is occurring across the arctic tundra. Increases in shrub cover could alter belowground carbon and nutrient dynamics as a consequence of shifts in root function. However, root dynamics associated with shrub expansion remain one of the least understood aspects of plant function in the Arctic. We sampled roots of common deciduous shrub genera (*Betula*, *Alnus*, and *Salix*) and tussock grass/sedge vegetation (dominantly *Eriophorum* spp.) in five moist acidic tundra sites along a latitudinal gradient in Northern Alaska (67.0 °N – 69.3 °N). Root morphology and mycorrhizal colonization of the non-woody absorptive roots were measured for both shrubs and tussock vegetation. Vertical distributions of absorptive root biomass within a shrub or tussock patch (1-m diameter) were determined from soil coring to the bottom of the active layer.

We found changes in root traits consistent with higher nutrient demand of shrubs. Shrubs had thinner roots than grass/sedge species at all the five sites, and shrub roots were frequently colonized by ectomycorrhizal fungi whereas tussock roots were non-mycorrhizal and rarely branched. The active layer was deeper in shrub patches than tussock patches at the two northern (colder) sites, and there were substantial roots below 20cm under the shrub patches. These findings suggest deeper rooting and higher capacity for resource acquisition associated with shrub expansion in Northern Alaska. Such changes may accelerate nutrient cycling and potentially stimulate carbon mineralization in both surface and deep soils, and a possible positive feedback to Arctic warming. We also found pronounced differences in root traits among shrub genera. Salix had absorptive roots that were generally thinner and less dependent on ectomycorrhizal fungi than *Betula* and *Alnus*. The accumulative root biomass in the active layer was higher under *Alnus* patches than *Betula* patches at the southernmost site. In contrast, *Betula* patches had the most abundant roots at the two northern sites, especially in the deeper layers. These climate-dependent variations indicate that deciduous shrub genera employ unique root strategies despite their similar growth form. The consideration of tundra root-trait data across an environmental gradient may enhance our ability to forecast how climate change will affect belowground functioning in the Arctic.