Title: Wood decomposition rates and functional types in a shifting climate.
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Project Objectives: This project, focused on decomposition of black spruce wood, would complement the SPRUCE decomposition trial (Kolka PI) focused on roots and non-woody plant tissues. That litter bag trial has a sampling schedule and an approach that can be mirrored in a small-diameter wood decay study and can allow us to leverage sampling efforts and analyses. Our objectives are to address the following questions about wood decomposition in this northern system: **1)** How will elevated CO_2, warming, and associated moisture changes conspire to affect wood mass loss rates? **2)** Can climate tip the balance between the two chief wood decomposer functional groups, white and brown rot fungi, thus shifting decay rates and residue composition? **3)** Given connectivity between above- and belowground, specifically by filamentous fungi, how do belowground dynamics relate to shifts aboveground in wood?

Hypotheses:

H1 - Year-round temperature increase will affect wood moisture but overall will accelerate wood decay.
H2 - Increased CO_2 will have little effect on decay rates but will shift branchwood microbial communities to resemble those in larger-diameter boles where gas exchange naturally depresses O_2/CO_2.
H3 - Higher temperature and moisture fluctuations with shift the functional rot type to favor brown rot.
H4 - Shifts belowground, such as N availability and mycorrhizal presence, will have an effect on dynamics within the wood, reflected in coupled microbial community analyses.

Methods: Our approach resembles that for the other decomposition studies, placing branchwood litter bags on hummocks. We will include an extra replicate to freeze for biological analyses, and we propose including ten black spruce boles (~5-7 cm dia) without bags. Branchwood (ten lengths per 20 x 20 cm bag) with 4 bags (3 to dry, 1 to freeze) per harvest (T0, 1, 2, 5, 10 yrs), and per treatment (11 total) requires 176 bags and 0.64 m^2 space per treatment cylinder. For 20cm boles, 5 replicates harvested (cross-section cut to halve, and again for dried vs. frozen halves) at two time points (5 and 10 years) requires 10 boles and 0.14 m^2. This totals 0.78 m^2 of cylinder space, opting for hummocks.

To incorporate endophytic communities, wood will be conditioned to constant weight prior to deployment rather than oven-dried. At harvest, fresh and oven-dried weights will be used to calculate density loss (per weight loss) and moisture content. Ground 40-mesh flour will be solubilized in dilute (2%) NaOH, to gauge rot type. Wood with brown rot approaches 60+wt% solubility - wood with white rot or no decay is ~20-30%. Lignin, C, N, and P will be measured as for other plant tissues being tested, and specific carbon fractions (ie, hemicellulose) can be tracked in acid hydrolysate via HPLC and RI detection. Frozen replicates will allow DNA assessment for metagenomics or coarser molecular analyses like qPCR (ITS, 16s, isolate-specific primers), using a CTAB extraction standardized in-house. We will also qualitatively assess sporophore fruiting on the wood, and in those cases can isolate fungi on water agar for molecular identification (ie, BLAST) and primer design to 'back track' dominance in the frozen time series.

Project Impact: Wood is Earth's largest pool of biotic C, and field-based assessments to improve our predictions of how climate will alter wood decay rates are crucial for model calibration. In wood, this is not as easy as linking plant traits (eg, lignin/N, C/N, C/P) to decomposition kinetics. Wood decomposer organisms may reside latent in healthy xylem, can defend wood volume during saprotrophy (priority), and have distinct rot type functionalities that can shift decay rates and residue qualities. These organisms also link aboveground dynamics in wood with those below ground via hyphal filaments. In context with the SPRUCE treatment structure, this collectively implores using wood substrates in natural condition (not kiln-dried lumber, etc.) and including an option for molecular assessment, as we propose. We feel a wood

decomposition component dovetails easily with the other decomposition studies, and that this inherent connectivity between nutrient pools reflects the potential for collaborative connections.