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Microbial substrate utilization and vegetation shifts in Boreal forest floors due to climate change

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Boreal forest soils are highly susceptible to global warming, and in the next few decades, are expected to face large increases in temperature and transformative vegetation shifts. The entire boreal biome will migrate northward, and within the main boreal forest of Western Canada, deciduous trees will replace conifers. The main objective of our research was to assess how these vegetation shifts will affect functioning of soil microbial communities and ultimately the overall persistence of boreal soil carbon. In this study, aspen and spruce forest floors from the boreal mixedwood forest of Alberta were incubated in the laboratory for 67 days without (control) and with the addition of three distinct ^{13}C labeled substrates (glucose, aspen leaves, and aspen roots). Our first objective was to compare aspen and spruce substrate utilization efficiency (SUE) in the case of a labile C source (^{13}C-glucose). For our second objective, addition of aspen litter to spruce forest floor mimicked future vegetation shifts, and we tested how this would alter substrate use efficiency in the spruce forest floor compared to the aspen. Tracking of carbon utilization by microbial communities was accomplished using ^{13}C-PLFA analysis, and ^{13}C-CO2 measurements allowed quantification of the relative contribution of each added substrate to microbial respiration. Following glucose addition, the aspen community showed a greater ^{13}C-PLFA enrichment than the spruce throughout the 67-day incubation. The spruce community respired a greater amount of ^{13}C glucose, and it also had a much lower glucose utilization efficiency compared to the aspen. Following addition of aspen litter, in particular aspen leaves, the aspen community originally showed greater total ^{13}C-PLFA enrichment, although gram positive phospholipid fatty acids (PLFAs) were significantly more enriched in the spruce community. While the spruce community respired a greater amount of the added ^{13}C-leaves, both forest floor types showed comparable substrate utilization efficiencies by Day 67. These results indicate that a shift from spruce to aspen may lead to a greater loss of the aspen litter through microbial respiration, but that incorporation into microbial biomass and eventually into the more persistent soil carbon pool may not be affected.