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TITLE: Fire Effects on Microbial Enzyme Activities in Larch Forests of the Siberian Arctic

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ABSTRACT BODY: Arctic forest ecosystems are warming at an accelerated rate relative to lower latitudes, with global implications for C cycling within these regions. As climate continues to warm and dry, wildfire frequency and severity are predicted to increase, creating a positive feedback to climate warming. Increased fire activity will also influence the microenvironment experienced by soil microbes in disturbed soils. Because soil microbes regulate carbon (C) and nitrogen (N) cycling between terrestrial ecosystems and the atmosphere, it is important to understand microbial response to fires, particularly in the understudied larch forests in the Siberian Arctic. In this project, we created experimental burn plots in a mature larch forest in the Kolyma River watershed of Northeastern Siberia. Plots were burned at several treatments: control (no burn), low, moderate, and severe. After, 1 and 8 d post-fire, we measured soil organic layer depth, soil organic matter (SOM) content, soil moisture, and CO2 flux from the plots. Additionally, we leached soils and measured dissolved organic carbon (DOC), total dissolved nitrogen (TDN), NH4, NO3, soluble reactive phosphorus (SRP), and chromophoric dissolved organic matter (CDOM). Furthermore, we measured extracellular activity of four enzymes involved in soil C and nutrient cycling (leucine aminopeptidase (LAP), β-glucosidase, phosphatase, and phenol oxidase). One day post-fire, LAP activity was similarly low in all treatments, but by 8 d post-fire, LAP activity was lower in burned plots compared to control plots, likely due to increased nitrogen content with increasing burn severity. Phosphatase activity decreased with burn severity 1 d post-fire, but after 8 d, moderate and severe burn plots exhibited increased phosphatase activity. Coupled with trends in LAP activity, this suggests a switch in nutrient limitation from N to phosphorus that is more pronounced with burn severity. β-glucosidase activity similarly decreased with burn severity 1 d post-fire, but by 8 d post-fire activity was the same in all treatments, indicating complete recovery of the microbial population. Phenol oxidase activity was low in all treatments 1 d post-fire, but by 8 d post-fire, severe plots had substantially increased phenol oxidase activity, likely due to microbial efforts to mitigate phenolic compound toxicity following severe fires. Both DOC and the slope ratio of CDOM absorbance increased with burn severity 1 d post-fire, indicating higher extractability of lighter molecular weight C from severe burns. These results imply that black C created from fires remains as a stable C pool while more labile C is mobilized with increasing burn severity. Our results suggest that the immediate effects of fire severity on microbial

communities have the potential to change both nutrient use and the form and concentration of C being processed and mobilized from larch forest ecosystems. These findings highlight the importance of changing fire regimes on soil dynamics with implications for forest re-growth, soil-atmospheric feedbacks, and terrestrial inputs to aquatic ecosystems.