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Soil fungal communities and decomposition after forest disturbance by clear cut harvest and tree girdling

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Natural and anthropogenic disturbance is a key driver of forest carbon (C) dynamics. However, disturbance effects on the soil C cycle and its environmental drivers are still highly uncertain. Here, we determined how soil fungal communities and decomposition processes respond to clear cut harvest and tree girdling. The study was conducted in a beech-dominated mountain forest located in the Austrian Alps. Regular soil sampling campaigns (spring, summer, fall) were performed over the course of four consecutive years (2015-2018). Sampling before and after treatment establishment allowed for a direct, plot-specific quantification of treatment effects on the investigated soil variables. DNA extracted from the organic topsoil was subjected to high-throughput amplicon sequencing of the fungal ITS2 region for community profiling. Operational taxonomic units were clustered into saprotrophic, symbiotic and plant pathogenic fungal guilds. Mass loss of standardized litter bags and microbial respiration were measured and served as proxy for decomposition of soil organic C. Treatment establishment had only little effects on soil fungal guilds in the first year after tree girdling and clear-cut harvest. However, abundance of symbiotic fungi started to decrease in the second year after harvest; this was accompanied by an increase in the abundance of saprotrophic fungi. Abundance of plant pathogenic fungi was unaffected by treatments. Microbial respiration rates under standardized temperature conditions as well as their temperature sensitivities (Q10 values) were similar among treatments. Litter mass loss was significantly increased at clear cut plots when compared to other treatments. Since soil temperature was markedly higher following clear-cutting, our results suggest that decomposition processes were basically enhanced by warmer soil conditions in the initial period following clear cut harvest.