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Impact of postfire management on soil respiration and C concentration in a managed hemiboreal forest

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Fire is the main natural disturbance in boreal forests and it is expected that its frequency will increase as a result of climate change. Fire is the primary process which organizes the physical and biological attributes of the boreal biome and influences energy flows and biogeochemical cycles, particularly the carbon (C) cycle.

The objective of this study was to assess the impact of forest fire and time since forest fire on soil respiration and soil C concentrations in scenarios where the area was managed or was not managed after fire disturbance. This study was carried out in two permanent research areas in northwestern Estonia (hemiboreal forest zone) that were damaged by fire: Vihterpalu ($59^o13'$ N $23^o49'$ E) and Nõva ($59^o10'$ N $23^o45'$ E). Fire occurred in Vihterpalu in year 1992 (550 ha burned), when the forest was 52 years old, and in Nõva in year 2008 (800 ha burned), when the forest was 70 years old. Before the fire disturbance both sites were covered with planted or sown Scots pine (*Pinus sylvestris* L.) forests originally regenerated after heavy fires in 1940 (Nõva) and 1951 (Vihterpalu). In all areas we are dealing with stand replacing fires where all (or almost all) of the stand was destroyed by fire.

In both study areas three different types of sample areas were set up: 1) control areas (CO), that are unburned and no management activities carried out; 2) burned and cleared (BC) with salvage logging, areas in which all dead and live trees were harvested from the plot after fire; 3) burned and uncleared areas (BU), areas without management in which both dead and live trees were left on the plots after fire disturbance.

On every area three measuring transects (40 m long) were established where soil respiration (g CO_2 $m^{-2}h^{-1}$) was measured on five collars, and five soil samples (0.5 m long and 0.05 m in diameter) were taken to estimate soil C (kg m^{-2}) content.

In our study, highest soil respiration values were recorded in control (CO) areas, which are not affected by forest fires. In the fire areas (BC and BU) the average soil respiration values were more than two times lower than in the areas which were not affected by forest fires. Different post-fire management activities (removing or leaving damaged trees) did not affect the soil respiration values. Soil temperature had a significant impact on the CO_2 flows. The recorded average soil temperature was lowest in CO and highest in BU areas, respectively. In spring and autumn soil temperatures in disturbed areas, as well as in cleared areas, were rising faster than in CO areas. In our study, 1992 fire areas had thicker litter and organic layer compared to 2008 fire areas. Most of the litter and organic matter was found in CO areas, followed by BU and BC areas. The highest C concentrations were found in CO areas. In the fire areas C concentration was also affected by the post-disturbance management, as in BC areas soil C concentration was lower compared to BU areas.