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Effects of fire intensity on SOM dynamics after clearfelling mixed-species eucalypt forest

R.J. Raison, P.K. Khanna and K.L.S. Jacobsen
Ensis Environment (phone: +61 2 62818280 fax: +61 2 62818312; John.Raison@ensisjv.com)

Changes in soil temperature and moisture regime and the dynamics of total soil C and soil mineral-N were studied for the initial 3-4 years following clearfall harvesting and slash burning of coastal mixed-species eucalypt forest. About 35% of the harvested area remained unburnt,41% was burnt by moderate intensity fire,and 24% was ashbed (areas where large woody debris had burnt). Under ashbeds temperatures still exceeded 50 degrees C in the surface (0-20cm) soil 18h after the fire was lit, and at that time temperatures exceeded pre-burn values to a depth of 90cm.The intense fire caused significant loss of moisture from the 0-10cm soil layer.

Harvesting had a profound effect on soil microclimate with surface (0-15cm) soil temperatures increased by 10-12 degrees C in summer and by 0-5 degrees C in winter during the initial 2 years. Soil moisture contents increased significantly after harvest. Both of these effects were attenuated over time as the site redeveloped a vegetative cover. The soil conditions after harvest and slash burning favoured increased microbial activity for several years and resulted in loss of soil organic matter and an increase in soil N mineralization.

Harvesting,with or without moderate intensity fire, doubled soil N mineralization rates during the following 2 years. On ashbeds there was a period of N immobilization or very low soil N mineralization 6-12 months after the fire, resulting from C input from roots killed by heating of the surface soil horizons under the ashbed.

Changes in organic C in the $<$5mm soil fraction (small quantities of fine and dead roots were also retained in the soil) were measured soon after the fire and then annually for 4 years in five depth intervals down to 40cm. Interpretation of temporal trends in ‘soil‘ C is complex especially after intense fire. Combustion methods overestimated the organic C content of ashbed soils because of release of C from bicarbonates and

carbonates in ash residues. Killed roots (especially under ashbeds) are progressively transferred to the ‘soil‘ C pool over time.

On unburnt sites, C was lost only from the 0-20cm soil layer,and this resulted in about a 20% decline overall for the 0-40cm soil during the first year after harvesting. Subsequent changes on unburnt sites were very small. On moderately burnt sites there was only a small decline in soil C during the first year,and then a net increase over the next 3 years. On ashbeds,heating resulted in the immediate loss of 30% of the C in the 0-2.5cm soil. Surprisingly there was no loss of soil C from the 0-40cm profile during the initial year - apparently input of decaying roots (which also resulted in periods N immobilisation or very low net soil N mineralization) matched respiratory loss of soil C. In the following years,very large increases in ‘soil‘ C were measured under ashbeds reflecting the high input of C from decaying roots.

Great care is needed in measuring and interpreting soil C dynamics following the harvesting and burning of forests.Both the ‘soil‘ and root pools need to be accounted for so that total stock change can be estimated.Understanding the changes in soil C fractions (particulate,more stabilized organic pools,charcoal pool) allows the calibration of models that can be used to aid interpretation of possible longer-term changes in soil C stocks in disturbed forests.