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Green tree retention: a tool to maintain ecosystem health and function

Variable retention of living trees is increasingly being favored as an alternative to clear-cutting in forest management. Soil organisms have a vital role in nutrient cycling, so preservation of a functioning soil community is essential for ecosystem function. Currently, only retention of woody debris and limitation of soil scalping are recommended to protect soil organisms after harvest. However, a more suitable management treatment may be preservation of living trees on harvested sites, providing soil organisms with sources of energy from tree roots and litter. The aim of this project is to determine (i) if green tree retention on harvested sites is a suitable management option for maintaining 'healthy' soil (in terms of maintenance of soil organisms and their associated functions), and (ii) what size and density of green tree retention patch is required for this purpose. This project brings together multi-disciplinary researchers, applying a range of novel techniques to quantify changes in soil microbial and faunal diversity and function in response to harvesting. The project is using the two STEMS installations, the first near Campbell River, the other near Elk Bay, Vancouver Island and comparing the benefits of aggregated versus dispersed retention treatments. We have 4 replicates of 4 aggregated retention patch sizes (5 m, 10 m, 20 m and 40 m diameter) and the dispersed retention trees are 6-12 m apart. Our investigations are determining how soil communities change, whether key species are lost, and if GTR of different aggregate sizes and density ameliorate modifications of these communities. Changes in rates of soil processes are being measured concurrently to determine if the observed alterations in soil communities have serious consequences for soil functioning.

Interim conclusions, inference or information that may be useful to forest practitioners and other researchers:

Analyses of our pre-harvest samples at STEMS 2 showed that less than 5% of the soil faunal population were found in the mineral soil. The forest floor harboured a distinct microbial community from the mineral soil in both composition and function as measured using enzymatic and catabolic profiles. These results indicate that the forest floor is a critical reservoir for soil organisms in this forest. One of the benefits, therefore, of green-tree retention may be retention of undisturbed forest floors in the retention patches, which could serve as refugia for colonization of disturbed areas following harvest.

This was confirmed by the analyses of post-harvest samples which have shown that populations of most of the soil macrofauna and Collembola are influenced more by the amount of disturbance of the forest floor, than by the influence of living trees. However, soil mites and pauropods showed a decline in abundance from the centre of the patch to the edge and out into the cut area, which may be related to differences in their food sources, pauropod guts were full of bacteria, bacteria rely mainly on readily utilizable C for growth from root exudates.

Ectomycorrhizal diversity decreased substantially by the edge of the 5 m patch and 10 m from the larger patches of green trees suggesting that the 'shadow' cast by these patches is quite small. This suggests patches greater than 1 tree are needed to retain the mycorrhizal community, but patches greater than10 m diameter are of no added benefit.

Microbial activity in the 5m patch size changed most post-harvest in terms of microbial function (i.e. enzyme activity) e.g. lower phosphatase, higher peroxidase. This suggests again patches greater than 1 tree are needed to ameliorate change. There was a trend for microbial activity to be retained and even increase10-15 m from the edge of patches then decline, which suggests patches will need to be within 20 m of each other.