Plant diversity and soil carbon; does the disturbance of active forest management affect these important ecological components.

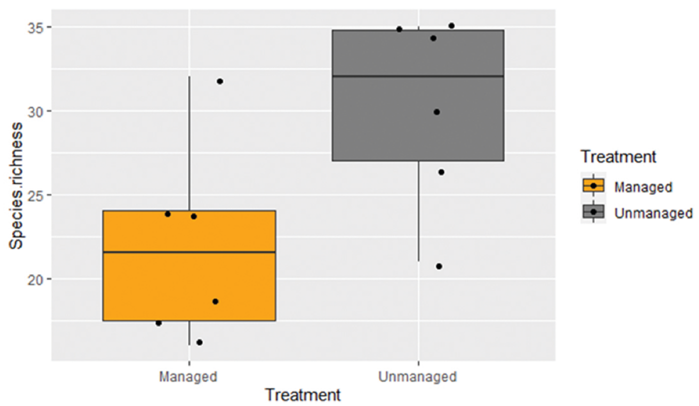
Introduction.

Biological diversity is fundamental for maintaining ecosystem functionality, and forests harbour considerable biological diversity, including many endemic and specialist plant species. They are also reservoirs for carbon, and previous studies have found increased soil carbon where plant diversity is high. Consequently, protecting forest habitats through appropriate forest management is vital for biodiversity conservation, preserving carbon stocks, and an essential mitigation strategy for climate change.

This research examined vascular plant diversity and soil carbon in 12 mature broadleaved woodlands in the Southwest of the UK. Managed and unmanaged forest stands were compared to determine any effects of management using continuous cover forestry methods, which is a more naturalistic management technique. Diversity was evaluated using species richness and the Shannon diversity index. Records were taken of Ancient Woodland Vascular Plants (AWVPs), total soil carbon was measured, and the effects of species richness on soil carbon measurements in both treatments was examined.

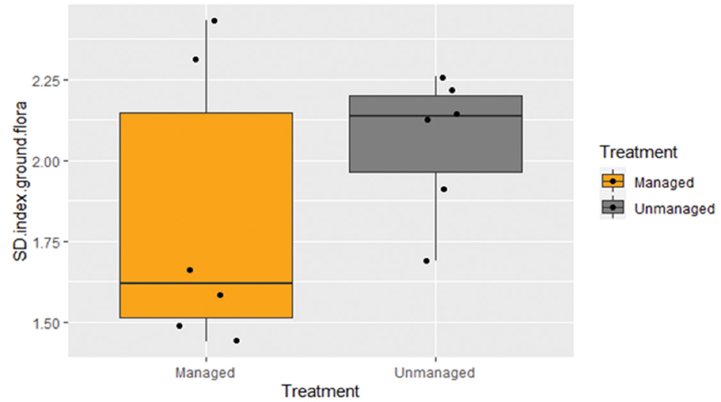
Results.

106 vascular plant species were recorded across the sites, with considerable variation in species recorded between sites. Analysis identified a statistically significant difference in records of plant species richness (t = -2.422, df = 10, p-value = 0.035) between the managed (M = 22, SE = 2.02) and unmanaged (M = 30.167, SE = 0.872) treatment/plots.



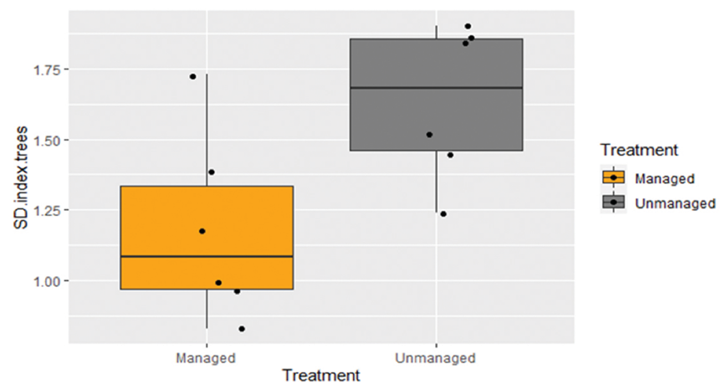
Species richness was significantly higher in the unmanaged treatment plots (t = -2.422, df = 10, p-value = 0.035). Dots represent actual numbers recorded. Box line is the mean number for the treatment.

Analysis demonstrated no significant difference in Shannon diversity index numbers for ground flora (t = -1.208, df = 10, p-value = 0.255) in managed (M = 1.818, SE = 2.275) and unmanaged (M = 2.058, SE = 1.922) treatment/plots.



Shannon diversity (SD) index number for ground flora demonstrates broad variation in the managed treatment, with higher mean value for the unmanaged treatment, although not statistically significant (t = -1.208, df = 10, p-value = 0.255). Dots represent actual numbers recorded. Box line is the mean number for the treatment.

17 tree species were recorded across the sites. Analysis demonstrated a significant difference in Shannon diversity index number for trees (t = -2.588, df = 10, p-value = 0.027) in managed (M = 1.18, SE = 0.872) and unmanaged (M = 1.633, SE = 0.577) treatment/plots.

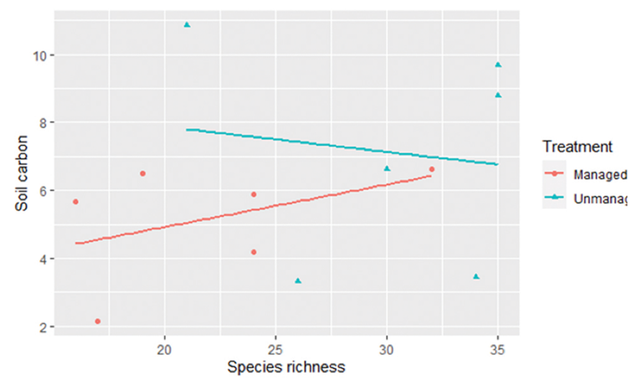


Shannon diversity (SD) index numbers for trees displays significantly higher number in the unmanaged treatment (t = -2.604, df = 10, p-value = 0.026). Dots represent actual number recorded. Box line is the mean number for the treatment.

All plots contained AWVPs. 20 different species were recorded across the selected sites, including common cow-wheat *Melampyrum pratense* found in one plot, English bluebells *Hyacinthoides non-scripta* found in eleven plots, and wood sorrel *Oxalis acetosella* found in four plots. No significant difference in AWVPs (t = -1.126, df = 10, p-value = 0.286) was found between managed (M = 5.167, SE = 0.654) and unmanaged (M = 6.167, SE = 0.601) treatment/plots

Ancient woodland vascular plants found in the test plots; on the left, common cow-wheat *Melampyrum pratense*, the centre is English bluebell *Hyacinthoides non-scripta*, and on the right is wood sorrel *Oxalis acetosella*.

Soil carbon results displayed considerable variation, particularly in the unmanaged treatment/plots. Analysis demonstrated measurements of soil carbon were not significantly different (t = -1.308, df = 10, p-value = 0.220) in managed (M = 5.17, SE = 0.702) and unmanaged (M = 7.12, SE = 1.31) treatment/plots.



Multiple linear regression analyses found no significant influence of plant species richness (R^2= 0.194, df = 8, p-value = 0.567) or treatment (R^2= 0.194, df = 8, p-value = 0.423) on soil carbon.

Discussion.

Tree diversity was significantly higher in the unmanaged treatment/plots. This may be due to natural regeneration which occurred freely in the unmanaged plots. Regeneration is dependent on various biotic and abiotic factors such as climate, pathogen predation, soil type and nutrient availability. However, a key component for natural regeneration is the abundance of local seed sources, which are typically genotypes suited to local conditions (Barna and Bosela, 2015). Di Sacco *et al*. (2021) reported that species richness in forests allowed to develop exclusively through natural regeneration was significantly higher than planted forests.

Species richness in both treatments did not display any significant relationship to soil carbon measurements in the present study, in contrast to several previous investigations. For instance, Jia *et al*. (2021) observed that plant species richness positively affected soil carbon volumes in topsoil through increased plant residues, and in subsoil through increased soil microbial components. Shen *et al*. (2022) established that plant diversity enhanced and stabilised soil fungal networks, which in turn stabilised soil carbon pools and facilitated carbon accumulation. Soil carbon dynamics are complex, and the relationship between soil carbon and plant species richness is compounded by numerous abiotic and biotic elements, posing challenges for generating clear, definitive information (Jia *et al*., 2021).

Conclusions.

This investigation found that ground flora plant diversity when considering richness and evenness, alongside ancient woodland vascular plants, was not necessarily compromised by active forest management using continuous cover forestry methods. Therefore, it was surmised that sensitive forest management practices have the potential to protect ground flora diversity and ancient woodland plants whilst generating valuable timber products . These findings help to support the case for employing less intensive forest management practices, where productivity can still be achieved alongside maintaining resilient forest ecosystems.

Previous investigations have found higher diversity in naturally regenerated forests, and natural regeneration which occurred freely in the unmanaged sites could have promoted higher tree diversity found in this treatment. So, forest management which facilitates these features can generate systems which support and promote diversity. Understanding the impacts of forest operations on plant diversity and soil carbon is essential to inform forest management. Consequently, further research is needed to clarify how forest management affects plant diversity and soil carbon, so these important ecological components can be conserved.

References.

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