**Changes in structure, community composition and functional diversity in a forest stand undergoing collapse**

**Introduction**

**Research questions**

1. **How has the forest structure changed over the gradient of collapse?**
2. **How have the tree and ground flora ecological communities changed over the gradient of collapse?**

* H0. Ecological communities show no relationship to the gradient of collapse
* H1. As percentage basal area lost increases the similarity of plot to the baseline community in 1964 is reduced
* H1.1 The effect of basal area loss on ground flora community and tree communities is similar
* H1.2 The effect of basal area loss on ground flora communities is more pronounced than that on tree communities

1. **How have the community weighted mean trait values of tree and ground flora changed over the gradient of collapse?**

* H0. Community weighted mean trait values show no relationship to the gradient of collapse
* H1. As the percentage of basal area lost increases there is an increase in the abundance of species adapted to conditions with greater light, lower soil nitrogen and higher moisture.
* H1.1 The effect of basal area loss on the community weighted trait values for ground flora and trees is similar
* H1.2 The effect of basal area loss on the community weighted trait values for ground flora is more pronounced than that on trees

**Methods**

**Site description**

Denny Wood is located in the New Forest in Southern England, with the transects used in this study located between 14 Long 15 Lat. Between the sixteenth and eighteenth centuries the woodland was an open oak-beech stand with some pollarding that was grazed by livestock and deer, resulting in limited regeneration. During the nineteenth and twentieth centuries pollarding stopped and regeneration increased, as did the number of beech trees. In 1870 part of the wood was fenced against livestock, though currently grazing pressure is likely to be high in both parts. For a comprehensive overview of the site’s history see Mountford et al. (1999). The woodland is largely comprised of beech (*Fagus sylvatica*) and pedunculate oak (*Quercus robur*) with an understory of holly (*Ilex aquifolium*) and birch (*Betula pendula*). However, the woodland also contains open areas that are relatively free of trees many of which were apparently dominated by beech and oak in the last century where vegetation now largely comprises Agrostis dominated grassy areas or bracken (Pteridium aquilinum) stands. The site consists of a gradient from beech dominated woodland to open grassland that may be indicative of alternative stable states.

Data at the site was collected over two permanent transects, one in the fenced part of the woodland and one in the unfenced part. These transects were subdivided into contiguous 20x20m (0.04 ha) plots with the fenced transect containing 51 such plots and the unfenced transect 20. The fenced woodland area was surveyed in 1959, 1964, 1984, 1988, 1996 and 2014, while the unfenced transect was surveyed 1959, 1964, 1999 and 2014. On each of these occasions all stems >5cm DBH were noted, their DBH measured, their species recorded along with their location within the 20x20m plot and whether they were alive or dead. In the case of dead trees whether the trees were snags or not was recorded, along with the estimated snag height and their degree of decay. In addition the degree of debarking by squirrels and ponies or deer of holly in each plot was recorded. To assess ground flora a 10x10m plot was located inside each 20x20plot and percentage cover of each species assessed. In addition to the data collected at the site data from the PLANTATT and (German – EDINA?) databases were used to provide information of the traits of each species at the site.

**Data analyses**

For our analyses all metrics were calculated at the scale of our 20x20m plots. To assess change in structural characteristics the basal area of each plot was calculated as:

where ? is ?, along with the stem density and aboveground biomass. The species richness was calculated as the number different species of live stem >10cm dbh present in each plot and species turnover was assessed by calculating Sorensen’s similarity using the first survey in 1959 as a baseline. The same calculations were done for ground flora at the 10x10m plot scale.

Community weighted mean values of traits were calculated by multiplying trait values by basal areas of tree species for each plot and then dividing the sum of all these values by total plot basal area. Similarly for ground cover trait values were multiplied by the percentage cover of a species and then summed and divided by 100.

Community weighted mean trait values were calculated for both ground flora and tree communities using measures of woodiness, life form, and Ellenberg values to indicate light and nitrogen requirements/tolerance (Ref). Temporal change in all metrics of interest was modelled over the period 1959-2014 using mixed effect models with plot number was defined as a random effect to account for repeated measures (Ref). All models included a fixed effect term for the year of survey which was centred to reduce correlation with random effects (Ref). The residuals of all models were examined to determine whether they conformed to assumptions of heteroschedasticity and in the cases where these assumptions were not met the metric was log transformed. The residuals of these models were also plotted spatially for each year to determine whether there were signs of spatial-autocorrelation, but there was little sign of spatial-autocorrelation. Model selection was undertaken by comparing models of temporal change with null intercept only models. Models were ranked by Akaiki’s Information Criterion adjusted for small sample size (AICc) and where differences in AICc (ΔAICc) between the most parsimonious model and other models was <7 model averaging was undertaken.

Results

* Figures of current results

Discussion

Conclusion