The Impact of Deer Browsing on Coppiced Vegetation at the Wyre Forest

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Introduction

There is an increasing emphasis within the Wyre Forest on re-establishment of coppice management in areas designated as being important for nature conservation. However, achievement of a successful coppice rotation is threatened by the impact of the deer population, which damages vegetation structure and coppice regrowth by browsing. Heavy browsing results in the death of coppice stools and reduced cover of sensitive species such as *Calluna vulgaris*. The shrub layer is reduced and a homogeneous grassland structure develops containing browse tolerant species such as *Deschampsia cespitosa* (Joys et al. 2004, Kirby 2001). These effects have shown to impact on woodland fauna by reducing nesting and feeding thickets for small mammals and birds, and removing sheltered ground vegetation for some invertebrates (Flowerdew and Ellwood 2001, Fuller 2001). However, studies have often found that browsed woodland supports a more diverse ground flora because dominance by a single palatable species such as *Rubus fruticosus* is reduced, which enables populations of less competitive species to remain. It is therefore accepted that some browsing is beneficial for biodiversity as it encourages heterogeneous patches.

Whether browsing is seen as detrimental or not depends not only on the population size, but also on the species of deer, habitat structure, woodland size and composition of plant species. The varied factors influencing the impact of deer justifies the need for specific studies in each location where deer are an issue, to be able to quantify their effects on a particular ecosystem. Studies are particularly justified in coppice as it is concentrated in woodlands of high nature conservation value, and so this study is valuable as it is located within a Site of Special Scientific Interest (SSSI).

Site

This study took place within experimental Forestry Commission (FC) coppice plots. The plots were cut to assess the vigour of natural regeneration under the influence of deer browsing compared to areas protected by deer fencing. Throughout the SSSI the aim is to reintroduce coppice management of the *Quercus* dominated woodland to cover at least 20% of the total broadleaved area, therefore it is important to assess how successful this may be in light of the current deer population. There is a combined effort by the landowners to address the issue of deer, by setting annual culling targets devised following population counts. The aim is to attempt to achieve a stable and sustainable deer population that does not impact negatively on the woodland biodiversity, and so this study provides an idea of the current impact from deer.

Methods

Of the fifteen experimental coppice plots, five were half fenced and half unfenced; their locations being shown in Figure 1. These five plots were chosen as suitable sites as they combined adjacent fenced and unfenced sections.

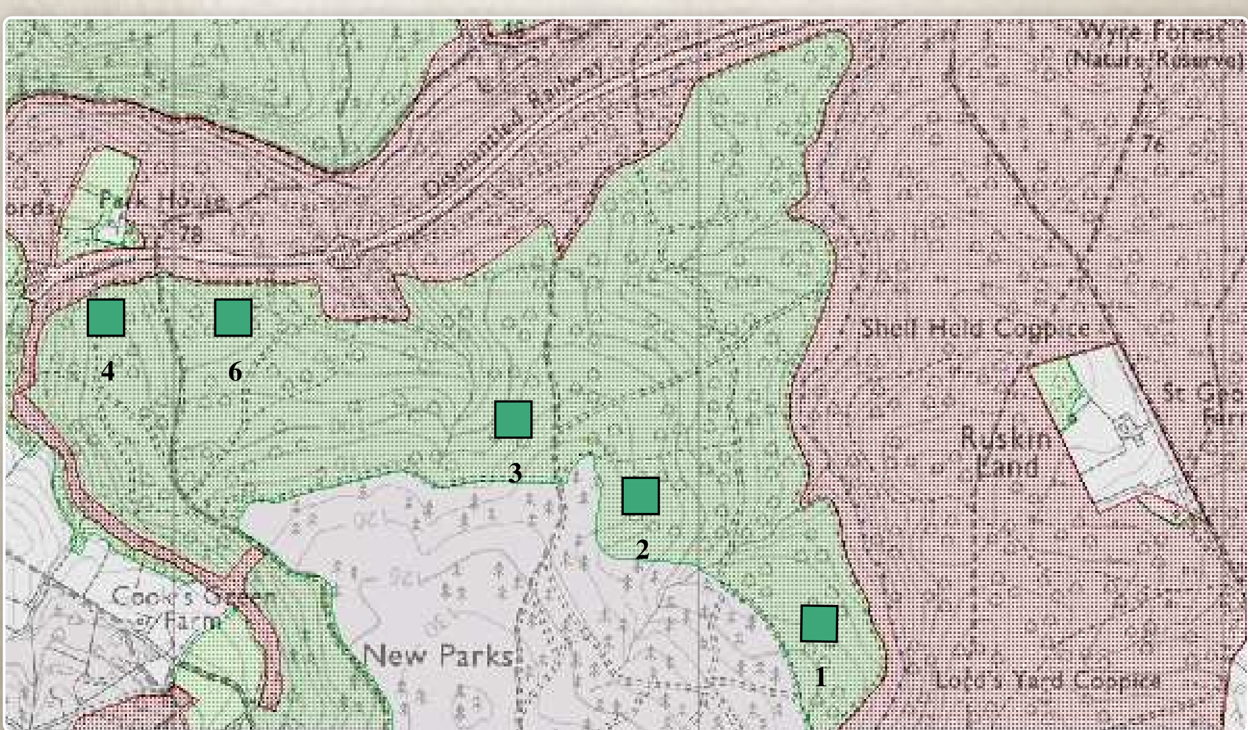

Figure 1. Location of coppice plots sampled in this study.

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Vegetation sampling used randomly placed 2m x 2m quadrats; an accepted size to measure ground flora and used in previous studies. For each of the five coppice plots, six samples were taken in the fenced section and six in the unfenced section – giving a total of sixty samples from all five plots. Sampling was carried out during the summer (July – September 2006) in order to record the majority of species that were present. All vascular plants and bryophytes that occurred within each quadrat were recorded, as was the mean height of all vegetation in the quadrat, and then the abundance of each species was listed using the 10-point Domin scale (Rodwell 1991).

The primary analytical methods were multivariate computer packages that classify and ordinate data, namely Two-Way Indicator Species Analysis (TWINSPAN) and Detrended Correspondence Analysis (DECORANA). TWINSPAN groups samples of similar species composition in order to classify vegetation community types, whilst DECORANA orders species responses to help create hypotheses about relationships between species composition and environmental factors (Kent and Coker 1992).

Results

58 plant species were recorded within the samples, and initial TWINSPAN analysis revealed groups representing plant communities ranging from those typical of acidic heath or grassland with high values for *Calluna vulgaris, Vaccinium myrtillus* and *Deschampsia flexuosa*; to less acidic soil with the appearance of species-poor shaded vegetation dominated by *Rubus fruticosus* or *Pteridium aquilinum* (Bingham 1995, Stace 1997). A dendrogram was constructed from the TWINSPAN results to aid interpretation, which is shown in Figure 2. The primary dichotomy of the dendrogram separates the samples of heathland communities from the samples of deeper woodland soils to form the two main branches of the dendrogram.

The groups identified by TWINSPAN were then overlaid onto the DECORANA species ordination as shown in Figure 3. The position of groups A-E indicate that Axis 1 represents edaphic changes from plant communities of deeper and more fertile soils with a lower score, graduating to the heathland communities of thin infertile soils higher up the axis, as already indicated by TWINSPAN. By highlighting the division of fenced and unfenced samples in Figure 3, there is the indication that Axis 2 represents the influence of deer on the vegetation composition and structure. This is because all fenced samples appear in the lower half of Axis 2, but are spread across the length of Axis 1. Fenced samples generally consist of taller shade-bearing vegetation, and those with the densest vegetation occur at the lower end of Axis 2. Fenced samples with a low open appearance are located higher up the axis, among many of the unfenced samples that have higher species richness and a shorter, grassland appearance.

A separate species ordination produced by DECORANA supports the interpretation that Axis 2 represents

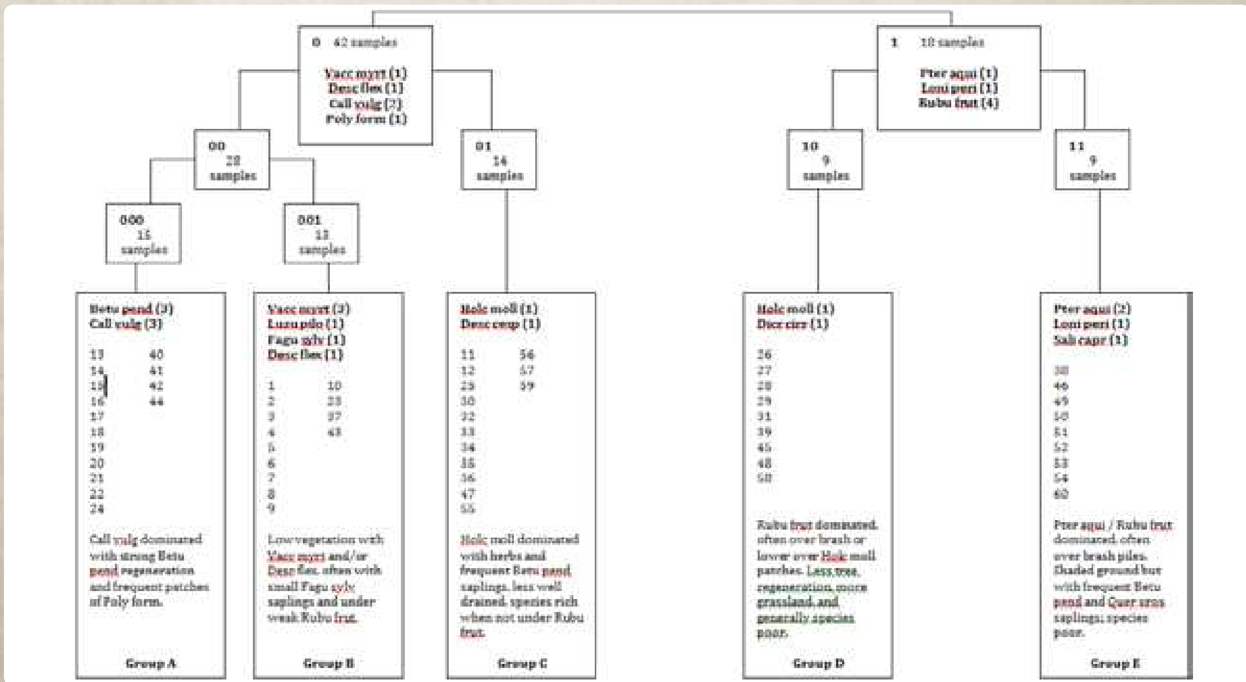

Figure 2. Dendrogram constructed from TWINSPAN results, showing the division of samples into groups based on similar species composition. Species in bold are indicator species for each group.

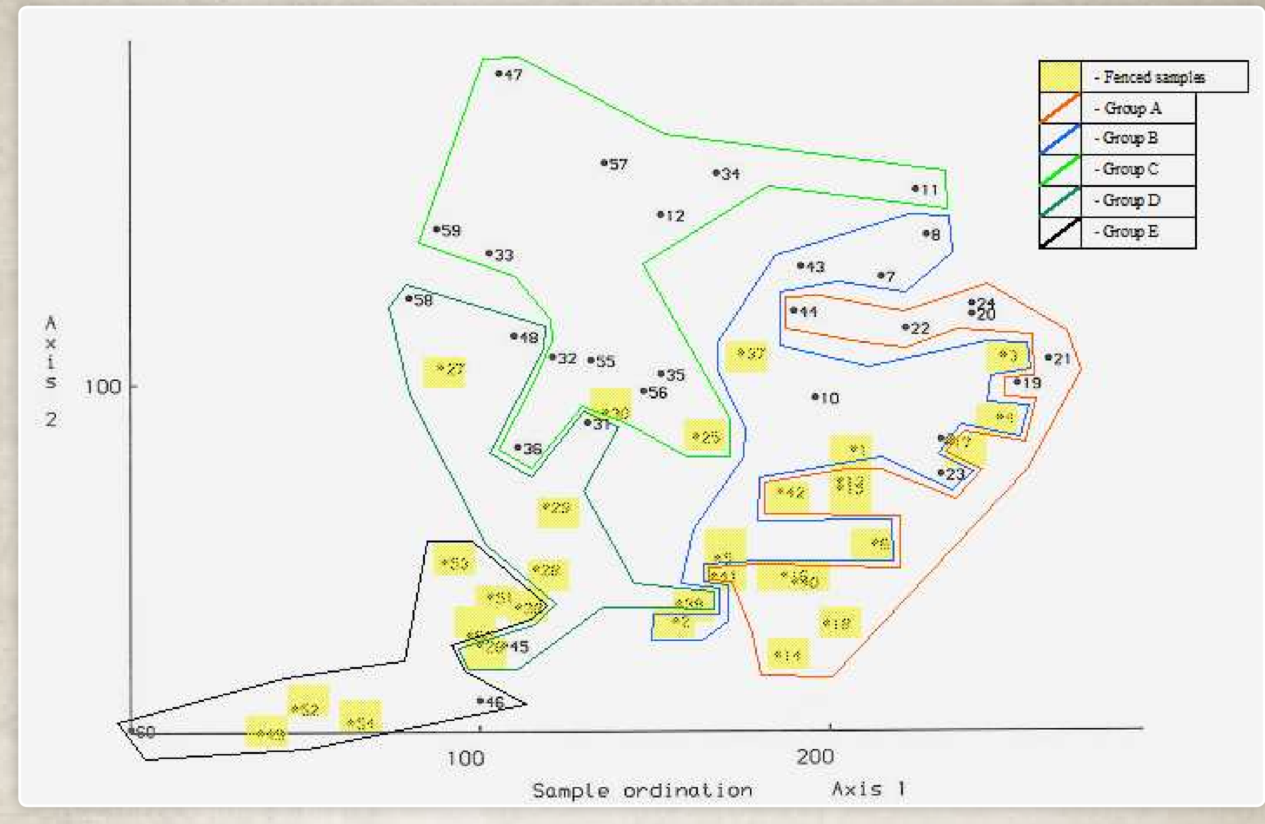

Figure 3. Two-dimensional samples ordination produced by DECORANA (axes are displayed in units of standard deviation x100), showing the division of fenced and unfenced samples, and overlaid with the five TWINSPAN groups.

structural changes due to deer browsing, as species higher on Axis 2 (i.e. corresponding to the unfenced samples), are mostly herb species of open grassland or woodland clearings. In contrast, species lower on Axis 2, such as *Eurhynchium praelongum* represent shaded woodland typical of fenced samples. However, some species did not fit this trend, such as *Mnium hornum* which is an indicator of shady woodland habitats but was located higher on Axis 2 among grassland species (Crawford 2002). The reason appears to be due to *R. fruticosus* scrambling over deadwood piles, providing a shaded microhabitat for it to persist in otherwise open vegetation. Despite such anomalies, after cross-referencing patterns from TWINSPAN/DECORANA, and ecological preferences of individual species and knowledge of the samples, it is possible to summarise the results as shown in Figure 4.

The interpretation of Axis 2 is reflected in that fact that for all coppice plots the mean vegetation height was lower in unfenced samples, as may be expected from areas exposed to deer browsing. This trend coincided with greater mean species richness in unfenced samples of all coppice plots, where fifteen species recorded in unfenced samples were absent from fenced samples. In addition, *Teucrium scorodonia* had significantly greater cover abundance in unfenced samples (U=22, p=0.05). The species strongly or solely associated with unfenced samples are typical of acidic grassland or open woodland, however in contrast Betula pendula (t=2.04279, p=0.05) and Quercus (t=4.201, p=0.001) both had significantly greater cover abundance in fenced samples.

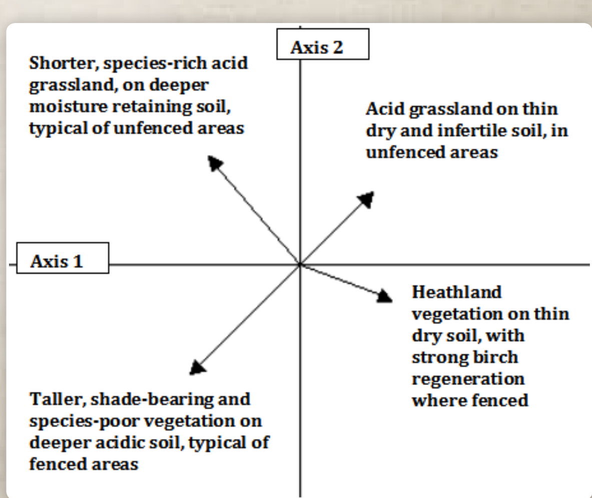

Figure 4. The main environmental variables identified from interpretation of DECORANA sample and species ordinations and TWINSPAN community types.

Discussion

Despite visual differences between fenced and open samples, the primary influence on vegetation composition is variation in soil type, even over the relatively small area covered by this study. The results identified a range of habitats including heathland, acidic grassland, woodland regeneration and scrub communities. This provides management with the knowledge that coppicing areas of high forest within just a small area can produce a mosaic of habitats to enhance biodiversity. Scrub communities identified indicate where coppiced woodland on deeper soils is becoming dominated by *P. aquilinum* or *R. fruticosus*, possibly to the detriment of woodland regeneration. Personal knowledge of such samples (mainly in TWINSPAN group D) revealed a management influence, as log piles smothered by *R. fruticosus* resulted in a lack of tree regeneration. Therefore deadwood piles can have a significant localised impact.

Effects of browsing and fencing

Although Axis 2 revealed the influence of deer browsing, there was no dramatic effect on species composition as only *B. pendula* and *Quercus* were significantly more abundant within exclosures. Instead there were subtle differences due mainly to the low abundances of extra grass species and low growing herbs in browsed samples. The two most common grasses (*Holcus mollis* and *D. flexuosa*) are sensitive to heavy browsing (Grime et al. 1989), which suggests that their prevalence in unfenced samples indicates low intensity browsing. The prevalence of *T. scorodonia* in unfenced samples also indicates browsing levels that restricts tall dominant species without weakening that species.

The most noticeable effect of fencing was the taller vegetation structure, typically averaging 1 metre, but often well in excess of this where *Betula, P. aquilinum* and *R. fruticosus* were vigorous. The vegetation was generally species-poor, however scrambling *Lonicera periclymenum* frequently occurred and shade-tolerant bryophytes such as *Lophocolea bidentata* and *Eurhynchium praelongum* persisted. The significantly higher abundance of *Betula* and *Quercus* in exclosures suggests an important impact of deer in the Wyre Forest. Browsing restricts both species but when it is absent they are stress-tolerant competitors that form a dominant canopy. In clearings *Betula* produces particularly dense stands of saplings with floristically poor vegetation beneath, as recorded in the fenced samples in this study. Few *Quercus* seedlings were recorded in unfenced samples and this lack of regeneration should be of particular concern to woodland managers, as it is valuable for forestry and conservation and shows that it is being selectively excluded by browsing. Overall, selective browsing is directly affecting species composition, but also indirectly changing composition by reducing the height of *R. fruticosus* and *C. vulgaris* to allow smaller light demanding grasses and herbs to persist. However, despite clear impacts on vegetation the indication is that browsing is not excessive because of the insignificant reductions in palatable grasses, *Lonicera periclymenum*, and *R. fruticosus* in unfenced samples.

Implications and recommendations

Deer browsing and/or exclusion can have positive and negative implications on many common and priority species of fauna within the Wyre Forest. It is considered that habitat heterogeneity resulting from moderate levels of deer browsing without total exclusion will maintain overall species richness (Stewart 2001). Within the current situation, judgement on whether conservation value is declining or increasing depends on the patterns of change for populations of target woodland species. Therefore it is important for future studies to monitor species of importance in addition to deer populations, to assess whether links suggested in other studies are present in the Wyre Forest. Despite the indications that browsing intensity is not severe, there is a need to address the impact of deer on Quercus regeneration. There are several recommendations to assist coppice and maintain species richness of the plant community:

1) As deadwood piles have shown to promote development of dense *R. fruticosus* thickets, piles should be placed around existing coppice stools to protect against deer browsing in unfenced coppice.
2) Fenced coppice plots should have standard trees to limit light levels, and so prevent exclusion of *Quercus* regeneration by vigorous *R. fruticosus* growth.
3) The location of new coppice areas can be chosen to encourage or avoid certain vegetation communities. For example, where *V. myrtillus* currently occurs under the canopy, coppicing should encourage the quick establishment of a temporary heathland community. In contrast, where *P. aquilinum* already occurs under the canopy, it is likely that coppicing will encourage dense stands of species-poor W25 scrub that prevents coppice regrowth and tree regeneration.

Other studies have recommended that studies should monitor varied deer densities within large enclosures (of at least 100ha to avoid interfering with their spatial behaviour), rather than the all-or-nothing situation of exclosure experiments (Feber et al. 2001). This could be carried out in the Wyre Forest due to its large size, and as a result may be able to recommend certain deer densities that allow structural diversity without loss of *Quercus* regeneration. Overall, woodland management can use data from this study to help establish what level of browsing is desirable. For example, if an increase in species richness of herbs in the generally impoverished woodland flora is desired, then current deer pressure should be beneficial as long as coppice stools are protected. However, if *Quercus* regeneration is the priority then the present impact of deer must be addressed.

Acknowledgements:

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One of the experimental coppice plots (number 3), New Parks, 27th August 2005 Rosemary Winnall