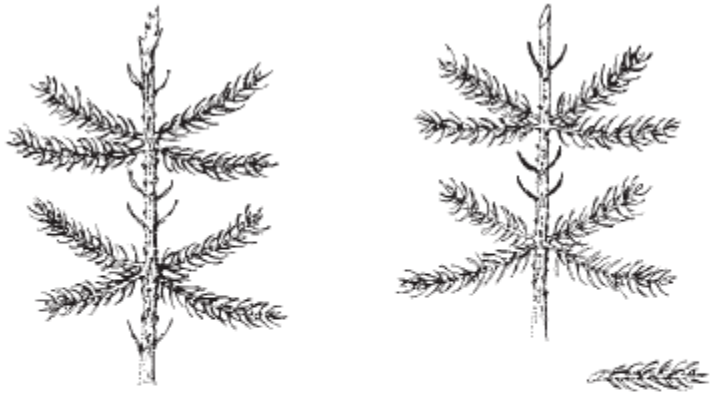
Impact of mammalian herbivores on woodland biodiversity in the UK
(Extract from Writers PHD 2010)

1. Introduction

Herbivorous browsing of woodlands has been recognised for a long time as a serious woodland issue (Ashby 1959). As part of an ecosystem it should be recognised that within a system with many components there is often a cumulative effect of direct and indirect activities by different sources and this is no different with herbivores (Strauss 1991). For example birch browsed by moose in the first year appeared to change leaf quality and produced an increase in insect and hare browsing in the following year (Danell and Huss-Dannell, 1985).

Non-mammalian herbivores such as birds and insects interact with woodland biodiversity through feeding and nesting activities (Campbell et al. 2004, Dennis 1997). Common seed eating birds such pigeons can also affect regeneration of woodland species such as oak and also influence long term woodland development (Mellanby 1968).

Physical impacts by herbivores are usually created through browsing, fraying and trampling (Hodge and Pepper 1998). Browsing is where herbivores selectively feed on buds, shoots and foliage or remove bark from stems or branches. Selective removal of under-story vegetation can have long term effects on the viability of some plant species populations (McGraw and Furedi 2005) and the impact of deer on flora is discussed in more detail later in this chapter. Removal of bark from stems and branches by gnawing or rubbing is known as bark-stripping. Rubbing bark off trees is also known as fraying and usually occurs as a result of male deer rubbing new antlers to remove ‘velvet’ or to mark territories. The species that causes the damage can often be identified through differences in browse pattern (Figure 1.).



Browsing by deer and sheep leaves ragged ends on stems and branches. The shoots are always eaten.

Rabbits and hares leave clean diagonal cuts on ends of stems and branches. The shoots are often left lying by rabbits, always by hares.

Figure 1. Identification of mammal browsing damage (Hodge and Pepper 1998)

2. Impact of Mammalian Herbivores on Woodland Biodiversity.

Small mammals such as voles, rabbits and squirrels affect biodiversity and woodlands, particularly in terms of bark stripping of regenerating trees and the browsing of young flora (Hodge and Pepper 1998, Putman 1994). To give examples of the range of impact of small herbivores on biodiversity in woodlands we can compare rabbits, voles, mice and squirrels. Whilst rabbits cause damage primarily through browsing and bark stripping up to a height of 540mm (Pepper 1998), voles and mice not only cause similar damage around the base of the tree but also can bark strip higher up the stem commonly from one to two metres in height and also harvest tree seeds (Rogers-Brambell 1974). Damage to woodland through grey-squirrel damage is recognised widely as a serious threat to woodlands in the UK (Mayle et al. 2003). Grey squirrels cause damage to woodland particularly through extensive bark-stripping that can result in tree death, and browsing of tree seeds. Roots, bulbs, invertebrates, birds eggs and nestlings may also be taken.

Larger herbivores often have a more visible effect on woodland biodiversity (Table 1.). In particular herbivores affect regeneration and vegetation structure which in turn affects other species of organisms. The level of impact can either be positive or negative depending on levels of grazing or browsing (Mitchell and Kirby 1990).

Table 1. Classification of some herbivores and their potential impact on upland woodland vegetation (Mitchell and Kirby 1990)

Herbivore	Type	Impact
Cattle	Grazer	Low selective herbaceous bulk feeder, trampling damage may be considerable in regenerating woodland. Will browse unselectively.
Horse	Grazer	Low selective herbaceous bulk feeder, creates large mosaics in grassland, tendency to strip bark. Will browse unselectively.
Sheep	Grazer	Highly selective herbaceous feeder, inclined to browse especially when the quantity and quality of available herbage is low.
Red deer	Grazer/Browser	Highly selective grazer, more inclined to browse especially when the quantity and quality of available herbage is low; bark stripper.
Goat	Browser/Grazer	Highly selective browser, will graze herbage when quality is high, bark stripper, destructive to saplings.

The grazing of ungulates is a common woodland management tool to regulate under-story vegetation (Frank 1998) although where excessive grazing occurs by other herbivores in addition to deer the effect can become negative (Linhart and Whelan, 1980). A moose for example can browse on 10,000 buds, tramples 25m square, producing 14 faecal pellet groups and ten litres of urine a day (Dannell & Bergstrom 2002) illustrating its effect on the woodland ecosystem in terms of nutrient recycling. Where fencing may be poor and sheep incur into woodland they can also negatively affect regeneration that can only be rectified by the exclusion of the sheep (Pigott, 1983).

The grazing of woodlands by livestock, particularly cattle, has been widely documented (Armstrong et al.2003, Mayle 1999a). Research has shown their value to biodiversity although positive influences on biodiversity are reliant on timing of exposure of woodland to

livestock grazing pressure and must be closely monitored and managed (Armstrong et al. 2003). Low levels of woodland grazing by large herbivores such as deer can promote a greater diversity of vegetative species and structure (Mitchell & Kirby 1990). Grazing of woodland vegetation has specific direct and indirect effects on the ecosystem and the long-term sustainability of the woodland flora and fauna, as illustrated in Table 2. The table also provides a useful tool to demonstrate how different intensities of grazing affect the floral and faunal components of a woodland ecosystem.

Table 2. The impact of increased grazing intensity on flora and fauna of woodland (shaded boxes indicate areas of most interest to nature conservation). (Mitchell and Kirby 1990)

No grazing → High grazing intensity

Trees & Shrubs	No regeneration due to competition from dense ground vegetation	Creation of regeneration niches	Loss of seedlings Damage to saplings	Loss of saplings, Severe tree browsing	Barking of mature trees Loss of shrub layer	Creation of parkland or moorland
Higher Plants	Reduced diversity dominated by by a few species	Reduction in vigorous species Increase in diversity	Reduction in vegetation structure. Increase in grazing tolerant species	Loss of plant diversity, particularly of grazing sensitive species	Loss of cover and damage due to trampling. Bare ground	Impoverishment due to net loss of nutrients from the system
Lower Plants	Reduced cover and diversity due to competition from higher plants	Increase in cover of ground dwelling species as competition from higher plants reduced		Damage to ground dwelling species due to trampling	Reduction of drought sensitive bryophytes	Increase in epiphytic lichens associated with parkland
Small Mammals	High small mammal populations, a few species predominate	Increase in diversity as structural diversity increases	Reduction in small mammal populations as ground vegetation structure simplified		Reduction of populations through competition for food	Loss of diversity and abundance. Species of open ground predominate
Birds	Favouring birds of dense shrub layers	Increase diversity as structural diversity increases	Increase in species favouring low shrub cover	Loss of ground nesting birds due to poor concealment	Loss of species dependant on berry bearing shrubs	Reduction in in raptors dependent on small mammals
Inverte-brates	High populations of phytophilous	Increase in diversity as sward structure diversified	Increase in dung utilising species	Decline in woodland species		Increase in parkland and moorland species

3. Discussions Conclusions

An example of the landscape level influence of grazing impacts by livestock and large herbivores such as deer these have been illustrated within riparian systems with fish habitats (Platts 1984, Larson et al. 1998, Hunt 2003). Where there has been excessive grazing by sheep and/or deer in upper river catchments areas problems can be created causing riverbank erosion and an increase in siltation and acidification effects. Vegetation responses are often localised and very site specific depending on riparian stream habitat and grazing. These effects in turn, influence freshwater habitat and its species composition. Looking at the wider landscape however, it has been indicated that it would also be difficult to carry out accurate research to establish the link between the woodland and freshwater ecosystems to determine the influence of grazing due to the complex interaction between natural and manmade parameters that need to be considered (MacDonald et al. 1991). These parameters also vary over time and therefore analysis can only provide a basic assessment of the significance of the functional relationships within the ecosystem.

4. References

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