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RESEARCH NOTE

Morphology of gorse (*Ulex europaeus* L.) and its consequences for browsing by ponies

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Summary

1 A method for determining the age of gorse plants (*Ulex europaeus* L.) in the field is described. Using this method it is shown how the vigour and morphology of gorse shoots change markedly with plant age.

2 In plants which have regrown after burning or cutting, the most vigorous growth occurs after 3–5 years, and there is a steady decline in vigour in older plants.

3 Ponies feeding on gorse in winter preferentially browse the shoots of young plants, despite their formidable spines, apparently because the shoots are longer and thus more accessible. The managment of gorse as winter browse for ponies is discussed.

Keywords: herbivory, horses, morphology, shrub growth, vegetation management

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Introduction

Despite its spiny and intractable nature, gorse, *Ulex europaeus* L., can be a valuable and highly nutritious source of food for large herbivores (Howe *et al.* 1988; Lambert *et al.* 1989 a–c). Radcliffe (1986), for example, showed that gorse can be a year-round maintenance feed for goats; indeed, in a four-year trial in Canterbury (New Zealand), non-lactating feral goats performed just as well on gorse as on pasture. In parts of Ireland, gorse was traditionally grown as a fodder crop for cattle and horses, and various machines have been developed to crush the plants and increase their palatability (Lucas 1960). In the New Forest in southern England, where this study was undertaken, gorse is an important food for free-ranging ponies during the winter months when grass is not available (Tubbs 1974; Putman *et al.* 1987). This research note describes changes in the morphology of gorse shoots as the plant ages, and examines the effects of these changes upon the availability of gorse to ponies. The management of gorse as a food supply for ponies is also discussed.

Material and methods

STUDY AREA

The New Forest region in southern England was designated in about 1087 as a royal hunting forest, and has enjoyed a special legal status ever since. It has a total area of 37700 ha of which some 19000 ha are now enclosed, mainly as forestry plantations and fields. The

remaining 18500 ha are unenclosed and include heathland, grassland, deciduous woodland and valley mires (Tubbs 1986). Grazing by large herbivores has long been an important factor affecting the vegetation of the New Forest. In 1982, when the field work for this paper was carried out, the unenclosed land was grazed by about 1500 cattle and 3000 ponies, though many of the cattle were removed in the winter. In addition there were about 2400 deer, mostly fallow deer (*Dama dama*), which moved freely between the enclosed and unenclosed areas of the forest. A survey in 1961 showed that approximately 3250 ha of the New Forest were then dominated by gorse (Tubbs & Jones 1964). This species is particularly abundant in areas which have been disturbed, such as banks, tracks and road sides, and fringing belts around settlements (Jones & Tubbs 1963). The gorse is managed by the Forestry Commission who cut or burn it at irregular intervals.

The main study site was close to an area of reseeded grassland known as White Moor lawn (National Grid reference: SU 280023). This is one of several former arable areas in the New Forest which were converted to grassland in the late 1940s and early 1950s, and which are heavily used by cattle and ponies (Edwards & Hollis 1982). At White Moor lawn, as at other sites with a similar history, a fringe of gorse has developed in the surrounding heathland, perhaps in response to high levels of animal excreta and to disturbance of the soil. The site has a large number of gorse plants which have been burnt or cut at different times and range in age from 1 to 25 years.

Gorse was also studied within a 5 ha woodland inclosure at Denny (SU 330050) occupied by fallow deer, in order to compare the effects of deer and ponies upon plant growth.

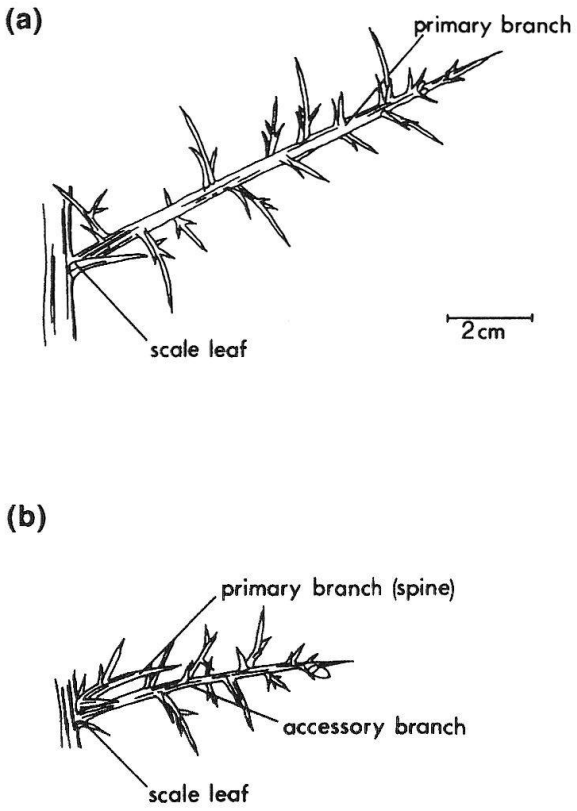

Fig. 1. (a) A single primary branch (spine) from gorse regrowth three years old. (b) An accessory shoot from a gorse plant 22 years old showing its origin from between a spine and a scale leaf.

SHOOT MORPHOLOGY OF GORSE

The growth of gorse is sympodial. The leaves, which are usually reduced to spiny scales, subtend primary branches which grow for only a short period in spring and then harden to form branching spines up to 12 cm long (Fig. 1). In the normal pattern of growth an accessory shoot develops from between the leaf and spine in the following year. The accessory shoot grows in length for only one season, bearing leaves and spines (primary branches), and ending in a spiny point. When it is mature the leaf and spine which subtend

the accessory shoot die (Wager 1897), though they are not immediately shed from the plant. Most of the accessory shoots are very small, but the largest of them (usually formed towards the tips of the previous year's shoots) gradually increase in thickness and form the main framework of the plant. Since an accessory shoot only grows in length for one season, the age of a gorse plant can be determined by counting the sequence of accessory shoots from the tip of a branch system to the base of the plant.

METHODS

The age of gorse plants was determined by the method outlined above and the result was confirmed on at least two branch systems. On stems older than about ten years the underlying pattern of branching becomes rather obscure, though it was usually possible to identify each year's growth from clues such as the distribution of branch scars and bends in the main axis. To test the method the ages obtained from six plants of between 6 and 21 years were compared with those obtained by counting annual rings. In five cases the two methods agreed and in one there was a discrepancy of two years (eight years from branching pattern, ten years from tree rings). The method described here is probably no less reliable than counting annual rings, since these are not easy to see in gorse.

In late October, when shoot elongation had ceased but before winter browsing had begun, 148 bushes were selected at the White Moor site to represent as evenly as possible the range of ages from 1 to 25 years. On each bush three two-year old branches were selected at random. The lengths of the three longest accessory shoots on each branch were measured and the mean for the nine shoots thus sampled was used as an *index of shoot length*. On a subsample of 25 bushes the diameter of the shoots and the mean length of spines were also found.

On 20 December 1982 and 24 May 1983 (chosen to represent the middle and end of the period when ponies feed on gorse) the proportions of 1982 accessory shoots which had been browsed were estimated for a range of plant ages. On each bush ten two-year old branches were selected and the three longest accessory shoots on each were examined. The number of shoots (out of a total of 30) which had been browsed provided an *index of browsing intensity.*

Results

All the plants studied have regrown after burning or cutting, and "age" refers to the time since this occurred. The most vigorous shoots were found on younger plants (3–9 years), though there was considerable variation in the index of shoot length between plants of the same age (Fig. 2). The longest individual accessory shoots, some of them over 80 cm long, were on 3- and 4-year old regrowth. On older plants the mean shoot length declined with age to about 10 cm on plants of 20 years or more. The length of spines also changed with age. Shoots of 3–5-year plants were usually ferociously armed with spines up to 12 cm long and with three orders of branching (see Fig. 1a). Thereafter there was a steady decline in the size and complexity of spines, and those of plants over 20 years old were about 2 cm long and had only one order of branching. The decline in length of shoots with age has a considerable effect on the shape of the plants. The long shoots of young plants formed a widely branching, open structure, while older plants had discrete masses of closely intermeshing shoots. The oldest plants at the study site (22–25 years old) were clearly in decline; they were broken and leggy, and many had dead

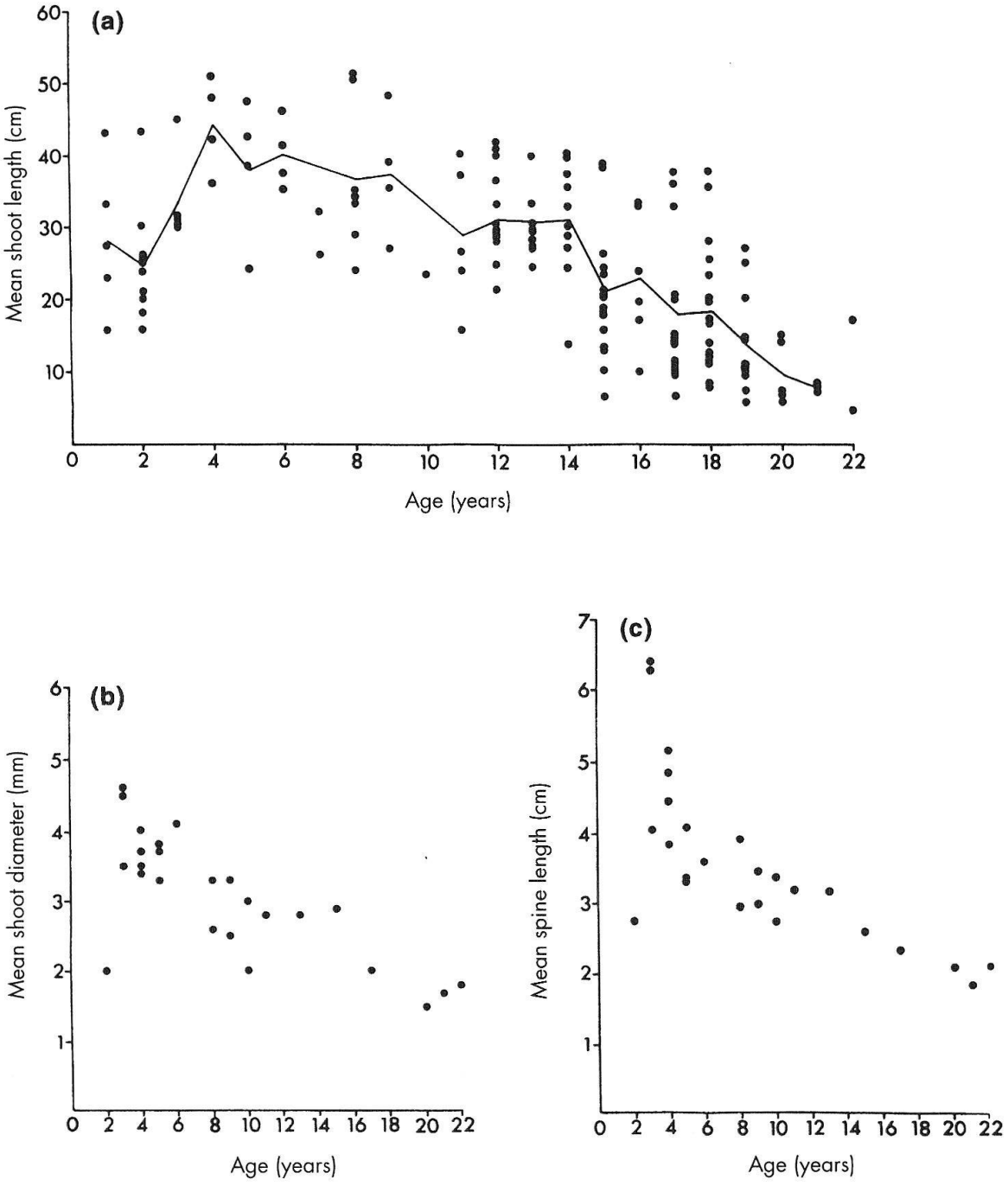

Fig. 2. Changes in shoot dimensions of gorse with age: (a) Length of current year's accessory shoots; each point represents a mean value for one plant. The line connects the mean values for all plants in each age class, omitting those ages for which fewer than four plants were available; (b) mean diameter of shoots; (c) mean length of primary branches (spines).

branches. Gelatinous orange sporophores of the ascomycete *Tremella mesenterica* were common on stems of this age.

Gorse is mainly a winter food for ponies in the New Forest and few shoots collected in October showed browsing damage. By 20

December many of the shoots on young plants had been browsed (e.g. nearly all of those on three-year bushes) and there was a broadly negative relation between proportion of shoots taken and plant age (Fig. 3). Heavy browsing of older plants did not occur until later in the winter. Even in May, by which time winter browsing had ceased few shoots had been taken from the oldest plants (>15 years).

Discussion

When mature gorse plants are cut or burnt there is usually abundant regrowth of shoots arising from the stump or root-stock. Growth proceeds rapidly and within four years a framework of long accessory shoots has been formed, giving the plants a bushy appearance. Plants developing from seed were observed to take 7–10 years to form a bush of the same size and vigour. As this study has shown, the performance of shoots changes markedly as the plant ages, to such an extent that young and old plants may be very distinct in their appearance. Skipper (1922) gives a detailed description of two forms of gorse growing in close proximity on Hindhead Common. The form referred to as the "ordinary type" had "accessory branches as long as 60 cm, their primary spines stout and thick and 3 cm long or more". The other form, described as "ericoid", had "accessory branches as little as 4 cm long with spines 1–2 cm long". These forms represented extremes, and every stage was found in the transition from one type to the other. From data and photographs in her paper there seems little doubt that she was describing the range of variation associated with plants of different ages. The changes in vigour of gorse plants with age are similar to those found in many perennial species (Kershaw & Looney 1985).

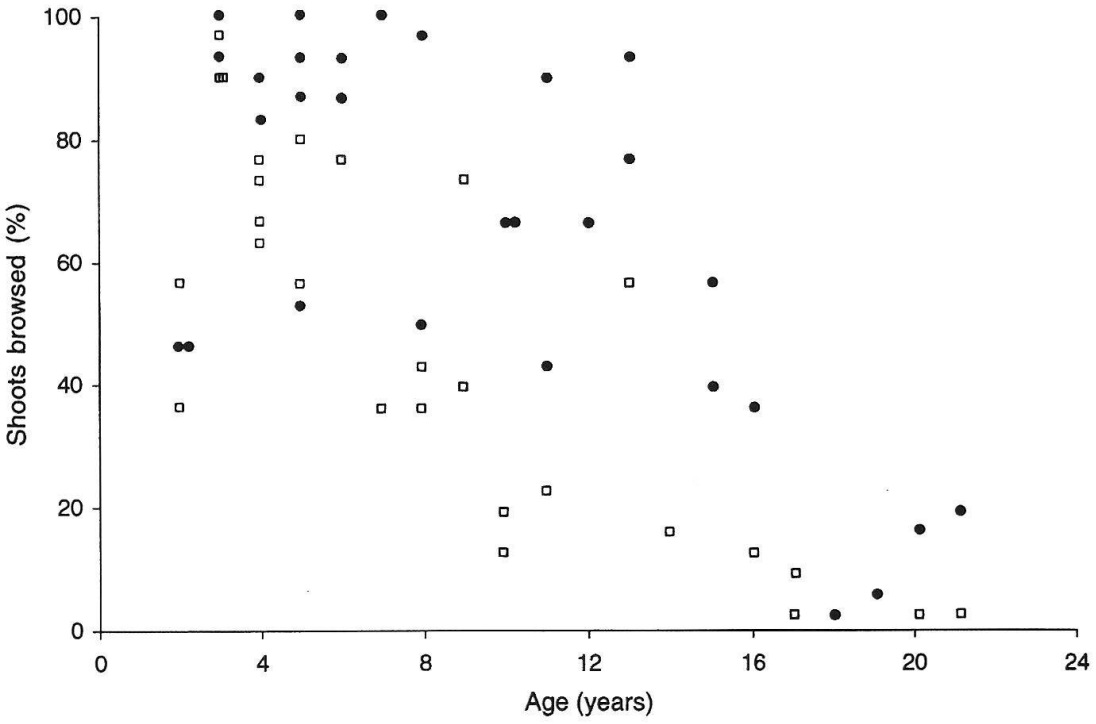

Fig. 3. The percentage of accessory shoots browsed on 20 December 1982 (□) and 24 May 1983 (●).

It might be expected that ponies would avoid the spiniest shoots and browse chiefly on older bushes with less formidable spines. As Fig. 3 shows, the reverse is true. The reason for this appears to be that the longer shoots, although exceedingly spiny, are more accessible to the animal; in contrast, the short shoots of older plants form a spiny, hedgehog-like surface which is difficult for a horse to feed on. However, as the winter proceeds and food becomes harder to find, ponies are forced to browse these smaller and less accessible shoots. The winter use of gorse by

our and if cut at this stage regrowth is usually weaker. Tubbs (1974) found that "the older the bushes the less likely they were to survive browsing after fire: few of 25 or more years of age recovered successfully". In general, where bushes fail to regenerate vegetatively they are unlikely to be replaced from seed in the absence of fresh disturbance.

These observations suggest that to manage gorse as a useful source of winter browse, it should be cut or burnt before its vigour declines. Since gorse is most useful as food when it is relatively young (Putman *et al.*

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