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THE IMPACT OF THE EUROPEAN RABBIT (*ORYCTOLAGUS CUNNICULUS*) ON FOREST TREES

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ABSTRACT: The rabbit is the most important mammalian pest of forest trees in Ireland. Damage can occur at all times of the year but the most severe damage has been reported in the late winter/spring period. Damage includes browsing to the leaders and side shoots and bark stripping. Four tree species, penduculate oak (*Quercus robur*), Ash (*Fraxinus excelsior*), Sitka spruce (*Picea sitchensis*), and Japanese larch (*Larix kaempferi*), were identified as being particularly susceptible to all forms of damage. Beech (*Fagus sylvatica*), sweet chestnut (*Castanea sativa*), and Douglas fir (*Pseudotsuga menziesii*) all displayed low levels of damage. The levels of damage to individual tree species varied with food availability. Trees planted in clear felled areas were severely damaged where there was a delay between harvesting and replanting. A delay of two years will allow the build up of the rabbit population in the clear felled area. Avoidance of such damage will necessitate a census of the area before clear-felling, elimination of the rabbit population where feasible, or fencing out of rabbits before planting.

KEY WORDS: European rabbit, tree damage, damage assessment

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INTRODUCTION

The European rabbit (*Oryctolagus cuniculus*) was first introduced into Ireland about the middle of the thirteenth century (Moffat 1938). Initially rabbit colonies were protected as a food source. Rabbit colonies became established on all parts of the island and on some of the small offshore islands. Rabbits reached peak abundance in the early part of the 20th century. Myxomatosis, when first introduced into Ireland in 1954, decimated the rabbit population killing up to 99% of the population (Lloyd 1970).

The rabbit is primarily a grazing mammal but can cause serious damage to young forest trees (Gibb 1990; Gill 1992). Rabbit populations have not been documented in Ireland to date, but anecdotal evidence indicates that populations have increased to pest status since 1970. It is unclear whether genetic resistance to myxomatosis (Ross and Sanders 1977) or a decrease in the virulence of the myxoma virus were responsible for the increase in population density in Ireland (Fenner and Chapple 1965).

Rabbits damage trees by browsing or by stripping bark (Springthorpe and Myhill 1985). Browsing of leaders depress height increment in Sitka spruce (*Picea sitchensis*) by 5 to 10 cm in the year of occurrence and can result in multi-trunked mature trees (Welch et al. 1992). Damage by browsing of Norway spruce (*Picea abies*) to the lateral shoots can reduce the rate of vertical growth over the following eight years (Pepper and Hewison 1989). However, Nielsen (1991) demonstrated that economic loss to *Pinus radiata* seedlings occurred only as a result of severe browsing to the leading shoot.

Rabbits are considered an important pest of all forest trees in Ireland, but the distribution of the rabbit within forest areas of the most vulnerable tree species and the level of damage to our most important commercial tree species Sitka spruce (*Picea sitchensis*) is not known. The principle objectives of the present studies were:

- To establish the importance of the rabbits in commercial forests in Ireland.

- To evaluate the relative susceptibility of seven tree species to damage by rabbits.
- To estimate the damage to Sitka spruce and Japanese larch in a commercial plantations.

MATERIALS AND METHODS

To establish the distribution and pest status of the rabbit in Ireland, a questionnaire was sent to all 246 forest offices throughout the country. Foresters asked a number of questions concerning their forest area and the presence or absence of the European rabbit. From the response it was possible to relate some aspects of the behavior of the rabbit to aspects of the forest and forestry practices.

Analysis of the survey results demonstrated differences in damage levels and severity to different tree species. To evaluate tree species differences, two sites in close proximity, planted with a mixture of tree species were assessed for damage. Seven tree species were examined for evidence of rabbit damage; oak (*Quercus robur*), ash (*Fraxinus excelsior*), beech (*Fagus sylvatica*), sweet chestnut (*Castanea sativa*), Sitka spruce (*Picea sitchensis*), Douglas fir (*Pseudotsuga menziesii*), and Japanese larch (*Larix kaempferi*). To assess the damage to commercial forestry planted on clear felled areas, trees on a 10 hectare site adjoining mature timber were evaluated. The dominant tree species on the site was Sitka spruce, representing 91.6% trees present, the remaining trees were Japanese larch.

Damage was quantified using nearest neighbor survey method (Melville, Tee, and Rennolls 1983). This involved the selection of a number of points in each species plot. At each of these points, six trees were examined for damage. The trees which formed a cluster were chosen objectively and independently of any damage. Sampling points were spaced systematically throughout the plot and reached by walking the required distance (D) as calculated after Melville et al. (1983).

$$D = \frac{\sqrt{A} \times 10,000}{N}$$

Where D = distance between points
A = area of plot in hectares
N = number of points allotted

Each tree in the cluster was examined for damage by browsing to leading shoot, side-shoot, and bark stripping was recorded. The severity of damage was visually assessed and classified as:

Slight	0–30% removed
Moderate	31–60% removed
Severe	61–100% removed

Rabbit population numbers are difficult to estimate with any degree of accuracy (Klob 1985). A rough index of the rabbit population density at each site was determined by systematic plot sampling of rabbit pellets and scrapes, based at each sampling point for tree damage. The number of pellets and scrapes in a plot of 10 m², centered on the tree cluster was counted. A count of 1 to 20 pellets (2 scrapes or less) constituted low rabbit activity, 21 to 40 pellets (2 to 4 scrapes) and 41 to 60 pellets (5 to 8 scrapes) were deemed to show medium and high rabbit activity, respectively. Very high activity was shown by a count of greater than 60 pellets, or more than 8 scrapes.

RESULTS

Rabbit Distribution in Commercial Forests in Ireland

Of the total 173 questionnaires (72%) returned, 4% could not be used in any analysis. Rabbits were present in 93% of forest areas with damage being recorded in 42%. The presence of rabbits was lowest in forests where one large block comprised 80% of the forest. The distribution of age classes within the forest area and species composition had no influence on the presence of rabbit. Rabbits appear to prefer small isolated stands, forests where clear-felling had occurred in the past 15 years and where the lengths of roads, ride-lines, and fire-breaks relative to forest area is low. Damage was most prevalent in forests where more than 50% of the growing stock was planted more than 15 years and where clear-felling had been practiced in the past 15 years. While rabbit damage was reported to all tree species, damage type and severity was variable.

Rabbit Impact on Different Tree Species

A total of 828 trees were sampled in this study of browsing damage. The percentage mortality for ash, oak, and beech was approximately 3% while no mortality was recorded for the other tree species. The proportion of tree species that suffered from any form of damage is shown in Figure 1. The four most vulnerable tree species were oak, ash, Japanese larch, and Sitka spruce.

Beech, sweet chestnut, and Douglas fir display relatively low levels of damage. Douglas fir, with an incidence of 16.7%, was the least susceptible to any form of rabbit damage.

Figure 1. Percentage damage for the seven species examined in the two study areas, (vertical bars represent 95% confidence limits of the estimates).

Two species, ash (74.3%) and oak (66.7%), had leader damage of economic importance (Figure 2). All other tree species had low leader damage (less than 20%) with sweet chestnut close to zero damage. Side shoots browsing was similar to that of overall damage (Figure 3); the lowest damage being recorded for beech sweet chestnut and Douglas fir. The incidence of this form of damage was relatively high in oak, ash, Sitka spruce, and Japanese larch. Almost 80% of ash trees were found to have stem damage caused by rabbit (Figure 4), for Japanese larch the incidence of this form of damage was just over 20%, low levels of the damage was recorded for all other species.

Figure 2. The percentage damage to the leading shoot for the seven species examined in the two study areas.

Figure 3. The percentage damage to the side-shoot for the seven species examined in the two study areas.

Figure 4. The percentage damage to the stem for the seven species examined in the two study areas.

Rabbit Damage to Commercial Forest Trees

A total of 574 trees were sampled in an unprotected 10 ha plot in a clear-felled area. Sitka spruce was the dominant tree species present at 91.6% with Japanese larch at 8.4%. Both species showed high levels of damage with Sitka spruce at 71.3% and Japanese larch at 66.7%. Of the Sitka spruce trees damaged, all showed browsing to the side-shoots with only 36.8% leader loss and extremely low bole damage (0.8%) (Table 1). Japanese larch had 50% damage to the leaders and side-shoots with 3.1% bole damage (Table 1).

The severity of damage recorded for Sitka spruce and Japanese larch is shown in Table 2. Sitka spruce had quite a high level of severe damage (40.5%) and lower levels of slight (36.8%) and moderate damage (22.7%). Severe damage was extremely low in Japanese larch (9.4%) with a high level of slight damage (59.4%).

DISCUSSION AND CONCLUSIONS

The majority of young trees are vulnerable to browsing by rabbits (Gill 1992) with side-shoot damage proving the most important form of damage. Tree species such as oak and ash are preferred for browsing and damage can happen very quickly (Lanner 1976). The browsing damage to Sitka spruce and Japanese larch in the initial study was relative high, but not severe; whereas, in the commercial plantation damage was much more serious. Both sites in the initial study had a good ground cover of grasses and herbs with the exception of an area in close proximity to each tree, whereas the commercial forest area had little ground vegetation.

The extent of overall damage was not related to rabbit activity levels. The distance from cover has been shown to be related to damage of winter barley (Cowan et al. 1989), with the majority of rabbits staying within 20 meters of cover. All plots within the present study had sufficient cover interspersed throughout the area for easy access by rabbits which may have been the principal reason for the high levels of severe damage recorded on Sitka spruce in the commercial plantation. Bole damage in the form of bark stripping was confined to two tree species; ash being most affected. The damage to Japanese larch was low in both studies.

It is important that proper site assessment for rabbits should be carried out prior to planting. In clear-felled areas, an assessment of the adjoining areas should take place. It may be necessary where high rabbit populations are present to fence the area with rabbit proof fencing and reduce as far as possible cover such as windrows or areas of scrub within the area for planting. The eradication of rabbits from the enclosed area is extremely important.

Table 1. Categories of damage expressed as a percentage of both species damaged in the commercial plantation.

Tree Species	Leader Damage (%)	Side-Shoot Damage (%)	Bole Damage (%)
Sitka spruce	36.8	100	0.8
Japanese larch	50	50	3.1

Table 2. Severity of damage expressed as a percentage of both species damaged.

Tree Species	Slight Damage (%)	Moderate Damage (%)	Severe Damage (%)
Sitka spruce	38.8	23.4	38.1
Japanese larch	59.4	31.3	9.4

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