

Spring traps, set in tunnels along likely routes, may catch squirrels traveling on the ground. Bait greatly improves the success of this method, but the choice of sites for the traps is also important.

Cage traps are most effective in late spring and early summer, when food supplies are running short. Acorns and whole maize are used as bait, and traps are prebaited for four or five days before setting. Using this method, a trapper can produce a score of squirrels from a wood apparently uninhabited by them. It is a more efficient method of control than shooting.

In England and Wales it is illegal to use poison against squirrels. There is evidence that they are susceptible to the effects of warfarin, the anti-coagulant widely used against rats.

The introduction of the gray squirrel into Britain has faced us with problems which are not felt in America. In Britain the squirrel causes appreciable damage, is not regarded as a prized game animal, and is not often eaten. It is, in fact, an unpopular animal.

## DAMAGE CAUSED BY THE GRAY SQUIRREL IN BRITAIN

By MONICA SHORTEN (MRS. VIZOSO)

### INTRODUCTION

The American gray squirrel (*S. carolinensis* Gmelin) has for many years been recognized as a destructive animal in the broadleaved woodlands of Britain. Growing concern has been caused as the range of the species has increased, and at the same time the expanding acreage of young broadleaved crops at the vulnerable pole stage has afforded greater risk of serious damage.

Although primarily pest in woodland plantations, the gray squirrel also attacks cereal crops and orchard fruit in Britain. It is reputed to take eggs of game birds and poultry, although the evidence on this charge is rather conflicting.

In order to gather information on the distribution, type and severity of damage caused by gray squirrels to forest trees, a questionnaire has been circulated annually since 1954 to every forest area supervised by the Forestry Commission. Damage by squirrels to farm crops has not been surveyed on a wide scale; except in years when squirrels are very abundant such damage tends to be overshadowed by the damage caused by rabbits, woodpigeons, and other species. A pilot survey has been used to show the order of frequency in which farm crops are attacked by squirrels. Damage to eggs and young birds by *S. carolinensis* has not yet been critically surveyed; there is a little information in connection with the woodpigeon and the common partridge.

Results of the annual survey of damage to forest trees will be considered in this paper.

### DISTRIBUTION OF DAMAGE

Gray squirrels were reported to be absent from more than 50% of Forestry Commission areas in each year. Where they were present, light damage was reported from 19 to 30% of the areas, and severe damage from 0.4 to 11% of them. The total number of forests in which some degree of damage by gray squirrels occurred was 87/469 in 1954, 68/538 in 1955 and 45/551 in 1956. In each of these years there was a bounty scheme in operation, whereby one shilling was paid for the tail of each squirrel killed.

Damage was most commonly reported from forests in southern Wales and southern England, and in west Scotland.

To justify classification as "severe," damage must be such that it affects the final value of a crop to an appreciable extent. Scrub, amenity trees, trees marked for thinning, or isolated trees of small importance may themselves be severely damaged without warranting the classification "severe" to describe damage on the area.

TABLE I  
 GRAY SQUIRREL IN FORESTRY COMMISSION FORESTS—DAMAGE SURVEY RESULTS, 1954-56

Area	Total No. of Forests	Squirrels Absent (%)		Squirrels Scarce (%)		Squirrels Numerous (%)		Forests with Squirrels		% with Light Damage		% with Severe Damage		Forests with Damage										
		'54	'56	'54	'56	'54	'56	'54	'56	'54	'56	'54	'56	'54	'56									
England	220	246	259	35	40	40	50	56	56	15	4	4	142	149	155	44	34	20	12	2	0	67	49	31
Wales	81	90	93	28	39	39	59	52	54	13	9	2	58	55	57	21	31	19	9	4	2	17	19	12
Scotland	168	202	199	92	94	91	7	6	8	1	1	1	13	13	17	23	8	12	0	0	0	3	1	2
TOTAL	469	538	551	55	60	58	36	36	38	9	4	3	213	217	229	29	30	19	11	2	0.4	87	68	45

## SUSCEPTIBLE TREE SPECIES AND AGE GROUPS

Table II illustrates the frequency with which various tree species are attacked by gray squirrels. The number of areas recording damage to a species is expressed as a percentage of the total number in which that species was grown, within the group of forests where squirrel damage occurred at least once in the two years concerned. Some forests had to be dropped from this sample because they did not return a complete stocklist of the trees grown.

TABLE II  
THE RELATIVE FREQUENCY OF DAMAGE TO VARIOUS TREE SPECIES

	No. Areas in Which		% Area With Damage		Parts of Tree Usually Attacked	
	Present	1954	1955	1954		1955
<i>Acer pseudoplatanus</i> .....	72	50	37	70	51	Crowns
<i>Fagus sylvatica</i> .....	96	44	41	46	43	Butts
<i>Quercus robur</i> , <i>Q. petraea</i> .....	87	18	11	21	14	Upper Stem
<i>Betula</i> spp. ....	60	9	7	15	12	Upper Stem
<i>Fraxinus excelsior</i> .....	68	7	11	10	16	Upper Stem
<i>Castanea sativa</i> .....	47	4	2	9	4	Upper Stem
<i>Larix leptolepis</i> .....	71	5	3	7	4	Upper Stem
<i>Pinus sylvestris</i> .....	83	5	2	6	2	Upper Stem
<i>Populus</i> spp. ....	52	2	1	3	0	Tops
<i>Carpinus betulus</i> .....	10	5	3	-	-	Tops
<i>Acer platanoides</i> .....	10	3	0	-	-	Tops

Sycamore (*A. pseudoplatanus*), beech (*Fagus sylvatica*) and possibly hornbeam (*Carpinus betulus*) are shown to be most susceptible to attack by gray squirrels. The slightly lower percentage of attacks on beech shown in this table is due to a preference on the part of the squirrels for a particular age range in these trees.

Previously it had been believed that gray squirrels would not attack coniferous trees. Although the instance are few in number, this habit can no longer be attributed solely to the British red squirrel since trees have been damaged in forests where red squirrels have been absent for four years. Although the gray squirrel prefers a habitat of mixed mature trees, with oak predominating, it also nests and feeds in pine and larch plantations: provided that food-bearing hardwoods are present on the borders or in the vicinity of the plantations. In addition to *Pinus sylvestris*, and *Larix leptolepis*, gray squirrels are reported to have attacked *Pinus contorta*, *Pinus nigra*, *Pinus pinaster*, and *Thuja plicata*.

The most susceptible age for trees likely to be damaged by gray squirrels is between twenty and thirty years. Sycamore, however, was reported to be damaged in more than 50% of the areas where it was grown from the age of five years up to sixty years or more. Beech was shown to be most vulnerable between eleven and forty years of age, and hornbeam between twenty and thirty years. Oak between twenty and thirty years of age was damaged in 26% of the forests where it was grown; but sycamore of this age group were attacked in 81% of forests.

### TYPE OF DAMAGE

The type of damage referred to here involves the stripping of bark from main stems of trees during the summer months. Shreds of outer bark which are left at the foot of the tree provide a means of distinguishing between damage done by squirrels and that caused by rabbits on the tree butts.

The cambium layer appears to be the attractive tissue, and often this is girdled. Although squirrels may not always girdle a stem completely in one season, they will often gnaw tissue adjoining the scar in the following year.

Where damage is done to the upper parts of the tree, it is usually found on the main stem just above a branch fork. If the stem is girdled, the parts of the tree above the damaged area may die, and growth of the laterals will increase, producing a deformed tree. Sycamores are sometimes almost denuded of bark in the crowns, and young beech trees are often killed by girdling on

the butts. When plantations are attacked before thinning, damage is usually found on the best trees in the crop.

Squirrels will also take outer bark from some tree species, which is then used as nesting material. Such activity is not considered to be harmful, and should not be confused with the damage described here.

A pure crop of young beech (10 years and upwards) planted at 65 trees per acre over 40 acres in a squirrel-infested locality was damaged to such an extent that half the crop was rendered useless, and 99% of the trees were affected to some degree.

The season of the year during which damage occurs runs from late April until July. This is the same period as that in which red squirrels strip bark from *Pinus sylvestris*, and is thought to be determined by the condition of the sap and by a relative scarcity of food for squirrels. This last statement may seem puzzling, but precisely during these months it is most easy to lure squirrels into traps with use of bait.

Some foresters believe that damage is more severe in dry summers, and that sap is licked because water is hard to find. Instances where trees have been stripped of bark in the immediate vicinity of streams would seem to weaken this theory.

### DISCUSSION

Whether the search for tree sap is a habit of particular individuals, or a generalized type of behaviour amongst the squirrel population, is not known. Observations are difficult at this season, when squirrels are shot at sight in the plantations. A forester encountering a marked squirrel would want to know why the animal had been released after capture.

The surveys have only been in progress since 1954, and during that time there has only been one marked variation in the general abundance of squirrels. 1955 was a poor year for the gray squirrel, and practically no breeding took place that spring. During the damage season, the population was judged to be at about one-third of its normal level. Reports of damage were fewer than in the preceding year, and there was a lower proportion of severe damage. Until August 1956 squirrels in Commission forests remained relatively scarce.

TABLE III

NUMBER OF SQUIRRELS AND INSTANCES OF DAMAGE ON NINETY-THREE AREAS			
Number of Forests Reporting:	1954	1955	1956
Squirrels Numerous, Damage Severe.....	14	1	1
Damage Light.....	24	9	8
Damage Nil.....	1	1	0
<b>TOTAL</b> .....	<b>39</b>	<b>11</b>	<b>9</b>
Squirrels scarce, Damage Severe.....	9	4	0
Damage Light.....	37	44	26
Damage Nil.....	8	34	53
<b>TOTAL</b> .....	<b>54</b>	<b>82</b>	<b>79</b>

As shown in Table III, there appeared to be a connection between the level of the squirrel population and the amount of damage suffered. Even with a bounty of two shillings for the tail of every squirrel killed, however, damage occurred in thirty-five of the forest areas.

Measures applied to protect trees from bark injury caused by rabbits or by deer, such as fencing and the application of repellents, cannot be used to prevent squirrel damage. Since it is illegal to use poison against squirrels in England and Wales, the only methods that can be used are trapping and shooting.

Foresters naturally feel that surrounding landowners should also kill squirrels, to prevent constant re-invasion of the plantations; but the provision of incentives to persuade those not affected by squirrel damage to participate in control is likely to be an uneconomic proposition.