- *The introduced grey squirrel has caused major problems for the silviculture of broadleaved trees in Ireland.*
- *Severe economic damage is caused by grey squirrels through their habit of stripping bark from trees to eat the soft tissue underneath.*
- *Certain trees are more prone to damage than others, and the damage tends to occur at specific times of the year.*
- *The problem is discussed and the best methods of preventing damage are laid out.*
- *Management schemes should be based around a) making the woodland less susceptible to damage, and b) predicting potential damage and reducing grey squirrel numbers during the worst damage periods.*

Controlling Grey Squirrel Damage in Irish Broadleaved Woodlands

Dr Colin Lawton[1]

Introduction

The commercial growth of broadleaved trees in Ireland can be hampered by damage caused by mammals browsing, fraying or stripping bark. Perhaps the worst of the 'bark strippers' is the grey squirrel, *Sciurus carolinensis*, which was introduced into Ireland in Co Longford, in 1911. The grey squirrel has since spread and can now be found throughout much of the eastern half of Ireland (Figure 1).

The spread of the grey squirrel has been mirrored by a retraction in the native red squirrel distribution in areas where the greys have been established longest. Red squirrels are still widespread throughout Ireland, though their distribution has become quite patchy in many areas. Red squirrels are out-competed by the grey squirrels in many woodland types; the more robust greys have a more varied diet, can eat acorns before they are ripe enough for the reds, and may also act as a vector of the parapox virus, which affects the red squirrels but not the greys.

Different approaches to controlling grey squirrels are taken, depending on the reason for control. When the primary objective is to conserve the red squirrel, greys are constantly removed as part of a larger scheme, which may include supplementary feeding for the reds. From a silvicultural point of view, however,

The grey squirrel (*Sciurus carolinensis*), was introduced into Ireland in 1911.

Inset: The red squirrel (*Sciurus vulgaris*) is native to Ireland.

PHOTOS: Richard Mills

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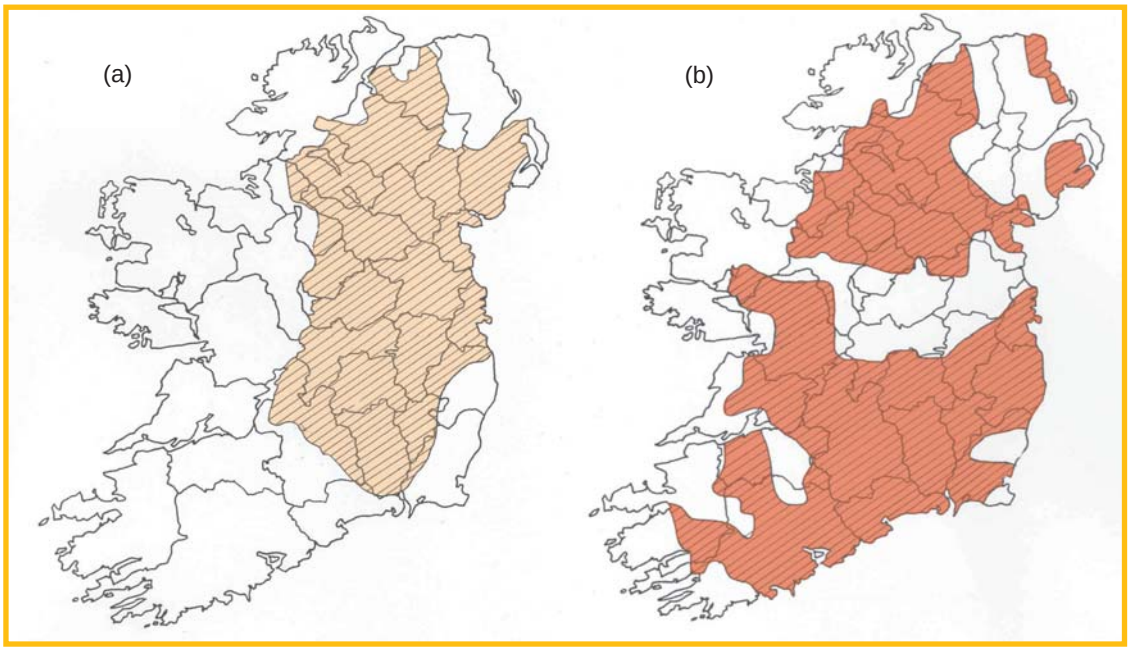

FIGURE 1: Distribution of (a) grey and (b) red squirrel in Ireland (adapted from O'Teangana *et al*. 2000).

it is important to protect commercial woodlands from damage, and targeted control at specific times of the year is more effective. No national grey squirrel control policy exists in the Republic of Ireland.

This note is aimed at offering sound practical advice to woodland owners and managers on the causes and consequences of damage, and the best strategies available to bring damage levels down to an acceptable level.

Bark stripping damage

Grey squirrels strip bark from trees (Figure 2), discard the external layer and feed on the soft vascular tissues underneath. This can cause serious damage, as the removal of the vascular tissues disrupts the flow of nutrients rising up the tree. This may stunt the growth of the attacked tree, or in extreme cases when an entire ring of bark has been removed (known as girdling), cause the upper part of the tree to die, leaving the trees vulnerable to windsnap. The

FIGURE 2: Typical grey squirrel damage at varying heights on trees.

removal of bark also leaves the tree exposed to disease and insect or fungal attack, and the timber vulnerable to discolouration.

The presence of grey squirrels within the vicinity of the woodland is quite easy to ascertain as they are fairly conspicuous animals. They can be seen both on the ground and up in the trees, and they often leave characteristic feeding signs on the woodland floor (e.g. hazelnuts are characteristically split lengthwise - after the squirrel makes a small incision at the top of the shell, it will lever it open using its teeth. Other small mammals and birds will scrape a hole in the shell and scoop the kernel out). Damage can be easily attributable to grey squirrels by its position on the tree (usually on the main stem or major branches, at all heights on the tree). Discarded pieces of bark often litter the ground around freshly damaged trees. Parallel grooves of 1 to 2 mm width running along the wound also implicate the grey squirrel.

The reason why grey squirrels cause such severe damage in Ireland and Britain has been debated for some time, particularly in view of the fact that relatively little damage is caused in their native eastern North America. It is now generally believed that the damage is initiated by young squirrels taking part in exploratory feeding or agonistic gnawing (behaviour exacerbated by population stress) and by older squirrels that have learned the habit. There is a tendency for damage to reoccur in certain areas, indicating that the habit is in part a learned behaviour.

Although all trees may potentially be attacked, certain trees are more at risk than others. Also, certain species are more prone to attack, and trees are more at risk at particular ages. Most of the damage occurs at specific times of the year as well. A full assessment of the most at-risk trees is given below. The chances of an individual tree being attacked are linked to the volume of sap flowing through the phloem, and the thickness of bark protecting the tree. This means that many of the features preferred for silviculture (fast growing trees), and tactics used, (encouraging fast vertical growth), may actually increase the likelihood of damage occurring.

Assessing potential damage

It is not possible, and indeed may be counter-productive, to attempt to control grey squirrels in all woodlands, throughout the year. Before a control strategy can be designed for any woodland, the potential damage must be assessed so an informed decision can be made on whether the control is worthwhile or not. There is little point in carrying out the control if the costs exceed the value of the damage prevented.

A recent COFORD study investigated tree species most prone to damage by grey squirrels in Ireland. Damage levels were found to be high in Ireland, and most woodland owners appeared to underestimate the problem within their areas. Table 1 shows the susceptibility of major tree species to damage. The two species listed in 'Damage Risk Level 1' (sycamore and beech) are prone to damage to such an extent that it is difficult to recommend them for broadleaved planting, no matter what control strategies are attempted. About 40% of both types of tree were found to be damaged, and as much as 16% of all sycamore planted were girdled by grey squirrels, despite control measures attempted by the various woodland owners. Other tree species, such as those placed in Risk Levels 2 and 3 are not as prone to damage, but may still be affected by grey squirrel bark stripping, and so some form of control is advisable.

TABLE 1: Order of susceptibility to damage of broadleaved tree species in Ireland.

	Tree Species	Damage Risk Level
Most susceptible	Sycamore Beech	1
	Willow Alder Elm Hazel	2
	Ash Birch Oak	3
Least susceptible	Horse chestnut Lime Coniferous species	4

Squirrels do not damage trees all year round. Damage is most likely to occur from mid-March to late June. The phloem carries the carbohydrate products of photosynthesis down from the leaves to storage organs in the roots in the late spring and summer, and back up to the developing buds in the following spring. It is when the sap is rising that the squirrels are most likely to cause damage.

Trees can be damaged at most stages of development, but in general it is most likely to occur when the trees are between 10 and 40 years old (pole-stage trees), although this may vary depending on species. In the COFORD study trees between 5 and 40 cm DBH (diameter at breast height) were damaged more often than other trees. At these ages growth rates and the phloem content are high, yet the bark is sufficiently thin to allow the squirrels to break through it with relative ease. Generally grey squirrel damage is considered more costly than many other types of wildlife damage, as the trees targeted are older, and therefore worth more money.

Stands that are most prone to damage tend not to carry large densities of grey squirrel. Damage is particularly likely if the susceptible woodland lies close to large mature woodland. The main period of damage (mid-March to June) coincides with dispersal periods for the squirrels, when mainly young squirrels are forced to leave the area of their birth in search of their own woodlands. These squirrels will be forced into adjoining plantations, where they are more likely to be subject to the stress that can trigger the damage-causing behaviour.

Control options

There are two approaches available to controlling grey squirrel damage; controlling the damage by reducing the susceptibility of the woodland to damage or targeting the squirrels, and reducing their numbers to a level that has little impact on the woodland.

The most obvious method of reducing the susceptibility of woodlands to squirrel damage is to avoid planting the trees most prone to damage. Although control of the squirrels can be carried out to protect most tree species through the damage period, the chances of beech, and more significantly, sycamore being damaged remains high no matter what protection is carried out. Plantations designed for timber production should be kept as far away from areas of high squirrel density also. Squirrel numbers can be kept to a minimum by making the woodland as a whole unattractive to grey squirrel populations. Mast bearing trees, such as oak and beech, should be pruned to reduce crown volume. Den trees should also be removed, along with potential sources of supplementary food (such as pheasant feed). Small seeded deciduous trees (e.g. ash, birch, alder, rowan, willow) should be planted rather than large seeded varieties (e.g. beech, sweet chestnut, hazel, oak) as they support a smaller population of squirrels.

Traditionally three methods have been used to remove grey squirrels with varying degrees of success. One of the most common methods is to shoot the squirrels, often employing drey poking to increase the number of squirrels removed. Shooting is a relatively cheap method of control, but it is largely ineffective. Shooting has never been shown to reduce damage. Although the grey squirrels are more commonly seen than the reds they remain fairly elusive animals, and rarely more than a small percentage will be removed in this manner.

Cage trapping (Figure 3) is a much more effective method of removing squirrels, and has been shown to reduce grey squirrel numbers over a short period of time. Squirrels can quickly be dispatched once removed from the trap. If intensive trapping is carried out a few weeks before the onset of the damage period, the population can be reduced until the period of greatest susceptibility has passed. Recolonising squirrels tend to be younger however,

FIGURE 3: Cage trap in place in woodland. The nest box encourages the grey squirrels to enter the trap, but is not essential.

and so potentially more likely to damage the trees, but on the other hand, breeding will be much reduced within the woodland in that year, and a subsequent trapping period will be more effective. Cage trapping, unlike snap traps or poisoning, ensures that only the targeted species are removed. Trapping, however, is labour intensive, and may prove too costly in some situations. A careful economic appraisal of the potential damage and control costs is required before committing to this method of control. Care must be taken not to trap or kill red squirrels – reds are a protected species and any trapping/killing is illegal.

Snap trapping is considered unsuitable as a means of removing grey squirrels due to the danger of removing animals protected under the Wildlife Acts 1976 and 2000.

The anticoagulant poison Warfarin is used quite frequently in Britain to remove grey squirrels, although its use is banned in areas in which the red squirrel remains. It can be effective in reducing grey squirrel damage in an area. There is no legislation covering its use in Ireland, but the recommendations made in Britain should be adopted. Wholewheat bait, coated with 0.02% Warfarin is placed in **grey squirrel only hoppers** (Figure 4), which have a weighted door (220 grams) which prevents entry by smaller animals and birds, and is too small for larger animals to enter. About one hopper should be placed per hectare, they should be checked regularly and unused bait should be removed outside of control periods.

Warfarin poisoning is not considered suitable for use in areas where red squirrels may be found, which is obviously a greater hindrance to the use of this method in Ireland than Britain.

Other methods, such as chemical repellents, tree guards, and fencing have been attempted for the control of grey squirrels, with little success. Attempts at producing an immuno-contraceptive to reduce grey squirrel reproduction have not been successful as the product needs to be species specific and cost effective, neither of which seems possible at this time.

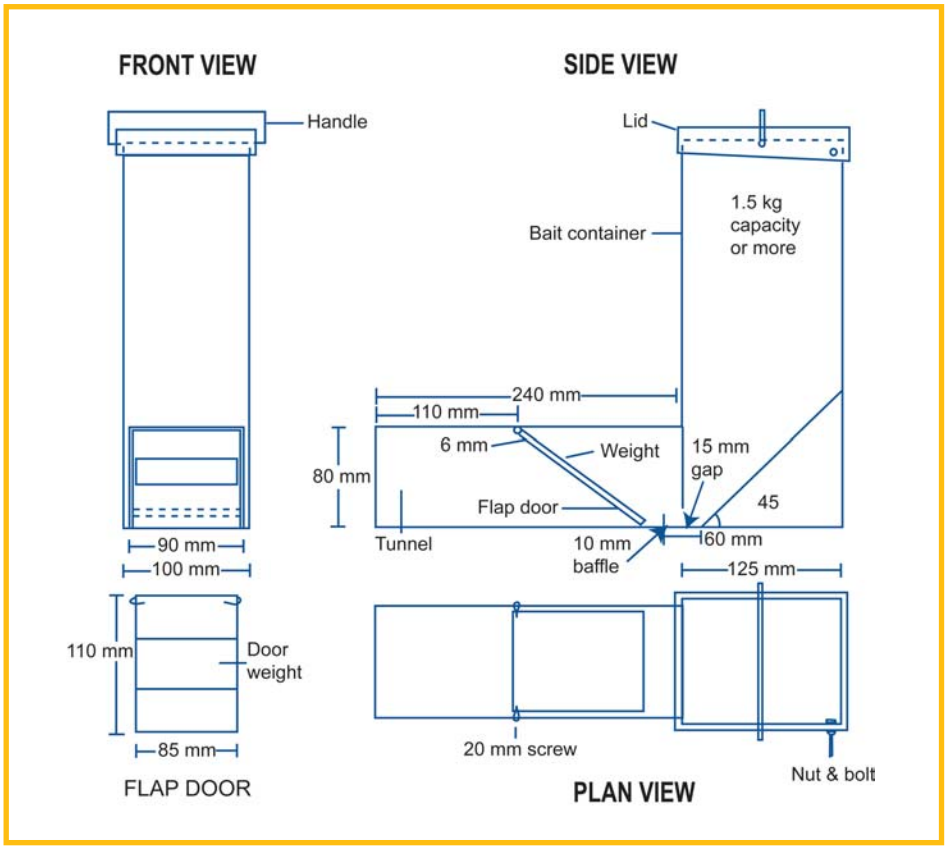

FIGURE 4: Grey squirrel only hopper, with a weighted door to prevent access by other animals (from Pepper and Currie 1998).

Devising a control plan

When planning a woodland, all effort should be made to ensure that squirrel damage will be kept to a minimum, such as:

- avoid large seeded trees that promote high grey squirrel densities;
- avoid trees particularly prone to damage (sycamore and beech);
- if possible only establish plantations away from areas of very high grey squirrel density.

If beech or sycamore is the preferred crop, the owner should be aware that they must commit themselves to a control plan in order to grow commercial timber. Even so, some degree of damage to the crop should be expected.

Full records and maps, updated regularly, should be kept of all woodlands, and the control schedule planned accordingly, depending on the age and species of trees and the time of year.

If control is deemed necessary this should be conducted through live trapping. Poisoned bait should only be used in conjunction with suitable **grey squirrel only hoppers**, and must not be used where red squirrels could be present.

Control should be carried out in an intensive fashion towards the end of February, with follow up removals carried out monthly until the end of May.

Grey squirrel control should not be carried out if:

- trees are not intended for timber production
- the woodland contains less vulnerable tree species, is relatively isolated, or the crop is too young to sustain a grey squirrel population
- the control costs outweigh the potential savings on damage (i.e. control is too costly).

Unfortunately the grey squirrel is here to stay in Ireland as eradication would be impossible, but with careful planning the damage caused by the species can be contained and the silviculture of broadleaved trees in Ireland can remain a viable business.

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