Trees in focus
Practical Care and Management

APN 7

Arboricultural Practice Notes

Grey Squirrels in Parks, Urban Woodlands and Amenity Plantings

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Summary

Grey squirrels are opportunistic animals well adapted to exploit both urban and suburban habitats. They are capable of inflicting damage to trees to such an extent that it threatens the successful replacement of mature and over mature trees. Effective methods of damage prevention are, at present, confined to grey squirrel control techniques developed to protect vulnerable trees in rural woodlands. These methods can be very unpopular in urban areas as people have become accustomed to the more endearing characteristics of these animals. Grey squirrel management is essential if trees and woodlands in urban areas are to survive or be established. Therefore, management must be planned and executed with care, sensitivity and thoroughness.

Introduction

Grey squirrels (*Sciurus carolinensis*) are woodland animals. They can survive successfully in large forests, small woodlands and copses of trees with their interconnecting hedgerows, as well as urban parks and gardens. In fact, they can become established anywhere there are trees and shrubs that will provide food and cover.

They were first introduced into the British Isles from eastern North America in 1876 to give an exotic arboreal companion to the native Red squirrel (*Sciurus vulgaris*). In the period to 1929 thirtyone introductions were made (Lloyd 1983). Some of these introductions were centred on city parks, in particular, Edinburgh, Glasgow, Birmingham and London. Today the Grey squirrel has replaced the Red squirrel to such an extent that the Red squirrel is now an endangered species in many districts (Gurnell and Pepper 1993). Grey squirrels are being regarded increasingly as pests because of the damage they cause. Their range continues to expand.

The damage caused - The havoc created

Grey squirrels can be destructive in most locations. In gardens, apart from damaging trees, bulbs and corms are dug up and soft fruit such as strawberries and raspberries are eaten. A particularly annoying habit is the removal of apples from trees when only the size of marbles. It is not unknown for squirrels to gnaw holes in the fine plastic netting of fruit cages and this not only allows entry by squirrels but also birds. Large seeds from trees such as oak, beech, chestnut and walnut are buried in and subsequently dug up from garden lawns and mown grass areas in parks. Grey squirrels destroy the growth point in acorns before burying them. Robbing bird tables of food and destroying plastic and even metal nut feeders commonly occurs in gardens. These losses are often unacceptable to the keen ornithologist and the avid gardener.

A less common activity, but one that is generally of more concern occurs when squirrels take up residence in houses, garages and sheds. The roof

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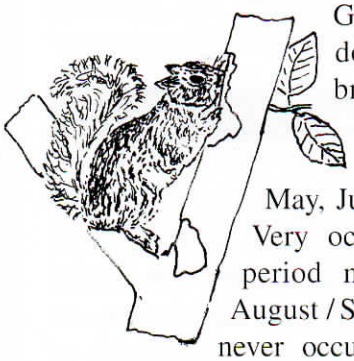
space of a house, being warm and dry, is often a favourite alternative to a squirrel drey. Once occupied, apart from the disconcerting effect that early morning and late evening squirrel movements may have on the people living below, there is a risk of electrical wiring, lead or plastic pipe, roof timbers and felt being gnawed. A number of house fires have been attributed to the removal of insulation from electric cables. Because Grey squirrels also strip bark they can have a severe impact on trees (Dagnall *et al.* 1999). They present the urban landscape manager, who has a programme of tree regeneration, with considerable problems especially when there is woodland present.

It is also widely believed that Grey squirrels prey on, and are partly responsible for, the decline of some bird species. Certainly there have been observed instances of both eggs and chicks being taken from nests, but these are relatively rare. There is no evidence to suggest that Grey squirrels are any more damaging than the other predatory birds and mammals that take their toll.

Grey Squirrel Tree Damage



Grey squirrels strip bark down to the wood of branches and the main stem of trees during the summer months of May, June and July (Figure 1). Very occasionally the damage period may be extended into August / September, but damage never occurs outside this period. Trees younger than 10 years are normally not damaged because the upper stem and branches are too small to support a squirrel. For the same reason they will not normally strip bark from stems and branches of older trees where diameters are around 50mm or less. The bark on the main stem of trees over 40 years is normally too thick to strip but Grey squirrels will then sit on branches and strip bark from them. On thin barked species, such as Beech (*Fagus sylvatica*), they will also strip bark from the buttresses at the base of the trunk. Damage to the branches and root buttresses of older trees may be acceptable/tolerated/tolerable however, because it has a less significant effect on the form and function of the tree or the life expectancy of the tree. That is provided such wounds do not become colonised by wood rotting organisms.

All tree species are vulnerable to bark stripping by Grey squirrels, but broadleaves, particularly (Figure 2) Sycamore (*Acer pseudoplatanus*), Beech and Oak (*Quercus* species) are the most severely damaged. Of the conifers Scots pine (*Pinus sylvestris*) and larch (*Larix* species) are most frequently damaged.

The occurrence of damage in parks, urban woodlands and along trunk roads and motorways is variable and sporadic; very serious in some years and places but not others. It may be startlingly visible along trunk roads when the top of a young tree suddenly dies (Figure 3). However, it is the accumulation of damage over years that can have a profound effect on the form of a tree, its safe useful life expectancy and its timber quality. Therefore, damaged trees are unlikely to form replacements for the single stemmed mature and over mature trees giving parks and urban woodland their character because frequently they either die back or suffer branch or stem snap. Trees that survive generally produce multiple stems and have no apical dominance and that may present future management problems. Damaged trees in public places, notably along roadsides, may become a safety hazard because stem or branch fracture frequently occurs through the damaged area and so may have to be removed prematurely.

Dead bark on branches and soft bark on the stems of trees such as Wellingtonia and cypresses is stripped in winter to line breeding dreys. Whilst this activity is harmless to the trees its presence and frequency gives an indication of the intensity of the forthcoming breeding season and may be used as an indicator of the potential for damage during the following summer.

Another activity, exclusive to grey squirrels, is the removal of the pith from the centre of Ash (*Fraxinus excelsior*), Horse chestnut (*Aesculus hippocastanum*) and Walnut (*Juglans* species) shoots. When in full leaf the upper side of green shoots (before they are fully lignified) are peeled back and the exposed pith eaten. The damaged shoots subsequently break, but remain attached to the branches and the leaves turn brown. A mature tree having a host of damaged shoots appears devastated but fortunately the damage has no long term effect with lammas and subsequent shoot growth compensating for the damage. It is unusual for the same tree to be damaged in consecutive years.

Figure 1. Fresh Tree Damage to a Hornbeam (Carpinus betulus) *9th & 11th June 2002. Note the strips of bark on the ground.*

Figure 2. Damage to Sycamore, 20th June 2002.

Figure 3. Sycamore with dead top, 10th August 2002.

Grey Squirrel Ecology

Grey squirrel populations fluctuate from year to year even though they have two breeding seasons - spring and summer (Gurnell 1987). These fluctuations, particularly in rural areas, are driven by the abundance of the autumn/winter tree seed crop (the mast). If tree seed production is poor or fails, winter Grey squirrel mortality, particularly of summer born young, will be high. If winter weather is also severe, prolonged periods of wet and cold, mortality of adults and summer born young will be significantly increased. At the end of winter the body condition of surviving animals will be poor; they will not come into breeding condition and no spring young will be produced. Conversely in years of abundant mast there will be an abundance of acorns, beech nuts and/or chestnuts throughout the winter enabling high survival and successful breeding. There will, of course, be years of variable seed production between these two extremes.

In urban areas Grey squirrel population fluctuations do not occur to any significant extent. Grey squirrel numbers are maintained at an artificially high level by the availability of supplementary food in the form of seed put out on bird tables, discarded food in litter bins, not to mention the public visiting parks with food specifically to attract Grey squirrels and watch their antics.

Grey Squirrel Damage Risk

It does not necessarily follow that damage will occur wherever trees and Grey squirrels are to be

found together. It is a combination of factors concerning the trees and ease of bark removal (Kenward *et al.* 1988), and the density and age structure of the Grey squirrel population that affect damage occurrence. These factors need to be assessed each year to determine the damage risk in a given area.

The Trees

The vulnerability of trees to damage depends on:

- Age - 10 to 40 year old trees are most severely damaged. The bark on the trunk of 40+ year old trees is normally too thick to be stripped.
- Species - some are more vulnerable to damage than others. Beech, Oak and Sycamore (other maples appear to be damaged less frequently) are consistently the most severely damaged. Severe damage to Sweet chestnut coppice (*Castanea sativa*) has been recorded (Collis pers. com.). Ash, Birch (*Betula* species), Scots pine and Larch are damaged less frequently. All other species are only very occasionally damaged.
- Tree status - the more vigorous trees are the most susceptible to damage. There is a relationship between the thickness of the moisture rich tissue - the phloem (inner bark) - and the ease of bark removal (ie the strippability of the bark) and damage. In a park open grown trees will encourage consistent deep crowns of lush growth and therefore damage vulnerability.

The Grey Squirrel Population

- Density - the more Grey squirrels there are present in the area during May, June and July the greater the risk of damage that year. There is evidence to suggest that damage begins to occur when numbers reach five Grey squirrels per hectare. Rural woodland populations range from 2 to 16+ per hectare and average around 8 per hectare. Urban population densities are driven by the availability of food in litter bins, on bird tables and by squirrel feeding in parks by the public, but are likely to be at or above the maximum density found in woodland.
- Breeding - the more juveniles there are surviving from the spring breeding the greater the risk of damage that year.

Control of Grey Squirrel Damage

By planting less vulnerable tree species and avoiding, where possible, potentially vigorous thin barked species such as Sycamore and Beech the future risk of damage should be reduced. The key to the control of damage is reducing Grey squirrel numbers (Mayle *et al.* 2003) in and around areas of vulnerable trees. This may need repeating each year just before and during the damage period (i.e. April to July).

There are no physical barriers currently available that can be recommended to reliably protect even isolated trees from Grey squirrel damage. The chemical repellent Aaprotect[1] painted onto the stem and branches will prevent bark stripping. Unfortunately the repellent is white, has the consistency of emulsion paint and alters the appearance of the tree. Also the active ingredient is a skin irritant and its application is not acceptable in areas of public access. The approval for use of this product is currently under review by the Plant Protection Directorate of the EU and its future availability is uncertain.

Awareness of a control programme is likely to cause concern to the public, particularly visitors to a park, and may result in passionate and vociferous opposition. Any publicity must, therefore, be executed with sensitivity with the emphasis on the vulnerability of the existing trees as well as the necessity to protect new trees if the character of the landscape is to be retained and perpetuated.

In order to achieve effective tree protection, with minimum conflict with the public, control operations should be confined to the period April to July, although, because of the reduced natural winter mortality in urban populations, there may be some justification for commencing control operations as early as mid-March.

There are four methods of grey squirrel control available. All were developed to protect woodland and forest trees and none is well suited for use in urban parks and woodland.

The methods are:

- Shooting, either alone or in conjunction with poles to poke out the dreys, is often considered first as a method of reducing numbers. However it has been shown to be an ineffective technique for reducing Grey squirrel numbers, at the prescribed time of year, to the level required to protect trees. Furthermore it is not suitable in a public place. Apart from the safety considerations that require shooting in the early morning and evenings, or excluding the public from the area of operation, it is a noisy operation that draws the attention of local residents. There

is also a safety hazard associated with the use of aluminium drey poking poles where there are power cables. (The risk of electrocution can be reduced by including a glass fibre pole in the set).

- Spring trapping, sometimes known as tunnel trapping, is an instant kill method, but unfortunately, like shooting, it is unsuitable for public places. This is because it is not possible to set the traps in such a way that pets, particularly cats, and children are not at risk from being injured by them.
- Cage trapping, a live-capture technique, relies on attracting the Grey squirrels with food, normally yellow whole maize (Mayle *et al.* 2003), to traps. The traps are either single capture (that will only catch one squirrel at a time) or multi capture (to catch and hold a number of squirrels). For best results, these are sited at the base of a large tree. Captured animals are held alive and because it is illegal to release a Grey squirrel into the wild all must be killed humanely. The traps, especially those containing a squirrel, even when well camouflaged, are very easily found by unleashed dogs. The dog owner, as a result, may release the squirrel and destroy the trap. The risk of accidental discovery can be reduced if the traps are placed in small fenced enclosures. An enclosure of 100 square metres is usually sufficient and the fence can be chestnut paling, wood or steel railing or wire mesh. Planting prickly shrubs around either the inside or outside of the fence can enhance the barrier effect of the fence. The effectiveness of live-capture traps can be reduced as a result of food being readily available from alternative sources, for example, provided inadvertently in litter bins or deliberately by hand. However, cage trapping is an effective technique that can account for nearly all the grey squirrels in an area, but it is labour intensive as it is essential that, for humane reasons, traps are checked twice a day and it is therefore expensive.
- Poisoning grey squirrels with 0.02% warfarin, on whole wheat, (Pepper 1996. Mayle *et al.* 2003) is approved for use under the Control of Pesticides Regulations 1986. The wheat bait is presented in hoppers of approved design that prevents access by other animals and birds. The hoppers are sited in a similar way to cage traps at the base of a large tree, if necessary also in enclosures, and camouflaged with branch wood, stones or turves. An alternative is to site the hopper under the floor of specially constructed litter bins. The advantage of this approach is that the public are used to seeing Grey squirrels visiting litter bins as are the squirrels used to visiting them to feed. Initially yellow whole maize is scattered around the entrance tunnel of the hopper to attract the Grey squirrels. It has been found that in parks, where there is often an abundance of alternative food available, it is necessary to continue to provide maize at the tunnel entrance for several days to ensure that the squirrels are habituated to entering the tunnel and eating from the hopper. After taking poison bait for eight or more days the majority of grey squirrels will die in their dreys, but inevitably some will fall to the ground. Regular searches are therefore necessary to find and remove these bodies. However consumption of cadavers is unlikely to adversely affect cats, dogs or wild scavengers.

Poisoning has replaced cage trapping in most woodland situations[2] because it has proved to be a less expensive operation whilst being at least as effective if not more so. Unfortunately the future availability of warfarin is uncertain because its approval is under review by the EU. Also, the ethical arguments against poisoning are being voiced more vociferously. Cage trapping is likely to be, once again, the preferred method of controlling Grey squirrels, at least until such time as some other method, perhaps birth control, is available.

The Control of Grey Squirrels in Houses and Gardens

There is, unfortunately, little that can be done to overcome the problems associated with Grey squirrels in houses and gardens because the squirrels are frequently numerous, have a lack of fear of humans and are therefore very persistent. There is currently no chemical available for use in such locations that will repel squirrels.

Once Grey squirrels are regularly entering a house loft it is insufficient to just block up the entrance hole. They will either find or make another entrance. Therefore, before blocking any holes with wire netting or metal sheeting it is important to ensure the loft is free of resident animals. Unfortunately there is no simple way to remove Grey squirrels from homes. Most local authority rodent control departments will not undertake squirrel control and shooting close to houses let alone in a confined space is generally unsafe and not to be recommended. Poisoning[3] is

Figure 4.

DAMAGE PREDICTION CHART

AUTUMN BROADLEAVED TREE SEED CROP

Tree Seed Availability

Low

Average

High

Winter Weather Conditions

Poor winter weather (prolonged periods of wet and cold)

Good winter weather (dry, warm conditions)

Squirrel Population Ecology

High winter mortality and poor body condition of surviving adults

Bark-stripping of dead bark to line breeding dreys

High winter survival. Adult body condition good

Little or no activity signifies

Abundant activity signifies

Successful spring breeding

Spring breeding absent or poor

The Tree

Low summer population and a low ratio of juveniles to adults

Winter/spring rainfall

DRY WET

High summer population of adults + a high ratio of juveniles to adults

Tree Damage Risk (Bark-stripping)

Poor tree growth

Vigorous tree growth

Low

Moderate

High

Tree* Protection

Low control requirement for tree protection measures

Targeted control around high value trees

Widespread but targeted control requirement for tree protection

Monitoring

August/September assess vulnerable trees for damage. Record damage/control data to improve damage prediction in following years

*The presence of high value amenity trees may increase the control requirement in low and moderate damage risk years

not normally recommended for use within buildings or gardens. Animals are likely to die within the building and unpleasant smells and insect infestations may occur.

Soft fruit can be caged with 25mm square or hexagonal wire mesh netting. The netting should ideally be buried 150mm or at least be in continuous contact with the soil. Grey squirrels will not burrow under netting. It is best practice to cage fruit trees and bushes before the fruit become palatable. If the cage is installed after Grey squirrels have started to feed they will search and probe for a way in and it may be necessary to remove the offending animals.

Single capture cage traps set around the outside of buildings or fruit cages are the most suitable method of control, but the householder must be aware that traps once set to catch must be inspected daily. Furthermore it is illegal to release captured Grey squirrels anywhere and they must be humanely despatched.

Live With Them or Take Action

It is important that anyone with a Grey squirrel problem should seriously consider if their problems are real and unacceptable or just a nuisance that can be tolerated. Grey squirrels are probably the most visible wild mammal in the urban environment. They do give much pleasure to many people who watch and feed them and attempts to control them can create even more and greater problems. However, publicity may be given in the local press and media informing the public about the problem and in particular the impact, intentionally or unintentionally, of making food available and how to avoid unnecessary and excessive feeding. *Feeding garden birds* and *All about bird tables* are two information leaflets published by The Royal Society for the Protection of Birds[4]. The former gives advice on what to feed and when and many of the recommended foods are unpalatable to squirrels. The latter offers guidance on how to prevent squirrels gaining access to the feeding area of the table.

So Trees Have Been Damaged?

Proactive damage prevention should always be the objective where valuable, vulnerable trees are concerned. Once fresh damage has started to occur it is too late to begin reducing squirrel numbers to prevent further damage that year and only desperation measures are left. The probability of such measures being a success is low and they can only be justified where there are other valuable specimen trees at risk in the landscape. One option is to try to get rid of the offending animals as quickly as possible. This can only be achieved using live capture traps baited with a mixture of yellow whole maize and peanuts. Mink or Legg single traps[5] should be used because squirrels are more likely to enter their large open doorways quickly.

Captured Grey squirrels must be killed humanely because it is an offence under the Wildlife and Countryside Act 1981 to transport and release them. Poisoning with warfarin takes at least 10 days from the time the squirrels start to eat the bait until it begins to kill; shooting and spring trapping are unacceptable where people and/or their pets are likely to be present.

Less than 5% of damaged trees are killed as a result of ring barking at the base. Trees that have suffered fresh bark-stripping that has ring barked stems or branches are not a lost cause, they may recover by producing new growth from below the damage. The reduction of dieback around non-girdling wounds can initially be aided by painting the edges of the wounds with a proprietary tree paint to reduce drying of the cambium and stimulate callus growth. **Do not** enlarge the wound by paring back the edges of the wound. Covering the area of the wound with a bandage of black polythene sheet will maintain a high humidity and have a similar effect. It may also be worth painting the areas of bark between wounds with the chemical repellent Aaprotect to prevent any further bark-stripping that might lead to ring barking. Treated bark should be out of reach in areas of public access.

Trees or Grey Squirrels?

If there are to be trees for future generations of townsfolk to enjoy there must be much more than tree preservation. New trees must be established and nurtured until they have grown beyond the threat of avoidable damaging agents. Grey squirrels are one such major agent threatening trees that can be limited by monitoring populations and timely action to control their populations. There is a danger that, because the risk of damage is not present until the trees are well established and then not every year, monitoring is ignored and the opportunity to protect vulnerable trees is missed. The flow chart,

(Figure 4) although based on subjective assessments, provides a predictive model of damage risk and the need for control. Experience gained over the years about an area should be recorded to enable future predictions to be more accurate.

Remember Grey squirrels are over weight, over sexed and over here posing a real threat to the sustainability of the tree population in Britain!

[1] Universal Crop Protection Ltd., Park House, Maidenhead Road, Cookham, Maidenhead, Berkshire SL6 9DS

[2] Poisoning is not permitted in areas where Red squirrels and Pine martens are present.

[3] Warfarin may only be used by professional operators and it cannot be purchased by householders or amateur gardeners.

[4] The RSPB, The Lodge, Sandy, Bedfordshire SG19 2DL

[5] Killgerm Chemicals Ltd., PO Box 2, Ossett, West Yorkshire WF5 9NA

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STATUTORY ACTS AND ORDERS

Abandonment of Animals Act 1960, Animal By-Products Regulations 2003, Control of Pesticides Regulations 1986, Grey Squirrels (Warfarin) Order 1973, Pests Act 1954, Protection of Animals Act 1911, Protection of Birds Act 1954, Spring Traps (Approval) Order 1995, The Animal By-Products Amendment (Scotland) Order 2001, Wildlife and Countryside Act 1991

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