INTRODUCTION

Since their introduction into Britain in various locations between 1876 and the 1920s, grey squirrels have spread rapidly. They have displaced the red squirrel throughout most of England and Wales and in central and south-east Scotland. In addition to displacing this native species they frequently cause damage to woodlands by stripping bark from the main stem and branches of trees.

Such damage acts as a major disincentive to the planting of broadleaved and coniferous trees for timber as it reduces the value of the final crop. Increasingly wider impacts are being recognised as potentially of major significance to woodland conservation, biodiversity and sustainability. In time damage may lead to a loss of particularly vulnerable species (e.g. beech) within the mature canopy of woodlands and this may be accompanied by loss of associated fungal and invertebrate fauna and their predators. In addition, there may be indirect competition, e.g. for food, between grey squirrels and native fauna such as the red squirrel and common dormouse; or predation by grey squirrels, e.g. on woodland bird populations. Grey squirrels are also implicated in the transmission of parapoxvirus, an infection fatal to red squirrels.

Many people enjoy the grey squirrel as a regular and approachable resident of our woodlands, parks and gardens. It is not practical to exterminate grey squirrels from areas where they are already established. However, targeted control is often necessary to reduce or prevent damage. This Practice Note focuses on the control of bark-stripping damage by grey squirrels in woodlands. Factors influencing damage and its occurrence are described, followed by guidance on damage risk assessment and best practice methods to control populations and reduce or prevent damage. Details of equipment manufacturers and formal training courses are also provided.

Grey squirrel control in urban areas is described in an Arboriculture Advisory and Information Service Note. The control of grey squirrels for red squirrel conservation is covered in Forestry Commission Practice Note 5: Red squirrel conservation. As research to determine the impact of grey squirrels on woodland birds has only recently started, guidance on this subject is not yet available.

BARK STRIPPING DAMAGE

Bark stripping damage (Figure 1) usually starts at the end of April and continues until the end of July (early September in high-risk years). Grey squirrels do not strip bark at any other time of year. Trees may be stripped anywhere on the main stem and branches, with vigorously growing and dominant trees generally being most affected. Damage levels vary between years and across sites within the same year.

Planted or naturally regenerated trees aged between 10 and 40 years, especially sycamore, beech (Figure 2), oak, sweet chestnut, pine, larch and Norway spruce, are most vulnerable to damage. Of particular note here is the fact that woodlands established in the early phases of the Farm Woodlands Scheme are now reaching vulnerability. However, other species (especially broadleaves) and age classes may be damaged, particularly in high-risk years (Table 1). Trees younger than 10 years are not normally damaged because their stem and branches are too small (<50 mm diameter) to support a grey squirrel. Bark on the main stem of trees older than 40 years is normally too thick to strip, but grey squirrels will strip the thinner bark on the larger branches in the crown. The planting of ‘sacrificial’ species in mixtures has not been shown to reduce damage to ‘high risk’ species.
Control measures are most likely to be required around these vulnerable stands, especially where timber production is an objective and where the value of the trees, including amenity benefits, is sufficient to justify the cost.

Trees from which the bark is most easily stripped by squirrels are generally the fastest growing and those with the most sap. They discard the outer bark (an important feature for identifying fresh damage – see Figure 2) and eat the unliignified tissue beneath, implying that it is a feeding activity \(^\text{10}\). However, squirrels strip bark when food and water are plentiful, and damage is most likely to be the consequence of aggressive interactions between young squirrels. In general the greater the number of juveniles present, the greater the number of interactions which occur. This in turn results in more damage \(^\text{9}\).

Tree seeds, particularly from large-seeded broadleaved trees, are the principal food of grey squirrels; seed abundance controls population densities \(^\text{11}\). Grey squirrels also feed on tree buds, shoots and flowers and will scavenge bird tables and litter bins. In poor mast years, wheat provided by game-keepers is a significant addition to the squirrel’s diet. Roots, bulbs, invertebrates, birds’ eggs and nestlings may also be taken.

**Effects of damage**

Up to 5% of damaged trees may die and many more will have degraded timber value through stem deformation, rot and broken tops. Oak, poplar, Scots pine and Norway spruce are particularly vulnerable to stem breakage (Figure 3). Fungal invasion at the damage site causes staining and rotting, reducing the value of the timber.

Damage is recognised to be associated with high numbers of squirrels, especially juveniles entering the population during early summer \(^\text{9}\). This occurs when there has been successful spring breeding (from January to April) following a good seed/mast crop the previous autumn. Damage tends to occur at densities of 5 or more squirrels per hectare (ha). In mixed woodland habitats average summer densities are around 8 per ha, but may reach 16 per ha.

Damage risk will be highest where stands of vulnerable trees are adjacent or in close proximity to mature mixed woodland areas producing good seed crops, as these will support high squirrel densities.

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**Figure 1**
Severe grey squirrel bark-stripping damage (pale patches), in a farm woodland plantation.

**Figure 2**
Fresh basal stripping damage to young beech tree; note the bark fragments on the ground. This type of damage is often confused with similar bark stripping carried out by rabbits during winter.

**Figure 3**
Top blown out of 40-year-old Norway Spruce following squirrel damage (Forest of Dean).
Callusing is common (Figure 4) and disguises damage or staining present in the timber at felling age. There may be a reduction in annual increment of up to 2 yield classes, and damage to branches in the canopy may cause dieback, with timber yield being affected if 30% of the canopy is lost.

**DAMAGE PREDICTION**

Predicting years of high squirrel damage will enable better targeting of control, reducing both costs and the number of squirrels killed. A new method (Index Trapping) is currently being developed. This explores the relationship between grey squirrel populations, winter food availability, spring breeding success and damage the following summer. Grey squirrel traps are set during a week in early January in habitats likely to hold high-density squirrel populations (i.e. mature broadleaved or mixed woodland) adjacent to damage vulnerable habitat.

If no squirrels are trapped this indicates that squirrel numbers are very low or that natural food availability is high and that early breeding, and a high risk of damage between April and July, is likely (Table 1). Confirmation of the factor explaining the low trapping results can be obtained by evaluating natural food availability during the same week.

Any animals captured are killed and assessed for breeding condition (it is an offence to release a captive grey squirrel; see page 9). Males with dark, prominent scrotal testes with staining are likely to be reproductively active. Females are checked for pregnancy (number of embryos in the uterus) and lactation (nipples raised and hairless, and expressable milk). This provides further information on which to base damage-risk decisions.

Results from the studies currently under way will be used to provide guidance on trapping protocol and interpretation of the information to identify high, medium or low damage-risk years and on the intensity and extent of control required to minimise damage. This guidance will be published as soon as it becomes available.

Table 1  The rationale behind the Index Trapping method based on three different scenarios leading to three different control requirements (after Gurnell and Pepper, unpublished).

<table>
<thead>
<tr>
<th></th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
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</thead>
<tbody>
<tr>
<td>Autumn tree seed availability in high density habitats</td>
<td>Poor</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Winter breeding</td>
<td>None</td>
<td>Some</td>
<td>High</td>
</tr>
<tr>
<td>Overwinter survival</td>
<td>Poor</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>Winter trapability</td>
<td>Good</td>
<td>Moderate</td>
<td>Poor</td>
</tr>
<tr>
<td>Population size during the following April–July</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Damage level in damage-vulnerable habitats near high density habitats</td>
<td>Very low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Control effort</td>
<td>None</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>

In poor seed years, overwinter survival and breeding will be poor, leading to relatively low populations the following spring and summer and hence reduced risk of bark-stripping damage. In ‘mast’ years with high numbers of broadleaved tree seeds available, survival and breeding overwinter will be good, leading to high spring/summer populations and high damage risk. Control will need to be intensive in high density habitats near to vulnerable habitats.

Dark banded areas show link between winter trapability and expected damage level in damage-vulnerable habitats.
DAMAGE CONTROL STRATEGY

Control for tree damage prevention should aim to reduce resident squirrel densities to below damaging levels (<5 per ha) just prior to and during the main damage period (April–July). It should be targeted in good squirrel ‘holding’ habitat adjacent to damage-vulnerable plantations. Studies have shown that all resident squirrels in a previously marked population can be trapped or poisoned within 5 weeks\(^4\). However, grey squirrels are extremely mobile and can recolonise isolated woodland within 3 months and a non-isolated area within 1 month. Thus killing squirrels at any other time of year will not reduce subsequent levels of squirrel damage.

The timing of control is important. Starting too early will allow grey squirrels in neighbouring areas to move in before the beginning of the damage period, resulting in a greater control effort and unnecessary killing of animals. Tree seed remaining on the woodland floor will also reduce the efficacy of the control measures\(^2\). Starting too late may not allow time to reduce the population sufficiently to prevent damage. Control, using live traps or Warfarin poison (see pages 6–13), should continue throughout the damage period to remove recolonising animals.

Resource availability and squirrel density will also influence the timing of control. It may be necessary to start earlier rather than to use more intensive control where the area to be controlled is extensive or there are very high squirrel densities. If many areas are to be controlled with limited resources (more likely when live trapping is used) then control will need to be carried out in a pulsed manner, with each area targeted at different times starting at the most central site (see Trapping programmes and management, page 10). This may necessitate an earlier than optimum start to control in the first area. However, it is illegal to use Warfarin poison before 15 March.

In amenity areas where timber production is not an objective the decision not to control may be taken. However, consideration should be given to the fact that trees may be affected in different ways: some may lose their natural form, others may have a reduced life expectancy as a result of secondary fungal infection, some may not even reach mature canopy stage, and mature trees may drop damaged branches, presenting a public safety hazard.

Collaborative squirrel control

Effective squirrel control may be difficult where the holding and adjacent damage-vulnerable woodlands are in different ownership. Collaborative control, through either informal or formal ‘Squirrel Control Groups’, enables better planning of control over wide geographic areas. It also provides the potential for joint contracts for control, the bulk purchase of materials and bait, and the collective disposal of unused bait, empty containers, contaminated personal protective clothing and other equipment.

If it is not possible to target control within holding areas then it should be located around the perimeter of vulnerable plantations, particularly at likely points of squirrel incursion from the holding areas. Control should not be located within the centre of vulnerable plantations as this is likely to draw squirrels into the area, and increase the risk of damage occurring.

Conflicts with pheasant rearing

Pheasant feeding stations provide an alternative food source for grey squirrels, particularly when there is little natural food available. This is likely to influence grey squirrel breeding and survival and should be taken into account in damage prediction and control strategies. If squirrels are drawn to pheasant feeder locations these same locations can be used to site traps and hoppers during the control period. However, it is generally insufficient to rely solely on the pheasant feed sites and additional trap/hopper sites will be required\(^{14}\).

Cost effectiveness

Control efficacy should be monitored through the season using maps of the control areas and locations of the woodlands vulnerable to damage. The numbers of squirrels killed per ha should be recorded or estimated from the amount of Warfarin bait used (200–250 g required to kill one squirrel depending on bodysize\(^3\)). It may be necessary to move traps or hoppers that are clearly not being visited by squirrels to new locations. Damage assessment in vulnerable plantations at the end of the summer will show the efficacy of the control operation. This can be done using either a quick visual assessment or by the ‘Nearest Neighbour’ assessment method\(^{14}\). If unacceptable damage has occurred this will suggest that control was either incorrectly targeted in time or place, or insufficiently intensive or widespread. This information should be used to help in the planning of future control programmes.

Chemical reduction strategies

UK Approved Codes of Practice for pesticide use require that pesticides are only applied where and when
they may reasonably be expected to prevent unacceptable levels of damage. Users are also expected to take steps to reduce pesticide usage through ‘integrated crop management’ or other strategies. The voluntary forest certification scheme offered by the UK Woodland Assurance Standard imposes stringent requirements for pesticide reduction. In relation to grey squirrel control, targeting control to moderate and high-risk years, and in high-density habitats in close proximity to vulnerable habitats, provides a means to reduce chemical (Warfarin) use in the environment.

**CONTROL METHODS**

**Warfarin poisoning and live trapping** using baited cages are the most effective methods of reducing grey squirrel populations. The live-trapping method was developed to provide a more effective alternative to shooting or tunnel trapping, and is easier for relatively inexperienced operators to use. The use of Warfarin poison has been favoured in most commercial woodland situations because it is less time consuming and hence a less expensive operation while being at least as, if not more, effective than live trapping. However, the approval of Warfarin is currently under review by the Plant Protection Directorate of the EU and its future availability is uncertain. There are also calls for the continued reduction in the use of chemicals in the countryside. Live trapping is likely to become re-established as the preferred and recommended method of controlling grey squirrels, and trapping expertise may have to be redeveloped.

**Shooting**, either on its own or in conjunction with poking out dreys with poles, is generally ineffective at reducing grey squirrel numbers to the level required to prevent summer bark-stripping. Grey squirrels are more visible in winter when there are no leaves on the trees, but animals killed at this time will usually be replaced before the summer damage period. Shooting (with drey poking) may also risk disturbance to nesting birds and accidental injury to protected species. Shooting squirrels that are seen at poison hoppers or live capture cage traps does not improve the efficiency of either method. It may actually reduce the efficacy, as squirrels in the tree canopy are encouraged to come down to visit traps and hoppers when they see others feeding there. Shooting may be effective for the removal of occasional ‘nuisance’ squirrels, for example those found ravaging a strawberry bed, hazelnut crop or specimen trees in an amenity area. As the presence of steel shot in timber may cause degrade, non-steel shot is recommended.

**Spring traps** set in tunnels may be useful for short-term control (see Tunnel trapping, page 13) but are less selective than cage traps and are therefore not recommended as a main control method.

**Control site selection**

The success of a control operation depends on identification of:

- woodlands that support a resident squirrel population;
- sites in those woods which squirrels will visit to feed at traps/hoppers.

Control is most productive in mature or semi-mature mixed broadleaved woodlands, so should be targeted in these habitats. As squirrels can be difficult to draw to traps in pure conifer stands within mixed broadleaf/conifer woodlands, control should be avoided in these areas. The best sites for traps or hoppers are generally under the largest trees in a wood, particularly those with branches extending well down the trunk with tips near to the ground. Yew and holly trees or a single conifer in a predominantly broadleaved wood will often make good sites, as do tree stumps that are regularly used as feeding sites. The presence of many stripped cone-cores (Figure 5) and the peeled outer skins of large broadleaved seeds identify these. The ground beneath the chosen tree and around the stumps should be bare so that scattered bait is visible to squirrels in the canopy. Squirrels avoid dense or wet vegetation, so it may be necessary to remove vegetation to create sufficient clear areas.

The next three sections describe each method in detail.
LIVE TRAPPING

Principles of live trapping

The bait
Live trapping involves attracting squirrels to a trap with food (bait). Many types of bait have been compared, including wheat, rice, peanuts, acorns and hazelnuts but yellow whole maize has proved to be the best all round bait. Not only is it a favoured food, but it is readily available in quantity, is relatively cheap, stores well and is very visible to squirrels when scattered on the ground. Uniquely, grey squirrels only eat the germ of the maize grain and discard the remainder (Figure 6). This can be used to advantage to show whether squirrels have visited a trap site. The maize bait can be supplemented with a small quantity of acorns, peanuts or hazelnuts to increase its attractiveness at times when squirrels are difficult to trap.

The trap
Live capture traps generally consist of a wire mesh cage with sprung, drop or lift doors. The mesh size of a wire cage must be no greater than 25 mm x 25 mm and the wire diameter must not be less than 1.6 mm. Internal condensation is a problem in solid metal box cages and will cause considerable discomfort and suffering to trapped animals which may die if held in a damp environment. Wood and plastic are unsuitable materials because a confined grey squirrel will gnaw its way out.

There are two types of trap: single-capture and multi-capture.

- **Single-capture traps.** These are designed to catch one squirrel at a time so the trap is out of commission until the animal inside is removed and the trap reset. The catching mechanism generally consists of a treadle connected to a wire (strand or rod) that holds the trap door open. The wire is released when an animal puts weight on the treadle and the door closes either under its own weight (Figure 7) or by a spring (Figure 8). Accidental release of squirrels from this type of trap will occur if the trap rolls over when occupied or during removal of the squirrel for dispatch. Another design (Figure 9) has a single lift door with baffle bars. The drawback of this particular trap is that another squirrel lifting the door to gain entry may release a captive squirrel.

Grains intact.

Grains with their germs removed (arrowed) by squirrels.

Grains which have been chewed by mice.

**Figure 6**
Whole and damaged maize grains.

**Figure 7**
Single-capture trap. The door closes under its own weight once the animal stepping on the treadle releases the trip wire (Legg single type).

**Figure 8**
Spring activated single-capture trap (mink type).
Multi-capture traps. Once set, these catch continuously and, depending on their size, can hold up to 7 squirrels although 1–3 is the norm. They have two lift doors in a tunnel (Figure 10). The second door is fitted to prevent any squirrels in the trap being released by the next incoming squirrel. Behind each door there is a set of vertical and horizontal baffle bars (Figures 10 and 11). These bars prevent captive squirrels opening the doors and their shape and position in the trap is crucial. As manufacturers occasionally modify their trap design the dimensions of the doors, tunnel and baffle bars should be checked before accepting delivery to ensure they comply with the specifications (Figure 11). These traps have one or two sliding doors through which the captured animals are extracted.

Some traps are also termed ‘permanently baited’ because they have a metal tray that sits beneath the wire mesh trap floor and is filled with maize. The maize in the tray is protected from mice, voles and squirrels by a fine wire mesh above the tray. This mesh must not be greater than 6 mm x 6 mm (Figure 10).

Red squirrels are more likely to enter the ‘open door’ type of trap (Figures 7 and 8) so their use should be avoided where red squirrels occur. Although there is also a risk of a red squirrel being caught with a grey squirrel in multi-capture traps, these should be used in preference where red squirrels occur. Red squirrels are less likely to enter this design of trap and are extremely unlikely to enter a trap if a grey is present.
The trapping session

A successful trapping session can remove at least 90% of the resident grey squirrels in the wood at the time. It is possible to achieve this by simply setting out the traps and visiting them daily to check the catch, but the aim should be to trap the squirrels in the shortest possible time to minimise labour costs. To achieve this, a period of pre-baiting is essential to give the squirrels a chance to find the traps and become used to feeding from within them (see section on Pre-baiting). The presence of animals feeding at traps will attract others passing through the tree canopy down to the ground. As traps on pre-bait are only visited every other day, there is less human disturbance than when traps are set immediately and visited daily. Pre-baiting lasts for a minimum of five days after which the traps are set for a period of four to five days. Without a pre-bait period it may take 2–3 weeks to catch the squirrels with a daily (preferably twice-daily) visit necessary throughout.

The trapping method

The density of traps/sites required in a wood is dependent on whether single or multi-capture traps are used. Single capture traps are spaced 75–125 m apart and multi-capture traps 150–200 m, equating to approximately 1 trap per ha and 1 trap per 2 ha respectively. Experience will determine the most productive sites and be far more effective than placing traps to a regular grid.

The trap sites are normally laid out to form a trap round which may use existing tracks, paths or rides for convenience. However, trap sites should be chosen to ensure the traps are not visible from the track, particularly in woods with high public access, if vandalism is to be avoided or minimised.

Trap deployment

A sound trap in good working order (as described on pages 6–7) is allocated to each chosen trap site. Whether the entrance is facing towards or away from the tree or stump makes no difference to the ability of the trap to catch squirrels. However, it is sensible to ensure that squirrels can be removed from the exit door without having to move the trap.

An area of ground, large enough to accommodate the trap and approximately 1 m in front, is levelled. Traps fitted with a bait tray require a shallow depression to be dug. The bait tray is placed in the depression so that the rim of the tray is flush with the surface of the ground, half filled with a layer of soil and then filled with a layer of yellow whole maize. The trap is placed in position so that the flap doors in the entrance tunnel are above the tray and the wirenetting floor of the trap is flush with the ground. Some soil may be riddled through the wire netting roof of the holding area of the trap to fill in any hollows under the trap and to form a false floor. This helps to prevent mice and voles burrowing under the trap and stealing the maize. Once in position the traps are secured to the ground using pegs cut from the surrounding wood, small tent pegs or meat skewers.

Pre-baiting

During the pre-bait period trap entry doors should be propped open and any exit doors removed or pushed under the trap until it is set. At least two large handfuls of yellow whole maize are placed in the main body of the trap (Figure 12). Black plastic (e.g. a bin liner) is used to cover the trap to make the inside weather proof and dark and therefore attractive to a squirrel. The plastic is held in place with branch wood, stones or any other suitable material, which can also be used to camouflage the trap. More maize is scattered liberally all around the trap for up to 20 m.

After 2 days the traps are visited again and the maize outside and inside each trap inspected to see if the germ has been eaten out of any of the grains (Figure 6). This indicates whether squirrels have visited the site and entered the trap. However, mice, voles, birds, particularly pheasants and pigeons, and deer may also eat the maize and there may be little or none left. The presence of a bait tray is particularly useful where mice populations

**Figure 12**

Multi-capture trap prepared for pre-bait period, with lift doors wedged open and exit doors removed.
are high, as it ensures that bait is always present (see page 7). The maize inside and outside the trap should be replenished if necessary, but not broadcast as widely as at the first visit. If there is little evidence of squirrel presence at the trap sites this procedure is repeated after a further 2 days.

**Setting traps and catching squirrels**

Two days after the last pre-bait visit the traps are set by releasing the doors and activating the treadle mechanism, if fitted, after first checking that all moving parts are working properly and removing bait or debris capable of fouling the system. The sliding exit door, when fitted, is replaced firmly and checked to see that the bottom of the exit door is below the floor of the trap in order to prevent it being lifted up by a captured squirrel. The maize inside the trap is replenished and a few grains (8–10, more if mice have been removing bait) placed outside the entrance to the trap. Before leaving the trap any covering material is replaced (Figure 13).

Traps that are set must be visited regularly to conform to the law. Although daily inspection should be the minimum, twice a day is recommended especially where the squirrel population is considered to be high or where single capture traps are used. At each trap the covering is first removed to identify the number of squirrels caught. It may then be necessary to replace some of the covering to calm the squirrels, enabling them to be removed from the trap in a controlled manner and dispatched humanely. Gloves, preferably waterproof, should be worn while handling squirrels to minimise the risk of bites, scratches and exposure to leptospirosis (Weil’s disease).

A medium weight hessian sack is used to extract the squirrels from the trap. If the sack is too thin there is a high risk of being bitten or scratched through the fabric, and if too heavy it will be difficult to control the movement of a squirrel inside. Polythene sacks have an open weave and are unsuitable. After first checking that there are no holes in it, the open end of the sack is placed around the trap exit door and the width of the sack rolled up to form a tunnel. The exit door is opened and captive squirrels are driven, one at a time, into the sack and the exit door closed. When squirrels are reluctant to leave the trap, e.g. in poor light conditions, they can be encouraged to move into the sack by blowing on the base of their tail. The squirrel is then moved into the corner of the sack and with the head positioned carefully within the corner, killed rapidly and humanely by a single blow to the back of the head with a blunt instrument. (Alternatively, when only a few squirrels are involved, they may be securely restrained in the sack and taken immediately to a veterinary surgeon for euthanasia.) No attempt should be made to kill the squirrel by any other means. Shooting at close range with an air rifle through the trap is not recommended as it is difficult, potentially inhumane and there is a risk of injury to the operator as the wire mesh can deflect a pellet.

It is illegal to release a grey squirrel into the wild.

Once empty the trap mechanism should be checked and reset. The exit door should be put firmly in position, the maize inside the trap and at the tunnel entrance replenished, and the trap covering replaced.

If there are no squirrels present in a trap the maize should be checked to see if the germ has been removed (Figure 6). This would indicate that a squirrel has entered the trap and has either not been caught or escaped. The trap should be checked to ensure that the mechanism is working effectively, the baffle bars have not been dislodged and the exit door is in place, and that there are no escape holes in the wire mesh made by a captive squirrel gnawing at the wire.

Trapping normally lasts for just 4 or 5 days provided it was preceded by a pre-bait period. The highest number of squirrels will usually be captured during the first three days and fewer thereafter. However, prolonged heavy rain will delay captures. A particularly high squirrel population or too low a trap density may also result in good numbers being caught on days 4 and 5. The trapping period should therefore be extended until no squirrels are caught.

Figure 13

Multi-capture trap in situ with plastic sheet and camouflage covering. Traps are best sited away from final crop trees.
Poor trapping success

There are some situations that prevent successful trapping. Squirrels are generally most trappable from mid March to the end of July, although there may be a short period when they may feed on flowers of broadleaved trees and captures will be low. Squirrels will not be attracted to traps when there is abundant natural food available, e.g. the autumn/winter tree seed crop.

Brand new traps should be left outside for a few weeks before use to weather off the shine and manufacturing smells, otherwise squirrels will avoid them. Traps that have been visited by a stoat or a weasel, both of which leave a strong musky smell, will need to be lifted and left aside for a few days.

Very occasionally, and for no apparent reason, a trap site will not be visited. In these circumstances just moving the trap to a new site 10 to 20 m away is often sufficient and the trap should then catch.

Trap maintenance and storage

After trapping operations are complete, traps should be washed, thoroughly checked and repaired as required. They should be stored with exit doors removed. Multi-capture traps should be stacked upside down and the mechanism of other traps secured either open or closed to prevent animals and birds being inadvertently captured.

Trapping programmes and management

The trapping methodology described above should be used irrespective of the number of traps deployed or the location (e.g. garden, park or woodland). A number of trapping sessions will be required when traps are to be used in quantity, for example in a forest or series of small woodlands. Traps should be moved sequentially from one trapping area to another and in these situations a rolling programme along the following lines may be employed, starting in this example on a Wednesday, which avoids weekend visits:

- Day 1 (Wednesday) traps are put out and pre-baited.
- Day 3 (Friday) traps are visited and rebaited.
- Day 6 (Monday pm) traps are set.
- Day 7 (Tuesday) set traps are visited twice.
- Day 8 (Wednesday) set traps are visited twice and a second batch of traps are put out and pre-baited in a new area.
- Day 9 (Thursday) set traps are visited twice.
- Day 10 (Friday) set traps are visited once and lifted and held ready for putting out in the next area to be trapped the following Wednesday. The second batch of traps are visited and pre-baited so that they are ready for setting on the following Monday.

This sequence is repeated until all the target areas have been trapped. It is possible for one person to manage two batches of around 30 to 40 traps provided there is reasonable access between the trap sites and the two trapping areas are not too far apart.

WARFARIN POISONING

Warfarin poison may only be deployed out of doors against grey squirrels for tree protection and only between 15 March and 15 August. A successful poisoning operation will be at least as effective as cage trapping, even though few, if any, dead squirrels will be found.

Legislation

The Grey Squirrels (Warfarin) Order 1973 permits the poisoning of grey squirrels with the anticoagulant Warfarin for the purpose of tree protection. The Control of Pesticides Regulations 1986 specifies, on the product label (reference number MAFF 06455) how, where and when it may be deployed. These specifications include the bait, and the design and dimensions of the hopper. Warfarin must not be used outdoors where red squirrels or pine martens occur. Operators must be trained before using Warfarin. The National Proficiency Tests Council (NPTC) provides a nationally recognised Certificate of Competence for Vertebrate Pest Control, which includes grey squirrel control. The responsible use of Warfarin is vital and every attempt must be made to prevent or reduce risk to other species. Hoppers should be clearly labelled with a warning that they contain a poison, as shown in Figure 14(a) and (b). Label (a) is more informative and is preferred to (b).

Poisoning method

The bait

Only 0.02% Warfarin on whole wheat may be used. It should be prepared at least 24 hours before use by mixing 500 ml of 0.5% w/w Warfarin grey squirrel liquid concentrate with 12.5 kg clean whole wheat. It is essential to mix the liquid thoroughly with the wheat. Large quantities of bait are best made up using a small, motorised concrete mixer. Small quantities are mixed in a drum, ideally 25 kg DIY cement mixing drum, or a strong
polythene bag. The liquid is poured onto the wheat and agitated vigorously until all the grains become evenly coloured red. The mixed bait should be spread out to dry for at least 12 hours under cover (away from access by domestic animals) and then shaken before use to break up any lumps. Gloves (300 mm, unlined synthetic rubber), coveralls (heavy duty polycotton or disposable, rated to at least Type 3) and goggles/face shield (to BS 2092 1CD) should be worn at all times when preparing bait. Disposal of empty liquid concentrate bottles, contaminated personal protective and other equipment should be through a registered waste contractor. The mixing operations must be covered by a written COSHH (Control of Substances Hazardous to Health) assessment, and a written Risk Assessment produced to cover the control operation.

**Hoppers**

Figure 15 shows the required dimensions of the hopper, which are set to prevent animals larger than grey squirrels gaining access to the poison. A flap door in the tunnel entrance prevents access by smaller animals. There are two types of door: the weighted door which is the most reliable; and the magnetic door that is equally effective when operating correctly, but the magnet may become dislodged or lose power with age or from a coating of debris. It is recommended that hoppers with flap doors are always used.

**Checking door operation**

The correct operation of the flap door can be measured with a small, 85 mm wide, electronic pocket balance. The balance is modified in two ways by attaching a probe, metal or plastic rod, 6 to 8 mm diameter, to the weighing platform (Figures 16 and 17). Two small adhesive plastic cable clips are adequate. The probe protrudes 70 mm beyond the platform and is rounded off at the end. The measurement is made, by sliding the balance, probe first, along the hopper tunnel floor, until the door is lifted above the floor. The reading on the digital scale should be between 100 and 115 g (Figure 17).

**Hopper deployment**

The choice of sites for hoppers is as described in control site selection (page 5). Sites should be spaced approximately 200 m apart and distributed throughout the control area at a density of one hopper to 1–4 ha, depending on intensity of control (Table 1). At each site a hopper is placed at the base of a tree or stump with the tunnel tilted slightly down to prevent surface water flowing down the tunnel into the bait. The entrance may either face into or away from the tree/stump. The hopper is then firmly secured with branch-
wood or with one or two stakes (Figure 18) which must not prevent the lid from closing fully. The hopper is held to the stake with either tying wire or bands made from a car tyre inner tube. Branchwood, stone or turf can then be used to camouflage the hopper from the public. An alternative is to dig the hopper into a bank. Occasionally, badgers or muntjac deer will persistently disturb hoppers despite being well staked and secured. Another site should first be sought, but if this is not possible or it is also disturbed, the hopper must be placed above the ground either in the fork of a tree or on a platform (Figure 19). Hoppers sited above ground are difficult to hide.

Bark-stripping damage can occur on trees close to a well-used hopper due to subordinate animals ‘waiting’ for a dominant squirrel to finish feeding. The addition of a second hopper 3 to 5 m away will generally curtail further damage. It is advisable to avoid placing hoppers near to final crop trees.

Poisoning operation

Each hopper is filled with between 1.5 and 4 kg (legal maximum20) of poisoned bait. Two or three handfuls of yellow whole maize are initially scattered around the hopper to attract squirrels to the site. Maize must never be treated with Warfarin. If pheasants remove the maize the tunnel entrance can be extended approximately 150 mm with rabbit netting (Figure 20).

It is essential that a continuous supply of bait is available as each squirrel needs to consume 200–250 g bait (depending on bodysize) over a 10-day period to kill it15. The hoppers must not be allowed to become empty and should be visited once every 2–3 days initially, particularly if squirrel populations are very high, and thereafter at least once every 2 weeks to check that they have not been damaged or disturbed and to top up the bait. (For example, where there are 10 squirrels per ha present, to remove 5 squirrels per ha at least 1.25 kg of Warfarin bait per ha would need to be consumed over a 10-day period.)
A plastic jug, or similar utensil, labelled ‘poison’, should be used as a scoop to top up hoppers. Bait is too easily spilt when pouring it from a polythene bag into the relatively small opening of the bait container. All spillage caused or found at any hopper should be cleared up at each visit.

Hoppers should be checked at each visit to ensure that moisture has not caused the wheat grains to stick together and prevent the bait running. A thin stick is used to check for and free any blockage, but should be used with restraint to avoid pulling out too much bait into the tunnel. Any grain that has been soiled by moisture and is not in a suitable condition to be replaced in the hopper should be removed for safe disposal, i.e. burned or through a registered waste contractor. The flap door should also be checked at each visit to ensure that the retaining screws are both in place (as well as the magnet, when fitted) and that the door is working properly, i.e. the correct weight is required to lift the door (see page 11).

Hoppers are generally left in place throughout the control period to ensure removal of both resident and recolonising animals. Bait consumption is greatest during the first 4 weeks or so, followed by a decline, indicating a reduction of the resident population. A period of about 3 weeks of little or no take of bait will follow before recolonising animals start feeding. Some maize should be scattered around the hopper to attract incoming squirrels and topping up of the hoppers reduced to maintain them between half and quarter full. Control operations should stop during mid to late July and certainly before 15 August. At the end of the control period all the bait remaining in hoppers should be removed and stored safely if in a sound condition (dry and with no weevils) or sent for safe disposal, along with any empty concentrate bottles and contaminated personal protective and other equipment, through a registered waste contractor.

**Hopper maintenance**

At the end of the control period hoppers should be washed and dried thoroughly before being stored for next year. Loose or missing flap door retaining screws should be tightened or replaced and the doors secured in the open position to avoid the accidental trapping of small mammals during storage. Hoppers may remain in situ after the end of the control period (15 August) but must be emptied completely and doors secured to prevent small mammals being trapped.

**TUNNEL TRAPPING**

Tunnel trapping, also known as spring trapping, can be effective when used by a skilled operator and can be useful when a rapid kill is required; for instance, when unexpected damage is occurring and the squirrels must be removed immediately. Otherwise it is not recommended as a principal method of control. Grey squirrels may be caught incidentally in woodlands on game estates where spring traps are routinely used for predator control.

Spring traps have arms or jaws activated by strong springs which, when triggered, close violently around the squirrel’s neck. Death should be instantaneous. In practice there are many variables that may influence this outcome, such as speed of movement over the trap, size of animal and the way the traps are individually sited and set. Sometimes the animal is caught by a leg, the tail or around the abdomen. This is inhumane and the animal will suffer before eventually dying if a trap is not visited for some time after capture. Only traps that have been approved under the Spring Traps (Approval) Order 1995 may be used. The Pests Act 1954 and the Wildlife and Countryside Act 1981 require the traps to be set in tunnels. Traps must be inspected at least daily.

Tunnel traps should be sited in places and runs normally used by grey squirrels. This requires considerable expertise if the trapping effort is to be successful. Fenn and Springer traps are set in tunnels so that the treadle is level with the tunnel floor. Tunnels may be natural, such as the hollow base of a tree, dry drains and holes in banks and walls, or artificial, constructed from turf, logs, pipes, bricks, flat stones or wood. The tunnel should be at least 600 mm long and its internal dimensions sufficient (15 cm wide x 13 cm high) to allow the arms of the trap to strike. The entrance holes at either end of the tunnel should be no greater than 80 mm x 80 mm. This prevents animals larger than a squirrel from entering. Any animal capable of travelling through the tunnel is at risk. Stoats and weasels are particularly vulnerable as they may be lured by the scent on the trap of a previously captured grey squirrel. Body grip traps (e.g.
Magnum, Springer No. 4) may also be used successfully to take grey squirrels by making a wire mesh tunnel on a branch that squirrels run along and setting the trap inside.

Red squirrels, when present, will also be at risk although they are less likely to enter tunnels. As there are no reasonable precautions that can be taken to protect red squirrels from spring traps, it is probable that their use is prohibited under the Wildlife and Countryside Act 1981 in areas where red squirrels are known to be present. There is no known case in law, but it is strongly recommended that spring traps should not be used when red squirrels are present.

Baiting tunnel traps to attract squirrels increases the risk to birds if the bait is visible. A few grains of maize or wheat under the trap plate can attract squirrels into the tunnel without being noticed by birds. Advice on the scribing and use of spring traps is available from the Game Conservancy Advisory Service (see page 15).

**DISPOSAL OF CARCASSES**

Disposal of carcasses can be subject to a number of regulations. Carcasses suspected of being infected with diseases communicable to humans or animals will be subject to controls under the Animal By-Products Regulation. Carcasses cannot be buried and must be sent for incineration or rendering. Advice should be sought from the local office of the State Veterinary Service. Carcasses of animals, which have had access to Warfarin poison, should also be burnt in accordance with the statutory conditions relating to the use of Warfarin. Advice on the disposal of all other carcasses should be sought from local Environment Agency (Tel: 08459 333111) or SEPA offices. Guidance on the environmental conditions concerning the disposal of animal carcasses is available in the MAFF Codes of Good Agricultural Practice (Tel: 08459 556000 or at www.defra.gov.uk/animalh).

**IMMUNOCONTRACEPTION**

Immunoc contraception has been investigated as an innovative method to keep populations of grey squirrels below the density at which they damage trees. However, research into squirrel reproductive physiology and the chemical mechanisms controlling fertility is required to enable the development of a suitable vaccine. Once an agent has been identified, the minimum dose required to produce a long-term effect, a suitable carrier bait and delivery systems, and confirmation of species specificity will be required before legislation is passed to enable its use. Such studies are both long term and costly, and the method will not be available for many years.

**REFERENCES**


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 1981

FURTHER ADVICE

Details of areas where the use of Warfarin is restricted or prohibited are available from National Conservancy Offices of the Forestry Commission: www.forestry.gov.uk. For grey squirrel problems in urban areas advice may be obtained from:

The Game Conservancy Advisory Service
Fordingbridge, Hampshire SP6 1EF
Tel: 01425 651013 | advisory@gct.org.uk

SUPPORTING INFORMATION

Training

National Proficiency Tests Council (NPTC)
Avenue ‘J’, National Agricultural Centre, Stoneleigh, Warwickshire, CV8 2LG
Tel: 024 7669 6553 | Fax: 024 7669 6128
information@nptc.org.uk | www.nptc.org.uk

Certificate of Competence in Vertebrate Pest Control (Level 2)

Forestry Commission
Forestry Training Services, Dean Management Training Centre, Prosper Lane, Coalway, Coleford, Glos, GL16 7JY
Tel: 01594 832096 | Fax: 01594 810514
forestry.training.services@forestry.gsi.gov.uk | www.forestry.gov.uk

Rabbit and grey squirrel control (course no. 4.68)
0.5 day each – rabbit/squirrel
1.5 days for PA01 certificate

British Pest Control Association (BPCA)
Ground Floor, Gleneagles House, Vernongate, Derby, DE1 1UP
Tel: 01332 294288 | Fax: 01332 295904
enquiry@bpca.org.uk | www.bpca.org.uk

Mammal management: Grey squirrels and other mammals: 1 day (covers trapping, shooting and poisoning)
Safe use of pesticides course: 1 day

Killgerm Chemicals Ltd
PO Box 2, Ossett, West Yorkshire, WF5 9NA
Tel: 01924 268400 | Fax: 01924 264757
sales@killgerm.com | www.killgerm.co.uk

Modular training courses:
Foundation module: Safety and legislation module.
Vertebrate module (covers squirrels).
Training information: Tel: 01924 268445

Other sources of training:
Colleges: Countryside management, Forestry and woodland management and Controlling vertebrate pests
Environmental consultancies
Grey squirrel control groups

Enquiries relating to this publication should be addressed to:

Mark Ferryman
Forest Research
Alice Holt Lodge
Wrecclesham
Farnham
Surrey
GU10 4LH

Tel: 01420 22255 | Fax: 01420 23653
Email: mark.ferryman@forestry.gsi.gov.uk

The Mammal Society
Tel: 02074 984358 | Fax: 02074984459
enquiries@mammal.org.uk

Tree Help Line
Alice Holt Lodge, Wrecclesham, Farnham, Surrey GU10 4LH
Tel: 09065 161147 (calls charged at £1.50 per minute)
### Manufacturers and suppliers

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Contact Details</th>
<th>Manufacturers</th>
<th>Suppliers</th>
<th>Grey squirrel liquid concentrate</th>
<th>Hoppers</th>
<th>Trap type</th>
<th>Drey-poking poles</th>
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<tbody>
<tr>
<td>Albion Manufacturing</td>
<td>The Granary, Silfield Road, Wymondham, Norfolk, NR18 9AU Tel: 01953 605983</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Cage Multi-capture Mink/squirrel single capture</td>
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<tr>
<td>Alpe Thermo Products (North)</td>
<td>Tel: 01509 620217</td>
<td>Fax: 01509 620217 Mobile 07931355190 <a href="mailto:alpethermo@aol.com">alpethermo@aol.com</a> Contact: D.R. Allen</td>
<td>No</td>
<td>Yes</td>
<td>None</td>
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<tr>
<td>Barrettine Environmental Health</td>
<td>St Ivel Way, Warmley, Bristol, BS30 8TY Tel: 0117 967 2222</td>
<td>Fax: 0117 961 4122 <a href="mailto:sales@barrettine.co.uk">sales@barrettine.co.uk</a></td>
<td>No</td>
<td>Yes</td>
<td>Cage Multi-capture Mink/squirrel single capture Spring Fenn trap Mk.4</td>
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<tr>
<td>Gamekeepa Feeds Ltd</td>
<td>Southerly Park Farm, Binton, Stratford-upon-Avon, Warwickshire, CV37 9TU Tel: 01789 772429</td>
<td>Fax: 01789 490536 <a href="mailto:info@gamekeepafeeds.co.uk">info@gamekeepafeeds.co.uk</a></td>
<td>Yes</td>
<td>Yes</td>
<td>Cage Multi-capture (Fuller style) Legg single capture Spring Springer No. 4.</td>
<td>Yes</td>
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<tr>
<td>Janus Contract Services Ltd</td>
<td>Mounts Farm, Shalford Road, Rayne, Braintree, Essex, CM7 SXA Tel: 01376 342111</td>
<td>Fax: 01376 329500</td>
<td>Yes</td>
<td>Yes</td>
<td>Cage Multi-capture mink/squirrel single capture Spring Fenn trap Mk.4</td>
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<tr>
<td>John Dee Humane Traps</td>
<td>Unit 4 Russett Cottage, Greendale Barton, Woodbury Salterton, Exeter, EX5 1EW Tel: 01395 233340</td>
<td>Fax: 01395 233548</td>
<td>No</td>
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<tr>
<td>Killgerm Chemicals Ltd</td>
<td>PO Box 2, Ossett, West Yorkshire, WF5 9NA Tel: 01924 268400</td>
<td>Fax: 01924 264757 <a href="mailto:sales@killgerm.com">sales@killgerm.com</a> <a href="http://www.killgerm.co.uk">www.killgerm.co.uk</a> Training information: 01924 268445</td>
<td>Yes</td>
<td>Yes</td>
<td>Cage Multi-capture Legg single capture Spring Magnum 110</td>
<td>No</td>
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<tr>
<td>Males</td>
<td>Warners Lane, Selsey, Chichester, West Sussex, PO20 9EL Tel: 01243 602231</td>
<td>Fax: 01243 602270 <a href="mailto:sales@bjmale.co.uk">sales@bjmale.co.uk</a></td>
<td>No</td>
<td>No</td>
<td>Cage Mink/squirrel single capture (traps made to order)</td>
<td>No</td>
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<tr>
<td>Network Pest Control Systems Ltd</td>
<td>1030 Centre Park, Slutchers Lane, Warrington, Cheshire, WA1 1QR Tel: 01925 411823</td>
<td>Fax: 01925 414994 <a href="mailto:Info@network-pest.co.uk">Info@network-pest.co.uk</a> <a href="http://www.network-pest.co.uk">www.network-pest.co.uk</a></td>
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<td>Cage Multi-capture Legg single capture Spring Springer No. 4.</td>
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<tr>
<td>The Labsales Company</td>
<td>Over Industrial Park, Norman Way, Over, Cambridge, CB4 5GR Tel: 01954 233190</td>
<td>Fax: 01954 233195</td>
<td>–</td>
<td>–</td>
<td>Electronic pocket balance Tania model No. 1475</td>
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