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Controlling grey squirrels in forests and woodlands in the UK

Grey squirrels (*Sciurus carolinensis*) have spread rapidly since their introduction into Great Britain in the late 19th century, and Ireland in the early 20th century. They have a significant impact on woodland biodiversity, and in particular the native red squirrel (*Sciurus vulgaris*). Grey squirrels have displaced red squirrels throughout most of England and Wales, central and southeast Scotland, and parts of Northern Ireland, through competition and disease. Grey squirrels also pose a threat to the sustainable management of woodlands through the damage they cause to trees by bark stripping. Such damage may lead to a loss of particularly vulnerable tree species (e.g. beech) within the canopy of woodlands and this may be accompanied by a decline in associated fungal and invertebrate fauna. In some areas this can act as a disincentive to the creation of new woodlands for timber because it reduces the value of the trees. In many areas of the UK, grey squirrels are unaffected by predation and therefore targeted control is often necessary to reduce their impact on woodlands and biodiversity. This Technical Note provides updated information on methods of grey squirrel control. It has been produced in response to changes in legislation as well as recent developments in control methods and trap designs.

Forestry Commission
Scottish Forestry
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Introduction

There are several methods and approaches for controlling grey squirrels. The suitability of each depends on aims and objectives, the prevailing landscape character and squirrel abundance. The ultimate effectiveness of any technique may depend on equipment and operators' experience. Broadly, there are two aims for controlling grey squirrels in the UK, depending on whether the objective is either to limit damage to trees or to protect red squirrel populations (Figure 1).

The two aims differ in scope, timing and effort. For example, grey squirrel control to protect vulnerable stands of trees from bark stripping damage is carried out in spring, with the aim of reducing squirrel numbers from May to September when trees are most vulnerable to damage. Control for tree protection is needed most frequently in lowland parts of England and Wales where broadleaved trees are widely grown. By contrast, grey squirrel control to protect red squirrels may be needed at any time of year and is most often conducted across landscape areas containing resident red squirrel populations. Control is often carried out in response to sightings, trail camera images or other evidence of grey squirrel presence. Complete eradication of grey squirrels is not normally feasible but it may be attempted where re-invasion can be prevented (e.g. Anglesey).

This Technical Note sets out detailed guidance for controlling grey squirrel populations in pursuit of either objective and explains control strategies, site selection and details of control methods. Our aim in this Technical Note is to describe the methods as clearly and simply as possible. However, it should be recognised that an element of skill is involved in successfully and humanely using some of the methods (notably shooting and use of spring traps) and an inexperienced user is advised to seek training (see Useful sources of information on page 16).

Figure 1 The grey squirrel can pose a serious threat to the survival of native red squirrel populations.

Squirrel control is expensive in terms of human resources and there is a continual need for innovation for more efficient and humane methods. Comparative evidence of the relative performance of different control methods and trap designs are needed, particularly for the newer methods. Users are encouraged to keep careful records during control operations (see Programme monitoring on page 15). This evidence will help guide choices about control operations in the future.

A change in legislation should be noted with respect to previous editions of this guidance. The use of warfarin poison has previously been favoured in most commercial woodland situations to control for grey squirrel damage in the absence of red squirrels because of its cost-effectiveness. However, the EU licence for the production and sale of warfarin as grey squirrel bait ended in 2014, making the chemical illegal to use against grey squirrels as a plant protection product in woodlands.

Collaborative action

A prerequisite for any control programme requires an examination of the landscape surrounding the target woodland area, to consider the potential for establishing a collaborative programme with neighbouring landowners and reduce the potential for re-invasion. Collaborative action, through either informal or formal squirrel management groups, enables better planning and delivery of control over wide geographical areas. It also has potential for letting joint contracts for control, and for the bulk purchase of materials.

The need for collaborative management is most acute when there are high grey squirrel populations adjacent to vulnerable woodland, and where these are in different ownerships. Squirrels disperse readily, and will cross open ground, so any neighbouring woodland should be considered a priority for inclusion in a joint control programme. Squirrels will exploit limited tree cover, so collaboration between woodland ownerships linked by tree lines, hedgerows, parks or gardens is also important.

Control strategies

Prior consideration of local circumstances and relevant wider policies or strategies is important when considering your approach to squirrel control. Using the decision tree in Figure 2 may be helpful when selecting an approach. A variety of methods are available, and an appropriate choice will depend not only on whether non-target species (e.g. red squirrels and pine martens) are present in the area, but also upon the availability of any necessary expertise (Table 1).

Figure 2 Choosing grey squirrel control strategies and methods.

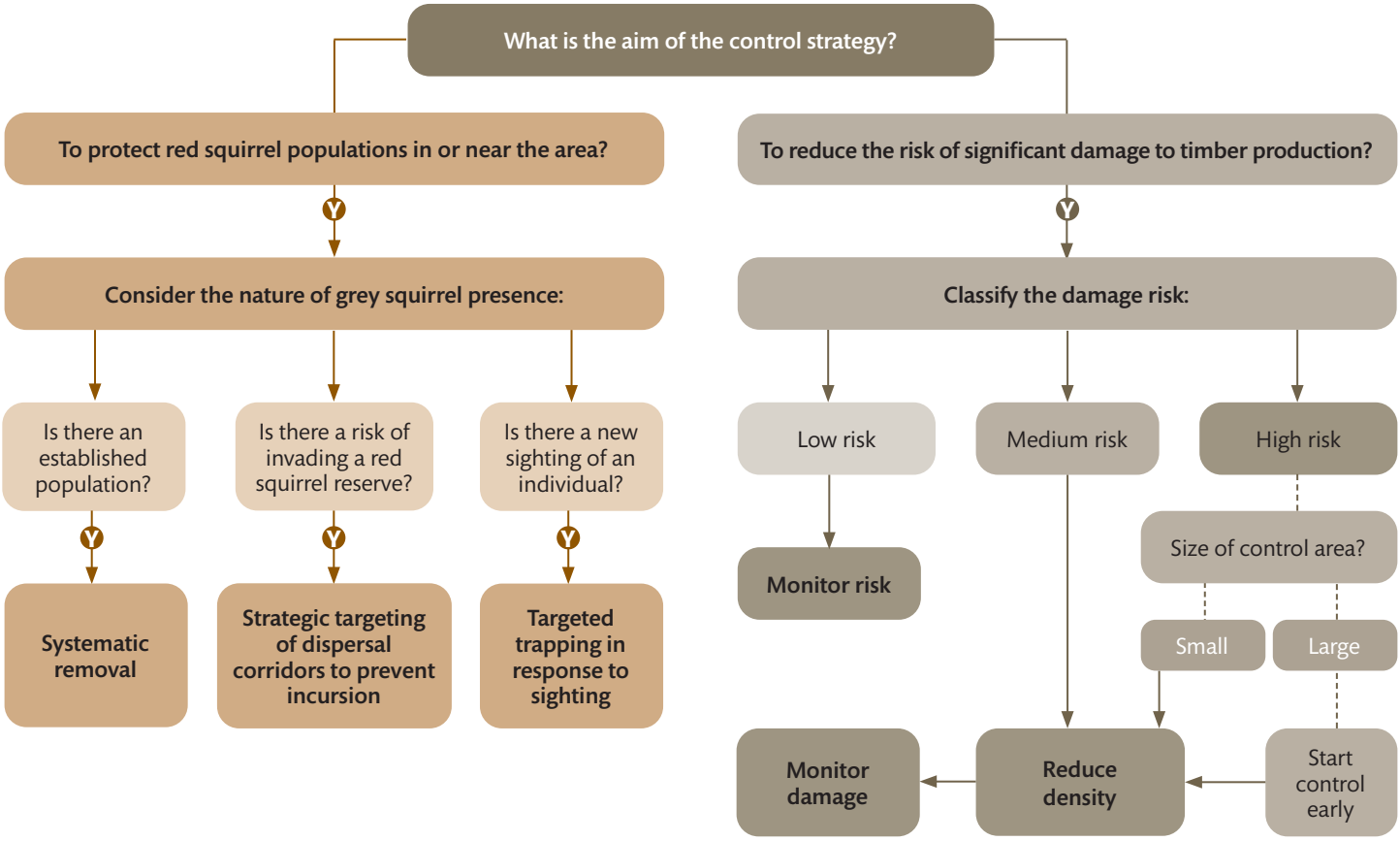


Table 1 A comparison of the attributes of grey squirrel control methods.

Control method	Non-target impacts	Timing	Advantages/disadvantages of method	
			At high squirrel density	At low squirrel density
Live trapping	• Traps can be placed on platforms in trees to reduce by-catch and maintain efficiency. • Non-target species can be released.	All year – but most effective during winter and spring. A high production of seed in autumn can reduce capture success.	Effective at reducing densities, but multi-capture traps can only be used in grey-only areas.	Labour-intensive.
Live traps with alarms	• Immediately alerts user to all captures, allowing non-targets to be released quickly.		Little efficiency gain.	Can reduce time spent monitoring traps.
Tunnel (spring) traps	• Not to be used in areas with red squirrels or pine martens. • Bird by-catch should be minimised by using baffles.		May be more effective to reduce high densities.	Reduced man-hours.
Shooting	• Risk of misidentification of red squirrels; trained shooters only. • Drey poking should be avoided in areas with red squirrels or pine martens.	All year – easier in winter with reduced foliage.	Useful when combined with trapping for trap-shy squirrels. Cost-effectiveness is improved if volunteers can be used.	Allows rapid targeted response to remove greys from red areas at any time of year. Use of baited sites may improve effectiveness.

Situations may arise where control is needed for both red squirrel conservation and tree protection. Collaboration between woodland owners and red squirrel protection groups will be helpful in this situation and control methods and effort need to be compatible with both objectives. However, the use of spring traps, multi-capture live traps and drey poking should be avoided (both red squirrels and pine martens use grey squirrel dreys so drey poking should not be used where these species occur).

Tree protection

A key part of any strategy for tree protection involves an assessment of the risk of damage – for grey squirrels this involves identifying the most vulnerable stands, the abundance of seed in the previous autumn, and the proximity of mature woodland that provides good habitat (Table 2). Grey squirrels are more likely to target faster growing pole-stage trees, usually between 10 and 40 years old. Trees that are not suppressed by neighbours and stands after thinning are most susceptible. A wide range of species can be damaged but some species (notably beech, sycamore and oak) are much more susceptible than others.

Control for the purposes of tree protection aims to reduce grey squirrel numbers to a level where damage is negligible. Control must be carried out leading up to or during the period when damage to trees normally occurs (May–September). The most effective period for trapping is usually just before this period in late winter or early spring, when the availability of natural foods is lowest (Table 2). However, a large seed crop the previous autumn, or feed put out for pheasants, may influence the effectiveness of trapping and therefore the choice of timing for squirrel control. Completing control too early in spring on the other hand may risk damage occuring later by grey squirrels recolonising from neighbouring areas.

If many adjacent woodland habitats are to be controlled then activities will need to be carried out in a pulsed or phased manner, with each discrete area targeted at different times starting at the most central woodland site (see The trapping programme on page 12).

Selecting a control site

A successful control operation depends on identifying:

- woodlands that support a resident grey squirrel population;
- the location of stands vulnerable to damage and their spatial relationship to mature woodland;
- locations within control woods where traps and/or bait stations can be placed to attract squirrels.

Control should be targeted in all habitat containing grey squirrels that is adjacent or close to woodlands containing trees vulnerable to damage. Typically mature or semi-mature broadleaved or mixed stands offer the best habitat for grey squirrels and control is most productive in these sites. The abundance of dreys can give a good indication of the presence of squirrels. If it is not possible

Table 2 Effects of seed availability on squirrels. In poor seed years, overwinter breeding and survival will be poor, leading to relatively low populations the following spring and summer. In good seed (mast) years, with high numbers of broadleaved tree seeds available, overwinter breeding and survival will be good, leading to high spring/summer populations.

	Poor seed year	Average seed year	Good seed year
Autumn tree seed availability in high-density habitats	Poor	Moderate	High
Winter breeding	None	Some	High
Overwinter survival	Poor	Moderate	Good
Winter trapability	Good	Moderate	Poor
Population size during the following April–July	Low	Moderate	High
Damage level in damage-vulnerable habitats near high-density habitats	Very low	Moderate	High
Control effort	None	Moderate (targeted at high-density habitats adjacent to vulnerable areas)	High (widespread control in all high-density habitats within 1 km of vulnerable areas)

to target control within adjacent areas, then control measures should be put in place around the perimeter of vulnerable habitats, particularly at likely points of squirrel incursion. Control should not simply be restricted to within the centre of vulnerable habitats, as bait used for trapping is likely to draw squirrels into the area and this is likely to exacerbate damage.

Control methods for tree protection

Grey squirrels can be controlled all year round by a variety of methods (Table 1). At some sites a combination of methods may be most effective. The most effective methods are:

- Trapping using either baited cages or spring traps is an effective method: however, live trapping should be the preferred option as it ensures that non-target species are not killed and it is relatively easy for inexperienced operators to undertake. Trapping is the preferred method where shooting may present a risk to public safety.
- Shooting is also an effective control method and can be used in combination with trapping to remove individuals reluctant to enter traps.

Monitoring for tree protection

If control is being carried out for damage prevention, then an assessment of damage in vulnerable plantations at the end of the summer will show how effective the control operation has been. This can be performed using either a quick visual assessment or by the 'Nearest neighbour' assessment method (see Useful sources of information on page 16). Comparison with areas without control will be helpful.

Red squirrel protection

Grey squirrels carry the squirrelpox virus, which does not harm them, but if transmitted to red squirrels can cause mortality rates in excess of 80%. Grey squirrels can also outcompete red squirrels, especially in habitat dominated by broadleaved woodlands or pine forest. Control for red squirrel protection therefore aims to prevent dispersing grey squirrels in a red squirrel area or removing an already established grey squirrel population. This is carried out to eliminate competition for resources and to reduce the risk of disease transmission.

To prevent invasion, targeting of control efforts should focus on dispersal corridors along which grey squirrels move into the area as well as adjacent high-density grey squirrel habitats. It should also occur in response to any grey squirrel sightings in a habitat containing red squirrels. Ideally, control efforts should be outside the main area of red squirrel presence as traps and feeding stations will create a focal point that attracts both species and therefore increases the risk of disease transmission between them. Traps need to be regularly checked and disinfected, including prior to relocating equipment to a new area.

Control operations may occur throughout the year, but if any trapping is needed during the breeding season where both red and grey squirrels are present then it is good practice to check traps every four hours (see Welfare in traps on page 12). The main dispersal periods are in the autumn and to a lesser extent following the weaning of spring litters. The availability of tree seed, which is a major food, will influence trapping success. This means that the willingness of squirrels to come to bait or to enter traps ('trapability') is typically highest in spring and early summer before declining in autumn and winter when natural food is more abundant.

Selecting a control site

A successful control operation depends on identifying:

- woodlands that support a resident grey squirrel population and the proximity of these to known red squirrel areas;
- corridors or routes along which squirrels are likely to disperse;
- locations that are determined by local grey squirrel sightings.

When removing an existing population, control is most productive in mature or semi-mature mixed broadleaved woodlands. A strategy that initially targets habitats likely to contain a high grey squirrel density and then moves effort out from these has been shown to work. However, the pattern of permissions to access local areas with multiple ownership, as well as sightings information, will invariably influence control strategies. Evidence of the presence of squirrels needs to be obtained to guide placement of traps. Trail cameras can be particularly helpful, as they reveal the identity of each species using a site over time. Feeding signs, direct observations and hair tubes (from which hair can be obtained from visiting animals) can also provide helpful information; however, feeding signs look similar for both species (Figures 3a and 3b).

Control methods for red squirrel conservation

Grey squirrels can be controlled all year round by a variety of methods (Table 1):

- Live trapping using single-capture, baited cage traps is an effective method of reducing grey squirrel populations. As there is a risk of trapping non-target species, traps must be covered to provide shelter and need to be regularly inspected (see Welfare in traps on page 12). Traps that kill instantly should not be used.

Figure 3a The remains of pine cones consumed by squirrels.

Figure 3b The remains of hazel nuts consumed by squirrels.

- In parks and gardens, the placement of a cage trap concealed within a wooden box located up a tree has proved successful. However, where there is a high likelihood of catching red squirrels, placing traps on the ground and baiting with whole maize is more likely to attract grey squirrels than reds.

- Shooting is also an effective control method, particularly in combination with live trapping. It can be carried out all year round but appropriate care must be taken to ensure that the species can be identified so that no red squirrels or other non-target species are harmed.

Where pine martens occur (Box 1), live trapping or shooting are the only recommended control methods.

Monitoring for red squirrel conservation

If control is being carried out for red squirrel conservation, the records will help to assess distribution changes, the effectiveness of control and thus the future effort that may be required to continue control operations. In addition, blood or skin samples can be collected from culled grey squirrels and tested for the squirrelpox virus. A local squirrel conservation officer should be contacted for advice before control operations begin (see Useful sources of information on page 16 for contacts).

Box 1 Pine martens

There is growing evidence to suggest that pine martens have a negative impact on grey squirrel populations. This may be due to predation or disruption of normal behaviour; the reasons are still not fully understood and are the focus of continuing research. However, the impact of pine martens can benefit local red squirrel populations, and a reduction in grey squirrel numbers is likely to result in less damage to vulnerable trees.

For much of the 20th century, pine martens have been mainly confined to places where few if any grey squirrels occur (northwest Scotland and western Ireland), however they have been spreading out from these areas and have been re-introduced to southern Scotland, mid-Wales and the Forest of Dean. This geographical range expansion is likely to continue.

While the impact on grey squirrels is helpful, it should not be assumed that squirrel control can cease following the establishment of pine martens in an area. In the absence of control, grey squirrels may continue to spread and compete with or infect red squirrels, so the maintenance of control programmes is recommended. It is important nonetheless to ensure that monitoring of squirrel populations and damage continues, as this will provide evidence of the need to maintain control operations in the future.

Where pine martens occur, live trapping or shooting are the only recommended control methods. Spring traps fitted with a restrictor of approximately 45 mm width to the tunnel entrances will prevent entry by adult pine martens, but these may also reduce trapping success for grey squirrels and juvenile pine martens may still be caught.

The pine marten (*Martes martes*).

Live trapping

Live capture traps generally consist of a wire mesh cage with sprung, drop or lift (free-swinging, one way) entry doors. There are two types: single-capture or multi-capture.

The entry doors can be either sheet metal or wire mesh. One or two separate doors might be provided for removal of squirrels. The size of square wire mesh used for the cage should not be larger than 25 mm x 25 mm and most traps are now made using this size. The wire diameter should not be less than 1.6 mm to maintain rigidity.

Some older traps use 19 mm x 19 mm square mesh or consist of a rigid wire frame covered in 10 mm hexagonal mouse-proof mesh. Although smaller sized mesh might be used for making the cages it increases the weight and cost of the trap. New traps should be left outside for a few weeks before use to weather off the shine and manufacturing smells.

Single-capture cage traps

Single-capture cage traps are designed to capture one squirrel at a time and are only effective again after a squirrel has been removed and the trap reset.

The entry tunnel is inclusive to the trap design and usually has a single entry door at one end of the trap although some consist of a double-entry design. The catching mechanism usually consists of a treadle connected to a flexible wire or rod that holds the entry door open. When a squirrel puts its weight on the treadle the action releases the door, which closes either by a spring or under its own weight (Figure 4).

A simpler design (e.g. Figure 5) has a single lift door that closes behind the squirrel. Traps that have a lift door should have metal baffle bars behind the door that allow a squirrel to pass through. Once in the trap these bars prevent squirrels from opening the door and escaping. The shape and position of the baffle bars in relation to the swing of the door is crucial to their effectiveness (Figure 5).

Squirrels may accidentally be released from this type of trap if it rolls over, or if another squirrel lifts the door to gain entry.

In areas where red squirrels or pine martens are also present, only use single-capture traps that are positioned on the ground.

Figure 4 A spring-activated single-capture trap (mink type).

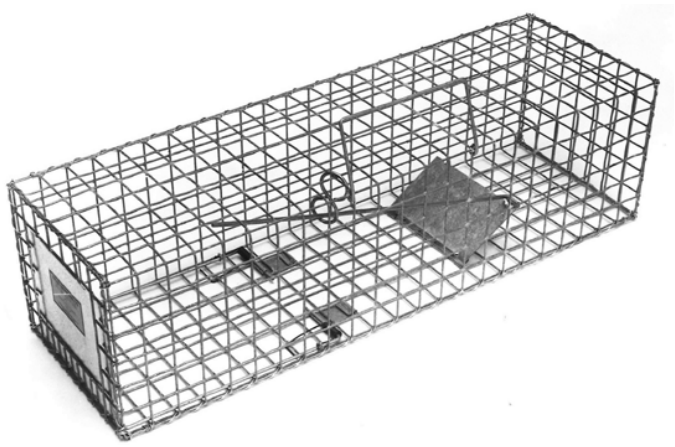
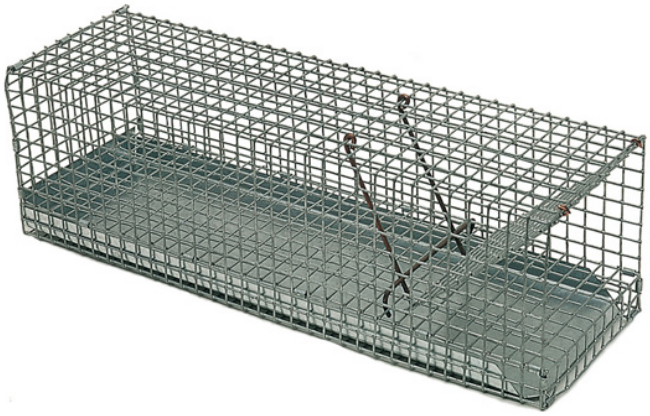


Figure 5 Single-capture trap with single flap-door entrance (midget type), best suited for use in gardens.



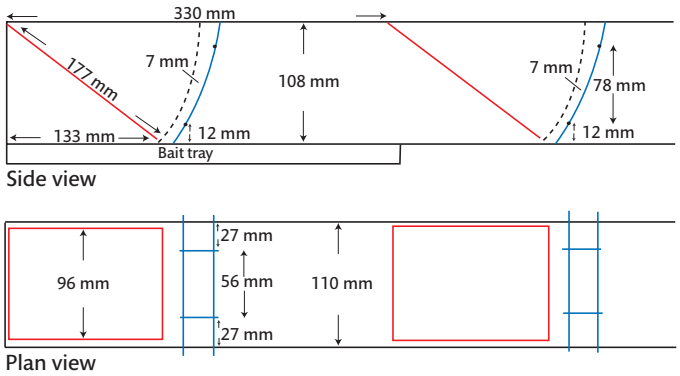
Multi-capture cage traps

Multi-capture cage traps are larger than single-capture designs and are capable of catching continuously. They include a holding area to one or both sides of a separate entry tunnel (Figure 6). Some traps are constructed from mesh, while others use a combination of mesh and sheet metal. In these traps the front of the cage, inside wall of the tunnel and door(s) to remove squirrels are made of sheet steel. In traps of this design, squirrels in the holding area might not deter others from entering the trap. Depending on their size it is possible to capture at least six squirrels between twice-daily visits, although one to three squirrels would typically be captured.

The catching mechanism consists of two lift doors, each with metal baffle bars and set apart in the tunnel as shown in the multi-capture trap specifications (Figure 7). The second door is fitted to prevent any squirrels in the trap being released by the next incoming squirrel. Multi-capture traps are not suitable for use where red squirrels are present as the capture of both species is stressful to red squirrels and increases the risk of infection from the squirrelpox virus.

Figure 6 Multi-capture trap. The baffle bars prevent captive squirrels from opening the double lift doors. To be most effective, baffle bars should be curved (as shown in Figure 7).

Figure 7 Multi-capture trap specifications showing flap door (red) and baffle bar (blue) positions.



The use of a bait tray will make traps more efficient by luring squirrels through the door(s) into the traps even when the bait in the main body of the trap has been taken. This is a rectangular shallow tray containing bait that is placed directly under the entry tunnel of cage traps with a mesh floor (Figure 8). The position of the bait trays under the floor makes the bait less accessible and the traps can remain baited for longer periods. Covering the bait tray with a small gauge mesh will prevent most of the bait from being taken by mice and squirrels. Alternatively, the mesh can be attached under the tunnel of the trap. Traps used with a bait tray are known as permanently baited.

Figure 8 Bait tray. A covering of fine wire mesh (6 mm x 6 mm) will protect bait from being taken by mice and squirrels. A larger mesh of up to 13 mm x 13 mm will also provide some protection.

The trapping method

Choosing the layout of traps

- Space the traps at one per hectare (if single-capture traps are used), equivalent to one trap every 100 m, or if multi-capture traps are used then one per 2 hectares (~140 m apart). A narrower or wider spacing may be more appropriate where grey squirrels are at particularly high or low densities, respectively. In sites that may attract a lot of squirrels, place single-capture traps in pairs to improve capture rates.
- Consider the time needed to visit all of the traps and deal with captures (within daylight hours) when planning the number and layout of traps. A person might expect to manage around 20 multi-capture cage traps a day, placed at the recommended spacing, provided there is reasonable access between the traps.
- Inspect traps twice a day, once in the morning and once in the evening, especially if pine martens are present. If trapping in areas containing red squirrels during their breeding season then it is advisable that inspections be made at least once every four hours.
- Fit trap alarms where traps are widely dispersed and two visits per day are impractical (e.g. where grey squirrels are at a low density). This can help reduce the number of visits and the time animals are held in traps.

Selecting trap sites

It is important to make careful observations of the site when selecting the trap locations. Well-located traps are likely to be more productive than placing them in a regular grid:

- Place traps where squirrels have been seen feeding or moving, or where feeding remains are evident. Squirrels often leave feeding remains on tree stumps or natural mounds, on the stems of fallen trees or near the base of trees.
- Select trap sites at the base of large trees, especially those with branches extending well down the trunk, and with little surrounding ground vegetation so that scattered bait is visible to squirrels in the canopy.
- Avoid sites that are out in the open, away from trees, or in dense cover, or that may become waterlogged. Placing traps near to trees offers a route to and from the trap for squirrels. Placing traps alongside a fallen tree is often successful as squirrels will use the tree as a pathway. It makes no difference to effectiveness whether the entrance of the trap is facing towards or away from a tree or stump, but placing traps with the entrance away or to the side makes the removal of squirrels easier.

- Position traps so they are not visible from any track to reduce the risk of disturbance, particularly in woodland with a high volume of public access.
- Mount single-capture traps on platforms in trees, at a height of 1–2 m at sites that are at risk from disturbance (e.g. by badgers, foxes, feral boar or domestic dogs), or where ground vegetation is dense enough to deter grey squirrels from coming to ground.
- Position multi-capture traps on the opposite side of large trees to public rides or paths, hidden behind banks, large stumps or fallen trees.

The trapping programme

Traps can be moved sequentially from one woodland area to another and in these situations a rolling programme along the lines of the example in Box 2 may be employed, starting in this case on a Wednesday. This sequence is repeated until all the target areas have been trapped.

In a typical trapping session, a large proportion of squirrels will be captured in the first few days of trapping, after which numbers will decrease until few if any animals are caught. There are, however, situations when captures do not follow this pattern – if adverse weather delays captures or where the traps are widely spaced, then higher numbers of squirrels may be caught towards the end of the trapping period. On occasion, it may be necessary to move the traps, before capture ceases entirely, in order to focus effort on another area.

Box 2 Example of a trapping programme

- **Day 1** (Wednesday) traps are put out in Area 1 and baited in the 'open position'.
- **Day 3** (Friday) traps are visited and rebaited.
- **Day 6** (Monday pm) traps are set.
- **Day 7** (Tuesday) set traps are visited.
- **Day 8** (Wednesday) set traps are visited and a second batch of traps are put out in a new area, Area 2. Traps are baited in the 'open position'.
- **Day 9** (Thursday) set traps are visited.
- **Day 10** (Friday) set traps in Area 1 are visited once, lifted and checked (and disinfected if red squirrels are present) and then held ready for putting out in the next area to be trapped the following Wednesday. The second batch of traps in Area 2 are visited and rebaited so that they are ready for setting on the following Monday.

Preparing the traps

Once a site has been selected then traps need to be carefully prepared to ensure successful captures. You should:

- Select an area of level ground in the shade that is large enough to accommodate the trap.
- Clear branches and leaves from the area in front of the trap.
- Dig a shallow depression beneath the area where the tunnel of the trap will lie, to accommodate the bait tray.
- Place the bait tray in the depression so that the rim is flush with the surface of the ground and that the front is in line with the front of the tunnel.
- Part fill the bait tray with a layer of soil and then a layer of yellow whole maize.
- Position the trap so that the entrance tunnel is above the tray and the wire netting floor of the trap is flush with the ground. Fill in any hollows by riddling some soil through the wire netting of the trap.
- Secure the trap to the ground using wire pegs or ground anchors to prevent badgers or dogs carrying it away.
- Secure the trap doors with wire in the open position so that there is no possibility of accidental capture.
- Remove exit door(s) where fitted, or place them under the trap and keep the entry doors open with wire or cable-ties. Exit doors that are hinged should be secured in the open position with pegs to prevent them from being closed.
- Cover the top and sides of the trap with black plastic or breathable roofing felt to make it weatherproof and dark inside (Figure 9). This keeps captured squirrels calm.
- The sheeting can be held in place with branch wood or other suitable material found nearby, which also serves to camouflage the trap. Wooden trap covers can also be used and may provide more protection and less chance of being disturbed by other animals.
- Single-capture traps sited in trees should be securely covered in waterproof material, or alternatively, have a nest box attached to provide shelter.

Figure 9 Multi-capture trap set to catch. The trap is covered with a plastic sheet held in place with branches and covered with camouflage material. Single-capture traps should be similarly concealed.

Pre-baiting the traps

Once the traps have been placed then they can be baited and left fixed open until the trapping starts:

- Place around two large handfuls of yellow whole maize (or alternative bait) in the main body of the trap and a few grains on the floor of the tunnel above the bait tray.
- Scatter four or five large handfuls of maize around the trap for up to 10 m in all directions, or in the forks of nearby trees.
- Revisit the traps after two or three days to see if the germs have been eaten in any of the maize grains (Box 3). This helps indicate whether squirrels have visited and if they have entered the trap. If all the bait has been taken in the main body of a multi-capture trap then the bait tray should still contain bait if it is covered in wire mesh.
- If any of the bait has been taken by other animals (Table 3), replenish the maize inside and outside of any single- or multi-capture trap, but this time only scatter it over a 5 m radius.
- Repeat this procedure after a further two days if there is no evidence of squirrel presence at the trap.

Box 3 Bait types

Bait serves a dual purpose: to attract squirrels to the trap as well as providing food for the squirrel once captured. Many types of bait have been compared, including barley, wheat, rice, peanuts and a range of small animal feed pellets – but yellow whole maize (not to be confused with cut or rolled maize) has proven to be the best suited for grey squirrels. It is readily available in quantity, is relatively cheap, stores well and the bright yellow colour attracts squirrels to the ground.

Squirrels only eat the germ of the maize grain and discard the rest (see below). This can give a helpful indication as to whether squirrels have visited a trap; however, it is important to note that mice will also sometimes consume the germ before consuming the remainder of the grain later. Squirrels will cache (bury) and dig up buried food items around traps; the latter activity will leave small 2 cm-wide shallow holes scattered in the vicinity of the trap. If it proves difficult to attract squirrels, maize can be supplemented with higher quality food items (see Poor trapping success on page 14).

Intact grains | Grains with germs removed by squirrels | Grains chewed by mice

Setting the traps

- Check the traps for evidence of squirrel visits a few days after the last visit, and set to capture. For multi-capture traps, release the entry doors from the fixed open position and replace the exit doors.
- Check the trap doors are correctly operating to ensure that they move freely, and adjust the release mechanism if necessary. Ensure that any baffle bars fitted behind lift doors do not interfere with the movement of the doors. Remove the bait and other debris that could disrupt the correct operation of doors.
- Replenish the maize inside the trap if necessary and scatter a small handful outside the trap entrance. Do not broadcast any maize around the trap during the trapping period. Replace the covering material before leaving the trap (Figure 10).

Figure 10 Multi-capture trap prepared for the pre-baiting period, with the lift doors wedged open and the exit doors removed.

Trap alarms

Trap alarms can be fitted to any trap and will signal the operator when an animal has been caught. Alarm systems rely on the mobile phone network and hence may not work where there is no signal; however, modern systems can inform the operator of the signal strength at each trap's location, or if the signal subsequently fails. The use of alarms can improve animal welfare by reducing the time spent by squirrels in traps, as well as improving efficiency by reducing the number of visits to empty traps. However, it is the operator's responsibility to ensure that the alarms are functioning correctly, and visits to check for disturbance or to top up bait may still be needed. Alarms are most useful where grey squirrel density is low or traps are widely dispersed, making regular inspection more difficult.

Table 3 Grey squirrel trap disturbance: evidence-based for some common species that visit multi-capture cage traps placed on the ground (disturbance includes both physical interference of the trap and taking bait).

Animal	Disturbance	Timing	Likely impact	Remedy
Badger	Takes bait from outside and under the trap. Can remove the trap cover, dig around, undermine, uplift and move traps. Can reach far into traps that have a tunnel of as little as 152 mm square. Might visit traps repeatedly and on successive nights. Usually visits alone.	Night	High	Raise the trap off the ground. Badgers may visit several traps on a site. If present, consider raising traps from the outset.
Wild boar	Will damage, crush or move traps.	Night		Raise the trap off the ground (>2 m).
Fox	Can remove the trap cover but does not usually move multi-capture traps. Might return to the trap on successive nights. Usually visits alone. Lighter single-capture traps might be moved.	Day or night		If frequently disturbed, raise the trap off the ground or move it to a new position.
Mice	Can remove all of the bait inside and outside a trap during one night. Traps can also be filled with leaves, which can prevent the lift doors from opening. Mice visit traps with regularity and usually in small groups. Some individuals visit during the day.	Mostly at night		Cover the trap in mouse-proof mesh or add more food in the trap and bait*. Tree-mounted traps can be visited by mice, but raising the trap off the ground will be more effective than moving the trap.
Larger birds (pheasants, crows or jays)	Take bait outside and from the trap entrance in a relatively short time; might disturb or remove the trap cover.	Day		The cover should be firmly fixed; add more bait*. Tying a wire across the trap door may prevent entry.
Rats	Will enter and trigger traps and eat bait.	Day or night	High (due to health risk)	None.
Deer	Take bait from outside the trap and from the trap entrance. Roe deer usually visit alone, sometimes in pairs. Larger deer species are more likely to disturb traps.	Day or night	High or medium	If frequently disturbed, raise the trap off the ground or move it to a new position.
Muntjac deer	Take bait from outside the trap and from the trap entrance. Might lift the entrance door on traps with a larger tunnel to get to bait. Sometimes returns to the trap repeatedly. Usually visits alone.	Day or night	Medium	If frequently disturbed, raise the trap off the ground or move it to a new position.
Stoat/weasel	Usually visits alone; captures are infrequent. The smaller weasel has been observed passing through 25 mm square mesh.	Day or night		Not required. Traps should be cleaned before being reset.
Pigeons	Take bait outside the trap and from the trap entrance. Often visit in pairs.	Day		Tying a wire across the trap door may prevent entry.
Rabbit	Not usually an issue with multi-capture traps but are sometimes captured in single-capture traps set with an open door. Usually affects individual traps in open areas with vegetation or along fence lines.	Night	Low	Move the trap to a new area.
Voles	Takes some bait from inside and outside trap but the impact is lower than for mice. Either visits traps individually or in pairs.	Day		Not required.
Small birds	Take bait from outside the trap and from the trap entrance, but may enter or trigger the trap and steal bait. Visits can be frequent and may be individually, in pairs, or with other species.	Day		Not required.
Hedgehogs	Will regularly enter and trigger traps placed on the ground and eat bait.	Night	Dependent on local abundance	Raise the trap off the ground.

*Adding more than just a small handful of bait outside set traps can be counterproductive as squirrels will feed but may not enter trap. A bait tray under the entrance tunnel (Figure 8), protected from bait removal by mice, voles and birds, ensures there is always bait available to attract squirrels.

Welfare in traps

Live capture traps must be covered by plastic or synthetic sheeting. This keeps the inside of the trap dark, which helps to keep trapped animals calm, as well as to protect them from adverse weather. Traps should be placed in the shade and not exposed to direct sunlight and sufficient bait should be provided to feed the animal while it is held in the trap.

Where traps might be disturbed by badgers, deer, wild boar or other large animals, it is advisable to place traps on a platform or in a box in the trees (see Table 3). Traps should be secured to avoid being moved. This is particularly important for lighter single-capture traps that could roll over and expose any captured animals to the elements or to predators. Traps should not be placed on the ground near public rights of way or in locations where domestic dogs or wild predators may find the trap.

Traps that are set must be visited regularly to ensure the welfare of the animal. Where possible, squirrels should not be held for more than 12 hours. Where there is a possibility of red squirrels being caught during the breeding season, checks should be made every four hours to reduce the chance of confining squirrels that may have dependent young. If there are concerns about trap performance, trail cameras can be used to record behaviour in and around traps. Cameras can help to improve efficiency and welfare and minimise the risk of non-target captures.

Dealing with capture and dispatch

Check the trap to see if any (or how many) squirrels have been caught, only removing the cover if necessary. If you will be handling the squirrel(s), wear gloves, preferably waterproof, to minimise the risk of bites, scratches or exposure to infection. Trapped squirrel(s) can be killed humanely by cranial dispatch, the use of a spring trap in partnership with a live capture trap, or by shooting at close range through the trap with an air gun.

Cranial dispatch

- Keep the trap covered until the squirrel is to be removed.
- Remove the squirrel from the trap using a hessian sack. Ensure the sack has no holes that could allow it to escape.
- When there is more than one squirrel in the trap, replace the trap cover as each squirrel is transferred to the sack.
- Use one or two trapping combs to persuade the squirrel to move along the trap (Figure 11). Place the second comb between the first comb and the squirrel, repeating this until the squirrel is confined to one position in the trap. A second comb is useful to prevent any other squirrels from escaping, if present.
- Place the open end of the sack around the trap exit door (if fitted), or over the open end of traps. Wrap the sack tight to form a seal around the exit and roll it to form a tunnel so that a squirrel can see its way into the sack. The exit door can then be opened to enable the squirrel to move into the sack. If there is more than one squirrel in the trap, close the door quickly to prevent another squirrel being transferred.
- Gently blow on the squirrels if they are reluctant to leave the trap. You should also position yourself so as not to deter the squirrel from moving towards the exit of the trap.
- Once a squirrel is in the sack, move it to one bottom corner by rolling the sack material. Carefully position the head within the corner and hold the sack firmly behind the squirrel to prevent it moving.
- Dispatch the squirrel rapidly and humanely by a single blow to the back of the head with a blunt instrument.

Figure 11 Trapping combs are used to separate squirrels in traps before removal or to position them for dispatch.

Spring trap used with a live capture trap

- Use a trapping comb to restrain the squirrel at the back of the live capture trap.
- Arm the spring trap and securely attach it to the live capture trap using spring hooks or bungie cords (Figure 12). Restricting the entrance to a 10 cm x 10 cm hole will ensure the squirrel is perfectly positioned to trigger the dispatch mechanism.
- Lock the door open with a wooden dowel and release the trap comb. The squirrel should run towards the spring trap and be dispatched cleanly.

Figure 12 A few minor alterations to the Kania 200 spring trap housing allow it to be fitted tightly to the entrance of a live capture trap. The back of the housing can also be cut out and a perspex window inserted to encourage the squirrel to run towards the light.

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Shooting

- Keep the trap covered until you are ready to shoot.
- Ensure that you position the muzzle of the air gun inside the cage and that the animal is motionless, to reduce the risk of injury to the squirrel or any pellets being deflected.
- Implement the guidance in Trap maintenance (page 14) for hygiene to ensure that there is no blood left in the trap to deter other squirrels or to pose a risk of disease transfer.

After the squirrel has been removed and dispatched, check the trap mechanism and reset the trap. Replace the exit door on multi-capture traps. Replenish the maize bait and replace the cover. See Handling carcasses and diseased squirrels (page 15) for guidance on dealing with dispatched squirrels.

Spring (tunnel) trapping

Spring traps typically have spring-tensioned jaws that will forcefully close around an animal and quickly kill it when the trap is activated. The trigger mechanism may be the depression of a treadle or movement of a wire.

There are three kill traps that are commonly used for the control of grey squirrels. These are the Mark IV Fenn (or springer), BMI Magnum Bodygrip 116 and Kania 2000. The first two designs must be set either in a natural or artificial tunnel, and these are often placed within specially designed wooden boxes with a 60 mm diameter entrance hole.

The Kania 2000 is fixed directly onto a wall, tree trunk or wooden post. Users should be aware that it will become illegal to use these traps on stoats from 1 April 2020 (1 January 2020 in Scotland); however, provided steps are taken to avoid by-catch, they can continue to be used on squirrels.

Spring traps can be deployed at similar intervals within woodland to that prescribed for live traps. It is worth noting that live traps may be entered more readily than tunnels or boxes containing spring traps. Welfare is also an important consideration when choosing a trap, as animals may be confined in live capture traps for some time, whereas spring traps obviously minimise this risk.

Spring traps can be baited with hazel nuts, sunflower seed and maize in order to draw animals to a location and improve trap efficiency, although this will also attract non-target species. It is important that any bait does not disrupt the trap mechanism. Grey squirrel bodies should be removed from traps as soon as possible and it is advisable that they should not be discarded in the vicinity of any trap.

Only trap designs that have been approved under the Spring Traps (Approval) Orders may be lawfully used and then only to target those species which are listed at:
www.legislation.gov.uk/uksi/2018/1190/schedule/made

The order was updated in 2018, bringing changes to the list of approved designs that came into force in 2019 (for new designs) or 2020 (for withdrawn designs). Users are advised to check the orders for any further updates that may be introduced.

Traps must be used in accordance with manufacturers' guidelines and it is advisable that operators obtain appropriate training beforehand. Trapping must, where possible, avoid the capture of non-target animals and especially of protected species.

Spring traps must not be used in woodland where red squirrels or pine martens are likely to occur.

Spring traps should be positioned with care and inspected at least daily to ensure that they function correctly. Mark IV Fenn traps must be placed in a depression created in the tunnel floor so that the trigger plate is level with the ground. Failure to ensure this may result in squirrels being trapped by their limbs.

BMI Magnum 116 traps can be set in tunnels but may be more effective in Fineren boxes (Figure 13), which standardise both trap orientation and position of the trigger mechanism relative to the direction from which a squirrel can approach. Modification of the trap housing with plastic tabs (arrowed) prevents avian by-catch. The use of tree-mounted boxes rather than tunnels minimises the potential of catching hedgehogs, stoats and weasels.

Figure 13 A Fineren box for housing a Magnum 116 trap. Flexible tabs made of building damp-proof membrane can be stapled beneath the lower hole in the Fineren box to prevent songbirds from accessing the chamber containing the trap.

Self-resetting traps

Automatic humane traps for squirrels (e.g. the Goodnature A18) are designed to humanely kill an animal entering the trap with a blow to the head. The trap is powered by a small CO_2 cylinder and is self-resetting. It is therefore capable of killing at least 18 animals (on one 16 g CO_2 canister) before cylinder replacement is needed on a six-monthly basis, which also aligns with the lure replacement cycle. However, this type of trap is a relatively new innovation and there is little evidence yet relating to its effectiveness on grey squirrels, or effects on non-target species. If used, the trap should be placed on trees above ground level to minimise the risk to hedgehogs and they should not be used where red squirrels or pine martens occur.

Trap maintenance

When traps are deployed it is important to check that no metal edges or mesh have become damaged so that they could injure a confined animal. Springs must be operating freely and if a spring is damaged or has lost tension then it must be replaced. To minimise the risk of infectious diseases being spread between individuals and between different species, it is good practice to carry an anti-viral disinfectant in a hand sprayer and to spray live capture traps after an animal has been confined.

When trapping grey squirrels in habitats containing red squirrels, a trap containing a captured grey squirrel should be taken 20–30 m from the trapping location, the grey squirrel killed (see dispatch methods) and the trap cleaned with anti-viral disinfectant before placing it back in its original position. This will minimise the exposure of red squirrels to infection from grey squirrel blood or tissues.

After trapping operations have been completed, traps should be washed with disinfectant, thoroughly checked for damage and repaired as required. Stored traps must have any sliding doors removed and all other doors secured open or closed to prevent animals and birds being inadvertently captured. Traps with lift doors should be stored upside down.

Poor trapping success

Squirrels are typically most trappable from March to July in broadleaved woodlands but can be trapped from as early as December when natural food is low. In the autumn when there is a large amount of tree seed, it can be difficult to draw animals to traps. However, grey squirrels are selective feeders and the use of alternatives to maize such as walnuts, hazel nuts and other high quality food items used as trap bait can entice animals to enter even at these times. Using a longer pre-bait period can improve capture success in conifer woodlands.

The use of bait invariably attracts other animals and this can reduce capture success. Larger mammals, in particular, can move traps, and it is important to top up bait regularly to ensure that there is sufficient to continue to attract squirrels and to provide food for animals once trapped. Appropriate remedial measures, such as placing traps in trees, can be taken, depending on the species involved (see Table 3 on page 11).

The use of single-capture traps with entry doors that are held open when set can be more enticing for squirrels to enter than traps with lift doors. In addition to periods of abundant natural food, heavy rain, high winds and poor choice of trap position can affect trapping success. If a trap has previously caught a stoat or weasel, it should be thoroughly cleaned as the strong musky smell may deter squirrels. Sometimes grey squirrels will regularly visit a trap but do not enter. In these circumstances, either moving the trap to a new site 10–20 m away, or turning the trap around 180 degrees, is often sufficient for it to then catch.

Shooting

Although it is often easier to shoot in late winter or early spring, it can be carried out at any time of year and can be selective enough for the removal of grey squirrels from areas occupied by red squirrels. Shooting may be used as a control method in its own right or used in conjunction with a trapping programme, as it can help to reduce squirrels that are reluctant to enter traps when natural food is abundant.

Traditionally, shooting is done in tandem with drey poking. Long poles are used to disturb dreys, and any squirrels that are flushed out can be shot. The best times for this activity are wet rainy days during winter months, when broadleaved trees have no leaves and when squirrels will be sheltering in dreys. This activity may need to be repeated on subsequent days since squirrels concealed in tree holes can avoid detection.

! Avoid drey poking in areas where pine martens and red squirrels are present; these animals may also use grey squirrel dreys.

An alternative approach to control has been developed that uses fixed, monitored feeding stations to attract squirrels to the area where they can be shot (Figure 14). This method of control removes grey squirrels quickly without any adverse effects upon non-target species. The standard safe practice for setting up and

Figure 14 Feeding stations are pre-baited with whole maize, which may be mixed with small amounts of nuts and seeds.

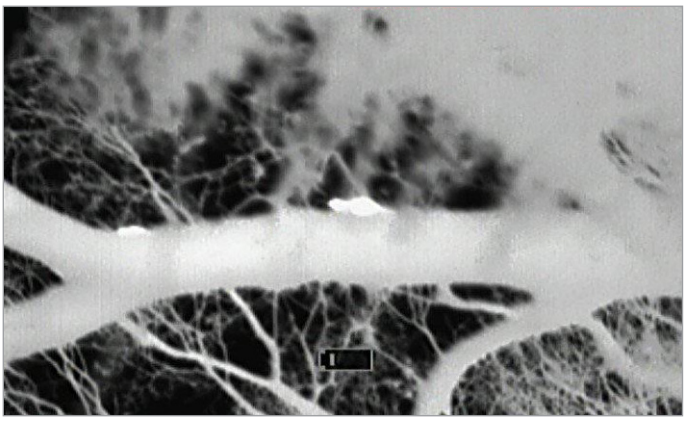
using feeding stations includes risk assessment, establishing a safe back-stop and a fixed shooting position. If a natural safe back-stop cannot be established in the area then a substantial wooden board or metal plate may be used as an alternative.

Unfortunately feeding stations create a risk of disease transfer by attracting both red and grey squirrels to the same site. It is important that feeding equipment is regularly disinfected with an anti-viral solution; if both species are seen at the same station then it may be advisable to cease feeding altogether.

Thermal imaging

The efficiency of shooting can be enhanced using a thermal imaging device. Thermal imaging detects radiant heat energy and converts the heat signature onto a visual screen (Figure 15). Warm bodied animals are revealed more quickly and at much greater contrast than that achievable with natural vision or binoculars. Once the presence and location of a squirrel have been determined using this technique, distinguishing red squirrels from grey requires additional observation by a spotter – either by eye or using binoculars. Thermal imagers will detect squirrels at greatest distances (100 m is possible) when used in broadleaved woodland during winter; however, they can be used to good effect in any woodland type at any time of year.

Figure 15 Grey squirrels in a woodland canopy, revealed by thermal imaging.



Handling carcasses and diseased squirrels

Grey squirrels do not normally show any symptoms of infection from the squirrelpox virus, but if a local outbreak is known or suspected, or if the carcasses are suspected of being infected with other communicable diseases, then they must be sent for incineration or rendering. Seek advice from the local office of the statutory veterinary service to establish the local risk of infectious disease. You should also contact the local squirrel control group to ensure that information and appropriate control measures can be coordinated.

Squirrels killed away from areas of infection risk and not showing any symptoms of infection may be treated as carrion and either left in the woodland, composted or buried at the location killed. If any red squirrels showing symptoms of squirrelpox virus (scabs around the eyes, nose, mouth and feet) are found, they should (if dead) be sent to the statutory veterinary service for investigation, or if alive, taken to a nearby veterinary practice. Infectious individuals should not be re-released.

The Moredun Group carries out testing for the squirrelpox virus. For more information, see: **www.moredun.org.uk**.

For more advice on disease risks, see:
apha.defra.gov.uk/vet-gateway/surveillance/seg/wildlife.htm

Programme monitoring

Monitoring the effectiveness of control will be informative for both current and future operations. For example, changes in the number of captures per trap each night during the programme gives an indication of the impact of trapping on the squirrel population; it can also help to reveal traps that are not being visited by squirrels so they can be moved to new locations. Record-keeping may be a requirement if a grant for control is being sought.

Records should include maps of the control areas and the locations of traps and bait stations, as well as a count of the number of traps used, their locations, number of days and dates trapped, or when shooting was undertaken, and numbers of squirrels killed.

UKFSTN022/FR(ECD)/WWW-1K/DECL19

Useful sources of information

Forestry authority publications

- The UK Forestry Standard (UKFS)

Guidance and good practice

- Nearest neighbour method for quantifying wildlife damage to trees in woodland. Practice Note (FCPN001)
- The prevention of mammal damage to trees in woodland. Practice Note (FCPN003)
- Red squirrel conservation. Practice Note (FCPN004)
- Practical techniques for surveying and monitoring squirrels. Practice Note (FCPN011)

Other publications

- Grey squirrels in parks, urban woodlands and amenity plantings. Arboricultural Practice Note 7. Arboriculture Advisory and Information Service, The Tree Advice Trust.
- Grey squirrel management action plan for Wales. Welsh Government.
- Northern Ireland Squirrel Forum Standard Operating Procedure: Control of grey squirrels for red squirrel conservation.

Statutory Acts and Orders

- Animal Welfare Act 2006
- Destructive Imported Animals Act 1932
- Nature Conservation (Scotland) Act 2004
- Pests Act 1954
- Spring Traps (Approval) Orders (England) and (Scotland) 2018 and (Wales) and (Northern Ireland) 2019
- The Animal By-Products Amendment (Scotland) Order 2001
- Wildlife and Countryside Act 1981
- Wildlife (Northern Ireland) Order 1985 (as amended)

Training and further advice

For support with grey squirrel management:

- The British Association for Shooting and Conservation: **www.basc.org.uk**
- European Squirrel Initiative: **www.europeansquirrelinitiative.org**

For support with red squirrel conservation:

- UK Squirrel Accord: **www.squirrelaccord.uk**
- Northern Red Squirrels: **www.northernredsquirrels.org.uk**
- Saving Scotland's Red Squirrels: **www.scottishsquirrels.org.uk**
- The Northern Ireland Squirrel Forum: **www.daera-ni.gov.uk/landing-pages/northern-ireland-squirrel-forum-nisf**
- Red Squirrels Northern England: **www.rsne.org.uk**

For training in methods of squirrel control:

- The British Association for Shooting and Conservation: **www.basc.org.uk**

The guidance in this Technical Note was compiled by Robin Gill and Mark Ferryman (Forest Research); Craig Shuttleworth (Bangor University); Peter Lurz (Royal (Dick) School of Veterinary Studies, University of Edinburgh); Aileen Mill and Peter Robertson (Newcastle University); and Charles Dutton (Pryor & Rickett Silviculture).

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Enquiries relating to this research should be addressed to:

Dr Robin Gill
Forest Research
Alice Holt Lodge
Wrecclesham
Surrey GU10 4LH

+44 (0)300 067 5900

robin.gill@forestresearch.gov.uk
www.forestry.gov.uk/forestresearch

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