

RED SQUIRREL CONSERVATION: FIELD STUDY METHODS, by John Gurnell and Harry Pepper

Summary

This Note describes methods of studying red squirrels in the field. Indirect methods include time–area observation counts, hair tube surveys, squirrel feeding signs, drey counts and inspection of nest boxes. Trapping and radio tracking are the principal direct methods. The application of these techniques is important to the understanding of how these vulnerable animals may be conserved.

Background

1. Red squirrels (*Sciurus vulgaris*) have disappeared from large areas of central and southern England and much of Wales, and they remain vulnerable in the north of England and Scotland (Gurnell and Pepper, 1991, 1993). In the interests of their conservation, information on the distribution and abundance of red and grey squirrels is urgently needed. There are a number of ways in which amateur and professional biologists can help by studying squirrels in the field. Some of these are indirect and do not involve contact with squirrels; others are direct and involve trapping and handling animals. This Note offers practical advice on carrying out these sorts of field study. Methods can be modified to take into account local circumstances, such as the number of people who can help with the work.

The law

2. The red squirrel, *Sciurus vulgaris*, is a fully protected species under the Wildlife and Countryside Act 1981, and a licence is required from the appropriate government agency (English Nature, Countryside Council for Wales, Scottish Natural Heritage) if any planned study is likely to interfere in any way with red squirrels or their nests. Information on grey squirrels and the law is provided by Pepper (1990).

Red squirrel/grey squirrel identification

3. Surprisingly, it is not always easy to distinguish red and grey squirrels by visual appearance alone, even though adult grey squirrels are about a third larger than red squirrels (Table 1). In particular, general fur colour is not a reliable guide.

Table 1. The dimensions of adult squirrels		
	Red squirrel	Grey squirrel
Head and body length (mm)	180–200	240–290
Tail length (mm)	140–200	190–240
Hind feet length (mm)	55	>60
Body weight (g)	280–350	450–650

4. The dorsal coat of red squirrels varies considerably in colour from grey to brown or dark brown, or from sandy to bright red; frequently the tail may be darker than the rest of the coat. The underside is whitish. During the autumn the ears grow long tufts which are at their finest in mid-winter; during the spring they thin and by the summer the tufts have largely disappeared.
5. The underside of grey squirrels is white or pale grey and the sides, limbs and paws are often reddish-brown. The underfur is grey but the longer guard hairs have characteristic salt-and-pepper appearance from their grey bases, black and brown shafts and white tips. Grey squirrels never have prominent ear tufts.

Indirect survey methods

Time-area observation counts

6. The presence, distribution and relative abundance of red and grey squirrels in a forest can be determined by a team of observers, consisting of up to 10 people, using standardised time-area counts. Surveys carried out each season for a number of years can determine changes over time. Survey lines, 800 m to 1000 m long, are selected along rides or inspection racks, or between rows of trees within suitable squirrel habitat, at a density of about one line per 100 ha. Each line is walked by single observers on specified days of the year, starting as soon after first light as possible, which is when squirrels are most likely to be active. Five-minute stops are made at 100 m intervals along each line and it should take approximately five minutes to walk each 100 m. A record is made when walking and when stopped of all squirrel sightings. If the weather is unsuitable (heavy rain, strong winds or very cold) squirrels are unlikely to be very active, and the survey should be postponed.

Hair tube surveys

7. The collection of squirrel hairs in tubes is a simple and inexpensive way of identifying the presence of red or grey squirrels in an area. Three hundred mm lengths of 75 mm diameter PVC drain pipe, with double sided sticky tape put inside the tube at the top or on one side, are strapped to branches at a convenient height, and sunflower seed and maize placed in them. The tube may be blocked at one end or left open for the squirrel to pass through. Alternatively, food hoppers with a tunnel entrance may be used. As the animals enter the tubes to get the food, they leave some of their hairs on the tapes which are removed for later examination. It is not possible to separate red and grey squirrel hairs on the basis of colour, and they also have similar cuticle scale patterns and medullas. The cross-section is the only characteristic that is different; red squirrel hairs have a concave or a dumb-bell shaped cross section whereas grey squirrels have a round one (Figure 1).
8. The type of cross-section can be most easily seen using the technique of negative staining (Dagnall *et. al.*, in press).
 - a. Place the tapes in warm water containing a strong detergent and leave to soak overnight.
 - b. With forceps, remove at least 10 representative hairs from each identifiable cluster of hairs, avoiding very fine, small underfur hairs.
 - c. Only use complete hairs and measure the length from bulb to tip. Make a note of the colour bands along the hair. A binocular microscope at x80 is useful here. Hairs <15 mm long should be discarded; these will be from mice or voles.
 - d. Make up a 5:1 solution of Indian ink:water. Place two or three hairs on a slide together with a few drops of ink solution. Cover with a coverslip and examine using a light microscope (x400 is best). Look at the hairs at their widest part (i.e. the shield region). Ninety-five percent of mounts which show a continuous dark band along the hair are red squirrel hairs. Hairs which show no banding could be grey squirrel, polecat, pine marten, stoat or weasel.

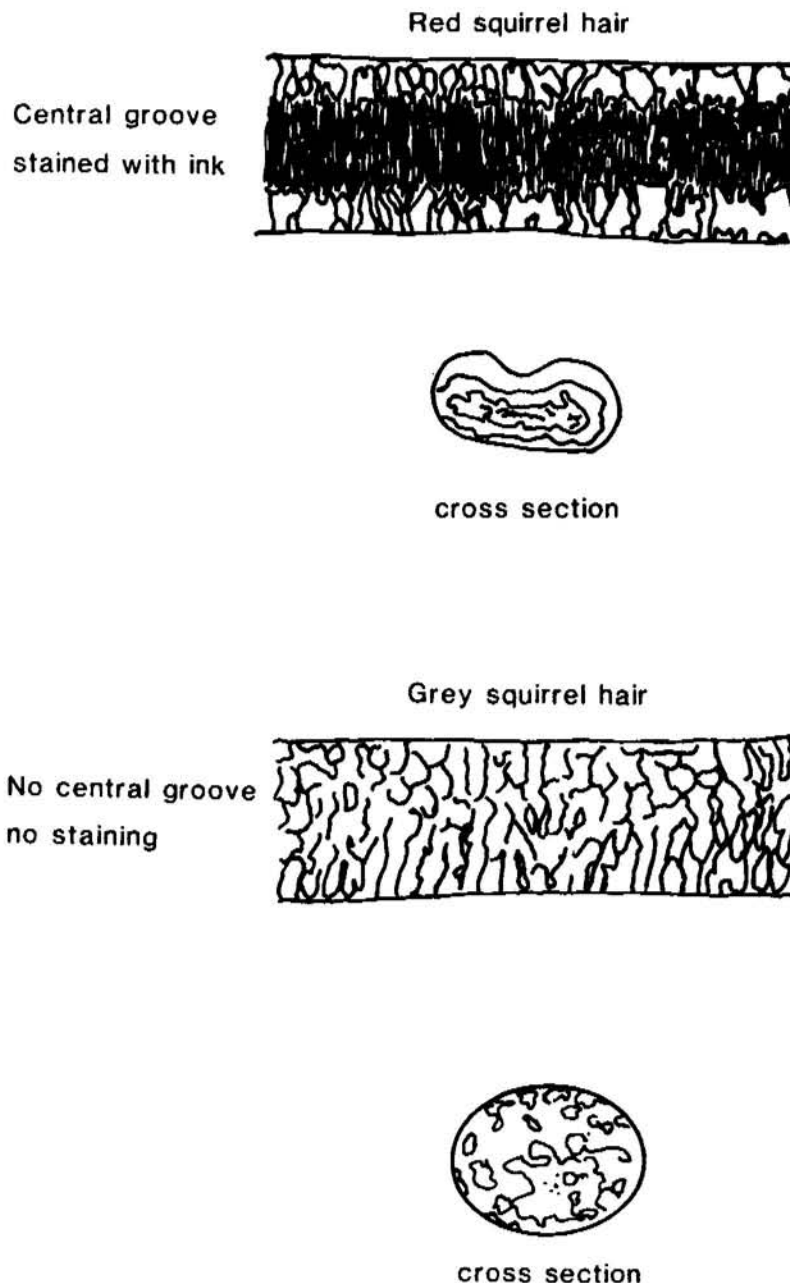


Figure 1. Cross-sections of red and grey squirrel hairs.

Squirrel feeding signs

9. In conifer forests, a systematic assessment of the remains of complete cones and cone cores fed on by squirrels can provide good information on the timing and spatial distribution of conifer seed availability, and on habitat-use by squirrels. There appears to be little difference between feeding signs made by red and grey squirrels.
10. To sample cone cores, quadrats or line transects are marked out on the forest floor. Transects require less effort to manage and are therefore more frequently used. Each transect consists of a measured line, 50 m x 1 m marked with small sticks. The lines do not necessarily have to be straight, and should not avoid natural objects such as logs or stumps. The transects are raked to bare earth to remove all complete cones and cone cores. Each transect line is visited at regular intervals to remove and count all fresh complete cones and cone cores. The number of cores taken at each visit is recorded and this provides a measure of the intensity of feeding between successive inspection dates. After each visit the transect line is raked clean.

11. An estimate of the quantity of seed eaten can be obtained by measuring the length of the cone cores, as there is a relationship between the number of seeds in a cone and the cone length for each tree species in a locality. It will be necessary, initially, to establish this relationship by collecting a sample of up to 100 ripe cones, measuring their length and extracting and counting the number of seeds contained in each.
12. The number of line transects required for an assessment will depend on the area of forest, the mix of tree species and the resources available. One line every four hectares is a reasonable guide. Cone producing trees can be patchily distributed throughout a plantation, and edge trees generally produce more cones than centre trees. Where possible, lines should cross the most important cone producing area. Squirrels will use different feeding areas at different times of the year, but this will become clear as the studies progress.
13. The presence of squirrels can be determined from the remains of yellow whole maize put out as feed or bait for traps or hair tubes. Squirrels, both red and grey, are the only species to remove the germ from the maize grain and discard the rest intact.

Drey counts

14. The density of winter dreys can be used as a crude index of squirrel numbers and it may be particularly useful as a relative measure of habitat-use. Only winter dreys should be counted. It is important to distinguish squirrel dreys from bird nests as crows, magpies and some raptors build large nests made of twigs (Table 2).

Table 2. Characteristics of squirrel dreys and bird nests		
	<i>Squirrel</i>	<i>Bird</i>
<i>Close to a main tree stem with support from one or more side branches</i>	+	—
<i>>50 cm diameter and >30 cm deep</i>	+	+
<i>Twigs with leaves attached</i>	+	—

15. February and March are the best months to count dreys as winter dreys in regular use will appear well maintained – dreys not in use will look derelict – and dreys in broadleaved trees are easy to see at this time.
16. Drey counting is most effectively done by several observers walking 25 m apart through the forest in line abreast and in view of each other. All the dreys to either the left or the right of an observer up to the next observer are counted. The total number of dreys are then related to the area of forest searched. An underestimate of the number of squirrel nests present will occur in over-mature broadleaf woodlands, where squirrels build dens in tree cavities, and in mixed or conifer woodlands, in which dreys are far more difficult to spot because of the dense foliage.
17. The drey densities may be used as a relative measure of habitat-use, as a comparative measure between habitats, and/or as a comparison from one year to the next, although the problems of drey visibility need to be considered. The estimated drey numbers may be converted to crude indices of winter squirrel densities by using established relationships from the literature (Table 3).

Table 3. Estimating squirrel densities from drey counts

Red squirrels

Number of red squirrels per hectare = number of dreys per hectare x 0.26

(From data in Wauters and Dhondt (1988), from a variety of coniferous and deciduous woodland types in Belgium. Counts were mostly made in November.)

Grey squirrels

Number of grey squirrels per hectare = number of dreys per hectare x 0.74

(From data in Don (1985), from a variety of deciduous forests in southern England. Counts were made between January and May.)

Nest boxes

18. Owl nest boxes are sometimes used by squirrels and a modified tawny owl box made out of rough sawn timber has successfully been used as a red squirrel box (Figure 2). They should not be used where both red and grey squirrels are present since grey squirrels will use boxes as much as, if not more than, red squirrels. Boxes are secured to a tree with either aluminium or copper nails at a height of six to eight metres, at a density of at most one every two hectares.

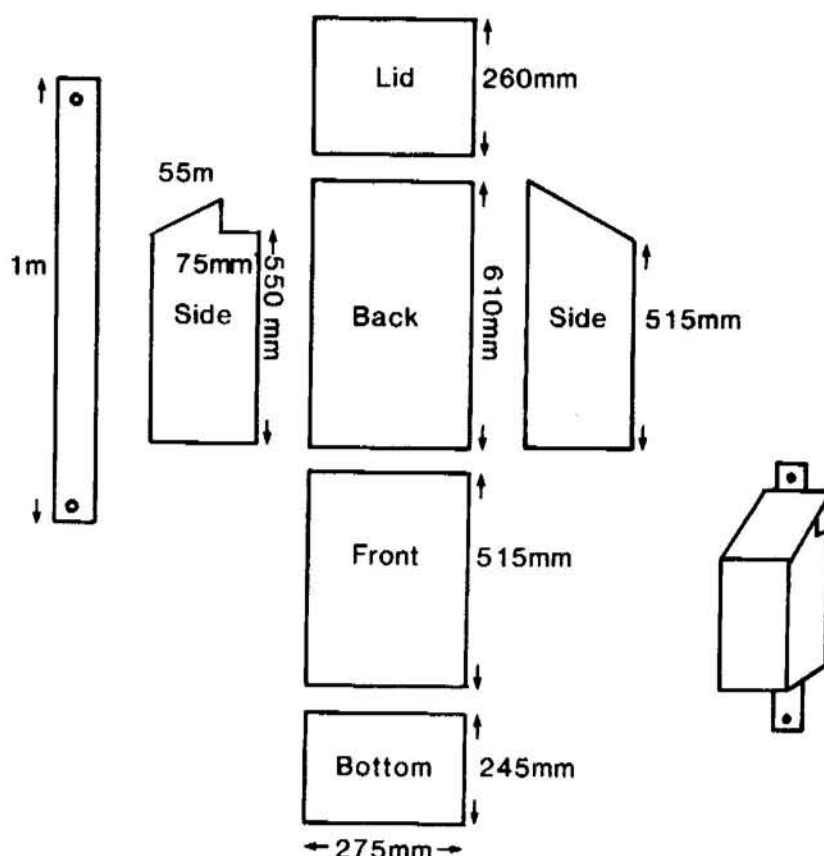


Figure 2. Nest box.

19. The boxes should be inspected periodically, for which a licence is required. Open the boxes carefully using gloves, since a resident squirrel may bolt when the lid is lifted. Nest box records should be made at intervals on the presence, amount and type of nesting material found (e.g. twigs, leaves, grass or moss). A small sample of the inner lining of any rooting material found can be removed for later examination for the presence of hairs. Well made dreys and the presence of live fleas in the drey lining suggest the box is currently in use. Nests with young red squirrels may also be found; the young should NOT be touched or disturbed.
20. Squirrels have been known to make more use of nest boxes during the breeding season, in spring and summer, than in the winter. It is not yet known if nest boxes improve red squirrel population breeding success or survival, and therefore how useful they are.

Direct survey methods

Trapping

21. There are several types of live trap available to catch red squirrels. The recommended design is a mink trap modified by adding a nest box (Figure 3). The traps are placed approximately 100 m apart on baseboards attached to trees at a height of three or four metres or fixed to two 1.5 m fencing stakes. Place peanuts, sunflower seeds, maize, wheat or, especially, hazel nuts inside the trap and secure the door in the open position for 10 to 14 days before the trap is set. Initially, scatter bait on the ground five to ten metres from the trap and replenish bait every three or four days, but progressively reduce the area of scatter until the day of setting when only the entrance of the trap is baited.

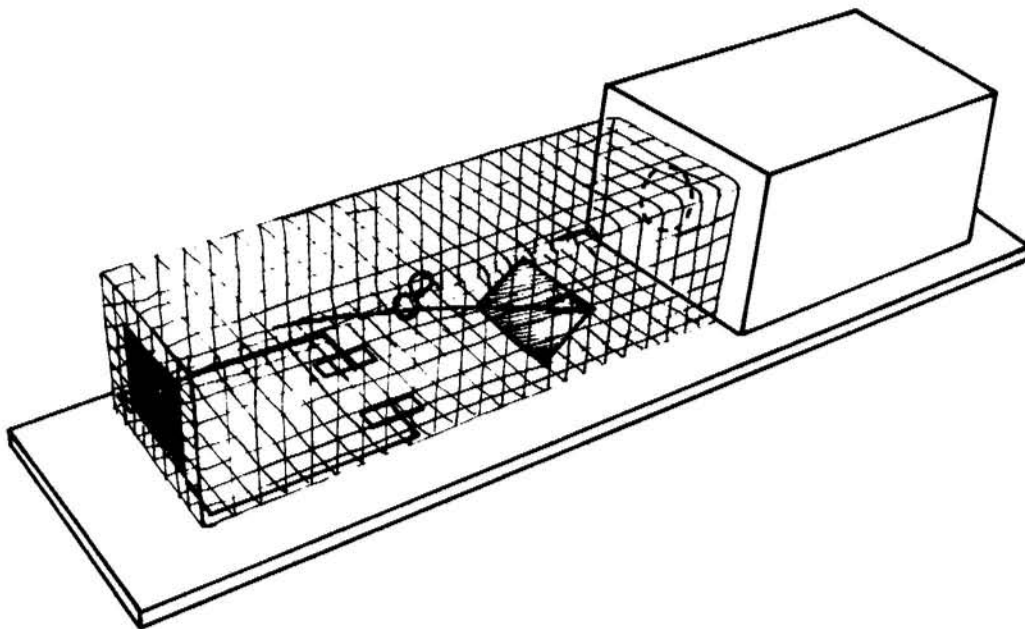


Figure 3. Live trap.

22. Once the trap is set there is a legal requirement to visit and check the trap daily, but two visits a day are recommended when trapping red squirrels to minimise stress. Trapping is usually carried out for four or five days. Red squirrels can be difficult to trap, especially in some types of habitat such as mature conifer forests, or at certain times of the year when there is seed available on the trees. It may be necessary to continue trapping for several months before captures become frequent. Grey as well as red squirrels are captured in mink traps. If only grey squirrels are required use Legg multicapture ground traps set at a density of about one per hectare, as red squirrels rarely enter this trap.
23. Handling trapped animals requires care and skill to ensure that the squirrel is not harmed. Remove squirrels by placing a sack over the rear door of the trap and gently persuading the animal into the

sack. Once in the sack the animal can be removed using a gloved hand, or manoeuvred into a handling cone (Figure 4). Squirrels can be marked in two ways: for permanent marking use numbered ear tags; for temporary marking, use fur marking with Durafur black (Figure 5), bleach (Rice-Oxley, 1993), or trimming the tail (Figure 6). The animal may also be weighed and its breeding condition recorded: the size of the testis in males; whether females are lactating; abdominal swelling indicating pregnancy; and a pink and swollen vulva indicating a female in oestrus. The visual characteristics of breeding condition found in squirrels are similar to those described in other small rodents (Gurnell and Flowerdew, 1990).

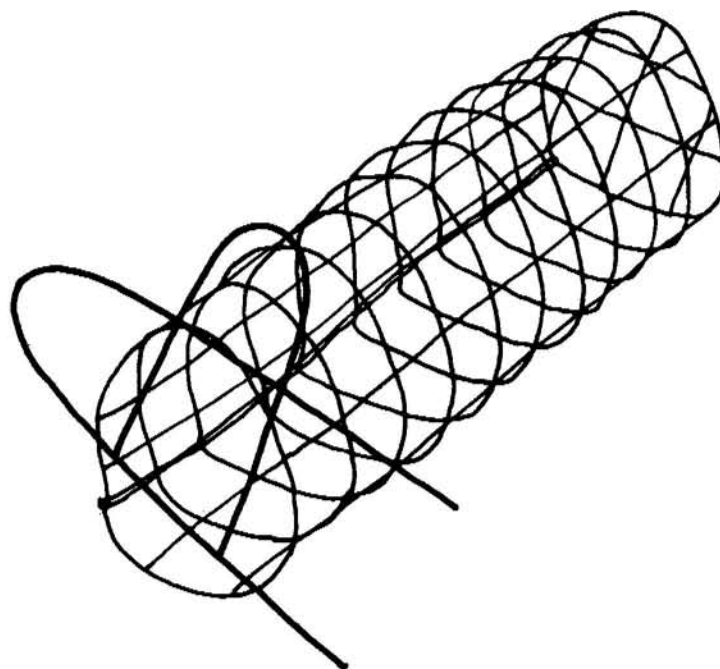
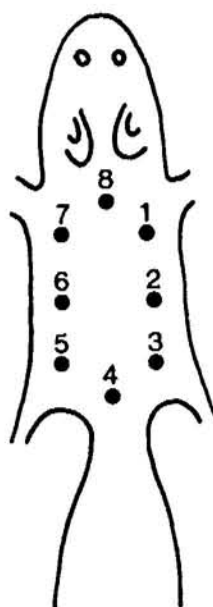


Figure 4. Handling cone.



Squirrels

Numbering sequence:

1 to 8

then 1.2, 1.3, etc
2.3, 2.4, etc

1.2.3, 1.2.4, etc

(192 animals marked)

The numbers can be doubled
by marking 0 and 0 separately.

Figure 5. Fur marking positions and sequence.



Figure 6. Squirrels with tail marking.

Radiotracking

24. Radiotracking is used to study red squirrel movements. Collars for red squirrels with radiotransmitters emitting a pulsed signal are available commercially. Transmitters with built-in thermistors are particularly useful as they show by their pulse rate whether a squirrel is active or in its drey. The radios transmit for up to 15 months. A radioreceiver with a directional aerial is used to track the squirrels across distances of 400 to 800 m. If the squirrels are to be anaesthetized before fitting the collars, a Home Office licence is required. Up to 20 squirrels can be radiotracked at the same time, although 10 is a more manageable number for one person tracking on foot. A detailed map of the forest is needed.
25. Squirrels are tracked by triangulation taking compass bearings on the direction of the strongest signal from at least two predetermined fixed points (Pride and Swift, 1993). However, the signals can bounce around off trees making it difficult to pinpoint the true direction of the animal, and squirrels can move considerable distances between successive fixes. Another method is to follow the direction of the strongest signal until the actual position is found, but care must be taken not to disturb the squirrel. It is usual to obtain between three and six fixes of an animal, at two to four hour intervals, each day for five to ten days; the times should be staggered each day, to get a true picture of the home range, of the habitat utilisation and of the location of the night-time dreys.

Literature sources and further information

- DAGNALL, J.L., DUCKETT, J.G. and GURNELL, J. (in press). A simple negative staining technique for the identification of mammal hairs. *Journal of Zoology*.
- DON, B.A.C. (1985). The use of drey counts to estimate grey squirrel populations. *Journal of Zoology*, **206**, 282–286.
- GURNELL, J. and FLOWERDEW, J.R. (1990). *Live trapping small mammals: a practical guide*. Occasional Publication Number 3. Mammal Society, London.
- GURNELL, J. and PEPPER, H. (1991). *Conserving the red squirrel*. Research Information Note 205. Forestry Commission, Edinburgh.
- GURNELL, J. and PEPPER, H. (1993). A critical look at conserving the British red squirrel *Sciurus vulgaris*. *Mammal Review*, **23**, 127–137.
- PRIDE, J.G. and SWIFT, S.M. (1994). *Wildlife telemetry: remote monitoring and tracking of animals*. Ellis Horwood, Chichester.
- PEPPER, H.W. (1990). *Grey squirrels and the law*. Research Information Note 191. Forestry Commission, Edinburgh.
- TEERINK, B.J. (1991). *Hair of west European mammals*. Cambridge University Press, Cambridge.

RICE-OXLEY, S.B. (1993). Caching behaviour of red squirrels, *Sciurus vulgaris*, under conditions of high food availability. *Mammal Review*, **23**, 9–100.

WAUTERS, L. and DHONDT, A.A. (1988). The use of red squirrel (*Sciurus vulgaris*) dreys to estimate population density. *Journal of Zoology*, **214**, 179–187.

Useful addresses

Traps	Fuller Engineering Ltd., Falcourt, East Grinstead, West Sussex, RH19 2JY. Males, Warners Lane, Selsey, West Sussex, PO20 9EL.
Hopper	Alpe Thermo Products Ltd., 24 Willsbridge Hill, Willsbridge, Bristol, BS15 6EY.
Ear tags	Dalton Supplies Ltd., Nettlebed, Henley-on-Thames, Oxfordshire, RG9 5AB.
Balances	Most suppliers of laboratory equipment.
Radiocollars	Biotrack, Stoborough Croft, Grange Road, Wareham, Dorset, BH20 5AJ.
English Nature	Northminster House, Peterborough, PE1 1UA.
Scottish Natural Heritage	2 Anderson Place, Edinburgh, EH6 5NP.
Countryside Commission for Wales	Plas Penrhos, Fford Penrhos, Bangor, Gwynedd, LL57 2LQ.

Issued by:
Research Publications Officer
The Forestry Authority, Research Division
Alice Holt Lodge, Wrecclesham
Farnham, Surrey GU10 4LH

September 1994

© Crown copyright 1994

ISSN 0267 2375

NOT TO BE REPRODUCED WITHOUT FORESTRY COMMISSION PERMISSION

Phototypeset and printed by: Forestry Commission, 231 Corstorphine Road, Edinburgh EH12 7AT