FES licence for managing red squirrels during forest operations

Scottish Natural Heritage (SNH) has issued Forest Enterprise Scotland (FES) with a single licence to cover forest management activities that may affect red squirrels on the national forest estate (NFE). This is in accord with the Scottish Biodiversity Strategy's aim to resolve species management issues. This document details the processes that FES will follow and the mitigation actions that will be used as conditions of this licence.

Introduction: Red squirrels are present in the majority of Scotland's productive forests. Therefore, for the country to have an economically viable forestry sector, it is inevitable that forest operations will impinge upon a small proportion of the red squirrels and their dreys each year. At a national level, however, forestry and forest management are overwhelmingly beneficial for red squirrels (see Appendix 1), because they create and maintain a huge amount of suitable habitat. Thus, the favourable conservation status of squirrels across their natural range in Scotland depends upon the forestry sector.

This document explains how the site-level negative impacts of forestry on red squirrels will be mitigated in a proportionate way. The focus is on minimising the impact on individual squirrels. Adult squirrels are not harmed directly by forest operations, but dependent young in dreys during the breeding season could be at direct risk. Red squirrels are protected by the Wildlife & Countryside Act (1981). It is an offence to damage, destroy or obstruct access to any structure or place which a red squirrel uses for shelter or protection (a drey). However, under licence from SNH, it is possible to carry out activities that could otherwise be illegal, provided the activities contribute to significant social, economic or environmental benefit. Forest management work is of recognised importance and it is in the public interest because it confers benefits upon society in Scotland. Tree felling and restocking result in significant economic and environmental benefit, both locally and nationally. Therefore, these activities are licensable, provided the work is done as part of a formal, approved plan (e.g. FES Land Management Plan).

The squirrel breeding season stretches from February to September inclusive. The decision to work in a red squirrel forest during the breeding season must be based upon an objective assessment of the likely impact on squirrels, and upon a demonstration that there is no satisfactory alternative. Typically, the satisfactory alternative will be to reschedule the operation to work outside the breeding season. This can seem like a straightforward decision to stakeholders, so the justification for working within the squirrel breeding season must be robust.

The flowchart below outlines the stepwise, decision-making process that FES staff should follow when planning and carrying out tree-felling operations in forests with red squirrels.

Using the licence – Roles and Responsibilities

The SNH licence is issued to FES staff and allows them to give permission to contractors and machine operators to carry out otherwise illegal activities. To be covered by the licence, those contractors and machine operators must adhere to the requirements of the appropriate Mitigation Package. The responsibilities of all those involved are described below.

FES Decision Maker – The FES Decision Maker is the person who is responsible for deciding whether to go ahead with an operation and upon the appropriate mitigation. This will normally be a staff member from Environment, usually in liaison with FES Operations staff. The FES Decision Maker must ensure that those people carrying out the works understand the terms of the licence, and the necessary mitigation, in order to be covered by the licence. Their key responsibilities are therefore as follows:

1. Follow this guidance to decide upon the appropriate Mitigation Package
2. Inform all necessary contractors and/or machine operators of:
    - The requirements of the appropriate Mitigation Package;
    - Their responsibility as agent(s) on the licence;
    - The locations any dreys if know, or areas thought to have dreys;
    - Any restrictions on start or end dates, any geographical limitations, and any site-specific mitigation.
3. Record details of the operation and the justification for going ahead with the operation in the Squirrel Licence Assessment Spreadsheet.
4. Consulting with the FES Species Ecologist as necessary.
5. Compliance monitoring via site visits during the operation.

Lead Contractor or Lead Machine Operator

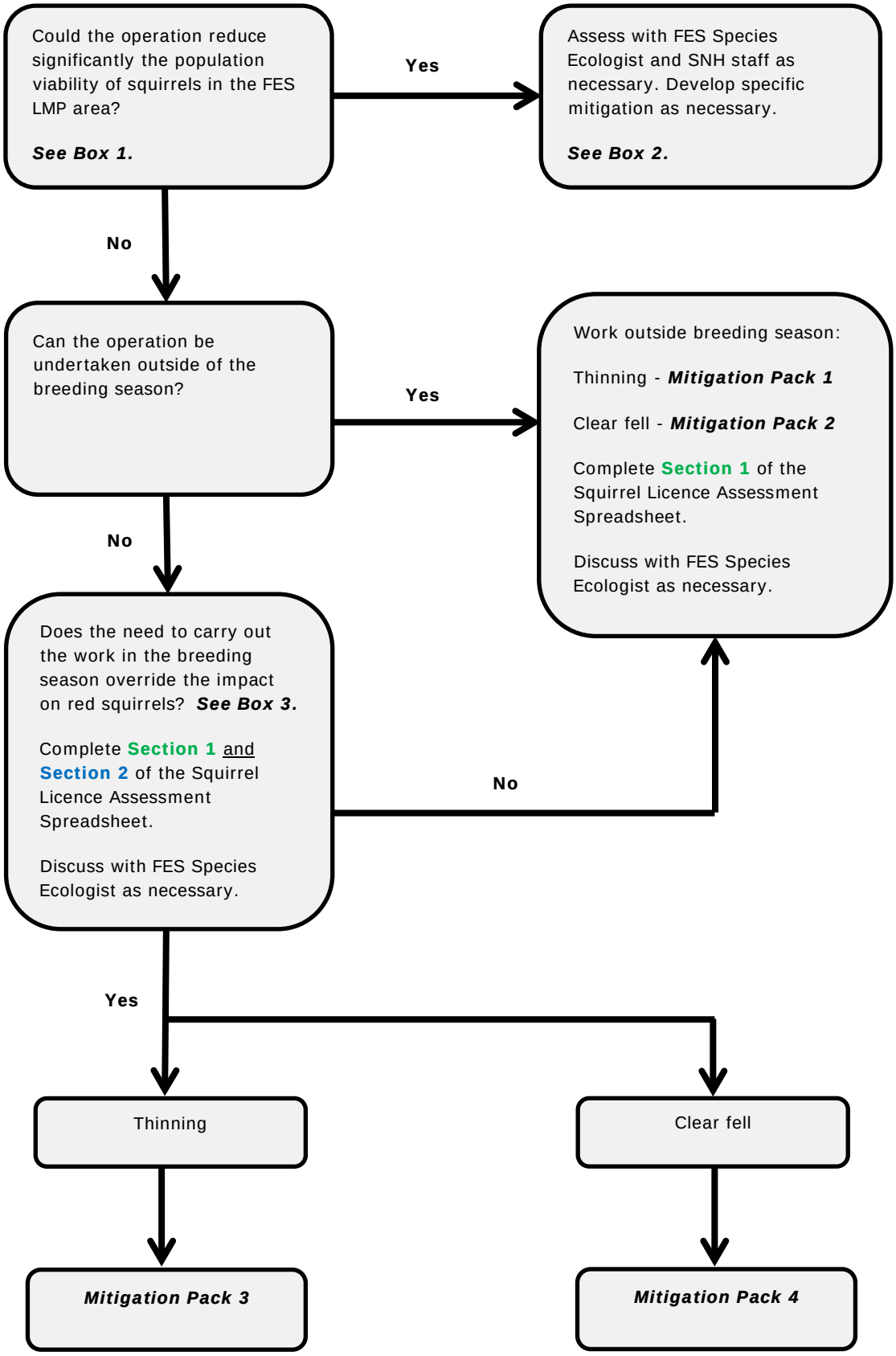
The Lead Contractor or Lead Machine Operator is the person on the ground that is responsible for carrying out or overseeing the licensed works under the terms of this licence. Their key responsibilities are therefore as follows:

1. Ensure that they understand the requirements of the appropriate Mitigation Package;
2. Ensure that the operations are carried out in accordance with those requirements including ensuring that all other contractors and machine operators are aware of the requirements of the Mitigation Package.

Additional contractors and machine operators

Additional contractors and machine operators are those other persons carrying out forestry operations on the site. They too have a responsibility to ensure that they adhere to the requirements of the appropriate Mitigation Package.

Flowchart for managing operations in coupes with red squirrels



Box 1 – Could the operation reduce significantly the population viability of squirrels in the FES LMP area?

In the vast majority of cases, it will be obvious that a tree felling operation will not reduce significantly the population viability of red squirrels in the LMP area. This is because individual tree felling operations normally remove a very small proportion of the available habitat. For example, it is reasonable to assume that a clear fell of 10ha of Scots pine within an FES Land Management Plan (LMP) area of 500ha of Scots pine will not affect the overall viability of the population; especially if the LMP is contiguous with a bigger forest area.

However, there may be cases where a significant proportion of the tree crop in a LMP has to be clear felled (usually because of wind blow). In such circumstances, a significant reduction in the population viability of red squirrels in the LMP area, leading to possible localised extinction, may be possible if the LMP area is isolated. In this context, 'isolated' means: 1) that the remaining forest habitat within the LMP area is not physically connected to other forest habitat in the wider area by riparian woodland or woodland corridors etc.; 2) that the remaining forest habitat within the LMP area is not effectively linked to other forest habitat by a sufficient number of small patches of woodland that squirrels could 'island hop' across to access the LMP; and 3) that the LMP is separated from other woodland by over 500m of open ground (e.g. moorland).

To estimate the number of squirrels that can be supported in a LMP area, or remaining part thereof, simply calculate the number of hectares of each tree species crop over twenty years old, and then multiply the number of hectares for each tree species by the appropriate 'Middle' squirrel density estimate in Appendix 2. Then add up the totals to give an estimate of the number of squirrels.

Based on advice from SNH, and as a working rule of thumb, if **habitat for less than 125 squirrels** is left after felling in an isolated LMP area, it can be assumed that the squirrel population has a high probability of going extinct. In such circumstances, discuss the case with the FES Species Ecologist and with SNH staff as necessary. If there is no satisfactory alternative, and the felling must proceed, specific mitigation will be needed (see Box 2).

Box 2 – Assess with FES Species Ecologist and SNH staff as necessary. Develop specific mitigation as necessary.

If it has been determined that the population viability of red squirrels in an isolated FES LMP area will be reduced significantly as a result of the operation (i.e. in cases where there is no functional connectivity[1] to other woodland, and the habitat remaining after felling will support fewer than 125 squirrels), then the case should be discussed with the FES Species Ecologist and SNH as necessary. Ideally, such discussions should take place well in advance e.g. as part of the Land Management Plan consultation.

If there is no satisfactory alternative to the felling proposals, then specific mitigation will need to be developed. Some of the possible options may be:

1. Trapping as many squirrels as possible in the LMP area and relocating them to other forest blocks prior to the commencement of felling.

2. Trapping as many squirrels as possible in the LMP area and reintroducing then to parts of their natural range in Scotland, from where they have been previously lost.

3. Periodically reinforcing the remaining population within the LMP area with squirrels from elsewhere to maintain the population until the carrying capacity of the LMP area increases sufficiently for the population to be self-sustaining. This mitigation plan requires a long-term commitment in staff and resources.

All of these possible mitigation actions would need to be carried out in accordance with the Scottish Code for Conservation Translocations and the associated Best Practice Guidelines, both of which have been produced by the National Species Reintroduction Forum.

[1]Functional connectivity – The degree to which the landscape facilitates or impedes movement of animals among resource patches. Movement between patches is generally more frequent and more successful if the patches are physically linked. However, patches do not have to be physically connected for a species to move between them. Squirrels dispersal is frequent through continuous woodland. However, they can move between mature forest patches via strips of trees along field edges, via riparian woodland, and even along dykes. They can also cross open ground, but if they do they are subject to elevated predation rates. An assessment of the functional connectivity of an isolated LMP will identify any possible dispersal routes.

Box 3 – Does the need to carry out the work in the breeding season override the impact on red squirrels?

The objective is to decide if an operation can proceed within the breeding season (February to September inclusive) by assessing the scale of the impact on red squirrels in relation to the other management pressures that apply to the operation. It is acceptable to apply **proportionality** when making this assessment, because the impact of an individual operation on the red squirrel population will never be severe and will not affect the conservation status of the species. Use the following four-step procedure:

Step 1: Confirm which of the following management pressures apply to the operation:

Tree Health Order or precautionary felling of diseased crops

Health and Safety

Power line outage

Other endangered species or designations

Serious environmental impact of working in autumn/winter

Significant cost of delay

If none of these management pressures apply, then the operation must be scheduled for a time outwith the squirrel breeding season.

If one or more of these management pressures does apply, move to Step 2.

Step 2: Estimate the number of squirrels that will be directly affected by the operation (i.e. that live within the operational area).

Then estimate the overall population in the LMP forest block (or LMP area if the blocks are physically connected or are close enough for squirrels to disperse over open ground). In some cases, it will be appropriate also to consider the squirrel population in habitat contiguous with the LMP.

To estimate the number of squirrels in an area, simply calculate the number of hectares of each tree species crop over twenty years old, and then multiply the number of hectares for each tree species by the appropriate 'Middle' squirrel density estimate in Appendix 2. Then add up the totals to given an estimate of the number of squirrels in each area of interest. Move to step 3.

Step 3: Assess the magnitude of the impact on the local squirrel population in relation to the scale of the management pressure or pressures.

For all cases, record details of the operation and the justification for going ahead with the operation in the Squirrel Licence Assessment Spreadsheet. Consult with the FES Species Ecologist as necessary. The assessment will consider the scale of the impact of felling on the local squirrel population in relation to other management pressures including: tree health issues; Health & Safety issues (e.g. wind blow); impacts on other species (e.g. run off into watercourses important for salmonids); significant costs of delay (including loss of income, compensation payments, and increased logistics costs); the importance of the site (e.g. squirrel stronghold or

SSSI); and technical and operational considerations (e.g. ground conditions and adverse weather). The aim is to make an objective and proportional decision.

In making the assessment, three basic questions need to be answered:

1. What will the **scale of impact** be on the red squirrel population?

2. What are the **management consequences** of delaying the operation until outwith the breeding season?

3. Is the impact on the red squirrel population acceptably small enough to **allow** the operation to proceed?

Accumulating all of the relevant facts in the Squirrel Licence Assessment Spreadsheet will enable a judgment to be made about whether or not the operation can proceed in the breeding season. In the majority of cases, it will be clear that the scale of impact will be small enough to allow the operation to proceed, or too big, meaning the operation will have to be delayed until the breeding season is finished. However, in some cases it will be more difficult to decide e.g. where there is a significant safety risk associated with delaying the operation, but potentially a large scale impact on the local squirrel population of proceeding. Discussions among all relevant Environment and Operational staff will be particularly important in such cases to develop least-harm solutions. Hypothetical cases are given as a guide in Appendix 3.

If the magnitude of the impact on squirrels is assessed to be too large in relation to the management pressure, then the operation must be scheduled for a time outwith the squirrel breeding season.

Otherwise, move to Step 4.

Step 4: Tell the Lead Contractor and/or the Lead Machine Operator: a) the earliest starting date; b) the appropriate Mitigation Pack; and c) any other site-specific mitigation.

These details should be recorded in the Site Specific Conditions form in the contract, if possible, and in pre-commencement meeting form ('PCM 3'). It is crucial to have a record of this information being communicated to the contractor.

For all operations proceeding during the breeding season under Mitigation Packs 3 and 4, work should be delayed to after mid-July (i.e. after peak breeding activity – see Note) if possible.

Note – The red squirrel breeding stretches from February to September inclusive. Most females (c. 90%) have a first litter in the period February to mid-July. However, even in a year with abundant food (tree seeds), only 40 to 60% will have a second litter in the period mid-July to September, and in years with lower food availability a much lower proportion of the females have a second litter in this period. In poor food years, no squirrels will attempt a second litter. Therefore, the period February to July is consistently the most important part of the breeding season.

Mitigation Packs

Mitigation Pack 1 Thinning outside breeding season	• Mark and retain drey trees
Mitigation Pack 2 Clear felling outside breeding season	• Fell areas with dreys or signs last and/or: • Use squirrel-friendly order of felling[1] • Drey trees must be felled in daylight only
Mitigation Pack 3 Thinning within breeding season	• Mark and retain drey trees • Use squirrel-friendly order of felling
Mitigation Pack 4 Clear fell within breeding season	• Use squirrel-friendly order of felling • In squirrel strongholds and PARCs[2], FES Environment Forester/Ranger to visit site frequently (ideally daily) to liaise with machine operators on squirrel activity. • Machine operators to be alert for drey structures and to delay felling trees with suspected dreys. Machine operators to contact FES Environment Forester/Ranger if suspected drey structure is identified. • Drey trees left standing can be retained as 'future deadwood' (as per FES deadwood guidance), or felled outwith breeding season. • Suspected drey structures in felled trees to be inspected by FES Environment Forester/Ranger. Any young squirrels to be transferred immediately to SSPCA.

[1]**Squirrel-friendly order of felling** = Plan the felling operation to avoid isolating squirrels in a clump of trees surrounded by open ground e.g. clear fells, new restocks and moorland. Areas of the coupe that are adjacent to such open ground should be felled first whenever possible. Ideally, the felling should also start as far away from the area with dreys as possible, and should move towards the area with dreys – providing there is an escape route for the squirrels via connectivity with adjacent crops. Maintain the connectivity with adjacent mature crops as long as possible during the operation and plan the direction of the operation such that squirrels are still able to escape into adjacent crops even when the operation approaches completion.

[2] Squirrel strongholds are an FCS designation assigned to forests where management for red squirrels is a priority. The boundaries of strongholds can be viewed on the FES GIS system. Priority Areas for Red Squirrel Conservation (PARCs) are a designation assigned to forests by the Saving Scotland's Red Squirrels project.

Appendix 1 – Red squirrels in Scotland

The key factor in the decline of red squirrels in the UK has been the introduction of North American grey squirrels. Interactions between red and grey squirrels are two-fold. Firstly, grey squirrels carry and spread a squirrel-pox virus that is deadly for red squirrels (McInnes et al. 2009) with recorded mortality rates of greater than 80% (e.g. Chantrey et al. 2014). The virus is currently spreading northwards in Scotland. Secondly, grey squirrels also compete with red squirrels for space and resources (Gurnell et al. 2004). Grey squirrels are broadleaf specialists and their natural habitat is the oak-hickory forests of Eastern North America. Competitive interactions between the two species are modified by habitat type and forest composition, annual patterns of seed food availability and landscape connectivity. Red squirrel persistence has been highest in conifer forests that deny grey squirrels a competitive advantage (Bosch & Lurz 2012).

Conifer plantations play a critical role in the conservation of red squirrels in Scotland. The National Forest Estate (NFE) in Scotland includes approximately 480,000 hectares of woodland, of which just over 360,000 hectares are conifer plantations. By applying average squirrel densities, it is estimated that there could be upwards of 50,000 red squirrels in plantations on the NFE. This total will fluctuate upwards and downwards each year according to food availability. Eighteen conifer-dominated forests termed 'squirrel strongholds' have been identified, mostly on the NFE. Guidelines have been developed to help manage these areas to ensure long term red squirrel survival (Anonymous 2012).

The plantation habitat on the NFE is managed to produce timber and is subject to ongoing tree felling and replanting. This creates an ever-changing mosaic of tree stands of different ages and species. Red squirrel space use is highly flexible and the species is well adapted to cope with this changing forest environment – it could be argued that they are preadapted to live in forests managed for timber production. This is because seeds of conifer tree species are the most important food for squirrels (they extract the seeds from tree cones). Plantations therefore provide an abundance of food, but seed availability varies annually, with some tree species producing little seed in some years. Seed production also varies with tree age. Squirrels track these changes through space and time. The variety of tree species and ages within a typical forest that is managed to produce timber ensures that food is usually available for squirrels somewhere in the forest in all years.

Each year, less than two percent of the plantation habitat on the NFE is clear felled, and nearly two thirds of this is Sitka spruce, which supports the lowest density of red squirrels. Timber operations tend to be small relative to the population ecology of red squirrels and their large home ranges in conifer forests (e.g. 11 to 14 ha per individual in spruce). Overall, clear felling is roughly estimated to displace between 1000 and 2000 squirrels each year, depending on food availability and thus the population density at the time. These squirrels will disperse into adjacent crops, and there are no records of adult squirrels being killed directly by forest operations. Most forest operations are done when squirrels are not breeding, but some operations need to be done in the summer (e.g. to avoid water pollution or ground damage). Female squirrels can and do move their young between dreys and it is thought that this happens during forest operations. However, this aspect of squirrel behaviour is poorly understood and FES is carrying out research to clarify how females with young respond to forest operations. Research so far (as of 2016) indicates that red squirrels make minor adjustments to their home ranges in

response to operations. However, it is probable that some dreys containing young will be destroyed during clear felling, particularly in spruce crops where it can be very difficult to locate the dreys during pre-operational surveys – although there are only a handful of known cases of breeding dreys being damaged by operations. Overall, unintended damage from forestry operations is thought to have a trivial impact on the red squirrel's conservation status, especially when compared to the threat posed by grey squirrels, and the business of growing timber is overwhelmingly beneficial for squirrels.

Cited literature

Anonymous, 2012. Managing forests as red squirrel strongholds. Forestry Commission Practice Note 102.

Bosch, S. & Lurz,, P. W. W. (2012). Eurasian red squirrel. Westarp Wissenschaften Verlagsgesellschaft mbH. Germany.

Gurnell, J. *et al*. (2004). Alien species and interspecific competition: effects of introduced eastern grey squirrels on red squirrel population dynamics. Journal of Animal Ecology 73: 26-35.

McInnes, C. J. *et al*. (2009). First cases of squirrelpox in red squirrels (*Sciurus vulgaris*) in Scotland. Veterinary Record 164: 528-531.

Chantrey, J. *et al* (2014). European red squirrels population dynamics driven by squirrelpox at a gray squirrel invasion interface. Ecology and Evolution 4: 3788-3799.

Appendix 2 – Estimated red squirrel carrying capacities in crops of different tree species

Estimated red squirrel density per hectare in crops of different tree species.

For the purposes of this guidance note, the 'Middle' estimate has been derived and is the mid-point between the High and Low estimates. This 'Middle' estimate should be used in calculations for this guidance note.

Tree species	High	Middle	Low	Tree species	High	Middle	Low
Ash and sycamore	0	0	0	Oak	1	0.81	0.62
Birch	0	0	0	Scots pine	0.83	0.33	0.04
Douglas Fir	0.45	0.31	0.17	Sitka spruce	0.2	0.11	0.011
Larch species	0.38	0.3	0.21	Western hemlock	0	0	0
Lodgepole pine	0.4	0.22	0.04	Other conifer	0.45	0.31	0.17
Mixed broadleaf	1	0.81	0.62	Other spruce	0.2	0.11	0.02
Norway spruce	0.58	0.42	0.25	Mixed conifer	0.45	0.31	0.17

The High and Low squirrel densities in the above table are derived from the following paper:

White, A., Jones, H., Lurz, P. & Boots, M. 2016. A modelling assessment of the population dynamics of red squirrels in the Kidland and Uswayford forest, Northumbria, in relation to proposed forest design plans. Forestry Commission Commissioned Report.

The original data for the High and Low estimates in the table were derived from the following references:

1) Bosch, S. & Lurz, P.W.W. (2012). The Eurasian Red Squirrel. Westrap Wissenschaften, Vol 1.

2) Holm J. 1991. The ecology of red squirrels (Sciurus vulgaris) in deciduous woodland. Ph.D. Thesis, University of London.

3) Lurz, P.W.W., Garson P.J. & Ogilvie J.F. (1998). Conifer species mixtures, cone crops and red squirrel conservation. Forestry, 71: 67-71.

4) Magris L. 1998. The ecology and conservation of the red squirrel (Sciurus vulgaris) on Jersey C.I. Ph.D. Thesis, Queen Mary & West_eld College, University of London.

5) White, A. & Lurz, P.W.W. 2014. A modelling assessment of control strategies to prevent/reduce Squirrelpox spread. Scottish Natural Heritage Commissioned Report No. 627.

Appendix 3 – Hypothetical cases

Case 1: Clear felling 30ha of Scots pine. Operation brought forward to April (at short notice due to sudden unavailability of a scheduled coupe elsewhere). At least 27 dreys located in pre-operational survey. Abundant feeding signs found. Decision: Operation deferred to outwith breeding season, using Mitigation Pack 2.

Case 2: Clear felling 20ha of Sitka spruce. Operation scheduled for June. No dreys located but feeding signs in northern half of coupe. Forest block is 300 ha (Sitka: 60ha; Scots pine: 120ha; larch: 20ha), with an estimated population of 36 squirrels, and is connected to other forest blocks. Estimated that only between 1 and 2 squirrels will be directly affected (0.06 squirrels/ha) by the operation. Site is not designated. However, the site boundary is a tributary of an SAC for freshwater pearl mussels. Working outside squirrel breeding period significantly increase risk of water pollution. Decision: Operation approved as scheduled, using Mitigation Pack 4.

Case 3: Clear felling 30ha of wind-blowing Lodgepole pine in squirrel stronghold in May. Nine dreys plus abundant feeding signs located in northeast corner (c. 7ha) of coupe. At least 7 squirrels estimated to be directly affected, out of an estimated population of 120. Access options limited due to steep terrain, which will be much more difficult at times other than summer due to rain and snow. Lodgepole pine has some signs of Dothistroma needle blight. Operation involves powerline switch off for which dates are outwith FES control. Power company has offered switch-off period in May. Decision: Operation approved as scheduled, using Mitigation Pack 4.

Case 4: Clear fell 16ha of Norway spruce in Eskdalemuir squirrel stronghold scheduled for June. Abundant feeding signs and three dreys located. This mature block is rather isolated within a large area of post-2004 Sitka restock and is regarded as an important food source for squirrels. Decision: Operation deferred pending discussions about the impact on the population viability of the population and the possible long-term retention of this block for red squirrels.

Case 5: Thinning 42ha of Scots pine in Moray & Aberdeenshire FD in June via standing sale. 23 news dreys located in pre-operations check in western section. Dreys not present in first site visit, so not in contract. Forest block is 2000ha with an estimated population of 440 squirrels (0.22 squirrels/ha) in the LMP area, all of which is interconnected by habitat corridors. Operation will directly affect about 10 squirrels. Delaying the operation will involve renegotiating contract rates and haulage costs. FES will incur income loss of several thousand pounds compared to original contract. Decision: Operation approved as scheduled, using Mitigation Pack 3, with area containing dreys not worked until after mid-July.