

Is there hope for the red squirrel?

Amy-Jane Beer asks if anything can be done to stop the decline of the red squirrel in the British Isles

The red squirrel is an icon of the British wildlife scene, immortalised by Beatrix Potter as mischievous Nutkin — a bright-eyed, fluffy-tailed, breathtakingly agile bundle of energy. Sadly, across much of the British Isles, it is not this much-loved native you see bounding across your lawn or dashing from tree to tree, but its cousin — the introduced American grey squirrel.

Where did the grey squirrel come from?

Grey squirrels were imported into Britain deliberately between 1876 and 1929, and released in more than 30 different locations. These days, such introductions are regarded as irresponsible, but at the time it was thought that grey squirrels would make a charming addition to the British fauna. No-one imagined that they would be so damaging. But as the greys colonised new areas, local populations of red squirrels died out, usually within 20 years. Today, 75% of British red squirrels live in Scotland. The rest are in Northern Ireland, northern and mid-Wales and northern England,

with isolated populations on the Isle of Wight and Brownsea Island, Dorset (see Figure 1).

Competing species

Grey squirrels are adapted to the broad-leaved forests of eastern USA, and where they find similar habitat in Britain they do exceptionally well. They eat a wider range of foods than red squirrels, and raid stores of nuts and seeds hidden by red squirrels. These effects add up and, in areas where red squirrels face competition from greys, they tend to be smaller and less successful in reproducing than those in red-only populations.

The red squirrel's **optimum niche** is coniferous woodland. In areas where this is the dominant vegetation, such as Scotland, parts of Northumbria and Cumbria, they thrive. Here their small size and nimbleness allows them access to pine cones growing at the tips of narrow branches, which grey squirrels are simply too heavy to negotiate.

This competitive advantage was cause for hope that the spread of grey squirrels might find a natural limit, creating a balanced situation in which the broad-leaved forest became the home of the greys, while the reds retained their coniferous strongholds. But this was not to be. Little by little, red squirrel populations in seemingly optimum habitats have failed, and the decline of red squirrels in other

Key words

- Red squirrel
- Grey squirrel
- Squirrel pox virus
- Reintroduction
- Alien species

Red squirrel



Terms explained

ELISA Enzyme-linked immunosorbent assay — laboratory test using antibodies to label specific substances, which are then tagged with enzymes that develop into coloured or fluorescent markers.

Epidemiologist A scientist who studies the transmission of disease.

Habitat fragmentation Breaking up an area in which a species lives (for example by roads or deforestation). The remaining fragments may be too small to support a viable population.

Optimum niche Ideal ecological situation in which a species will thrive.

Polymerase chain reaction (PCR) Laboratory procedure used to increase or amplify a few copies of a particular fragment of DNA, usually so that it can be sequenced.

Box 1 Identifying squirrel pox virus

In red squirrels the symptoms of SQPV infection are usually obvious, but an infected grey squirrel appears perfectly healthy. In either case, laboratory testing is required to be sure of the diagnosis. In red squirrels with SQPV symptoms, the cause of death can be confirmed using transmission electron microscopy to identify the viral particles in samples taken from the lesions (see Figure A).

In squirrels without obvious symptoms, two laboratory procedures can be used to test for the presence of squirrel pox: enzyme-linked immunosorbent assay (ELISA) and a form of DNA fingerprinting. The ELISA test shows up the presence of antibodies to the virus, which indicates past exposure to squirrel pox, but cannot reveal whether the squirrel is currently infected. The antibody is identified using another antibody that binds to it. This antibody is in turn linked to a coloured or fluorescent marker.

The DNA tests are used to detect elements of the virus itself in tissue samples and thus to confirm current infection. SQPV virus can be recognised by its characteristic DNA. A laboratory technique called real-time **polymerase chain reaction (PCR)** (see *BIOLOGICAL SCIENCES REVIEW* Vol. 24, No. 2, pp. 20–21) is used to detect and assess the amounts of viral DNA in a sample. It does this by looking for a specific segment of viral DNA (a 'signature' specific to SQPV) and using this to quantify the number of virus particles present. If the SQPV signature is detected, it means that the squirrel was infected at the time the sample was taken.

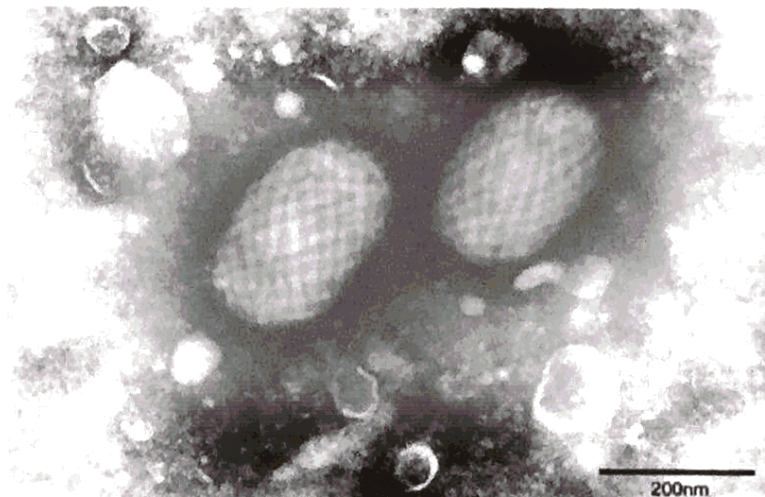


Figure A Transmission electron micrograph of SQPV from the first case detected in 1981

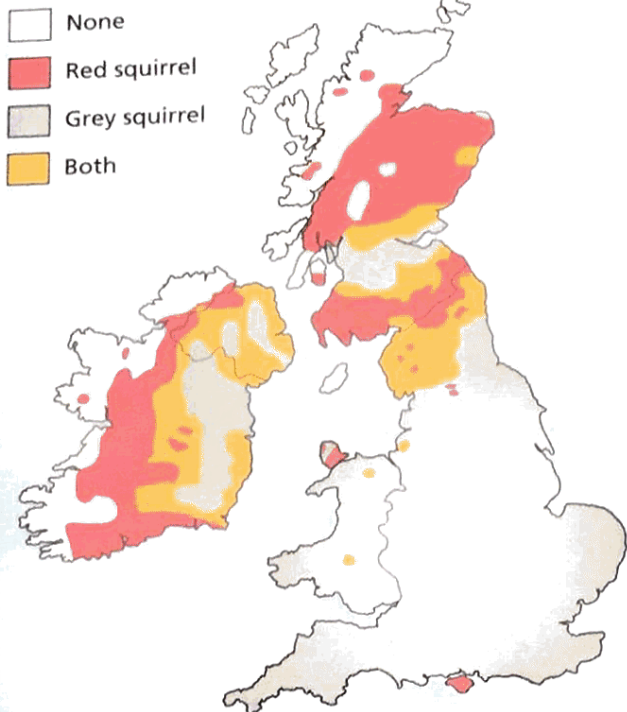


Figure 1 Red squirrel distribution in 2010



Figure 2 Red squirrel killed by squirrel pox, showing typical lesions to the face

areas has been much more rapid than we would expect if competition for food was the only factor. Clearly something else is going on.

The decline of the red squirrel

The chief problem for Britain's remaining red squirrels is disease. Grey squirrels are carriers of a viral disease — squirrel pox (SQPV, see Box 1), which is fatal to reds. The infection causes no harm to a grey squirrel, but an infected red develops lesions on its face, paws and genitals (see Figure 2). It becomes weak and listless, stops feeding and typically dies within 2 weeks. Squirrel pox has the potential to wipe out red squirrel populations even in areas where they ought to be doing well.

Squirrel pox probably arrived in Britain with grey squirrels. Outbreaks of the disease were first recorded in

British red squirrels in 1930 and began to be mapped in the 1950s. In the 1970s a virus was isolated from squirrel carcasses and identified as squirrel pox. Since then it has been diagnosed in red squirrels in England, Wales, southern Scotland and most recently in Northern Ireland in 2011. Predictions of the spread of SQPV suggest that red squirrels in the more northerly Scottish strongholds are likely to be affected within the next 20 years.

It seems likely that squirrel pox is not the only problem disease — **epidemiologists** are now tracking two other contagious pathogens known as adenovirus and rotavirus, which are also carried by grey squirrels and may be harmful to reds. So far, red squirrel deaths from adenovirus have been recorded in Cumbria, Norfolk, on Anglesey, in southern Scotland and in Northern Ireland. But other red squirrels are known to have survived adenovirus infection.



The introduction of the grey squirrel into the UK has led to a decline in red squirrel numbers

Evolving immunity?

Until 2008 it was thought that squirrel pox was always fatal to red squirrels. But in 2008, tests on seven carcasses from northern England and one from north Wales revealed that the animals had been infected and recovered. All had died of other causes, but their bodies contained antibodies to squirrel pox virus. Antibodies give immunity to infection, but they only develop after exposure to the antigen, in this case the SQPV virus. These eight squirrels must have encountered the virus and fought it off. This suggests that red squirrels might be able to evolve immunity to the disease, and that a vaccine could be effective in protecting red squirrels in critical areas where grey squirrels are encroaching. But there are no guarantees, and conservationists are anxious to avoid a false sense of security. To sit back and simply hope for a solution to evolve, or to pin too much hope on the possible future development of a vaccine would be folly, and active conservation is essential if the British red squirrel is to be saved.

Biodiversity action plan

Red squirrels have full protection in Britain under the *Wildlife and Countryside Act 1981*, and the species is a priority for conservation, with a Biodiversity Action Plan with two main aims:

- to maintain and enhance remaining populations
- to re-establish the species where appropriate

Maintenance of red squirrel populations

Current efforts to stabilise the remaining populations include a variety of measures of which the most important and effective is grey squirrel control. With greys gone, red squirrel populations are able to rebound. The largest project of this kind is coordinated by Red Squirrels Northern England, and preliminary results suggest that, though the work is difficult, red squirrel strongholds can be defended

in this way. On the small scale, many people take it on themselves to help by feeding red squirrels in parks, gardens and nature reserves. Nationwide, many nature reserves and Sites of Special Scientific Interest have earned their status by virtue of having red squirrels, which represent a significant draw for tourists and wildlife enthusiasts. There have also been a number of larger scale projects.

In the last 6 years, the British conservation charity People's Trust for Endangered Species (PTES) has funded 12 red squirrel projects, tackling issues as diverse as **habitat fragmentation**, how SQPV infection passes from one animal to another, and the spread of adenovirus. PTES-funded research is also pioneering new monitoring techniques and strategies. Monitoring is vital, before and after conservation measures are put in place. This is because changes in populations are often small at first, and difficult to detect without statistical analysis to ensure that cause and effect are properly linked and the results are not down to chance.

Monitoring also helps avoid mistakes. Even the best intentioned efforts can have unexpected results. Feeding red squirrels may be one example. The extra food is no doubt welcome, but feeding stations may be a source of disease. Researchers at Queen's University Belfast are currently investigating this possibility. The fear is that squirrel pox and other pathogens may be passed on in traces of saliva left on feeders. The researchers are collecting swabs from feeders set up in parks and reserves, and these will be screened for traces of viral DNA (see Box 1). The team is also making a study of parasites such as fleas, which may carry diseases as they move from squirrel to squirrel.

Re-establishment

The second part of the Biodiversity Action Plan is to re-establish red squirrel populations where possible. Reintroducing red squirrels to parts of the country where they have disappeared is an appealing idea, but the reality is complex. For such a scheme to succeed, the reasons for the original decline must be addressed. This means killing grey squirrels — capturing and moving them would break laws against releasing non-native species into the wild. But killing members of an otherwise charismatic species that has been established in this country for over 100 years is distasteful, and unacceptable to many people who have come to love the invader.

Ethical objections aside, there are doubts over the feasibility and affordability of keeping mainland reintroduction zones free from grey squirrels in future. This criticism has been levelled at proposals for red squirrel reintroductions. Until an effective and sustainable method

Weblinks



Red squirrel protection and reintroduction projects:
www.northernredsquirrels.org.uk
www.scottishsquirrels.org.uk
www.rsst.org.uk

Further reading



For a detailed general account of red squirrels see Harris, S. and Yalden, D. (eds) (2008) *Mammals of the British Isles: Handbook* (4th edn), Mammal Society, pp. 57–66

for eradicating grey squirrels is available, the best option for reintroductions is on islands. Since 1998 a programme has been operating on the Isle of Anglesey (Ynys Mon) in north Wales. This aims to control grey squirrels and boost numbers of red squirrels by translocating animals from elsewhere, with the result that SQPV has been eradicated. A thriving population of reds is beginning to disperse to the mainland via the island's two bridges.

Fighting back

Meanwhile red squirrels have made a comeback in the western Yorkshire Dales. This was not a reintroduction. The squirrels arrived of their own accord from a neighbouring population in Cumbria. Their return has been made possible by intensive control of grey squirrels and careful management of coniferous forests. By avoiding the temptation to plant broad-leaved trees around the edges of conifer plantations, forest managers have made the area uninviting to grey squirrels and given the reds a fighting chance.

Similar methods are being applied in parts of Northumberland, where the reds are now recolonising woodlands in which active control of grey squirrels is taking

Get involved

The methods used to track viral diseases in squirrels rely in part on sharp-eyed members of the public. If you find a dead red squirrel, you can help research efforts by contacting the Veterinary Laboratory Agency (<http://vla.defra.gov.uk/>) for instructions on sending the carcass for post-mortem testing. Live red squirrel sightings should be reported to local ecological record centres to help monitoring schemes, and any grey squirrels spotted in areas where reds still exist should be reported immediately. Details of record centres and local squirrel projects are easy to find online or through local Wildlife Trusts.

place. But maintaining this status quo requires constant vigilance and control of any grey squirrels seen in the vicinity.

Saving British red squirrels is a long-term commitment, and one that requires the cooperation of scientific agencies, wildlife charities and the general public alike.

Points for discussion

- Is it ethical to kill grey squirrels in Britain?
- What might be the effect on British ecosystems if red squirrels became extinct?

Dr Amy-Jane Beer is a biologist and author of several books on mammals. She is editor of the magazine *Wildlife World* for the conservation charity People's Trust for Endangered Species, which funds much of the red squirrel research currently taking place in the UK.