

Red squirrel conservation: Strategies and science 2025

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Published: 01/01/2025

Publisher's PDF, also known as Version of record

[Cyswllt i'r cyhoeddiad / Link to publication](#)

Dyfyniad o'r fersiwn a gyhoeddwyd / Citation for published version (APA):
Shuttleworth, C., Robinson, N., & Sheehy, E. (Eds.) (2025). *Red squirrel conservation: Strategies and science 2025*. Red Squirrel Trust Wales.

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Red Squirrel Conservation

Strategies & Science 2025



Edited by

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Nikki Robinson Red Squirrels Trust Wales

Emma Sheehy Sheehy Ecology Services



Red Squirrel Conservation: Strategies & Science 2025

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The Case Studies

In October 2024, we invited a range of conservation projects and scientific research groups to contribute to this publication.

In order to streamline the submission process, authors were asked to complete a standard template. This contained defined headings, a maximum word limit per section and standard tables to complete.

Within each case study, a short overview section is followed by a list of project aims to provide a foundation for the following longer sections within which the project activity is described. Each case study then presents (i) Success Indicators, (ii) Major Difficulties Faced, (iii) Major Lessons Learned, (iv) Success of the Project and (v) the Reasons for the Level of Success. The final sections of each case study present key areas for future development and list any reports or published findings that would be useful additional reading.

Foreword

I was always aware of our native red squirrels from a young age growing up in the countryside and reading about them in books of folklore, history and of course via the late Beatrix Potter's delightful, classic 'Squirrel Nutkin'. However, it wasn't until later in my life that I began to understand and appreciate why "red scamps" as I affectionately call them, are endangered.

As it happens, in recent years I've humbly become a renowned and multi-award winning filmmaker producing hit documentaries featuring the beauty of Cumbria that have been enjoyed by millions of viewers both nationally and internationally.

Having been a volunteer for a local red squirrel charity for a couple of years, I felt compelled to produce a film sharing the beauty of our native reds but also the tremendously huge amount of work countless volunteers do to ensure their survival.

We face a nature crisis on many levels and sadly the public often have no idea as to why. As is often the case with nature, much of the blame lies with us humans; be it habitat loss or the introduction of flora and fauna that creates many problems on many levels. Just as us humans have inadvertently created a problem; it's often the case that we need to solve the problem.



Whilst producing my red squirrel documentary, I was fortunate enough to capture footage of them that's never been seen before. I observed their behaviour in the wild over countless hours and days, hearing them chatter and sometimes befriending some! I'm as objective a person can be, but you just cannot help but fall in love with our red scamps. I've even introduced lucky folk to some and often they're moved to tears.

They're flighty, bouncy and amazingly agile. They literally are aerial acrobats. Furthermore, they have distinct personalities too. You get shy ones, bold ones, and a whole mixture of such traits that I often describe akin to those seen in cats or dogs.

Thankfully, my labour of love project focused on the plight of our precious native red squirrels was a critically acclaimed and smash hit on the BBC. Thanks to streaming and social media it continues to be so. I've continued volunteering for a local reds charity, and am proud to be an ambassador for the cuties.

I still do what I do because I care. I am also acutely aware that further education is needed too and also support from both the public and government to ensure the survival of a national favourite creature; one that even King Charles adores.

This book explains why red squirrels are rare and how many good folk endeavour to save their populations. I hope you enjoy sharing their journeys.

Terry Abraham FRGS

*Multi-award winning broadcaster and
photographer, conservationist*



Contents

	Project Title	Author	Organisation	Page
NATIONAL				
1	EVALUATING DIVERSIONARY FEEDING AS AN APPLIED CONSERVATION TOOL, TO ALEVIATE CONSERVATION CONFLICT	Jack Bamber	Aberdeen University	<u>9</u>
2	THE ANIMAL AND PLANT HEALTH AGENCY DISEASES OF WILDLIFE SCHEME	David Everest, Samantha Holland, Jennifer Cantlay, Paul Duff & Paul Holmes	Animal Plant Health Agency	<u>19</u>
3	DEVELOPING A SPECIES-SPECIFIC CONTRACEPTIVE FEEDER FOR THE MANAGEMENT OF GREY SQUIRRELS	Sarah Beatham	Animal Plant Health Agency	<u>31</u>
4	WHY DO GREY SQUIRRELS NOT DAMAGE ALL BROADLEAVED TREES IN THE SAME WAY?	Charles Dutton	European Squirrel Initiative	<u>41</u>
5	PROJECT RED HAVEN	Emma McClenaghan	Genysys Engine Ltd	<u>49</u>
6	TOWARDS A SQUIRRELPOX VACCINE	Craig Shuttleworth	Bangor University	<u>57</u>
SCOTLAND				
7	RED SQUIRREL FORUM FOR SOUTH SCOTLAND AND SAVING SCOTLAND'S RED SQUIRRELS	Peter Garson & Steven McKillop	Scottish Wildlife Trust	<u>65</u>
8	THE HIGHLAND LINE: SAVING SCOTLANDS RED SQUIRRELS (SSRS)	Susie McNaughton	Scottish Wildlife Trust	<u>75</u>

9	ERADICATION OF GREY SQUIRRELS FROM ABERDEEN: SAVING SCOTLANDS RED SQUIRRELS (SSRS)	James Kennedy & Emma Sheehy	Scottish Wildlife Trust	<u>87</u>
ENGLAND				
10	SOLWAY RED SQUIRREL GROUP	Marion Grave	Solway Red Squirrel Group (SRSRG)	<u>99</u>
11	PENRITH AND DISTRICT RED SQUIRREL PROJECT	Robert Benson	Penrith & District Red Squirrel Group (P&DRSG)	<u>107</u>
12	EXPANDING GREY SQUIRREL MANAGEMENT IN YORKSHIRE, LANCASHIRE AND COUNTY DURHAM	Kay Haw	UK Squirrel Accord	<u>117</u>
13	RED SQUIRRELS NORTHERN ENGLAND (RSNE)	Abbie McQueen	Red Squirrels Northern England	<u>125</u>
14	WIGHT SQUIRREL PROJECT	Helen Butler	The Isle of Wight Red Squirrel Trust	<u>135</u>
15	BEYOND THE THIN RED LINE 2024-2029	Leon Savage	Cramlington & District Red Squirrel Group	<u>145</u>
16	RED SQUIRREL PROJECT	Molly Frost	The Wildlife Trust for Lancashire, Manchester and North Merseyside	<u>155</u>
17	GRASMERE TO GRIZEDALE PROJECT	Josh Adams	Cumbria Wildlife Trust	<u>165</u>
18	THE CALDEW SQUIRREL INITIATIVE	Steve Kirk	The Caldew Squirrel Initiative	<u>175</u>
19	PONTELAND RED SQUIRREL CONSERVATION	Ponteland Red Squirrel Group	Ponteland Red Squirrel Group	<u>183</u>

20	GRASMERE RED SQUIRREL GROUP	Stewart Sutcliffe	Grasmere Red Squirrel Group	<u>191</u>
21	FOREST ENGLAND RED SQUIRREL COLONY	Ian Lakey	Lower Coquetdale Red Squirrels	<u>201</u>
22	BRAMPTON & DISTRICT RED SQUIRREL GROUP	Julie Bailey & Paul Bassindale	Brampton & District Red Squirrel Group	<u>207</u>
23	ARNSIDE AND SILVERDALE NATIONAL LANDSCAPE	Bob Hamnett & Danni Chalmers	Westmorland Red Squirrels	<u>215</u>

WALES

24	NATURAL RESOURCES WALES RED SQUIRREL PORTFOLIO	Rebecca Clews-Roberts	Natural Resources Wales	<u>225</u>
25	MID WALES RED SQUIRREL PARTNERSHIP	Adam Dawson, Ben Allen, Phil Harries & Alice Chapman	Wildlife Trust of South & West Wales	<u>233</u>
26	RED SQUIRREL CONSERVATION IN CLOCAENOG FOREST	Julian Mason	Clocaenog Red Squirrel Trust (CRST)	<u>243</u>
27	GREY SQUIRREL REINVASION: RED SQUIRREL CONSERVATION ON ANGLESEY	Craig Shuttleworth	Red Squirrels Trust Wales	<u>255</u>

NORTHERN IRELAND

28	PROTECTING THE RED SQUIRREL IN NW OF NORTHERN IRELAND	Pam Hardeman	North West Red Squirrel Group	<u>265</u>
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Editors' Note and Acknowledgments

RED SQUIRREL CONSERVATION: STRATEGIES AND SCIENCE 2025

It has been a pleasure to edit this third edition of case studies showcasing red squirrel conservation efforts from across the UK. The contributions span national partnerships, volunteer-led regional initiatives, inspiring examples of local success, and cutting-edge scientific research and innovation. Together, they reflect the broad range of elements that drive effective red squirrel recovery.

This volume serves as a valuable reference, offering a unique snapshot of progress towards sustainable red squirrel management and effective grey squirrel control. We are deeply grateful to the contributors who generously shared their findings, experiences, and reflections—including honest insights into the challenges faced along the way.

We have intentionally taken a light-touch approach to editing, allowing authors to present, describe, and illustrate their projects in their own words. As such, some case studies may include views or opinions that diverge from, or challenge established practices in red squirrel conservation.

We hope these case studies will be a valuable resource in shaping future strategic policy and will also inspire others to get involved in red squirrel recovery efforts. We would like to thank the National Lottery Heritage Fund, Red Squirrels Trust Wales, Natural Resources Wales, and the Clocaenog Red Squirrel Trust for funding the production of this publication. Their support was part of the Magical Mammals project, a five-year initiative focused on forest mammal conservation, which aimed to provide diverse volunteering opportunities and promote well being by removing barriers to public engagement and participation.

Finally, a heartfelt thank you to Tegan Swindells and Dave Everest for reviewing the various drafts.

Craig, Nikki, and Emma
May 2025

EVALUATING DIVERSIONARY FEEDING AS AN APPLIED CONSERVATION TOOL, TO ALEVIATE CONSERVATION CONFLICT

University of Aberdeen

Geographical area of conservation work

Cairngorms National Park. Speyside
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 - Forestry Land Scotland
- RSPB
- Wildlands
- NatureScot
- NERC
- SUPER dtp
- Cairngorms Connect

Maps of project land area

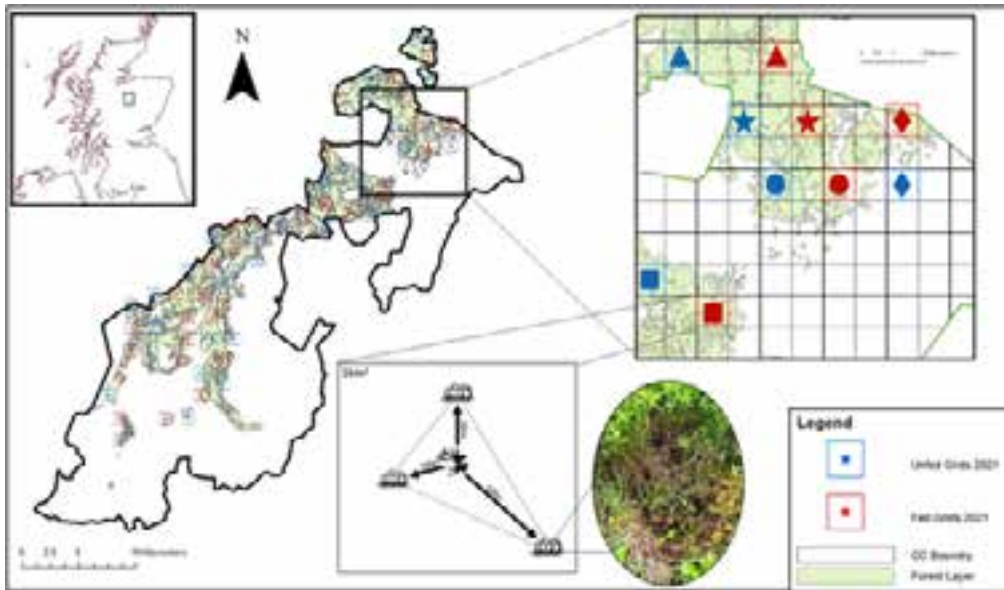


Figure 1. Illustration of experimental design. (J.Bamber)

The main map (Figure 1) shows the forested areas of the Cairngorms Connect Landscape, which was our scope of inference. The red and blue squares show the locations of our 60 sampling grids, with feeding sites (2021) in red and control sites (2021) in blue. The highlighted rejoin in the top right zooms into our sampling grid to show the site structure of 1km² sampling grids; ‘paired’ sites are shown with matching shapes. The lower 1km² area shows an example of the internal structure of a diversionary feeding site, an example of an initial deployment of nests and a central feeding station. Control sites mimicked this structure without the feeding station. An exemplary artificial nest with heather cover is also included.

Introduction

This study focused on the coexistence between recovering predator species, with focus on pine martens (*Martes martes*) and other rare prey of conservation concern. Taking place in the Cairngorms National Park, it is a stronghold for both pine martens, red squirrels (*Sciurus vulgaris*) and British red-listed species such as the capercaillie (*Tetrao urogallus*).

The project took place within the Cairngorms Connect Landscape, a multi-stakeholder group focused on forest restoration. As such, the sampling of this study took place mostly in forested zones. The project was performed as part of a PhD research project where its key aim was to address predation on rare prey by recovering pine martens, with a non-lethal impact-based intervention, diversionary feeding (Figure 2).



Figure 2. The author in the field study area. (X.Lambin)

Project aims

- Evaluate impact-based interventions to reduce predation by recovering pine marten populations.
- Test diversionary feeding as a non-lethal, scalable conflict mitigation tool.
- Assess predator behavioural responses to targeted feeding in forested habitats.
- Provide evidence to support coexistence strategies between recovering predators and species of conservation concern (e.g. ground nesting birds).
- Inform policy and practice on sustainable, ecosystem-based conservation.

Description of the project

The recovery of native predators is reshaping conservation challenges and opportunities across the UK. One such predator is the pine marten, once nearly extinct in Britain but now recolonising large parts of Scotland, including the Cairngorms National Park. This area, home to the Cairngorms Connect Forest restoration partnership, supports a diverse range of rare species, including capercaillie and red squirrels, and has become a key site for studying species coexistence in dynamic, recovering ecosystems.

Pine martens have received increasing attention for their role as biological control agents in red squirrel conservation. A pivotal study by Sheehy et al. (2018) showed that the presence of pine martens in both Ireland and Scotland led to marked declines in invasive grey squirrel (*Sciurus carolinensis*) populations, which in turn allowed native red squirrels to recover. This predator-prey dynamic is now widely regarded as a conservation success story—one where predator recovery has indirectly benefited native prey.

However, concerns remain about spillover predation by pine martens on other rare or vulnerable species, particularly in areas where martens are newly returning. These concerns include potential impacts on ground-nesting birds and by some red squirrel groups fear that pine martens will present pressure onto red squirrels in breeding dreys and as adults. For some land managers and stakeholders, such risks can reduce enthusiasm for predator restoration, despite the broader ecological benefits.

To address this, Bamber et al. (2024) conducted an experimental study in the Cairngorms Connect Landscape to test whether diversionary feeding (Figure 3) could reduce predator impacts on ground-nesting birds, specifically the capercaillie. Diversionary food was provided at bait stations placed within 1 km² grid cells (to emulate the size of marten daily movement territories) during the nesting season of capercaillie, and the fate of artificial nests was monitored using camera traps and field surveys. The study found that martens, badgers, foxes and other predators made regular use of these food sources, and this correlated with reduced depredation of artificial nests, resulting in increased artificial nest survival.



Figure 3. Pine marten attracted to a bait station. (J.Bamber)

The significance of this study could potentially extend beyond the focal birds. Importantly, it demonstrates that predator behaviour, specifically pine marten and badger foraging behaviour, is flexible and can be influenced by diversionary food, offering a non-lethal tool for reducing incidental predation. For red squirrel conservation, this presents an important opportunity: while pine martens benefit red squirrels at the population level by controlling grey squirrels, diversionary feeding could mitigate spillover predation onto other local species of concern, theoretically this could include the occasional localised risk to red squirrel juveniles during breeding, particularly in areas where concerns about predation might hinder restoration efforts.

This dual perspective—pine martens as both allies and occasional risks—supports a more nuanced and adaptive approach to conservation. Rather than framing predator recovery as a binary “good or bad” outcome, the findings of Bamber et al. allow us to move toward coexistence-based management, where benefits are maximised, and risks are actively managed.

The project was led by a PhD researcher and supervisory teams at the University of Aberdeen, University of St-Andrews and Forestry and Land Scotland and carried out in collaboration with Cairngorms Connect partners, including RSPB Scotland, Forestry and Land Scotland, Wildland Ltd, and NatureScot. All data collection was field-based relying on camera traps and ground surveys to assess both bait station use and nest fate. This practical, low-tech approach offers a scalable model for impact-based intervention.

In the context of red squirrel conservation, this study adds a valuable new layer to current strategy. Combined with the evidence from Sheehy et al. (2018), it suggests we can embrace pine marten recovery for its long-term suppression of grey squirrels, while deploying diversionary feeding in sensitive periods or locations to reduce unintended impacts on other locally threatened prey.

This integrated model could be especially valuable in landscapes where pine marten re-introductions or natural recolonisation are still contentious. By demonstrating that practical tools exist to address stakeholder concerns, this work helps build broad support for predator-prey coexistence and supports more resilient, balanced ecosystems.

Success indicators

- Reduction in predator visitation rates to monitored artificial nests diversionary feeding was provided.
- Increased confidence among stakeholders in coexistence strategies that balance predator recovery and prey protection, triggering deployment.

Major difficulties faced

- Resistance from some land managers toward adopting new, novel predator management techniques.
- Logistical constraints of deploying and maintaining feeding stations across a remote, forested landscape.
- It is currently an unknown that feeding interventions did not produce unintended ecological effects, such as increased predator density. Although indications point to that not being the case.

Major lessons learned

- Behavioural ecology of predators can be manipulated to reduce impacts on conservation-sensitive prey.
- Diversionary feeding is most effective when integrated into landscape-scale, data-driven conservation frameworks.

- Multi-stakeholder collaboration is essential for implementing experimental interventions at scale.
- Adaptive, field-tested management is critical for addressing conflict in recovering ecosystems.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Strong experimental design.
- Collaboration across multiple stakeholders.
- Co-design and Co-production.
- The approach is being adopted in North Wales to minimise pine marten activity at red squirrel translocation enclosures (Figure 4).



Figure 4. The diversionary feeding approach has been adopted in Wales to minimise pine marten activity at red squirrel release enclosures (C. Shuttleworth, Bangor University).

Future project development

- The next steps would be to evaluate the method to reduce predation by pine martens in different ecosystems, i.e. wetland edge habitats. Or with different prey species of concern, i.e. red squirrels or wading birds.

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- IV. <https:// Cairngorms.co.uk/capercaillie-emergency-plan/>
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THE ANIMAL AND PLANT HEALTH AGENCY DISEASES OF WILDLIFE SCHEME (APHADoWS): Wildlife disease surveillance in England and Wales, with special reference to the Eurasian red squirrel (*Sciurus vulgaris*)

The Animal Plant Health Agency

Geographical area of conservation work

The Animal and Plant Health Agency Diseases of Wildlife Scheme (APHADoWS) covers England and Wales and undertakes work in areas where remaining English red squirrels survive. Areas of interest are in Formby (Lancashire), Northern England (Cumbria and Northumberland) and in specific areas of North Wales (Anglesey, Gwynedd and Clocaenog Forest in Denbighshire/Conwy), but we will examine red squirrels from wherever in England and Wales they are submitted. We also provide analytical support when requested to both Scotland and Northern Ireland through the University of Edinburgh, NatureScot and the Ulster Wildlife Trust and the Northern Ireland Environment Agency.

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Key partners

- APHADoWS
- GB Wildlife Health Partnership
- Red Squirrels Trust Wales
- Lancashire Wildlife Trust
- Northumberland Wildlife Trust
- Cumbria Wildlife Trust
- Local red squirrel groups
- UK captive red squirrel breeding scheme
- International Zoo Veterinary Group

Resources

All staff are Animal and Plant Health Agency employees. Veterinary and scientific staff at the various agency sites provide support as directed and would typically total around 10 to 12 people as required on a case-by-case basis

Maps of project land area

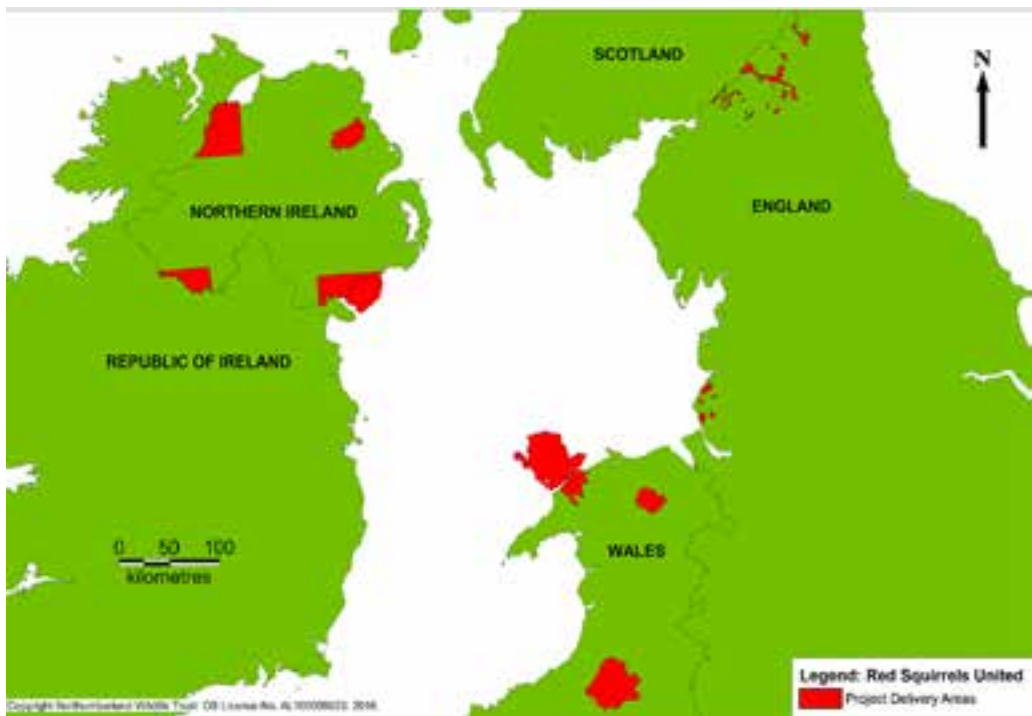


Figure 1. Areas of England and Wales covered by the APHADoWS that are specifically mentioned in this chapter. (© Northumberland Wildlife Trust).

Figure 1 illustrates the Red Squirrels United Project Delivery areas and denotes the three areas in England and Wales covered by the APHADoWS for surveillance purposes referred to in this chapter. Area 1 denotes the Formby area of primarily coastal pine incorporating deciduous woodland in Lancashire, which borders several urban areas from which we receive a small number of samples each year. Area 2 covers large tracts of Northern England (Cumbria and Northumberland) which is largely commercial coniferous-based woodland in origin, again with several areas incorporating mixed deciduous stands. Area 3 relates to three areas in North Wales (Anglesey, Gwynedd and Denbighshire/Conwy), where woodland areas on both Anglesey and Gwynedd comprise mixed deciduous woodland, interspersed with coniferous woodland blocks linked with hedgerows among many urban developments. The main Anglesey coniferous woodland areas are the Newborough and Mynydd llwydiarth (Pentraeth) forests, alongside the Gwynedd Faenol Estate and Treborth Botanical Garden woodlands and the Denbighshire/Conwy mainland Clocaenog Forest.

Introduction

The native Eurasian red squirrel (*Sciurus vulgaris*) and invasive North American grey squirrel (*Sciurus carolinensis*) are present throughout the UK areas covered by the APHADoWS. Our coverage encompasses designated red squirrel strongholds like Whinfell Forest (Cumbria), Kielder Forest complex (Northumberland), Newborough and Pentraeth forests (Anglesey), the Formby coastal woodlands (Lancashire), alongside smaller, fragmented woodlands and urban areas with remnant red squirrels, notably the isolated small site for red squirrels at Grasmere, Cumbria.

Anglesey and areas of North Wales have recently become a focal point of study due to the re-introduction of red squirrels to the island and their subsequent recolonisation of the nearby mainland. The landscapes we cover are both mixed deciduous types, and due to ongoing decreases in red squirrel distribution, increasingly more coniferous-based, which offers a competitive advantage to the native species. Throughout the areas we work within, grey squirrels have been a constant presence over the last 25 plus years that the APHADoWS has operated and a significant factor in the constant but variable numbers of squirrelpox cases diagnosed. Although red-to-red squirrel transmission undoubtedly occurs, it is not as efficient as grey-to-red squirrel transmission (Duff et al. 2010). The APHADoWS is solely a Defra-funded scheme, provided by dedicated APHA staff, who undertake wildlife disease incident investigations and subsequent scientific analyses to supplement the veterinary input. This input is in response to animals submitted for examination to the scheme by members of the public, private veterinary surgeons, or volunteer-led conservation groups having common conservation interests.

Project aims

- The APHADoWS provides wildlife disease surveillance (wild mammalian and avian species) in England and Wales for the Government, but resource availability currently precludes investigation of all wildlife disease incidents. Each incident is therefore triaged and responded to wherever possible, to provide a mechanism to investigate both English and Welsh wildlife disease outbreaks. Surveillance Portal: [Animal disease scanning surveillance at APHA - GOV.UK](#)
- The APHADoWS only covers wildlife, but both farmed and domestic livestock species, which have obvious importance to the national food chain, are covered by other specific APHA surveillance projects.
- The APHADoWS is unfortunately unable to respond to every wildlife incident but does assess each incident on a case-by-case basis using set criteria and responds where there is a suspicion of new or emerging disease threats posed to the wildlife species present.

- Two of these diseases are the well-established squirrelpox, a disease caused by an invariably fatal infection with squirrelpox virus (SQPV), that is increasingly threatening the extirpation of the native sciurid species in its last remaining range in mainland England and Wales and in addition, an increasing emerging disease threat posed to the red squirrel by another agent, known as adenovirus (AdV). We are also interested in other, less frequent viral detections and occasional diseases and causes of mortality in red squirrels such as coccidiosis, lice (*Neohaematopinus* sp), squirrel leprosy and other rodent viral infections.

Description of the project

Deaths and suspected disease outbreaks are reported to APHA by private veterinary surgeons, reserve and project managers, the public, or volunteer groups monitoring wildlife species. Information is triaged by APHA and where appropriate, samples dispatched to regional Veterinary Investigation Centres (see APHA Veterinary Investigation Centres and Surveillance Pathology partners-Gov.UK) and examined for the animal's cause of death. Examinations are undertaken free of charge for accepted cases and reports supplied. A range of laboratory-based tests including bacteriological, fungal, parasitological, viral and histological analyses may be undertaken. The results, including the suspected cause of death are sent to the sample's submitter. Information regarding the animals may then be released to aid procedures established to provide aid and further knowledge of the disease or causes of mortality.

With reference to the red squirrel, an interest in the discovery of squirrelpox in the native species was made. This continues to this day, as over the last few decades, this native species has faced extirpation through the disease and the part played in it through the grey squirrel, an immune carrier of the virus associated with the disease and the competition provided by it in terms of habitat and food resources.

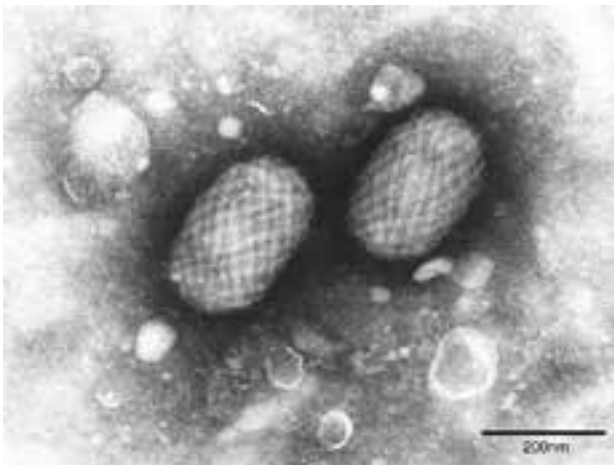


Figure 2. SQPV particles detected by TEM from the first case of squirrelpox detected in a red squirrel from Norfolk in 1980. (© APHA Labs).

Historically, the first squirrelepox case was detected in a red squirrel from Norfolk (Figure 2) in 1980 (Scott et al. 1981), by a predecessor organization of APHA, when the causative agent, originally described as a parapoxvirus was identified. It is in fact a different virus, a chordopoxvirus, which resembles parapoxvirus, but is distinct from it. No further red squirrel cases were detected until the early 1990s, when sporadic cases simultaneously appeared in Cumbria, Northumberland, County Durham and Lancashire. Cases were also detected in Dorset, Suffolk and North Wales, in red squirrels involved in several early trial releases and associated reinforcements undertaken at that time.

The analytical platforms utilised in the detection of both SQPV and AdV, consist primarily of electron microscopy, to detect the presence of viral particles of both agents, with SQPV from visible skin lesion material and AdV from intestinal or faecal material. In addition, another assay, the polymerase chain reaction (PCR) assay is used mainly for AdV, where the virus may be present in an asymptomatic infection. This type of infection means the squirrel may contract the virus but may live happily with it and display no outward sign of infection. This is particularly the case with the grey squirrel, where both SQPV and AdV are present as asymptomatic infections. No visible signs of disease via surveillance and monitoring through post-mortem and analytical testing have been detected in the grey squirrel caused by either of these two agents, bar a single recorded case of pathogenic SQPV detected in a single animal from England in 1994 (Duff et al. 1996).

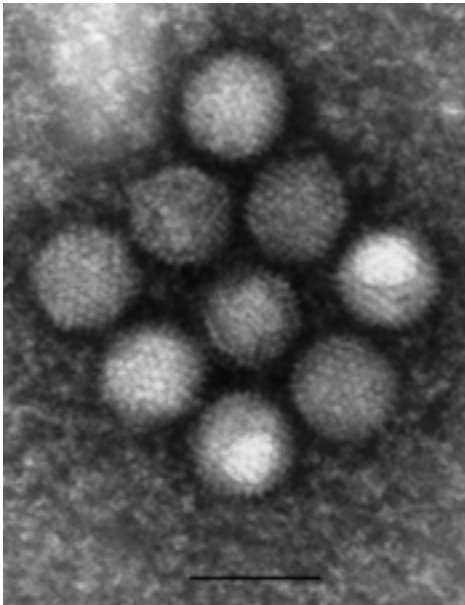


Figure 3. AdV particles detected in intestinal content from a captive red squirrel from England (Bar = 100nm). (© APHA Labs).

AdV is geographically widespread within the UK red squirrel population as both an asymptomatic and pathogenic presence, the first detection being identified in 1983, from Anglesey, in an archived traffic accident victim. The first large outbreak was recorded in 1997 during a Suffolk reinforcement programme, with wild animals translocated under license from Cumbria. AdV cases have been detected across the UK since then and a study (Everest et al. 2018) recorded a widespread presence in captive animals (Figure 3), used for re-introduction and reinforcements. All known AdV and SQPV locations within the UK are displayed in Figures 4 and 5.

Refinement to this analytical support network for local red squirrel groups recently developed non-invasive assay platforms using PCR and hair or whisker samples to detect both SQPV and AdV amplified DNA (Everest et al. 2019). This platform utilises whiskers as a matrix from dead animals, where internal organs are precluded for examination, such as road deaths, deaths from nest boxes or decayed animals, considered beyond use. Additionally, hair may be utilised from live animals, where welfare considerations preclude whisker use from live animals, using remote hair tubes or sticky pads on feeders. Accordingly, a general assessment of infection presence can be made using a population basis over any given area and timeline. This represents an environmental detection on the hair, revealing an infection presence, classed as a danger to any red squirrel present. The process may equally be utilised for grey squirrel management purposes.



Figure 4. Case locations for known AdV cases detected in red squirrels to end of December 2024. (© Northumberland Wildlife Trust).



Figure 5. Case locations for known SQPV cases detected in red squirrels to end of December 2024. (© Northumberland Wildlife Trust).

Success indicators

- The analysis of all submitted suspected SQPV and AdV samples wherever possible and the detection of outbreaks from any new geographical locations in a timely manner.
- To assess changes in the epidemiology of squirrelpox disease and to examine the effects of conservation management programmes for both red and grey squirrels. To measure the geographical distribution of SQPV with time, to assess the prevalence of the disease.
- To provide suitable follow-up advice for each wildlife incident able to be responded to and to ensure it is administered and that the appropriate responses are undertaken, such as in terms of biosecurity information.
- The completion of all appropriate examination and analytical procedures and the identification of disease processes to discover and report the cause of death and all the associated findings relating to each case. The provision of grid reference case locations in any outbreak area is paramount wherever possible, which will inevitably aid any epidemiological investigation.

Major difficulties faced

- Ongoing finite resource availability for the various surveillance activities undertaken realistically still precludes investigation into every wildlife incident, so appropriate choices are required to be determined which follow set protocols. This could be true for SQPV analyses where numbers of samples are submitted from a single area location. If a current squirrelpox disease outbreak is ongoing, then it is less likely that additional samples will be examined. Priority would most likely be given to any suspected squirrelpox cases from areas with no history of the disease and from areas which have not incurred a case confirmed for a significant period.
- Changing priorities in terms of staff deployment with notifiable disease outbreaks, will at times mean resources will need to be re-focused towards work of a higher national priority, such as with the ongoing highly pathogenic avian influenza outbreaks or other notifiable and exotic diseases such as bluetongue virus affecting both ruminant and camelid species across the country.
- Establishing clear pathways for knowledge dissemination regarding sample collection. This will enable the correct types of samples, or whole carcasses to be submitted to the most appropriate APHA laboratory location to ensure wherever possible, both a prompt examination, with allied analytical testing and result dissemination.

Major lessons learned

- Sufficient funding needs to be secured to ensure that the appropriate analytical support is provided for the needs of red squirrel conservation initiatives to ensure comprehensive answers are obtained wherever necessary.
- Any laboratory re-organisation or rationalisation that may have a temporary adverse effect on ongoing surveillance activities, must be both focused and ideally minimised where possible. In cases such as this, laboratory resources, such as in terms of staff numbers, must be sourced for use to ensure that all analyses are completed, and the results reported in a timely manner.
- Clear knowledge paths need to be developed to streamline appropriate sample collection and dispatch for analysis. This will help to ensure prompt delivery of appropriate samples and timely examination and reporting of analytical findings.
- Resource constraints mean that there will be a likelihood for the need in some circumstances to prioritise and restrict analyses to the most appropriate incident locations in terms of gaining additional knowledge rather than continuing to focus on existing disease outbreaks. If funding is available from an outside source such as from the client or a support body, this will inevitably help to ensure that additional focused analytical provision can be provided.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- All the submitted cases that can be investigated are categorized as being either positive or negative for SQPV or AdV by electron microscopy or PCR analyses. Differential diagnoses are undertaken where possible in skin disease cases that are determined as SQPV negative by electron microscopy, and this has led to the discovery of the first report of dermatophilosis in wild European red squirrels (Holmes et al. 2017).
- We ensure that the analytical testing procedures are both highly sensitive and validated and that the staff undertaking them are both trained, experienced and competent to undertake the various tasks required.
- Although a viable system has been established to ensure that there is a good understanding between the various agency laboratories and the people submitting the samples, issues still occasionally arise with results delivery. Despite these acknowledged issues, we strive to ensure the animals wherever possible are collected and stored correctly prior to prompt submission and analysis at the appropriate laboratory location.

Future project development

- There is a need to ensure wherever possible that the available agency-based funding is sufficient to ensure the appropriate analyses are undertaken.
- Aid needs to be provided to local red squirrel groups to help source additional funding streams that may be available to ensure that all the appropriate analyses may be undertaken on each sample wishing to be submitted for analysis. This would provide as complete a picture of disease presence wherever possible.

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DEVELOPING A SPECIES-SPECIFIC CONTRACEPTIVE FEEDER FOR THE MANAGEMENT OF GREY SQUIRRELS

The Animal and Plant Health Agency

Geographical area of conservation work

Cumbria, Northumberland and North Yorkshire, England; Denbighshire, Wales

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Key partners

- UK Squirrel Accord
- Coquetdale squirrel group
- Grasmere red squirrel group
- Red Squirrels Northern England
- Independent volunteers
- Mr Barry Bickerton (Independent practitioner)
- Prof. Giovanna Massei, The University of York
- Prof. Phil Stephens, Durham University

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	
Paid Contractors (7-12 months)	
Volunteers involved with grey control	
Volunteers involved with squirrel monitoring	
Other Active Volunteers	16 One to four volunteers per site baiting feeders and managing cameras for one to three weeks

Maps of project land area



Figure 1. A map of the study locations where automatic weighing devices were deployed to collect the body weights of red squirrels. Woodlands were selected in Northumberland, Cumbria and North Yorkshire in England and Denbighshire in Wales.

Introduction

The Animal and Plant Health Agency are currently developing an oral contraceptive to manage the numbers of grey squirrels (*Sciurus carolinensis*) in the UK (UK Squirrel Accord, 2024). The contraceptive in development is an immuno-contraceptive vaccine, which is mammal-specific, rather than species-specific. It is therefore important that a species-specific bait delivery system is developed and tested to ensure contraceptives can be administered in a targeted and cost-effective way, with minimal impact on the environment and on non-target species.

A species-specific feeder will have to be easy to maintain and sufficiently robust to use in different environments and weather conditions. It is likely that two feeder designs will be required. Most of the UK has only the grey squirrel present, and in many of these areas grey squirrels are unique amongst wildlife species in terms of their body size, behaviour and locomotion. In locations such as these, a robust feeder with a weighted bait door has been shown to exclude most other species of UK wildlife while allowing grey squirrels to access bait numerous times (Beatham et al., 2023).

Due to the morphological and behavioural overlaps between grey and red squirrels (*Sciurus vulgaris*), a more complex design will be required to distinguish between the two species in areas where they coexist. The maximum red squirrel body weight is reported to be 350g, while the weight range for adult grey squirrels is reported to be 440-650g (Mammal Society, 2024). By setting a minimum weight threshold required to open a feeder door, body weight should provide a relatively simple way to distinguish between the two species. To assess how effective this would be, more detailed data were required on the comparative body weights of the two species in different seasons and locations.

Squirrel feeders with integrated automatic weighing platforms, were used to gather data on red squirrel weights from several red squirrel woodlands in Cumbria, Northumberland, North Yorkshire and North Wales (Figure 1). The maximum red squirrel weights recorded were compared to the weights of grey squirrels collected at the same time of year, as part of bait uptake trials conducted by APHA. From the data collected, a prototype feeder was developed and tested in a small pilot trial, in an area of Cumbria where both red and grey squirrels were present.

Project aims

- Test whether body weight could be used to develop a bait-feeder that allows access by most grey squirrels whilst excluding red squirrels.

Description of the project

A squirrel feeder with an integrated automatic weighing platform, was designed and developed by a practitioner, Barry Bickerton, with some guidance on the design provided by Sarah Beatham. The feeder consisted of a wooden bait compartment fixed to a one-metre-high wooden stand. In front of the compartment was a load cell covered by a 12 x 20 cm metal weighing platform, connected to a battery pack and SD card reader, contained within a plastic, waterproof box (Figure 2a).



Figure 2a. A red squirrel feeder with integrated automatic weighing scales, designed to record the body weights of red squirrels that feed from it. The weights, together with the date and time they were recorded, were stored on an SD card.



Figure 2b. Animals using the feeder were identified from photos and videos recorded by a Reconyx™ HS2X camera focused on the entrance of the feeder. Although multiple red squirrels were recorded around the feeders, the weighing platform and tunnel size meant that no more than one individual was ever recorded on the weighing platform at one time.

When an animal stood on the weighing platform (Figure 2b), the load cell recorded 20 weights every two seconds, to minimise weight variation caused by animals moving around. Data transfer was managed by an Arduino microcontroller board, which read data from the load cell and converted it into grams. The weight in grams was saved to an SD card, together with the time and date. A metal mesh tunnel with a clear plastic roof covered the weighing platform. This was designed to prevent more than one red squirrel from sitting on the scales at once and to prevent rain or debris falling onto the scales and affecting the readings or function.

Between 2021 and 2023, one to five weighing devices were deployed in eight areas of woodland (Figure 1), during trials conducted in Northumberland, Cumbria, North Yorkshire and North Wales. All these woodlands were known to be inhabited by red squirrels. Trials were conducted at some areas twice, in different months of the year, to assess weight variation for different seasons. Some woodlands were chosen as they were known to have grey squirrel present, to test whether competition between the two species would affect body weights. The weighing devices were deployed with the help of local red squirrel volunteer groups or practitioners. In each location, the devices were positioned at least 200 metres apart or in separate woodlands, to record weights from as many different red squirrels as possible.

Each weighing scale was monitored with a Reconyx™ HS2X remote camera, fixed to a tree and focused on the weighing platform. When the weighing scales were first set up, a 200 g check weight was placed on the weighing platform, to check the accuracy of the scales. The bait compartment of the apparatus was filled with approximately 500 g of bait (peanuts, sunflower seeds and hazelnuts), except for one trial, where only whole hazelnuts were used as the preferred bait choice of the squirrels in the woodland. The volunteers/practitioners rebaited the feeders every two to four days, for between seven and 16 days, dependent on volunteer/practitioner availability. All the photos and videos recorded within 60 seconds of each weight recorded were used to identify the animal weighed. This interval was used as the camera trigger often did not coincide exactly with the weight record and the clocks on both devices were manually set, so were not exactly synced.

The maximum red squirrel weights collected from all woodlands were 378-442 g (Table 1). Weights recorded were consistent (within 50 g) between squirrels from the same areas at different times of year and between areas that did and did not have grey squirrels present, surveyed at the same time of year. The heaviest weights recorded for wildlife species in each area were those from red squirrels, or grey squirrels if present.

In total, 205 grey squirrels were weighed as part of APHA bait uptake trials conducted in six woods in Yorkshire. In two woods studied in winter 2018, 96% of 50 squirrels weighed were at least 450 g, in two woods studied in summer 2022, 94% of 89 grey squirrels in two woods weighed at least 450 g and in two woods studied in spring 2023, 92% of the 66 grey squirrels weighed were at least 450 g. In total, 3.4% of the grey squirrels weighed in all six woods were aged as juvenile.

Table 1. The maximum red squirrel weight ranges recorded by 'automatic weighing scales' deployed in different red squirrel woodlands in the north of England and north of Wales. Each weighing scale were deployed and baited for seven to 16 days at each location. Some could not be analysed due to faults with the weighing system or the associated camera. The total number of weighing scales analysed, number of days analysed and number of weight records matched to red squirrels are included.

Location	Year	Month	N days	N weigh scales analysed	N days analysed		N records	Max. red squirrel weights (g)
					Mean	Range		
Horsley, Northumberland	2021	Nov/Dec	13	5	10	2-13	1164	424
	2022	July	9	3	9	9	373	378
Grasmere, Cumbria*	2022	Aug	8	5	6	3-8	307	429
Otterburn, Northumberland	2022	Jan	11-14	5	12	11-14	1946	397
		July/Aug	7	5	7	7	3271	429
Snaizeholme, North Yorkshire	2022	June	8	1	3	3	497	410
Beckermonds, North Yorkshire	2023	June/July	7	4	3	2-4	5899	435
Clocaenog, Denbighshire*	2023	August	8	4	8	8	88	431
Heppele, Northumberland	2023	August	16	4	16	16	2563	442
Newby Bridge, Cumbria*	2023	July/Aug	15	1	15	15	230	429

*Locations with grey squirrels present, confirmed on cameras

From the comparative body weights of red and grey squirrels, it was concluded that a selective feeder with a 450 g weight threshold should exclude all red squirrels, while allowing access to over 90% of adult grey squirrels. Barry Bickerton developed a prototype based on this. The selective feeder prototype (Figure 3a) consisted of a passive infra-red sensor, which, when it detected movement, activated a weighing platform, similar in design to the automatic weighers. If the recorded weight was at least 450 g, a signal was sent to a radio control servo to open a door to the bait compartment. If the weight fell below 450 g, the door closed. The prototype was deployed in a woodland in Cumbria, where both red and grey squirrels were present (Figure 3b).



Figure 3a. A grey squirrel selective feeder based on body weight. When a passive infra-red sensor detected movement, the weighing platform was activated. If the weight recorded was at least 450 g, the door to the bait compartment opened. If the weight fell below 450 g, the door closed. The feeder entrance was monitored using a Browning™ Dark Ops Pro X 1080 camera, set to record one photo and one 10 second video per trigger, to identify animals using the feeder.



Figure 3b. Red and grey squirrels in the apparatus.

The feeder was baited for 26 days with whole hazelnuts and a few grams of 100% hazelnut paste, either by Sarah Beatham or a local red squirrel practitioner. All videos were analysed and each animal at the feeder identified, along with whether they had opened the door. The feeder entrance was monitored using a Browning™ Dark Ops Pro X 1080 remote camera.

The camera recorded 23 visits by grey squirrels. On seven occasions, the grey squirrels activated the bait door so it opened and on six occasions the door remained closed; 10 occasions were inconclusive as the full visit was not captured on video. On two occasions when the door did not open, the squirrel was only very briefly on the platform. The camera recorded four visits by red squirrels. On one occasion, the red squirrel was chased off the feeder by a grey squirrel, on two occasions the red squirrel was on the weighing platform and the door was not activated and one occasion was inconclusive, as the full visit was not recorded. The only other animals recorded on the weighing platform were wood mice (*Apodemus sylvaticus*), on 24 visits, none of which activated the door. The results from this trial provide an initial proof of concept, that body weight could be used to select between the two species of squirrel, allowing grey squirrels access to a bait while excluding red squirrels.

Thank you to the UK Squirrel Accord for funding the study and to all the volunteers and practitioners that devoted their time to the field work.

Success indicators

- Whether there was a sufficient separation in body weight ranges between adult grey squirrels and red squirrels, to make a grey squirrel selective contraceptive feeding hopper based on body weight viable.
- A demonstration that a prototype of a grey squirrel selective contraceptive feeding hopper based on body weight could feed a bait to grey squirrels while excluding all red squirrels

Major difficulties faced

- Some of the automatic weighing devices failed in the field due to electronics faults, possibly due to wet conditions.
- Bait that was dropped on the weighing platforms occasionally making the weight data unreliable.
- The remote cameras occasionally were not triggered by animals on the weighing platforms, so not all weights could be assigned to a wildlife species.
- If more resources were available, a greater number of locations would have been sampled.

Major lessons learned

- The contraceptive feeding hopper requires a more robust design for use in the field. The prototype feeders were subject to failure when the electronics became wet or when bait was dropped on the weighing scales.
- These issues could be addressed by thorough design refinement and additional product development.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- The data collected suggest that body weight could be used to select between red and grey squirrels and the prototype trial results provide an important proof of concept. However, a field robust, cost-effective feeder design is now required, that can be manufactured and tested on a larger scale in more locations with different UK wildlife species present.

Future project development

- Work with manufacturers to develop the design of the selective contraceptive feeding hopper, so it is sufficiently robust for the field and cost-effective to produce.
- Explore ways of adapting the selective contraceptive feeding hopper to exclude pine martens (*Martes martes*).

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in the project currently	Future importance in developing this aspect of grey squirrel management in the project area
Shooting		
Live traps		
Kill traps		
Pine marten (as natural grey predator)	★ ★ ★	Any contraceptive feeder in the future is likely to need to exclude pine martens as their range is spreading into more grey/red squirrel areas
Immuno-contraception (oral bait delivered via hoppers)	★ ★ ★	Further development of a selective contraceptive hopper is dependent on the development of an effective immuno-contraceptive
Gene Drive (Selected inheritance manipulated so only male young are born)		
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).	★	
Squirrelpox vaccine		

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

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WHY DO GREY SQUIRRELS NOT DAMAGE ALL BROADLEAVED TREES IN THE SAME WAY?

European Squirrel Initiative

Geographical area of conservation work

Devon, Dorset, Somerset, Surrey, Midlands (England)

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Key partners

- Rebecca Isted of the Forestry Commission
- Prof Patrick Doncaster of Southampton University
- Prof John Pickett of Cardiff University

Project land area

Grey squirrels (*Sciurus carolinensis*) cause significant bark-stripping damage to broadleaved trees across their UK range. Grey squirrel control to protect trees has proved difficult to sustain due to land ownership and differing management objectives.

I have carried out my research across a large geographic area centred on mid- and southern England. This has encompassed private woodland estates, the National Forest Estate (NFE) and various arboretums around the country.

Introduction

I have been a practicing Chartered Forester for 30 years and have managed estates across England, Wales, Northern Ireland and Scotland. I have been involved with grey squirrel (*Sciurus carolinensis*) research for the past 35+ years, working with Prof Robert Kenward and Dr Frank Doyle, initially looking at bark-stripping damage prediction and understanding the factors affecting grey squirrel damage. My current research project (spread over the past 10+ years) builds upon much of Prof Kenward's work and collaborative observations.

There are no red squirrels (*Sciurus vulgaris*) present in any of the areas connected with my bark-stripping damage research. The closest red squirrel populations are on Brownsea Island in Poole Harbour. In contrast, grey squirrels are widespread and damage a range of lowland mixed broadleaves. Pine martens (*Martes martes*) have recently been legally released into the Dartmoor region and there are other unregulated releases taking place across the region. This illegal, so called 're-wilding', will have a massive impact on ongoing grey squirrel control as 'kill traps' will no longer be legal to use; no extra funding for control has been agreed to help land managers in those areas, even though live traps are significantly more expensive to operate. The concern is that land managers cannot afford to use live traps and therefore, effective control will fall, and the efforts by some to protect native trees and timber crops over the past decades will be undermined.

Project aims

- To better understand the reason behind why grey squirrels damage certain tree species more than others.
- To investigate whether there are any tree species that can be grown without damage risk.
- To develop a wider range of woodland management techniques that can be used to minimise grey squirrel damage.

Description of the project

In a client's poplar (*Populus*) plantation (Figure 1), I observed severe grey squirrel bark-stripping damage on certain poplar clones but not others. In one plantation there were 11 poplar clones, replicated three times at random: each group consisting of 49 trees. Out of the 11 clones, I observed that four clones were destroyed (damage score 4 and damage frequency 10) and the next-door trees were untouched. They were *P.Trichobel*, *P.Columbia River*, *P.Fritzi Pauley* and *P. Scott Pauley*. On the neighbouring trees, there were no bark 'trial marks' (where a squirrel nibbles away a small area testing the phloem sap contents) at all. The undamaged trees were *P. robusta*.



Figure 1. Study area containing Poplar species

Three things immediately came to mind regarding the different rates of damage:

- The phloem in the damaged trees must have something special in it – an 'X factor' which grey squirrels wanted.
- Grey squirrels must be able to 'detect' this X factor by smell.
- All broadleaf trees must have this X factor to a greater or lesser extent.

All the damaged poplars had one poplar parent tree in common. Initially, I was unable to get help from anyone to test the phloem, but eventually Rothampstead Institute helped. Their analysis of the phloem revealed my prediction was correct. We discovered a particular amino acid that was present in hundreds of times higher concentrations in one clone than any other. In this poplar, no damage had been observed, this was *P. Robusta*. This amino acid is, I believe, linked to the 'Nitrogen cycle' in the tree's growth which rises

and falls during the growing season. Interestingly, it has a dip around mid-summer, about the time when grey squirrel damage starts to appear in vulnerable trees. I was able to test several other broadleaf trees and have produced a table (Table 1) showing tree species, the amino acid reading and damage indication.

Table 1. Tree species, amino acid level and observed grey squirrel damage risk. Green shade = safe to grow. No shade = ‘be very careful’ there is a risk of squirrel damage. Red shade = prone to grey squirrel damage.

Tree Species	Amino acid level (mg/ml)	Damage-ability Scale: 0 – 10 (low to high risk)
Poplar (<i>Populus robusta</i>)	2.840	0
Wild Cherry (<i>Pranus avium</i>)	1.500	0
Small Leaf Lime (<i>Tilia cordata</i>)	3.03	0 - 1
Common Walnut (<i>Juglans regia</i>)	0.898	0 - 1
Eucalyptus (<i>Eucalyptus sp.</i>)		Not tested yet
Ash (<i>Praxinus excelsior</i>)	0.8	2
Sweet Chestnut (<i>Castanea sativa</i>)	0.7	7
Sessile oak (<i>Quercus petraea</i>)		
Pedunculate oak (<i>Quercus robur</i>)	0.5	7
Beech (<i>Fagus sylvatica</i>)	0.5	8
Sycamore (<i>Acer pseudoplatanus</i>)	0.310	9
American Walnut (<i>Juglans nigra</i>)	0.273	10
Field Maple (<i>Acer campestra</i>)		10
Poplar (<i>Populus trichobel</i>)	0.268	10

On another client's estate, I was able to test my theory on his walnut plantations. He had American black walnut growing next to European or common walnut plus some Hybrid Walnut. Again, one type of tree had major damage and the other was undamaged. Amino acid tests were carried out, and the American walnut had a very low reading (and was damaged) and European walnut had a high reading (above 8 mg/ml) and was undamaged.

More recently, I have found a large group of silver birch trees growing in the NFE, all of which were severely damaged (Damage Score 4, frequency 9), however there was one tree growing on the edge of the wood perfectly undamaged. It is believed that this tree is a Downy Birch, rather than a Silver Birch. Both are native birch trees yet damage by grey squirrels has varied.

The trees behind the tree in the foreground (Figure 2) are the standard silver birch. Being an edge tree, the tree at the front should have had the highest phloem volume (sap) levels and hence more likely for damage: but there were no 'bark-stripping trial' marks on the tree.

I collect phloem samples personally and get them tested in a biochemistry lab at my personal cost. Each test costs approximately £400.



Figure 2. Trees growing on the edge of woodland have a high risk of bark-stripping unless they have a high 'amino acid' level.

The link to the 'Nitrogen cycle' is interesting. Another example is at Paradise Wood on the Earth Trust Estate where a two-hectare plantation of Common walnut was established, interplanted with *Elaeagnus* as a 'nitrogen fixer'. Every *Elaeagnus* tree / bush had heavy bark-stripping on all upper branches, but there was no sign of damage to any of the Walnut trees.

Success indicators

- Finding a chemical difference in the phloem between the trees that were damaged and not damaged.

Major difficulties faced

- Lack of funding for my field research and access to biochemistry facilities.
- Lack of scientific knowledge and denial of my research by some in the forestry world.
- Each time I received an offer of help, those interested in the project wanted to go off in their own direction, or to try to think of any potential monetary gain from it.
- Lack of time for my research to test all UK broadleaf species.

Major lessons learned

- Trust in your 'gut feelings', observations, knowledge and having an open mind.
- Don't over complicate things, and look overseas to see if there are similar issues, for example, over grazing by moose (*Alces alces*) in Canada on young trees account for huge losses – can the 'amino acid compound' research help?

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Future project development

- If funding was available, I would like to test a range of tree species, such as Pin Oak (*Quercus palustris*), Hungarian Oak (*Quercus frainetto*), Red Oak (*Quercus rubra*), Wild Service Tree (*Sorbus torminalis*), Tulip tree (*Liriodendron tulipifera*), Norway Maple (*Acer platanoides*), Wych Elm (*Ulmus glabra*), Chilean Beech (*Nothofagus obliqua*, *Nothofagus prostrata*), Aspen (*Populus tremuloides*), and Locust Tree (*Acacia sp.*) and perhaps some of the oak at the National Collection at the Lovell Arboretum in Cheshire.
- We need to find tree species that will not get damaged and that will be resilient to climate change

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area	Comments
Shooting	★★★	★★★	At bait stations Very important and effective. Support shooting in the rural community
Live traps	★	★	Very costly
Kill traps	★★	★★	Costly
Pine marten (as natural grey predator)			Only in certain areas, not in lowland Britain and they could have a major impact on Red listed ground nesting bird species, curlew, lapwing, grey partridge etc. Illegal re-wilding is a major problem and Defra and the Police should be much more focused on stopping it. At the moment, they turn a blind eye
Immuno-contraception (oral bait delivered via hoppers)	★	★	Unlikely to work due to the difficulties in spreading the bait
Gene drive (Selected inheritance manipulated so only male young are born)	★★★	★★★	This is the only really reliable control option, but it is dependent on Government support
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)	★★	★★★	More could be done on this. My work is aimed at giving today's foresters a chance to grow broadleaf trees in the lowland, that they know will not get destroyed by grey squirrels.
Squirrelpox vaccine			

★★★ High; ★★ Medium; ★ Low, blank = None.

PROJECT RED HAVEN

Genysys Engine Ltd

Geographical area of conservation work

United Kingdom

Author and organisation contact details

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Key partners

- Bangor University and Ulster Wildlife: are providing knowledge, environmental testing location and support for feeder integration and maintenance for ongoing development and testing.

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	
Paid Contractors (7-12 months)	
Volunteers involved with grey control	
Volunteers involved with squirrel monitoring	
Other Active Volunteers	
Others	2 Core team of two specialists (AI/ Software)

Introduction

Genysys Engine is an AI research and engineering startup; Genysys Engine has recently completed the development and initial testing of the “Squirrel Agent” AI system and its associated “Squirrel Feeder” prototype.

This project aims to provide a technologically advanced solution for red squirrel (*Sciurus vulgaris*) conservation, and monitoring. This case study details these two core components’ development process and initial testing results.

The Squirrel Agent represents the initial steps in a broader project to leverage AI and IoT technologies for wildlife conservation. The focus of this initial phase has been to create reliable technology that can accurately distinguish between the red and grey squirrel (*Sciurus carolinensis*), and provide a controlled feeding method and environment, with real-time alerts. Later phases of the project will focus on providing a whole-of-environment planning capabilities to the respective natural population nationwide.

Project aims

- To develop an AI agent capable of accurately identifying and classifying red and grey squirrels based on their features e.g tail, eyes, weight etc.
- To design and develop a low-maintenance and low-wear prototype squirrel feeder (IoT device) that dispenses food exclusively to red squirrels and sends alerts to partnered organisations to alert them in real-time of grey squirrel intruders.
- Increase wildlife and surrounding area security through transparency.
- To conduct initial testing of the AI agent and feeder in controlled environments.
- To establish a foundation for future development and deployment in real-world conservation settings.

Description of the project

The project consisted of two main development streams:

Squirrel Agent AI Model:

This will utilise advanced multi-stage vision systems such as ‘Object Detection’, ‘Image Recognition and Classification’ techniques to analyse and extract the visual features of squirrels including ear shape, tail length, and body size (Figures 1 and 2). In parallel, the

Success indicators

- High accuracy of the Squirrel Agent in species identification and classification.
- Reliable functionality of the Squirrel Feeder prototype.
- Successful integration of the squirrel agent and feeder prototype.
- Completion of initial testing and data collection.
- Initial System and Application layers functional.

Major difficulties faced

- Financial Constraints: The project is entirely self-funded, lacking any government support or external financing. This limits the scope and pace of development and deployment.
- Supply Chain Disruptions: Brexit-related logistical challenges, specifically concerning Northern Ireland, result in extended lead times (approximately 3.5 months) for essential battery and hardware components required for the squirrel feeders.
- Sensor usage must be considered carefully, as some sensor's characteristics can affect wildlife (ultrasonic sensors etc).
- Security of the units and hardware must also be factored in, prototyping anti-tamper panels.
- Designing and Prototyping parts for use is quite slow on consumer printing hardware, with commercial solutions falling short due to minimum order quantities.
- Environmental Integration and Product Design: Designing a robust and reliable feeder prototype that seamlessly integrates into natural environments presents significant challenges. This includes ensuring: Effective waterproofing of components, durability to withstand varying weather conditions, and a user-friendly design for both squirrels and volunteer personnel.

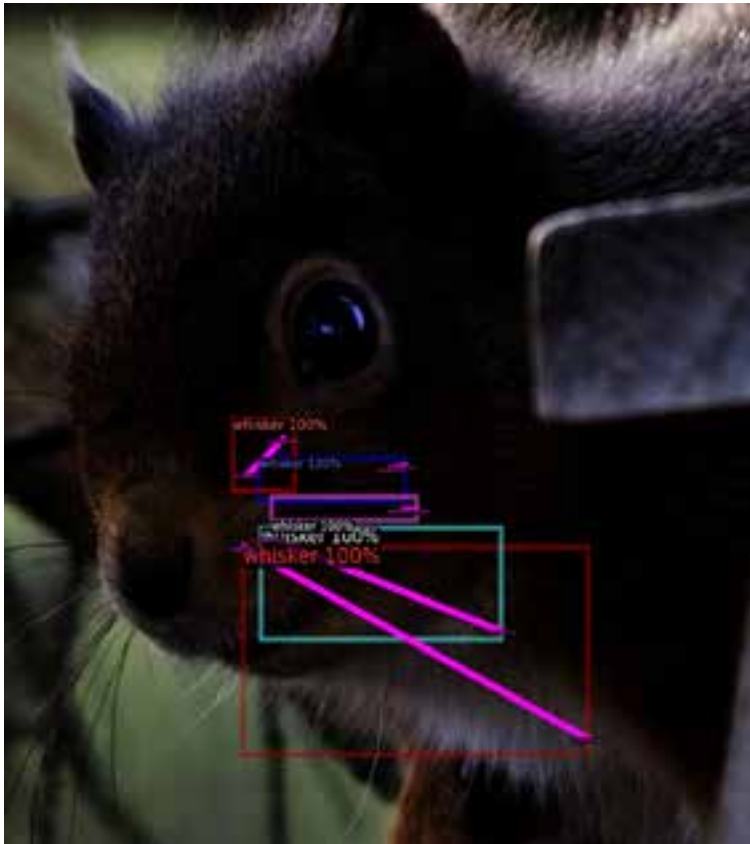


Figure 3. AI detection of individual red squirrel.

Major lessons learned

- AI systems can be effectively applied for real-time wildlife species identification and classification.
- IoT integration allows for precise control and automation in wildlife management to save resources and time for organisations working at ground level.
- Long-term testing in environments is crucial for the development of the squirrel feeder prototype.
- Solutions that interface with wildlife need to be designed with minimal interference as possible, as to reduce the total dependence on humans/prevent any cross-relation dependence (i.e automatic opening feeder doors vs, unlocked feeder door which forces the squirrel to still achieve 95% of the task themselves).

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- The Squirrel Agent has shown high accuracy in initial testing for identifying and classifying red and grey squirrels.
- The Squirrel Agent has shown from initial results that the identification and re-identification of individual squirrels is highly feasible with further research.
- The feeder prototype functions as designed to communicate with the squirrel agent in real-time and carry out a series of actions.
- The Feeder prototype has a Large and robust method of food delivery, with a consistent and reliable method for accessing the target food in any environment setting.
- The project has established a strong foundation for future development of both the squirrel feeder and the squirrel agent.
- Initial Systems and Application layers have been deployed and tested through various connection methods. Hardware and Application interoperability is highly functional with events being processed on and the Hardware behaving as expected.

Future project development

- Conduct extensive field testing of the Squirrel Agent and feeder prototype in red squirrel conservation areas.
- Optimise detection areas.
- Refactor and Optimise Feeder skeleton.
- Enhance the Squirrel Agents' capabilities, including individual squirrel identification and re-identification through whisker pattern analysis.
- Develop additional IoT integrations for tasks such as trap deployment and disease monitoring.
- Explore the application of this technology to other endangered species.

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TOWARDS A SQUIRRELPOX VACCINE

Bangor University

Geographical area of conservation work

United Kingdom

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Introduction

In 2005, Natural England commissioned and published a research report exploring the potential routes for the development of a squirrelpox vaccine. The detailed assessment described laboratory trials and provided associated timescales and costs. Subsequent experimental research attenuated the pox infection to weaken it and produce vaccine candidates (potential vaccines). Laboratory trials funded by the Wildlife Ark Trust in 2012/13 demonstrated that one candidate was sufficient to prevent mortality in red squirrels (*Sciurus vulgaris*) when they were later exposed to the wild-type pox virus. The experimental vaccination research conducted by the Moredun Research Institute caused some skin lesions, and although the red squirrels healed, the tissue damage presence was nevertheless unacceptable. Additional research was imperative. However, although a fund-raising campaign was launched, insufficient funds were pledged and the vaccine attenuation research ended.

A successful public petition (P-06-1332) *'Fund vaccine research to protect red squirrels from deadly Squirrelpox virus'* exceeded the mandated 10,000 signature threshold to trigger a Senedd (Welsh Parliament) debate (Figure 1). On 27 September 2023, Senedd members discussed squirrelpox (<https://www.theyworkforyou.com/senedd/?id=2023-09-27.7.526310.h>) and the Government Minister commitment to undertake a squirrelpox feasibility study. The Cabinet Secretary decisions report reflected this in a May 2024 entry (Figure 2). In response to a member's question (WQ944401(e)), the Deputy First Minister replied (14/10/24) reconfirming, *'As I set out in my letter to you in June, I have agreed to commission an external, independent review of the feasibility of the deployment of a squirrelpox vaccine. The review will focus on the risks, benefits, and costs, and look at research, manufacture and marketing authorisation aspects.'*

Vaccine research was clearly popular with the public, and with UK-wide red squirrel conservation group support, it was possible to reignite the debate over the merits of vaccine research through a petition.

Closed petition

Fund vaccine research to protect red squirrels from deadly Squirrelpox virus

Squirrelpox virus is carried and spread by grey squirrels. It doesn't harm them. When red squirrels are infected they develop open extensive skin lesions and die a painful death within 2 weeks

In North Wales, 70-80% of the Gwynedd red population was lost in a 2020/21 outbreak <https://theconversation.com/squirrelpox-virus-detected-in-north-wales-without-a-vaccine-the-disease-will-keep-decimating-red-squirrels-126871>

Promising research by Moredun Institute into a vaccine ran out of funds

[More details](#) ▼

This petition is now under consideration by the Petitions Committee

Petitions that collect more than 250 signatures are discussed by the Petitions Committee

[Find out about the Petitions Committee's discussion of this petition](#)

11,313 signatures

[Show on a map](#)

10,000

 **The Senedd debated this topic**

The Senedd debated this petition on 27 September 2023

You'll be able to watch the debate online at [senedd.wales](https://www.senedd.wales)

Date closed

11 May 2023

Figure 1. 2023 Senedd petition on Squirrelpox virus.

Squirrelpox vaccine feasibility study

20 May 2024

The Cabinet Secretary for Climate Change and Rural Affairs agreed to the recommendation to carry out a feasibility study to assess the prospect of the research, manufacture, marketing authorisation, and deployment of a squirrelpox vaccine for red squirrels, and associated risks, benefits, and costs. The Cabinet Secretary also agreed to outsource the feasibility study to an external provider.

Figure 2. Section from the Welsh Government decision reports 2024.

Project aims

- The campaign aimed to highlight the ubiquitous threat posed by squirrelpox virus to regional red squirrel populations.
- A series of magazine articles and social media posts informed the public about the issue and galvanized support for vaccine research.
- A petition to the Senedd in Wales was created. This process accepted signatures from anywhere in the UK. The target was to obtain more than 10,000 signatures.

Description of the project

Vaccines prepare the body to fight viral pathogens or another foreign invader. The attenuation process approach, which was used in 2012/13 for squirrelpox virus, modified the virus so that when an animal was exposed to this new virus variant, it was less damaging than the wild-type virus. The resulting antibodies would ready the animal's immune system should it later encounter the wild-type virus. Messenger RNA (mRNA) vaccines work differently, by introducing a piece of mRNA that corresponds to a viral protein, such as that found on the outer membrane of the virus. This mRNA then triggers an immune response and the production of antibodies.

An attenuated virus can mutate, and this risks the vaccine itself becoming more pathogenic. An mRNA vaccine cannot mutate, it is not a virus. However, the wild-type virus it is meant to vaccinate against can mutate in a way that potentially would make the mRNA ineffective. In this scenario, a new mRNA vaccine would need to be developed.

Vaccines are routinely used to manage pathogenic infections in wildlife. For example, oral-bait immunisation of susceptible mammals is an effective method to control and eliminate rabies in Europe. In 2018, Elephant endotheliotropic herpesvirus (EEHV) which causes deadly hemorrhagic disease in Asian elephants, was associated with two young captive animals dying at Chester Zoo. By 2024, a lengthy scientific collaboration developed a vaccine, and the first-ever dose was given to a captive adult elephant in Houston Zoo. On another continent conservationists are racing towards the target of vaccinating Tasmanian Devils (*Sarcophilus harrisii*).

Tasmanian Devils suffer from a lethal tumour disease. Researchers highlighted the successful use of oral baits to vaccinate European wildlife against rabies. Adopting that approach they wrote (in 2022), 'In 2019, we hypothesized an oral bait vaccine could be made to protect devils from DFT1 and DFT2 [tumour disease]. Fast forward to November 2022 and the pieces of this ambitious project are falling into place.'

There is no reason why here in the UK, we cannot adopt a similar resolve to wildlife disease in the case of the squirrelpox threat posed by grey squirrels (*Sciurus carolinensis*) to red squirrels. The successful attenuation of a potential vaccine candidate in 2012/13 by

the Moredun scientists is a fantastic platform to explore the feasibility of either further attenuation or an mRNA vaccination approach.

Without a vaccine, grey squirrels, which have a high squirrelpox sero-prevalence (presence of antibodies) will always pose a significant disease risk to native red squirrels in the same area. Unlike grey squirrels, red squirrels have little or no natural immunity and outbreaks of squirrelpox in their populations can be significant. The infection does not harm grey squirrels, but in red squirrels causes severe blistering and lesions forming around the face, eyes, lips and on the paws (Figure 3) and is invariably fatal. The lesions get infected by bacteria and animals die a painful death.

The initiative to petition (P-06-1332) urging vaccine research was launched in 2023 because an earlier Welsh Parliament petition (P-06-1208 New laws to protect rare red squirrels from habitat loss which causes population decline) successfully led to better habitat protections in Wales. There have also been repeated squirrelpox outbreaks in Wales and national media coverage of these was comprehensive.

The petition successfully passed the 10,000-signature threshold for a debate and was then discussed in a plenary debate in the autumn of 2023. The Government commitment to undertake a feasibility assessment was warmly received by those supporting the petition including red squirrel groups across the UK. The independent review will assess research, manufacture and deployment of a vaccine and will consider the associated risks, costs and benefits.



Figure 3. Vaccination could potentially prevent red squirrels from dying from squirrelpox virus infection.

Success indicators

- Ultimately, the minimum objective is to achieve a transparent and independent assessment of vaccine feasibility.
- More widely, we succeeded in generating a groundswell of public support for vaccine research and fostering discussions around practicalities and utility.
- Rolling out an oral-based mRNA vaccine to protect wild red squirrels is the ultimate success indicator.

Major difficulties faced

- There was an apathy towards the petition amongst key conservation NGOs and few actively supported it. Notable exceptions were the Campaign for the Protection of Rural Wales (CPRW) and Coed Cadw (Woodland Trust Wales).
- The biggest challenge faced, was that the campaign was unable to specify exactly what form future viral research (Figure 4) would take. Consequently, there was no clear timetable or funding target.



Figure 4. Guardian Newspaper headline 24th November 2024. Although few large rural NGOs actively supported calls for vaccine research, many regional squirrel projects did.

Major lessons learned

- The Senedd plenary debate of the petition (P-06-1332) demonstrated strong cross-party support for red squirrel conservation and wide interest in progressing squirrelpox vaccine development.
- Public support was essential in evolving strategic red squirrel conservation policy and action. In this case urging Government to revisit the issue of squirrelpox vaccination.

Project success

Success or failure	Confidence	
Highly Successful		
Successful		
Partially Successful	X	High
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Even though the majority of large conservation NGOs were not supporting vaccine research, the public were, and their enthusiasm and pragmatism pushed the petition beyond the number required for a Senedd debate.
- The petition was launched on 28/01/23 and yet, sadly two years later, there was no feasibility study underway. This type of delay is symptomatic of the divergence between Government delay and the urgency of red squirrel volunteer groups keen to explore whether vaccine is an achievable objective because they are on the conservation 'front line'.
- The willingness of Welsh Government to maintain a petition process open to signatures from across UK, and the 10,000 names needed for a debate should be applauded. The UK Parliament debate threshold is 100,000 names.

- In March 2025 the Deputy First Minister announced that a call-off contract for vaccine feasibility would be sent 'shortly' to potentially interested parties. By the end of June 2025 the contract tender process had still not been advertised.

Future project development

- Greater political dialogue with Welsh Government is essential.

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RED SQUIRREL FORUM FOR SOUTH SCOTLAND AND SAVING SCOTLAND'S RED SQUIRRELS

Scottish Wildlife Trust

Geographical area of conservation work

Scottish Borders and Dumfries and Galloway, Scotland

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Facebook: [https://www.facebook.com.SavingScotlandsRedSquirrels](https://www.facebook.com/SavingScotlandsRedSquirrels)

Key partners

Saving Scotland's Red Squirrels (SSRS) Partnership:

- Scottish Wildlife Trust (lead)
- NatureScot
- Scottish Forestry
- Scottish Land and Estates
- RSPB Scotland
- Forestry and Land Scotland
- Loch Lomond and The Trossachs National Park Authority
- Aberdeen City Council

Resources

Typical Annual Resource available	Number of people	
Paid Contractors (1-6 months)		
Paid Contractors (7-12 months)	4 (2024-25)	SSRS employees
Volunteers involved with grey control	246	Shooting and trapping (including trap hosts)
Volunteers involved with squirrel monitoring	c.85	e.g. Solway Forests, Gatehouse and Berwick
Other Active Volunteers	59	All admin and outreach roles
Other info	Volunteer totals represent 17 groups/networks	

Maps of project land area

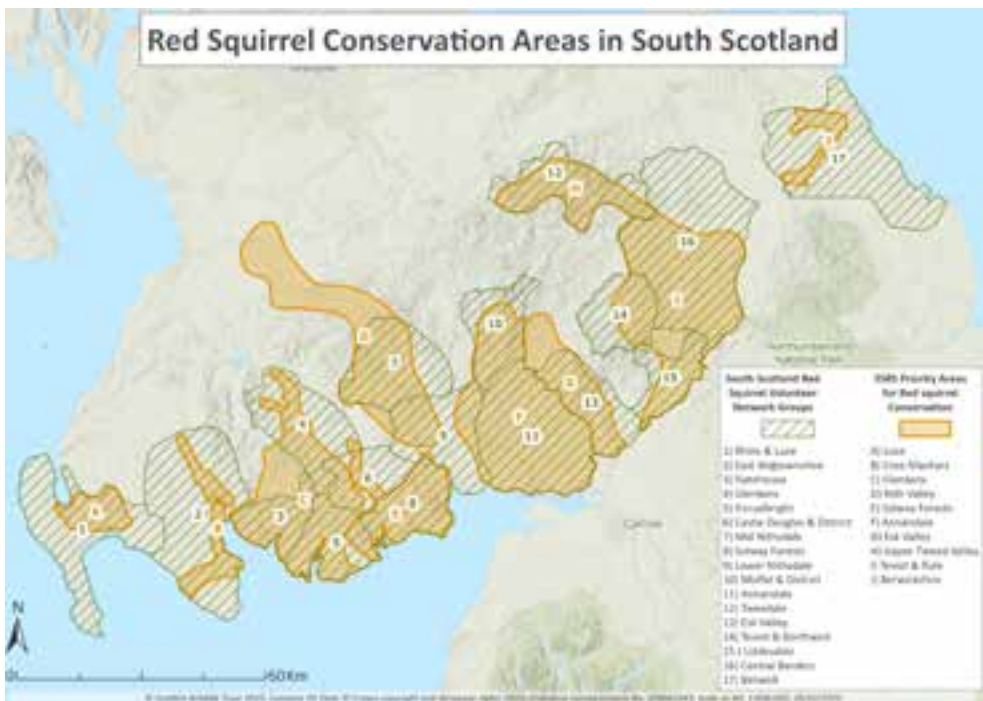


Figure 1. Volunteer Squirrel Group/Network areas and SSRS Priority Areas for Red Squirrel Conservation (PARCs) in South Scotland (©SSRS). Map prepared by Tom Lewis, SSRS.

Introduction

From 2008, grey squirrels (*Sciurus carolinensis*), often carrying squirrelpox virus (SQPV), spread rapidly across South Scotland, adding dramatically to the level of threat faced to red squirrel (*Sciurus vulgaris*) populations. Now, grey squirrels are numerous in some areas (e.g. Nithsdale, Annandale) alongside red squirrels, and have already displaced red squirrels in others (e.g. Berwickshire, South Ayrshire). Simultaneously, pine martens (*Martes martes*) are spreading from re-introductions into Galloway Forest Park (1981), and more recently in the Scottish Borders.

Saving Scotland's Red Squirrels (SSRS) increased the coverage of 10 Priority Areas for Red Squirrel Conservation (PARCs) in 2019, to cover all or part of the major river catchments in South Scotland. In 2010, Forest Enterprise Scotland, now called Forestry and Land Scotland (FLS) demarcated two Red Squirrel Strongholds in Dumfries and Galloway, overlapping with two of the PARCs. Red Squirrel Forum for South Scotland (RSFSS) is an umbrella body for all volunteer Squirrel Groups/Networks (SG/Ns) in the region. The Forestry Grant Scheme (FGS) may provide funds for grey squirrel trapping to landowners within the PARCS.

Red squirrel conservation in southern Scotland is currently being maintained by volunteers, SSRS grey squirrel control officers (GSCOs) who are funded by partners and other stakeholders, and landowners in receipt of FGS grants. The GSCO's work with volunteer groups and landowners, not always directly, to control the grey squirrel populations in the PARCs across the south of Scotland.

When the PARCs were created it was anticipated they would provide enhanced protection of red squirrel populations from displacement by grey squirrels (Figure 1). The PARCs have provided areas where red squirrels can survive and be protected, however this requires constant monitoring, surveying and control work by SSRS staff, volunteers and landowners on FGS. Any disruption to monitoring and control can/will lead to increased grey squirrel activity in the PARCs as the threat of grey squirrel immigration is constant. This was demonstrated during the 2020 Coronavirus (COVID-19) emergency when no GSCOs or volunteers were allowed out to carry out any control work between March and June 2020. When free movement was restored following the lifting of restrictions, GSCOs and volunteers observed a noticeable increase in grey squirrel numbers and activity in areas that previously had low numbers or had been cleared of grey squirrels. Further disruption to SSRS GCSOs in 2022 at the end of the DCA project showed a marked decrease in the grey squirrel numbers culled (Figure 2), which may be attributable to the abrupt reduction in GSCO numbers in relation to both grey squirrel control and volunteer support. The number of grey squirrels culled from 2020 – 2024 has remained stable (apart from 2022, which may be due to staff changes) with a similar ratio split between volunteers and SSRS GSCOs. The cull figures for GSCOs have been similar annually despite a reduction in GSCO numbers. This may be an indicator of higher grey squirrel numbers being present than has been the case in previous years.

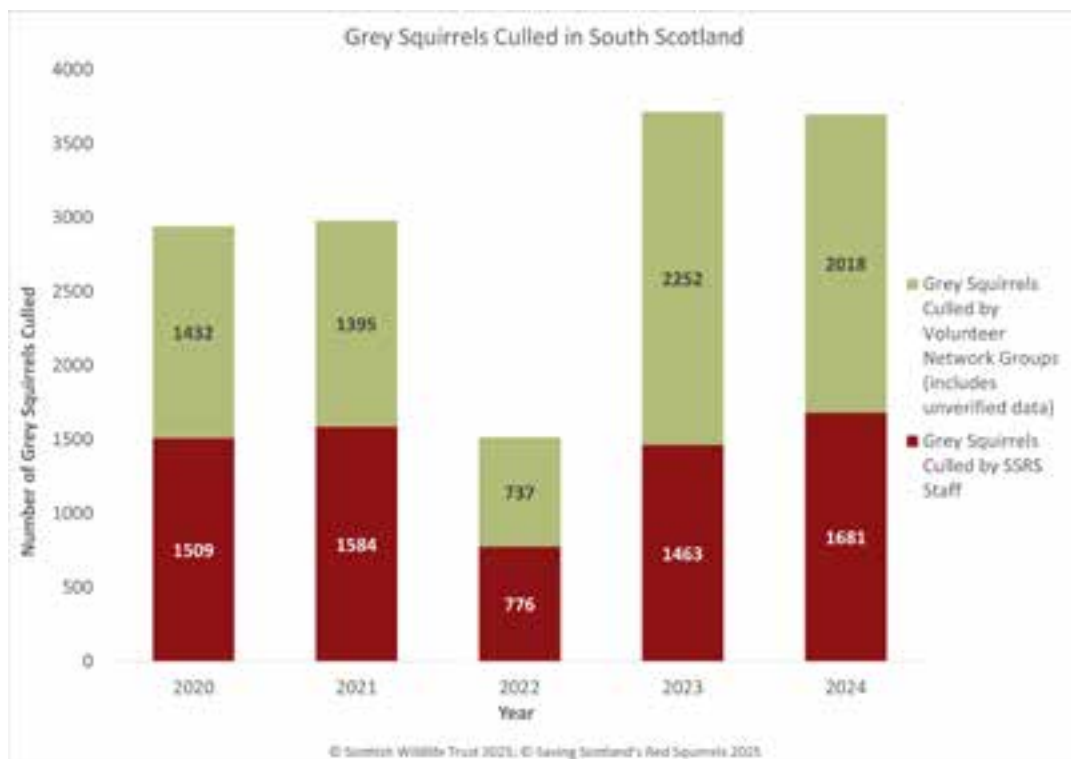


Figure 2. Grey squirrel cull totals in South Scotland for volunteers and SSRS GSCOs, 2020-2024 (©SSRS).

Project aims

- Conserving viable populations of red squirrels in South Scotland’s PARCs.
- Controlling grey squirrel populations and taking rapid action to mitigate the impact of squirrelpox outbreaks.
- Collaborative working by SG/N volunteers, SSRS GSCOs and those operating on landholdings in receipt of FGS grants.
- Awareness-raising and education, recruiting volunteers and promoting FGS (by SSRS).

Description of the project

RSFSS was brought into existence in 2018 as the regional volunteer partner in South Scotland for the SSRS 'Developing Community Action' (DCA) project phase (2017-22). RSFSS was set up as a permanent umbrella body for its constituent SG/Ns but has no constitution or funds. SSRS-DCA had a prime role in the formation and ongoing support of the SG/Ns, including equipment provision and training. As planned, by 2024 all 17 SG/Ns had become independent of SSRS. Individual SG/Ns now oversee all their own local activities for surveys, grey squirrel control, awareness-raising, education and fundraising, but continue to submit their trapping and shooting records to SSRS.

Most of the volunteer effort in grey squirrel control is focused on private land. However, permission for surveys and grey squirrel control by trapping within the National Forest Estate may be granted to trained and accredited volunteers in SG/Ns by FLS. Private landholdings may obtain FGS support from Scottish Forestry for grey squirrel trapping, and in some places, volunteers have been contracted by landowners for this purpose, thereby providing some funds for their SG/Ns. RSFSS encourages mutual self-help amongst the SG/Ns through the sharing of expertise and experience in all areas of their work.

Recently, members of SG/Ns have started collaborating with The Vincent Wildlife Trust's Martens on the Move (2024-27) project (e.g. Tweeddale, Solway Forests) and the volunteer Dumfries and Galloway Pine Marten Group (e.g. Gatehouse). The aim is to support and document the continuing increase and spread of the pine marten (*Martes martes*) population through the provision and monitoring of den boxes (Figure 3).

The Forum organises an Annual Meeting to bring together its volunteers with representatives of the border counties in England via its sister volunteer forum, Northern Red Squirrels [NRS], staff from ongoing funded projects like SSRS and Red Squirrels Northern England (RSNE), professionals with related responsibilities (FLS, UK Squirrel Accord) and scientific expertise (e.g. specialists on squirrel diseases, pine marten biology and contraception research).

When SSRS's DCA project finished in 2022 the control and monitoring of grey squirrels and protection of red squirrels in the south of Scotland was mainly carried out by the volunteer groups/networks. Some of the SSRS GSCOs were retained with two seasonal and one full-time staff across the south of Scotland. The GSCOs would provide support to the volunteer groups by working in areas where the volunteers had no access at that time, such as the National Forest Estate (NFE), and in other areas where the groups did not have volunteers available to provide control. In March 2024, funding became available to recruit four full-time GSCOs across the south of Scotland for a period of six months. The contracts were renewed in September 2024 for a further six months. Since March 2024, full-time GSCOs have worked on private land and the NFE to reduce grey squirrel numbers, particularly in areas that had been cleared previously.

SSRS GSCOs rely on two main methods when carrying out grey squirrel control, live-trapping and free-shooting. Live-trapping is particularly effective during the period March – August, with GSCOs still live-trapping outside those months i.e. over the whole year. In the winter months, free-shooting using thermal imagers is particularly effective and is combined with live-trapping in suitable locations. It has been noticed by SSRS GSCOs in the south of Scotland that grey squirrel females either lactating or pregnant have been captured in various months throughout the year outside the normal expected breeding periods. It could be assumed that this may be happening due to favourable conditions such as milder weather and food availability.

It is important to the overall conservation efforts that everyone involved works collaboratively including SSRS GSCOs, volunteers, landowners and partner organisations. This is maintained in part by SSRS staff updating landowners, linking up with volunteers and meeting with partners. The importance of working collaboratively has led to a potential new funding source for recruiting full-time GSCOs. Local landowners agreed to establish a cooperative that willing participants would contribute to for the purpose of recruiting a GSCO. The funding obtained to date is appreciated but it relies on goodwill from the landowners, and as such should not be considered a long-term funding solution.



Figure 3. Putting up a pine marten den box in Galloway (©Stephanie Johnstone).

Success indicators

- Important contributions to grey squirrel control are being made by volunteers, SSRS GSCOs, and estate staff and contractors supported by FGS grants.
- Each year, RSFSS holds an Annual Meeting in November, inviting guest speakers and others from organisations involved in red squirrel conservation elsewhere. There are also Forum Board meetings in March and September to which representatives from all 17 SG/Ns are invited.
- Funding secured to increase GSCO capacity in the south of Scotland, even for short-term contracts has had a positive impact on reducing grey squirrel numbers.
- The production and application of an SSRS SQPV protocol, made available to GSCOs and volunteer groups.

Major difficulties faced

- COVID-19 lockdown regulations in Scotland had a severe impact on all field activities in 2020-21 and greatly impeded grey squirrel control, to bad effect.
- Recruitment into SG/Ns, and especially for grey squirrel control, continues to be challenging. Several SG/Ns depend on a few volunteers who take on several key roles, with grey squirrel control as their only main activity.
- Reporting and verification of records by SG/Ns is patchy, despite SSRS and RSFSS emphasizing its great importance.
- The lack of sustainable funding to ensure GSCO activities can continue in the long-term can affect the continuity of control work. Gaps in short-term funding and associated breaks in control work carried out by GSCOs set back previous control efforts.
- Encouraging landowners to apply for the FGS grant as a fund to control grey squirrels can be challenging. This may in part be due to the application process being considered too onerous and so not worth the effort. This has been highlighted in the past as an issue due to the requirements for a Forest Plan or Forest Management Plan to receive the grant. Also, there is a perceived lack of support by some landowners who previously had the support of SSRS staff to complete the application, which included advising on trap numbers, locations, data collection and application completion. The input now required from SSRS for FGS applications is to provide support letters only. Some landowners who previously received the grant have not renewed and uptake has been lower than expected. This is of concern due to the lack of effective control in those areas and the impact on the wider landscape.

Major lessons learned

- For maximum regional effect, landscape-scale collaboration requires good communication, leading to better coordinated efforts in the field and the public domain. There is always room for improvement.
- The application of GDPR has been an obstacle for the Forum in the exchange of personal contact details between the key players (RSFSS, SSRS, FGS) and individuals on the ground. Seeking initial consent for sharing contact details amongst all the individuals and organisations involved would reduce the impact of this problem.
- Regular analysis and interpretation of the incoming data should be disseminated amongst all participants, to show volunteers and others that they are contributing meaningfully to a national effort, as well as demonstrating the extent of the work done to donors and partner organisations.
- There have been SQPV outbreaks reported across South Scotland during 2023/24 which appear to have occurred mainly in areas where very little or no grey squirrel control has been conducted. When an SQPV outbreak occurs the SSRS SQPV Protocol is used to guide a rapid response that is designed to reduce the impact of the outbreak in the affected neighbourhood.
- Landowners have been supported by SSRS staff in making new and repeat applications for FGS funding.
- During the SSRS-DCA phase the GSCO remit was expanded to include volunteer training, including mentoring and shadowing to strengthen the grey squirrel control network. This work together with additional public engagement and administration duties required additional staff training so that the GSCOs in South Scotland could compensate for the loss of Project and Community Engagement Officer posts in early 2022.
- In South Scotland, publicly owned forestry areas include significant amounts of grey squirrel habitat, especially on the more diverse margins of large plantation areas. Working with FLS under a new funding agreement, SSRS has been able to employ additional seasonal GSCOs to provide more coverage in such areas.

Project success

Success or failure		Confidence
Highly Successful		
Successful	X	High
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Red squirrel populations continue to persist widely across South Scotland.
- Despite the challenging lack of long-term sustainable funding since 2022 for the volunteer SG/Ns and SSRS GSCOs, pressure has been maintained on grey squirrel populations in South Scotland throughout 2020-24.
- These activities have been in place for some time and are continuing.
- When the DCA project finished in 2022 there were 17 volunteer SG/Ns spread across the south of Scotland. Not all groups were independent of SSRS when the project ended, so some of the groups formed in the later stages of the project were given a two-year extension, called the Transition Phase. The volunteer SG/Ns were supported during the Transition Phase, and all became fully independent of SSRS by 2024. There have been difficulties and challenges faced by the volunteer groups and SSRS GSCOs during the DCA project (2017 -2022) and the Transition Phase (2022 – 2024).
- Some of the volunteer groups have experienced difficulties with member recruitment, which can in some cases leave groups with fewer resources for carrying out grey squirrel control and fundraising.
- Raising funds to recruit full-time GSCOs or provide expenses for volunteers has become an issue that has impacted on the red squirrel conservation efforts in the South of Scotland.

Future project development

- RSFSS will continue its efforts to encourage mutual assistance amongst SG/Ns and improve performance in all areas of their activity, including new initiatives.
- From 2025, RSFSS is restarting the annual Spring Survey of red and grey squirrel distribution, in collaboration with RSNE. This was organised and funded by SSRS during 2013-19, after which the COVID-19 pandemic and then a lack of funds curtailed it. It is crucial in providing the only objective measure of squirrel distribution throughout South Scotland on an annual basis.
- SSRS is continuing to seek long-term sustainable funding for GSCOs to maximise the impact on grey squirrels in critical areas of South Scotland.
- During 2025-30 a new Lottery-funded (Red Squirrel Recovery Network) will support the SG/Ns in both Northern England and Southern Scotland.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)	★ ★ ★	★ ★ ★
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).		
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

THE HIGHLAND LINE: SAVING SCOTLANDS RED SQUIRRELS (SSRS)

Scottish Wildlife Trust

Geographical area of conservation work

Highland Line Priority Area (Scotland):

Coast-to-coast across the Highland Boundary fault region, the transition zone between the Lowlands and Highlands of Scotland. This band of land runs through areas of Argyll, Loch Lomond and the Trossachs, Stirlingshire, Perthshire, Angus and the Mearns.

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Key partners

- Scottish Wildlife Trust (lead)
- NatureScot
- Scottish Forestry (SF)
- Scottish Land and Estates
- RSPB Scotland
- Forestry and Land Scotland (FLS)
- Loch Lomond and The Trossachs National Park Authority
- Aberdeen City Council

Resources

Typical Annual Resource available	Number of people	
Paid Contractors (1-6 months)	0	
Paid Contractors (7-12 months)	7	6 Monitoring and Control Officers; 1 Conservation Lead
Volunteers involved with grey control	65	
Volunteers involved with squirrel monitoring	60	This number is expected to go up in 2025 when a Rapid Response Monitoring network is set up in Loch Lomond and Trossachs National Park
Other Active Volunteers	0	

Maps of project land area

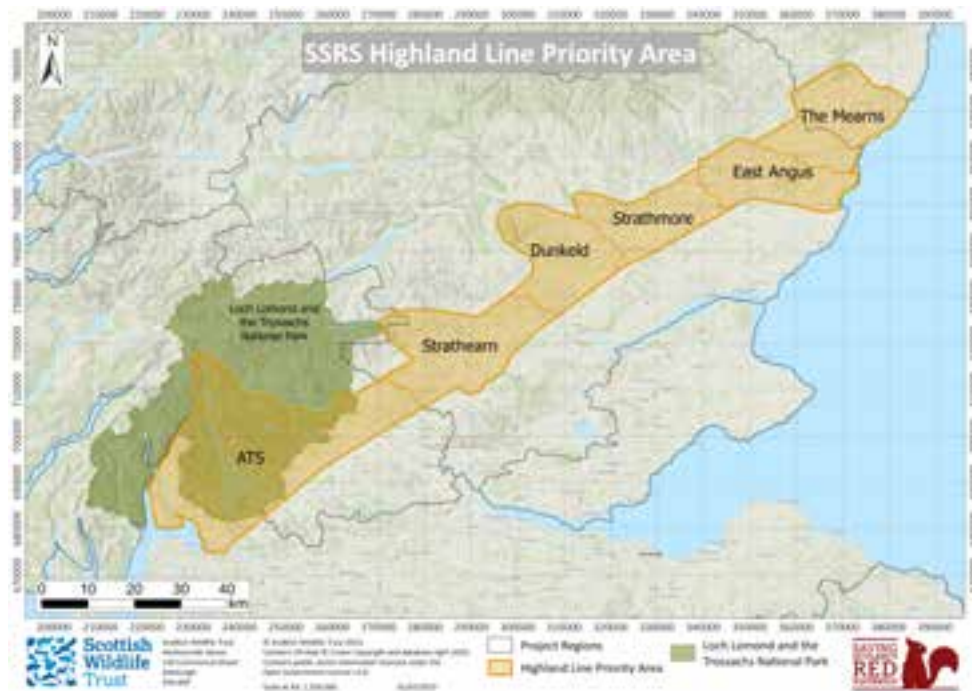


Figure 1. The Highland Line Priority Area.

The Highland Line Priority Area marks the interface between the core red squirrel (*Sciurus vulgaris*) only populations of the Highlands and Aberdeenshire and mixed and grey squirrel (*Sciurus carolinensis*) dominated areas to the south. Grey squirrel control work must be maintained in this area to prevent grey squirrel incursion northwards. Project work over the last 15 years has successfully countered the ongoing risk of such incursion and red squirrels have expanded their numbers and range in the area due to the project's interventions.

The area is divided into six operational areas, each with a full-time, year-round Monitoring and Control Officer. These areas are: (1) Argyll, the Trossachs and Stirlingshire (ATS), which includes Helensburgh, Loch Lomond, Stirling, Callander; (2) Strathearn, which includes Crieff, Comrie, Almondbank; (3) Dunkeld, which includes Aberfeldy, Pitlochry, Dunkeld, Blairgowrie, Luncarty; (4) Strathmore, which includes Coupar Angus, Meigle, Glamis, Kirriemuir; (5) East Angus, which includes Forfar, Brechin, Friockheim, south Montrose; (6) the Mearns, which includes Edzell, Benholm, north Montrose.

Introduction

The work of Saving Scotland's Red Squirrels (SSRS), in tandem with landowners and local volunteers, has found evidence of reversing the trend of red squirrel (*Sciurus vulgaris*) decline in the Highland Line Priority Area through targeted, landscape-scale grey squirrel (*Sciurus carolinensis*) control and monitoring work along the project area. There are pockets of clear recovery of red squirrel populations from Dumbarton to Stirling and from Dunkeld to Montrose.

We have seen no further spread of grey squirrels into the Highlands in recent years. However, due to the high-density grey squirrel population to the south of the Highland Line, grey squirrels constantly incur northwards into the priority area and further on towards high-risk dispersal routes, such as eastern Angus towards the border with Aberdeenshire, northwards along the Tay and Tummel, and northwards/westwards in the National Park area (Figure 1). Therefore, this red/grey squirrel interface remains a critical site for active intervention.

Evidence from both camera monitoring (Figure 2) and feeder surveys (Figure 3), plus additional anecdotal reports, point to the continued presence of our allies, the pine marten (*Martes martes*) across the line with a rise in detections in some areas.

The project has had a presence in the Highland Line area since 2009, with the level of resource input, structure and staff capacity ebbing and flowing in line with short-term funding cycles.

We hope to move this geographical frontier between the grey and red squirrel southwards and expand the red squirrel only areas to include this part of Scotland. Our present operations are preparing the ground for the movement of the frontier, which would require far-sighted investment of resources.

Project aims

- Rapid response monitoring and grey squirrel control to prevent incursion northwards into the red squirrel-only population in the Highlands and Aberdeenshire.
- Protection of red squirrels in the central lowlands from squirrelpox by reducing grey squirrel densities.
- Facilitate the development of a landscape-scale network of partners – SSRS, volunteers, landowners, gamekeepers, local authorities, the public – to create a resilient framework for achieving success and maintaining efforts.
- Removal of grey squirrels from the Loch Lomond islands, leading to eventual eradication.

Description of the project

The Scottish Wildlife Trust is the lead delivery partner of this partnership project, responsible for the practical day-to-day management of all project activities and its financial management. Both a Steering Group, composed of relevant Trust staff and the project Partnership, convene quarterly to steer, agree and contribute to relevant aspects of the project. Since the last book was published, SSRS has moved from the Developing Community Action (DCA) phase, into the Transition phase, and currently are in the Transforming Nature Phase (TNP) supported by the Scottish Government's Nature Restoration Fund, managed by NatureScot.

The TNP in the Highland Line is delivered by six Monitoring and Control Officers (MCOs – see map for locations) and one Conservation Lead. All roles are full-time, compared to previous phases where half the staff were seasonal. This move to year-round staffing is a game-changer, strengthening continuity of knowledge and relationships and supporting year-round operations, leading to improved impact.

The main planned outcome of the TNP in the Highland Line area is the 'prevention of grey squirrel spread and incursion – and squirrelpox transmission – into the UK's largest grey squirrel free red squirrel population'. The following activities set out to achieve this:

- I. Deliver targeted and adaptive grey squirrel control in critical areas, expanding the involvement of householders and volunteers participating in a trap-loan scheme and operational monitoring.** This is a continuation of previous core activities, with trapping by MCOs, yielding the highest grey squirrel captures, supported by captures by volunteers who have been loaned traps and independent trappers. Free-shooting by MCOs has expanded, where appropriate, and is proving to be an effective way to control grey squirrels in low-density areas especially in the winter months. Operational

monitoring by both volunteers and MCOs has also expanded, leading to improved methods of detection in low-to-medium density areas.



Figure 2. Cameras are a key tool in the detection of grey squirrels.



Figure 3. Feeder boxes attract squirrels.

- II. **Increase long-term sustainability and resilience of monitoring and control efforts through (a) forging new partnerships, and strengthening existing partnerships, with landowners to expand landscape coverage; (b) training and supporting volunteers and external partners in grey squirrel control:** The team continues to work closely with landowners, including private individuals, Forestry and Land Scotland, private forestry companies, and local authorities. This may be by facilitating access for volunteers or MCOs to carry out control on private land, providing technical support, training partners to carry out grey control, or through networking and information exchange. The team mostly meets with co-operation, though progress in meeting our targets for training external agencies in grey squirrel control has been slower than anticipated.
- III. **Establish and deliver Rapid Response Monitoring (RRM) Networks along key incursion routes and priority low density areas within the Highland Line control zone:** This is being done by recruiting, training, and supporting landowners and volunteers to carry out monitoring, with linked grey squirrel control following detections, in

conjunction with MCOs. Approximately 3,000 annual feeder box visits take place in the existing Mearns network, and five new RRM Networks are/have been established: Loch Lomond and Trossachs National Park; Comrie to Loch Earn; Dunkeld to Pitlochry/Aberfeldy; Blairgowrie to Bridge of Cally and up the River Isla; Kirriemuir northwards.

- IV. **Carry out annual Central Lowlands squirrelpox monitoring:** Since 2012 we have carried out annual blood-sampling of grey squirrels across the Central Lowlands for the Morden Research Institute to test for squirrelpox virus (SQPV) antibodies, as part of a national squirrelpox monitoring scheme designed to detect any spread in the disease. This is a coordinated effort of SSRS staff, volunteers, landowners and the Morden Research Institute.
- V. **Work with the National Park to remove grey squirrels from the Loch Lomond Islands:** The first phase of the removal is planned for summer 2025 when intensive grey squirrel control will take place on all islands with grey squirrels. Afterwards an RRM Network will be set up on the islands and the shoreline to detect any remaining island grey squirrels and to prevent re-colonisation from the shoreline. New RRM volunteers will be recruited, trained and supported by the National Park/SSRS to continue efforts to ensure long-term monitoring and control as required on the islands, with the goal of eventual eradication.
- VI. **Public Engagement:** Highland Line staff regularly participate in local talks and events to raise awareness of red squirrel conservation and encourage people to report sightings to the citizen science website, scottishsquirrels.co.uk. This website is a key resource for guiding our everyday work as all 'red flag' sightings are followed up by MCOs, as well as giving insight into squirrel distributions.

Success indicators

- Increased occupancy or stability of red squirrels in surveys, sightings, and trapping returns in some areas.
- Decreased occupancy or abundance of grey squirrels across the Highland Line showing up in trapping returns, sightings and surveys.
- Continued and expanding positive engagement with volunteers (Figure 4), landowners and the public in red squirrel conservation work and grey squirrel control.

Major difficulties faced

- Lack of long-term, sustainable funding model leading to disruption in continuity of staffing/knowledge. As an example, there has been more continuity in volunteers than staff. The disruption to staff continuity erodes project effectiveness. This has been partly addressed in the present project phase by moving from seasonal to year-round contracts for all staff.
- Challenges with gaining land access to a small number of key locations where grey squirrel densities need further control. This difficulty has continued, but the dynamic has changed. Most landowners are co-operative and either control grey squirrels themselves or allow access for control. This has supported a significant reduction of grey squirrel densities across the Highland Line to the point where the remaining hotspots of breeding populations have a big overall impact as sources of dispersing grey squirrels. Where the landowners of these hotspots cannot be persuaded to increase their grey squirrel control, or allow access for control, over-spilling grey squirrels mean that achieving low/very low densities in the surrounding landscape is very difficult.
- Reluctance of some landowners to participate in the Forestry Grant Scheme (FGS): The number of landowners on FGS in the Highland Line has reduced by about three-quarters since 2020 for a variety of reasons, but this is not regarded as a major difficulty in the context of the present project. The important aspect is that appropriate landowners apply for FGS.
- Opposition to grey control: MCOs generally encounter support rather than opposition from the public in the Highland Line area. There are isolated instances of opposition, but this has not been a significant factor hindering work in recent years. This may stem from a shift in public attitudes towards invasive species and nature conservation.
- Limited scientific knowledge to inform decisions and limited resources to further explore the most effective balance between using resources to facilitate control of higher density grey squirrel populations to the south of the priority area (and hence reduce northern incursion into the priority area), versus using resources to implement RRM or other follow-up to detections/sightings in very-low density grey squirrel areas to the north of the Highland Line (and hence reduce risk of single pioneering grey squirrels dispersing further north into 'red-only populations'). With more resources available, for a greater and more affective impact, both methods would be operated in tandem.
- The present ATS area has, in general, higher grey squirrel densities than the other MCO-operated areas, plus a higher risk of squirrelpox reaching red squirrels from the Central Belt. It also covers the largest geographic area. An additional MCO is needed to share operations in this area, bringing it into greater equivalence with the other MCO-operated areas.

Major lessons learned

- Importance of sustained grey squirrel control efforts to ensure the population does not rebound due to constant grey squirrel influx from the south.
- Need to adapt control methods to fit with specific situations and opportunities: for example, when to use mink traps, discreet trapping boxes or free-shooting.
- Need to adapt monitoring methods to fit with specific situations and opportunities: for example, rural RRM's often benefit from using higher proportion of camera-traps to hair-traps compared to urban RRM's; creating Operational Monitoring (OM) Networks with volunteers helps address regular incursion routes into the priority area from the south. Monitoring techniques have adapted and evolved significantly since 2020, in response to both a move from seasonal surveys to year-round monitoring linked to responsive trapping, and new technological innovations opportunities such as live cameras and volunteers submitting photos with their phones.



Figure 4. Squirrel hair analysis.

- Importance of creating conditions conducive to staff continuity, such as competitive salary levels and increased length of contracts, for effective implementation of project activities.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason for success/failure

- Community involvement – committed landowners and volunteers are central to the success of the project.
- SQPV has not spread northwards into red squirrel populations as quickly as predicted, though we know it is present in some of the Central Lowlands’ grey squirrel populations, with the first death of a red squirrel due to squirrelpox in Dunfermline in April 2024 (Wilson et al. 2024).
- The region is bordered to the north and west by strong populations of red squirrels in Grampian, northern parts of both Stirling and Perthshire, and Argyll, providing a ready source for re-colonisation to areas where grey squirrel densities have been reduced.
- Pine marten recovery appears to have contributed to decline in grey squirrel numbers in some areas.

Future project development

- Increased use of free-shooting by project staff in low and medium-density grey squirrel areas.
- Increased use of OM Networks, utilising volunteers on grey squirrel incursion routes coming into the Priority Area from either the south or at key pinch points.
- Recovery and expansion of Scotland’s ‘red-only’ squirrel population southwards.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in <u>developing</u> this aspect of grey squirrel management in your project area
Shooting	★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)	★	
Immuno-contraception (oral bait delivered via hoppers)		★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)		
Squirrelpox vaccine		

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

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- III. Available at: <https://doi.org/10.1002/VETR.4182>.

ERADICATION OF GREY SQUIRRELS FROM ABERDEEN: SAVING SCOTLANDS RED SQUIRRELS (SSRS)

Scottish Wildlife Trust

Geographical area of conservation work

North East Scotland

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Key partners

- Scottish Wildlife Trust (lead)
- NatureScot
- Scottish Forestry
- Scottish Land and Estates
- RSPB Scotland
- Forestry and Land Scotland
- Loch Lomond and The Trossachs National Park Authority
- Aberdeen City Council

Resources

Typical Annual Resource available	Number of people	
Paid Contractors (1-6 months)	4	1 Eradication Co-ordinator 1 Eradication Operations Lead 1 Eradication Officer 1 Community Outreach Officer
Paid Contractors (7-12 months)	0	
Volunteers involved with grey control	0	
Volunteers involved with squirrel monitoring	40	This number may fluctuate from time to time
Other Active Volunteers	1-2	Student intern placement to carryout operation surveys

Maps of Project Area

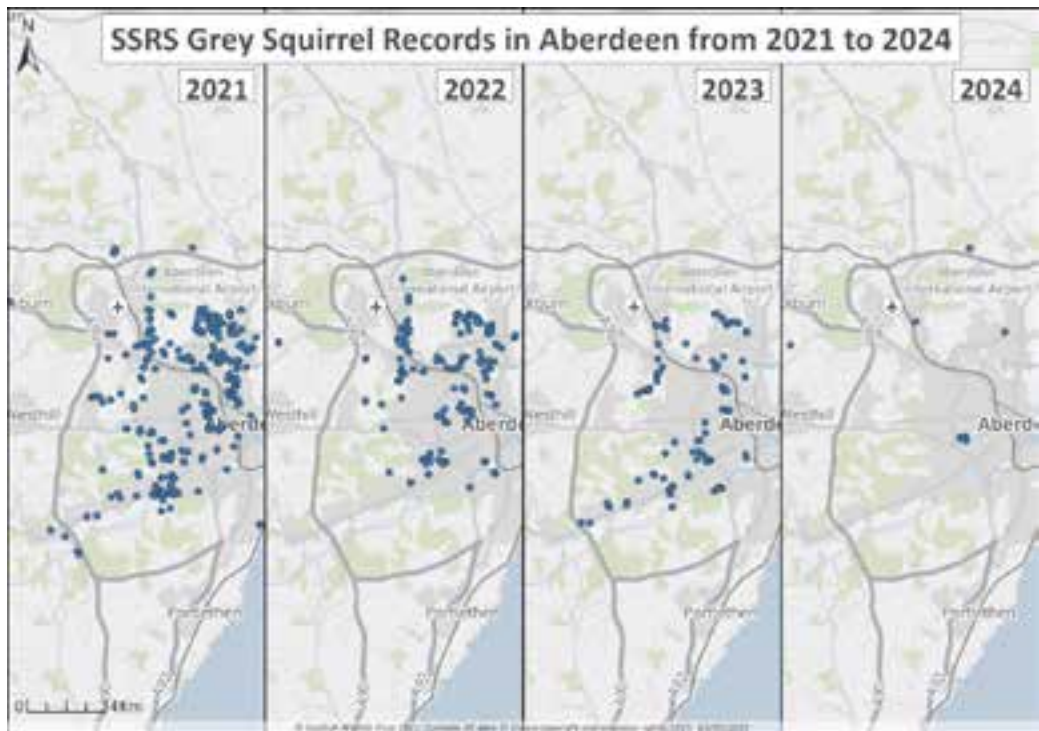


Figure 1. Locations of grey squirrel (*Sciurus carolinensis*) detections (blue dots) across the Aberdeen region including SSRS grey squirrel control records, verified SSRS recorded sightings and a snapshot of detections at feeders from May and June in years 2021 to 2024. There has been a significant reduction in grey squirrel records from 2021-2024.

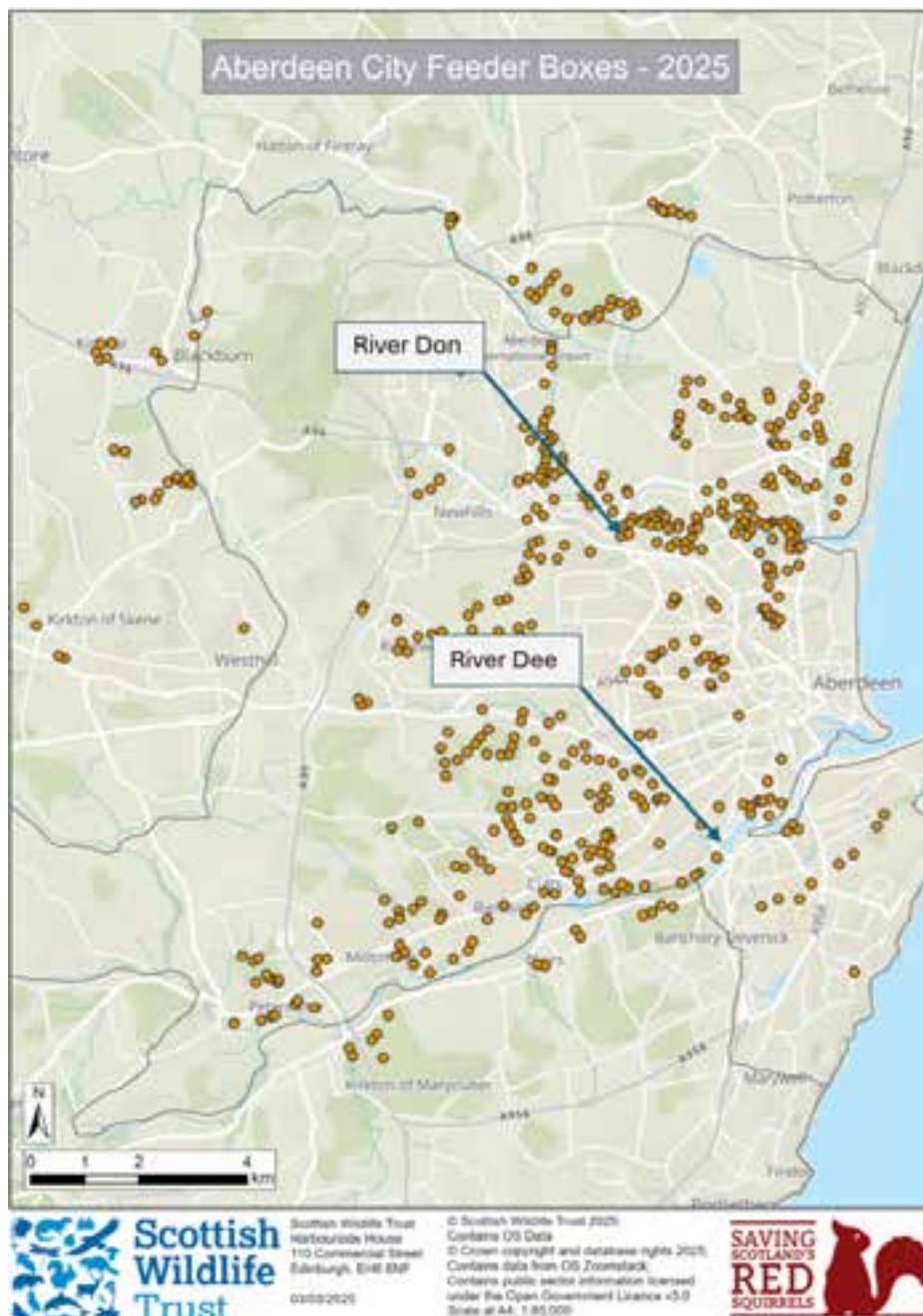


Figure 2. Map of Aberdeen city showing locations of feeder box monitoring stations (yellow dots) which are part of SSRS’s Rapid Response Monitoring (RRM) scheme. Most suitable squirrel habitat within Aberdeen City, and key incursion route along the river corridors of the Dee and the Don are covered by the RRM scheme, which aims to detect and remove any remaining grey squirrels.

Introduction

Saving Scotland's Red Squirrels (SSRS) in North East Scotland focuses on removing a geographically isolated population of grey squirrels (*Sciurus carolinensis*) centred on the city of Aberdeen (Figure 1), where they were introduced in the 1970s. When SSRS began in 2009, grey squirrels had spread along the two river catchments of the Dee and the Don into rural Aberdeenshire. Left unmanaged, they threatened the healthy red squirrel (*Sciurus vulgaris*) populations of Grampian and the Scottish Highlands. In the early stages of the project, Grey Squirrel Control Officers (GSCOs, now known as Eradication Officers, EOs), undertook grey squirrel monitoring and control in both the urban city parks and by working inwards from the widest known grey squirrel populations in Aberdeenshire back towards the city.

With the continuation of grey squirrel control efforts since 2009, the refinement of urban grey squirrel trapping techniques in 2015, followed by the introduction of new monitoring and control techniques and the development of a large network of volunteers since 2020, grey squirrel density has dramatically reduced, to what is now only a very small known breeding population. Red squirrel populations in both Aberdeen city and Aberdeenshire have recovered relatively quickly, with red squirrels now regularly being reported throughout Aberdeen city's urban parks, residential gardens, suburban woodlands and further out into Aberdeenshire. The pine marten (*Martes martes*) population in Aberdeenshire has been recovering quite well in recent years, with pine marten regularly being detected through the RRM surveys. However, it is understood that the timing of their recovery did not coincide with the reduction in density and distribution of grey squirrels in Aberdeen city and Aberdeenshire, which can be largely attributed to grey squirrel control efforts. As the NE Team have worked to contain grey squirrels within the limits of Aberdeen City, the population of pine martens has steadily increased in the woods surrounding Aberdeen City, complementing the team's efforts to prevent grey squirrels spreading from the city back into the countryside. Whilst there is no expectation that pine martens would reach densities sufficient to suppress grey squirrels within an urban environment, since 2020, pine martens have been detected repeatedly at numerous urban locations. Crucial partnerships with Forestry and Land Scotland (FLS) and Aberdeen City Council (ACC) supported this work through significant funding contributions and facilitating access for the purpose of grey squirrel monitoring and control on the National Forest Estate (FLS) and in urban woodlands and city parks (ACC).

Project Aims

- The overall project aim is to permanently eradicate grey squirrels from the north east of Scotland. The main project goals include:
- To continue to encourage public support for red squirrel conservation.
- To continue the coordination and delivery of rapid response monitoring, including recruiting and supporting volunteers, and responding to positive detections / sightings with grey squirrel control.

- To prevent immigration of grey squirrels into northeast Scotland from the Mearns and northeast Angus.
- To develop additional methods of detection such as specialist detection dog searches and explore alternative humane methods of removal in addition to trapping to target trap-shy individuals.
- To achieve an eradication milestone of zero detections of grey squirrels, over an extensive confirmation phase, following an eradication plan.
- To establish the infrastructure and institutionalise expertise for long-term, post-eradication monitoring.

Update on major difficulties faced

Control work in public areas: Since 2020 the team have deployed urban trap boxes in areas of increasingly high public footfall, with great success and very few instances of trap tampering. The use of mink police alarms means that traps do not have to be visited twice per day, rather twice per week (to set, and to put on “prebait”) and thereafter only when the trap has been triggered.

Access to critical sites: This is an ongoing difficulty but with the success of the SSRS project, including the highly visible recovery of the red squirrel population, there has been a perceived increase in public awareness and support for the project. The Scottish MSP who acts as the red squirrel “species champion” has also advocated with private landowners on behalf of SSRS in critical cases. There are now very few areas that the team do not have access to.

Lack of scientific knowledge: Since 2020, the NE team have adopted a much more scientific approach to achieving the project goals. For example, the team collaborated with a masters student to design and implement the first GPS collar study of grey squirrels in an urban environment, which led to a greater understanding of grey squirrel distribution and movement such as home range sizes, movement across the urban landscape, and additionally, the density of feeders and traps required across the urban landscape to ensure that all individuals are at risk.

Major lessons learned

Need for adaptive approach for low density populations: grey squirrel occupancy can be decreased with the use of a sustained and coordinated control programme, but eradication will require flexibility and adaptive management. During the Developing Community Action (DCA) phase (2017 – 2022) one of the stated project’s aims in the NE was for the eradication to be completed by volunteers. This was based on a misconception that as grey squirrel

density reduced, so too would the effort required to remove the remaining individuals. However, the NE team have been working since 2020 to improve both our understanding of how low-density grey squirrels use the urban landscape, and our understanding of the effort that is required for invasive mammal eradications to succeed. In 2021, the NE team developed the Rapid Response Monitoring (RRM) technique, dramatically increasing detection effort which has led to increasingly targeted trapping. The development and refinement of the RRM technique has proven highly successful in ensuring that all squirrel habitat in Aberdeen city is constantly under surveillance, and any grey squirrel detections can be responded to swiftly. In addition, the team have been working to secure the services of specially trained detection dogs, along with the development and refinement of novel removal methods. This novel RRM method which was designed by the NE team was a finalist in the RSPB Nature of Scotland Awards in 2024 (in the Innovation Category).

Possibility for urban recovery: red squirrels can recover and recolonise their former range when grey squirrels are removed (or their densities reduced to low levels) even in urban areas provided habitat and connectivity is suitable. There is a general misconception across the UK that red squirrels do not belong in more urban environments. However, red squirrels are regularly now reported throughout Aberdeen City and will demonstrably use any habitat that grey squirrels have been removed from. This also serves as excellent publicity for the project, as Aberdeen residents are observing red squirrel recovery in real-time, across many urban and suburban parks and gardens.

Importance of community engagement: the appointment of a dedicated Community Co-Ordinator and Outreach Officer (CCOO) since 2022 has been instrumental in recruiting, managing and providing support to a growing network of RRM volunteers, who carry out feeder-box surveys every fortnight. The CCOO is also responsible for the development and implementation of a campaign to identify through mapping, and target through outreach such as flyers, posters and door-knocking, any residential areas that do not yet have sufficient feeder or trap density.

Spatial Ecology: as the spatial ecology study in 2021 illustrated, low-density urban grey squirrels can move large distances, presumably searching for conspecifics. Additionally, some home ranges, mainly those of breeding females, can be comparatively very small. This effectively means that all squirrel habitat in Aberdeen and its surrounding area is at risk of grey squirrels returning to the locality, until the very last grey squirrel has been removed from Aberdeen. Therefore, to meet the requirement that “all individuals must be at risk”, the NE Team have systematically increased coverage of Aberdeen City and its surrounds via RRM monitoring. Due to the success of RRM, grey squirrel detections and captures have decreased annually since 2021 despite an exponential increase in detection effort. For example, there were more than 8,000 feeder checks in 2024 (Figure 2), but only 22 grey squirrel records (note this total includes public sightings and detections at feeders, some of which could be from the same grey squirrel). There was a total of just six grey squirrels captured in 2024.

Description of the project activity

The Scottish Wildlife Trust is the lead project delivery partner, responsible for the practical day-to-day management of all project activities and the finances. The project is delivered in collaboration with eight project partners and with the cooperation of multiple stakeholders. In terms of funding, since the last book was published in 2020, SSRS has moved from the DCA phase, into the Transition phase, and are currently in the two-year Transforming Nature phase, through NatureScot's Nature Restoration Fund. The cyclical and short-term nature of these project phases, and the challenges that come with them reflect the need for long-term sustainable funding.

Recommendations from the DCA phase included the continuation of a professional team in Aberdeen, to implement project activities, (as opposed to earlier proposals for a volunteer-led eradication), along with the requirement of dedicated staff-led grey squirrel control and volunteer-delivered monitoring in the Mearns and South Aberdeenshire. This critical area was identified in 2020 by the NE Team as the northernmost frontier of the Central Lowlands grey squirrel population. By 2020, the Mearns was host to a breeding population of grey squirrels, as well as habitat corridors which could connect them to the Aberdeen population if not addressed, violating the principal of eradication that immigration must effectively be zero. To address this in 2022, a new role of Monitoring and Control Officer for the Mearns was created, which now sits within the Highland Line Team's remit.

Project staff in the North East consist of an Eradication Co-ordinator, Eradication Operations Lead, Eradication Officer, and Community Co-ordinator and Outreach Officer. The current project phase is a partnership project supported by the Scottish Government's Nature Restoration Fund managed by NatureScot, along with project partners including Forestry Land Scotland (FLS) and Aberdeen City Council (ACC).

In 2021, an opportunity arose to collaborate on FLS funded research with the University of the Highlands and Islands, using GPS collars and radio-tracking to learn about the movements of grey squirrels in Aberdeen's urban environment. The field element of the research took place in 2021 when grey squirrel density was considered medium-low at the time. Overall, 371 Grey squirrels were trapped in 2021 (compared to 153 in 2022, 95 in 2023, and 6 in 2024). Although the work is yet unpublished, this Master of Research work, has helped to inform the NE team on the spatial ecology of this low-density urban population of grey squirrels in Aberdeen. As the study illustrated, low-density urban grey squirrels have much larger home ranges than previously published for the species, and move large distances, presumably searching for conspecifics. In comparison, some home ranges - mainly those of breeding females - can be much smaller than the team expected. The study also looked at optimum trap-spacing in various habitat types, informing the NE team the considerations needed to ensure that every grey squirrel is at risk of being trapped. The work highlighted the need for the RRM scheme to increase both the density of feeders in existing areas and increase coverage in woodland areas not previously covered by RRM or trapping.

Some 8,073 feeder box checks were carried out in 2024, supported by 40 volunteers, resulting in one grey squirrel, 4,219 red squirrel and 216 pine marten detections. Fortnightly surveys are carried out, and samples dropped off by volunteers at dedicated “drop-off” points around the city. Staff collect samples and use microscopes to identify to species level every sample as it comes in. When a grey squirrel is detected, staff respond immediately with traps. Every grey squirrel detection is responded to as soon as practically possible, with discreet urban trap boxes utilised alongside a mink police trap alarm to increase trapping efficiency.

At the start of the current project phase in 2024, RZSS Wild Genes Lab carried out genetic sexing tests and ddRAD library construction to determine individual grey squirrel identification with a view to estimating population size to inform eradication efforts. The work was undertaken using 85 grey squirrel tissue samples representing populations from Aberdeen City, Aberdeenshire and the closest neighbouring population in Tayside. This was supplemented with an additional sample sourced in Edinburgh. The genetic sexing test was successfully performed. The study found the Aberdeen population to be genetically distinct from the Tayside populations, with no evidence of genetic connectivity. This further supports earlier work by Signorile *et al*, and anecdotal evidence that all grey squirrels in Aberdeen have originated from a single introduction event.

Major Difficulties Faced

- Potential trap/feeder shy grey squirrels and the need for innovative methods of detection and removal within the urban environment.
- The need for a long-term and sustainable funding model required to see through the entire eradication process and confirmation phase.

Major Lessons Learned

- The combination of full-time, long-term staff working in conjunction with a network of managed volunteers is needed to achieve consistency and efficacy (i.e. volunteer delivery of project objectives), are crucial, but they must be staff led, and staff supported to succeed.
- The ability to trap squirrels in high visibility/high footfall areas such as the urban and suburban environments, including school grounds, universities, offices, residential estates, and essentially anywhere there are trees, has been a result of work to increase public education and awareness combined with the development of the urban trap box by the NE Team.
- To achieve eradication, the NE Team need to be aware of grey squirrel distribution

across the region at any point in time. Implementing RRM in all available squirrel habitat requires the support of dedicated and reliable volunteers to achieve this level of survey effort.

- Due to the eradication progressing faster than anticipated in Aberdeen, and the time involved for the initial development of genetic markers for individual identification and genetic sexing tests, we learnt that the potential for genetic insights to aid the eradication in real-time should have been conducted at an earlier stage of the eradication process (estimate: before annual captures fell below 500 in 2021).

Success indicators

- Number of feeder checks (per quarter, per year etc)
- Record low grey squirrel detections
- Control rate of any grey squirrels detected
- Disruption to grey squirrel breeding cycle
- Red squirrel recovery (location and number of detections)
- Long-term commitment of volunteers
- High level of support and engagement of community

Project Success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reasons for success/failure

- The adoption of the scientific method of eradication.
- The development and expansion of the RRM networks, including the extension of RRM to all available squirrel habitat has led to the current exceptionally low grey squirrel density.
- The support of the CCOO, along with the visible recovery of red squirrel populations has helped build and maintain a committed network of volunteers.
- Communicating the successes of the project, the fast reaction, communication and action of grey squirrel sightings, as well as visible recovery of red squirrel populations has helped contribute to the support and engagement of community.
- North East Scotland's grey squirrel population are a geographically isolated population, and the NE team work closely with the Highland Line team to prevent incursions of grey squirrels moving north from Angus into Aberdeenshire.
- A partnership approach has enabled continuity of funding, national and local cooperation between a range of Government agencies, NGOs, academics, local authorities and land managers and a momentum that sustains the work on the ground.
- The grey squirrel population in the north east of Scotland do not carry squirrelpox virus.

Future project development

- The aim of SSRS in the North East is confirmation of the complete elimination of Aberdeen's grey squirrels. This will be achieved through the careful development and implementation of a robust eradication plan and confirmation phase.
- The plan incorporates the use of a trained drey detection dog to enable the detection of remnant grey squirrel individuals, particularly any potential trap-shy or feeder-shy grey squirrels.

Opinion on methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting		
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)	★	★
Immuno-contraception (oral bait delivered via hoppers)		
Gene Drive (Selected inheritance manipulated so only male young are born)		
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).		
Squirrelpox vaccine		

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

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- V. Signorile AL, Reuman DC, Lurz PWW, Bertolino S, Carbone C, Wang J (2016) Using DNA profiling to investigate human-mediated translocations of an invasive species. *Biological Conservation* 195: 97-105

SOLWAY RED SQUIRREL GROUP

Solway Red Squirrel Group (SRSG)

Geographical area of conservation work

The Solway Plain, North Cumbria, England

Author and organisation contact details

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Key partners

- Red Squirrels Northern England (RSNE)
- Northern Red Squirrels (NRS)
- Caldew Squirrel Initiative
- Cumbria Wildlife Trust
- Natural England
- Landowners and members of the public

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	None
Paid Contractors (7-12 months)	None
Volunteers involved with grey control	18
Volunteers involved with squirrel monitoring	19
Other Active Volunteers	6

Map of project land area



Figure 1. Solway project area.

The Solway Red Squirrel Group (SRSG) covers an area of approximately 184 square miles. The Solway estuary forms our boundary to the north and west. The Solway Area of Outstanding Natural Beauty (AONB) extends along the coastline and inland and comprises large areas of salt marsh and raised mire. Natural England, Cumbria Wildlife Trust and the RSPB manage reserves in this area. To the south, the land rises towards the northern fells of the Lake District and has the largest area of woodland, over 240 acres, which consists of managed forestry and mixed woodland which are privately owned. The central area is intensively farmed, however, there are small patches of mixed woodland throughout with five areas of woodland over 20 acres, one of which is managed by Natural England, the others are largely privately owned. The city of Carlisle is on the northeastern boundary. With the demise of the Allerdale Red Squirrel Group and the formation of two new red squirrel groups, our southern boundary changed in 2023.

Introduction

Until about 20 years ago, red squirrels (*Sciurus vulgaris*) occurred throughout our area (Figure 1) and were often seen visiting gardens, but by 2012 concerns were raised that red squirrels were being seen less often and not at all in some areas and that grey squirrels (*Sciurus carolinensis*) were being seen more frequently. Now, our only remaining small red squirrel population is resident within woodlands to the south of our area. Until recently, we had two other very small populations. After a squirrelpox outbreak in 2023, we have had no further red squirrel sightings from one area and none in the other for a year, the reason for that disappearance is unknown.

The rest of our area is grey squirrel only, and despite year-round control in many areas where we have permissions, grey squirrel numbers are increasing due to more frequent breeding.

The work of the group is undertaken entirely by volunteers. We received grants in 2021, 2022 and 2024 to help fund two projects. All other funds are raised by volunteers.

There are no pine martens (*Martes martes*), designated squirrel reserves or strongholds in the Solway area.

Project aims

- To protect our small remaining population of red squirrels so that hopefully numbers will increase and expand to adjacent areas.
- To control grey squirrel numbers as much as possible throughout our area.
- To raise public awareness of the threats posed by grey squirrels to red squirrels and tree damage.
- The recruitment of more volunteers to help with all aspects of our work.

Description of the project

The Solway Red Squirrel Group (SRSOG) was formed in 2012. Our work is carried out entirely by volunteers. The group provides feeders, feed and trail cameras and we have two thermal cameras. All other day-to-day expenses are met by the volunteers themselves, most have bought their own thermal cameras and those who have attended training courses have self-funded. The use of trail cameras and thermal imaging is vital to our work.



Figure 2. Camera traps are vital in red squirrel monitoring.

In 2021 we set up our 'Reinforcing the Reds' project. This is based in Westward where we still have a small population of red squirrels. It covers two areas of privately owned woodland which lie either side of a minor road between Wigton and Caldbeck. The aim is to protect that population from grey squirrels so that they can safely thrive and survive. The first year of the project was funded by a grant from the Lake District Foundation and we were grateful to receive a grant from the Joyce Wilkinson Trust to carry on for a second year. The project is now self-funded.

Grey squirrel control is carried out year-round by both shooting and trapping. Of the grey squirrels culled 60% are shot and 40% trapped. Feeders and trail cameras (Figure 2) are used to monitor where grey squirrels are present and confirm red squirrel presence and monitor their health. Detailed records are kept, and graphs show time and frequency of feeder use and numbers present.

Initially, red squirrels were only present in a single woodland, but both woodlands now have red squirrels, and while this shows that red squirrel numbers are increasing, both sites have had cases of squirrelpox which knocks numbers down. Grey squirrels are still present, but in smaller numbers. However, without control they would soon overwhelm the area again. Grey squirrel control is also carried out throughout surrounding areas to try and create a buffer zone. Despite a lot of continued hard work from our volunteers, we feel that our red squirrels are in a precarious position and only just holding their own against the constant threat of squirrelpox and grey squirrel incursion. If the project was not ongoing, we would have no red squirrels left.

Red squirrels do occur in a few areas immediately adjoining our project area and one lucky householder had nine red squirrels in his garden on one occasion. This, however, is very much an exception. In 2024, we received a grant from the Robin Rigg Foundation to support our work on the Solway Plain. This is a 'grey squirrel-only' area, but the grant enabled us to obtain further permissions, to recruit three volunteers and raise public awareness. Year-round control was carried out in eight woodlands, and the use of trail cameras has provided a lot of valuable information. It also confirmed the loss of the small red population near Aspatria.



Figure 3. Community outreach is key.

We do get a very occasional red squirrel sighting in our northeastern area. However, only one has been verified via a photograph (in October 2023) but there have been no sightings since. Without photographic evidence, we cannot be certain that the others were not just very reddish grey squirrels. Grey squirrels are numerous and widespread despite year-round control.

Our SRSNG volunteers do an amazing job; it is noteworthy that the majority are retired (and we're all getting older). We'd like to recruit more volunteers of all ages to help with all aspects of our work, including grey squirrel control, monitoring, fundraising and particularly publicity to raise awareness (Figure 3) of the multiple threats grey squirrel pose. It would be nice to raise awareness among the younger generation, but we do not visit schools as we have no one qualified to do so.

Success indicators

- We still have a small population of red squirrels in our area.

Major difficulties faced

- Squirrelepox outbreaks continue.
- Grey squirrels are currently breeding year-round.
- A small vulnerable red squirrel population means that it is crucial that grey squirrel control is undertaken rigorously. It will take many years for re-colonisation to occur; this is still difficult despite our 'Reinforcing the Reds' project.
- We still lack resources for publicity and raising awareness particularly in schools.

Major lessons learned

- Year-round control of grey squirrels is essential.
- Squirrelepox outbreaks must be contained quickly and thoroughly.
- The public must be made more aware of grey squirrel threats to both red squirrels and to woodlands.

Project success

Success or failure	Confidence
Highly Successful	
Successful	
Partially Successful	X Medium
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Failure: The increase in numbers of grey squirrels due to year-round breeding.
- Failure: Squirrelpox outbreaks are frequent.
- Success: The use of trail cameras and thermal imaging.
- Success: The dedication and hard work of our volunteers.

Future project development

- A further project in an adjacent area if funding can be obtained.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in the project currently	Future importance in developing this aspect of grey squirrel management in the project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)		★
Immuno-contraception (oral bait delivered via hoppers)		
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)		
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

PENRITH AND DISTRICT RED SQUIRREL PROJECT

Penrith and District Red Squirrel Group (P&DRSG)

Geographical area of work

North East Cumbria, England

Author and organisation contact details

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Key partners

- Center Parcs
- Members
- Corporate and Individual Sponsors
- Landowners
- Neighbouring Groups
- Red Squirrels North England (RSNE)
- Cumbria Wildlife Trust
- Lake District National Park
- Cumberland Council
- Westmorland and Furness Council and Parish Councils
- Forestry England (FE)
- National Trust
- United Utilities
- Northern Red Squirrels (NRS)

Resources

Typical Annual Resource available	Number of people	
Paid Contractors (1-6 months)	0	
Paid Contractors (7-12 months)	6 Rangers	One further Ranger funded externally
Volunteers involved with grey control	25	
Volunteers involved with squirrel monitoring	10	
Other Active Volunteers	50+	Many are involved in fundraising, organising local events and acting as eyes and ears for Rangers etc
Other info	600 members of P&DRSG	

Map of project land area



Figure 1. P&DRSG areas of operation.

Penrith & District Red Squirrel Group (P&DRSG) covers an area of approximately 610 square miles incorporating the north and upper River Eden valleys, the area around Ullswater and Haweswater and takes in two of the original designated ‘red squirrel reserves’ at Whinfall and Greystoke Forests. This includes a mixture of steep wooded terrain, commercial and private amenity forestry, and mixed farmland with hedges and a lot of connectivity for squirrel movement. Some pheasant (*Phasianus colchicus*) shooting interests limit grey squirrel (*Sciurus carolinensis*) control, from July to the end of the shooting season on 1st February. Despite an ongoing shooting trial with Forestry England, the restrictions on

control in their woodland is a huge issue and the negative effect on grey squirrel control in surrounding woodland is enormous. Increasingly grey squirrel populations in towns and villages are making landscape control extremely difficult. These urban settings are now acting as reservoirs from which grey squirrels are constantly dispersing into the surrounding countryside.

Introduction

P&DRSG was started over 35 years ago when the first significant incursions of grey squirrels from the south spread into key red squirrel (*Sciurus vulgaris*) areas. Grey squirrels (*Sciurus carolinensis*) are now well established virtually surrounding our project area boundary (Figure 1), and in the last three years, grey squirrels which are now breeding all year round, have become established inside some of the group's area. It is only an increase in group activity and the number of self-employed professional trained contractors, supported by volunteers that are maintaining red squirrel numbers by controlling grey squirrels. Consequently, the stronghold/buffer zones of two national 'red squirrel reserves' Whinfell and Greystoke are not geographically relevant in terms of focussing grey squirrel management. Instead, our control approach is targeted at achieving landscape-scale coverage. This comprehensive approach is much more effective.

To date there have only been two pine marten (*Martes martes*) recorded in the P&DRSG area, despite releases in other parts of Cumbria. As a conservation group we, and particularly most of our private landowners on whom we rely for access, are opposed to the reintroduction of this predator but we accept natural recolonisation in due course.

Woodland grant aid through Stewardship and WS3 (<https://www.gov.uk/countryside-stewardship-grants/ws3-squirrel-control-and-management>) is potentially available. The scheme states that payments are 'To manage the population of invasive grey squirrels and help increase the population of native red squirrels'. However, this scheme is designed for 'grey squirrel-only areas' as the required actions to comply with the conditions of the grant, particularly the trapping requirement, are not optimal for woodland with a surviving red squirrel population still present.

Project aims

- Maintain and expand red squirrel population distribution within the P&DRSG area by promoting and carrying out effective grey squirrel control.
- Implementing grey squirrel control on a landscape-scale and encouraging the use of thermal imaging as an efficient means of detection, in addition to trapping which has a limited effective period.

- Supporting evolving grey squirrel control methods.
- Promoting ‘Save Our Reds’ – our new project aimed at raising funds and in doing so supporting the call and funding for a vaccine for red squirrels against squirrelpox.

Description of the project

- P&DRSG has evolved over the last 35 years or so. It differs from a lot of other groups in that our strategy is to use paid contractors to control grey squirrels assisted by volunteers. We recruit volunteers to promote our work and help with our fundraising over the 610 square miles in which we operate (Figure 1). The aim is to provide landscape-scale grey squirrel control over the entire geographical area rather than the limited to the original concept of strongholds and buffer zones. Our experience shows that short-term contracts do not work – control must be kept in place throughout the year (Figures 2 and 3).

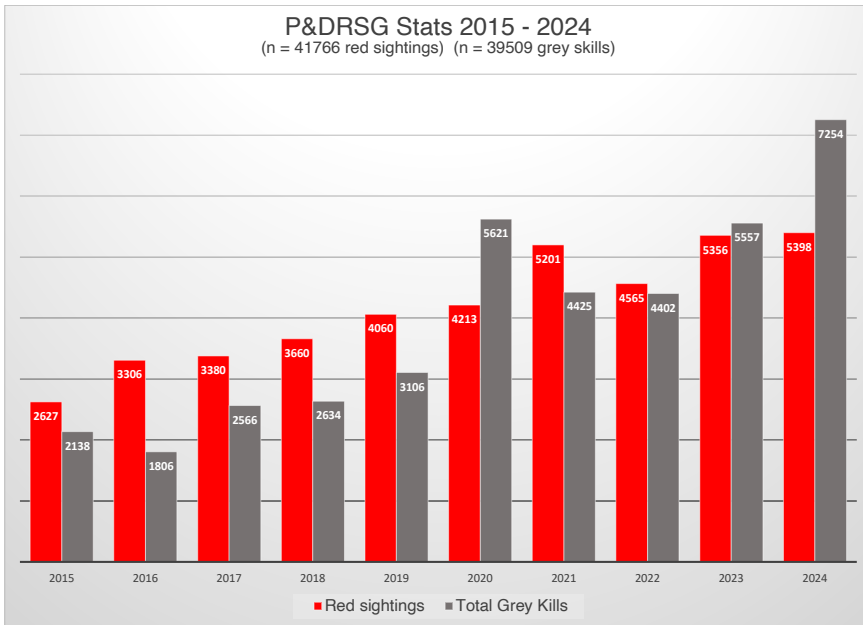


Figure 2. P&DRSG grey squirrel control and red squirrel sighting data.

The contractors are called ‘Red Squirrel Rangers’ and are trained professionals. Their primary role is grey squirrel control. Rangers carry identification and help publicise the work being undertaken. The area covered shown on the map (Figure 1) is divided into seven sub-areas with one Ranger operating in each area and recruiting experienced/ trained volunteers to help with grey squirrel control. We currently have seven Rangers – five full-time and one part-time, funded by the group, with an additional Ranger directly

employed by Center Parcs. All put in many more hours than they invoice for and are dedicated to red squirrel conservation.

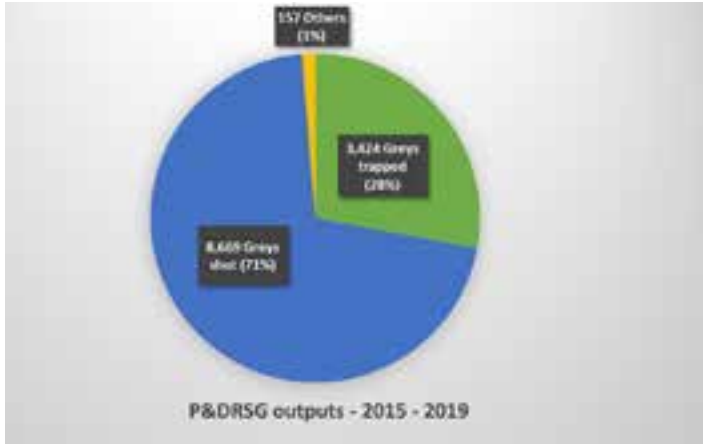


Figure 3. Grey squirrels shot and trapped.

Fundraising to meet the cost of this Ranger service is the key activity of the Trustees and other volunteers. In 2006, P&DRSG became a charity, and this has had some major benefits in terms of fundraising, with claiming gift aid being a major contribution to income. Our membership support is vital. Also included, is the sale of merchandise, with by far the biggest seller and our most important income stream being squirrel feeders made from Stokbord™ by our Ranger team.

Methods of grey squirrel control have also changed, particularly in the use of thermal imaging, combined with feeders and trail cameras. This has completely revolutionised grey squirrel control and made it a lot more cost effective, resulting in a much higher proportion of grey squirrels controlled by shooting rather than trapping. This once again highlights the ongoing major problem of Forestry England (FE) woodland policy, still relying on trapping as the main control method. Live-cage trapping plays an important part at some times of the year – May to July in particular - but is relatively ineffective when there is so much natural feed. It is labour intensive with all traps having to be visited at least twice every 24 hours, with red squirrels often having to be released.

Whilst we support the investigation and research into other methods of grey squirrel control, the possible introduction of immunocontraception as a tool for controlling grey squirrels may still be somewhere on the horizon, but it is taking far too long to develop. Getting through the hoops before it can be rolled out is still several years away – 2030 at the very earliest.

Finding a sustainable way of keeping the group going, based on grey squirrel control alone, is becoming very difficult.

For this reason, P&DRSG is looking to rekindle and promote the development of a vaccine against squirrelpox virus (SQPV) for red squirrels. Most grey squirrels are almost certainly exposed to, or actively infected and carrying SQPV. Squirrelpox outbreaks have increasingly dented our efforts, year by year, which is both disappointing and disheartening. This is not surprising given the increase in grey squirrel numbers moving through the landscape. There is a clear need for better biosecurity, in particular, disinfection of feeders and if necessary, the withdrawal of feeders during a disease outbreak to try to eliminate viral cross-infection. However, this is very difficult to implement especially with so many bird feeders providing feed for both squirrel species.

Promotion of our work through the website, social media, exhibiting stands at local shows (Figure 4) and illustrated talks is ongoing. Trustee, Ranger and supporter meetings take place every six weeks. This frequency keeps the groups' activity on everyone's agenda. The creation over some years of a dedicated red squirrel walk where visitors are guaranteed to see red squirrels in the wild is helping enormously to promote both the indigenous red squirrel itself and the work of the group. We continue to look for innovative ways of raising money for the group. Our 600 members and sponsorship are a vital part of this.



Figures 4a and 4b. Raising public awareness is a key element in P&DRSG efforts.

Major difficulties faced

- Difficulty of maintaining funding streams and attracting new funding (Figure 5).
- Continued refusal/restrictions of FE to allow shooting on the National Forest Estate - this is a major problem.
- Numbers of red squirrels being killed on roads.
- Lack of support/ interest from the next generation.



Figure 5. Fundraising is derived from a wide range of sources including merchandise.

Major lessons learned

- Use of trail cameras, feeding stations and monitoring has been key to grey squirrel control, with very much increased use of thermal imaging and shooting.
- Absolute necessity of regular and repeat grey squirrel control – the vacuum effect otherwise undoing control work success in a few weeks.
- Reports of squirrelpox outbreaks are more widespread. Biosecurity and withdrawal of feeders by the public in areas of outbreak is essential.

Project Success

Success or failure	Confidence
Highly Successful	
Successful	
Partially Successful	X Medium
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct.

Reason(s) for success/failure

- P&DRSG covers a very large area with challenging geography, topography and ground conditions. Given the scale of the landscape covered, the outcome is not the same across the whole area and varies from very successful to a struggle to maintain even the status quo. Grey squirrel numbers have increased with over 6,000 controlled in 2024. More resources are needed.

Highlighting how challenges identified in the last five years have been approached

- **Grey squirrel control** – Sustaining the required level of grey squirrel control has become increasingly difficult due to funding constraints, reduction/ difficulties in grant funding and government support, particularly where there are still red squirrel populations at risk. Grey squirrel numbers are increasing with year-round breeding.
- **Shooting restrictions** - FE have now included a shooting trial. This is for sub-12ft pounds air rifles only from fixed positions. Recently, they have now also stipulated the use of non-lead pellets. This is a further huge handicap, reducing the effective range. Additionally, the lack of grey squirrel control in urban areas allows them to breed and spread.
- **Forestry management** - A large increase in forestry felling and thinning has reduced red squirrel habitat. Increased planting / wilding schemes might replace lost habitat for red squirrels, but this is also providing a much better toe hold for grey squirrels getting established.
- **Thermal imaging** - Thermal imagers are now supplied to all Rangers and have made

grey squirrel control a great deal more effective and efficient. This is allied to the use of trail cameras which have also become a very important tool. There has been a large reduction in reliance on trapping as a result, but it remains an important part of the tool kit.

Future project development

- Increased funding to enable the expansion of the Ranger team is essential.
- Use of Apps to improve record keeping and management of contractors.
- This needs to be supplemented by increased participation of volunteers taking advantage of further development of technology and kit in controlling grey squirrels.
- Development of a ‘Red Squirrel Vaccine’ against SQPV.

Current and future importance of contemporary and future methods of grey squirrel control.

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)		★
Immuno-contraception (oral bait delivered via hoppers)		★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)		★
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

EXPANDING GREY SQUIRREL MANAGEMENT IN YORKSHIRE, LANCASHIRE AND COUNTY DURHAM

UK Squirrel Accord

Geographical area of conservation work

Yorkshire, Lancashire and County Durham – England

Author and organisation contact details

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Key partners

- Forestry Commission
- Red Squirrels Northern England
- UK Squirrel Accord
- Red Squirrel Survival Trust

Resources*

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	
Paid Contractors (7-12 months)	2
Volunteers involved with Grey control	115
Volunteers involved with squirrel monitoring	115
Other Active Volunteers	10
Other engaged stakeholders	2,393

* figures from February 2025

Maps of project land area



Figure 1. Map of the total UK Squirrel Accord pilot project area. Covering Yorkshire, Lancashire and County Durham in England. Project Officers are targeting work to set up landscape-scale partnerships that cover defined areas within the counties.

Introduction

The UK Squirrel Accord pilot project, funded by the Forestry Commission, covers Yorkshire, Lancashire and County Durham in Northern England (Figure 1). The three counties have small red squirrel (*Sciurus vulgaris*) populations that need protecting from far larger numbers of grey squirrels (*Sciurus carolinensis*). They also neighbour Cumbria and Northumberland, which support most of mainland England's surviving red squirrel populations.

Two squirrel project officers were taken on in January 2024 on a fixed-term, self-employed basis initially until March 2025. Their aim was to engage stakeholders across the three counties to raise awareness and set up new grey squirrel management partnerships/groups to protect red squirrels and trees from grey squirrel bark-stripping damage. Alongside support for the project officers, funding was provided for events and communications, initial volunteer group set up costs, equipment, and training.

Building on existing work by stakeholders and volunteers, it was hoped that having squirrel-focused officers on-the-ground would galvanise coordinated grey squirrel management efforts. Yorkshire, Lancashire and County Durham were chosen as they have remnant red squirrel populations and various woodland creation schemes. Effective action in those counties could help to buffer Northumberland and Cumbria from further grey squirrel incursions.

Project aims

- Expand the grey squirrel management network.
- Establish new volunteer groups/partnerships.
- Provide training and mentoring.
- Offer advice and guidance.

Description of the project

Following discussions with stakeholders, Forestry Commission (FC) secured funding to enable the UK Squirrel Accord (UKSA) to deliver a pilot project that explored the benefits of having project officers on the ground. The aim was to work across large landscape areas to increase grey squirrel management for red squirrel and tree protection. This approach was similar to the FC's deer officers who enable collaborative, landscape-scale management to reduce the negative impacts of deer on England's woods.

Despite a short timeframe and a difficult time of year for recruitment, two skilled squirrel project officers were taken on in December 2023 for a January 2024 start. Their contracts

were on a fixed-term, self-employed basis, initially until the end of the pilot phase in March 2025. With the Red Squirrel Survival Trust providing legal administration on behalf of the UKSA partnership. Both individuals had a strong knowledge of grey squirrel management, good communication skills and the ability to work with a wide range of stakeholders.

The project officers engaged with woodland owners and their agents, stakeholders and the public. Providing advice and guidance on introduced grey squirrel impacts on trees and red squirrels, and how this established, widespread invasive species can be managed collaboratively at a landscape-scale. The primary focus of their role was to establish groups and partnerships to increase grey squirrel management across the project area. Working with landowners and managers to encourage, coordinate and support action, and recruiting, training and mentoring volunteers.

Five new groups/partnerships were established by the officers during the pilot:

- Bowland Red Squirrel Alliance
- River Allen Red Squirrel Group
- Weardale Red Squirrel Group
- West Yorkshire Red Squirrel Alliance
- Yorkshire Dales Red Squirrel Alliance

Funding for the pilot project was not restricted to contracting the project officers. It covered wider costs to deliver awareness events (Figure 2), set up the groups (e.g. insurance), provide equipment (e.g. wildlife cameras) on a loan basis initially, and train volunteers. Groups/partnerships and stakeholders were also encouraged to apply for Countryside Stewardship higher tier options for grey squirrel management. In England, this provides important government funding, which does not rely on the need for fundraising, to support active management by landowners and managers, volunteers and/or contractors.



Figure 2. Weardale Red Squirrel Group was set up during the pilot project.

To enable the project officers to train volunteers that they would then mentor and ensure cost effectiveness for the project, UKSA worked with BASC to create a grey squirrel management competency course. Its focus was the humane trapping and dispatch of grey squirrels through the provision of theoretical and practical sessions that enable participants to demonstrate competency before being certified. Following training, volunteers would be mentored by the project officers to ensure practical support and skills development.

Awareness raising and communications are an important part of the project. Communications on the project were shared by UKSA once FC funding was secured and led to an initial shortlist of interested stakeholders. The project officers then engaged numerous stakeholders through organising, attending and delivering public events alongside online and field meetings. These included educational events (Figure 3) with schools and youth groups, and a webinar to celebrate progress that is available on UKSA's YouTube channel.

On Red Squirrel Appreciation Day, 21 January 2025, a press release was shared after a project officer identified a new red squirrel colony in West Yorkshire. This positive news story was shared nationally by the BBC and various local media outlets. With the many negatives that can be associated with invasive species management and endangered species conservation, it is valuable for communicators to find good news stories that capture imaginations while helping highlight the problems. Importantly, the find enabled the landowner to build red squirrel conservation into their land management plans.



Figure 3. The pilot project included community outreach. Here UKSA film red squirrels with local volunteers.

By the end of the March 2025 pilot project to expand grey squirrel management in Yorkshire, Lancashire and County Durham, the project officers engaged nearly 2,400 stakeholders across over 400,000 hectares of land and created five new groups/partnerships – with another in early development. However, the short timeframe for the project did prevent some stakeholders from engaging due to concerns around lack of continuation post March 2025.

This does not detract from the significantly positive progress made by the project on a complex matter in just over 14 months. The project received a great deal of stakeholder interest and praise within and outside of the counties. A stakeholder from a key Yorkshire environmental NGO said, “The FC-funded UKSA project is an encouraging and proactive initiative, one that can bring together residents, landowners and organisations in a joint effort.” Further funding would enable this work to be consolidated and expanded.

Success indicators

Quarterly milestones increasing over time:

- Number of stakeholders engaged over a specified landscape area.
- Number of new volunteer groups established.
- Number of awareness raising events delivered.

Major difficulties faced

- Data sharing – concerns over the use of point data resulted in reluctance by some to share data in case it could be used to identify individuals. Explaining that data is only ever shown publicly at the tetrad level eased some worries. Data sharing is important to recognise effort and enable better coordination.
- Timescale – the short life of the pilot project meant some stakeholders did not get involved. It was felt there was not enough time and there would be no continuation of activity once the project officer roles ended.
- Recruitment – due to the timing of funding approval, there was a relatively short window to recruit skilled individuals that fell just before the festive period. Some candidates interpreted the roles as contractors delivering grey squirrel management rather than officers engaging stakeholders and building partnerships.

Major lessons learned

- Training – a cost-effective course that could be delivered by our project officers was not available at the start of the project and took time to create. Tackling this earlier would have enabled more training within the project’s lifetime.
- Landowner understanding of red squirrel conservation – some landowners were wary of engaging with conservation projects due to negative past experiences. Constructive communications and discussions around grey squirrel impacts and effective management actions were needed to build stakeholder trust.
- Planning – due to the uncertainty of further funding, an exit strategy for the pilot was needed alongside planning a continuation of the project, to ensure both potential eventualities were covered. Even if funding continues, it is still useful to have an exit strategy in place and keep thinking about long-term legacies beyond the life of any project.



Figure 4. Training events provided local volunteers with technical skills and equipment.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Project officers' skills – both project officers have demonstrated excellent abilities to engage a wide range of stakeholders, effectively communicate the issues and need for effective grey squirrel management and build partnerships to work across landscape scales.
- Communications and engagement – various communications were shared through UKSA and its signatories, and by the project officers and stakeholders. This promoted the project, encouraged engagement and importantly shared successes to maintain positive momentum.
- Depth of funding – project funding was not only provided for two project officers, it also supported the wider needs of the project. This included funding to acquire essential equipment (e.g. feeders and wildlife cameras), provide the costs needed to set up groups (e.g. insurance and leaflets) and deliver management training to volunteers (Figure 4).
- Landowner engagement – identifying key stakeholders that helped influence others across the landscape played an important role in galvanising engagement and enhancing collaborative working.

Future project development

Plans dependent on further funding following the pilot phase:

- The project secured a further year of Forestry Commission funding until 2026 and will focus on consolidating initial progress. The two project officers by supporting the groups/partnerships developed in the pilot to become self-sustaining and training the volunteers involved.
- Outline plans for funding following March 2026 include exploring recruitment for a third project officer that would help set up further new grey squirrel management groups/partnerships and the potential to expand into other areas.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps	★ ★	★ ★
Pine marten (as natural grey predator)	★	★ ★
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		Unknown – too early in research to assess likely importance and regulatory approval
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)	★ ★	★ ★
Squirrelpox vaccine		

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

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- I. Forest Research, 2019. Controlling grey squirrels in forests and woodlands in the UK. UK Forestry Standard Technical Note. Available online: https://cdn.forestresearch.gov.uk/2019/12/ukfstn022_m7ldper.pdf
- II. Forestry Commission, 2023. Red squirrels and forestry operations in England – operations note 65. Available online: <https://www.gov.uk/government/publications/red-squirrels-and-forestry-operations-in-england-operations-note-65/red-squirrels-and-forestry-operations-in-england-operations-note-65>

RED SQUIRRELS NORTHERN ENGLAND (RSNE)

Northumberland Wildlife Trust

Geographical area of conservation work

Northern England

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Key partners

- Northumberland Wildlife Trust (NWT)
- Northern Red Squirrels (NRS)
- Forestry Commission (FC)
- Forestry England (FE)
- UK Squirrel Accord (UKSA)

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	5
Paid Contractors (7-12 months)	3
Volunteers involved with grey control	
Volunteers involved with squirrel monitoring	150+ Annual Monitoring Programme in northern England

Maps of project land area

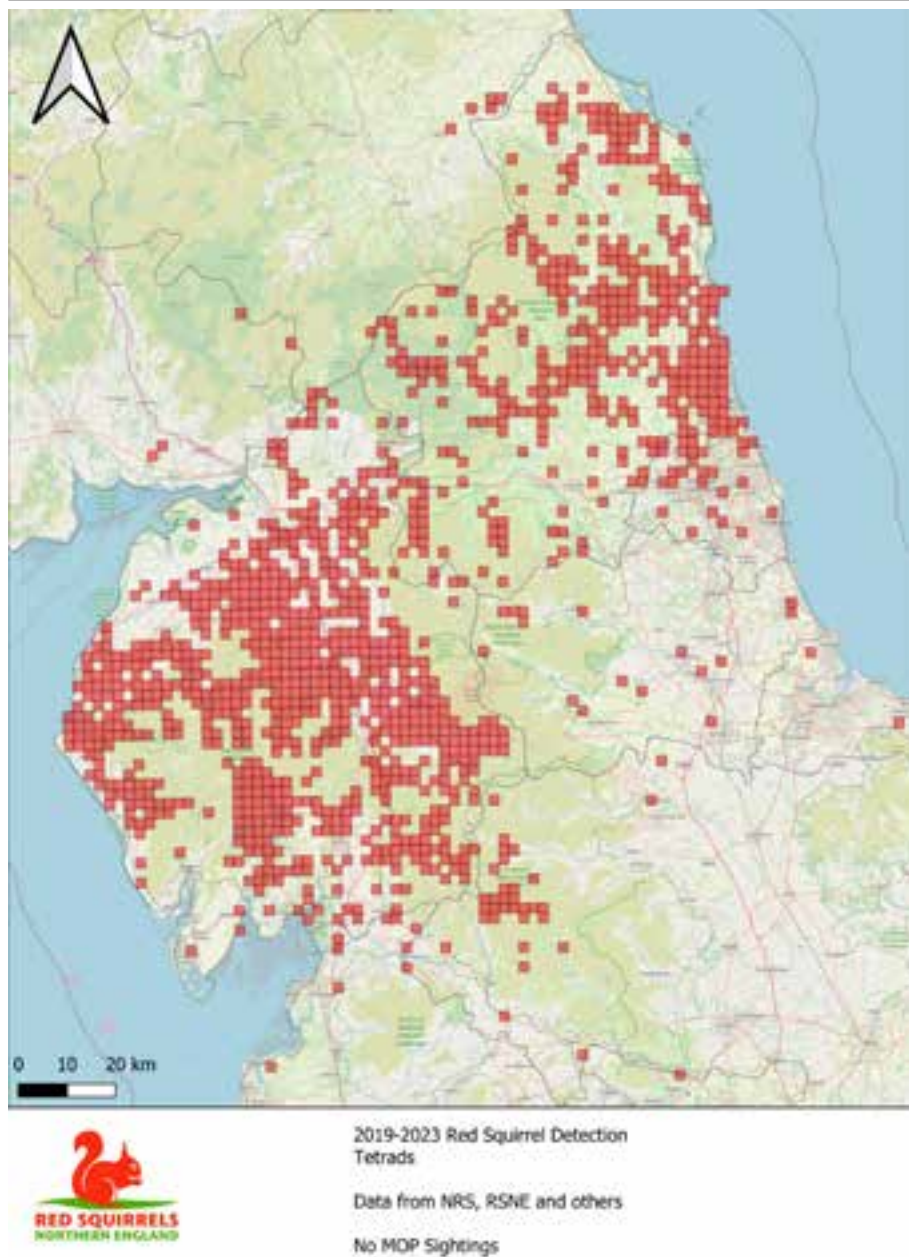


Figure 1. Red squirrel distribution 2019-2023.

The project land area map shows the main area of landscape collaboration. Data from NRS, RSNE and others.

Introduction

Red Squirrels Northern England (RSNE) is a project of Northumberland Wildlife Trust (NWT), which strives to conserve red squirrels (*Sciurus vulgaris*) in northern England. We currently have four rangers working across Cumbria, Northumberland and North Yorkshire, whilst also influencing conservation activities in neighbouring counties and nationally (Figure 1). The rest of the RSNE team consists of our project manager and project officer, based in Newcastle. Kielder, North Lakes, Slaley, Kylee, Harwood and Greenfield 'red squirrel reserves' lie within the project area, some being key focus areas for rangers.

The project has been active since 2011 and builds on three decades of conservation activity, involving local communities and many other partners. RSNE's formation was a direct response to a series of Government agency reviews of red squirrel conservation from 2008 to 2011, which pointed to an urgent need for annual squirrel range monitoring, unified recording and compilation of grey squirrel (*Sciurus carolinensis*) management and to develop a coordinated and joined up approach to red squirrel conservation.

Project aims

- Working with communities, volunteers, landowners and red squirrel groups to encourage local support, involvement and conservation action.
- Monitoring woodlands to better understand where red squirrels live so we can take appropriate action to conserve them and managing a database of sighting data to inform conservation activity.
- Facilitating and undertaking the management of grey squirrels in areas where red squirrels are found to allow them the space they need to thrive.
- Developing and nurturing partnerships to ensure there is a joined-up approach to this work, whilst assisting with national plans and alternative conservation methods.

Description of the project

RSNE is a project of NWT which has now been active in northern England for 13 years, effectively working from the east to west coast to protect red squirrels. We currently employ four full-time rangers and one full-time contractor in Cumbria, Northumberland and North Yorkshire to undertake on-the-ground activities. The project additionally assists nationally with plans and policy, such as the England Red Squirrel Action plan. Collaboration with partners and stakeholders is integral to the project outcomes with RSNE working alongside other Wildlife Trusts, community volunteer groups like Northern Red Squirrels (NRS), Forestry Commission (FC), Forestry England (FE) and the UK Squirrel Accord (UKSA).

The Countryside Stewardship Higher-tier grant scheme is a key source of income for the project. Current schemes offer £60 a hectare for grey squirrel control to landowners which then pays to employ rangers to undertake grey squirrel monitoring and control on estates. Most grey squirrel management is focused within or near red squirrel reserves and buffer-zones to target conservation activity where it's most needed. To encourage the uptake of grey squirrel management and monitoring, across the region, RSNE promotes the grant schemes to landowners and assists with applications. This entails writing management plans, completing the grant application process on behalf of landowners and in some cases also undertaking grant claims and evidence submissions.

Our work has been further funded through a variety of channels, including: RSNE's Friend of the Red Squirrel membership, NWT's red squirrel adoptions, RSNE's corporate membership scheme, private donations, fundraising, FE and FC, United Utilities, Scottish Woodlands, Savilles, Tilhill, Edwin Thompson, the National Trust, Northumbrian Water, Ray Wind Funds and others.

RSNE's annual spring monitoring programme, established in 2012, is undertaken every year to help monitor changes in squirrel distribution across northern England (Figure 2 and 3). The huge citizen-science project is the only systematic evidence available for assessing whether all our collective conservation effort is paying off and is therefore a key component of the project. Volunteer involvement is crucial for survey completion, with approximately 150 volunteers involved each year who make the survey possible.

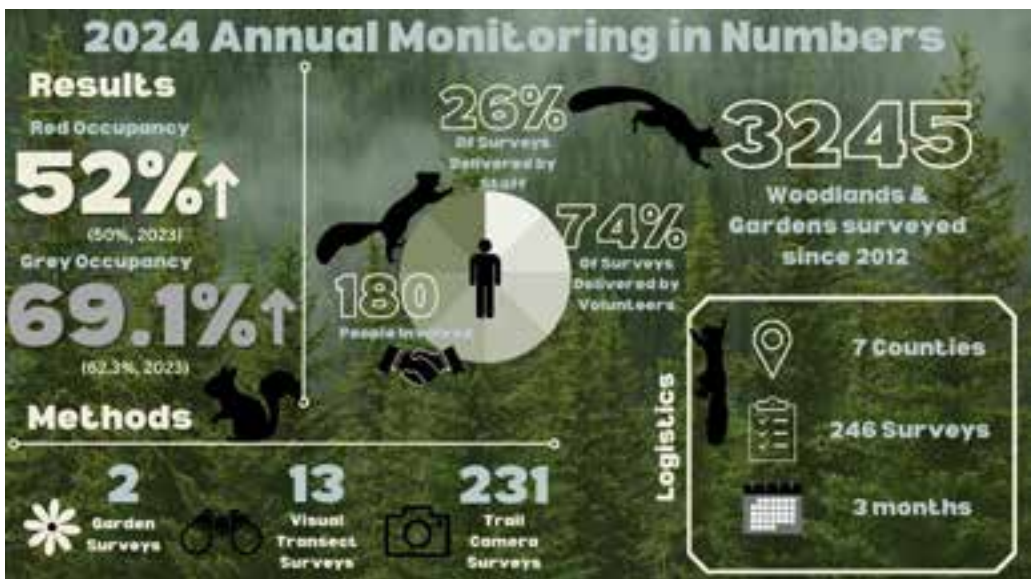


Figure 2. Infographic outlining 2024 RSNE spring survey results.

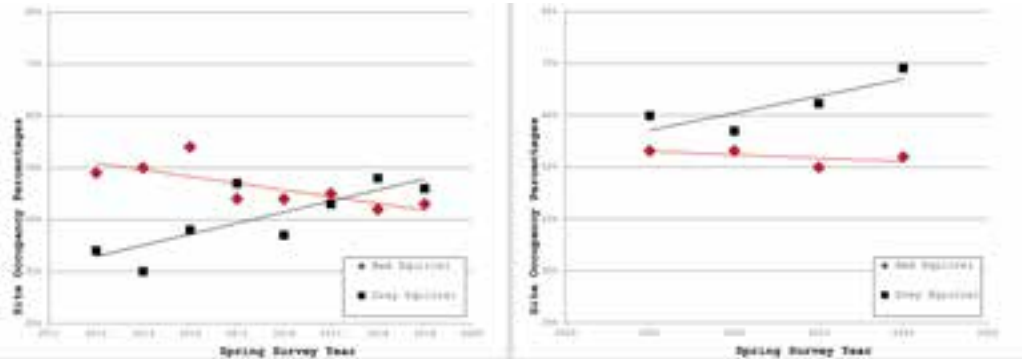


Figure 3. Red and grey squirrel site occupancy for all spring surveys 2012-2024 shown as a percentage of the total number of surveys completed each year, plus trend lines. (2012-2020= 2-week survey window; 2021-2024= 4-week surveys).

Collaboration with volunteer groups is essential to effectively target our conservation efforts and work at a landscape-scale to protect red squirrels. It is thanks to these groups that red squirrels are in the position they are today, with most of the conservation effort in England undertaken by volunteers on the ground. RSNE helps to support these groups through, for example, delivering targeted community talks to recruit new volunteers; delivering best practice trapping and survey training workshops; facilitating access permission where needed; supplying and/or loaning out equipment; making groups aware of funding opportunities and supporting applications; collating regional data and providing bespoke analytical maps. RSNE have also set up ArcGIS dashboards for groups interested in viewing or sharing their data and to provide technical support to assist with this.

Engagement is a key element of what we do as it helps with reaching further audiences and spreading the word about the plight of the red squirrel. RSNE attend various shows and events with informational displays to educate and discuss red squirrels with locals (Figure 4). We additionally deliver presentations, which can help recruit volunteers for local groups and work closely with local colleges and organisations to promote awareness.



Figure 4. The RSNE team at Wallington Hall, 2023

Success indicators

- Thanks to the combined efforts of the local groups, land managers and organisations like us, we continue to successfully maintain the current red squirrel range. The spring survey results confirm this, with red squirrels still found in 52% of sites surveyed (Figures 2 and 3). This is despite the influx of grey squirrels being observed across the project area and proves that consistent, widespread effort pays off. This success highlights that we require continued and sustained effort in the future, at least until alternative solutions are developed.
- The comprehensive database of sighting and control data from groups and organisations helps us effectively advise on important developmental plans, such as tree felling license applications. This in turn has helped shape a landscape more suitable to red squirrels and their conservation, whilst protecting isolated populations or areas of importance, such as the red squirrel reserves. Once again, this is thanks to volunteers and groups for sharing data and consistently working to protect red squirrels.
- Working alongside groups and assisting with local conservation talks has facilitated the recruitment of new volunteers in areas that need them, whilst equipping people with the skills and knowledge needed to take local action.

Major difficulties faced

- One of the main challenges has been the ability to support local groups because of limited project capacity. Volunteers play a crucial role in the success of red squirrel conservation across northern England. RSNE are grateful to work alongside such a passionate and dedicated community and it is essential that we accommodate groups and volunteers where possible. The Red Squirrel Recovery Network project (see future project development) plans to strengthen and build on connections with local groups, volunteers, communities and other stakeholders.
- Many groups and landowners share conservation data with RSNE, which helps provide a valuable overview of squirrel distribution and conservation efforts. This encourages conservation effort by demonstrating the positive impact of our collective work and is used to help advise on various planning applications, developments and wider national policy. However, there are some gaps in the data we receive which can impact our understanding of distribution patterns in certain areas. We are actively working with groups to encourage data sharing and equipping them with the technology and means to submit and share data.
- The yearly spring monitoring programme is a substantial undertaking, requiring considerable time and resources from both staff and volunteers to collect the survey data and analyse the results. There are also occasional challenges with gaining access

permission within a set timeframe and difficulties in covering certain remote areas. Without access to unrestricted funds (i.e., funds not dedicated to direct grey squirrel control efforts), it would not be feasible to carry out the programme.

Major lessons learned

- With recent influxes in grey numbers (2023-2024) rangers have needed to be adaptable to the level of control work required to sufficiently reduce populations and protect red squirrels within the project area.
- Building strong relationships with local groups and communities has been essential for joined-up region-wide conservation activities.
- In 2021 there was a change to the spring survey methodology, with the observation window moving from two to four weeks which was justified to produce more reliable results. In 2024 we changed the reporting method to accommodate the change, and separated results reporting into the two different timeframes (Figure 3). We consistently aim to adapt and alter the monitoring programme to help produce robust results, including reviewing survey placement to equally cover the region.

Project success

Success or failure	Confidence	
Highly Successful	X	
Successful	x	High
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- We successfully collaborate with many local groups and volunteers to form networks of action, such as the collective spring survey effort. RSNE rangers also work with local people to help identify grey squirrel incursion or any potential squirrelepox cases, ensuring quick responses to any actionable developments, and adaptable working patterns to address changes.
- Some areas are hard to cover with grey squirrel control, due to a lack of funding or ranger/volunteer availability in the area. For example, Slaley reserve has been struggling with its isolated population of red squirrels for several years. It is hoped with the new Countryside Stewardship Higher-tier scheme will be incentive for landowners in these areas to focus more so on grey squirrel control.
- The database of records collected since the start of RSNE, has been instrumental in showing that our collective efforts are positively impacting the stability of red squirrel distribution (Figure 1), alongside spring survey results. This has not only motivated volunteers but also demonstrated the value of supporting red squirrels. Perhaps less recognised, the data has also been key in influencing government policy, such as the inclusion of red squirrels in broader environmental strategies and grants beyond their strongholds.

Future project development

The Red Squirrel Recovery Network project has been under development since 2020 and is a partnership between three Wildlife Trusts (Northumberland, Cumbria and Lancashire), Knowsley Safari and a Scottish partner. We have recently completed the development phase of the project and if given the go ahead from the National Lottery Heritage fund, will receive funding to begin the five-year delivery phase very soon.

Some of the deliverables throughout the project will include:

- Building on emerging science to carry out field trials relating to fertility control for grey squirrels and establish new methodologies which are potentially transformative for the future of red squirrels.
- For the first time, employing a dedicated Communications Officer to audiences within and beyond the project area including responding to volunteer requests to increase profile/raise awareness, using new opportunities to build a more resilient supporter base for the red squirrel conservation movement.
- Engaging new audiences within the red squirrel range – involving more volunteers to support existing local groups and building a wider network of engaged and aware people in local communities and the public.

- Utilising the endearing red squirrel (Figure 5) as an opportunity to connect new audiences most in need to explore woodlands, notice nature, develop skills, feel less isolated, connect with their community and potentially, see one of our most iconic native species in its natural habitat.
- Providing new targeted activities which will benefit communities in south and east Ayrshire, west Cumbria Coast, southeast Northumberland and Knowsley, Lancashire.
- Working with volunteers and communities in rural areas to understand and monitor the potential impact of pine martens (*Martes martes*).
- Improving data sharing across the area to build a more coherent current picture of status and likely impact of new game-changing interventions.
- Sustaining current conservation efforts, ensuring that decades of investment are not lost just at the time when more sustainable approaches are on the horizon.
- Providing training, equipment and other support to local groups and volunteers at local and regional/national levels.
- Providing small grants for local projects which support local volunteer action (delivered by squirrel groups or other community groups).
- Working with current and new partners to secure a future for red squirrels and resilient woodlands/forests across northern England and southern Scotland – this will include working with partners and landowners to establish new income streams for red squirrel conservation.



Figure 5. Red squirrels captured on trail camera during the spring survey, photo credit: Matt Stuart

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★
Live traps	★ ★ ★	
Kill traps		
Pine marten (as natural grey predator)	★	★ ★ ★
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)	★ ★ ★	★ ★
Squirrelpox vaccine		★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

References

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WIGHT SQUIRREL PROJECT

The Isle of Wight Red Squirrel Trust

Geographical area of conservation work

Isle of Wight

Author and organisation contact details

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www.iowredsquirreltrust.co.uk

Key partners

- IoW Council
- Hants and Wight Wildlife Trust
- PTES
- Wild heart Animal Sanctuary
- Nature Zones
- ARC
- Parish Councils
- National Landscapes
- The Museum of Ryde

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	0
Paid Contractors (7-12 months)	0
Volunteers involved with Grey control	0
Volunteers involved with squirrel monitoring	5
Other Active Volunteers	22
Other info	Most only for a few hours monthly or annually

Maps of project land area

Isle of Wight woodlands consist of many small blocks of predominantly broadleaved trees. Compared to other counties, the Island has a relatively small percentage of woodland, with only 12% tree cover, of which 87% is broadleaf, the remainder is coniferous. When hedge and tree cover plus woodland are factored in, tree cover rises to 16%. There are 1,603ha of ancient woodland. The Forestry Commission owns 1,109ha of all woodland on the Isle of Wight.

To ensure that biological and geological diversity are conserved and enhanced, many Isle of Wight woodlands are designated Sites of Importance for Nature Conservation (SINC). This status does not confer habitat protection. Site of Special Scientific Interest (SSSI) status is also applied to woodland if it is of particular biological interest or local importance. However, the designation does not necessarily restrict the landowner on how they manage the woodland. There are no deer on the Island so hazel regrowth is strong.



Figure 1. The Isle of Wight.



Figure 2. Woodland distribution on the island.

Introduction

The Isle of Wight is a stronghold for red squirrels (*Sciurus vulgaris*) thanks to a stretch of water called the Solent which separates the island from the mainland. Contingency plans are in place to deal with grey squirrels (*Sciurus carolinensis*) and all sighting reports are investigated, with follow-up action if deemed necessary.

Woodland area is small and fragmented, although the JIGSAW project has greatly enhanced connectivity between woods. Encouragingly, a recent study shows the squirrels have corridors moving east to west and north to south, although not in a straight line. This hasn't always been the case as the western population is genetically different to the eastern. Management varies and squirrels are in lower numbers in neglected woods or where other species or objectives (usually commercial) are a priority.

There are no pine marten (*Martes martes*) on the Island.

Woods are small and fragmented, often with busy roads running through them. Development has encroached into woodland, so there is garden feeding but also associated perils such as cats, rat poison, fenn (kill-traps) traps and water-butts. Road traffic deaths are common when squirrel numbers are good but, as expected, drop when numbers are poor. These numbers are used as part of our long-term monitoring programme.

Wight Squirrel Project is run by volunteers and The Isle of Wight Red Squirrel Trust by trustees. The Trust has recently purchased 12 acres of woodland which will be improved to support red squirrels and other wildlife. A grant and felling license will be applied for.

No staff are employed by either organisation. Funding is from donations, fund-raising, legacies and sometimes grants.

Project aims

- Keep the Island grey squirrel-free.
- Improve and plant woodland habitat and corridors plus protect what we have.
- Work with labs and universities by providing tissues from dead squirrels for research.
- Extend our established educational programme now we have a woodland.

Description of the project

The two charities have different aims:

- Wight Squirrel Project covers the science side, working with universities and labs.
- The Isle of Wight Red Squirrel Trust educates the public about red squirrels, their habitat and the flora and fauna they share it with.



Figure 3. Red squirrel charity logos.

Both charities rely heavily on volunteers as nobody is paid, except to run the websites. Eight trustees govern the registered charity The Isle of Wight Red Squirrel Trust. Wight Squirrel Project is run by volunteers. Both charities are affiliated to The Conservation Volunteers.

Funds are mainly from donations, legacies and fundraising. Online auctions have proved very successful and well supported by businesses giving lots and supporters bidding. We were fortunate that a local gentleman rowed the Atlantic for us, unsupported and alone to raise funds to buy the woodland. Another local put in money so we could have an extra two acres of woodland. This is obviously a one-off event!

Projects undertaken are largely driven by what is happening on the Island. Engagement with local authorities and other institutions is good. The public will contact us regarding tree felling, planning applications or areas where there are excessive road kills for example.

The Isle of Wight Red Squirrel Forum, chaired by Helen Butler, brings organisations together annually to discuss and implement ways of improving habitat and other projects. The latest is setting up a tree warden scheme and a tree nursery. The trees will go to

parks, gardens etc where they will benefit red squirrels and other wildlife.

Red squirrels are using gardens, cemeteries and parks more often as people provide supplementary feeding. 'Taming' squirrels and getting them to take food by hand is a problem. Most people are sensible but there is a certain element of the population that just does not care whether it's good for the animals or not if it suits their purpose, which is usually photography for social media. This will be discussed at the next Forum meeting.

Camera traps are used for surveys, mainly to inform woodland management or suspected grey squirrel incursion. There are only five people left in the bi-annual woodland monitoring programme. Many have been trained but most give up quickly.

Since Covid, no more 'planted' dead grey squirrels have been found on the Island, although one did wash up dead on the beach at Gurnard in the summer of 2024. Reports of suspected grey squirrels occasionally come in, but they are grey coloured red squirrels.

A genetic study of Isle of Wight red squirrels is underway at Bournemouth University using tissue supplied from dead squirrels. This is proving interesting and underlines the need to keep the corridors we have and plant more where possible. The IOW Red Squirrel Forum has agreed to runs DNA tests every 10 years. Tissues will come from dead squirrels or hair tube surveys. After 800 postmortems, Helen has decided that is enough. The results are in the 30-year report and published papers. Bodies are still collected if a laboratory or University needs them for study.

Re: education, there are a small number of speakers who provide talks when they are requested. The pocket book '200 fascinating facts about red squirrels' is selling very well, especially to visitors. The latest children's story is going well too. The huge book giving 30 years of red squirrel work on the Isle of Wight in a semi-scientific way is a heavy read for most people and costs £35. A free copy is offered to universities, colleges and libraries, where it is better suited.

The newly acquired woodland is designated a Planted Ancient Woodland Site (PAWS). The planted crop needs thinning and the whole wood is in bad condition. We aim to return it to mixed woodland to favour wildlife. Experienced local contractors and the Forestry Commission have been contacted. Once the woodland is safe from falling trees, a cabin and hide are planned so we can run relevant courses for small groups. There is no public access. The 12 acres we bought is half of a block within a larger woodland and we would like to buy the rest of the block if we can obtain funding.



Figure 4. We purchased 12 acres of woodland for red squirrel conservation.

Success indicators

- Thirty years of red squirrel work was written up and published.
- Buying woodland for red squirrel conservation.
- Wight Squirrel Project has been going for 31 years and The IOW Red Squirrel Trust will be celebrating 20 years in 2025.



Figure 5. Thirty years of red squirrel conservation book was published.

Major difficulties faced

- Lack of statutory funding.
- Competition with other charities for volunteers.
- Over development and very busy roads intersecting woodland.

Major lessons learned

- Not giving up – you get there with persistence.
- It pays to work with the authorities.

Project success

Success or failure		Confidence
Highly Successful		
Successful	X	High
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Goals have been met.
- No grey squirrels living on the Island.

Future project development

- Improve woodland that is designated Planted Ancient Woodland Site.
- Raise more public awareness.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in the project currently	Future importance in developing this aspect of grey squirrel management in the project area
Shooting		
Live traps		★★★ If a grey squirrel was detected on the island
Kill traps		
Pine marten (as natural grey predator)		
Immuno-contraception (oral bait delivered via hoppers)		
Gene drive (Selected inheritance manipulated so only male young are born)		
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).		
Squirrelpox vaccine		

★★★ High; ★★ Medium; ★ Low, blank = None.

BEYOND THE THIN RED LINE 2024-2029

Cramlington & District Red Squirrel Group

Geographical area of conservation work

Southeast Northumberland

Author and organisation contact details

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X: Cramlington & District Red Squirrel Group (@CramlingtonRed)

Instagram: CramlingtonRed (@cad_redsquirrelgroup)

Key partners

- Northumberland County Council
- Blagdon Estates
- Delaval & Horton Estates
- National Trust Seaton Delaval
- Northumberland Wildlife Trust
- Red Squirrels Northern England

Resources

Typical Annual Resource available	Number of people	
Paid Contractors (1-6 months)	0	
Paid Contractors (7-12 months)	0	
Volunteers involved with Grey control	17	940 volunteer hours in 2024
Volunteers involved with squirrel monitoring	48	1,299 volunteer hours in 2024
Other Active Volunteers	10-20	Collaboration with other conservation/friends groups in the area and activity sessions at our local nature reserve involving general maintenance of the site
Other info	Some volunteers also dip in and out of supporting the group due to other commitments.	

Maps of project land area



Figure 1. The map shows the project boundary (red) including the parishes of Cramlington, Blyth, Seaton Valley and Stannington covering a total area of approximately 39 square miles.

Introduction

The group is completely run by volunteers and self-funded via donations and small grants.

Over the last 10 years, the central project area has always had an established red squirrel (*Sciurus vulgaris*) population with the perimeter geography being a focus for grey squirrel (*Sciurus carolinensis*) incursion and control. The year 2024 was associated with a high number of grey squirrels breaching the perimeter buffer zone compared to previous years.

The conservation group has over 200 monitoring stations which are checked every 7-10 days and some cellular cameras support to record squirrel presence.

There is no national 'red squirrel stronghold' or 'squirrel reserve' status at present anywhere in the project area. The project team is keen to establish how such designations could be achieved locally.

The project area consisting of (Figure 1) Cramlington, Seaton Valley and Blyth are densely populated, heavily influenced by urban settlements, industry, and infrastructure, with farmland, open space and woodland filling the areas between each location. A newly adopted Stannington area sharply contrasts as it is mainly rural with much smaller villages and settlements.



Figure 2. Volunteers are at the heart of our local red squirrel conservation success.

Project aims

- To monitor and conserve red squirrels.
- To provide information about the impact grey squirrels have on the red squirrels and wider biodiversity issues.
- To monitor and control grey squirrels to protect the native red squirrels and reduce woodland damage.
- To engage with the public regarding our red squirrel conservation project through social media, activity days and other events.

Description of the project

Our current project 'Beyond the Thin Red Line' 2024-29 is timetabled to last five years. As a group, our main aim is to protect our native red squirrel. In that regard, we are blessed to have several geographical red squirrel conservation strongholds in south-east Northumberland.

We plan to increase our volunteer membership to enable us to continue our proactive approach to our conservation work.

This project looks at how we can achieve a long-term management programme with the support of local volunteers and the wider community. We'll also be looking for support from local councils, businesses, sponsorship, donations and grants to secure the required funding to help with our conservation efforts. All the work is carried out on a voluntary basis but vital funds are required for this project to be delivered.

Whilst the status of the red squirrel in our area is maintained and expanding, this is due to the endless hours our volunteers dedicate (Figure 2). Our main area was historically 24 square miles in size, however, it has recently expanded to 39 square miles in 2024.



Figure 3. Activities take place across urban and rural habitats.

Our volunteers dedicate endless hours a year to our red squirrel conservation work, including monitoring, trapping and shooting.

We have broken our project down into the following aspects:

Monitoring - Our monitoring takes place every 7-10 days in the form of hair samples from monitoring feed boxes. The group has over 200 monitoring stations across its area, monitoring which is supported by cellular trail cameras. Each volunteer's visit is recorded in an app and this then feeds back into a database which collates all the information.

Grey Squirrel Control - Following the outcome of the data received from the monitoring visit, culling volunteers follow this up in the form of live-trapping or shooting depending on the location and the agreement in place with the landowner.

Volunteers - Our volunteers cover three aspects of our project: Monitoring, Culling and Conservation Maintenance work within East Cramlington Nature Reserve. The area covered by each individual volunteer is unique in size and location. This ranges from three

monitoring stations to more than 20 for some individuals. Most volunteers work alone, although some do buddy up with other volunteers at times. Our activity days within the nature reserve are an opportunity for everyone to come together (Figure 3), we aim to have one each calendar month.

Fundraising - The group applies for numerous small grants and has set up local lottery links, 'easyfundraising' and receives general donations via its website. This is always an area of concern because without this funding the group couldn't operate

Landowners - We are lucky to have tremendous support from local landowners and permission to monitor and control in our core area. We are progressing this collaborative approach within the newly adopted Stannington area.

Community Engagement - The group hosts information stands at local Fairs and Fetes and shopping complexes. This is something that we do both individually and as part of wider Environmental events. We hold approximately 12 activity days per year, in which we encourage the local community to come along and engage in wider Environmental tasks such as tree planting, hedge laying, squirrel monitoring box making, whilst also learning about our red squirrel conservation work. We have an annual Easter egg hunt based on red squirrel facts which allows us to engage with the younger generation. We have had engagement and events with the local Community, including Scout groups and Brownies. Most recently we have worked with Northumberland Wildlife Trust & Red Squirrel Northern England in collaboration as part of the Red Squirrel Recovery Network.

Social Media - We have over 4,000 followers on our social media channels and we try to keep the pages active with multiple posts a week, sharing group and local information as well as national news and the good work completed by other groups across the country. We encourage engagement in the form of requesting photos of squirrels and nature from our area as well as posting topics that encourage interaction and debate.

Other significant Projects:

- I. Squirrel rope bridges over the B1326 road (Figure 4) to protect local red squirrel populations between two fragmented woodlands.
- II. Creating an interactive nature trail within East Cramlington Nature Reserve.
- III. Creating a wildlife viewing screen and engaging with over 2,500 key stage 2 children to form the artwork.



Figure 4. Rope bridges reduce road deaths in the project area.

Success indicators

- Evidence of grey squirrel eradication within our working area.
- Results from our squirrel presence/absence data.
- Continuing with an effective network of volunteers, landowners and other stakeholders to ensure the project's longevity.

Major difficulties faced

- Securing the funding to deliver our monitoring & control element of our project.
- Despite an excellent volunteer base, additional help (Figure 5) is still required with the culling element of our project.
- Poor communication from lead bodies confusing the public in regard to alternative methods of control, 'Gene Drive', 'Oral Contraceptive' and 'Squirrelpox Vaccine'.

Major lessons learned

- Partnership working with other environmental groups has vastly assisted the group in achieving its goals.
- An active social media presence is an essential form of communication with the local community.
- The age demographic of the group and the contribution of core members is a concern if these members leave the group.
- The lack of support on a national and regional level is a major concern, whilst we champion our own work it's difficult to see the same level of commitment to protect this endangered native species from non-voluntary sources.

Project success

Success or failure	Confidence
Highly Successful	
Successful	X High
Partially Successful	
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- A dedicated group of volunteers.
- Significantly reducing the number of grey squirrels within our buffer zone.
- Over 4,100 followers on our social media pages.
- Strong support from our local community including all five local councils, major landowners and other conservation groups in the area.

Future project development

- Secure funding to ensure the project can be delivered.
- Additional volunteer base to deliver the groups aims across the whole working area.



Figure 5. Recruiting more volunteers is a key objective.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)		Unsure, further research and a discussion required to make an opinion
Immuno-contraception (oral bait delivered via hoppers)		Unsure, further research and a discussion required to make an opinion
Gene drive (Selected inheritance manipulated so only male young are born)		Unsure, further research and a discussion required to make an opinion
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).	★	★ ★
Squirrelpox vaccine		Unsure, further research and a discussion required to make an opinion

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

RED SQUIRREL PROJECT

The Wildlife Trust for Lancashire, Manchester and North Merseyside

Geographical area of conservation work

North Merseyside and West Lancashire, England

Author and organisation contact details

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Instagram: https://www.instagram.com/lancs_redsquirrels/

Key partners

- Red Squirrels Northern England
- National Trust
- Natural England
- Merseyside Environmental Advisory Service (MEAS)
- Mersey Forest
- Sefton Council/Green Sefton
- Knowsley Safari & Knowsley Estate
- UKSA
- Liverpool John Moores University
- University of York

Resources

Typical Annual Resource available	Number of people	
Paid Contractors (1-6 months)	1	WS3 funded contractor
Paid Contractors (7-12 months)	1	LWT core funded part-time contractor
Volunteers involved with Grey control	10	
Volunteers involved with squirrel monitoring	27	
Other Active Volunteers	3	Fundraising and education
Other info	1	Red Squirrel Officer – FTE role

Map of project land area



Figure 1. The red squirrel conservation project area. Map indicates the stronghold boundary and frontal woodlands refuge area.

Introduction

The Wildlife Trust for Lancashire, Manchester and North Merseyside (LWT) has been coordinating red squirrel (*Sciurus vulgaris*) conservation in the area since 1993. The project (Figure 1) is based in the north Merseyside and west Lancashire red squirrel stronghold, a 400-hectare coastal coniferous woodland on the Sefton Coast surrounded by small, privately owned woodlands inland. The area is heavily populated with large urban areas in the north and south. Red squirrels (Figure 2) are present throughout the stronghold, the urban areas to the north and south, and in isolated woodlands as far inland as west Lancashire.

Trapping is the main method of grey squirrel (*Sciurus carolinensis*) control undertaken by the Red Squirrel Officer and Contractors. Volunteers undertake ad hoc shooting and run a trap-loan scheme in the urban areas. In 2008 almost 80% of the red squirrel population in the reserve woodlands was lost due to an outbreak of squirrelpox virus. Since then, the population recovered to almost pre-pox numbers, however subsequent, smaller outbreaks have had impacts on the population. Despite this, overwinter survival and breeding success has remained relatively stable.

Volunteers assist with a bi-annual monitoring programme (Figure 3), grey squirrel control and local fundraising. Squirrel monitoring is also supported through submission of public sightings.

The project is financially supported via core funding brought in through memberships and charitable donations, with the addition of fundraising efforts, grant applications, and England Woodland Grant Schemes.

Project aims

- Control grey squirrels throughout the stronghold and in targeted areas beyond the boundary to reduce the risk of further outbreaks of squirrelpox and reduce the effects of competition, allowing the red squirrel population to increase in size and range.
- To engage landowners and the public and encourage them to become involved in red squirrel conservation and grey squirrel control, including educating people on the risk of supplementary feeding in areas of known squirrelpox cases.
- Undertake bi-annual surveys to monitor trends in both red and grey squirrel populations and ensure continuity in data already collected.
- Work with landowners involved in new planting and woodland restoration schemes to ensure trees are of benefit to red squirrels and a grey squirrel control plan is in place.



Figure 2. Red squirrel conservation has been underway since the 1990s.

Description of the project

Since the 1990's, grey squirrel control has been carried out in north Merseyside and west Lancashire by gamekeepers and volunteers in response to increased number of grey squirrels encroaching on the native red squirrel population. A bi-annual monitoring programme has been an integral part of the project since 2002, when the stronghold was designated, and provides a baseline against which annual population trends are measured. This is the activity that gains the most interest from volunteers and there are currently 27 volunteers undertaking visual transects and hair tube surveys across 15 woodlands. However, due to conflicting habitat management with retreating sand dunes, and the reduction of supplemental feeding, the red squirrel population is moving out of frontal woodlands, we therefore need more monitoring sites beyond the "reserve" area to gain an accurate representation of the population dynamics.

Supplementary feeding in the Formby pine woods and surrounding residential areas is believed to have led to an unnaturally high density of red squirrels, which, due to grey squirrel incursion, resulted in the squirrelpox outbreak in 2008 causing an 80% decline in the reserve population. Supplementary feeding in the pinewoods ceased, and engagement work with the public and landowners is ongoing to further reduce the levels of supplementary feeding. A Red Squirrel Officer has been in post since 2009, and this role was made permanent via core LWT funding in 2022. The Red Squirrel Officer, alongside a part-time contractor, and a team of volunteers conduct grey squirrel control via humane live-capture traps, and shooting is carried out on sites where trapping is ineffective or not possible. Another outbreak of squirrelpox started in 2018, and cases of squirrelpox are still seen frequently, however they are primarily in gardens where feeders are present. Although the virus is present, we have not seen a population level decrease to the extent of the 2008 outbreak.

There is a reactive element to the project which deals with sightings of red and grey squirrels from members of the public in the towns and urban areas. These sightings allow us to deal with squirrelpox cases and direct grey squirrel control to priority areas. A trap-loan scheme allows members of the public who have grey squirrels visiting their gardens to loan and monitor a trap and then call a volunteer to dispatch any grey squirrels caught. The trap-loan scheme is primarily coordinated by a core group of volunteers and is an area of the project that has now been expanded to Crosby and Southport; where the trap loan scheme is active, the red squirrel population has remained strong.

In 2020, a National Lottery Heritage Fund (NLHF) project, "Reclaiming Reds", was hosted by Knowsley Safari. This pilot project worked to increase grey squirrel control, public engagement, and volunteer recruitment in the areas of Merseyside that bridge the gap between the north Merseyside and west Lancashire red squirrel stronghold and the Earl of Derby's Estate, inclusive. Although thought to have been locally extinct for seven years, red squirrels were discovered in a woodland on the Knowsley Estate in spring 2024. Additional to this good news, there was another discovery of red squirrels in 2024 in Aintree, which, according to our records, had not been seen since 2016.

As well as working with local authority on the Local Nature Recovery Strategy (LNRS), in 2024, the Sefton Coast Red Squirrel Steering Group was set up with local landowners and stakeholder organisations to help with land access and coordinated grey squirrel control across the region. Red squirrels have been identified as a priority species for the Liverpool City Region LNRS, and work is being done by the Steering Group to ensure that all new planting schemes meet climate and biodiversity targets and are coupled with a grey squirrel management plan.

In 2023-2024, LWT collaborated on the development phase of the NLHF project “Red Squirrel Recovery Network”, with the other two lead partners, Northumberland Wildlife Trust, Cumbria Wildlife Trust, and various supporting partners. During this time, LWT worked with Knowsley Safari to help develop the proposed extended project area in Merseyside and west Lancashire to ensure the Reclaiming Reds project work continued and engagement work was completed in previously underrepresented areas.

Success indicators

- Red squirrel population dynamics.
- Public engagement and volunteer support.
- Project expansion.



Figure 3. Annual monitoring using walked transects and hair tubes is an important part of assessing the success of local conservation.

Major difficulties faced

- Funding for the project is still difficult, and we continue to apply for grants with varying levels of success. Over the past few years, we have been successful in several fundraising campaigns, however these are not enough to maintain a steady funding stream and often take time away from the officers conducting crucial conservation work.
- Whilst we still struggle with changing woodland ownership bringing changes to access permissions, we continue to work towards gaining access to land. In 2024, the Sefton Coast Red Squirrel Steering Group was set up with local landowners and stakeholder organisations to help with land access and coordinated grey squirrel control across the region. Although still very new, this is a promising step towards better landowner communication and cooperation.
- The number of protests against grey squirrel culling have significantly decreased since the final year of the Red Squirrels United (RSU) project (2020). However, in 2024, there was a protest at a volunteer-led talk that had to be dealt with by police. Volunteers have had emergency procedure training because of this, and we regularly update FAQs to ensure volunteers and staff feel equipped with up-to-date knowledge. Despite protests and misinformation spreading via social media, we continue to have public support for the project, and our trap-loan scheme still gains considerable applications, even in areas where red squirrels are not currently present.
- Lack of funding. The project has core funds for one full-time member of staff and limited contractor time for grey squirrel control; however, we must continue to bring in external funding to support this.
- Conflicting priorities causes problems for habitat management. Sand dunes are retreating into the frontal woodlands that used to provide safety for red squirrels. Consequently, red squirrels are moving into other areas that are at risk of population isolation, grey squirrel incursion, and urban development.
- Turnover of internal staff, supporting partners, landowners, and volunteers can cause continuity issues. For example, losing land permissions due to change in management or time delays when staff or volunteers are being trained can reduce the effectiveness of work.

Major lessons learned

- The use of social media for project advertisement can be both beneficial and limiting. When used successfully, social media can help bring in both public and volunteer support, as well as donations. However, it can also be a platform for demoralisation, spreading misinformation, and aiding organised protests. Staff and volunteers would

benefit from media and marketing training if running any online platforms, and ideally projects should aim to employ dedicated communications specialists where feasible.

- Local and historical knowledge is key. Where there is staff and volunteer turnover, it is possible for project knowledge to be lost. Comprehensive records of past activities, current strategies, and up-to-date stakeholder information is vital to keeping project work consistent.

Project success

Success or failure	Confidence	
Highly Successful		
Successful		
Partially Successful	X	High
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Despite increased grey squirrel incursion, we have continued presence of red squirrels, good breeding success and over winter survival across the stronghold and outside the stronghold boundary, including red squirrels returning to woodlands where they had previously vacated.
- Public engagement and volunteer effort has led to the trap-loan scheme becoming very popular across the region, including areas where we are currently unable to support it.
- Funding and difficulty recruiting enough control volunteers makes it difficult to expand the project into new areas.

Future project development

- Continuing work with the Knowsley Estate and bridging the gap between the current project area and the small, isolated populations of red squirrels to ensure their survival and expansion.
- The Red Squirrel Recovery Network project has been under development since 2020 and is a partnership between three Wildlife Trusts (Northumberland, Cumbria and Lancashire) and has now received full funding for five years.
- Dedicated work with landowners to aid in stewardship applications for grey squirrel control.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★
Live traps	★ ★ ★	★ ★
Kill traps		★
Pine marten (as natural grey predator)		★
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)	★ ★	★ ★ ★
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

References

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GRASMERE TO GRIZEDALE PROJECT

Cumbria Wildlife Trust

Geographical area of conservation work

Lakeland heartland, Grizedale, Cumbria

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Key partners

- Cumbria Wildlife Trust
- Red Squirrels Northern England
- National Trust
- Lowther Estates
- Neaum Crag Estate
- Westmorland Red Squirrel Society
- South lakes Red Squirrel Group
- Cumberland Building Society
- Lakeland Limited

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	2
Paid Contractors (7-12 months)	1
Volunteers involved with Grey control	46
Volunteers involved with squirrel monitoring	3
Other Active Volunteers	0

Maps of project land area

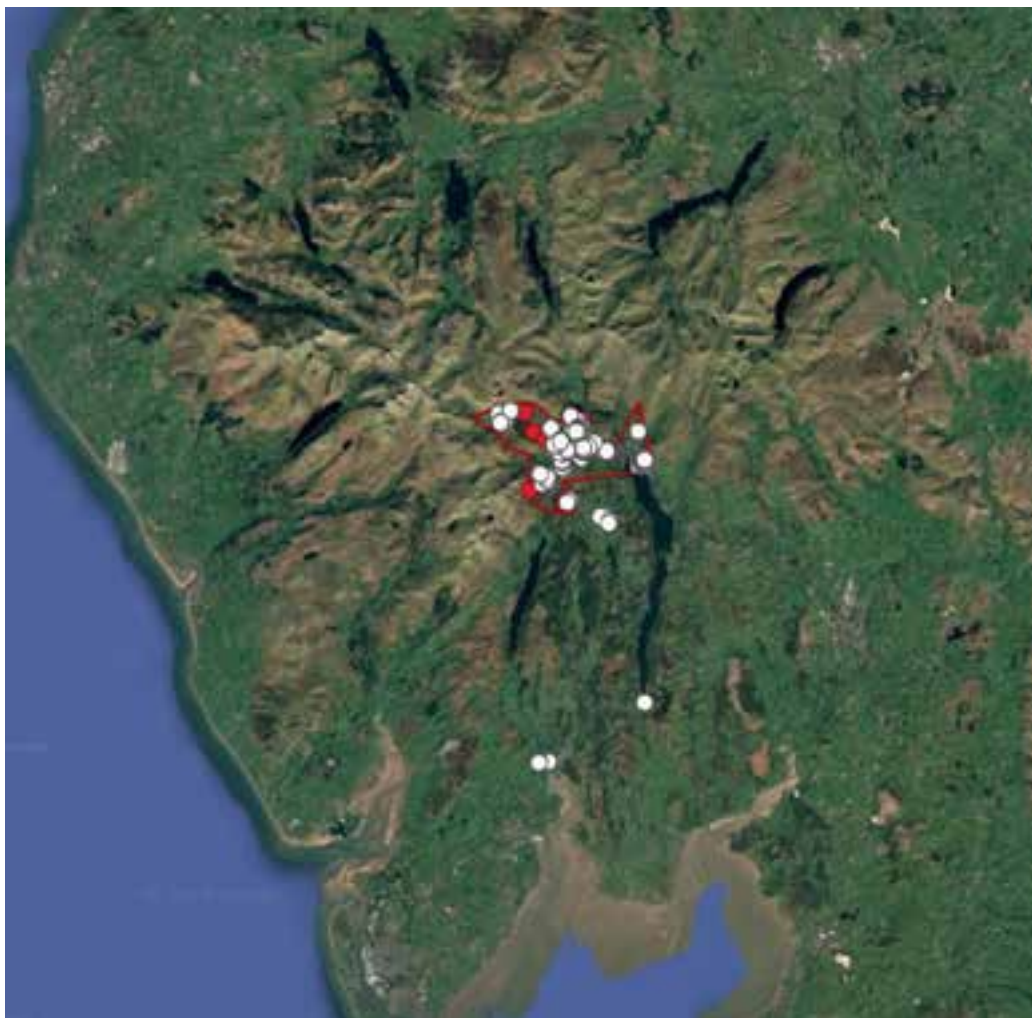


Figure 1. Grizedale area showing red squirrel (red circles) and grey squirrel (grey circles) records.



Figure 2. Grasmere to Grizedale project grey squirrel control area, mainly bordering Grasmere, around Loughrigg and on to Hawkshead. Red squirrel records are shown by red circles.

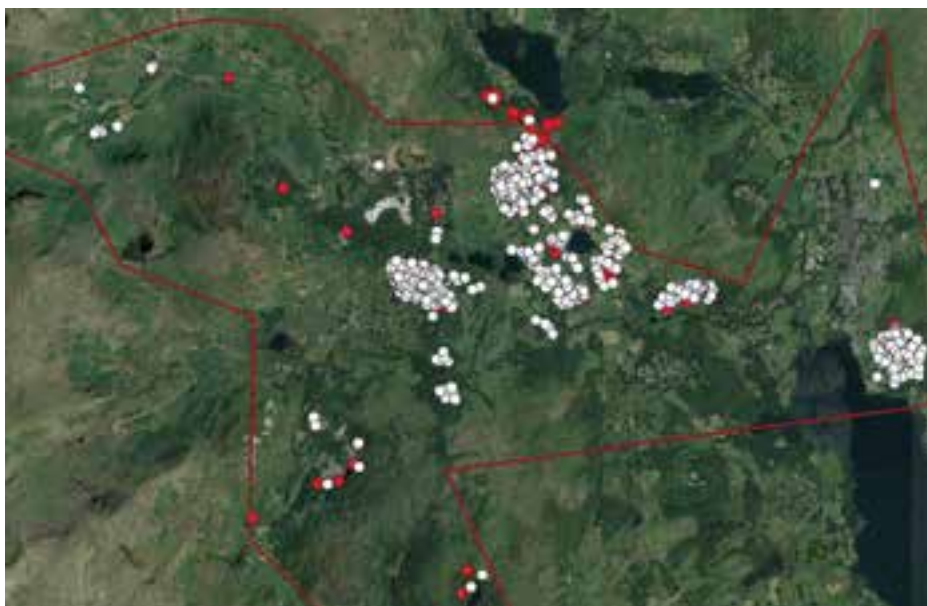


Figure 3. Grey squirrel cull record in the project areas. Grey circles = 1x grey squirrel cull record; Red circles – 1x red squirrel record at a location where there were no grey squirrel culls.

Introduction

In April 2023, the Cumbria Wildlife Trust employed a 'Red Squirrel Ranger' to work within the Grasmere to Grizedale landscape area (Figure 1). Their project focus was to record red squirrel (*Sciurus vulgaris*) sightings (Figure 2), clear key woodlands of grey squirrels (*Sciurus carolinensis*), and to encourage positive woodland management. It was noted that the removal of larch (*Larix spp.*) had been devastating in recent years, removing key squirrel food sources and reducing areas of habitat.

In the first 19 months, more than 1,000+ grey squirrels had been removed (Figure 3). Numerous red squirrel colonies were recorded; plastic nest boxes were constructed and these were installed to provide safe shelter for displaced (following forestry operations) or breeding red squirrels. In addition, the ranger recruited and trained volunteers who were keen to help with the red squirrel monitoring and grey squirrel control. Online presentations were offered to community groups and members of the public with the objective to raise the profile of the red squirrel's struggle. Current efforts were deemed a success, but it was felt that there was a long way to go to 'perfect' the strategy and turn the grey squirrel tide on a wider geographical scale. The setting up of local WhatsApp group attracted 42 members who are actively culling grey squirrels; averaging around 500 culls a month collectively.

Project aims

- To create a dynamic 'Red Squirrel Ranger' role managed by the Cumbria Wildlife Trust in order to monitor and protect endangered red squirrels in the Lakeland heartland between Grasmere and Grizedale.
- To control grey squirrels through shooting and trapping: targeting eradication in priority areas.
- To encourage red squirrels and boost population numbers through targeted feeding and nest box installation.
- To explore the potential of a captive breeding programme to encourage the release of red squirrels with key genetic bloodlines.

Description of the project

Without ongoing conservation intervention, red squirrels could disappear from this landscape. The Grasmere to Grizedale project delivers a programme of collaborative action to protect red squirrels, working in partnership with local NGOs, volunteer red squirrel groups and public and private landowners. Through this new initiative, red squirrels have

been given breathing space through the removal of a non-native competitor, the grey squirrel. The result is increased opportunities for local communities and visitors to the region to experience the joy of seeing red squirrels in the wild.

One ranger is employed full time to coordinate grey squirrel control and to monitor local red squirrel populations. Supplemental feeding and nest box provision are key elements of the strategy to benefit red squirrels by promoting good health, increase body mass and encourage successful breeding. The protection of priority forest habitat (Figure 4) is a significant objective to facilitate habitat resilience including the maintenance of key forest corridors.



Figure 4. Maximising natural food supplies is a key element of the project.

The project ranger and volunteer network seek to educate and bring local communities together to help preserve the remaining red squirrels. The rallying of regional support is further aided by giving talks and holding meetings with landowners.

Grey squirrel control is undertaken using shooting and trapping. In the spring and summer months around 70 traps are deployed and then shooting is used for the remaining part of the year with the aid of a thermal imager.

Success indicators

- Over 1,000+ grey squirrels were culled in the first 19 months following the start of the project.
- It was estimated that there were 70 red squirrels present (based upon a 2024 spring survey).
- Evidence of successful wild breeding in local populations.
- Red squirrels and pine marten (*Martes martes*) were present in October 2024.

Major difficulties faced

- Grey squirrel numbers have been sharply increasing, making it difficult to prevent them spreading into red squirrel habitats from adjacent buffer zones.
- Squirrelpox outbreaks are reported annually.
- Project funding is a significant issue and currently there is only one full-time ranger post. Many more are needed!
- A red squirrel vaccine would help reduce the looming threat of pathogenic squirrelpox outbreaks occurring.
- Gardens with bird feeders and local people encouraging red squirrels to visit properties can have a big effect on red squirrels by increasing rates of road traffic deaths, elevating the risk of squirrelpox and making animals more at risk from domestic cats.

Major lessons learned

- Red squirrels must not be provided with supplemental feeding unless extensive grey squirrel control has been implemented.
- Traps must be sanitised daily to prevent disease spread.
- Grey squirrel control effort should be targeted and not dispersed too thinly.
- It is important to stick to careful plans and to expect grey squirrels to 'bounce back' within a few months of control.
- Removal of grey squirrel carcasses following control operations is important to reduce predation of surviving red squirrels. Leaving carcasses out encourages predator activity.

- Non-invasive monitoring techniques are an absolute must, thermal imagers and thermal drones being employed alongside volunteers to get an 'eyes on' approach to red sightings is an adaptive approach.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason for success/failure

- 42 volunteers were recruited.
- Grey squirrel control has maintained red squirrel populations.

Future project development

- Special feeders for red squirrels are essential. These are not the 'flip top' style design, instead, red squirrels access a boxed/closed in food hopper through a small 42mm hole, where food is found at the rear, reducing the risk of food and feeder contamination by grey squirrels (Figure 5). Designs such as these prevent grey squirrels from accessing food.
- Facilitating 'generational skills' within red squirrel populations is key. Peanuts are not provided, and instead the project offers pinecones, acorns and ripe hazel nuts. These foods allow younger animals to develop key foraging and food processing skills which are vital for any wild squirrel.
- Recent discoveries of local pine martens has been deemed a positive, further monitoring

is needed but hopes to encourage the pine martens to breed are high. The red squirrel ranger has been working alongside a recent pine marten release project, monitoring pine marten movements and behavior.

- Research is required to develop ‘escape holes’ to allow red squirrels to escape when caught in traps set to catch grey squirrels. Success has been had with 42mm holes cut into the “Albi” style trap door, with an additional “collar” glued onto the front. It seems the extra depth added to the sheet metal door stops grey squirrel trying to escape.



Figure 5(a) & (b). Feeder boxes are inaccessible to adult grey squirrels.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)	★	★ ★ ★
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★ ★
Habitat management (reducing availability of tree seed crops favored by grey squirrels)	★ ★ ★	★ ★ ★
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

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- II. [Building society helps provide nests for red squirrels | Cumbria Wildlife Trust](#)
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- IV. [Red Squirrel Recovery Network | Cumbria Wildlife Trust](#)

THE CALDEW SQUIRREL INITIATIVE

The Caldew Squirrel Initiative

Geographical area of conservation work

Carlisle, Allerdale & Eden, North Cumbria, England

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Key partners

- Red Squirrels Northern England (RSNE)
- Solway Red Squirrel Group (SRSB)
- Landowners, field volunteers and members of the public

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	
Paid Contractors (7-12 months)	
Volunteers involved with Grey control	10
Volunteers involved with squirrel monitoring	10
Other Active Volunteers	5
Members/Donors/Supporters	45

Maps of project land area

The Caldew Squirrel Initiative (CSI) covers an area of approximately 40 square miles that surrounds the course of the river Caldew from the villages of Hesket, Newmarket and Caldbeck up to the parish of Dalston on the southern fringes of Carlisle. Most of the woodland in the area is in relatively small parcels linked by watercourses and/or natural corridors and contain a mix of broadleaved and coniferous trees. There are some areas of managed forestry owned by the Church Commissioners and Forestry England but most woodland ownership lies within private individuals. The city of Carlisle is located immediately to the north and this conurbation is the responsibility of the Brampton Red Squirrel Group although the opportunities for grey squirrel control within this built-up area are understandably very limited. Aside from the various villages, the rest of the area is mostly farmland with the open fells of the Lake District National Park on our southern boundary.



Figure 1. Project landscape area.

Introduction

Red squirrel (*Sciurus vulgaris*) conservation has taken place in the Caldew valley for more than 10 years and up until 2022 was previously supported under the umbrella of the Penrith and District RSG.

There are small populations of red squirrels spread across our area (Figure 1) and we believe their numbers are just about holding steady, but it is a very fragile situation with a continued abundance of grey squirrels (*Sciurus carolinensis*), with squirrelpox a constant threat. We have encountered three or four lethal pox cases in the last year, but as our red squirrel populations are quite scattered, thankfully these have not proved as devastating as they might have been. Nonetheless, despite more than 10 years of field work and the removal of c. 1,000 grey squirrels every year, there is simply no respite. Had this control work not been undertaken, the red squirrels would have disappeared long ago, but any drop-off in volunteer efforts does risk the position very quickly reversing.

There are no pine martens (*Martes martes*) and the nearest designated national reserve/stronghold (at Greystoke) lies just outside our southeastern boundary.

Our activity is entirely voluntary and is supported by a small number of personal and business donors plus our own fundraising efforts.

Project aims

- To preserve and enhance the native red squirrel population and their natural habitat within the project area for public benefit.
- To work in collaboration with local volunteers, landowners, statutory bodies and communities to support an all year-round conservation programme of recorded sightings, supplementary feeding, camera monitoring and grey squirrel control.
- To raise awareness of and to promote red squirrel conservation within the wider community.
- To support the efforts of regional and national red squirrel conservation bodies.

Description of the project

Red squirrel conservation has taken place in the Caldew valley for more than 10 years. This work is undertaken by landowners on their own property and by a small group of individual field volunteers (Figure 2) with personal access permission to properties. The field work consists of a year-round programme of supplementary feeding, camera monitoring and grey squirrel control using a combination of trapping and shooting. Trapping alone achieves

seasonal success but when combined with roaming, thermal guided shooting achieves greater efficiencies at the times of year when feeder-based trapping and shooting is not as effective. The use of monitoring cameras is vital to the efficiency of the control work, particularly in areas where both red and grey squirrels are present. Shooting is considered the best option for control in these areas (where possible) as red squirrels are not then stressed by being caught in traps at a time when they may be pregnant or have young. Shooting is also much more time efficient, as traps need to be visited every few hours to check for squirrel presence.



Figure 2. Red squirrels only persist in the project area because of volunteer-based conservation.

The Caldew Squirrel Initiative (CSI) is a collaboration between landowners, volunteers, and supporters and was established in 2022 to ensure continuation of this vital conservation effort after a previous third-party ‘resourcing arrangement’ ended. CSI is entirely volunteer run and acts as a support group for the conservation effort by providing resources (e.g. feed, feeders, trail cameras and traps), fundraising, holding various public awareness events and by capturing and monitoring the data generated by the conservation activity (Figure 3). This is in addition to recording any squirrel sightings reported to us by members of the public.

CSI as an entity does not direct, manage or control the field activity and the group does not hold any access permissions. Instead, each field volunteer typically holds several consents they have personally obtained over time to operate in certain woodlands. In our experience, the landowners much prefer to know exactly who is accessing their property and to build up a personal working relationship with the individual concerned. The field workers are unpaid and operate entirely of their own volition and responsibility and they

make their own personal public liability arrangements. However, CSI does endeavour to provide some additional support for field volunteers via the reimbursement of mileage costs, professional membership subscriptions and other out of pocket expenses.

Membership of CSI is free and the group is funded through a combination of regular personal and business donors plus grant applications and our own fundraising efforts. We issue regular updates to our members and supporters via emails, newsletters and various social media channels but we do not work with schools.

We have a good working relationship with our neighbouring Red Squirrel Groups (particularly Solway RSG with whom we share several volunteers). We also support regional and national conservation efforts through our affiliation with Red Squirrels Northern England (RSNE) and by involvement with the UK Squirrel Accord ERSAP steering group.

Success indicators

- Red squirrel population numbers increasing and spreading and grey squirrel numbers falling.
- Increased manpower, funding and support from major landowners to ensure greater grey squirrel control coverage.
- More support and awareness from the local community and nationally.

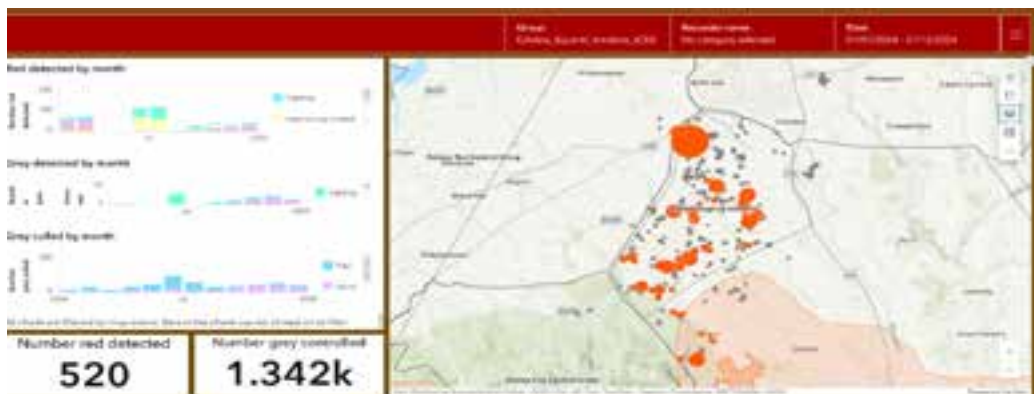


Figure 3. Monitoring red and grey squirrel population requires good record keeping.

Major difficulties faced

- Red squirrel survival locally is entirely reliant on the continued efforts of the field volunteers. Grey squirrel ingress is relentless and any drop off in field activity would see the position deteriorate very quickly.
- We are under constant pressure to raise funds.
- We believe the current situation relies far too heavily on the efforts of volunteer groups and, instead, requires an extensive and sustained national grey squirrel management effort, organised and funded from outside of the voluntary sector (most obviously via the organisations and Government agencies associated with the UKSA) and alongside early delivery of the fertility control and gene drive projects.
- We desperately need something to tip the balance back in favour of the red squirrel if there is to be any real future for this native species.

Major lessons learned

- For grey squirrel control to be effective it needs to be carried out all year round and a ‘trapping only’ policy in certain areas makes this very difficult.
- Repeat monitoring and control alongside constant vigilance are necessary to check for any further grey squirrel incursions.
- The use of monitoring cameras and thermal imaging is invaluable.
- Re-colonisation by red squirrels will only be possible if there is sufficient, suitable woodland free from grey squirrels, alongside safe dispersal corridors.

Project success

Success or failure	Confidence
Highly Successful	
Successful	
Partially Successful	X High
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- We are extremely fortunate to have an experienced, motivated and highly dedicated team of field volunteers working all year round in their own time and at their own expense and in all weather conditions. Without their efforts there would be no red squirrels locally.
- Despite removing over 1,000 grey squirrels every year for over 10 years there is no sign of grey squirrel ingress relenting and squirrelpox remains a constant threat.
- Any drop off in field volunteer activity could see the position quickly deteriorate.
- The long-term prospects for survival of the red squirrel as a native species lie outside of continued local voluntary efforts.

Future project development

- To build up a financial reserve (Figure 4) to ensure sustainability of the group over a longer term.
- To try to add more field volunteers and landowner permissions to increase grey squirrel control coverage.



Figure 4. Fundraising is a key part of our work.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in the project currently	Future importance in developing this aspect of grey squirrel management in the project area
Shooting	★ ★ ★	
Live traps	★ ★ ★	
Kill traps		
Pine marten (as natural grey predator)		
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).	★	★
Squirrelpox vaccine		★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

PONTELAND

Ponteland Red Squirrel Group

Geographical area of conservation work

Ponteland, Northumberland

Author and organisation contact details

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Facebook Ponteland and District Red Squirrels

Key partners

- Farmer and landowners
- Homeowners

Resources

Typical Annual Resource available	Number of people
<hr/>	
Paid Contractors (1-6 months)	
<hr/>	
Paid Contractors (7-12 months)	
<hr/>	
Volunteers involved with grey control	12
<hr/>	
Volunteers involved with squirrel monitoring	2
<hr/>	
Other Active Volunteers	50
<hr/>	

Map of project area



Figure 1. Ponteland project area (red boundary) with adjacent red squirrel groups demarcated in other colours.

Darras Hall and Ponteland are key areas along with the expansion of green belt housing from Newcastle. There are key farm and landowner permissions for grey squirrel control in the Tyne Valley.

Introduction

The initial project was to get red squirrels back into Darras Hall and this succeeded. It was only achievable through quite intensive social media and the erection of crossing signs so that local people were reminded that red squirrels were still present.

During the pandemic local people had time to look for nature and were exploring green spaces and as a result they became better engaged. On the flipside, there were areas where people no longer went because of restrictions and that allowed more intensive grey squirrel control to be undertaken.

The approach uses shooting and trapping. There are local people who control grey squirrels who are not involved in the project specifically but who provide their cull data. The group control around 1,200 grey squirrels per year.

Project aims

- To maintain a robust population of red squirrels until there is a squirrelpox vaccine.
- Support technical evolutions such as gene drive and implement coordinated efficient grey squirrel control in our area.
- Improve trap protocols and trap development.

Description of the project

Ponteland Red Squirrel Group was established in around 2004. The project gained access to some areas in and around Newcastle including some parks in 2018 but is largely focused within a tight geography including Darras Hall (Figure 1). The project involves volunteers and has a key focus on shooting and trapping grey squirrels with the emphasis on shooting in rural areas. We have face-to-face meetings and rely upon WhatsApp and Facebook messenger to coordinate field work. The team traps in church grounds, golf courses, local parks and estates as well as more urban gardens. Thermal cameras are a game-changer because they allow you 'to spot a bumble bee at 20m', and squirrels can be spotted from 100m. We use Hik Gryffon 50mm lens models and Pulsar spotting thermals.



Figure 2. Calendars are produced annually and are sold to raise funds.

We have a large social media presence including a 950 member Facebook group, and have other pages for local people, some with 1,100 members. We sell calendars (Figure 2), raise funds at stalls and sell items online including on an eBay shop.

We rely upon local people to tell us about any sick squirrels. We post pictures of native red squirrels that have squirrelpox so that people can see the symptoms to look out for. Squirrelpox is a big risk to our red squirrels, however rapid response to grey squirrel incursions helps reduce the risk. One concern is that garden feeding of squirrels occurs and we have no control over monitoring or the types of food provided. Chipmunk and 'squirrel' food often has food types that are not eaten and which remain discarded so that it encourages other rodents that might carry infections red squirrels could pick up.

Often trap-loans end up with traps not being used properly, irregular checking and a lack of ongoing correct baiting. The project works hard to prevent this.

Without a large paradigm shift the future for red squirrels in the area is bleak. Grey squirrel numbers are increasing, volunteer fatigue is a problem and it is also hard to get people to volunteer, particularly for the role of trustee.

Success indicators

- To see a sustained increase in red squirrel numbers.
- To expand the range of the local population.
- To minimise the frequency of squirrelpox outbreaks by removing grey squirrels quickly and across the whole project area.

Major difficulties faced

- People interfering with, or stealing, feeders, traps and cameras.
- A lack of proactive management at Darras Hall to ensure that red squirrel habitat is retained. The loss of habitat is significant.
- Road traffic has increased locally in key red squirrel areas because of diversions and road closures locally.
- Some objections to shooting in part because of the tactical look of guns that suggests to the ill-informed that these are highly dangerous.



Figure 3. Road casualties frequently occur in key areas.

Major lessons learned

- Do not trust that all red squirrel groups have the same aims and objectives as you. There is a need to pull together.
- The number of grey squirrels that are present in the UK seems to be underestimated.
- Difficulty in recruiting people to red squirrel conservation as volunteers or just engaging general interest in red squirrels.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- The red squirrel population increased and in part was reflected in higher levels of road deaths (Figure 3) being recorded.
- Red squirrel sightings (Figure 4) increased on a local WhatsApp group.



Figure 4. Red squirrel sightings are recorded.

Future project development

- More team members are required to do grey squirrel control more intensively.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in <u>developing</u> this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★ ★
Live capture traps	★ ★ ★	★ ★ ★
Kill traps	★ ★	★ ★
Pine Marten (as natural grey predator)		
Immuno-contraception (oral bait delivered via hoppers)		
Gene Drive (Selected inheritance manipulated so only male young are born)		★ ★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).		★ ★ ★
Squirrel pox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

GRASMERE RED SQUIRREL GROUP

Grasmere Red Squirrel Group

Geographical area of conservation work

Westmorland & Furness Council
& Lake District National Park Authority,
Cumbria, England

Author and organisation contact details

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X: @GrasmereRed

Key partners

- National Trust

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	
Paid Contractors (7-12 months)	2 Part-time
Volunteers involved with Grey control	5
Volunteers involved with squirrel monitoring	30
Other Active Volunteers	50 Many householders have had traps in the past
Trustees of Charity	5

Maps of project land area

The area is 36 km² (14 square miles) (Figures 1 and 2) with a total of 200 hectares of woodland. The National Trust is the largest owner of woodland. The rest of the woodland habitats are in private ownership. There are several larch (*Larix spp.*) and conifer plantations, but the majority is broadleaf predominantly Oak (*Quercus spp.*) and beech (*Fagus sylvatica*) with several small estates around Victorian houses containing tall mature specimen pines (*Pinus spp.*) and other conifers. The woodland forms a narrow ribbon on both sides of the valley (Figure 2). There are approximately 500 residents and over 50% of the dwellings are second homes or holiday lets. Most of the year, the number of people in the area is swelled by day visitors, holidaymakers staying in hotels, guest houses and self-catered accommodation. Apart from the central village and several clusters of housing, individual dwellings spread out around the valley.



Figure 1. Maps of squirrel groups in northern England.



Figure 2. Satellite image of the Grasmere area.

Introduction

The English Lake District has always had red squirrels (*Sciurus vulgaris*). Grey squirrels (*Sciurus carolinensis*) arrived in the 1970s and numbers increased in the 80s and 90s with literally 100s resident by the year 2000. The Grasmere red squirrel population almost suffered a local extinction in 2002 with a massive outbreak of squirrelpox. The only reason that the red squirrels survived was the dedicated work of a few individuals who controlled grey squirrels. The red squirrels were forced to the outer peripheral edges of the woodlands at that time.

The Grasmere Red Squirrel Group (GRSG) was formed early in 2006, and we now have a good population of red squirrels. Until very recently there were no pine martens (*Martes martes*) in the area. Currently we have one known individual present.

Four kilometres to the north of Grasmere is the edge of the Thirlmere Red Squirrel Reserve/Stronghold. The area of the original buffer zone associated with the Reserve was extended southwards to include all of Grasmere and hence was eligible for England Woodland Grant Scheme (EWGS) and Woodland Improvement Grants (WIG). This funding historically provided the bulk of the Grasmere groups' funding, however most of these grant schemes were terminated in 2015. The replacement funding, the Stewardship scheme, seems to require administration that is far too burdensome for owners of small woodlands.

To the east and west are ridges of mountains reaching an altitude of 400-760 metres; at the northern end the vale splits into several valleys all ending at least at 230 metres. This forms a natural boundary on three sides, well above the tree line (only very occasionally have grey squirrels been seen on the fells and the road to the north). To the southeast and southwest, where the grey squirrels come from, the valley continues to Rydal and the adjacent valley of Great Langdale.

The Grasmere group is now a Charity, run by local volunteers and currently pays two part-time rangers who shoot the grey squirrels.

Project aims

- Protection of red squirrel populations from squirrelpox by eradicating all grey squirrels in the area.
- Maintaining/Expanding the red squirrel population.
- Preventing grey squirrels from getting to the Thirlmere Red Squirrel Reserve/Stronghold from the south.
- Education of the public about red squirrels.

Description of the project

With the formation of the Grasmere Red Squirrel Group in early 2006 we were able to coordinate effort and record statistics which have been very valuable for identifying trends and developing strategy. In 2009, we decided to remove all the grey squirrels in the area, starting in the north and working southwards. With the large population of grey squirrels, trapping was very effective. The red squirrel population increased, and they had second litters in 2010.

We built a network of over 100 people who contributed by monitoring garden feeders and walking local woodlands. The work has been a real community effort, initially carried out entirely by people living in the village.

We deployed mainly 'Beck' feeder/traps (designed in Cumbria) which catch only grey squirrels based on weight, allowing red squirrels to access the food and escape should they set off the trap. They have many advantages over live-capture cage traps but cost much more and unfortunately are no longer in production. We also put holes (44 to 46mm diameter) in live-capture cage traps to allow red squirrels to escape and mounted them off the ground in wooden sleeves to prevent interference from badgers (*Meles meles*).

Our methods changed when the area became red squirrel-only. Grey squirrels are extremely wary of traps when they enter a red squirrel-only area. We have obtained landowners' permission to both trap and shoot. Free-shooting is now the most effective method as at any point in time there are very few grey squirrels. The proportion of grey squirrels culled by free-shooting has increased from 30% in 2010 to 97% in 2019 and is now 99%. Our two part-time paid Rangers (contractor) use thermal spotting monoculars and these are a great benefit.

From 2010, we have concentrated on the 'frontier' areas on the main incursion routes for immigrating greys travelling from Rydal and Skelwith Bridge/Elterwater from our south. From 2014 we monitored activity with trail cameras which sent emails with a photo in near real time. In 2024 we changed to cameras that send photos to cloud storage which can be viewed in near real time.

We have a grey squirrel sightings hotline for locals and the public to report sightings and communicate daily via email and texts. Our aim is to remove newly arriving grey squirrels as quickly as possible to minimise the chances of squirrelpox transmission to the red squirrels.

We carry out red squirrel population surveys (Figure 3) in our area and keep detailed statistics on red and grey squirrels. We analyse the data to establish trends, etc. and change our strategy when appropriate.

Red squirrel numbers have recovered following population crashes caused by major outbreaks of squirrelpox in 2002 and 2003.

All the effort has paid off with a good population of red squirrels which has expanded outside our area to the south. Many of the red squirrels in Grasmere have two litters a year and this started in 2010 after grey squirrels were removed in 2009.

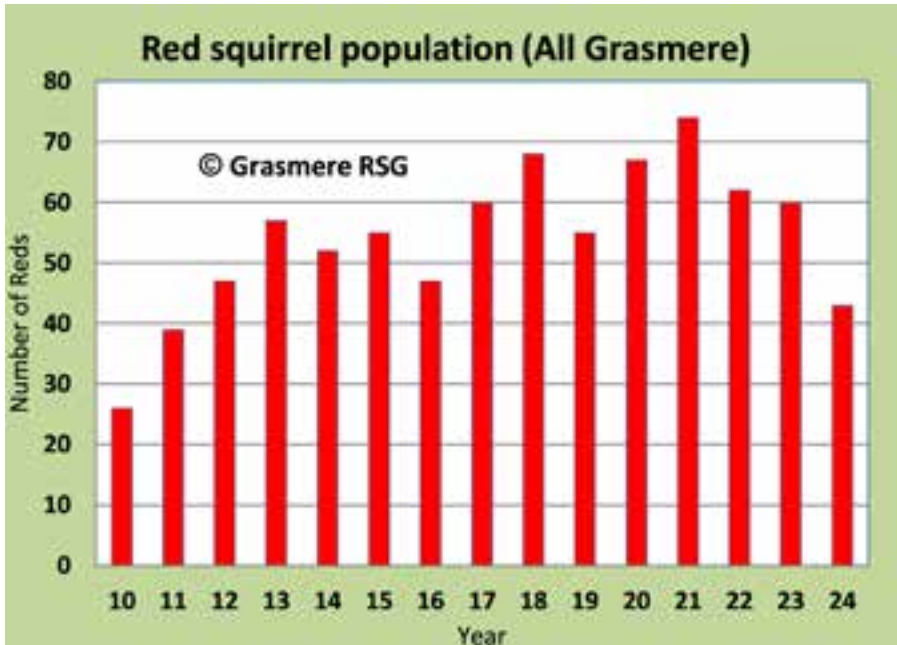


Figure 3. Numbers of red squirrels in Grasmere.

Figure 3 shows the results of our annual population surveys of red squirrels in Grasmere between 2010 and 2024. The overall density of red squirrels in the Grasmere woodlands has been as high as 0.3 per hectare, with some woodlands supporting more 0.6 per hectare. Unfortunately, in 2024 the number of red squirrels is lower than previously. This reduction is mainly on the western side of the valley. The cause is unknown but there were many more grey squirrels arriving on the western side in 2024. Surprisingly, there were no reports of red squirrels (alive or dead) with squirrelpox in 2024 (the average for 2010-2024 was three). There was one red squirrel roadkill in 2024 (the average for 2010-2024 was six).

In September 2024 a pine marten was seen on one of our cameras. This animal, a female, has taken up residence in the valley. It was one of 13 animals that were relocated from Scotland to South Cumbria in a planned reintroduction project. We wait to see what the impact is on the number of grey squirrels coming to Grasmere and on our red squirrels.

We carry out supplementary feeding of red squirrels and deploy road signs.

We communicate with the local community and the public using our Facebook Page, Instagram and Twitter, and publish newsletters in the Parish Magazine and circulate detailed information to many people by email. We produce a newsletter for the community and carry out monitoring for RSNE.

We are a member of Northern Red Squirrels and the South Lakes Red Squirrel Forum.

We give talks on red squirrel conservation to the local primary school, local groups, the public at Allan Bank National Trust property as well as helping to train countryside leadership trainees. Our work has enabled the National Trust property of Allan Bank in Grasmere to gain a national reputation for being an excellent location for the public to see red squirrels (Figure 4) and they heavily promote this aspect, as do the local hotels.

We created a leaflet about red squirrels and maps with local walks for visitors which are available from hotels and businesses.

We are very grateful to everyone who has donated to our group. The National Trust has been our biggest funder and this has been supplemented by local charities, traders, hotels and individuals.

We became a charity in 2022 and, though it creates extra work to fulfill the requirements of the Charity Commission, it enables us to claim Gift Aid on donations from individuals and is helpful in asking for donations from businesses.

Success indicators

- Maintaining the size of the red squirrel population in Grasmere.
- Evidence of breeding female red squirrels producing second annual litters.
- Elimination of each detected grey squirrel within 24 hours or less from the time of a sighting report or photograph from a camera trap.

Major difficulties faced

- An increasing number of grey squirrels entering our area. Currently our primary problem is that grey squirrels are arriving in even greater numbers than five years ago! So, this problem has become much worse.
- Obtaining ongoing funding to pay for our squirrel rangers. We managed to increase funding by recruiting additional administrative effort to organise becoming a Charity, starting use of social media and approaching more businesses for financial support.

Major lessons learned

- We have reinforced our view that once an area has been cleared of grey squirrels, regular monitoring, rapid response and shooting is the most effective way to keep it grey squirrel-free. Obtaining permission from landowners to shoot is critical. Grey squirrels are extremely wary of traps when they enter a red squirrel-only area.
- Squirrelpox outbreaks do occur, but so long as red squirrels survive in adjacent areas, they will repopulate. In different parts of Grasmere, repopulation took two years after an outbreak in 2002, nine months in 2003. Occasionally, a recognisable red squirrel survived whilst continuously present during an outbreak. Rapid intervention reduces the scale and duration. This includes mercy killing of sick animals, to stop them infecting the rest of the population. An outbreak in one part of Grasmere does not seem to spread to other parts of Grasmere. A single infected grey squirrel can wipe out a whole area of red squirrels. It's red or grey squirrels, you can't have both!
- We only use cage traps with holes to allow red squirrels to escape and these are mounted on trees to prevent disturbance from badgers.
- We maintain our 'red only' area by using a great deal of effort and at considerable cost. Our area is very small - to do the same for a much larger area would be almost impossible to resource. We believe that community-led groups are the best way to tackle areas like ours. Large forests without local communities obviously need a different approach.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Dedication of our Trustees, volunteers and our rangers, working together to keep Grasmere a grey squirrel-free zone.
- Eliminating grey squirrels as soon as they enter the area to minimise the chance of them breeding in the area and of passing on squirrelpox to the red squirrels.
- Use of technology to provide close to real time monitoring of key incursion routes for grey squirrels via trail cameras that can be monitored in near real time and use of thermal monoculars for shooting.
- Communicating the plight of the red squirrels and our conservation work to local people and the public encouraging them to get involved in their own locality.

Future project development

- Continue to work as we have been to maintain Grasmere as a grey squirrel-free zone and helping with grey squirrel control and population monitoring in adjacent areas when we have sufficient resources.



Figure 4. Partnership with the National Trust is key.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★	★
Kill traps		
Pine marten (as natural grey predator)		★ ★
Immuno-contraception (oral bait delivered via hoppers)		
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)		★
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

FOREST ENGLAND RED SQUIRREL COLONY

Lower Coquetdale Red Squirrels

Geographical area of conservation work

Northumberland

Author and organisation contact details

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Key partners

- Forestry England (FE) provide access permissions

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	0
Paid Contractors (7-12 months)	0
Volunteers involved with grey squirrel control	8 Most of these volunteers check and set traps, but do not yet have the certificate to dispatch them in Forestry England woodland. Only two of the volunteers can dispatch
Volunteers involved with squirrel monitoring	As above
Other Active Volunteers	1 Does initial filtering of trail camera images to remove any 'non-squirrel' images before cataloguing grey squirrel images
Other info here	

Maps of project land area



Figure 1. 2023 grey squirrel cull data.



Figure 2. 2024 grey squirrel cull data.

The woodland we cover was approximately 165 acres (67 hectares) in size until Forestry England (FE) felled approximately 42 acres (17 hectares) in January/February 2024. The woodland is mainly close grown Sitka spruce (*Picea sitchensis*) and Norway spruce (*Picea abies*), however, there are some areas of beech (*Fagus sylvatica*) which may have been associated with a large estate house which no longer remains. The wood is bisected by some golf course fairways, though the course is not well used the fairways are still maintained. One side of the wood is immediately adjacent to a village of reasonable size, this is associated with lots of people, road traffic and disturbance in the wood.

Introduction

Over the last 20+ years, grey squirrels (*Sciurus carolinensis*) have significantly increased in number in our part of Northumberland and now red squirrels (*Sciurus vulgaris*) only remain in small, isolated colonies. Currently, we have suppressed the grey squirrel population, but it is a constant battle to keep numbers down. The red squirrel population is extremely small with, perhaps, only three or four individuals remaining. We do not have pine martens (*Martes martes*) present in this wood and there are no designated red squirrel strongholds nearby, though we do believe similar small colonies live locally elsewhere.

The woodland is a poorly managed forestry conifer plantation. Unfortunately, FE felled a large area of it in January/February 2024. A major waterway (large burn) runs along one edge of the wood, which leads to a large river. The river serves as a corridor for grey squirrels moving up the valley and they move from the river using the trees along the large burn as a corridor to the woodland habitat which is home to the red squirrels.

Project aims

- Keep the grey squirrel population as close to zero as possible in this small woodland.
- Protect the remaining red squirrels from squirrelpox virus.
- Prevent the red squirrels from becoming locally extinct.
- Hopefully, see signs of red squirrel kittens.

Description of the project

We have very few red squirrels left in our conservation group area. We are trying to prevent the red squirrels from dying out completely in one of our local FE managed woodlands. We do this by carrying out grey squirrel control within the plantation and in adjacent private woodland, in gardens in the small village nearby and along a water course that runs along one side of the woodland and travels to a major river not far away and which grey squirrels use as an incursion corridor (Figures 1 and 2).

We are volunteers in the local red squirrel conservation group. Last year we held a public meeting to recruit new volunteers so that we could expand our trapping and monitoring operation and we recruited five new volunteers. We now operate up to ten traps on trapping routes through the wood which can be two and a half miles or more long. We use 'red squirrel escape traps' (that have a hole that allows any captured red squirrel to get out), monitored by trail cameras (Figure 3). The trail cameras enable us to record red squirrel activity and times of visits, as well as show us any grey squirrels present which are small enough to get out of the escape holes. The traps are checked twice per day during

which they are disinfected with VirkonS™ and refilled with food. In locations that record red squirrel images we place out extra hazelnuts to supplement their diet. We don't trap over weekends and the cameras are collected during Friday's last check. The SD card images are analysed and red squirrel visits recorded on time sheets, this enables us to confirm red squirrels are in different locations at the same time.



Figure 3. Red squirrel photographed near a live-capture trap with an 'escape hole'.

Forestry England worked with us to mark drey trees before harvesting contractors felled a large area of the wood in early 2024. Local landowners allow us access to trap grey squirrels as do homeowners in their gardens. Some homeowners dispatch, but most set/check their own traps and call us in to dispatch. Their support is a massive help. A talk has been given in the local school to inform the local children of what we are doing and why.

Success indicators

- Keeping the remaining red squirrels alive in the woodland.

Major difficulties faced

- Funding is a major problem.
- Training availability to get the necessary certificate to trap in FE woodland. Currently our volunteers can only disinfect, set and check traps and maintain trail cameras. If a grey squirrel is found during a trap check, they must call one of the few people who have the BRS training certificate. This impacts on the time availability for those people to operate unhindered in buffer zones adjacent to the wood.

Major lessons learned

- Using ‘red squirrel-friendly’ traps monitored by trail cameras to monitor red squirrel presence, instead of feeders and cameras. The traps are easier to keep clean and offer the chance to catch any grey squirrel that turns up.
- Holding public meetings to get more support works!

Project success

Success or failure		Confidence
Highly Successful		
Successful		
Partially Successful	X	Medium
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- We are doing a good job of keeping the grey squirrel population very low in the wood. However, the number of red squirrels detected is very low – maybe as low as three. From studying the trail camera images it looks like the remaining red squirrels are all female. So, while we are being successful in keeping the habitat available only for the red squirrels and minimizing their risk of contracting squirrelpox, they might die out due to a lack of males in the wood.

Future project development

- Now that we have more volunteers we hope to trap/monitor in areas of the wood we have not yet covered. This may reveal the presence of another red squirrel!

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★ ★	★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey squirrel predator)		
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)		
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

BRAMPTON & DISTRICT RED SQUIRREL GROUP

Brampton & District Red Squirrel Group (B&DRSG)

Geographical area of conservation work

North Cumbria/Southwest
Northumberland

Author and organisation contact details

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Key partners

- Northern Red Squirrels
- National Trust
- Woodland Trust
- United Utilities
- RSPB
- Parish Councils
- Woodlands.co.uk
- Private and individual landowners, and members of the public

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	0
Paid Contractors (7-12 months)	0
Volunteers involved with Grey control	70+
Volunteers involved with squirrel monitoring	15+
Other Active Volunteers	40+ Trap loan scheme
Others	175+ Members

Maps of project land area

Brampton and District Red Squirrel Group (B&DRSG) operates in an area from the fringes of Kershope Forest in the north spreading west along the England/Scotland border to just south of Carlisle. The geographical area then moves east towards Slaggyford and Haltwhistle in Northumberland and then northwest back up to Kershope (see Figure 1)

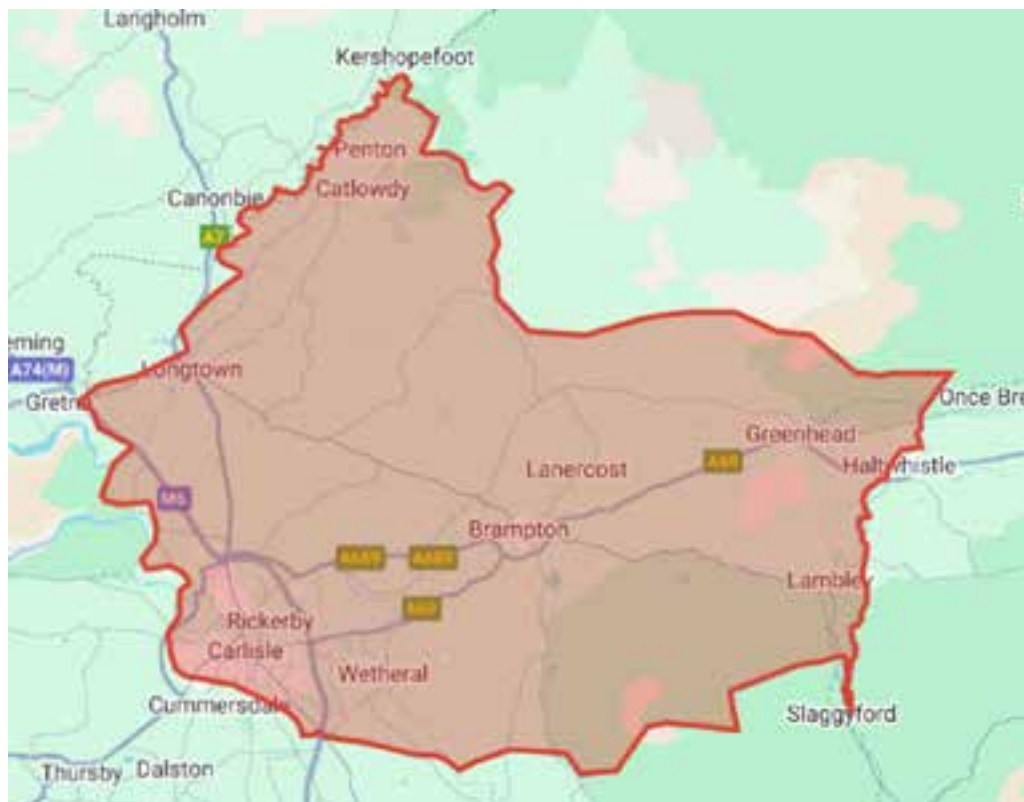


Figure 1. Brampton and District Red Squirrel Group Areas of Operation Map.

Introduction

Historically, red squirrels (*Sciurus vulgaris*) were in abundance in the Brampton area of north Cumbria. A news report in the summer of 2007 highlighted a decline in local red squirrel numbers, a fact coinciding with the local invasion of grey squirrels (*Sciurus carolinensis*) to this part of the county. This news prompted the launch of the Brampton Red Squirrel Group in September of that year.

With increasing volunteer support, coordination and local knowledge, the group were able to identify and target significant grey squirrel populations threatening the local red squirrels. The group expanded into neighbouring and surrounding land areas in the summer of 2010 and expanded further in January 2020 and again in June 2024 and 2025.

The group now holds registered charity status as B&DRSG and is a volunteer-based community red squirrel group, which for 17+ years has and continues to, contribute immensely to the red squirrel conservation movement in the north of England.

There have been no sightings of pine marten (*Martes martes*) within the group area. The impacts on red or grey squirrel are unclear in an England landscape context.

Project aims

The B&DRSG seeks to manage grey squirrels in order to consolidate and expand the regional red squirrel population.

Specific objectives:

- To maintain a community-based contribution to the wider integrated conservation of red squirrels in northern England.
- To raise awareness of the plight of the red squirrel through community events and educational activities.

Description of the project

The B&DRSG delivers direct and practical red squirrel conservation by managing grey squirrel populations across key target areas. The woodlands covered within this project are a range of broadleaved, coniferous and mixed deciduous habitats.

We systematically live-trap and shoot grey squirrels that currently threaten our existing red squirrel population. The retention of red squirrels in the project area contributes towards the wider regional conservation of red squirrels in adjoining areas within the landscape of

the two counties of Cumbria and Northumberland in the north of England.

We have many other resources to aid our work including trail cameras for monitoring sites and thermal imaging cameras which have proven to be an invaluable resource in detecting grey squirrels which can then be culled.

All the group's work is carried out by volunteers. We have 70+ regular operatives involved in conventional grey squirrel management and the group membership currently sits at 175+. Volunteer work encompasses administration, fundraising, the provision of talks (Figure 2), project representation at shows and events, management of the group's activities, record coordination, charity collection box monitoring, merchandise sales and media representation. Our operatives have successfully removed a further 15,734 grey squirrels (Jan 2020 - Dec 2024) since the last publication study five years ago and red squirrels have returned to many areas following grey squirrel management. However, grey squirrels continue to move in from all directions so we must provide continuity of grey squirrel management work to ensure the benefits to red squirrels are maintained.



Figure 2. Local community outreach events strengthen support for red squirrel conservation.

A key focus of our management programme is to restrict grey squirrel invasion from the incursion corridors of the Rivers Gelt and Eden. Work is ongoing and the group will continue to facilitate grey squirrel removal and complete standardised record keeping which provides invaluable data.

Success indicators

- Secure and maintain woodland sites as free from grey squirrels as much as possible to allow the return of red squirrels to such habitats.

Major difficulties faced

- Grey squirrel management in areas with public access remains difficult - traps and monitoring equipment occasionally being damaged and/or stolen.
- The prevalence of grey squirrels in some urban areas (that will not allow access) remains problematic.

Major lessons learned

- Red squirrels have and continue to return to several woodland areas following intensive and sustained grey squirrel management.
- Grey squirrels continue to move into woodland sites previously controlled and repeated management is therefore always necessary.
- Population monitoring, using feeding station, standardised data and the use of thermal imaging remain invaluable programme components.

Project success

Success or failure		Confidence
Highly Successful	X	High
Successful		
Partially Successful		
Failure		

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Red squirrel distribution has been maintained and many local populations have recovered following grey squirrel management.
- Increasing support, coordination, local knowledge and the use of technology are key to the ongoing success of this project.

Future project development

- The B&DRSG are keen to further develop our proven success where woodlands have been repopulated with red squirrels (following grey squirrel management) following an absence of many years.
- We will seek additional funding to provide continuity of grey squirrel management work where clear benefits to red squirrels will be demonstrated.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in the project currently	Future importance in developing this aspect of grey squirrel management in the project area
Shooting	★ ★ ★	★ ★ ★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)		
Immuno-contraception (oral bait delivered via hoppers)		★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).		
Squirrelpox vaccine		

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

ARNSIDE AND SILVERDALE NATIONAL LANDSCAPE

Westmorland Red Squirrels (WRS)

Geographical area of conservation work

Arnside, Cumbria

Author and organisation contact details

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Key partners

- Saving Scotland's Red Squirrels Partnership:
- National Trust
- RSPB
- Natural England
- Moredun Institute
- Most local landowners
- Welsh Mountain Zoo
- Animal and Plant Health Agency
- Woodland Trust
- Cumbria Wildlife Trust
- Holgates Holiday Parks Silverdale
- Dallam Tower Estate
- The Barns Trust
- The Arnside Landscape Trust
- The Bittern Countryside Community Interest Company
- The Linder Foundation

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	
Paid Contractors (7-12 months)	Up to 3. Currently one trainee trapper
Volunteers involved with Grey control	15-20. Trapping, shooting and monitoring to check squirrel presence
Volunteers involved with squirrel monitoring	2
Other Active Volunteers	20. Garden trapping

Maps of project land area

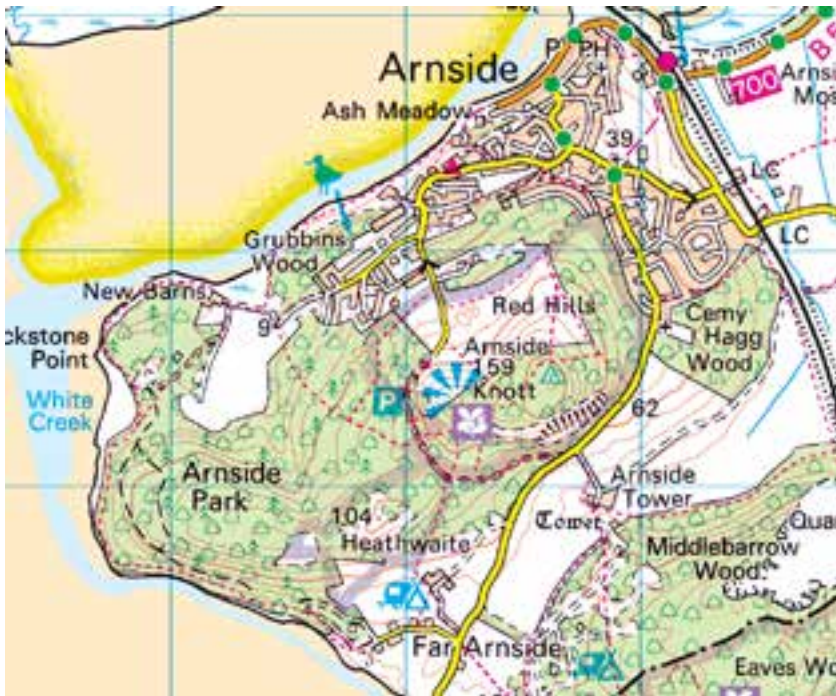


Figure 1. Arnside project area.

The area we are concentrating on is the Arnside Peninsula west of Arnside. There are several landowners, but the two main landowners are the National Trust for Arnside Knott and the Barber family which own Arnside Park, Croppidding and Frith woods all to the west of Arnside Knott. Partly surrounded by the sea, marshland and a Dairy farm it has a limited protection from grey squirrel (*Sciurus carolinensis*) incursions. The Barber estate is 125 ha and includes a caravan static caravan site

Introduction

We started as a separate volunteer group, under the umbrella of Westmorland Red squirrels (WRS), in 2015 as a combination of volunteers and paid trappers trying to clear our AONB of grey squirrels. Since then, we have culled an estimated 18,000 squirrels mostly by trapping. We have occasional sightings of red squirrels (*Sciurus vulgaris*) within the area, but no known breeding population. Despite high cull rates, it has proved impossible to clear the area of grey squirrels and we have recently reduced our control efforts.

We have decided to concentrate our efforts to the Arnside Peninsula area, which is better protected from grey squirrel incursions because of natural barrier features (marshland, sea, dairy farm intensive grassland etc). We have been encouraged to explore the possibility of building a squirrel enclosure after a visit to see the example at the Yorkshire Arboretum, Castle Howard. A prerequisite will depend on the success of an application for Higher Level Stewardship for woodland owned by the Barber family on the western edge of the peninsula as described above. We hope to be invited to make an application this autumn and are encouraged by the Forestry Commission and Natural England response. We regard the presence of red squirrels, even if this is limited to individuals in an enclosure, we see this as vital to maintaining motivation of our volunteers.

Project aims

- Successful application for higher level stewardship to include the 'WS3 grant' for grey squirrel control (assuming we are invited to apply this autumn).
- To follow up on this with grant applications to build a red squirrel breeding enclosure under the supervision of the Welsh Mountain Zoo and BIAZA supervision locally from the Wildlife Oasis.
- Continue our control methodology within the Peninsula area to reduce grey squirrel numbers to very low levels.
- We have been monitoring squirrelpox antibody levels in culled grey squirrels and have reduced these levels to 28% and hope to reduce levels to less than 20% using the ELISA testing offered by the Moredun Research Institute at Penicuik.

Description of the project

We started the project in 2015 after encouragement from WRS. They were the umbrella organisation that provided the banking, record keeping and many other duties including helpful advice and support. We started as a firewall, keeping numbers down in our area to reduce grey squirrel movement north to add to the pressures in the existing WRS area north. We held meetings to recruit volunteers and explain our ambitions to eventually

regain our red squirrels that were lost to us less than 20 years previously. We found that there was a lot of support and we quickly recruited volunteers and landowners to cooperate with us. We devised new trapping techniques to mostly live-trap grey squirrels successfully by attracting them to our trap locations with prior feeding of black sunflower seed placed within squirrel specific feeders.



Figure 2. Photograph taken from Arnside Knott looks out over the New Barns Estate (125 ha) and Morecambe Bay beyond. This is the most western end of the Arnside Peninsula where we have concentrated our effort and where we hope to build a squirrel enclosure. To the right is the Kent estuary and the caravan site owned the NBE.

We recruited up to three trappers and this was paid for, sometimes by the landowners, particularly the holiday/caravan site owners. We also attracted mainly local grant money to pay for our expenses. We were very successful in catching grey squirrels as our numbers over the years demonstrate (circa 18,000). We also supplied many traps for garden trapping and, because it has been difficult to get feedback on numbers caught in gardens, the 18,000 total in 10 years is likely an underestimate.

It became obvious that although we were controlling numbers, we were unable to eliminate grey squirrels and this has led to some disillusion amongst paid and volunteer trappers. We realised that it was not going to be possible to clear the area but may be possible to clear a more limited area with more intensive targeted spatial trapping. We switched our target area to the Arnside Peninsula west of Arnside (Figure 2).

We also realised that motivation was vital and that we should have a more realistic target that also meant eventual reintroduction of red squirrels to a cleared area. Getting red squirrels back is the motivation for volunteers and local residents alike. We also like the idea of 'red squirrel enclosures' like those built at the Yorkshire Arboretum and the British Wildlife Centre in Sussex. The experience of the public walking through such enclosures is wonderful for explaining the plight of red squirrels.

At the moment, we are in the ridiculous situation where there are no approved release sites within England for captive-bred red squirrels.

In 2024, we partially closed the project down. Latterly the inspiration of a potential squirrel enclosure and the new WS3 grant under Higher level Stewardship (HLS) for our target area at the end of the Arnside Peninsula has reawakened our enthusiasm. We have been encouraged by the potential for HLS within a 125 hectares of land, and we have discussed this with the Forestry Commission and Natural England who are supportive. We realise that there is no application window yet and, even then, we must be invited to make an application if/when the window opens, perhaps in the autumn.

New hope means that we have been trapping again in the Peninsula area and have taken on a new trapper together with new volunteer trappers. We also hope to blood test culled grey squirrels to check for squirrelpox virus antibodies as we view this as a very good indicator of risk to any released red squirrels or those that move into the area.

Red squirrels moving into the area to recolonise (any time soon) is viewed as unlikely as over the 10 years we have only had circa 10 confirmed sightings. In 2024 we actually caught a red squirrel in a trap, which we released but there is no evidence that we have a breeding population.

Future progress in this project is very much down to Higher Level Stewardship together with WS3 funding for grey squirrel control. This could then lead to grey squirrel clearance on the Peninsula which would then justify the building of a red squirrel breeding enclosure. This would be potentially helpful in fundraising because the public would be charged for entry. It would also lead to much needed education of visitors about red squirrel conservation and the plight of the species. The area is a popular and beautiful area for walkers and caravan owners and also has a well used Café. So, we are confident there would be a good paying footfall for the enclosure.

Red squirrels then sell themselves!



Figure 3. Feeders made by volunteers that we use to attract and detect the presence of Grey squirrels by filling with black sunflower seed. If the feeder is being used we set live-traps thus maximizing our use of time. The feeders are specific to squirrels as confirmed by trail camera recording providing they are placed five feet up to avoid deer opening the lid.

Success indicators

- SQPV Elisa test for squirrelpox antibodies in culled grey squirrels to be pushed below a 20% incidence.
- Successful application for Higher Level Stewardship for New Barns Estate (NBE)
- Successful establishment of breeding enclosure for Reds within NBE and ultimate return of breeding Reds to the area

Major difficulties faced

- Lack of belief amongst government and NGO bodies that re-establishment of red squirrels in the area is possible.
- Insufficient control capacity to clear the whole Arnside and Silverdale National Landscape of grey squirrels.
- Continued volunteer motivation without the presence of a breeding population of red squirrels naturally or within an enclosure.

Major lessons learned

- The extreme difficulty of clearing our area of grey squirrels without adequate paid contract control and the committed support of national conservation bodies.
- Motivation of volunteers (Figure 3) has been excellent despite the difficulties, but they need hope because their motivation is to get red squirrels back into the area after they were lost in the late '90's.
- Intensive control leads to a dramatic drop in the incidence of ELISA squirrelpox positive animals. This indicates that the remaining population of animals is less exposed to the virus. We observed a fall from 84% (21/25) to 28% (7/25) incidence in just three years from 2021 to 2023.

Project success

Success or failure	Confidence
Highly Successful	
Successful	X Medium
Partially Successful	
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Establishment of Higher Level Stewardship at NBE coupled with WS3 payments for squirrel control.
- Subsequent establishment of a red squirrel enclosure at NBE.
- The advance in new technologies to better control grey squirrel populations.

Future project development

- The key to successful grey squirrel control is to use more contract paid control supplemented by volunteer help.
- Progress will be monitored by blood testing culled grey squirrels for squirrelpox antibodies (ELISA testing).
- With satisfactory progress we will start progressing the building of a squirrel enclosure.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★	★
Live traps	★★★	★★★
Kill traps	★	★
Pine marten (as natural grey predator)	★	★
Immuno-contraception (oral bait delivered via hoppers)		★★★
Gene drive (Selected inheritance manipulated so only male young are born)		★★★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)	★	★
Squirrelpox vaccine		★★★

★★★ High; ★★ Medium; ★ Low, blank = None.

References

- I. Arnside and Silverdale AONB Red Squirrel Initiative leaflet.
- II. Shuttleworth C, Armstrong G, Russell G & Miah J (2025) Managing the squirrelpox threat to red squirrels. *Veterinary Record* 196, 485.

NATURAL RESOURCES WALES RED SQUIRREL PORTFOLIO

Natural Resources Wales

Geographical area of conservation work

Wales, with a focus upon three key areas (focal sites) containing red squirrels

Author and organisation contact details

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Key partners

The Wales Squirrel Forum aims to enable effective red squirrel (*Sciurus vulgaris*) conservation and manage the impacts of grey squirrel (*Sciurus carolinensis*) on tree and woodland ecosystems and their associated services in Wales. Membership is voluntary and consists of public bodies, environmental NGOs, sector representatives and other organisations and individuals whose objectives align with the aims of the forum.

NRW partners are those members of the Wales Squirrel Forum:

- Welsh Government
- Clocaenog Red Squirrels Trust (CRST)
- Red Squirrels Trust Wales (RSTW)
- Mid Wales Red Squirrel Partnership (MWRSP)
- British Association of Shooting and Conservation (BASC)
- Wales Squirrel Forum members
- Countryside Alliance
- UK Squirrel Accord
- Coed Cymru
- Confor
- Tilhill
- Wildlife Trust of South and West Wales
- Mid Wales and the Marches Assessment Centre
- Vincent Wildlife Trust
- UK Squirrel Accord

Maps of project land area

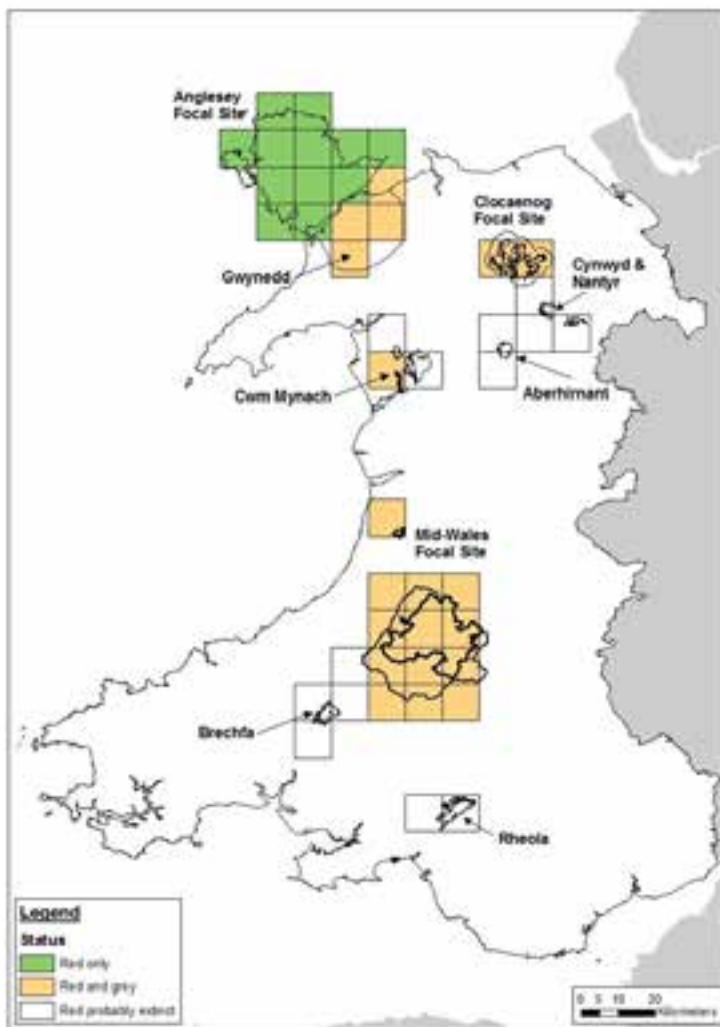


Figure 1. Distribution of red squirrels in Wales in 2017.

Map shows records at 10km square level at the three Focal Sites, their buffer zones and other sites where red squirrels were considered to have been present in the last 20 years.

Introduction

NRW's responsibility with regards red squirrel involves:

- Membership and Secretariat for the Wales Squirrel Forum (WSF) which coordinates, supports and provides advice on the implementation of actions of the 'Red Squirrel Conservation Plan for Wales' and the 'Grey Squirrel Management Action Plan'.
- NRW is tasked to undertake research into red squirrel survival and recruitment within the three Focal Sites (as set out in the Wales Red Squirrel Conservation Plan).
- To assist local squirrel groups in the red squirrel focal sites (Figure 1) to help deliver the Wales Red Squirrel Conservation Plan objectives and provide financial and staff support to red squirrel conservation projects. This includes assistance with reduction of grey squirrel numbers.
- Issue guidance on activities relating to red squirrel such as woodland creation and forest operations.
- Issuing felling licences under the Forestry Act 1967 (as amended). Under the Agriculture (Wales) Act 2023 NRW has the power to add environmental conditions to felling licences. This includes conditions for safeguarding red squirrels.
- Overseeing the legal protection of red squirrels under the Wildlife and Countryside Act (1981). This includes issuing conservation and education licences to applicants who undertake such tasks that may constitute an offence (such as trapping, handling or taking samples for studies that help better understanding).
- Under section 6 of the Environment (Wales) Act 2016 NRW has a duty to maintain and enhance biodiversity and promote the resilience of ecosystems.
- Under the Wellbeing of Future Generations Act (2015), NRW has a responsibility to work to maintain and enhance a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change). With regards to red squirrels, resilience can be achieved by securing and improving their habitat so that a sustainable population can be reached and maintained. They have been assessed as Endangered in Wales, and GB.
- As the Land Manager of the Welsh Government Woodland Estate, NRW manages forests where red squirrels are present. This is done using sustainable forest management practices, ensuring sufficient habitat and food for red squirrels, keeping canopy connectivity and undertaking grey squirrel control. Internal guidance is followed ensuring operations do not negatively impact red squirrels and the local team liaise regularly with local red squirrel groups.

- In addition to supporting red squirrels through the way we manage the Welsh Government Woodland Estate (WGWE), we also support in how we regulate felling and woodland creation, and how we provide advice, evidence and support for partners.

Project aims

- Sustainable red squirrel populations in the Focal Sites.
- Build strong partnerships with red squirrel conservation groups.
- Support grey squirrel control within the boundaries of the focal sites.
- Instigate and where possible, fund, research projects and novel ideas that will increase knowledge, achieve further understanding of red squirrel in Wales and that enable NRW to manage forests whilst protecting red squirrels.

Description of the project

Priority work that NRW has undertaken since 2020 with regards red squirrel is summarised below:

Red Squirrel Reinforcement – NRW's role

In 2021, NRW contracted a review of work to support the conservation of the red squirrel population at Clocaenog Forest. The subsequent evidence report, '5-year Review and Recommendations for Clocaenog Forest', recommended that without further reinforcement, the red squirrel population could become extinct within 12 years. As a result, a proposal was written to reinforce with captive-bred and/or wild caught animals applying the recommendations of the report regarding the approach to be taken to maximise the chances of success. This proposal underwent internal consultation against the IUCN Conservation Translocation Guidelines. Permission was granted in 2023 and the first tranche of animals were released in 2024 under the Magical Mammals project.

NRW Evidence Report 791: Mitochondrial DNA Analysis of Red Squirrels (Sciurus vulgaris) in North Wales (2024)

The Mitochondrial DNA study compiled previously published and unpublished data relating to the genetic diversity of the red squirrel population in Wales (Figure 2). The report detailed the genetic diversity and haplotype composition present in the north Wales red squirrel population today following DNA analysis on 70 hair and faecal samples. The results found an additional 4 haplotypes not recorded before with the research concluding

that there is good genetic diversity within the population.

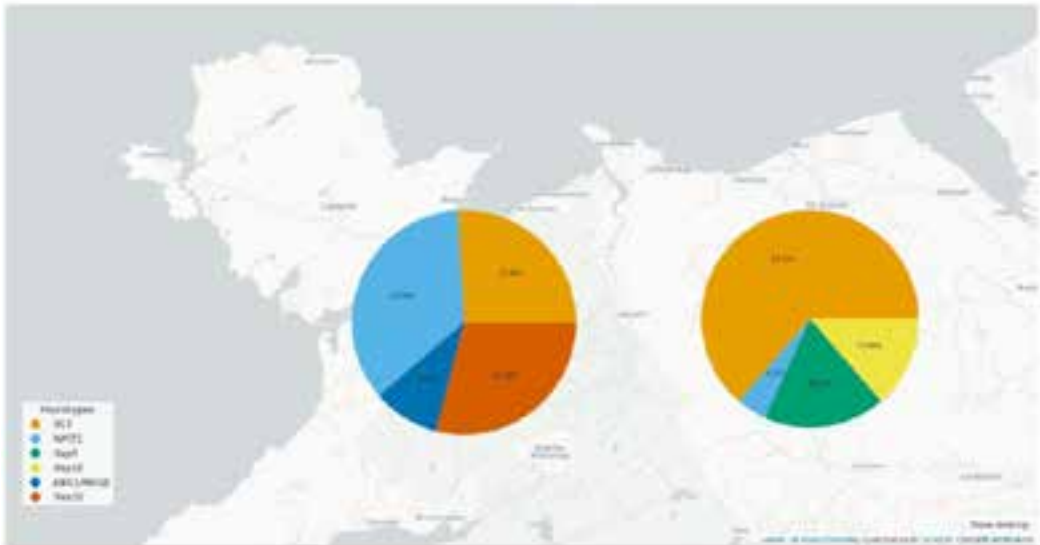


Figure 2. Distribution of haplotype frequencies shown as pie charts, with Gwynedd on the left and Clocaenog on the right. Note that H13 and WMZ1 were the only haplotypes found in both areas. ANG1/ANG2 and Hap32 occurred exclusively in Gwynedd, while Hap9 and Hap10 were unique to Clocaenog.

Population estimation

NRW has commissioned two studies relating to the use of remote activated cameras as a population monitoring method:

- Shannon G, Valle S & Shuttleworth CM. 2022. Using remote activated cameras to estimate relative abundance and habitat preference of red squirrels (*Sciurus vulgaris*). NRW Evidence Report Series. Report No: 672. 40pp
- Shannon G, Barton O, Valle S, Shuttleworth CM. 2024. Developing a method for assessing the relative abundance of red squirrels in low-density populations. NRW Evidence Report Series, Report No:795, 22 pp, Natural Resources Wales, Bangor

The first study (Shannon et al. 2022) took place on Anglesey and compared live trapping results with camera trapping data. The study found a strong correlation between the number of live-captured red squirrels and the number of camera trap images recorded, supporting the use of camera traps as an index of relative abundance for red squirrels using a standardized approach. Analysis of the data found that red squirrel relative abundance

indices were negatively related to stand canopy openness, while the presence of Scots pine and increased tree species diversity were positively related to squirrel abundance.

The second study (Shannon et al. 2024) aimed to evaluate the effectiveness of the same approach to detect red squirrels in Clocaenog Forest, a much lower density population. A random sampling strategy was used to select 60 camera locations across conifer stands in three age categories (< 20 years, 20-40 years and 40+ years). Twenty cameras were deployed for 10 days during three independent surveys. Each site was ground-baited with sunflower seeds and hazelnuts for seven days before camera activation.

The initial survey, totalling 590 camera days, did not detect any red squirrels but recorded grey squirrels and pine marten at several sites. A secondary targeted survey of 200 camera-days in a favoured habitat type (40+ years old coniferous stands) detected red and grey squirrels at two sites each. The findings indicated a significantly low population density of red squirrels within the forest.

Recommendations were provided suggesting research around factors that may be impacting the population such as habitat structure, tree species composition and coning cycle patterns, and proposed management actions such as intensified grey squirrel control, reinforcement of red squirrel populations, changes in forest management practices and consistent monitoring.

Cone Transect study

We commissioned Dr Sarah Cartmel to undertake a 'Review of Cone Transect Methodology'. The report was produced in March 2023. The review compared the original methodology that measured cone crops, (undertaken between 1990 and 2005), with a look at newer survey methods and tools that can be used. The aim was to advise on a suitable survey method for the future and one which volunteers are able to undertake.

Felling licences and red squirrels

The Agriculture (Wales) Act 2023 includes new forestry provision which amends the Forestry Act 1967 to enable environmental conditions to be added to felling licences (Figure 3), or to allow licences to be amended, suspended, and revoked once granted. The environmental conditions relate to the avoidance or mitigation of impacts on the environment, biodiversity or species when undertaking operational activities related to a felling licence.

In the three Red Squirrel Focal sites, the following conditions relating to 'Red Squirrels' are included in all felling licences, so 'The Licence Holder' must:

- Ensure that felling of trees with active dreys does not take place in the period 1st

February to 30th September.

- Ensure that the direction of felling operations allows movement of red squirrels into retained woodland habitat.
- Maintain connectivity through the retained tree canopy to enable squirrel movement through the woodland landscape.



Figure 3. Timber harvesting licences now can include wildlife conservation conditions.

Success indicators

- With regards to reinforcement projects there is a need for monitoring key success factors including evidence of breeding. The project should include regular reviews summarising factors influencing the project, including lessons to be learned.
- Stabilised population as a minimum, ideally increasing.

Major lessons learned

- With regards to reinforcement projects, do not underestimate the length of time it takes for proposals to be written and approved by NRW. Consideration against the IUCN

Conservation Translocations Guidelines is a key part of the process. There is a need to: allow a longer lead in time than might initially be expected – early discussions are encouraged; ensure there are sufficient resources to undertake such a project and include staff and volunteer time to oversee required activities; ensure known predation threats are accounted for prior to releases as well as removal of grey squirrel from the area.

- With limited resources for conservation activities, the goodwill of dedicated volunteers continues to be key to the delivery of red squirrel conservation in Wales.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area (<u>within the Welsh Government Woodland Estate</u>)
Shooting		
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)	★	★
Immuno-contraception (oral bait delivered via hoppers)		★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		★ ★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)	★ ★ ★	★ ★ ★
Squirrelpox vaccine		★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

MID WALES RED SQUIRREL PARTNERSHIP

Wildlife Trusts of South and West Wales (WTSWW)

Geographical area of conservation work

Eastern Ceredigion, northeast Carmarthenshire and southwest Powys (Wales)

Author and organisation contact details

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(Red Squirrel Rangers) Delivery and volunteer coordination

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Email: redsquirrel@welshwildlife.org
Website: <https://www.welshwildlife.org/red-squirrel-project>

Key partners

- Carmarthenshire County Council
- Ceredigion County Council
- Powys County Council
- Natural Resources Wales (NRW)
- Vincent Wildlife Trust
- The National Trust
- Coed y Bont Community Woodland
- BASC
- SelectFor Ltd
- Sylvaen Ltd
- Tilhill UPM
- Scottish Woodlands
- Other private woodland owners and interested individuals

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	0
Paid Contractors (7-12 months)	0
Volunteers involved with grey control	40
Volunteers involved with squirrel monitoring	11
Other Active Volunteers	3
Other info	1

Map of project area

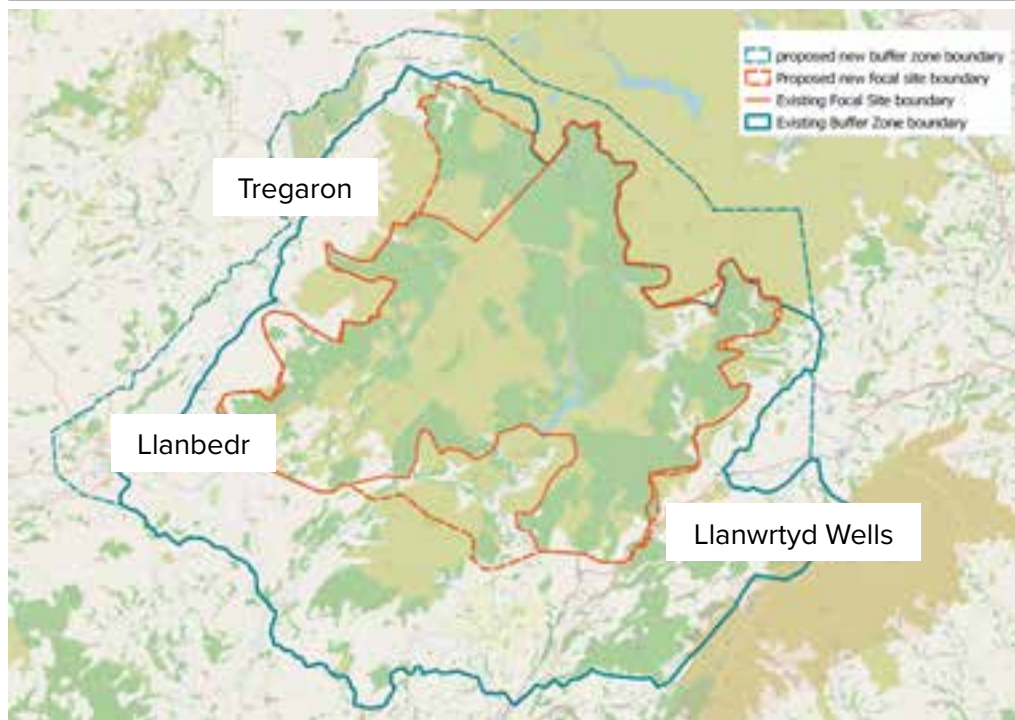


Figure 1. Mid-Wales red squirrel project area.

The project (Figure 1) covers a large area of conifer forest, native woodlands and open ground in the area around Llyn Brianne and the upper afonydd Teifi & Tywi (Towy) catchments. Most woodland is owned by the Welsh Government (WG) and managed by Natural Resources Wales (NRW). However, private forest companies such as UPM Tihill and Pryor and Rickett manage a substantial area of conifer woodland in the Focal Site. The National Trust and the RSPB have significant land holdings in the area, and there are numerous small landowners and farmers that manage small woodlands within the Focal Site.

Introduction

The red squirrel (*Sciurus vulgaris*) population in this area retreated to the conifer plantations of the upper Tywi valley, buffered on much of their boundary by extensive moorland. This offered a partial refuge from grey squirrels (*Sciurus carolinensis*).

The population of red squirrels in the mid-Wales focal area is thought to have declined to between 100 and 300 individuals (MISE 2015).

Since its inception in 2002, the Mid-Wales Red Squirrel Partnership (MWRSP) has worked to establish evidence and data about the red squirrel population in mid-Wales, to develop a robust strategy to conserve them.

The Partnership aims to protect and expand this genetically unique population of red squirrels in mid-Wales. Conservation efforts include establishing a buffer area around the red squirrel stronghold, with control of grey squirrels. Anecdotal evidence suggests that the expanding pine marten (*Martes martes*) population has helped that process.

The focus of the Partnership remains engaging volunteers in grey squirrel control (offering LANTRA accredited training), and camera trapping to establish the presence or absence of red squirrels. This also provides useful information about the distribution of pine martens and other wildlife. We also support landowners and forest resource planners to improve habitat for red squirrels.

The past work of the Partnership has depended upon the availability of external funding, currently small donations support modest running costs, and WTSWW fund salaries for two part-time staff, as well as supervisory, coordination and communications roles. We are seeking funding to enable the continuation and expansion of this project to include DNA analysis and population and habitat modelling.

Project aims

- To maintain, and where possible enhance, the red squirrel population and its habitat in mid-Wales, particularly through grey squirrel control, contributing to national initiatives and strategies.
- To research and monitor the distribution and status of red squirrels in mid-Wales.
- To raise public and professional awareness of the red squirrel population in mid-Wales, to increase understanding of its conservation needs and encourage people to get involved in the Partnership's work.
- To ensure that red squirrel conservation issues (including grey squirrel control) are incorporated in all relevant plans and policies that affect all of Wales' forests and that these plans and policies are implemented effectively.

Description of the project

When the Partnership was set up in 2002, its focus was on research and proof of principle, with the aim of demonstrating that mid-Wales was still home to a viable population of red squirrels. This culminated in the area being confirmed by the WG as one of three Welsh focal sites for the conservation of the species in 2009, empowering the Partnership to prioritise its resources on conservation action.

The Partnership's direct conservation activity can be broadly divided into four areas:

- Research to establish population size and dynamics
- Optimising habitat management in the red squirrel focal area
- Grey squirrel control
- Advocacy and education

Optimising land management has proved challenging, but the Partnership's influence has increased with the quantity of research data it has generated. The Partnership works with private foresters and NRW to inform forest design planning, with a focus on maintaining 'key areas', stands of conifer species such as lodgepole pine (*Pinus contorta*), Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*), and maintaining landscape connectivity during the process of silvicultural rotation. Land management advice has been guided by a habitat suitability study (Cartmel and Denman 2012) funded by NRW, and the local knowledge of Partnership members.

Influencing land management remains a significant area of work with many challenges. Significant threats are still posed by: the large size, location and scale of clear-fell coupes, inappropriate clear-felling of key areas, development pressure to establish wind power, regular and severe annual storms; all leading to loss of arboreal connectivity and forest fragmentation. The failure to replant some important tree species is also a potential threat to future red squirrel food supplies and habitat.

Grey squirrel control remains critical to the Partnership achieving its objectives, as significant riparian sessile oak (*Quercus petraea*) woodlands within the buffer zone host populations of grey squirrels, which periodically invade the red squirrel core area. Anecdotal evidence suggests that where the grey squirrel populations have been sufficiently reduced, the increasing pine marten population suppresses their recovery. Previously we set up a Trap Loan Scheme (TLS) in the red squirrel focal site, to give local people free access to trapping equipment, training and support for grey squirrel control. The TLS operates from volunteer 'hubs' headed by volunteers, who coordinate trapping activity in their local areas. These local community networks of trappers present a more sustainable model of grey squirrel control, and we are now able to offer LANTRA accredited training.

Further to the direct conservation action there remains a significant need for advocacy work (Figure 2). Generally, this has been undertaken by many members of the Partnership through their own professional roles within the partner organisations. Public awareness of the presence of red squirrels in mid-Wales remains low but is growing. A website has been established, leaflets distributed and events and talks held. A website, social media posts and email account are hosted by WTSWW.

Research into the red squirrel population is also ongoing and ties closely with volunteer and public engagement. The Mammals In Sustainable Environment project (2011-2015) has contributed to red squirrel research, undertaking monitoring and research such as hair tubes, camera traps, live-trapping and radiotracking of red squirrels. This work remains key to our understanding of the red squirrel and its needs in mid-Wales.



Figure 2. Community outreach is a major element of strategic conservation in mid-Wales.

Opportunities for the Partnership to progress its work have been dependent on fixed-term sources of grant funding, so activity has varied over time in extent and intensity. We are currently unfunded but exploring new strategies to enable the project to continue and expand.

We are seeking to bring our research up-to-date and develop robust methodologies to gather the data needed to inform our strategy going forward. This is made more challenging as it also requires renewing our volunteer base, and embracing new models

for delivery, without the resources to support that capacity. We are building relationships with universities and other organisations to support collaborative research and delivery projects.

The Partnership also liaises with and contributes to other UK projects and the Wales Squirrel Forum, whose remit is to address red squirrel conservation issues nationally.

Success indicators

- Grey squirrel control being in place across a significant area of the mid-Wales red squirrel focal site, with focus on the buffer zone, with a long-term trend of decline in numbers of grey squirrels caught (as a ratio of effort expended).
- An increase in the size and extent of the red squirrel population in the focal site (Figure 3). The low density of red squirrels makes assessment of their status difficult, but we are seeking a proxy measure to help quantify our future impact, with the intention of recording increasing red squirrel numbers as a success indicator.
- A substantial and diverse volunteer base, building skills and applying their expertise to support red squirrel conservation in this area and across Wales.



Figure 3. Boosting red squirrel numbers is a key success indicator.

Major difficulties faced

- Lack of long-term funding or currently any significant funding; leading to challenges with staff capacity, retention and continuity. In recent years the project has relied on WTSWW to fund it, with occasional donations from partners (such as Carmarthenshire and Ceredigion Nature Partnerships) and external funders (like the Esme Fairburn Trust).
- The inevitable reduction in resources has led to reduced capacity to meet the aims and maintain engagement. By working with the expertise of our volunteers and implementing innovative technology we seek to achieve our aims more efficiently.
- The current low density of red squirrels and the infrequency with which they are seen is a barrier to public engagement, and robust studies.
- Canopy connectivity within the area is under threat from development pressure and more frequent winter storms. Developing more resilient forest management (such as continuous cover forestry and more diverse canopy structure) will be paramount to the future success of commercial forestry in the area, and the red squirrel population.
- Lack of support from commercial forestry to prioritise conservation measures. Coupled with increasing development pressure and catastrophic damage to canopy connectivity.

Major lessons learned

- Nationally coordinated, and Government backed strategy (utilising statutory and financial mechanisms) for red squirrel conservation and grey squirrel control is critical if the survival of this remnant population is to be secured and maintained.
- Sound evidence for the presence of a significant red squirrel population (extensive trapping, DNA analysis and photographic records) is necessary to secure engagement of funders and commercial forestry managers.
- Dedicated members of staff (Figure 4) are necessary to support the development of volunteers and volunteer groups for grey squirrel control and coordinate the disparate elements of this project.
- The partnership approach, whereby the varying strengths and opportunities of the different partners and sectors are utilised to achieve different elements of the work programme, has been very successful, although reliant on all partners sharing the workload.



Figure 4. Dedicated staff are essential to the project.

Project success

Success or failure	Confidence
Highly Successful	
Successful	
Partially Successful	X High
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- Since the formation of the Partnership in 2002 we have learned much more about red squirrel distribution in mid-Wales and have an active network of volunteer and contract grey squirrel trappers and the beginnings of a meaningful dialogue with forest managers.
- However, recent results from red squirrel monitoring suggest red squirrel numbers are low, and the population may be very vulnerable to local and regional extinction in the short-term. Limited capacity means that we lack the high-quality data on which to base lobbying and funding applications for more active conservation measures.
- There are currently many areas where grey squirrel control is still not practiced, particularly around the local villages and towns, and more resources are required to achieve a uniform standard and a systematic landscape-scale grey squirrel control in all areas over time.
- Additional work is required to ensure no further key areas are lost to clear-felling and that forest managers fully understand and implement the requirements to maintain arboreal connectivity across the forest landscape.

Future project development

- A new phase of red squirrel monitoring. Formal, repeatable surveys are undertaken such that population changes are easier to monitor. To include: DNA samples to establish population size and dynamics, to inform strategic conservation measures; exploring innovative use of technology such as bio-acoustic monitoring and visual recognition processed by artificial intelligence; surveying and modelling habitat across the focal area to understand the carrying capacity for red squirrels, as well as updated significant opportunities and threats.
- Developing a wider network of project partners and expert volunteers, within and beyond mid-Wales; with the capacity to lead on individual research specialisms (such as forest ecology, DNA, pathology, database management, lobbying and seeking corporate support). We are also developing opportunities to support the project for differently abled volunteers and people who cannot access the forest.

Opinion on methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area
Shooting	★	★
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)	★ ★	★ ★
Immuno-contraception (oral bait delivered via hoppers)		★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)	★	★
Squirrelpox vaccine		★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

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- I. Cartmel S, Denman H (2012) Developing an understanding of forest management requirements for red squirrels in the Mid-Wales Focal Site. Countryside Council for Wales Science Report No. 1016.
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- III. Shannon G, Barton O, Valle S, Shuttleworth C (2024) [Developing a method for assessing the relative abundance of red squirrels in low-density populations](#). NRW Research Reports 34 pp.
- IV. Optimising Habitat Management for Red Squirrels Management Plan 2017 – 2022. Mid Wales Red Squirrel Focal Site. MWRSP - WTSWW.

RED SQUIRREL CONSERVATION IN CLOCAENOG FOREST

Clocaenog Red Squirrel Trust (CRST)

Geographical area of conservation work

Clocaenog Forest, Nr Ruthin,
Denbighshire, North Wales

Author and organisation contact details

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C/O RSTW

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Website: www.clocaenog-rst.org

Key partners

- Natural Resources Wales (NRW)
- Red Squirrel Trust Wales
- Magical Mammals Project
- Welsh in Business
- Wales Squirrel Forum
- RWE (Wind Farm)
- Clocaenog Forest Wind Farm Fund
- Dŵr Cymru (Welsh Water)

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	Grey squirrel control contractors are employed periodically by NRW
Paid Contractors (7-12 months)	2 The Magical Mammals project provides annual funding for a part time, self-employed grey squirrel controller and community ranger
Volunteers involved with grey control	4
Volunteers involved with squirrel monitoring	20
Other Active Volunteers	2/3 CRST also benefit from the help given by several members who provide support with necessary Welsh translations of written materials and information

Maps of project land area

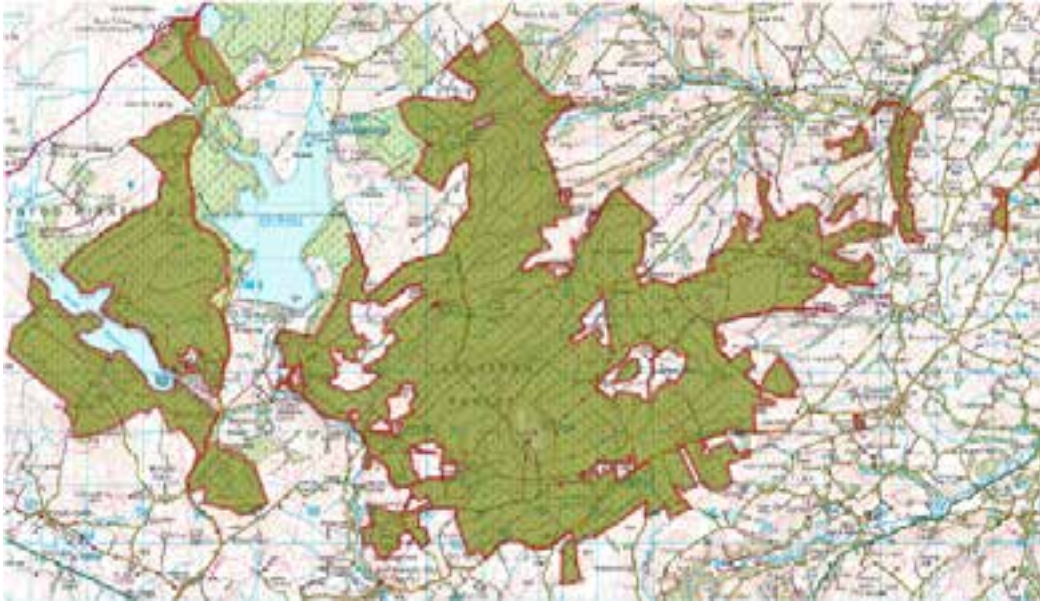


Figure 1. A map of the Clocaenog forest © Natural Resources Wales

Clocaenog Forest (near Ruthin) is a large upland commercial conifer plantation (Figure 1) in northeast Wales (5,000 hectares) located on the Denbighshire and Conwy county boundary. The forest is managed by Natural Resources Wales (NRW) on behalf of the Welsh Government. The plantation comprises a mix of conifer species including larch (*Larix spp.*), Norway (*Picea abies*) and Sitka Spruce (*Picea sitchensis*) (69%), and pine (*Pinus spp.*). There is also a small amount of mixed broadleaved trees.

The forest sits between 300 and 500m above sea level and is surrounded by moorland and farmland to the north and west making it somewhat of an island. This isolation is thought to be the saving factor of the red squirrel (*Sciurus vulgaris*) as the geography has acted as a partial barrier to grey squirrel (*Sciurus carolinensis*) dispersal.

Clocaenog Forest now contains a large onshore wind farm (completed in 2020). RWE operate 27 turbines that are sited through the central area of the forest. Clocaenog is one of seven areas across Wales which has been identified by the Welsh Assembly Government for this kind of development. Further wind farm development is planned to the west of Clocaenog in The Alwen Forest.

Introduction

Mainly planted in the 1930s, it was not until the early 1950s that red squirrels (*Sciurus vulgaris*) started making use of the food items (buds, shoots and seed) that the maturing trees started to offer. In the late 1990s, there were up to 400 animals present and they were considered Wales' largest population until the subsequent red squirrel population recovery on Anglesey. This former Clocaenog stronghold for red squirrels (Figure 1) is no more; the current population figure is still estimated to be very low.

Historically, the dominance of Sitka spruce (*Picea sitchensis*) has made the forest less attractive to grey squirrels (*Sciurus carolinensis*) as the small size of seed produced by this coniferous tree species meant that it is harder for grey squirrels, relative to red squirrels, to gain enough energy from this food alone. However, over the last decade, grey squirrel incursions into the forest have become more frequent and widespread requiring a greater emphasis on monitoring and control. In addition, the presence of pine marten (*Martes martes*) across the forest has increased over the last couple of years. Trail cameras are regularly picking up pine marten.

Clocaenog Red Squirrel Trust (CRST) was formed in 2019 by a group of conservation enthusiasts who were already involved in the protection of red squirrels in Clocaenog Forest. Previously, group members had been volunteering through the Red Squirrels United (RSU) project which ran for four years, (up to spring 2020).

CRST is a fully constituted voluntary group and registered charity. Since 2020, CRST have worked in partnership with Red Squirrels Trust Wales (RSTW) and conservation funders to develop and secure funding for a five-year project called 'Magical Mammals' (MM) to protect and conserve red squirrels in Clocaenog Forest / north Wales (and pine marten in Gwynedd) through translocations.

In 2020, an application was made to the National Lottery Heritage Fund (NLHF) to support the funding for the project outlined above. After a successful development phase lasting a year, and securing match funding from various sources, the Magical Mammals project was awarded funding in March 2022.



Figure 2. Volunteers building a release enclosure.

Project aims

- Help conserve and protect the small red squirrel population by enabling and supporting conservation volunteers.
- Raise awareness of the threats red squirrels face through community partnerships, awareness raising activities, public engagement and practical conservation activities.
- Continue with grey squirrel monitoring / control within and around the forest (including a buffer zone).
- Increase the population of red squirrels by using a programme of reinforcement when and where appropriate (Figure 2).

Description of the project

It is worth noting for the period in question (2020-2024), that the pandemic presented several challenges regarding CRST's practical monitoring and conservation work. The stop- start nature of the lockdowns and other restrictions severely hampered volunteer capacity overall. However, because a few key CRST volunteers lived close to the forest some crucial tasks and activities continued. The dedication and commitment shown by these volunteers in this period helped CRST as a charity to survive and then build its conservation activities back to where it was pre-2020.

As stated earlier, CRST and RSTW received the go-ahead to start the Magical Mammals project in March 2022. Magical Mammals is funded by NLHF and other match funding sources; it is a five-year conservation programme.

To map out a plan, Natural Resources Wales (NRW) commissioned a review of the conservation work that had already been undertaken over the previous few years (from 2016 to 2021). Its aim was to assess the level of success (or not) regarding the management interventions that had taken place. This included phases 'one' and 'two' of red squirrel translocations which occurred between 2017 and 2019, (when eighteen captive-bred animals were released into the forest).

From the above review, an Action Plan for the Conservation of Red Squirrels in Clocaenog Forest 2023 – 2028 was published. Briefly, the plan outlines the following:

The Magical Mammals project will release 10 red squirrels (minimum) in year one and a further 10 in years four/five. This will help towards achieving a sustainable forest population with regards to the number of red squirrels. It will also help avoid the genetic bottleneck as seen within Holy Island of the northwest Anglesey coast. The releases will help achieve a sustainable population that will be better placed to withstand unforeseen threats as well those from known predators within the forest such as goshawk (*Accipiter gentilis*) and pine marten.

The plan highlights that a key factor for implementation is the successful recruitment of a red squirrel ranger (2½ days a week) to assist CRST with the ongoing conservation work. The plan also detailed actions regarding woodland management, red squirrel monitoring, grey squirrel control, data recording and scientific research.

In March 2023, a red squirrel ranger was recruited for Clocaenog. There was quite a delay in recruiting to the role from receiving NLHF funding to getting a ranger in place, some of the delays were unavoidable. Once the ranger was in place, planning and coordination quickly began in a range of areas as well as the practical work needed to translocate animals from various breeders across the country to Clocaenog Forest.

One of the lessons learnt from the 2017 to 2019 releases was the time it took to complete important health screening (samples to a lab and gaining subsequent results) before releasing any animals into the wild. Sometimes, there were lengthy delays between receiving animals and then releasing them. Also, this process did not account for the fact that animals could become ill but that this was not picked up by direct observation alone. The practice now is that all health screening is completed prior to moving any animals identified for translocation. Breeders are supported with this process.

In 2024, a western area of Clocaenog Forest was surveyed and identified as a suitable location for three release enclosures to be built. Red squirrels had been recorded in the west but not frequently. The aim was to try and help establish a stronger presence as had

happened in other areas of the forest with previous releases. Unfortunately, on release of the first group of animals it quickly became apparent that something had happened. Trail cameras covering the enclosure and wider dispersal area suddenly stopped showing any pictures of the first three animals released. While we were trying to work out what might have happened, further footage from a trail camera showed a male goshawk on the ground next to the enclosure. This led us to conclude that predation was the most likely cause of their disappearance.

During this time, we had received more red squirrels which were housed in other enclosures in the same area. It was decided that they could not be released locally and all three enclosures would have to be dismantled and moved to new areas of the forest. This was completed in a staged way so dismantling and rebuilding enclosures allowed for the transfer of animals from one enclosure site to another. This was an enormous amount of work but by this time the ranger had successfully recruited more volunteers to the cause of red squirrel conservation. The ranger's input was and is making a real difference.

As a result of what happened, the criteria for selecting suitable release sites were reviewed and a stronger emphasis was placed on areas of the forest with greater dense canopy and understory. Currently, the new locations are working as expected and the phase three releases are nearly complete, with eight animals released and four more to go. There have been a couple of fatalities and these animals are awaiting post-mortem to determine cause of death. Initial assessments have ruled out squirrelpox.

As well as goshawk presenting risks to red squirrel recovery in the forest, the ever-increasing presence of pine marten across the area is also a concern. This is especially the case when releasing captive-bred animals into Clocaenog Forest. In mitigation for this, the five-year plan outlined some measures to take to help distract and deter pine marten from visiting release sites. Currently, there are five pine marten lure sites (feeding stations) set up around the forest which are set three/four kilometres away from enclosure locations.

Two lure sites are baited with deer carcasses, the others are baited with a mix of eggs, peanut butter and jam. These sites are covered by trail cameras and checked regularly. They have shown so far that the deer carcass sites have had no pine marten visits but two of the other sites show regular pine marten appearances. In addition, we also have all-weather battery-operated radios placed in areas not too far away from enclosure sites, constantly playing speech radio (BBC Radio 4). Throughout the time of the releases so far, pine martens have hardly come anywhere near enclosures but have been regularly recorded on trail cameras in the general area (Figure 3).

Through closely scrutinising trail camera footage of pine marten, we can safely assume there are now numerous resident animals in the forest. It remains unclear whether they are breeding or not. Five years ago, camera footage of a pine marten was a rare and infrequent event. Now, volunteer trail camera checkers regularly see pine martens on their cameras. The ever-increasing presence of pine marten in the forest is continually kept under review in relation to the viability of red squirrel conservation measures. Any impact

the martens are having on grey squirrels is currently unknown.



Figure 3. Pine martens are now frequently recorded on camera in the forest.

To evaluate the success or otherwise of previous releases, the genetic diversity of the red squirrel population at Clocaenog was assessed by the University of Chester. Non-invasive sampling was undertaken using sticky-tab hair traps. In all, 19 hair samples had mtDNA extracted, amplified and sequenced. Analysis distinguished five haplotypes, three of which were new to Clocaenog. The study indicated the presence of a genetic bottleneck event prior to 2017 and the start of our translocation programme. However, the data suggests the population is recovering from this event. In parallel, NRW funded a wider geographical screening which revealed six haplotypes across mainland north Wales.

Given the limitations of the genetic studies in terms of sample sizes, a further study involving a larger population sample from a wider geographical area is already underway and may include microsatellite DNA to differentiate between individuals. The results could be used to inform future introductions.

As with previous years, no-one is sure or can say with any certainty how many red squirrels there are in the forest. Or indeed, whether previous reinforcements have yet had any significant impact on population size. An occupancy model research project has highlighted that red squirrel numbers appear to remain low and distribution is associated with recent release sites.

Currently, we are awaiting the publication of a further study that might provide some insight into ongoing concerns about the possible low numbers of red squirrels in Clocaenog Forest. This has led to questions being asked about the food they eat. A stable isotope analysis has been completed as a way of finding out more about the animals' diet. Hair samples have been collected from squirrels, as well as specimens of the foodstuffs on offer to them in the forest. These have been freeze dried, analysed and compared, to establish

the proportions of various foods eaten. This may help us to understand more about how supplementary feeding impacts on the choices red squirrels make about available food sources.

CRST continue to have over 80 cameras placed around the forest. Depending on what information cameras pick up, this will help to determine how often these are checked by volunteers. More areas of the forest are now inhabited by red squirrels so several camera blocks get checked far more frequently than in previous years. Although this does not necessarily mean there are many more squirrels, just that they might be ranging further afield. As reported previously, there is little change to the available resources for grey squirrel control. Volunteer time and resources for this work remains extremely valuable but limited. Our resources for this activity must be used carefully which usually means the people carrying out this work are firefighting rather than anything else. The MM project has now recruited a grey squirrel control contractor to assist.

Other important activities that have recently been undertaken by the MM project is the design and placement of information boards (Figure 4) to be displayed by red squirrel breeders who have supported Clocaenog’s population reinforcement efforts. These boards will help visitors to Wildwood Trust and Welsh Mountain Zoo (for example) to learn about their role in red squirrel conservation. Information boards are also being placed within Clocaenog Forest to help visitors learn about red squirrels in the area.



Figure 4. Information boards will be erected in the forest as part of the Magical Mammals project.

With the introduction of a part-time ranger, engagement with local groups and communities has increased dramatically. Popular walk-and-talk sessions in the forest are provided by the ranger throughout the year, volunteer recruitment is positive and in 2024, CRST had an 'information stand' at all the local summer shows. The overall activity across the board for red squirrel conservation has been and is the best it's been for several years. However, everyone involved in red squirrel conservation in Clocaenog Forest knows and understands the continued challenges faced by what is still a very endangered species.

Success indicators

- Sustained and verifiable increases in population numbers i.e. year on year breeding successes that supports growth in the numbers and lowers risks associated with small populations.
- Wider appreciation and understanding from local communities of the benefit to everyone of protecting and preserving local wildlife.
- Increased involvement from a wider range of people in conservation volunteering.

Major difficulties faced

- Grey squirrel control and the lack of resources / personnel to create and maintain an effective buffer zone around core red squirrel areas and habitats.
- Not really knowing the full impact of previous trans-locations / reinforcements on population size and dispersal patterns. Are we anywhere near or making enough progress to achieve a viable red squirrel population?
- Clocaenog Forest is a man-made plantation, it's a commercial enterprise. Clear-felling and thinning across the forest continues. The forest is getting smaller.

Major lessons learned

- Without continuing resources to employ a dedicated ranger, along with other professional advice and support (as and when needed), conservation leadership and coordination is diminished. Success / failure are largely based on levels of volunteer input.
- Stop, start approaches to conservation. Any written plans (from any agency / organisation) are meaningless without sustained funding / support or identified and accessible resources.
- Even with a small increase in population size, significant risk factors remain that continually threaten survival rates.

- Competing priorities for forest managers, commercial forest harvesting over heritage conservation.

Project success

Success or failure	Confidence
Highly Successful	
Successful	
Partially Successful	X Low
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- A growing number of areas are now known to be used by red squirrels where they have not been seen previously.
- Red squirrel breeding has occurred and continues. However, it is not known if the overall numbers have increased or declined.
- Presence of grey squirrels in red squirrel areas continues, maybe in low numbers but grey squirrel control is a challenge given the small numbers and how labour-intensive trapping is.
- Difficulty in knowing / judging what a sustainable and viable population of red squirrels in Clocaenog Forest should be.

Future project development

- Implementation and execution of the five-year plan which outlines a comprehensive approach to red squirrel conservation and incorporates some of the lessons learnt from previous action plans.
- As a group, be ready to embrace new ideas and practices. Where possible, learn from others.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in the project currently	Future importance in developing this aspect of grey squirrel management in the project area
Shooting		
Live traps	★ ★ ★	★ ★ ★
Kill traps		
Pine marten (as natural grey predator)	★	★ ★ ★
Immuno-contraception (oral bait delivered via hoppers)		★ ★ ★
Gene drive (Selected inheritance manipulated so only male young are born)		
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).		
Squirrelpox vaccine		★ ★ ★

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

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GREY SQUIRREL REINVASION: RED SQUIRREL CONSERVATION ON ANGLESEY

Red Squirrels Trust Wales

Geographical area of conservation work

Isle of Anglesey and the northern coastal area of Gwynedd centred on the city of Bangor

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Key partners

- Red Squirrels Trust Wales
- Isle of Anglesey County Council
- Animal Plant Health Agency (APHA)
- Moredun Research Institute

Resources

Typical annual resource available	Number of people
Paid Contractors (1-6 months)	3 Two grey squirrel control contractors and one wellbeing officer
Paid Contractors (7-12 months)	
Volunteers involved with grey control	19
Volunteers involved with squirrel monitoring	12
Other Active Volunteers	20 Including one collecting red squirrel bodies
Other info	7,000 members of Facebook page. Reporting suspected grey squirrel sightings

Map of project land area



Figure 1. Southern Anglesey and the northern Gwynedd mainland separated by the Menai Strait. Red squirrel 2005-2024 records submitted by the public are shown in red. The mainland project focus is the area demarked by a solid black line.

Grey squirrels (*Sciurus carolinensis*) are widespread on the mainland, and consequently repeated squirrelpox outbreaks within sympatric red squirrel (*Sciurus vulgaris*) populations have been recorded. Grey squirrels were eradicated from Anglesey in 2013. Since then, in the period 2015-2020, lone animals were detected and removed. In 2024 however, a small breeding population was discovered in the south of the island.

Introduction

Grey squirrels were eradicated from the island of Anglesey in 2013. However, in subsequent years, individuals were discovered to have ‘dispersed’ across the Menai Strait from Gwynedd. This movement was despite ongoing and intensive mainland grey squirrel control. None of the captured animals were found to have been in breeding condition and subsequent research revealed the individuals to be genetically distinct from the original island population which had been eradicated. This genetic finding reinforced the earlier surveillance evidence indicating the island-wide eradication had been complete.

Red Squirrels Trust Wales (RSTW) had raised awareness of the need for local people to report grey squirrel sightings so that animals could be quickly removed. Grey squirrels which had dispersed onto Anglesey were often first discovered by members of the public. They used social media, a dedicated phone line and online sightings form to alert RSTW.

Anglesey currently contains the largest and most genetically varied red population in Wales. This recovery was achieved by augmenting the small remnant population that had persisted prior to grey squirrel eradication. Captive-bred animals were obtained from Zoos and released into parts of the island where red squirrels had become extinct. In 2009, the first red squirrel was discovered within mainland woodland bordering the Menai Strait and close to the Britannia road and rail bridge. It is unclear as to whether the animal swam over or had moved across the sea channel by using one of two bridge structures.

Project aims

- Preventing the successful re-colonisation of Anglesey by grey squirrels. Browning™ ‘Spec Ops’ wildlife cameras are deployed to record foraging squirrels. When a grey squirrel was identified, baited Albion™ live-capture traps were set in the woodland to catch it.
- Encouraging local people to report sightings of red or grey squirrels on Anglesey or in adjacent areas of Gwynedd (Figure 1).
- Undertaking research to understand the proportion of grey squirrels carrying adenovirus and squirrelpox virus (SQPV) infections. Polymerase chain reaction (PCR) tests reveal the presence of viral DNA, whilst enzyme-linked immunosorbent assay (ELISA) tests indicate whether viral antibodies are present in animals.

Description of the project

The project aims to raise awareness of the threat posed by grey squirrels, maintain Anglesey free from grey squirrels and prevent squirrelpox outbreaks in native red squirrels. Grey squirrels carry SQPV, but it seldom harms them. However, it is invariably fatal in red squirrels, which can lead to significant mortality rates.

A grey squirrel was sighted on Anglesey in January 2024 and this led to the discovery of significant numbers of animals. In response to the initial sighting, five camera traps were deployed for five days, each being focused on ground bait scattered at 100m intervals in and around the location of the reported animal. Images of grey squirrels were recorded on two adjacent cameras, but in subsequent trapping only red squirrels were trapped. A second trapping session trapped numerous red squirrels and caught a 440g sub-adult male grey squirrel. The presence at that time of year of an animal of that size suggested that it may very well have been born late in the previous year and likely on Anglesey. Consequently, cameras were re-deployed which led to further grey squirrel images being recorded along with continued photographs of red squirrels. An adult male grey squirrel and an adult female that had recently lactated were then trapped.

The detection of multiple grey squirrels, and evidence of breeding, led to camera traps being repeatedly deployed across a 4km area of the island through the spring and summer months. At locations where grey squirrels were recorded by cameras, trapping was undertaken. This led to a total of 16 grey squirrels ultimately being caught (Table 1).

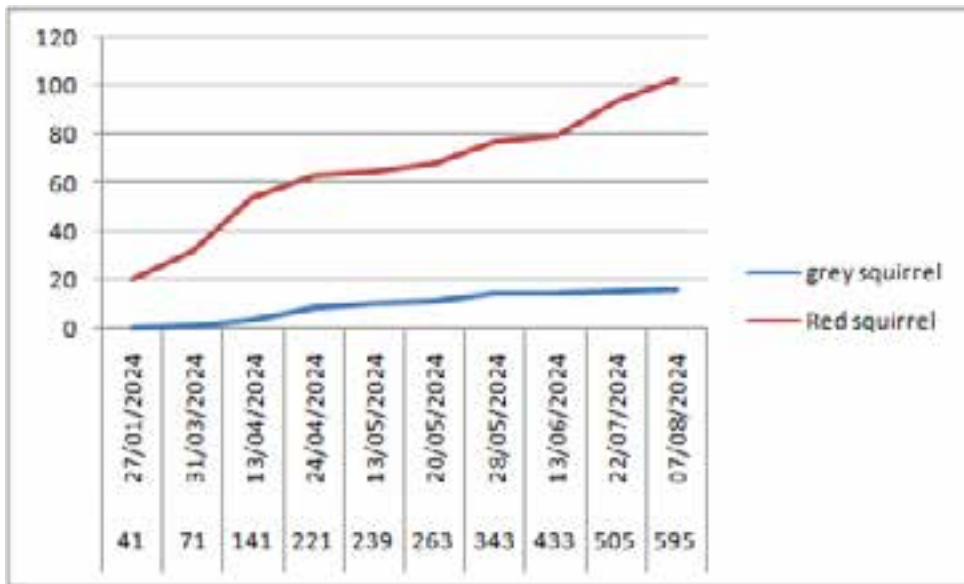


Figure 2. The cumulative number of red and grey squirrel captures over 10 trapping sessions. The start date for each session is provided along with a running cumulative total trapping effort (number of traps set x days when trapping took place).

In addition to grey squirrels, there were 103 red squirrel captures during the 595 trap days (number of traps set x number of days operated over). This large number of red squirrel captures (Figure 2) was despite attempts to limit captures by only setting traps at camera locations where grey squirrels were filmed. All the trapped red squirrels were visually examined for signs of squirrelpox infection before release and none showed any obvious visible skin lesions.

Table 1. Sex, body weight, nose to anus length and sexual condition of grey squirrels trapped 01/04/24 and 12/08/24. Sexual condition was recorded in males as ‘Scrotal’ or ‘Abdominal’ to reflect the location of the testes. Females were categorized as 0 (non-breeding), 4 (lactating) and 4+ (lactation ended). Animals tested by ELISA for SQPV antibodies are identified by a shaded entry under ‘Number’.

Sex	Number	Weight (g)	Length (mm)	Sexual Condition	Date
M	1	440	238	Scrotal	01/04/24
M	2	610	258	Scrotal	13/04/24
F	3	610	256	4	16/04/24
M	4	530	248	Scrotal	24/04/24
F	5	515	244	0	25/04/24
F	6	535	242	4+	25/04/24
M	7	653	255	Scrotal	26/04/24
F	8	625	254	4+	26/04/24
M	9	440	238	Scrotal	14/05/24
M	10	540	247	Abdominal	15/05/24
F	11	510	248	0	24/05/24
M	12	260	194	Abdominal	29/05/24
F	13	570	257	4+	29/05/24
M	14	480	260	Scrotal	02/06/24
M	15				26/07/24
F	16	360	240	0	12/08/24

Initial regional media coverage of the situation was elevated to national news following an article in The Times newspaper (Figure 3). Press and social media coverage highlighted that breeding animals were discovered (see Table 1) and that grey squirrels carry SQPV and spread this to red squirrels.

A total of four breeding female grey squirrels were caught: one lactating and three squirrels which had completed lactation. Only two young grey squirrels weighing less than 400g were caught. It is hoped that future genetic research will reveal whether the animals trapped were related to each other.

A total of ten individuals were blood tested for SQPV antibodies, as indicated in Table 1,

and all were negative. In contrast, the majority (16/17) of mainland animals tested in the same timeframe were positive. This suggests that the infection was absent on the island but was circulating within the adjacent mainland population.

The redeployment of cameras in late August led only to images of red squirrels being recorded. However, subsequent surveillance led to grey squirrel images being recorded briefly on a camera and then a few weeks later a photograph showing two grey squirrels together was obtained. Trapping efforts were hampered by bad weather and traps being vandalized and will continue into 2025.



Figure 3. Headline of the online article in The Times 5th May 2024 featuring grey squirrel re-establishment on Anglesey.

Success indicators

- The complete removal of any grey squirrels discovered within the island landscape.
- Assessing the disease risk to red squirrels posed by grey squirrels using ELISA tests.
- Preventing outbreaks of squirrelpox disease within the Anglesey red squirrel population.

Major difficulties faced

- The presence of red squirrels reduced the chances of catching grey squirrels because red squirrels readily enter traps.
- It is also possible that resident red squirrels dominate baited areas and that associated inter-specific aggression also lowers the chance of catching grey squirrels.
- Some individual grey squirrels use very small areas of woodland and may be hard to detect.
- Despite tests indicating that the grey squirrels on Anglesey were not carrying SQPV, their presence offers hosts for the infection should it arrive on Anglesey.
- The lack of a squirrelpox vaccine means that ultimately red squirrels on Anglesey and in Gwynedd remain at risk from epidemic viral disease

Major lessons learned

- To facilitate the early detection of grey squirrels, local people were provided with information so that they could readily differentiate between red and grey squirrels. The resulting community network resulted in the initial grey squirrel sighting, but this occurred after the species had already re-established a small population on Anglesey.
- Negative SQPV antibody ELISA test results suggest that the small isolated island grey squirrel population was virus free. In contrast, parallel tests of the mainland grey squirrel population showed high levels of ELISA positive individuals. This highlights that future dispersal from the mainland to island risks bringing the virus onto Anglesey.
- The presence of sympatric red squirrels in the local area meant that live-trapping was only undertaken at locations where grey squirrels were detected by camera surveys (Figure 4). Traps were inspected every 2-3 hours which was labour intensive.



Figure 4. Grey squirrel detection on Anglesey in January 2024 led to the discovery of a breeding population across a 4km band of woodland.

Project success

Success or failure	Confidence
Highly Successful	
Successful	
Partially Successful	✘
Failure	High

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Reason(s) for success/failure

- There have been no confirmed cases of squirrelpox within the Anglesey red squirrel population.
- None of the red squirrels caught in 2024 showed any visible external signs of pathogenic squirrelpox infection.
- Grey squirrels appear not to have been eradicated from the area where the small re-established population was discovered. At the time of writing, two other animals were caught and two others remain present after being detected.
- Viral testing (ELISA and PCR) was undertaken in both red and grey squirrel populations in the project region. This provided invaluable data on the risk of viral infection to native red squirrels.

Future project development

- Regular camera trap surveys will be undertaken in woodlands in the south of Anglesey to attempt to detect future grey squirrel re-establishment.
- RSTW will continue to campaign for a squirrelpox vaccine to be developed.
- Continued community outreach (Figure 5) will maintain awareness of the threat posed by grey squirrels and the wellbeing benefits of activities associated with red squirrel conservation.



Figure 5. Regular community events raise awareness of red squirrel conservation and are great fun.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in the project currently	Future importance in developing this aspect of grey squirrel management in the project area
Shooting	★	
Live traps	★★★	
Kill traps		
Pine marten (as natural grey predator)	★	★★
Immuno-contraception (oral bait delivered via hoppers)		★★
Gene drive (Selected inheritance manipulated so only male young are born)		★★
Habitat management (reducing availability of tree seed crops favoured by grey squirrels).		
Squirrelpox vaccine		★★★

★★★ High; ★★ Medium; ★ Low, blank = None.

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PROTECTING THE RED SQUIRREL IN NW OF NORTHERN IRELAND

North West Red Squirrel Group

Geographical area of conservation work

County Derry, Northern Ireland

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Key partners

- Ulster Wildlife Trust
- Woodland Trust
- Forest Service Northern Ireland
- Department of Agriculture, Environment, and Rural Affairs (DAERA)

Resources

Typical Annual Resource available	Number of people
Paid Contractors (1-6 months)	0
Paid Contractors (7-12 months)	0
Volunteers involved with grey control	14 Six volunteers shoot and others trap
Volunteers involved with squirrel monitoring	10 Annual survey of woodlands in NW and weekly survey in Muff Glen
Other Active Volunteers	8 Information stalls and fundraising

Maps of project land area



Figure 1. Map of the project area covered in 2024 survey. Red squirrels (*Sciurus vulgaris*) were found in Forestry owned plantations. This included three areas of coniferous forest habitat and in a mixed woodland southwest of Derry City. Pine martens (*Martes martes*) were recorded in coniferous plantations and in mainly deciduous woodland along the Faughan valley belonging to Woodland Trust. Grey squirrels (*Sciurus carolinensis*) were found mainly in urban areas but, also in mixed woodlands throughout the area.

Introduction

25 years ago, red squirrels (*Sciurus vulgaris*) were in most of the woodlands in the North West with very few grey squirrels (*Sciurus carolinensis*). This has changed dramatically since, and we are seeing a lot more grey squirrels in areas where red squirrels are found. Pine martens (*Martes martes*) are now present in more woodlands in Faughan Valley and Loughermore. Our main conservation efforts are at Muff Glen, Eglinton – a 34-hectare mixed woodland of mainly larch (*Larix decidua*) belonging to Forestry Commission. The forest contains a small population of around 10 red squirrels that we have been working to protect since 2011. On average we cull 40 grey squirrels annually, mainly by setting humane traps and dispatching captured animals using a Kania2000 kill-trap. The project is entirely volunteer- based.

Since mid-December 2024, we have been seeing a lot more grey squirrels and have been actively trapping in response (Figure 1). At the start of the project in 2011 there were red squirrels only in one area of Muff Glen with grey squirrels common in other areas. We trapped the grey squirrels, and the red squirrels were then seen in all areas. Red squirrels were also found in a small plantation in Donnybrewer, Banagher Glen and on private property in Ballougry.

Project aims

- We aim to continue protecting the red squirrel population in Muff Glen by controlling grey squirrels.
- We continue to monitor and supplementary feed the red squirrels to promote good health.
- We will control grey squirrels in urban areas around Derry City and land close to Eglinton.
- We will continue to educate the public about the dangers of grey squirrels.

Description of the project

Our main project is protecting the red squirrels in Muff Glen. We are all volunteers who visit every weekend to feed, clean feeders and check camera footage. We have six cameras located in different parts of the glen in three feeding areas. We have 10 humane 'live-capture' traps near these areas, which are set at first light, checked at midday and again late afternoon, in response to grey squirrel detections on camera. Grey squirrels are mainly dispatched by using a Kania2000 trap or are shot in the trap.

We have a five-year license issued by the Forest Service that permits us to carry out grey squirrel control in all local forests but sadly do not have enough volunteers to carry out control there. As a result, Ballykelly forest is overrun with grey squirrels.

We fundraise regularly by holding raffles at information stalls, holding quizzes and applying for grants (Figure 2). We have installed a hide and two information boards (Figure 3), litter bins and three benches along the public trails in Muff Glen. Red squirrel 'safaris' are held for youth groups, U3a and local schools; educational visits into schools and youth groups are also carried out.



Figure 2. Education and community outreach are key elements in the project.

Each year we carry out a two-week survey in local woodlands to determine absence/presence of red and grey squirrels, and pine marten. This survey involves putting a feeder up with a trail camera opposite it for a two-week period. For our last survey we had help from the Woodland Trust in Faughan Valley woodlands, which was a great help.

Pine martens were present and are being monitored in Loughmore by one of our

volunteers. He reports a breeding pair as two kits have been seen on camera. This can only help the local red squirrel population.



Figure 3. Allowing people to watch red squirrels helps boost interest in their conservation.

Success indicators

- Maintaining the red squirrel population in Muff Glen.
- Increase in active volunteer numbers.
- Making the public more aware of the dangers of grey and red squirrels living together.

Major difficulties faced

- Lack of support from Derry and Strabane Council: Gransha woods and St Columbs Park and City cemetery all had red squirrels 20 years ago. Despite our best efforts to remove grey squirrels we were not allowed on council land and must rely on trapping on private property.
- We have experienced traps being damaged/stolen or grey squirrels released.
- More volunteers are needed to help in other areas.

Major lessons learned

- Our major issue is the lack of support from the local council. Having the local authority on board and helping in grey squirrel control would help enormously, especially on their own land.
- Our greatest success is maintaining the small population of red squirrels in Muff Glen thanks to a dedicated group of volunteers.
- Grey squirrel control must be all year round. Areas where we stopped trapping due to public interference have seen a big increase in grey squirrel numbers in the last year after we had virtually wiped them out.

Project success

Success or failure	Confidence
Highly Successful	
Successful	X Medium
Partially Successful	
Failure	

High confidence means that the assessor feels they have approximately 80% chance of the given selected score (Failure, partially successful, successful or highly successful) being correct. Medium confidence is defined as 51-79% chance of the assessor score being correct and Low confidence only 50% chance of being correct

Future project development

- Extending the area around Muff Glen where we can control grey squirrels.
- Increase the number of volunteers in other areas and train them in grey squirrel control.

Current and future importance of contemporary and future methods of grey squirrel control

Approaches	Importance in your project currently	Future importance in developing this aspect of grey squirrel management in your project area	Comments
Shooting	★ ★	★ ★	Restricted to private land. We need more landowners on board.
Live traps	★ ★ ★	★ ★ ★	Very important
Kill traps			Kania traps have been great for dispatching squirrels trapped using live traps. We need more of these.
Pine marten (as natural grey predator)		★	Pine martens are only a couple of miles away so will hopefully kill grey squirrels in the area. There is some concern about the potential impact of pine marten on low density red squirrels.
Immuno-contraception (oral bait delivered via hoppers)			If designs can prevent red squirrels using the hoppers
Gene drive (Selected inheritance manipulated so only male young are born)			Doesn't stop grey squirrels destroying trees and would take a long time to wipe out grey squirrels
Habitat management (reducing availability of tree seed crops favoured by grey squirrels)			Trees are mainly conifer in Muff Glen. If trees are felled, they should be replaced by trees favouring red squirrels
Squirrelpox vaccine			

★ ★ ★ High; ★ ★ Medium; ★ Low, blank = None.

