

RED SQUIRRELS ON THE ISLE OF WIGHT

HELEN BUTLER MBE BSC



RED SQUIRREL CONSERVATION
ON THE ISLE OF WIGHT
1991-2020



This publication is dedicated to

The late Vic Simpson

BVSc DTVM CBiol FIBiol MRCVS FRSB Hon FRCVS

and

The late David Stapleford

Both instrumental in guiding a newcomer in the right direction

Thanks go to all volunteers who input the backlog of data years ago, woodland monitors and the general public who send in sightings. Monitoring would be far poorer without you.

In order to pull this huge amount of data together, volunteers with expertise in statistics or time on their hands were essential, also reviewers and proofreaders. So thank you:

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FOREWORD

By

Dr Colin Pope

I first came across Helen over 30 years ago at a meeting of the Isle of Wight Natural History & Archaeological Society. At the time I had recently taken up a post as Ecology Officer for the Isle of Wight Council. Helen told me that she had developed a particular interest in red squirrels and was keen to find out how she might develop this interest. I was delighted to hear this because, at that time, although there was a lot of public enthusiasm for our Island's squirrels, no-one was fighting their cause and promoting their conservation.

Shortly after this, interest in the special case of red squirrels on the Isle of Wight was taken up by the Forestry Commission in particular, but also by other statutory bodies and NGOs. However, Helen's enthusiasm and determination for our squirrels grew and prospered and was far more effective at getting the message across to ordinary people than Government bodies. She has shown an extraordinary and unfailing dedication to all aspects of red squirrels on the Island. She has a great interest in their biology, their ecology, their welfare and, over and above everything else, their conservation on the Island.

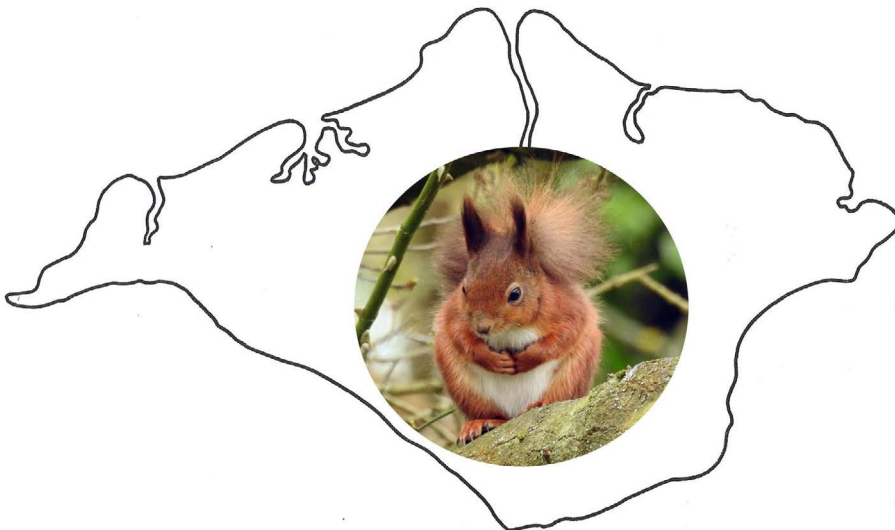
Helen is highly motivated and innovative in her approach and over the years she has built up a network of contacts both on the Island and across the UK. She is in contact with most red squirrel workers across the country. Working

with Bournemouth University has enabled her to develop the academic rigour required to analyse the large data sets which she has accumulated.

The outcome of this long period of dedication to red squirrels is apparent in Helen's latest book, where she has drawn together a huge amount of information on biology, ecology and conservation. If you want to know anything about red squirrels on the Island, then you are likely to find the answer here. If you are one of the many volunteers who helped Wight Squirrel Project in any way, then you are likely to find an account of the results of your efforts in this book. This is an impressive piece of work and I warmly recommend it.

PART 1

**AN INTRODUCTION TO
RED SQUIRRELS,
THE ISLE OF WIGHT
AND
WIGHT SQUIRREL PROJECT**



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for Part 1

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PREFACE

Why should we save our native red squirrels? Why spend 30 years working for them? Apart from having it all in the ‘cute and charismatic’ stakes, they are our only native squirrel and therefore fit well into our ecosystem.

With their bushy tails, inquisitive faces and naughty ways they are irresistible to most people. They are also the hard done by underdogs, pushed out of their territory by an introduced species, another reason to love them and fight their corner.

Life is never simple for any species and for our native red squirrel – the only species of British squirrel – fate has not been kind. After the introduction of the American grey squirrel in 1876, our native squirrels have suffered a severe decline due to competition and disease.

To the majority of people living in the British Isles today, the mention of squirrels conjures up an image of the American grey squirrel. But for those privileged few who live in a ‘red squirrel only’ area, there is no more gratifying experience than watching our native species. The red squirrel’s elusive and timid nature adds to their appeal – and the thrill – at seeing this most charismatic of our native woodland mammals.

This publication has been a long time in the writing. The aim of parts 1 and 2 is to be informative but at a level where adults and older students will find the statistics useful. The majority of the data is drawn from science and the rest from citizen science plus the author’s experience. Part 3 is a bit more challenging.

Red squirrel work is so intense and incoming phone calls can easily change the planned week. Time and time again this publication was started and then life intervened. On a more positive note, at least over a long timescale there is more information relating to our Isle of Wight red squirrels. It is the culmination of the author’s work since 1991, plus all the loyal volunteers and supporters who have made it possible and not forgetting the general public providing ‘citizen science’.



With so much data to write up, it was hard to decide how to present it. Breaking it down into manageable parts was the answer. Past reports, not published previously, are included in their entirety. Parts 1 and 2 of this publication are suitable for anyone, or agencies, to use as reference or just for interest. Part 3 is not for the faint-hearted as it shows graphic pictures of autopsies and uses medical language.

Part 1 is an introduction to the Isle of Wight and red squirrels. It’s aimed at anyone looking for information but is not conversant with red squirrels, or the Isle of Wight, but also provides a useful summary for anyone who has an interest in red squirrels. The rest of this publication looks at data collated on the Island since 1991. There are many other publications that delve into deeper detail relating to red squirrel physiology and behaviour but a brief overview is relevant here to better understand data and discussions in the following chapters.

To have a good understanding of red squirrels and their conservation, we first take a brief look at the history of red squirrels, followed by the present-day situation. This is followed by the conflicts facing red squirrel conservation on the Isle of Wight.

Chapter 1 outlines a brief history of red squirrels in the The United Kingdom and how it used to be thought they are remnants from a time when the UK was joined to Europe. This theory has recently been brought into question using DNA analysis. The focus is on the Isle of Wight but there are many other groups in the UK who write about their own areas if you wish to know more.

Part 2 focuses on 30 years of data gathered on the Isle of Wight, scientific and general observations from the general public. Several people were keen enough to document their dog walks or their 'garden squirrel' activity, which all helps to build up a comprehensive picture of our island population of red squirrels. This part is split into a further four sections.

Part 3 concentrates on mortality, morbidity and caring for sick or orphaned squirrels. Red squirrels have their own diseases and share some human health problems, the biggest shock being leprosy. Apart from natural causes, humans are responsible for the largest recorded cause of mortality – road traffic deaths.

In order to understand how this publication and its contents was derived, here is a brief introduction to the charity and its work. Founded in 1993 and for the first two years named Species Conservation Organisation Protecting the Environment – or SCOPE – the charity changed its name when another, much larger, charity wanted to use the acronym SCOPE. The work and volunteers remained the same regardless of a name change.

When a silver dish with a squirrel on was donated to the charity, I saw an opportunity to say thank you to loyal volunteers. The dish was mounted by volunteer Mike Evans and a different volunteer is awarded the trophy annually. Michael Hodge was the first to receive the trophy for writing a programme to input data and keeping records up together.

Wight Squirrel Project carries out the majority of red squirrel conservation work on the Island. It is a small local charity run by volunteers, headed



A new design of bridge being installed in Ryde in 2008

by the author. Being independent, it is reliant on donations, sponsorship and fundraising.

Newsletters are produced annually and leaflets given out at shows and venues around the Island. Books and DVDs are also a big part of 'getting the message out there'. More recently social media has taken on a role with publicity. Follow us on the Wight Squirrel Project Facebook page — [@wightsquirrelproject](https://www.facebook.com/wightsquirrelproject).

When I started working with red squirrels on the Island in 1991, numbers had dropped to a low level as a result of the October 1987 hurricane. Apart from the tree loss and the inevitable decrease in winter food, corridor links were disrupted, leaving some woods isolated. My first report, in 1992, looked at corridor links between woodland. The report is reproduced in part 2. I must take the opportunity here to thank Val Gwynn, who helped a novice with fieldwork and report writing.

People who had red squirrels in their garden before the storms reported their loss. However, numbers rose steadily in the 1990s and into the new millennium. Red squirrels are now seen regularly in gardens, parks and woods, even in areas where they had not been seen before the 1987 storm, according to older locals.

Monitoring is carried out in accordance with national guidelines by Wight Squirrel Project volunteers and the general public provide 'citizen science'. Citizen scientist is the catchy name given to any member of the public who reports sightings. However, most sightings are from popular woods for walking and in areas where there are 'garden' squirrels so there are still gaps

in our knowledge. There are over 25,000 reported sightings on the database, covering most of the Island. Citizen science is one of the most important aspects as it covers far more of the Island than volunteers alone could do.

This is where all the island woodland surveys, which are carried out every 5 –7 years, fill in the gaps. Hairtube surveys, woodland monitoring walks, questionnaires, sightings from the general public, post mortems and looking for food leavings are all more set methods used on the Island.

Other conservation efforts are rather more innovative. Wight Squirrel Project actively promotes non-invasive methods of monitoring, unless in exceptional circumstances, such as a grey squirrel incursion.

Road kills account for the majority of reported deaths, so Wight Squirrel Project campaigned for road signs and rope bridges to be installed. Official road signs were put up in the worst blackspots and more recently unofficial signs, designed by Kate Northover, have been erected on private property and facing the road.

Rope bridges sponsored by financial firm NPI were a big part of the project for 20 years. Sadly, due to tightening of insurance rules, it's no longer viable to hang ropes across the highway. The Fire Brigade erected the first rope bridge over Calthorpe Road, Ryde in June 1996. This was the first rope bridge in the country and, due to its success, others followed in the north of England and in Scotland.

Thanks go to tree climber Paul McCathie for filling the hoppers in Calthorpe Road and Carol Pryke for filling the hoppers in Wootton.

Raising public awareness of the red squirrel's plight is another aspect of red squirrel work and a priority with Wight Squirrel Project. Education is also an important part of red squirrel work. Advice is given on request and there are leaflets available as well as an informative website: www.wightsquirrels.co.uk.

Wight Squirrel Project attends local events to further the red squirrel's cause and raise funds. The main thrust on education is now carried out by partner group, The Isle of Wight Red Squirrel Trust. I gave talks up until 2016 when The Trust was given the task of putting together a group of trained people. Now I just talk about the science rather than give the generic talk.

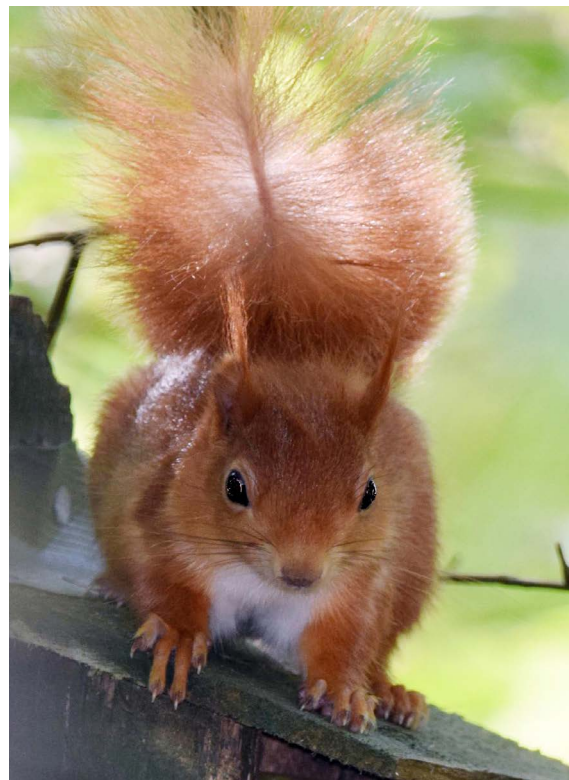
Sometimes a squirrel is taken ill in a garden and we are called in. Generally we will only go out on call if the animal is already captured. Too many times we have turned out just to find the animal has managed to scramble up a tree or gone into undergrowth.

Sometimes a squirrel is taken ill in a garden and we are called in. Generally we will only go out on call if the animal is already captured. Too many times we have turned out just to find the animal has managed to scramble up a tree or gone into undergrowth.

In the majority of cases the squirrel is too ill to survive and the illness untreatable. The stress of being handled is sometimes too much for a healthy animal let alone a sick one. It is sometimes kinder to leave them alone. I must take this opportunity to thank Bob and Jacquie Wilson for taking on a major role in this part of our work.

When you next look at a red squirrel, take time to marvel at their agility, diverse personalities and most of all, their charisma. There are other publications if you want to look at physiology in greater detail and you are inspired to learn more. Understanding how a red squirrel lives and it's needs are paramount if we are to help it's long term survival. Co-operation from authorities and landowners is also vital of course.

Keep up the good work everybody!



INTRODUCTION

Once widespread throughout the United Kingdom, our native red squirrels (*Sciurus vulgaris*) have been replaced by the introduced American grey squirrel (*Sciurus carolinensis*) in all but a few areas in the north of England, Scotland and offshore islands.

Strategies to conserve remaining populations recognise offshore islands with extant populations of red squirrels as important in the long-term survival of the species in the United Kingdom (JNCC Red Squirrel Strategy 1995).

The red squirrel's disappearance from mainland Britain is largely attributable to the introduced American grey squirrel, which does very well in our broadleaved woodlands. Therefore the Isle of Wight is an important stronghold for red squirrels as the Solent provides a barrier to grey squirrel invasion, although a grey does sometimes find its way over here.

Situated five miles from Portsmouth, off the south coast of England, the Isle of Wight has a human population of around 140,000. The capital is Newport, whilst Ryde is the largest town. Other major towns are Cowes, East Cowes, Sandown, Shanklin and Ventnor. All have red squirrels in or around the town.

Towns and villages are concentrated in the north and east of the island, with Totland, Freshwater and Yarmouth the main settlements in the west.

Over half of the Isle of Wight is designated an Area of Outstanding Natural Beauty (ANOB). In 2019 it was also given UNESCO status.

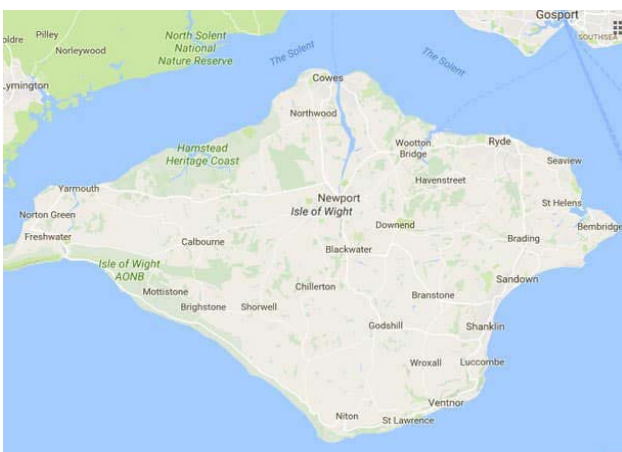
Woodland is scattered and fragmented with the largest woodland blocks in the north of the island and to the west of Newport. Woodland is scant in the south-west between Blackgang and Brook.

Farming and tourism are the mainstays that support the economy. Both influence red squirrels and woodland but in different ways.

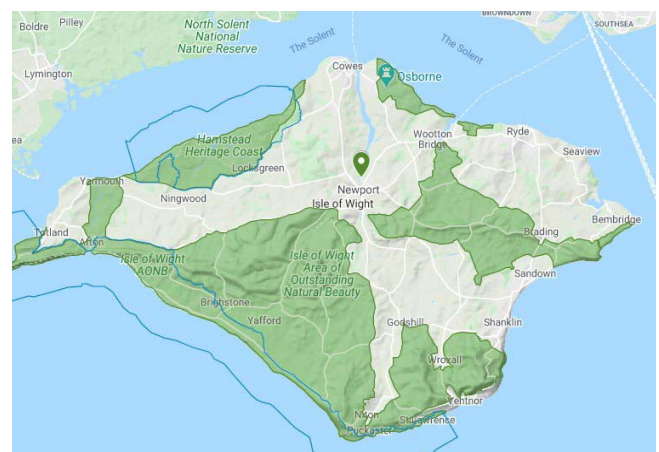
Development encroaches into woodland habitat bringing with it pets and cars. Woodland is also a popular place for developing tourist attractions, to the detriment of wildlife.

Sightings of red squirrels are frequent on the Isle of Wight as woods are relatively small, fragmented and often near roads or development, giving a greater chance of seeing a red squirrel.

Squirrels also help themselves to food put out by homeowners for the birds, so there are



The Isle of Wight



Map showing areas designated ANOB

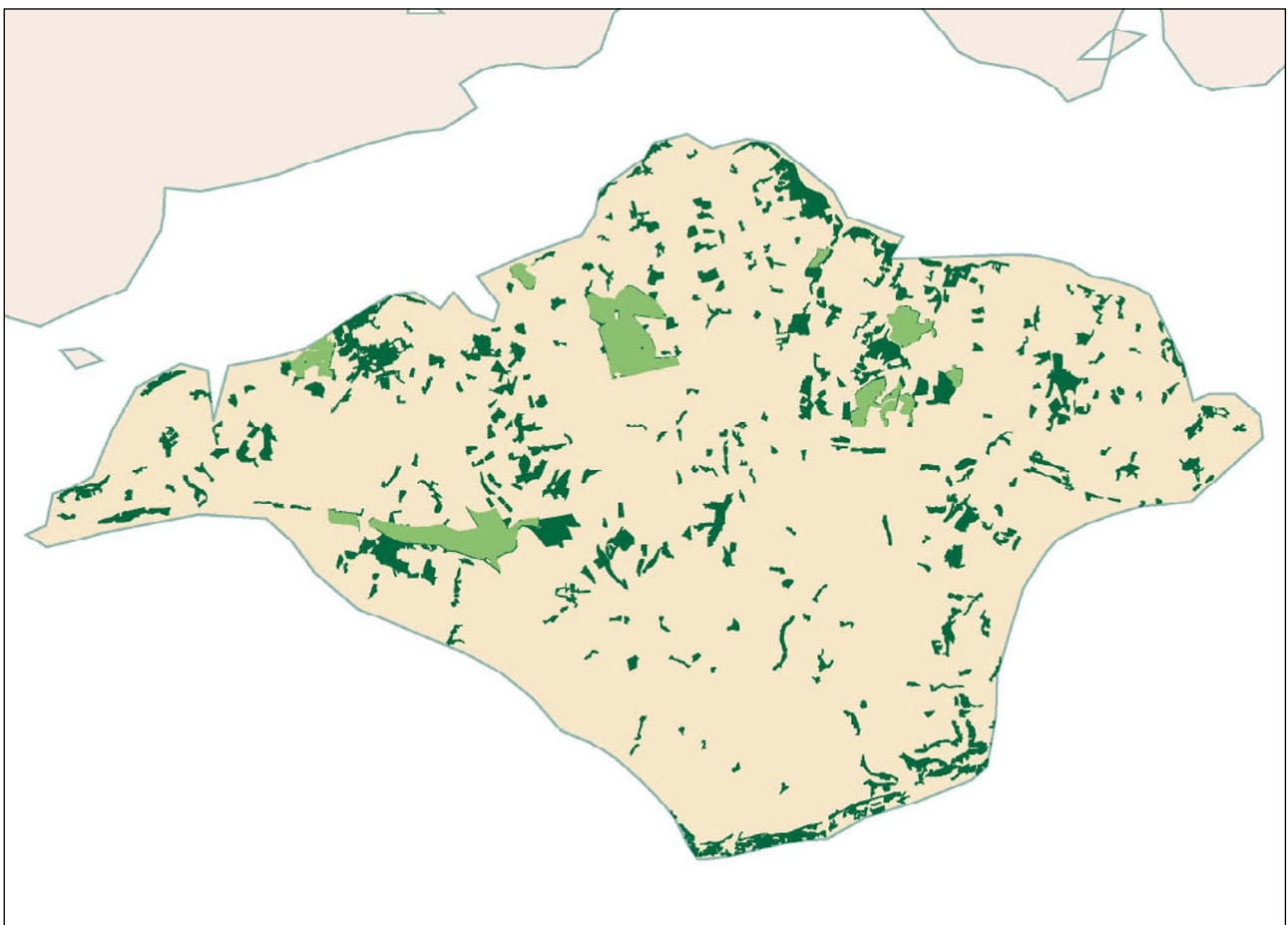
literally hundreds of homes on the Island that have squirrels visiting daily. Perhaps this is not ecologically sound but the squirrels will come to gardens and take bird food regardless.

Providing information about healthy feeding, taking care to cover water butts, highlighting the risk from pets and of putting down rat poison will at least limit harm to the squirrels. However, statistics show this is far from 100% effective.

There is a temptation to try and tame red squirrels. For the sake of the red squirrels, we discourage this practice and will not take on any volunteers that 'use' the squirrels purely

for their own pleasure. We are here to help them and their welfare must come first. Part 3 will explain how disease can pass between humans and squirrels.

The map shows how fragmented woodland on the Isle of Wight is. In part 2, corridor links are discussed. Since the Forestry Commission funded the JIGSAW project to extend ancient woodland and link up isolated woodland, squirrels can disperse from east to west and north to south. This isn't necessarily in a straight line and some routes will cross main roads. Road-kill locations and statistics are given in part 2.



Map showing distribution of woodland. The light green areas are owned by the Forestry Commission

1

A BRIEF HISTORY OF RED SQUIRRELS

This chapter is to introduce you to the subject species, *Sciurus vulgaris*, better known as red squirrel.

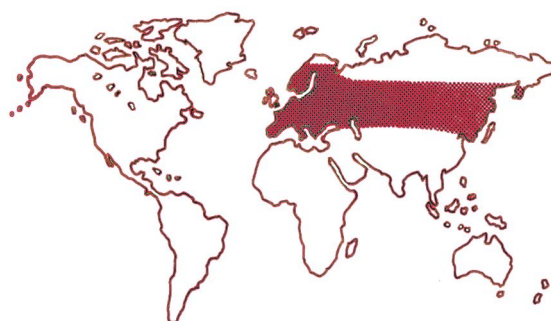
Squirrels belong to the order Rodentia, of which there are over 2,000 species, divided into 29 families worldwide. Rodents are characterised by their grinding molars and their incisors, which grow throughout their life.

Protosciurus is the oldest known member of the tree squirrel family, according to fossil records, dating from the Eocene period 37-32 million years ago.

The National Museum of Natural History at the Smithsonian Institute in Washington has on show a tree squirrel fossil dating back 34 million years. The skeleton is certainly similar to that of modern tree squirrels.

A paper describing the find is available on the internet (Emry & Thorington 1982): *Descriptive and comparative osteology of the oldest fossil squirrel, Protosciurus (Rodentia: Sciuridae)*. It's an interesting, scientifically written, read.

Members of this taxonomic group are the largest group of mammals living today. There are three groups of squirrel: flying squirrels, ground squirrels and tree squirrels.



Red squirrel distribution worldwide

Worldwide

Worldwide, *Sciurus vulgaris* is found throughout Europe and Asia, from the Arctic Circle in the north to the Mediterranean Sea in the south, and from China in the east to western Europe in the west. It's only in United Kingdom and Italy that they face an immediate threat. Greys were introduced into northern Italy in the 1940s.

Great Britain

Red squirrels were widespread over the whole of the British Isles and Ireland after the last Ice Age. Fossil remains of the red squirrel found in Britain were dated at between 7,000 and 10,000 years old.

Red squirrels disappeared from Ireland and were not reintroduced until the 19th century. It's believed deforestation was responsible for their

Kingdom	Animalia (Animals)
Phylum	Chordata (Backbone)
Class	Mammalia (Mammals)
Order	Rodentia (Rodents)
Family	Sciuridae (Squirrels)
Genus	<i>Sciurus</i> (Tree squirrels)
Species	<i>Sciurus vulgaris</i> (red squirrel)

Table showing the scientific classification of red squirrels

disappearance. Today there are red squirrels and the introduced American greys in Ireland.

In Wales and Scotland, squirrels rapidly declined during timber shortages in the 15th and 16th centuries as forests disappeared to supply timber for human endeavours. During the 18th century Scottish red squirrel numbers plummeted almost to the point of extinction. The reason is unclear.

At the beginning of the 19th century tree planting on a large scale took place, especially of fast-growing conifers, and red squirrel numbers grew.

In 1876 American grey squirrels (*Sciurus carolinensis*) were introduced into Henbury Park in Cheshire by landowner Mr Brocklehurst. This introduction was followed by 30 releases elsewhere in the country, thus sealing the red squirrel's fate in most of Britain.



Grey squirrel

Woodland destruction throughout the British Isles will naturally reduce the number of squirrels. Development and modern farming methods decreased woodland cover, including vital hedges linking woods together, which are important for many other species as well as red squirrels.

It is possible small, isolated populations could be wiped out in bad seed crop years and not replaced if 'corridors' of trees linking woods together are lost.

Disease has also played a major role in the decline of reds, as they appear to be more susceptible to certain diseases than greys, most notably squirrelpox virus.

Although not the sole reason for the reds' decline, the greys are a major contributory factor. If the greys had not been introduced into Britain, then it's highly probable red squirrel numbers would

have recovered from times of natural disease, habitat fragmentation and years of food shortage.

Concerted efforts to reduce grey squirrels and reintroduce red squirrels has been fraught with problems. Currently, methods to reduce breeding in grey squirrels and a squirrelpox vaccine for reds are under way.

A natural squirrel predator, the pine marten (*Martes martes*) is currently taking its toll on grey squirrel populations. Only time will tell if any of these methods are successful enough to allow native red squirrels to dominate British woodland once more.



Picture of red squirrel with squirrelpox

The Isle of Wight

The Isle of Wight is a small island of 380 km², off the south coast of England. The human population is approximately 140,000. The red squirrel population, based on habitat, is around 3,000.

From the Neolithic period onwards the needs of agriculture have altered the Island's landscape. When hedgerows and small fields were common, it's said that squirrels could travel from one end of the Island to the other. However, if there are no woodland blocks to settle in on the way, tree squirrels are unlikely to reach the other end of the Island. This is discussed in later chapters.

In the south of the Island, lighter soils have provided good agricultural land and there are no sizeable woods left. The heavier clay soils in the north are much harder to work and tree cover is higher. This is where the majority of our red squirrels are found.



The Isle of Wight is fortunate in having the Solent as a barrier to direct grey squirrel invasion. Although the odd grey squirrel has mysteriously found its way to the Island in the past, it has been quickly dealt with. However, Isle of Wight red squirrels have not been spared the landscape changes that also affect the rest of the country.

Over the years, tree loss due to development and modern farming methods has decreased woodland cover – and the vital hedges linking woods together.

Pollard, Hooper and Moore ([Hedges 1974](#)) in the New Naturalist Series suggested that hedgerows were lost at a rate of around 3,000 miles per year between 1946 and 1963. As farming became more intensive and machinery bigger, hedges were ripped out to accommodate modern farming methods.

Development and the need for housing has also had an impact on the countryside. This is an ongoing problem. It is not just the loss of habitat and corridors; humans bring pets, cars and other hazards with them.

On the plus side, humans also provide supplementary feeding. More on this subject follows.

When I started working with red squirrels on the Island in 1991, numbers had dropped to a low level as a result of the 1987 hurricane. Apart from the tree loss and the inevitable decrease in winter food, corridor links were disrupted, leaving some woods isolated. People who had fed squirrels in their garden for years reported their loss.

Red squirrel numbers rose steadily throughout the 1990s and once again red squirrels are seen regularly in gardens, parks and woods. From there on red squirrel numbers grew steadily and their home range spread, albeit with a few peaks and troughs in numbers along the way. Data in part 2 shows the rhythms and peaks.

Monitoring will continue using tried and tested methodology but also trying out new ideas, such as trail cameras and DNA testing. The sightings from the general public will continue to provide a baseline for research and surveys.

2

RED SQUIRREL PERSONALITY AND PHYSIOLOGY

Personality

When I lived in a property bordering an Isle of Wight forest, it was a great opportunity to study red squirrel behaviour and personality. The data is in part 2.

The greatest insight into red squirrel personality is raising orphaned red squirrels. Living with them makes you realise they are just as diverse in their traits and development as humans. For example, like us, squirrels are right- or left-handed.



Feeding an orphaned red squirrel

Most orphaned red squirrels adapt to having a human mother and I've only had one that most certainly did not. Food and warmth is paramount and if you are providing that, they are generally content.

Some are brighter and faster to learn, whilst others just give up when presented with a challenge. The young waited their turn at the feeders or picked up pieces dropped by the older squirrels. There is a pecking order and it is not always the largest squirrel that dominates. Gender doesn't appear to influence dominance either.

Red squirrels are not kind to aged or infirm squirrels. One member of the public reported the

bullying of a very old squirrel. When I had the body for post mortem, he was found to have had an arthritic hip joint that immobilised a hind leg (details in part 3, chapter 2) making it easy for younger, fitter animals to chase him away from food.

All have food preferences and start on solid food between seven and nine weeks of age. Characters range from timid to an 'I'm in charge' attitude. All are curious about everything and get into all sorts of scrapes. They are certainly not neophobes as everything is inspected with little or no hesitation, although wariness does come with age in most squirrels.

Animals with serious injuries such as lost limbs generally appear to feed when no other squirrels are around. Injured squirrels do adapt pretty well to loss of limbs, although they are more wary of other squirrels.

Physiology

The average body length of an adult red squirrel is 21.5cm with the tail nearly doubling the overall length. An average weight is 300g for an adult. By examining well over 700 animals post mortem, it became apparent size in squirrels has a wide range. Tail length also varied and a genetic anomaly has been observed in that, very

occasionally, a mother with an abnormally short tail gives birth to a kitten with a 'stumpy' tail.

Red squirrels have evolved to cope with life in the trees. Vision, hearing, sense of smell and balance are acute. Squirrels are diurnal, that is, active in the day, therefore night vision is poor. Their eye structure has evolved accordingly. Reaction is based on movement rather than sight. If you stand perfectly still, a squirrel will not react to your presence but if you move, it will be gone.

The inner tier of the two-tiered retina is made up of rods and the outer tier of cones, meaning that squirrels have colour vision, although studies of eye structure suggest it's possible that they are not able to see red. They have wide-angled vision, necessary for detecting predators.

Scent marking is achieved by face wiping and urination. A glandular lip plate secretes an odorous substance that identifies the squirrel to its neighbours. Marking territory is important and a message to anyone thinking of muscling in on your patch.

Olfactory sense is good and a male can detect a female coming into season from a kilometre away. It is thought that a good sense of smell, coupled with a good mapping ability, enables a squirrel to relocate buried caches of food.

The vibrissae (whiskers), which are on the underside of the body, limbs and at the base of the tail as well as on the face, aid movement through the trees with amazing accuracy. Squirrels have powerful hind legs and feet with a double joint which can turn 180°, enabling them to run up or down tree trunks with equal dexterity.



The tail, apart from being used as a signal when disturbed, acts as a balance, helping them to move through the tree tops at speed. It also aids as thermoregulation when held over the back.

Sharp claws and pads on the bottom of their feet provide effective gripping tools. The back feet have five digits and the forepaw four plus a residual thumb.



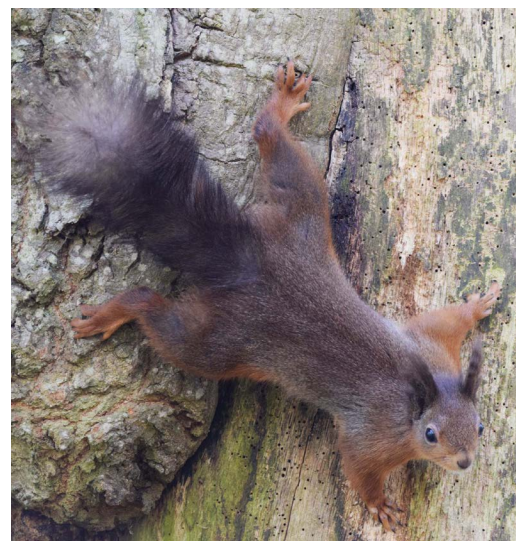
Pads on the bottom of the forepaw



Residual 'thumb' on forepaw



Hindpaw



An extra joint in the hind leg allows the hind legs to turn backward

Gender

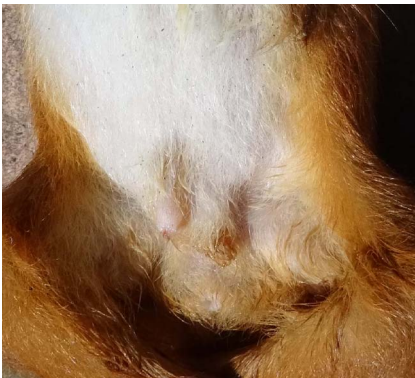
A popular misconception is that pelage colour is linked to gender, but it is not; it is determined by genetic variation. Unless you can see the genital area, it's difficult to tell male from female.

Male testes regress into the body in the autumn and appear again around December or the beginning of January. If you look carefully, you can see a greyish patch during the time the testes are abdominal.

Adult male genitals are obvious when males come into breeding condition at the beginning of the year, or as they approach their first birthday. Like humans, squirrels are mammals as they give birth to live young and produce milk, so if a female is lactating it is again, visually obvious.



*Young female
There is a
short distance
between anus
and genitals*



*Young male
There is a
greater distance
between the
anus and
genitals*



*Adult male in
breeding
condition. The
testes are very
evident*

Breeding

Red squirrels are polygamous. The male mate with a female when she is in oestrus and then leaves her to raise the kittens alone.

Red squirrels come into breeding condition at around one year old. A female comes into oestrus for one day twice a year and gives birth to, on average, two or three kittens. I have seen up to four on the Isle of Wight and on a few occasions, only one.

For squirrels over a year old, the beginning of the breeding season starts at the beginning of the year and lasts through until the autumn. This is when the male's testes shrink back into the abdomen and the females do not come into season.

Whilst males are in breeding condition for 9–10 months of the year, mature red squirrel females generally come into oestrus for just one day twice a year. The female must be in good condition to come into season. If she does conceive and then food becomes short or she falls ill, then some, or all, of the foetuses will be reabsorbed back into the body. This had occurred in a female brought in for post-mortem examination.

A few days before a female red squirrel is ready to mate, she gives off chemical signals, called pheromones, that can attract males from around a kilometre away. Mating chases ensue and the most persistent male will mate with the female when she is ready. Red squirrel males play no part in building the family home or rearing the kittens.



*Lactating
female*

Red squirrel gestation is 38–42 days and the female gives birth to, on average, two or three kittens, as baby squirrels are called. They are born blind, deaf and hairless. Mother has four pairs of teats and suckles the babies. If mother realises early on that a baby is weak or has a defect, she will not waste time rearing it. Occasionally a kitten is brought in for us to rear but found to have a congenital defect and cannot be reared successfully. (More in part 3.)

On one occasion a mother with four kittens was seen to push two out of the drey and was then witnessed biting them. I had the bodies and she was not eating them, just ensuring they didn't survive; there was significant blood loss and the injuries were severe. Perhaps she was not producing enough milk or realised the kittens were not viable. They were certainly thin.



Kittens at 2 weeks old

By two weeks old the kittens are covered in fine hair and take on a more familiar appearance. At around four weeks of age, teeth appear and ears and eyes open.

At around seven weeks old, although still very small and suckling, the youngsters start to follow mother from the nest and begin on solid food. They are vulnerable at this age and may get left behind or predated. At 12–14 weeks old, the kittens should weigh around 220g and are ready to leave the nest.



Kittens around nine weeks old

Although siblings may stay together to start with, for the most part, red squirrels are solitary animals but will huddle together in order to survive in cold weather. They need to find their own home range – which means competing with adult squirrels.

The youngsters must build several dreys so that they can move into a fresh home when the build-

up of fleas and other parasites becomes too much. Not keeping the flea burden down can lead to problems such as anaemia, particularly in young animals. (See part 3.)

The first year of life is crucial and mortality rates are high. Competition with adults and food availability plus the animal's strength of personality will influence whether or not they survive to see their first birthday and establish a home range. Scent marking is crucial to marking territory.

Scent glands are located on a red squirrel's cheeks and they can be observed rubbing their face along a branch. From personal experience when caring for red squirrels, urine is pungent and has a distinct odour and therefore ideal to mark territory.

Age determination

As with gender, colour is nothing to do with age, although many people think so. You will notice in this publication that ages are referred to as juvenile, sub-adult and adult. Juvenile is from birth up to 12–14 weeks old when they leave home, then sub-adult to breeding age at around one year old. There are various ways to determine age. Breeding condition is one way and described above.

It takes experience and just 'getting your eye in' to judge age. Kittens are born toothless and the incisors start to appear at around 4 weeks of age.

An adult has 22 teeth, the four specialised incisors are used for the all-important task of cracking nuts, whilst the molars grind the food.



Upper molars and incisors



Lower jawbone

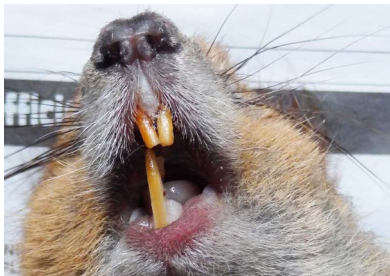
The lower incisors are the first to appear, at around 3–4 weeks of age. These are followed by three upper and three lower molars with the pre-molars, two upper and one lower. The lower and second upper pre-molars are replaced by permanent adult teeth at around 16 weeks of age. The other teeth are permanent and grow throughout life.

A squirrel's teeth grow throughout its life. They have a large pulp cavity providing a good blood supply, enabling the teeth to grow from the base as the tip erodes. Gnawing hard shells keeps the teeth in shape. If it's possible to catch a squirrel, with a tooth problem, it can be put right by careful dentistry from a local vet.

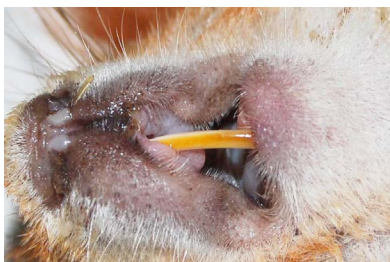
An unchecked misaligned tooth prevents gnawing, can grow into a tusk and penetrate the face.



Incisor which was growing into face. The vet snipped off the excess tooth before it cut into the squirrel's face.



With a lower incisor missing, this animal could not survive.



This squirrel only had one incisor and there was no sign of any broken incisors, so possibly this anomaly was due to a congenital defect

Shin (femur) length is another guide to age. From measuring shin length of animals brought in for post-mortem examination, the average shin length for an adult is approximately 70mm.

Behaviour is another clue. Sub-adults are generally less sure of themselves, avoid older squirrels and are less able at accessing food.

Watching squirrels who know there is food in a squirrel feeder but do not know how to open the

lid will give an idea of the age and how bright the animal is. Some squirrels are smart and learn quickly or watch the adults, whilst others just frantically bounce on the lid in the hope it will open. Most squirrels do get the idea eventually.

Musculoskeletal system

Featuring a strong flexible spine and a long tail, mainly for balance, a red squirrel's skeleton has evolved perfectly for a specialised for life in the trees. A ribcage encloses a heart and lung structure, as it does in humans. The ribcage is soft compared to a humans and is easily cut with small surgical scissors.



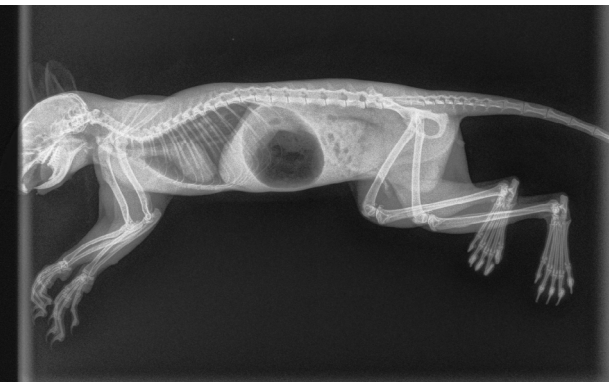
Ribcage

As expected with such an energetic animal, muscles are well developed, unless the squirrel is sick. With four digits on the front paws and five on the back, they display excellent dexterity in the trees and when extracting food from hard or prickly seed cases. Hind legs have an extra joint so the squirrels can run down trees equally well as running up them.

On the rare occasion I had a squirrel that died of old age, or was obviously old, having a ragged appearance and scars. The bones were yellowed and less smooth in appearance. One elderly squirrel had an arthritic joint which immobilised his hind leg.



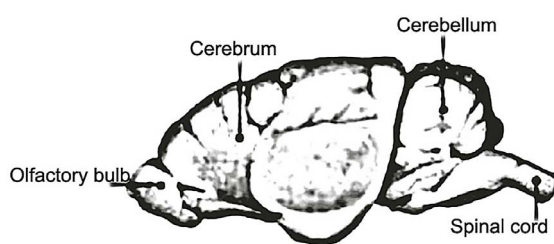
Arthritic joint



X-rays showing red squirrel skeleton.

Pictures courtesy of Medina Vets

A Squirrel's Brain by Dr Jon Fishman



The squirrel's brain is not fully broadsides, is not between the eyes and ears, but above and behind the upper/rear corner of the eye. The cerebellum is a small protuberance to the rear of the brain and beneath it is the junction of the brain and spinal cord.

The cerebrum is located towards the front of the brain but behind and above the olfactory bulb. The hippocampus is located on the underside of the brain and is believed to be the main memory

store location. Squirrels have excellent memory for locating food and navigation.

It is believed they make a mental map of each area using landmarks to triangulate the location of food stores. The large olfactory bulbs receive neural input about odours detected by cells in the nasal cavity. The axons of olfactory receptor (smell receptor) cells extend directly into the highly organised olfactory bulb, where information about odours is processed, which allows squirrels to detect food below the surface.

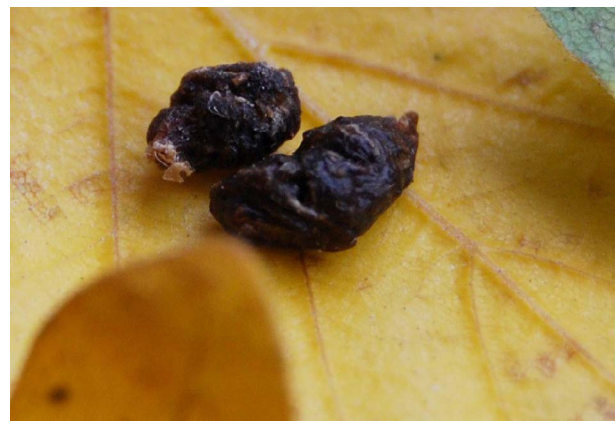
The cerebrum performs higher functions like interpreting touch, vision and hearing, but unlike in higher primates it is rather small. The cerebellum receives information from the sensory systems, the spinal cord, and other parts of the brain and then regulates motor movements. The cerebellum coordinates voluntary movements such as posture, balance, coordination, resulting in smooth and balanced muscular activity.

Internal organs

As you will read in volume 3, red squirrels share some common – and uncommon – causes of mortality and morbidity to humans.

Internal vital organs are aligned in a very similar way to those of humans. Their heart, lungs, liver, pancreas, kidneys, spleen and digestive tract look remarkably similar to ours.

The digestive tract has a stomach that stretches when full and contracts when empty. I found that in a few animals the stomach was small and not as elastic when empty, while, going to the other extreme, the full stomach dominated the body cavity. The intestines are long, as you would expect from a predominantly herbivorous animal.



Squirrel faeces, approximately 5mm long

Since squirrels are very active animals, few have excess fat deposits, and those that do generally have pathology. The most common area to store fat, in the animals I've autopsied, has been around the kidneys. The fat is pure white and of a mucilaginous texture.

Pelage

The pelage, or coat, colour can vary enormously in red squirrels and is nothing to do with age or gender but genetic variation. There is more on genetics in the next chapter.

The pelage consists of layers, the closest to the skin is the insulating underfur. The main body of hair is the colour we are familiar with and this is topped with longer guard hairs.

In red squirrels, the summer coat can be a different colour from the winter coat. The winter coat is moulted in the spring, beginning with the face and working backwards. The long eartufts are lost completely on most animals but some do retain a vestige of tufts.



Summer coat



Winter coat

The autumn moult starts at the rump and works forwards. At these times there are always phone calls from concerned members of the public because their garden squirrels have bald patches. Some squirrels are not at all elegant when they moult, whilst in others, the change in coat is hardly noticeable.

I've seen kittens that are a very pale grey in colour, so obviously not age related. Colours can range from every shade of grey through to virtually black. Equally, many shades of brown and ginger are found. Occasionally, multi-coloured reds are seen.

One of the oddest winter coats I observed belonged to a red squirrel (it had eartufts) with a brindled grey body and a bright ginger tail. It is quite common for a squirrel to have a light or dark tail tip or a dorsal stripe but occasionally a squirrel will have racoon-like rings in the tail or just a mixture of colours. In the summer some red squirrels may have very blonde tails.

A few examples of colour variation:



3

GENETICS OVERVIEW

As you will have read in an earlier chapter, red squirrels have many similarities to humans. They do have fewer chromosomes though, that is, red squirrels have 20 pairs of chromosomes and humans have 23 pairs.

Three islands DNA study

A batch of 25 DNA samples (left from leprosy testing) were sent to Bournemouth University. Geneticist Dr Emilie Hardouin and ecologist Dr Kathy Hodder put them together with samples from Brownsea Island and Furzey Island (Poole Harbour) to see how red squirrels from the three islands compared.

Results showed that genetic diversity was low overall; on the other hand, unique genetic strains were also discovered. Isle of Wight red squirrels are genetically most closely related to other British squirrels from the south of England. There is even a possibility that Brownsea and Isle of Wight populations might be remnants of an original red squirrel population, as there is no evidence of introductions in these islands.

In other parts of the country many releases of red squirrels from continental populations appear in historical records. Although more evidence would be required to be sure, at the moment, there is no

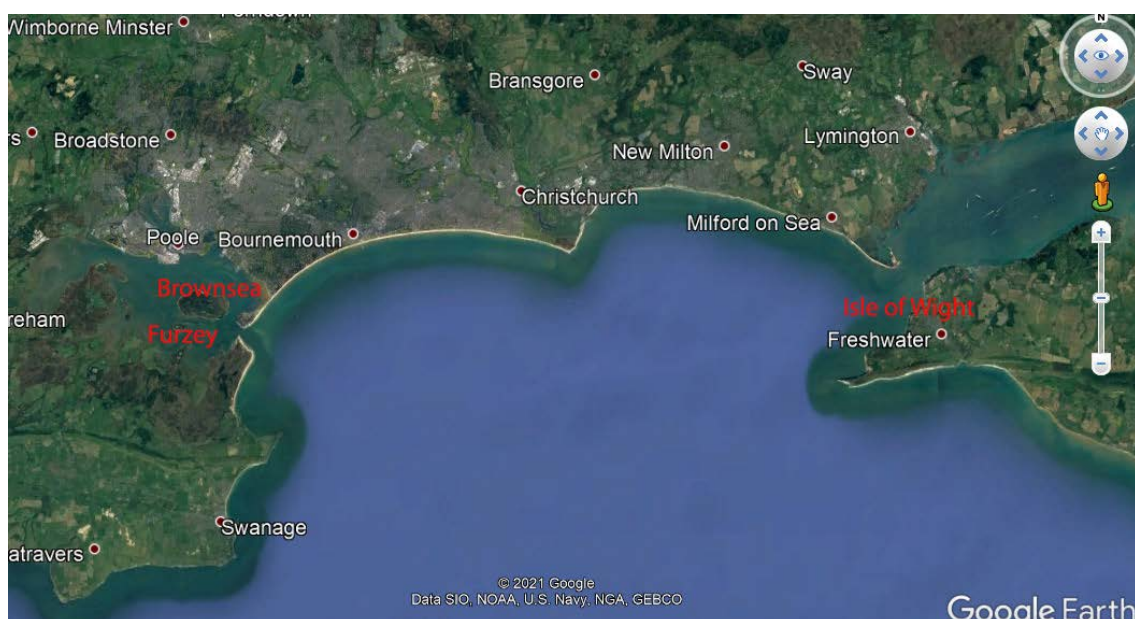
sign of Scandinavian or European origins on the islands.

Microsatellites

To take the original genetic study further, I sent another 125 tissue samples to Bournemouth University. This study was commissioned by Wight Squirrel Project with the remit to focus on how closely related Isle of Wight red squirrels are to each other.

More importantly, it can be compared to causes of mortality data to see if there is a correlation between inbreeding and disease. Also if there are any problem areas on the island.

Each animal autopsied is given an ID number; this has aided previous scientific research and will also contribute to this study. There are a number of locations where inbreeding is suspected and a study of the results do indicate the parents of several squirrels autopsied were closely related.

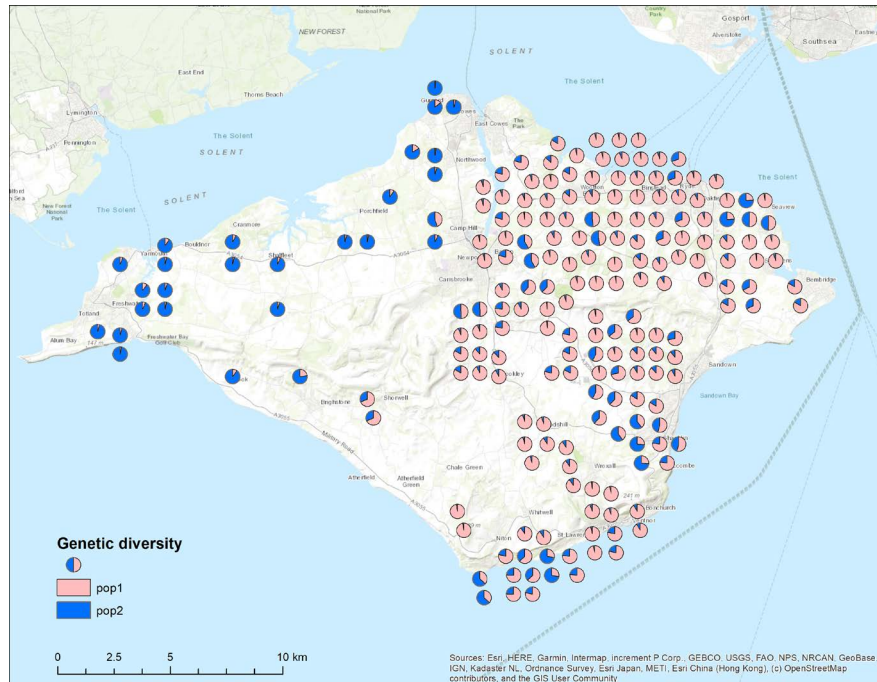


However, to date, no obvious signs of abnormally large numbers of ill-health has been found. As with any population of a species, there are congenital defects. On the Isle of Wight, there is no ‘hotspot’ and the occasional birth defect is found islandwide, in very low numbers.

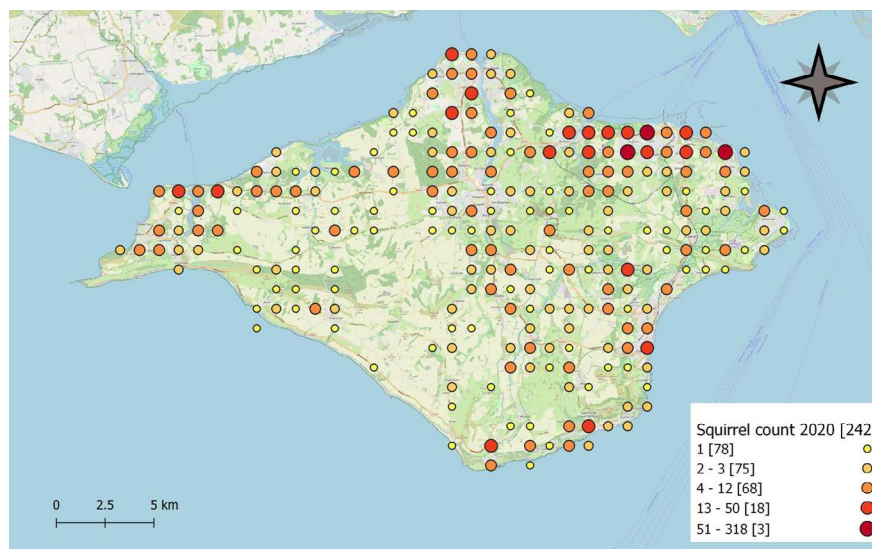
It is noticeable that genetic diversity is far less in West Wight and there are scant samples from the south-west. By comparing the genetic diversity map to a sightings distribution map, a similar

pattern emerges. This is partly due to woodland distribution but also accessibility to woodland and lower human habitation density. Where woods are remote, dead squirrels are less likely to be picked up, therefore no tissue samples are taken.

Further studies are planned to obtain tissue samples from missing areas. DNA testing every 5 –10 years would show if squirrels were dispersing across the island and identify areas that would benefit from tree planting.



Put simply, the larger the block of one colour, the closer related the parents are. The dots in the sea are inland but displayed in the sea for clarity. Note the area in the south-west where no tissue samples were available for testing



Sightings map for 2021. The area where sightings are scant or there are no squirrel records, matches the area on the genetic diversity map.

4

LIFESTYLE

To start this chapter we will dispel one myth about squirrels – neither red nor grey squirrels hibernate. Neither species goes into torpor as dormice, hedgehogs (*Erinaceus europaeus*) and bats do in the British Islands and Ireland. Red squirrels cannot go too long without venturing out to look for food, regardless of the weather, including snow. If the day is wet and windy, most squirrels will not venture as far as on a nice day but they are observed out in all weathers.



Red squirrel in the snow

Natural food is cached in the autumn when seeds such as beech (*Fagus sylvatica*), hazel (*Corylus avellana*) and sweet chestnut (*Castanea sativa*) are abundant and retrieved later in the winter and spring. Fungi is also a favourite and plentiful in the autumn. This is the red squirrel's version of

a winter larder. Caches are generally buried but may be hidden in cracks high up in the trees as well.

Smaller seeds, such as hawthorn (*Crataegus monogyna*), are also eaten and opened in the same way as hazelnuts, that is, split in half.

A squirrel's nest is called a drey. Dreys are approximately 30cm in diameter and have no obvious entrance. They are usually built in mature trees at least 8m from the ground and generally against the trunk. The outside is made of twigs which will initially have leaves on. The inside is lined with dried grass, leaves or moss to make a soft, warm, dry home. When human habitation is nearby they may help themselves to something soft off the washing line or shred string and ball it up in their mouth to take back to their drey.

Summer dreys may be little more than a platform of twigs and leaves and are not built to last. Winter dreys are very well made and can last for several years. There is no obvious difference between red and grey squirrel dreys.

A tree hollow is the ultimate home and called a den. Squirrels build more than one drey or den nest at a time so that they may move home when the build-up of parasites, predominantly fleas, becomes unbearable.



Red squirrel with coir for use as bedding material.

Picture is courtesy of Mr Myall



Squirrel using a tree hollow as a den



Drey high up in fork of tree

Predators may catch an unwary squirrel on the ground but in the trees they are relatively safe from most threats. Saying that, the rise in common buzzards (*Buteo buteo*) has taken a toll but some red squirrels, on the Isle of Wight at least, have adapted. There are now noticeably fewer dreys in the treetops. Some squirrels are building in more imaginative places and people have reported dreys built in lofts and barns. In 2019 a mother squirrel even had her kittens in a tractor roof!



Common
buzzard

Reds spend far more time in the trees than greys and prefer to feed from a vantage point such as a tree stump. Shoots, catkins, fungi, green cones and ripe cone seeds are available to them in a well-managed mixed woodland. A red squirrel's slender build and light weight enables it to climb out to the very tips of the trees to take cones and nuts. When the seed crop is poor, fewer squirrels will survive the winter, the young and weak or older adults being most likely to succumb'.

The beginning of the year heralds the start of the breeding season when females come into oestrus and the males' testes appear. Breeding details are in chapter 2.



Squirrels notch the top of the nut using their incisors and split it in half.

Depending on how abundant the autumn seed crop was, the squirrels should have enough stored nuts left from the autumn to

help them through until the spring. It's thought that squirrels use a map in their head coupled with a keen sense of smell to relocate their caches. They will also supplement their diet with other food such as lichen, fungi and mycelium found under bark.



Feeding stump. Note the split hazelnuts and chewed pine cone leavings

A red squirrel will hold a home range, which it scent marks, but it does overlap with those of other squirrels. Males generally cover a wider range than females, especially once the breeding season starts. There is no definitive range size as much depends on the tree species within the wood, food production and the time of year.

By the springtime, when the first litters of squirrels are leaving the nest, food is in short supply, making survival more challenging. If most of the stored caches have been used, shoots, buds and insects are foraged but do not have the nutritional value of nuts.

Trees such as wych elm (*Ulmus glabra*) produce seeds in early summer and Scots pine cones are eaten in June, although they are still green. Wild cherry (*Prunus avium*) and Rowan (*Sorbus aucuparia*) can also provide food early in the summer.

Statistics show that only around one in six red squirrels survive to see their first birthday. If they survive their first year, red squirrels can live up to around six years old in the wild. Food shortage, stress, disease and predation by birds and other mammals regulate the population.

Personality also plays a part as subordinate animals will be bullied and therefore will stress, making them more vulnerable to illness.

Carrying capacity of any habitat determines food and nest sites for a finite number of animals, who

are competing for food and space to ensure their own survival. In other words it is survival of the fittest.

It is a natural process for numbers in a population to fluctuate wildly according to the season; immigration, emigration, habitat disturbance and success or failure of the seed crop all have an impact. During the spring, summer and autumn months, kittens born will inflate numbers. Road casualties, predators and disease balance the number of squirrels.

Natural red squirrel predators in the the British Isles and Ireland are red foxes (*Vulpes vulpes*) and pine martens (*Martes martes*) and large birds such as buzzards (*Buteo buteo*), magpies (*Pica pica*) and carrion crows (*Corvus corone*). The Isle of Wight does not have pine martens.



Red fox (*Vulpes vulpes*)

Feeding peaks at dawn and dusk all year, whilst during the long days of summer they also feed around late afternoon. Red squirrels are opportunistic feeders and spend 60-80% (Holms 1991) of their active time foraging, the rest is spent in drey building, grooming and chasing.

Squirrels retire at dusk but may go back to their drey for a rest during the hottest part of the day. There are always exceptions and the more subordinate animals will appear at any time of the day, taking the opportunity to feed undisturbed by older or dominant squirrels.

Around the beginning of August, hazelnuts begin to ripen and the squirrels start eating them before they

are fully ripe. If reds are to survive the winter, they need to gain 10% of their bodyweight, so a good autumn seed crop is essential to their survival.

In the autumn squirrels gather other seeds such as sweet chestnut and beech. They also like fungi and berries. Autumn is when they stop breeding, presumably so they can concentrate on gathering the all-important glut of fruits and seeds.

The autumn moult starts around October. This time it starts at the base of the tail and works forwards and the iconic ear tufts, which were moulted in the spring, grow back again.

Survival for kittens born later in the year is better as more food is available. Periodically the autumn seed crop is poor therefore fewer young squirrels survive and the older or weaker adults may perish too. Lack of nutritious food is the most common cause of death within the first year. This may be coupled with a hard winter or disease.



A sick red squirrel will sit on the ground, head down and tail over the back.

Where greys interact with reds, there is the added danger of transmission of the squirrelpox virus. It's rare for a grey to contract the virus although they carry it. The symptoms resemble myxomatosis as lesions and swellings appear on the face, especially around the eyes. There is also ulceration and scabs on the body, plus movement is difficult. Thankfully the Isle of Wight does not have grey squirrels and therefore no instances of squirrelpox virus, to date.

Squirrels also carry external parasites such as fleas (*Hoplopyllus sciurorum*), which can cause anaemia, generally in young animals or very sick adults. Death follows if the build-up becomes too great.



Red squirrel that died of squirrelpox virus in the north of England



Hoplopyllus sciurorum

Internal parasites include worms and coccidiosis. They are also prone to toxoplasmosis from contact with cat faeces when burying nuts. This is common on the Isle of Wight. Morbidity described in more detail in part 3.

Red squirrels are prone to suffer from cold and wet conditions and will quickly die of exposure. Stress triggers weight loss and disease, which will weaken the squirrel and may lead to its death.

A variety of bacterial and viral diseases can attack squirrels and they can contract health problems similar to those experienced by humans, e.g. cancer, gastroenteritis or perforated stomach ulcer.

Natural predators also take their toll of young or unwary squirrels as stated in the previous chapter. On the Isle of Wight, a magpie was seen stabbing a young red squirrel through the chest and a crow was seen breaking a squirrel's neck – both in gardens.

5

ANTHROPOMORPHIC CONFLICTS

Despite a contraction of their range in Britain and Ireland, red squirrels are ranked globally as of Least Concern. In most of their range they are widespread and common. It is only in the UK and Italy, where they are under threat from the American grey squirrel, that they have a measure of legal protection.

A logical place to start this chapter is by looking at the laws pertaining to red squirrels. Red and grey squirrels are mentioned in the Wildlife and Countryside Act 1981 – but for different reasons. Red squirrels and their dreys are partially protected, whilst greys are classed as vermin and it is illegal to release a grey once it is caught.

Red squirrels

It is illegal to:

- 1) Intentionally kill, injure or take a red squirrel.
- 2) Possess or control (live or dead animal, part or derivative).
- 3) Cause damage to, destruction of, obstruction of access to, any structure or place used by a squirrel for shelter or protection.
- 4) Disturb a red squirrel occupying such a structure or place.
- 5) Sell, offer for sale, possess or transport for the purpose of sale (live or dead animal, part or derivative).
- 6) Advertise buying or selling of wild red squirrels.
- 7) Trap red squirrels for scientific purposes without a licence.

There are certain exceptions. It is legal to nurse or humanely destroy injured red squirrels. There is also provision to cover incidental actions that are an unavoidable result of otherwise lawful activity, e.g. if you accidentally hit a red squirrel whilst driving. Forestry operations are also exempt as long as reasonable care is taken.

Habitat prioritisation is another exception. The Act sets out the roles of Nature England and other organisations delivering Government objectives for wildlife. Red squirrels and woodland are not always seen as a priority.

Grey squirrels

- 1) It is illegal to bring a grey (even caged) into an area where there are only reds, e.g., the Isle of Wight. This offence carries a prison sentence of up to two years.
- 2) Once caught, it is illegal to release a grey squirrel.
- 3) It is illegal to breed or sell greys.

Isle of Wight safeguards

The biggest conflict is where grey squirrels, introduced by humans, come into contact with red squirrels. There is a strategy in place to deal with any grey squirrels that may stow away or are deliberately brought to the Isle of Wight. Wight Squirrel Project logs all reports of suspected greys and follows up on those that are near ports or are descriptive of a grey squirrel.

Action Plan

Apart from Wight Squirrel Project, Natural England, Forestry Commission, National Trust, People's Trust for Endangered Species, Hampshire and Isle of Wight Wildlife Trust and the Isle of Wight Council (Area of Outstanding Natural Beauty) make up the IW Red Squirrel Forum. Funds and manpower are available to enable an effective

control operation should a grey squirrel incident occur on the Island.

An incident that requires attention may be:

A detailed description from a reliable and trusted source who has had a good, clear view of the animal and is familiar with the differences between red and grey squirrels

A grey squirrel carcass

A good-quality photograph

A grey squirrel hair found in a hairtube and verified by an experienced person

The challenge is to remove a very small number of grey squirrels in an area inhabited by red squirrels. National guidelines regarding methods to deal with grey squirrels are updated regularly and must be checked prior to any action being taken. Traps should be placed on the ground and baited with maize.

This strategy is aimed at attracting greys and deterring reds from entering the traps. Grey squirrels are keen on maize but reds are not. Greys generally spend more time on the ground than reds, especially in the summer. Even after trapping has removed any grey squirrels, hairtubes should be left in place and checked twice yearly, spring and autumn, for two years.



Grey squirrel found dead on Isle of Wight beach

It is not impossible that a grey squirrel could reach Isle of Wight shores without human intervention as they are excellent swimmers; indeed, very occasionally a dead grey is washed up on the beach. The assumption is that the animal tried

to swim across but the strong tides and currents defeated it.

Wight Squirrel Project informs members of the Isle of Wight Red Squirrel Forum if it is believed there is a live grey squirrel incursion or a dead grey squirrel is found.

Grey squirrel incident

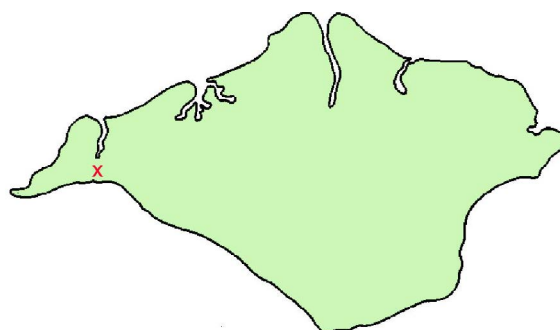
In spring 2001 I had reports from local residents that their reds had disappeared from the garden. At the same time, possible sightings of a grey squirrel around the Freshwater area came in.

In June, a post-lactating grey squirrel was found dead on Afton Road, Freshwater. The authorities were contacted and the strategy put into place.

Wight Squirrel Project volunteers set out hairtube grids around the whole of Freshwater and beyond to neighbouring woodland in West Wight.

No grey squirrel hairs were found after two years of monitoring. To date, no other incidents have occurred in West Wight. Full report in Appendix 1.

To date, reports of live greys have been a case of misidentification.



Location of grey squirrel road kill

It is not only squirrels and other wildlife that enjoy living in woodland as humans happily live amongst the trees as well. Although woodland is acknowledged as important nowadays, it hasn't always been the case and estates and holiday resorts were built into woodland – and still are.

When humans come into contact with wildlife and upset the natural balance there will be conflict and controversy. Where we have built our homes and roads through former squirrel habitat a number of problems arise. The obvious ones are traffic and pets. On the positive side, supplementary food provided by homeowners is helpful in times of shortage.

Traffic

Road traffic accidents are by far the largest reported cause of deaths on the Isle of Wight. Of course these unfortunate animals are easily found by a member of the public and so more often reported. A sick animal usually wants to hide so many natural deaths are unseen and therefore unrecorded. Sometimes 'garden squirrels' will go to where they know there is food and water even if they are ill or have suffered a glancing blow from a car.

Conventional road signs were erected at blackspots around the Isle of Wight in 1999. Previously, in 1996, an experimental rope bridge was erected across Calthorpe Road, B3330, in Ryde. Eight road deaths had been reported on this stretch of road, plus sightings of squirrels dashing across the road in front of vehicles. It was a very simple idea but took a surprising amount of time and trouble to arrange.

The first version was a plaited rope with food hoppers either side to encourage the squirrels to climb the trees and run across the rope instead of running across a wide and busy road. Permission was granted from the local Council with help from the late Councillor Alan Hersey. The fire brigade secured the rope 6m above the road.

The squirrels had no trouble at all getting used to the idea and deaths reduced. When road kills did occur, it was because the hoppers were empty.

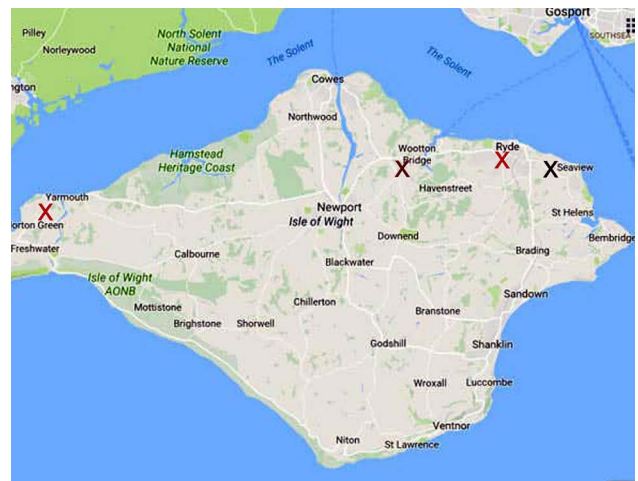
Ropes literally 'bridge the gap', so trees must partially meet across the road, as squirrels do not like to cross very wide, open expanses, where they are at risk from avian predation.

These innovations help but cannot replace sympathetic woodland management and planting corridor links in the long-term effort to save red squirrels.

Due to tightening of insurance regulations, there are currently no ropes across the roads. As an alternative, food hoppers are placed high in the trees where branches now meet across the road, which they didn't previously. Island Roads (responsible for road maintenance) have agreed to leave these crossing points for the squirrels.



Red squirrel crossing Calthorpe Road rope bridge shortly after it was erected in 1996. Photograph taken by the late Janet Dack



Map showing where ropes bridges were located

The pros and cons of garden feeding

Most people enjoy having red squirrels in their garden, particularly as red squirrels cause less damage than the grey squirrels. Isle of Wight red squirrels provide endless hours of entertainment and are commonly known as 'timewasters' as it becomes addictive to watch them. Statistics relating to garden-related mortality and morbidity are in part 2.

There are obvious hazards for squirrels entering gardens and the number one priority is to keep the squirrels off the ground; away from cats and dogs. Ropes or branches will keep squirrels off the ground, however, avian predators have been witnessed taking squirrels from ropes and open fences that are used as runways, so that is not a good idea unless there is cover.

Water butts and steep-sided ponds are another obvious danger. Squirrels are naturally curious

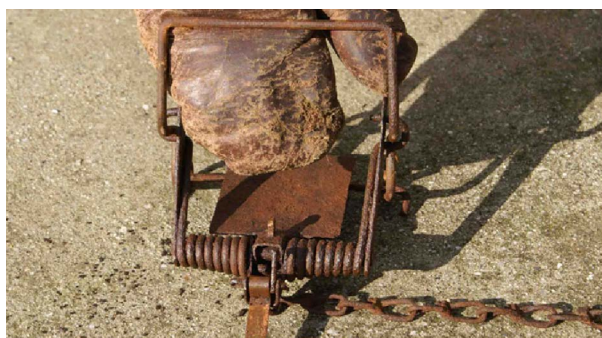
and can squeeze into very small gaps. They are good swimmers but die of exhaustion trying to climb out of an uncovered water butt. There have been instances of squirrels getting into the water butt via an uncovered drainpipe. The solution is to cover all open entrances in small mesh chicken wire.

Garden netting is another hazard and there is no easy answer to prevent squirrels getting caught in netting. To minimise accidents do not encourage squirrels into the garden by leaving food out. If the net cage contains food such as fruit, and squirrels are about, then eventually there will be casualties.

It is illegal to place rat traps or poison of any kind where a protected species can access it. Nevertheless, red squirrels are found annually either dead or dying after being poisoned.

Rat traps are another hazard. I have seen squirrels on the Island that were caught in a Fenn trap. They pulled themselves free but lost legs in the process. These horrific injuries are not always fatal and heal if there is no infection.

Amputees adapt well but noticeably feed when other squirrels are not around. Neither do they stay in the population for long, at least not visiting a garden feeding station.



Fenn trap



Fenn trap injury

Squirrels will readily take up residence in artificial dreys if placed correctly and these provide a residence that is more secure than a nest woven from twigs and moss.



Drey box

It's common to feed squirrels on peanuts in wire feeders. However, too many peanuts can cause thinning of the bones and a mixed diet of nuts and fruit is best. Brazil nuts must never be fed.

Squirrels quickly work out how to use a 'squirrel only' feeder. Food must always be of good quality, as chemically treated or stale food can – and does – cause digestive problems and even death. It is vital that feeders are kept clean and food fresh to prevent the build-up of bacteria and disease.

To help prevent the spread of disease, do not put more into the feeder than the squirrels will eat in one day. Scrub feeders thoroughly once a week and then use a bird cage cleansing disinfectant to minimise infection transference.

Squirrels naturally lick water from leaves and drink from puddles and ponds, but they are glad of a drink of water provided by garden owners during the drier months. Containers should be placed off the ground, near an escape route and water must be changed daily and kept clean.

Where gardens back onto woodland, cats may venture into the woods and catch squirrels. It is possible to buy a sonic cat collar, but a collar with several bells should be the least precaution taken where cats are likely to impact on any wildlife. If dogs are allowed to run unleashed in the wood, they do sometimes catch unwary squirrels.



Sonic cat collar



An uncut hedge, as on the left, is preferable to a cut hedge. Squirrels will use a cut hedge if there is no other option



A 'Squirrel only' feeder



Drinking from a raised water bowl

If a hedge or tree is cut, leaving a gap in a red squirrel's 'corridor' to a garden, then red squirrels may no longer visit. It is not uncommon for residents to report this problem. Sometimes the squirrels find another route, or they find another food source.

Red squirrels are omnivorous and catholic in their tastes when it comes to food. Natural food consists of insects and grubs as well as nuts, fruit, berries, fungi and lichen. They are also known to chew bone or antler, although there are no native deer on the Isle of Wight.

Supplementary feeding in gardens can upset the balance if unhealthy food is offered. On the other hand, a balanced diet aids survival in times of food shortage.

Red squirrels need to eat 20% of their bodyweight daily. An average weight for an adult is 300g, therefore they must eat around 60g of food a day. If natural food forms the majority of the diet, it's unlikely a few peanuts will cause a problem. If food is very short in the early summer months, then the squirrels may rely more heavily on a supplementary diet, therefore it must be balanced.

Peanuts are commonly put out to attract birds; however, squirrels will happily eat them as well. Contrary to the name suggesting they are a nut, peanuts belong to the legume family along with lentils, beans and soy. Opening nuts in hard shells is natural and keeps teeth in shape.

It's thought that oily food such as peanuts and sunflower seeds can retard the absorption

of calcium. Providing a bone to nibble or a supplement added to water can offset deficiency.

A study of metabolic bone disease in red squirrels in the UK was undertaken using radiology and bone densitometry. Comparing bone samples from 10 red squirrels from the Isle of Wight with those of 10 red squirrels from Cumbria, found slightly lower bone density and thinner cortices in the squirrels from the Isle of Wight.

The results suggested an imbalanced diet causing malnutrition and possibly generalised bone loss. Deficiency in bone formation is known as osteopenia. There are a variety of other reasons for the results, including genetic make-up.

Twenty-three femurs from squirrels submitted for post-mortem examination were x-rayed by Medina Vets to look for signs of osteopenia. The squirrels were of various ages, including juveniles, so some variation was expected. This is a small sample and has not been repeated. No cause for concern was raised by the vet.



Bones x-rayed X-ray photo courtesy of Medina Vets

Further research, using DNA techniques to analyse tissue samples from dead squirrels, may give some answers. However, as with any species, diet is key to survival. Wight Squirrel Project uses different avenues to get the message across to the general public and will continue to do so.



APPENDIX 1

Report on hairtube monitoring for Grey Squirrels in West Wight Helen Butler March 2004

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Wilmington Plantation, Upper Ham Copse and Lower Ham Copse Tapnell Furze and Withybed Copse

Lee Copse Saltern Wood Afton Manor

Conclusion

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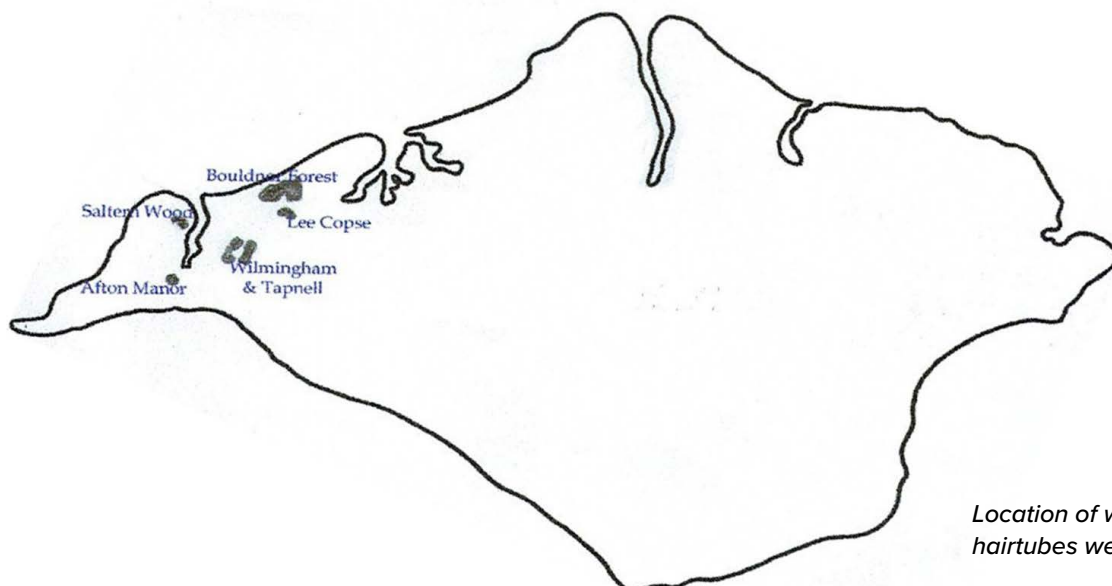
Introduction

The Isle of Wight is considered a stronghold for our native red squirrels (*Sciurus vulgaris*) as the Solent provides a natural barrier to grey squirrels (*Sciurus carolinensis*). Excluding grey squirrels from the Isle of Wight is imperative to the survival of the reds and in accord with the Isle of Wight Strategy, UK Red Squirrel Species Action Plan (SAP) and the UK Strategy for Red Squirrel Conservation. However, as past records show, a grey squirrel does find it's way to the Island occasionally.

On 21st July 2001 a post-lactating grey squirrel was found dead opposite the entrance to Afton Manor in Newport Road (B3399), Freshwater, West Wight. A post mortem revealed multiple skull

fractures consistent with being hit by a vehicle. She otherwise showed no signs of disease and was in good condition.

After a number of reports from the public of grey squirrels in the area between August 2001 and May 2002, it was decided by the Isle of Wight Red Squirrel Forum to place hair tubes and traps in the woods around West Wight. Hairtube monitoring by volunteers continued in 11 woods between July 2002 and May 2003. Mainland rangers carried out trapping sessions in July 2002 and February and March 2003. No evidence of a grey squirrel was found. This hair tube session is a follow up to the previous monitoring session in an attempt to ensure no grey squirrels remain in West Wight.



Location of woodlands where hairtubes were placed

Methodology

The concept of hair tube monitoring is very simple. The aim is to attract squirrels into baited tubes that have sticky pads either end. As the squirrel enters the tube to reach the food it rubs against the sticky pads, leaving hairs behind. These hairs are examined under a microscope to identify which species of squirrel they came from.

The tubes are plastic drainpipe cut into 30cm lengths with holes drilled either end to fix the wires that hold the tubes to the tree. The plastic blocks are approximately 2cm x 2cm and 7mm deep. Double-sided sticky tape is then wrapped around the block which is then stuck to the roof of the tube at either end, about 2cm in.

Tubes are placed roughly 100m apart, in grids, where practicable to do so. In all the woods apart from Bouldnor, the tubes were placed in the same grids as during the previous survey. Due to the bramble, brash and marshy areas at Bouldnor, the tubes were placed using paths and in areas of conifer where there was little bramble. Each tube was tagged with an identity number.

Sunflower seeds, peanuts and maize were used to bait the tubes. Food was put into the middle, and on the top of, each tube. The tubes were visited after approximately 2 weeks and blocks checked for hairs. Blocks with hairs on were removed and replaced. Any blocks that had become soiled or were no longer sticky were also replaced. All the tubes were rebaited. Blocks with hair samples on, were covered in waxed paper and placed

in a plastic bag with the location, date and tube number on. Two weeks later the tubes were removed and the blocks checked again.

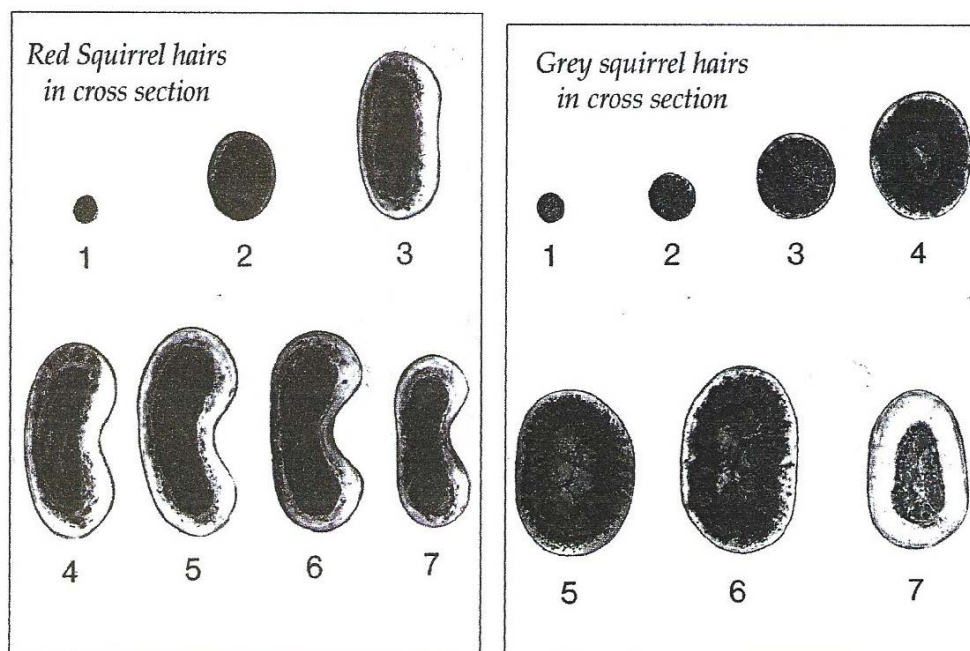
Hairs are then examined under the microscope with a 60x lens. Hairs from different parts of the body show differing characteristics even if they are from the same animal. When looked at in cross section, red squirrel hairs are concave or dumb-bell shaped. Grey squirrel hairs do not have this shape.

Most of the samples collected were easily identifiable if left on the blocks but those where any doubt remained were soaked off overnight in washing up liquid and hot water. The hairs were then stained with drawing ink mixed with 5 parts of water. The ink finds its way into the groove and is seen under the microscope as a dark line running longitudinally along the hair.

Care needs to be taken when removing hairs from the blocks as they must be undamaged from root to tip.

Breaks in the hair may allow ink to penetrate the inner medulla giving a false result. Under the microscope the concave groove that is characteristic of red squirrel hair is usually obvious.

Once the hairs have been inspected, blocks are cleaned thoroughly by soaking in either washing up liquid or biological detergent to loosen the sticky tape. They are then scrubbed, covered in double sided tape and re-used.

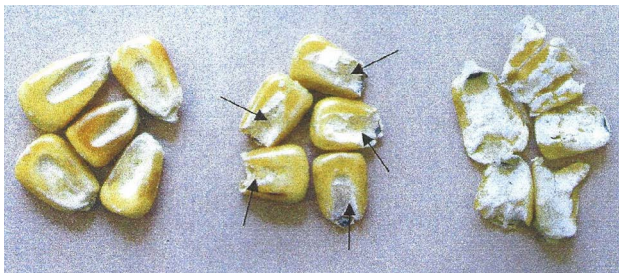


Results

Bouldnor

Bouldnor Forest is 110.45 ha of predominately conifer plantation, with some broadleaf, which is managed by Forest Enterprise. Some areas (marked on the map) have been recently clear felled or well thinned.

Apart from one tube placed in the south-east corner near the gate (squirrels feed in the adjacent garden), these areas were not monitored.



Maize samples. Left to right - Whole maize.
The germ removed by a squirrel. Nibbled by mice.

Sightings

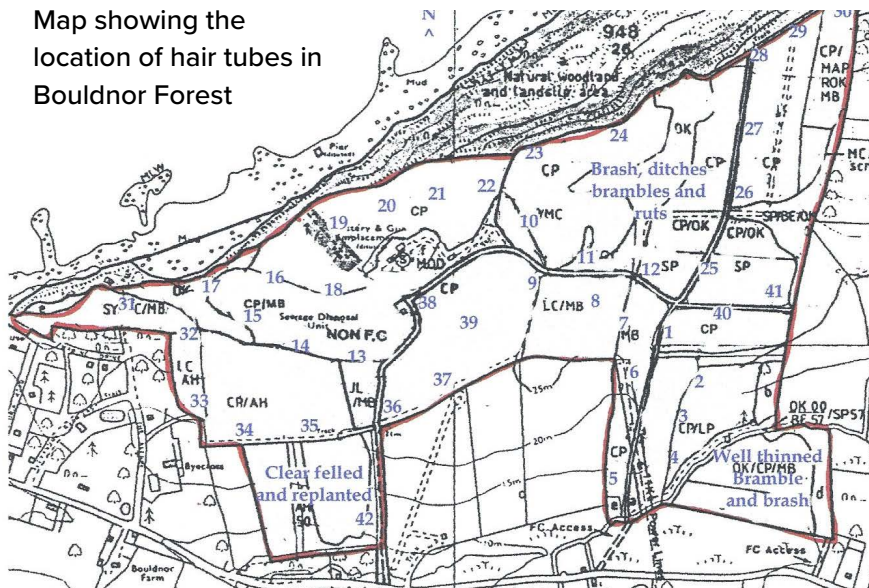
09/2/04	1 in conifers near tube 4
11/2/04	3 in conifers north forest
23/2/04	1 in conifer north forest

The number of blocks with hairs on was lower than expected after the first 2 weeks. The natural food supply was still abundant in February and the squirrels did not seem tempted by the bait. Tubes were placed in areas where there was evidence of feeding and dreys nearby and the bait was still not taken by squirrels. In most cases all the food was taken, but in 6 tubes - in the Corsican pine (*Pinus nigra*) compartments - maize nibbled by mice was left in the tube.

Table showing results in Bouldnor Forest

Date	Tube number	Details
22/02/04	2	Red squirrel
22/02/04	3	Red squirrel
22/02/04	6	Red squirrel
22/02/04	19	Red squirrel
22/02/04	39	Red squirrel
07/03/04	2	Red squirrel
07/03/04	19	Red squirrel
07/03/04	25	Red squirrel
07/03/04	27	Red squirrel
07/03/04	30	1 hair not identified
07/03/04	41	Red squirrel
08/03/04	29	Red squirrel
08/03/04	31	Red squirrel
08/03/04	32	Red squirrel
08/03/04	33	Red squirrel
08/03/04	39	Red squirrel

Map showing the location of hair tubes in Bouldnor Forest



Wilmington Plantation, Upper Ham Copse, Lower Ham Copse and North Park

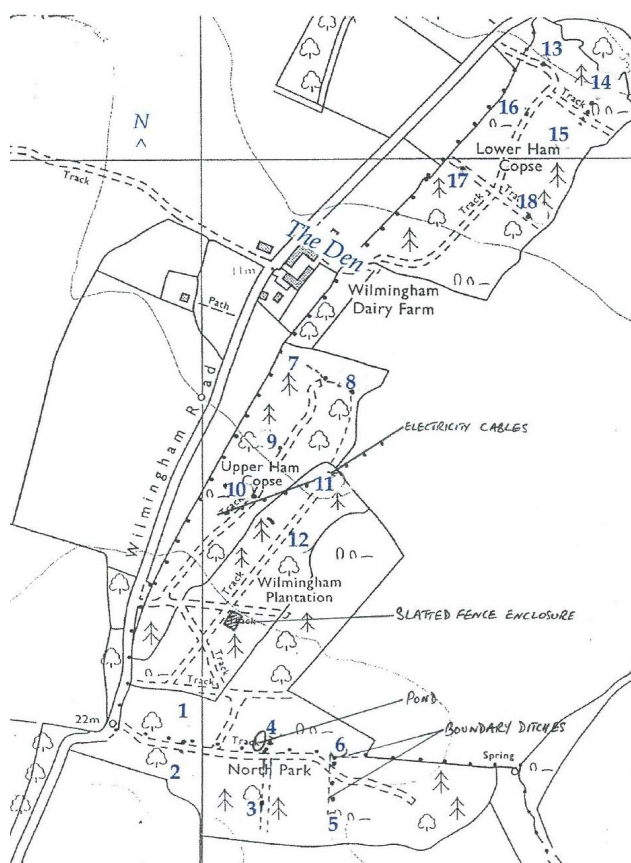
Wilmington Plantation, Upper Ham Copse, Lower Ham Copse and North Park, border Wilmington Lane and adjoin Tapnell Furze and Withybed Copse on the northern and southern borders. Together this is 50.45ha of predominantly mixed conifer plantation with some broadleaf. These woods are privately owned and used for shooting, so monitoring could not start before the middle of February.

The first visit to the woods that border Wilmington Lane seemed unpromising as no squirrels were seen and there was scant evidence of feeding or dreys. However, these woods produced a higher percentage of blocks with hairs on than any of the other woods. All the bait was taken.

Sightings: There was only one sighting of a squirrel. It was seen crossing the fence into the woods from a property called 'The Den' (marked on the map). This was on 03/03/04.

Table showing results from Wilmington Plantation, Upper and Lower Ham Copse and North Park

Date	Tube number	Details
03/03/04	1	Red squirrel
03/03/04	3	Red squirrel
03/03/04	7	Red squirrel
03/03/04	8	Red squirrel
03/03/04	9	Red squirrel
03/03/04	11	Red squirrel
03/03/04	12	Red squirrel
03/03/04	15	Red squirrel
03/03/04	16	Red squirrel
03/03/04	17	Red squirrel
17/03/04	3	Red squirrel
17/03/04	4	Red squirrel
17/03/04	6	Red squirrel
17/03/04	7	Red squirrel
17/03/04	10	Red squirrel
17/03/04	11	Red squirrel
17/03/04	13	Red squirrel
17/03/04	14	Red squirrel
17/03/04	16	Red squirrel



Map showing the location of hair tubes in Wilmington Plantation, Upper and Lower Ham Copses and North Park

Tapnell Furze and Withybed Copse

Tapnell Furze and Withybed Copse showed abundant signs of feeding and drey sites - all in the Corsican pine compartments. The majority of blocks with hairs on were found in these areas. Most of the bait was taken and mice had nibbled the small amount left.

Sightings: A squirrel was seen in Tapnell Furze on 19/02/04 running across the main woodland ride. Another was seen in a tree on 03/03/04 in the northern end of Tapnell.

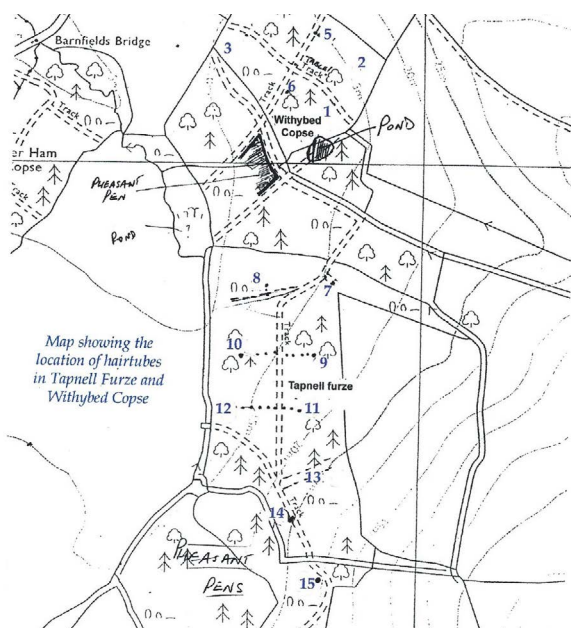


Table showing results from Tapnell Furze and Withybed Copse

Date	Tube number	Details
03/03/04	9	Red squirrel
03/03/04	10	Red squirrel
03/03/04	12	Red squirrel
17/03/04	2	Red squirrel
17/03/04	7	Red squirrel
17/03/04	9	Red squirrel
17/03/04	10	Red squirrel
17/03/04	11	Red squirrel
17/03/04	12	Red squirrel

Map showing the location of hair tubes in Tapnell Furze and Withybed Copse

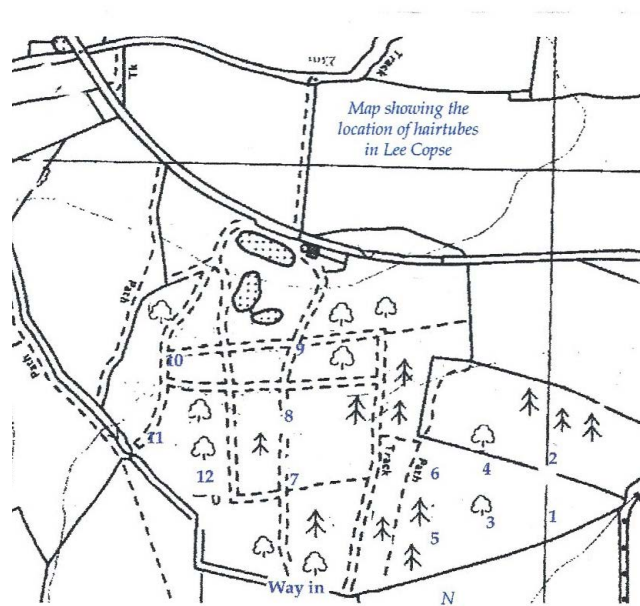
Lee Copse

Lee Copse is 16.5ha of mixed conifers and hazel (*Corylus avellana*) coppice. The copse is in private ownership. No hairs were found after the first 2 weeks and all the bait was taken. Feathers and droppings indicated that birds and mice had found the bait before the squirrels. Red squirrel hairs were found in the next inspection and again, all the bait was taken.

Sightings: A squirrel was seen in Tapnell Furze on 19/02/04 running across the main woodland ride. Another was seen in a tree on 03/03/04 in the northern end of Tapnell.

Table showing results from Lee Copse

Date	Tube number	Details
08/03/04	6	Red squirrel
08/03/04	8	Red squirrel
08/03/04	12	Red squirrel



Map showing the location of hair tubes in Lee Copse

Saltern Wood

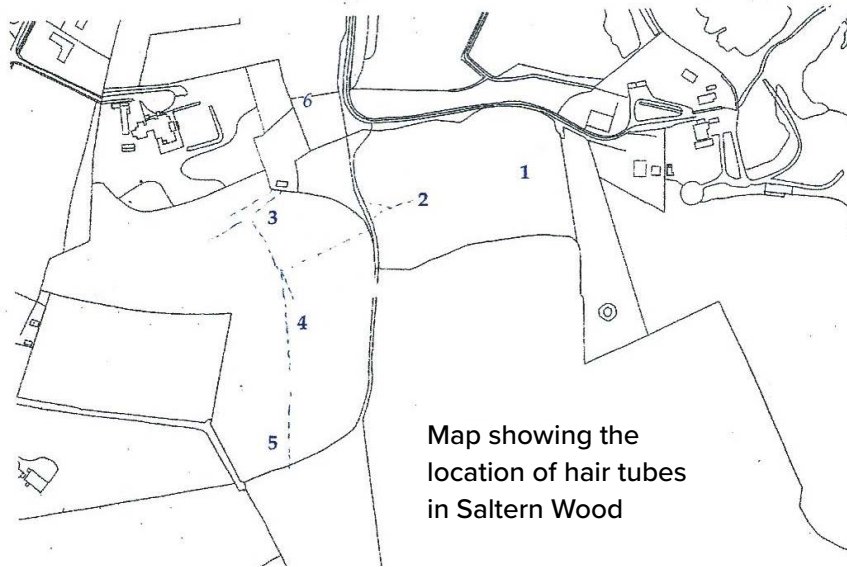
Saltern Wood is a privately owned wood of 10.5 ha. There are some conifers but the main tree species is hazel and oak. The grid was placed in the western end of the copse, with is currently unmanaged. The eastern side is under different ownership and managed.

There was sighting of a grey squirrel in a nearby garden in January 2002. The gentleman was so convinced it was a grey, he went to fetch his gun to shoot it - but it had disappeared by the time he returned.

Both owners of Saltern Copse have red squirrels visiting the gardens daily to feed on peanuts. Both gardens adjoin the copse and the owners walk through the copse regularly. No grey squirrel has been seen feeding in the gardens or the copse.

Table showing results from Saltern Wood

Date	Tube number	Details
04/03/04	3	Red squirrel
04/03/04	4	2 hairs not identified



Map showing the location of hair tubes in Saltern Wood

Afton Manor

The grounds of Afton Manor are, strictly speaking, not woodland although there are small wooded areas around the perimeter. As the dead grey squirrel was found opposite Afton Manor it was decided to include it in the survey. Although the owners say red squirrels are visiting the grounds regularly, no hairs were found on the blocks and the owners have not seen a grey squirrel.

As this is a private residence the map is not published.

Conclusions

No grey squirrel hairs were found and I have had no detailed sighting of a grey squirrel in the area since January 15th 2003. All the squirrel hairs found on the blocks very obviously came from a red squirrel when viewed under the microscope. The 2 samples that were not identifiable were probably not squirrel.

I have spoken to woodland owners, a gamekeeper and woodland monitors; nobody has seen a grey squirrel in any of the woods included in this survey. The monitor who saw a grey squirrel close up - and gave a detailed description - in Bouldnor during October 2002, has not seen the animal again. She carries out monthly and bi-annual monitoring in the forest.

People are certainly more aware of the importance of keeping the Isle of Wight a 'red only' area. Through the publicity, many more people have reported 'grey' squirrel sightings. Fortunately from the description of these (usually) fleeting glimpses, it is a case of mistaken identity. It is interesting to note, that even the people with garden squirrels only ever see a 'grey' passing through once. The animal does not return or even stop to feed.

Although no evidence of a grey squirrel was found during the hair tube and trapping sessions we must not be complacent. During this session, squirrels living in Bouldnor were not hungry enough to be tempted by the bait and if a grey is there, this survey may not have picked up evidence of its presence. One grey squirrel would not present a problem but if there were more, eg. two or three of the dead female's offspring of the opposite sex, then we could be facing a problem in the future.

Acknowledgements

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Thanks to landowners for giving permission to monitor their woods.

Also to Hilary Higgins for her assistance with Saltern Wood and Afton Manor.

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