

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 fine-tuned the final edit.

ISBN: 978-0-9552314-6-9

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



CONTENTS

for Part 1

	Page
Preface	5
Introduction	8
Chapter 1 A brief history of red squirrels	10
Chapter 2 Red squirrel personality and physiology	13
Chapter 3 Genetics overview	20
Chapter 4 Lifestyle	22
Chapter 5 Anthropogenic conflicts	26
Appendix 1	32

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 – on 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 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.

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 its needs are paramount if we are to help its 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 (AONB). 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

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.

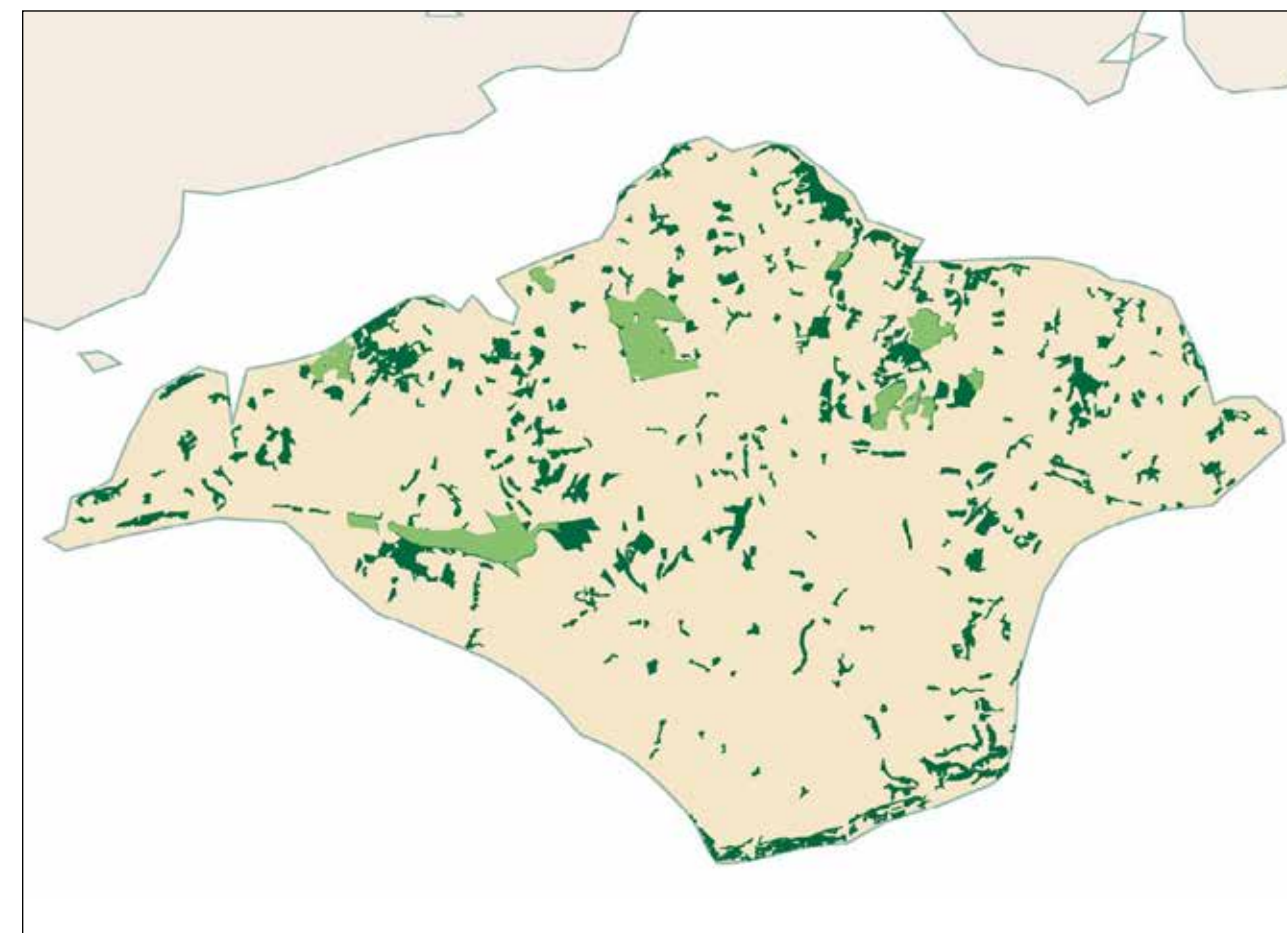
The map shows how fragmented woodland on the Isle of Wight is. In part 2, corridor links are discussed. Since the Forestry Commission funded the JIGSAW project to extend ancient woodland and link up isolated woodland, squirrels can disperse from east to west and north to south. This isn't necessarily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



The Isle of Wight



Map showing areas designated AONB



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.

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



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 the 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

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 & Moore (1974) in their book *Hedges* 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 3) 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.



Vibrissae, or better known as whiskers

The tail, apart from being used as a signal when disturbed, acts as a balance, helping them to move through the treetops 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 mates 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.

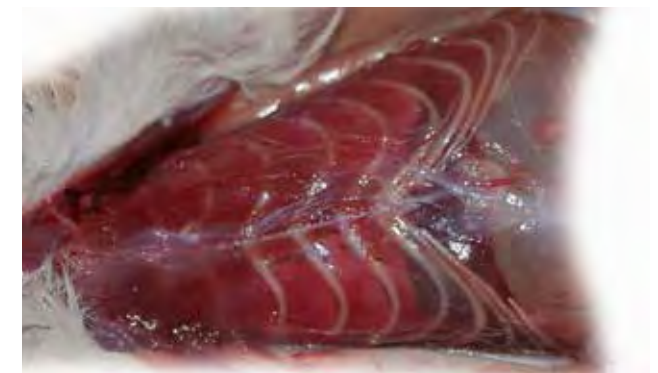
Behaviour is another clue. Sub-adults are generally less sure of themselves, avoid older squirrels and are less able at accessing food.

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 life in the trees. A ribcage encloses a heart and lung structure, as it does in humans. The ribcage is soft compared to a human's and is easily cut with small surgical scissors.



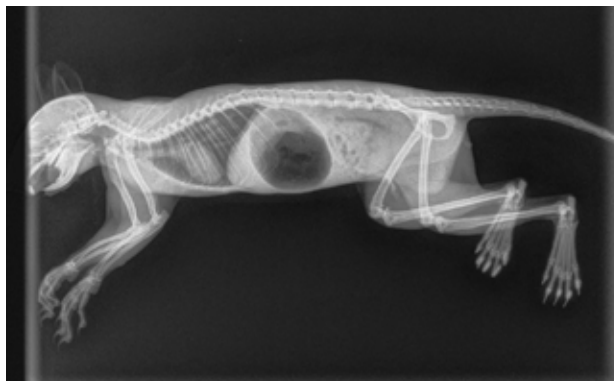
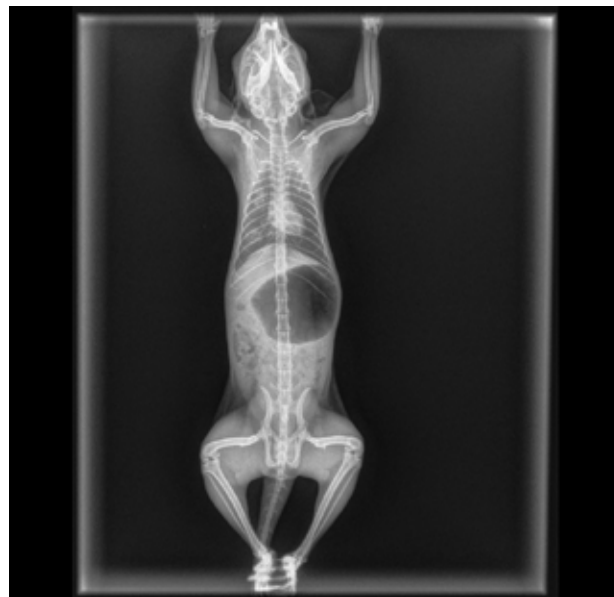
Ribcage

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.



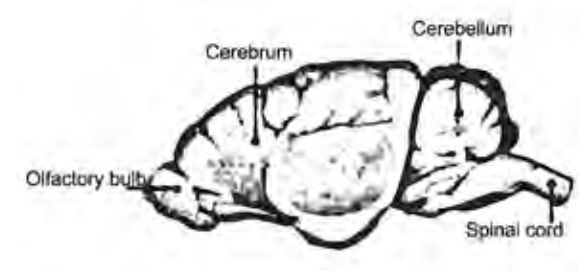
Arthritic joint



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 part 3, red squirrels share some common – and uncommon – causes of mortality and morbidity with 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



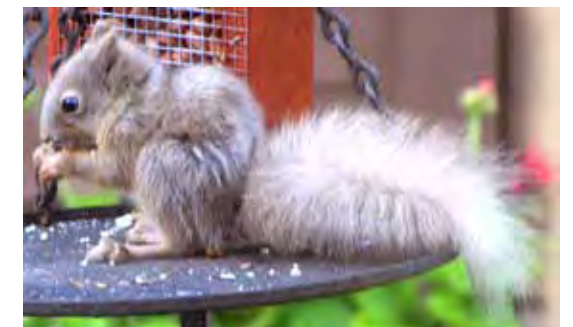
Winter coat

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.



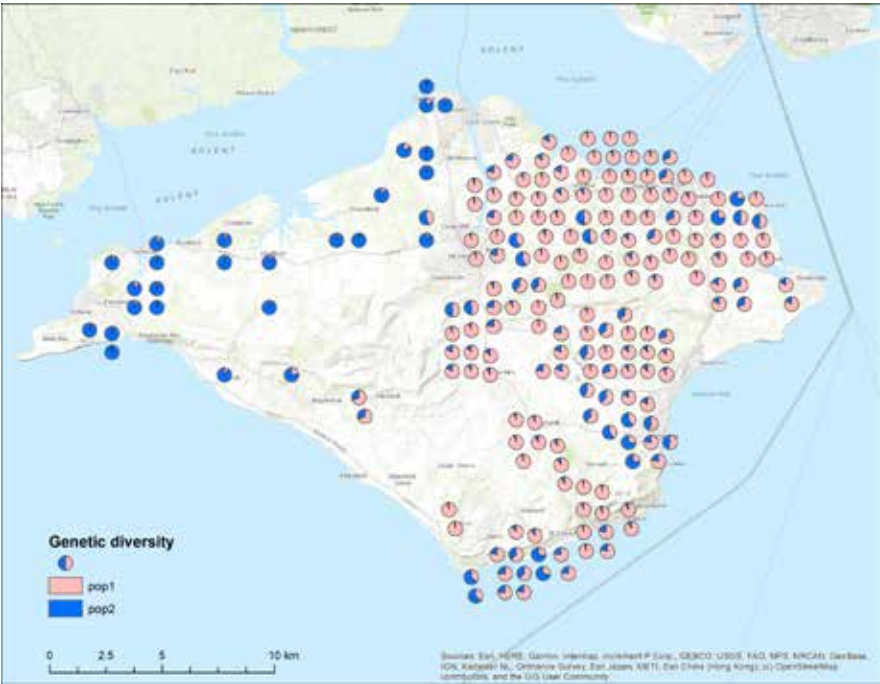
Map showing Brownsea Island and it's proximity to West Wight

However, to date, no obvious signs of abnormally large numbers with 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.

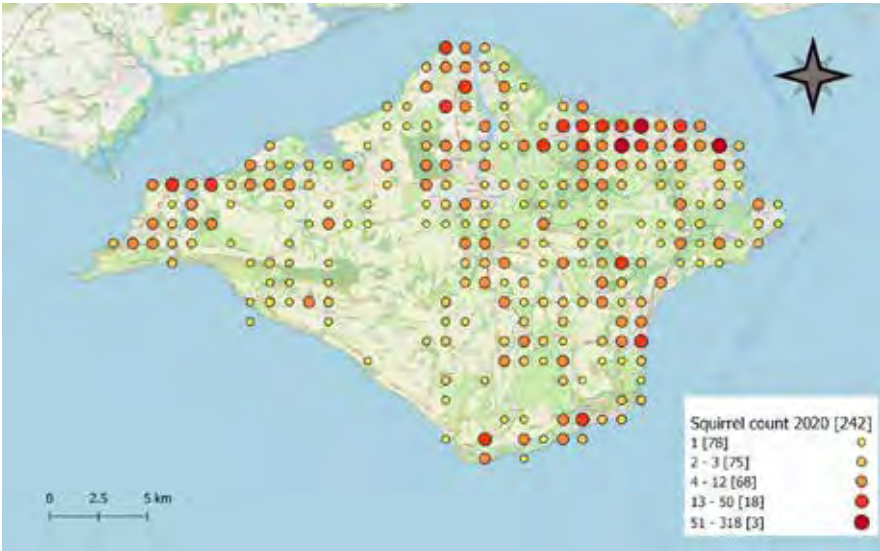
It is noticeable that genetic diversity is far less in West Wight and there are scant samples from the south-west. By comparing the genetic diversity map to a sightings distribution map, a similar

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 eartufts, 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 *Ceratophyllus (Monopsyllus) 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

Internal parasites include worms and coccidia. 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, magpie (*Pica pica*) was seen stabbing a young red squirrel through the chest and a crow was seen breaking a squirrel's neck – both in gardens.

5

ANTHROPOGENIC 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 Natural 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.

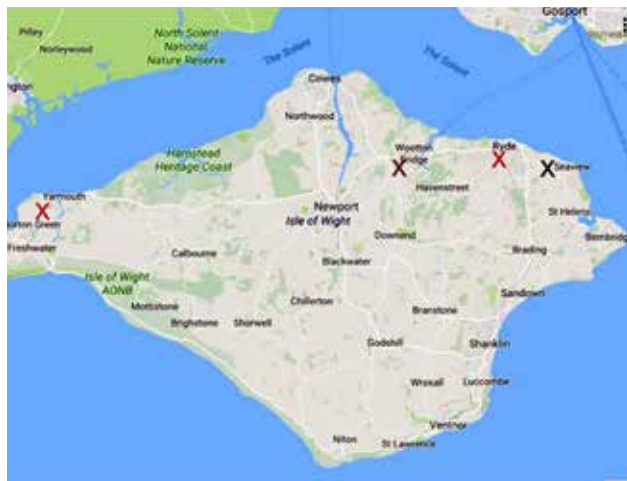
Ropes literally 'bridge the gap', so trees must partially meet across the road, as squirrels do not like to cross very wide, open expanses, where they are at risk from avian predation.

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 rope 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 3.

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



A 'squirrel only' feeder



Drinking from a raised water bowl



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

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.



Feeding only peanuts is bad for red squirrels

APPENDIX 1

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

Contents

Introduction Methodology Results and maps:

Bouldnor

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

Lee Copse Saltern Wood Afton Manor

Conclusion

Acknowledgements

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 its 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 hairtubes 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 hairtube session is a follow up to the previous monitoring session in an attempt to ensure no grey squirrels remain in West Wight.

Methodology

The concept of hairtube 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.

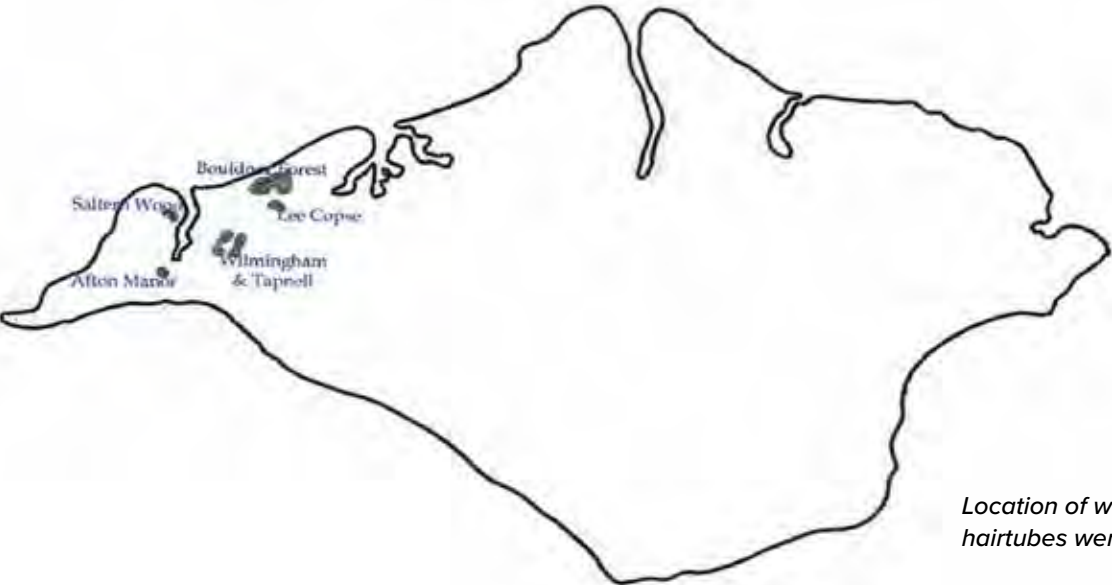
Hairs are then examined under the microscope with a 60x lens. Hairs from different parts of the body show differing characteristics even if they are from the same animal. When looked at in cross section, red squirrel hairs are concave or dumb-bell shaped. Grey squirrel hairs do not have this shape.

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.

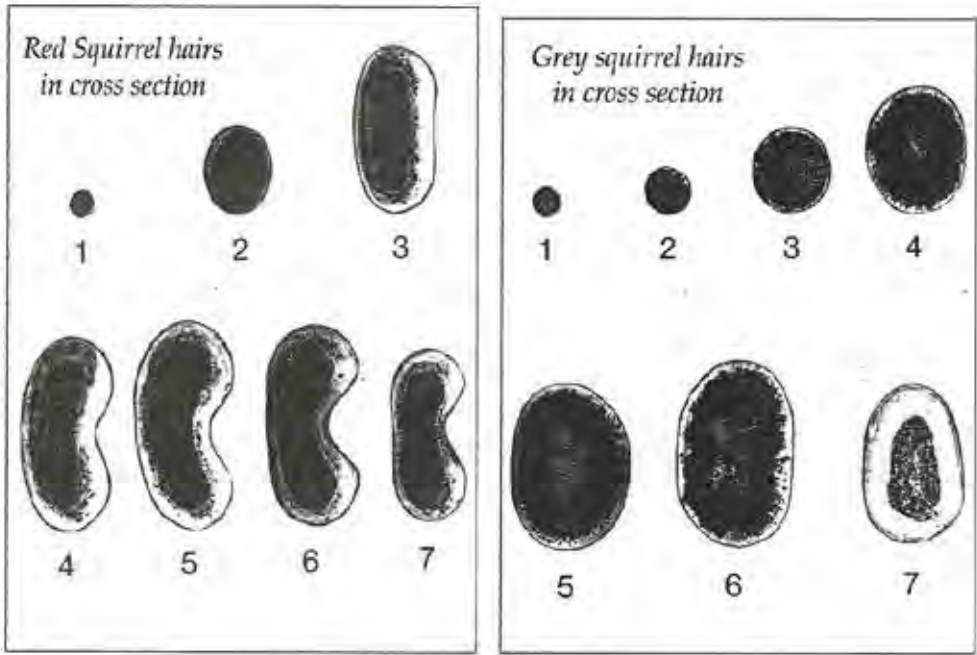
Care needs to be taken when removing hairs from the blocks as they must be undamaged from root to tip.

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.



Location of woodlands where hairtubes were placed



Results

Bouldnor

Bouldnor Forest is 110.45ha 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.

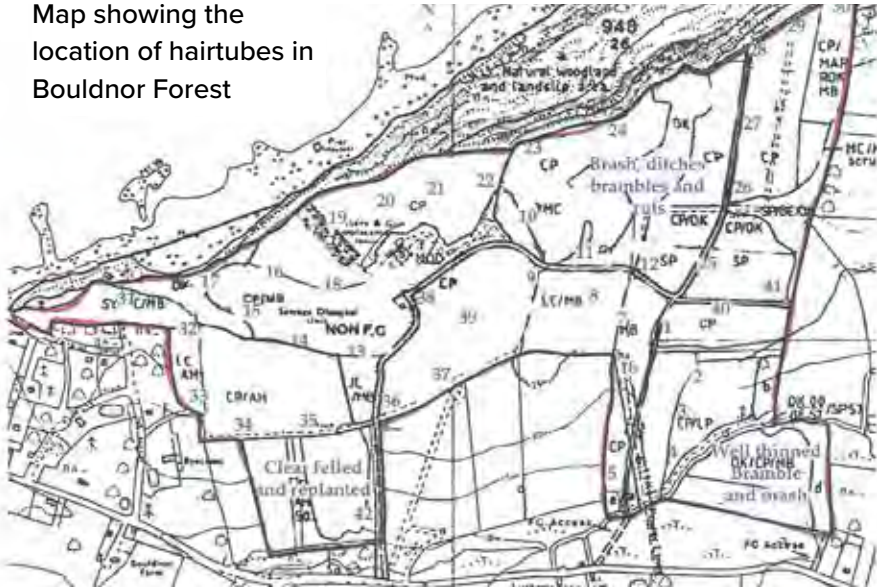
Sightings		
09/2/04	1 in conifers near tube 4	
11/2/04	3 in conifers north forest	
23/2/04	1 in conifer north forest	

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 hairtubes 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 hairtubes 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.



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

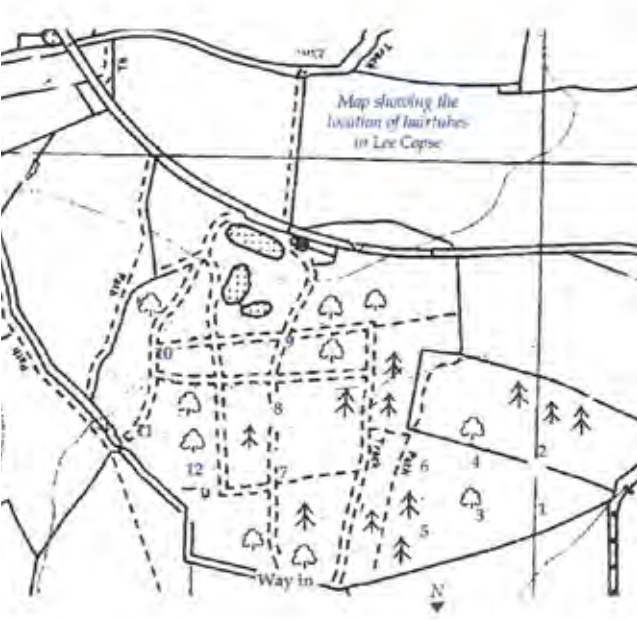
Map showing the location of hairtubes in Tapnell Furze and Withybed Copse

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 at the next inspection and again, all the bait was taken.

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

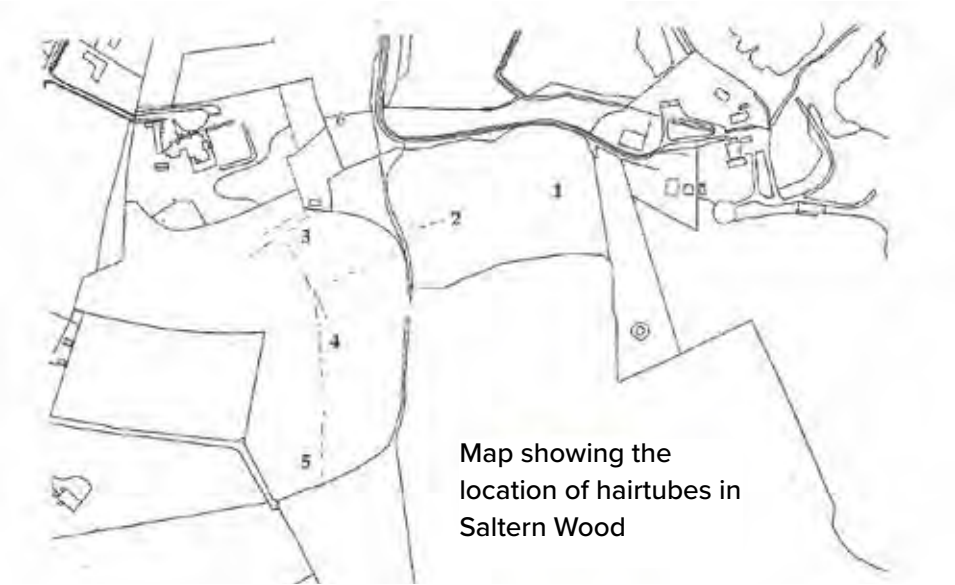


Map showing the location of hairtubes in Lee Copse

Saltern Wood

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

There was a 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

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 hairtube 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, e.g. two or three of the dead female’s offspring of the opposite sex, then we could be facing a problem in the future.

Acknowledgements

This survey was sponsored by English Nature and the Forestry Commission and administered by the Isle of Wight Council.

Thanks to landowners for giving permission to monitor their woods.

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

Part 1, Appendix

Garriga, R. M., Sainsbury, A. W., & Goodship, A. E. 2004. Bone assessment of free-living red squirrels from the United Kingdom (*Sciurus vulgaris*). *Journal of Wildlife Diseases* 40 (3): 515–522.

Hardouin, E. A., Baltazar-Soares, M., Schilling, A.-K., Butler, H., Garcia-Rodriguez, O., Crowley,

E., Liang, W.-J., Meredith, A., Lurz, P. W. W., Forster, J., Kenward, R. E., & Hodder, K. H. 2019.

Conservation of genetic uniqueness in remaining populations of red squirrels (*Sciurus vulgaris* L.) in the South of England. *Ecology & Evolution*: 6547–6558.

Holm, J. L. 1990. The ecology of red squirrels (*Sciurus vulgaris*) in deciduous woodlands. Unpublished PhD thesis. University of London.

Pollard, E., Hooper, M. D., & Moore, N. W. 1974. Hedges. New Naturalist Series. Collins, London.

Simpson, V. R., Hargreaves, J., Butler, H. M., Davison, N. J., & Everest, D. J. 2013. Causes of mortality and pathological lesions observed post-mortem in red squirrels (*Sciurus vulgaris*) in Great Britain. *BMC Veterinary Research* 9, 229. <https://doi.org/10.1186/1746-6148-9-229>

Forestry Commission

Isle of Wight BAP

PART 2

HABITAT AND MONITORING



INTRODUCTION TO PART 2

The Isle of Wight is unique in having red squirrels (*Sciurus vulgaris*) living in deciduous woodlands without a direct threat from grey squirrels (*Sciurus carolinensis*). The Solent has, so far, proved an effective barrier against grey squirrel colonisation.

Monitoring the Island’s red squirrel population and surveying its woodland has been a large part of Wight Squirrel Project’s work over the last 30 years. In 1997 it was decided to adopt the national methodology for monthly monitoring walks. This method was later updated to the bi-annual walks still used today. In this way, the Island can contribute to the national red squirrel conservation programme.

Continuous monitoring provides data which can aid decisions on where to direct conservation work on the Island. This is mainly aimed at habitat management and reinstating corridor links but may also encompass commenting on planning applications.

Ongoing vigilance for sightings of possible grey squirrel incursion is also paramount in the effort to maintain a ‘red only’ area on the Isle of Wight.

Part 2 is in four sections and focuses on habitat, monitoring and population trends. Wight Squirrel Project actively opposes intrusive monitoring methods unless there is a vital need and the outcome will result in a benefit for the squirrels. Not only is trapping and radio collaring stressful for the animals, it is expensive and time-consuming. It also requires a licence.

When I started red squirrel work, it was not long after the devastating storm of 1987, which destroyed many trees on the island. The data collected over the years plots the ‘return of the reds’ since the hurricanes, although there were a few downturns in squirrel numbers along the way when the weather and other factors dealt a temporary setback to recovery. Data is set out as individual reports and drawn together in section 4.

A detailed study of red squirrel habitat, including parks and gardens, began in 2017 and is ongoing. Extending woodland and planting corridor links through the JIGSAW (Joining and Increasing Grant Scheme for Ancient Woodland) project has improved red squirrel habitat. Conversely, development and the cutting down of trees that act as a corridor, so that homeowners can have a sea view, for example, is ongoing and detrimental to red squirrel survival.

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

Chapter 2 in section 1 is an abridged copy of a study undertaken in 1994, before I had a computer. Text was retyped and graphs and tables, originally hand drawn, digitised to match the rest of this publication.

Permission was granted to reproduce the hazel regrowth report from the Hampshire & Isle of Wight Wildlife Trust, conditional upon not naming woodland or landowners. Wight Wildlife is no longer running.

CONTENTS

Part 2 Section 1

		Page
Section 1	Habitat overview	44
Chapter 2	Hazel coppice regrowth on the Isle of Wight	46
Chapter 3	Bouldnor Forest – a case study	57

PART 2 SECTION 1

HABITAT OVERVIEW

Chapter 1

A BRIEF OVERVIEW OF ISLE OF WIGHT WOODS

This brief chapter is an introduction to the Isle of Wight woodland landscape, including the all-important corridors, which are discussed later.

The figure given previously for woodland cover on the island was around 3,500ha. A more recent inventory has put it higher – at around 4,500ha. A ballpark figure of around 3,500 red squirrels is estimated as they live at a density of about one red squirrel per hectare of woodland. However, squirrels are not found in all woods as some are poor in terms of red squirrel habitat.

Isle of Wight woodland consists of many small blocks of predominantly broadleaved trees. Compared to other counties, the Island is not well wooded, with only 12% tree cover, of which 87% is broadleaf, the remainder is coniferous. When hedge and tree cover plus woodland is 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 a 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.

As we do not have feral deer, hazel regrowth is strong (see chapter 2), therefore there is a good food supply for red squirrels and also dormice (*Muscardinus avellanarius*).

A Forestry Commission-funded project, JIGSAW has greatly improved connectivity between woodland blocks and extended ancient woodland.

The Isle of Wight is an area of 380km² with a population of approximately 140,000 people. The landscape is largely agricultural (approximately 66%) with woodland areas of 12% (Forestry Commission 2002). Only 2% is of ancient and semi-natural woodland (ASNW) and, of course, there are human settlements and also tourist attractions.

Ancient and semi-natural woodland is of high conservation value, with many species, including red squirrels, dependent for their survival on quality, well-managed woodland. Fragmentation of woodland and hedgerow loss has been identified as detrimental for the survival of red squirrels (Rushton *et al.* 1999). Around 60% of the Island has some form of conservation designation but this doesn't give 100% protection from development or other change.

The JIGSAW challenge fund, launched in 2000, saw approximately 200ha of tree planting on the Island between 2001 and 2005, with a further 47ha between 2005 and 2006.

Thanks to this incentive, the Island's woodland cover has increased from 7.5% in 1900 to 9.7% in 1980 and 12% by 2000. The balance between conifer and broadleaf has changed with the area of broadleaved woodland increasing by 43% between 1980 and 2000. Native broadleaved species of trees were more appropriate for the JIGSAW project when planting hedgerows and extending ancient woodland.

The Forestry Commission's Woodland Grant Scheme (WGS) began in 1988 with the Island benefiting from 200ha of new tree cover by 2005.

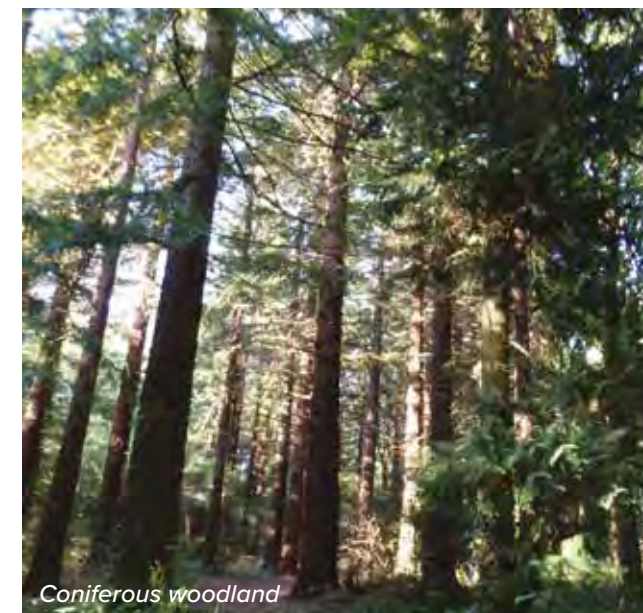
Hedgerows are important as corridor links between woodland. In the 1950s, the Forestry Commission suggested that there were one million

kilometres of hedgerow (in the UK). By 2007, the Countryside Commission Survey estimated that half of hedgerows in the UK countryside had been removed. This was evident on the Isle of Wight as some of our smaller woodlands became isolated in animal dispersal terms.

In 1997, the Hedgerow Regulations Act was passed in England and Wales. The act requires permission before removing a hedge or hedgerow, even small hedgerows if they are considered ancient or form part of an old field system.

Introduced hedgerow incentive schemes encouraged landowners to restore hedgerows, to the benefit of red squirrels and many other species. Animals not only travel using these hedgerow corridors, they also use them as a food source or nesting place in the case of birds and small mammals. The Isle of Wight has certainly benefited from the scheme.

Pictures show woodland types



Coniferous woodland



Mixed woodland



Broadleaved woodland



Hedge corridor

Chapter 2

A STUDY OF HAZEL COPPICE REGROWTH IN ISLE OF WIGHT WOODS (IN RELATION TO RED SQUIRREL HABITAT)

HELEN BUTLER 1994

Undertaken on behalf of Wight Wildlife,
The Gatehouse, Forest Road, Newport, Isle of Wight

The project analysed the growth of hazel (*Corylus avellana*) coppice and nut production on the Isle of Wight on different soil types. The results were then compared to two hazel coppice woodlands in Hampshire.

INTRODUCTION

This chapter is an abridged version of the study. The original report carried a confidentiality request that site information was used with discretion and was only circulated to landowners, English Nature (now Natural England) and Wight Wildlife, who designed and oversaw the study. Therefore the names of the woodlands and owners are omitted.

The Isle of Wight is probably unique in England in supporting good populations of red squirrels and dormice in native broadleaved woodland habitat. It offers perhaps the best opportunities for long-term conservation of these species within this habitat.

Red squirrel numbers in broadleaved woodland are heavily dependent upon hazelnut production. This study of hazel coppice regrowth in five Island woods has demonstrated that regrowth is much better than in many mainland woods where deer browsing is a problem.

Nut production can commence as early as the second year after cutting (in favourable situations) but generally starts after four to five years. Light is an important factor in determining rate of regrowth. Nut production in heavily shaded coupes is invariably poor and shrub diversity is also reduced.

It is impossible to extrapolate from a single season of observations, but invaluable information has been obtained on the productivity of worked coppice in a variety of situations and soil types in the absence of grey squirrels and deer. This data requires to be viewed in the light of continued observations made at these sites in future years.

The Isle of Wight is nationally important for red squirrels (*Sciurus vulgaris*) as it enables the squirrels to live in broadleaved woodland habitat without competition from grey squirrels (*Sciurus carolinensis*), and therefore represents an important stronghold. Feral deer are also absent from the Island so that coppice regrowth is not retarded by their browsing. Many of the Island's woods support dormouse (*Muscardinus avellanarius*) populations, which would also benefit from a better understanding of coppice regrowth.

Woodland on the Island varies from very small isolated woods to extensive interlinking areas of mixed tree species. Many woodlands are left uncut with increasingly mature stands of trees and shrubs. Woodlands managed for game birds may include extensive areas of worked coppice. Conifer plantations are also present.

A census of woodland and trees carried out by the Forestry Commission between 1979 and 1982 estimated the area of woodland on the Island in blocks over 0.25ha as 3,695ha covering 10% of the total area.

Ancient woodland in 1987 was assessed as 1,598ha or 4% of the total county area. Therefore much of the total woodland cover is secondary, either plantation or naturally regenerated woodland.

Approximately 43% of the Island's woodland is believed to be ancient. The remaining woodland has either regenerated on abandoned fields or heath or been commercially planted as seen at Parkhurst Forest and along the downland ridge between Shalcombe and Shorwell. Extensive amenity planting (18th and 19th century) is found on the estates at Osborne, Barton, Norris, Gatcombe and Appuldurcombe.

Since the Forestry Commission census, storms have uprooted many trees and large areas of conifers have been harvested. This has adversely affected our squirrel population by removing woodland habitat and an important food source. This makes it all the more important to improve our remaining woodland.

The aim of including this study is so that future researchers may follow the methodology and compare results. It will be interesting to see if coppice regrowth changes as climate change progresses.

METHODOLOGY

Selection of sites was limited because coppicing dates needed to be accurate and records were not generally kept beyond a few years. Knowledge of a site and the records often leave with the manager/gamekeeper. Accurate coppicing dates were only available for five sites: one on chalk, one on Lower Greensand and three on Tertiary clay, where there has been a recent sequence of annual coppicing.

At other sites where coppicing has taken place in recent years, it has not been possible to follow through a succession of coppicing within the same wood. Only the first four years of growth could be compared on the three different soil types.

Two woodlands in Hampshire were also sampled. This data has been used to demonstrate the

difference in regrowth between woods which are browsed by feral deer and Island woods, where deer are absent.

Comparison of coppiced hazel on the chalk site was particularly difficult as the whole of this extensive site is managed for shooting so 'coppicing management' in this case involved cutting the same areas on one- to four-year cycles and not coppicing other parts of the site at all.

Each woodland was visited prior to actually starting the survey to get a feel for the wood. Next, coupes were selected for sampling. Selected coupes were then assessed on Survey Sheet One. In some cases the acreage was provided by the landowner otherwise I estimated the size of the coupe by pacing the sides and multiplying them to find an approximate area.

Type of wood (ancient or secondary, pure coppice or coppice with standards) was recorded, soil type, aspect, age of coppiced hazel and other tree or shrub species within the coupe were noted, plus whether or not they were fruiting. A sketch map was made showing the position of the coupe within the wood.

The above completed, the next stage was to select four stools which appeared by eye to be typical, preferably in different positions within the coupe, e.g. central/edge/shaded. An average shoot was then measured from each of the selected stools and the mean of the measurements recorded on sheet one.

In some cases where the shoots were competing for light, one or two shoots were perhaps 1–2m higher than the average ones chosen for measurement. The number of shoots on each stool sampled was counted with the aid of a tally counter. If the stool was fruiting, the percentage of shoots producing nuts was recorded.

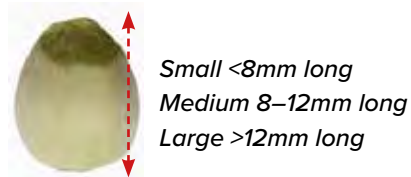
The average number of nut clusters per shoot and how many nuts per cluster were also recorded. This was difficult on the taller stools and in these circumstances, figures were arrived at after a thorough visual inspection of as much of the bush as was practicable.

A sketch showing the position of the stool within the coupe and any standards affecting available light was drawn. Blue string tied to a shoot was used to mark stools which had been sampled.

Copse 1 was used as the principal study area for

woods on Tertiary clays. A brief comparison was made with two more copses, also on clays. At these sites, only one stool was sampled in each coupe.

When nut growth was at its peak and before the squirrels began eating the new crop, two trees in each coupe from the three main sites were stripped of nuts. This was a very time-consuming and difficult task as some of the shoots were up to 8m high and inevitably entangled in the next tree. Assistance was needed for this part of the survey. The nuts were subsequently weighed, dried, counted and categorised as large, medium or small, according to the following diagram:



RESULTS

Copse 1

The chosen copse is an ancient broadleaved coppice with standards woodland on Tertiary clay.

It has a recent history of coppice management dating back over 12 years. The nut crop considered was relatively poor in 1994, with the majority of the nuts categorised as small.

Not all of the trees produced nuts and a number of them, particularly in the older coupes, appeared to have a fungal infection which had killed all the leaves. Material has been collected and is currently being investigated by Alice Holt pathology laboratories. Average distance between coppice stools was 3m, and the older hazel regrowth had become straggly in places.

There was a noticeable difference in the height of the second year's growth, but as I always chose average stools to sample this does not show in the results tables. This height difference was also noted in the tenth- and twelfth-year regrowth; self-seeded saplings may be an explanation here. There was also self-seeded ash (*Fraxinus excelsior*) saplings amongst the ninth- and twelfth-year regrowth.

Copse 2

The Lower Greensand copse is a mixed ancient woodland with areas of hazel coppice and standards. Coppicing of hazel has been carried out for the past six years.

Hazel coppice, bramble (*Rubus fruticosus*) and bracken (*Pteridium aquilinum*) grows very well here, and competition in the first year after coppicing was not always won by the hazel as some of the stools had all but disappeared in the bramble. There was self-seeded hazel growing within the coupe.

Accessing the stools was very hard indeed in the second-, third- and fourth-year coupes. The bracken in particular was competing fiercely with the hazel, reaching 2m in some places. There was no bracken amongst hazel older than four years.

It is impossible to assess with any certainty whether the bracken affected hazel growth from the results of this study, but growth was marginally better at the Lower Greensand copse compared with the other study sites. Nut production is good

here with some third-year stools producing nuts.

Assessing the average distance between stools was difficult because of the undergrowth but spatial distance appeared to be greater than at most sites. This could be another factor affecting growth rates.

Copse 3

Copse 3 on Upper Chalk is a large area of ancient and secondary broadleaved woodland. The woods are managed for shooting with one gamekeeper responsible for managing a large area. The coppicing cycles here are aimed at maintaining rides, hedges and cleared areas for the shoot rather than for the benefit of wildlife. It is, however, one of the best sites on the Island for both squirrels and dormice as the hazel seems to grow particularly well. This is especially marked on older regrowth.

The first-year growth I measured was in a coupe which has been cut annually over a number of years (number unknown). This may well affect regrowth. Instead of the usual bramble growing between the stools, this coupe had marjoram (*Origanum vulgare*), wild carrot (*Daucus carota*), ragwort (*Senecio jacobaea*), willowherb (*Chamaenerion angustifolium*) and other grassland wild flowers as ground flora.

The coupe was situated at the bottom of a valley and had plenty of light. Second-year growth was on a bank beside a track and consisted of a single line of coppiced hazel with uncoppiced stools behind. They faced west and all but the last few stools at the southern end of the coupe received light from this side. One stool at the end of the coupe had produced one cluster of nuts – the only second-year growth in the survey found to do so.

There are also areas of recent secondary woodland where a tree canopy is either lacking or very sparse. At one location (not sampled) where the standards created a dense canopy, the hazel had been coppiced four years previously. However, none of the shoots had grown higher than 50cm because of the density of the standards. The ground was also damp here despite the dry summer.

Copse 4

Copse 4 is a mixture of broadleaf and conifers on Tertiary clays. The areas of hazel used in the survey consisted of a strip which is directly underneath power lines and therefore not allowed to grow to maturity, a strip beside a path and a small coupe in the northern corner of the copse.

The third-year regrowth sampled here was producing a few nuts. This coupe was almost like a hedge beside a path and received plenty of light as the area to the east had been clear felled and the slope was south-facing. The nuts in Copse 4 were noticeably larger than those at Copse 1 or Copse 5, which are also on clay, but the hazel coppice at Copse 4 receives more light. First- and second-year regrowth was particularly good here, but the second-year-growth hazel had been attacked by an unidentified beetle and many of the leaves were pitted, with some virtually destroyed.

Copse 5

Copse 5 is a small broadleaved copse on Tertiary clays. A small amount of coppicing has been carried out annually by volunteers for the past 15 years and therefore the wood has a longer recent history of active coppicing than any others on the Island.

The clay soil is very wet here and didn't appear to have dried out in the hot summer compared with the other woods on clay. Although coppicing has been carried out regularly, because so many standards have been left, very little light penetrates the canopy in most areas of the wood and the understorey is struggling for survival.

The fungal infection noted in Copse 1 was very apparent here and quite a large patch at the northern end of the wood had been badly affected. Other tree species besides hazel showed signs of infection.

Nut production was very poor indeed with even the older trees producing very few nuts. There are no 'average' stools or shoots in Copse 5. As light conditions, which appeared to dictate rate of regrowth and nut production, were so varied it was virtually impossible to compare the data from here with data from the other sites.

The number of shoots were also considerably lower than at the other four locations. Many

shoots had died back and only the most vigorous managed to reach a gap in the canopy. Although conditions for hazel are not ideal here, Copse 5 has nevertheless made an interesting contribution to this study as it highlights the importance of light in the regrowth and nut production of hazel coppice.

General

At all sites the hazelnuts grew slowly and were very small up until the end of June, but by the end of July they were full size. By the third week in September all the nuts had fallen and the catkins had started to grow. The squirrels and dormice started to consume the nuts around the end of July.

When comparing hazel regrowth with that on the mainland, the damage caused by deer becomes apparent. Where deer are allowed to browse, regrowth is significantly retarded. As the deer browse on the young shoots, the hazel has scant chance of getting away. At Roydon even ten-year-old regrowth was still not producing nuts.

Results showed that hazel regrowth on the Island averages around 1m annually for the first two years and then averages a further 0.5m for the next three years.

After this age, conditions within the coupe, such as spatial distance, the position of the stool within the coupe and the amount of light penetrating the canopy, appear to dictate future growth.

DISCUSSION

A one-year study of this nature is not enough and work on the same sites, over a number of years, should be carried out to support this initial study.

Several factors seemed to influence regrowth and nut production, light being the most important one. Jessica Holm’s study on the Isle of Wight (Holm 1990) also found that light had a significant bearing on nut production and hazel coppice regrowth.

Stools on the edge of paths were noticeably healthier, less straggly and produced more nuts than those in the centre of a coupe where the stools were close together and the shoots competing for canopy space. Stools take on a bush-like appearance up to five years’ regrowth. The survey showed that the number of shoots

per stool diminished considerably between one and five years’ regrowth. After this the bushy appearance was lost and the remaining shoots grew up and spread out. At this stage the bramble and bracken lose the competition for light and die back.

If the stools are very close together, they start to compete with each other and some may die. Similar effects can be seen when too many standards are left, as they are in Copse 5. The hazel may die or become very tall and spindly, lose many shoots and produce only a few nuts on the tops of the shoots.

It is difficult after such a short study to say if the size of the coupe has any bearing on nut production. However, the few stools which produced nuts on the second and third years’ regrowth were those in the smallest coupes which were growing in a straight line (as in a hedge) rather than a block, so that most shoots were receiving light.

At Copse 1, one stool on the edge of third-year growth produced two clusters of nuts this year. The stool looked slightly different from the rest of the coupe in that there were fewer leaves on the bush and these were lighter in colour. This may perhaps be due to genetic variation.

The older, larger stools generally produced more shoots and grew faster and more vigorously than the smaller, younger stools. Nut production was also better, providing other factors were favourable as well.

Analysis of hazelnuts shows that the biomass of hazelnuts per stool varies considerably within a coupe. Size of hazelnut also varies. A stool mayw produce nuts of equal size or of all three grades but more usually two out of the three grades were recorded.

It is impossible to determine after only one year of study whether the exceptionally wet winter and spring followed by drought conditions in the summer had any effect on growth or nut production.

Figure 1 Height of coppice regrowth

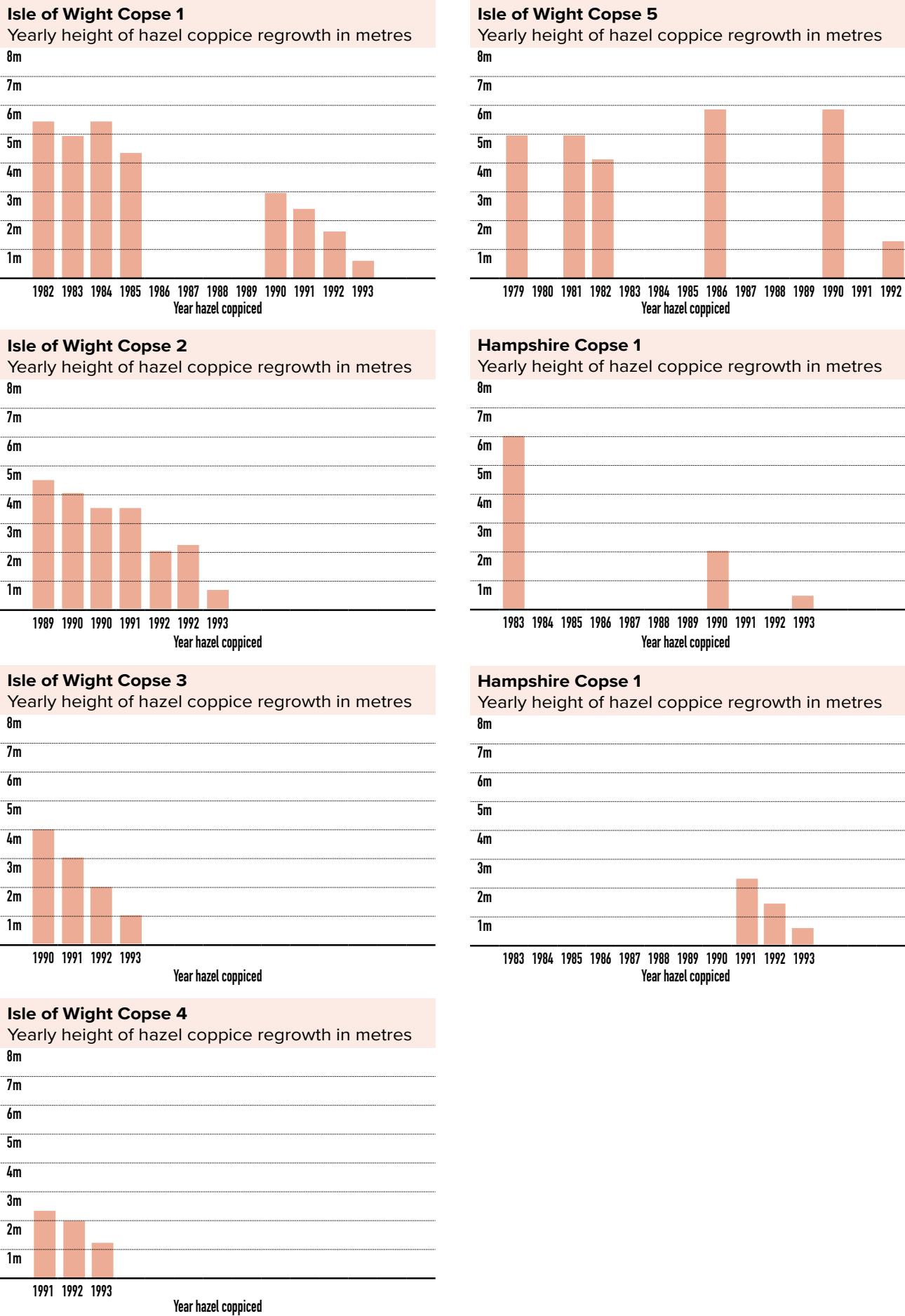


Figure 2 Measurements of hazelnut biomass and size in the three primary woods in 1994

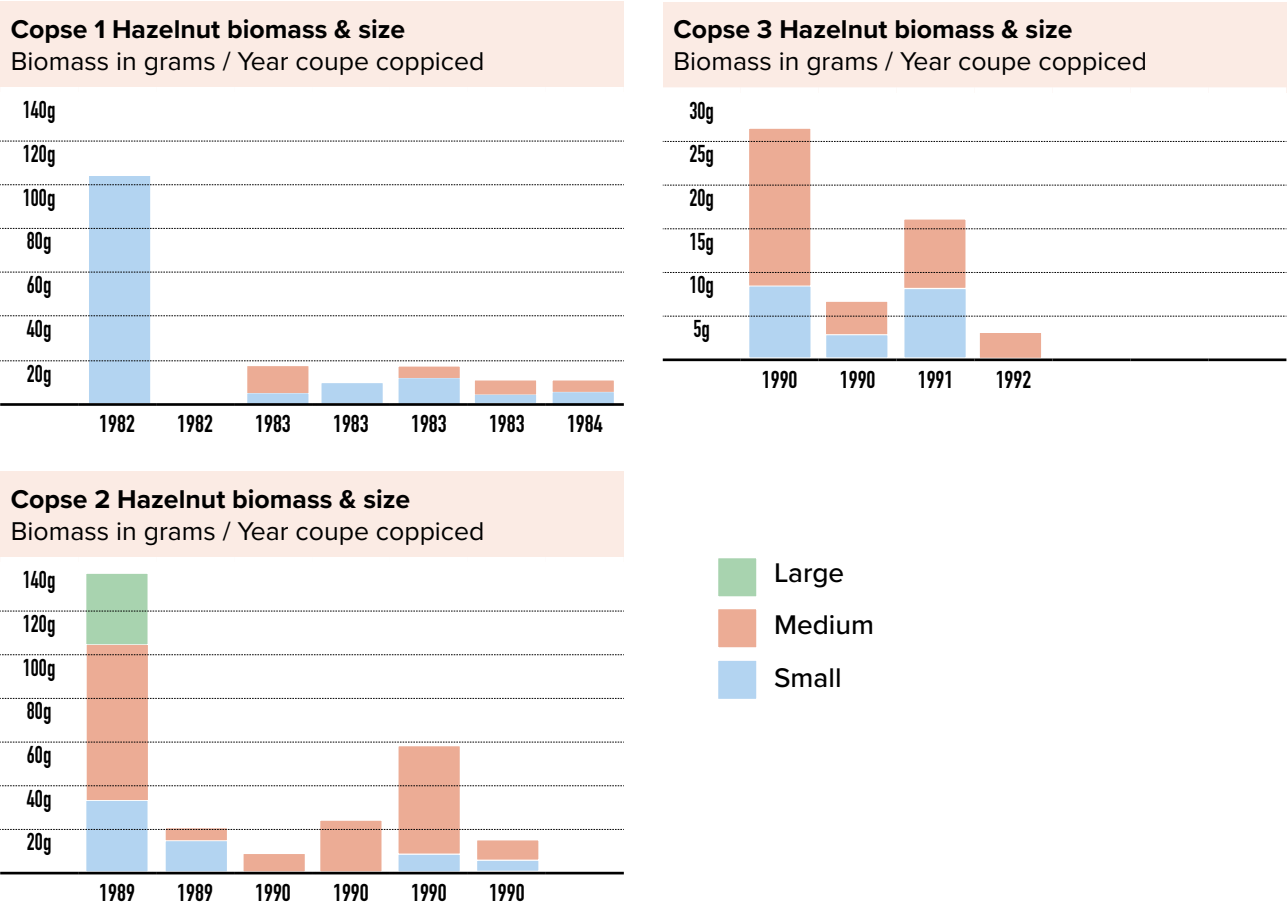
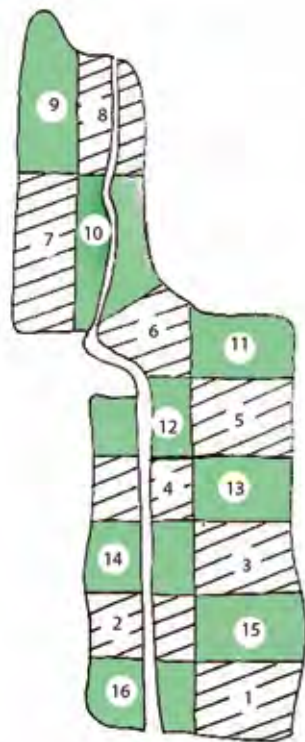


Figure 3 Example of ‘chequerboard’ plan for coppicing regime



RECOMMENDATIONS

A number of studies have been carried out looking at hazel coppice as squirrel habitat. Squirrel densities can fluctuate between levels of approximately 0.4 and 1.2 squirrels per hectare in both coniferous and broadleaved forests (Gurnell & Pepper 1991). Holm (1990) has shown that in oak/hazel woods on the Isle of Wight, red squirrel densities are strongly correlated with the abundance of hazelnuts and that squirrels favour areas of high tree density with high seed crops.

Squirrels also prefer the larger hazelnuts, therefore quality of the hazel production is related to breeding success, population density, foraging time allocation, food storage, behaviour and activity.

Actively coppiced woods with high nut production can support squirrel densities almost as high as good coniferous habitat. To achieve this end, a long coppice rotation period of 15–20 years is recommended in woods where red squirrels and/or dormice are present. Gurnell *et al.* (1992) suggest that coppice with a low to moderate density of standards (25–50/ha) produces a wider range and greater quantity of food.

These authors also suggest that in isolated woods a coppicing rotation which retains 30–50% of the coppice at 20–30 years’ growth is best suited to squirrels, dormice and other small mammals.

My findings would support this as a rule but hazel regrowth is generally much better on the Island than in mainland woods and under good conditions can be providing nut crops after 3–4 years.

There has been a resurgence of interest in re-coppicing on a commercial and semi-commercial basis in Island woods in recent years. Rotation periods shorter than 15 years in the interest of wood production may be acceptable for nature conservation in some woods. It has been found that red squirrels actively avoid newly coppiced areas (Holm 1990) and move into adjoining areas.

If re-coppicing is introduced on a commercial scale, important factors for consideration are:

- The size of the coppice cut in relation to the total woodland area
- The provision of travel corridors between recently cut areas
- The retention of good seed-bearing trees as a food source and for shelter

Moreover, this study has highlighted the importance of light to coppice regrowth and nut production. Recoppicing areas of coppice heavily shaded by

standards is of minimum benefit to red squirrels unless tree thinning is carried out. Thinning of standards is possibly of greater value than re-coppicing.

A chequerboard pattern for coppicing is ideal for squirrels and dormice (Figure 3) as they can still travel arboreally through the woods. This study needs to be extended over a number of years in order to build up a true picture of hazel coppice productivity in the five Island woods selected for study.

In 2000, a survey using the same methodology was carried out by Phil Le Masurier and Simon Young in Cope 1. They concluded that no nuts were produced in years 1 and 2 after coppicing and only a few nuts were produced in year 3 after coppicing. Other observations were:

Year 4 had a large crop of nuts, whilst years 5–10 had a variable number of nuts. It seems that the number of nuts is affected by factors other than the length of time from cutting the stool. Heavier nut crops (number of nuts) seem to be in the later years. The one stool measured at year 16 did not show any tailing off in yield. One stool may not give an accurate assessment, however.

From year 5 onwards the counting of nuts can be very difficult due to the height of shoots and stool density. Accuracy of counting is poorer as the stool height increases.

Factors affecting the results but not measured in these results are listed below and could be considered in the future:

Density of hazel and shrub layer per unit area If shoots are denser than optimum, growth and nut yield could be affected.

Degree of shading by standard trees If shrubs are excessively shaded, this could reduce shrub growth and hence nut crop.

Degree of water capture by standard trees If shrubs are starved of moisture, particularly later in the season, this could affect nut weight and could cause nut or cluster shedding.

In recognition of these other factors, such as shade and root effects, the number and species of standard trees were counted for most of the coupes but not the coupe area.

Care should be taken not to remove all old stool growth in each year coupe as it is known that many smooth bark species of lichen grow on old hazel stems. These lichen communities are also important for invertebrates and bryophytes.

REFERENCES

Gurnell, J., Pepper, H.W. 1991. Conserving the red squirrel. Research Information Note 205. Forestry Commission, Edinburgh.

Gurnell, J., Hicks, M., & Whitbread, S. 1992. The effects of coppice management on small mammal populations. In: Buckley, G.P. (ed.), *Ecology and Management of Coppice Woodlands*, pp. 213–232. Chapman & Hall, London.

Holm, J.L. 1990. The ecology and feeding behaviour of red squirrels (*Sciurus vulgaris* L.) in deciduous woodland. Unpublished PhD thesis, University of London.

Hornby, R.J. 1981. Ancient Woodlands Survey Isle of Wight. Nature Conservancy Council Internal Report.

Spencer, J., Cox, J., & Chatters, C. 1987. The Isle of Wight Ancient Woodland Inventory. Nature Conservancy Council Internal Report.

Hazelnut Yield in Copse 1. 2000 Survey. Phil Le Masurier and Simon Young

ACKNOWLEDGEMENTS

I should like to thank landowners for access to carry out this study.

APPENDIX 1

Sample Survey Sheet

HAZEL COPPICE SURVEY 1. COPPICE BLOCKS

SITE

OWNERSHIP

WOODLAND TYPE

COPPICE BLOCK

SOIL TYPE

SITUATION

ASPECT

TREES & SHRUBS

WITHIN SURROUNDING

COUPE*

OAK

ASH

SYCAMORE

FIELD MAPLE

SWEET CHESTNUT

BIRCH

ALDER

HOLLY

ELDER

BRAMBLE

HAWTHORN

SPINDLE

BLACKTHORN

ROSE

HONEYSUCKLE

SCOTS PINE

CORSICAN PINE

OTHERS

* INDICATE IF FRUITING

GRID REF.

DATE

PURE COPPICE

COPPICE WITH STANDARDS

AGE OF COUPE

AV. DIST. BETWEEN STOOLS

AREA OF COUPE (ha)

AV. HT. HAZEL REGROWTH (m)

SAND

CHALK

CLAY

OTHER

VALLEY

HILL SLOPE

HILL TOP

FLAT

OTHER

OTHER COMMENTS:

SKETCH MAP:

APPENDIX 2

Photographs

*Hampshire Copse 1 regrowth after eight years**Copse 1 fungal infection**Copse 1 second-year regrowth*

Chapter 3

BOULDNOR FOREST – A CASE STUDY

This case study looks at the red squirrel population in Bouldnor Forest, Yarmouth, from 1991 to 2020. As expected with a working forest owned by the Forestry Commission, it has been thinned and clear felled according to a forestry plan. On the northern, seaward side, open heathland has replaced mature Corsican pine, therefore prime red squirrel habitat is reduced.

A mixture of scientific methodology and citizen science builds up a picture of major changes to the forest and consequences for red squirrels.

INTRODUCTION

Bouldnor Forest is 38ha of mixed woodland owned by the Forestry Commission and situated on the north-west coastline of the Isle of Wight. It is a working woodland, planted and harvested as a crop. It is also the most monitored woodland on the Island for red squirrels.

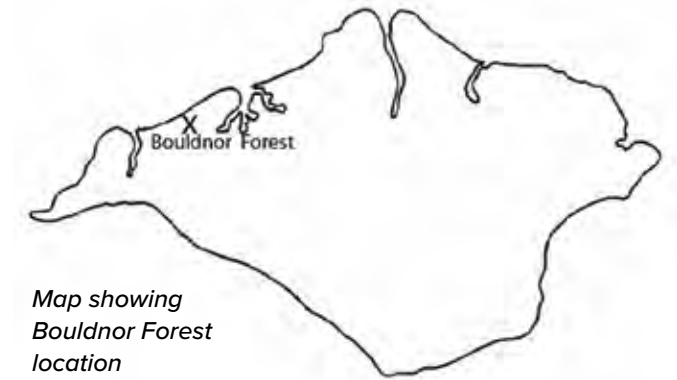
Bouldnor Forest has certainly undergone great changes in the last 30 years, possibly more so than any other Forestry Commission-owned woodland on the island.

Thanks to dedicated volunteer Hilary Higgins, it has been monitored using monthly monitoring and bi-annual monitoring techniques since 1999.

Successive residents of a dwelling on Yarmouth Road, which edges the south side of the forest, encouraged red squirrels and reported fluctuations in numbers, although owners have changed several times and data reporting is sporadic. This is citizen science but does give an indication regarding red squirrel activity.

Together with records of road casualties, a picture has built up over the years relating to the southern arm of the forest. The fast, busy stretch of highway between the Yarmouth ferry terminal and the main town of Newport has seen a steady number of squirrel road casualties over the years.

The northern, seaward, section of Bouldnor Forest suffers from slumping, with broadleaved trees naturally regenerating on the slumped ground.

*Map showing Bouldnor Forest location*

However, there is no safe way for a volunteer to access the area to monitor, therefore how squirrels may utilise this woodland is unknown.

METHODOLOGY

Citizen science

The general public are encouraged to report sightings of red squirrels seen on the Isle of Wight, alive or dead, to Wight Squirrel Project. Over the years, citizen science has provided baseline data and is used to indicate where actions such as installation of road signs or monitoring should be undertaken.

Bouldnor Forest is remote in terms of nearby settlements and parking is very limited, resulting in a low number of reports from the general public, compared to other publicly owned woodland.

In relation to this study, sightings from the general sightings database were extracted using the relevant grid references.

Monthly and bi-annual walks methodology

Monthly walks and bi-annual methodology are given in detail in section 2. The main aim is to get an index of squirrel numbers, not a record of total population size. By observing the trend in the increases or decreases over time, for a single wood, the health of the red squirrel population can be assessed.



Monthly and bi-annual walk route – west.
Drawn by monitor Hilary Higgins



Bi-annual route – east.
Drawn by monitor Sue Owens.

BOULDNOR MONITORING RESULTS

In the 1990s Bouldnor Forest was arguably the most densely populated woodland on the Isle of Wight for red squirrels. Monthly monitoring and bi-annual monitoring walks certainly confirmed this theory.

The reduction in red squirrels visiting the property by the entrance to the forest is largely due to the clear felling of a mature stand of maritime pine (*Pinus pinaster*). Maritime pine is not a good food source for red squirrels, the cones are large and take more energy to open than those of the smaller Corsican pine (*Pinus nigra*) or Scots pine (*Pinus sylvestris*). This stand of trees did, however, provide good drey building sites and a corridor from the main forest to a source of supplementary food. The area has been replanted and is growing well.

Citizen science sightings in Bouldnor Forest also dropped over time. The low number at the start of the graph (three) is due to a ranger being the only person reporting sightings. Some years are better reported than others for sightings, so citizen science is no substitute for the science-based monthly and bi-annual transect walks. Publicity initiates sightings from the general public, which does skew the figures in the one-off sightings reported from the general public.

The forest is far more open than in the 1990s and tree cover reduced, with approximately 17ha now open heathland. Transect monitoring does reflect the reduction in squirrel numbers, as you would expect.

Garden sightings

Sightings from the garden near the entrance to the forest tails off in 1999. Once the trees were cut, the owners didn't see many squirrels and were too upset to report the occasional sighting.

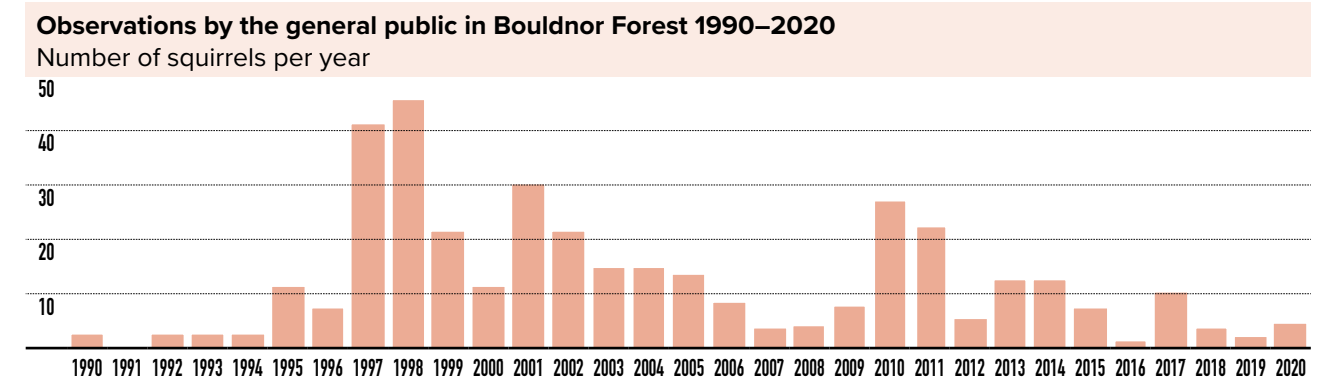
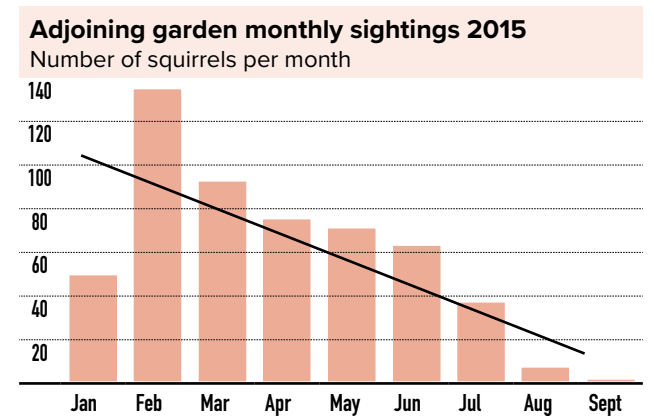
As the new planting adjacent to the garden grew, squirrel numbers increased slowly and sporadically (homeowners pers. comm.) but didn't reach the number of visits seen in the 1990s. In 2015 the owner documented visits (529) as shown in the graph. In 2020 the owner said she saw hardly any squirrels and hadn't since 2015.

The Hampshire & Isle of Wight Wildlife Trust now feeds the squirrels in the north of the forest, so it is possible that this feeding station is preferred to the garden.

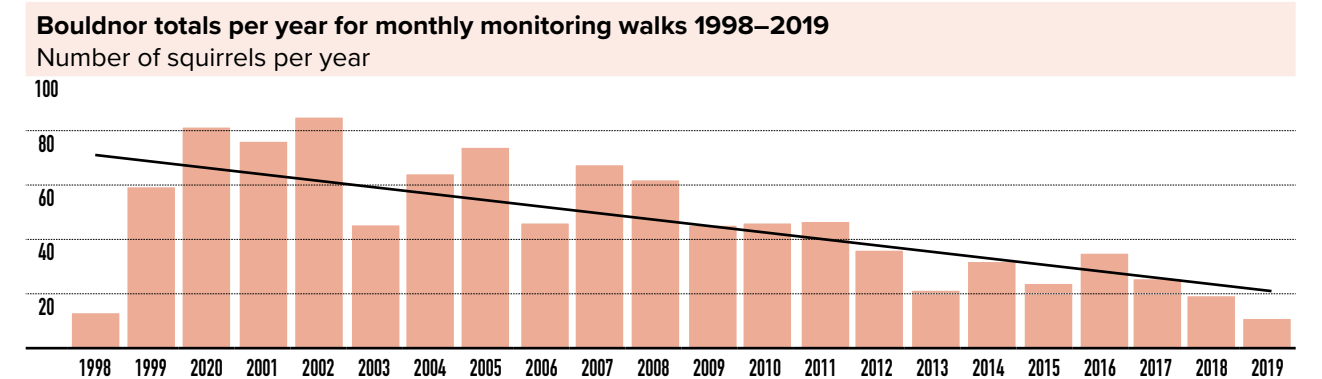
The 2015 graph illustrates how food availability in the forest influences garden visits. Red squirrels sometimes start to eat green cones as early as May on the Isle of Wight and certainly by June.

Disappearance from gardens in late summer is normal throughout the Island as the autumn seed crop ripens.

The number of females visiting drops in the spring as they are busy with the first brood of young. As Bouldnor Forest still has mature Scots pine and Corsican pine, garden visits tail off earlier than in broadleaved areas.



Monthly monitoring walks



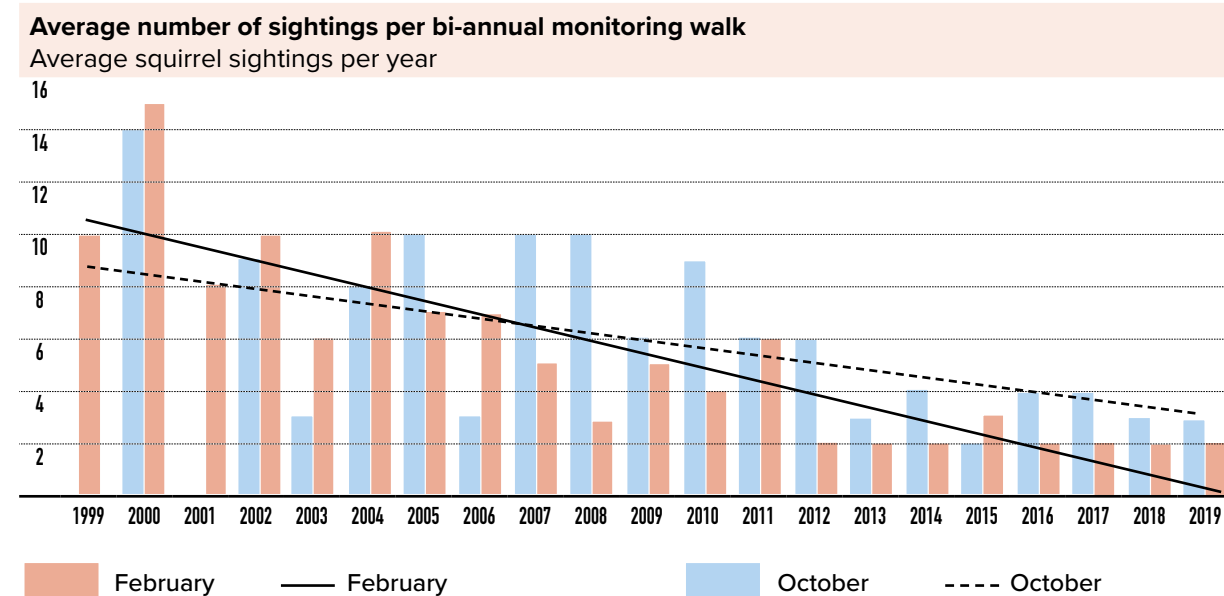
Monthly monitoring walks graph, showing decline in numbers. Only two walks instead of six were undertaken in 1998.

The graphs clearly show how sightings declined over the 20-year period. As with the rest of Bouldnor Forest, the transect covering the western side of the forest has undergone harvesting. Tree species along the transect are mixed.

Bi-annual monitoring results for the western route show the same decline in overall sightings as general sightings by the public, garden visits and the eastern transect do. The volunteer for Bouldnor west is dedicated and stuck to the transect even when numbers reduced or, occasionally, there were no sightings during the walks.

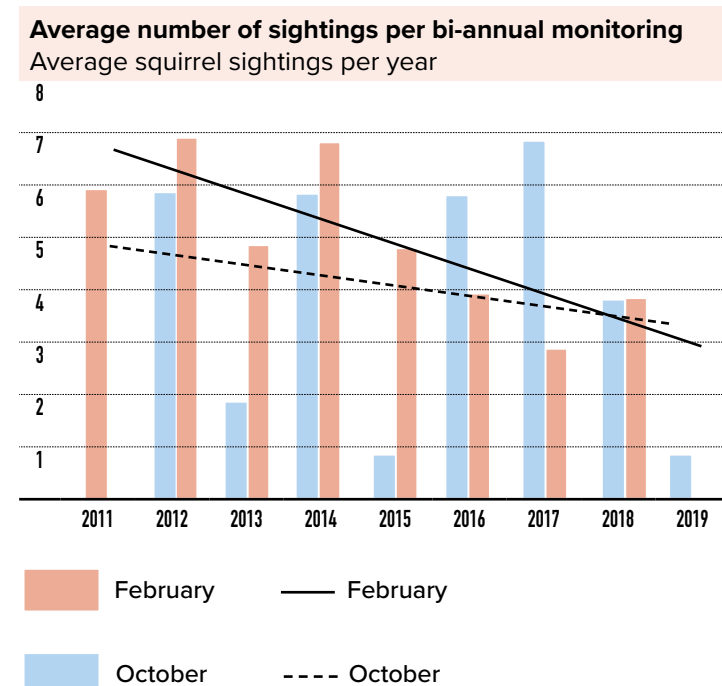
Bi-annual monitoring walks Bouldnor west

The sightings are higher in the spring walks in most years and numbers have dropped over time as shown in the previous graphs.



Bi-annual monitoring walks Bouldnor east

The volunteer for Bouldnor east adjusted the transect, according to forestry operations, to give the best chance of seeing squirrels. The volunteer gave up when sightings diminished along the transect. Habitat is mixed.



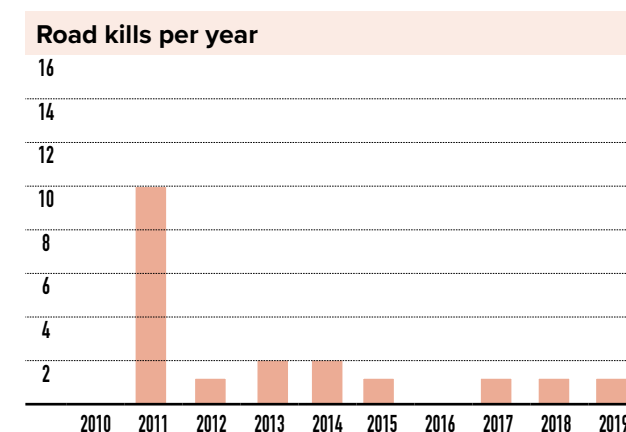
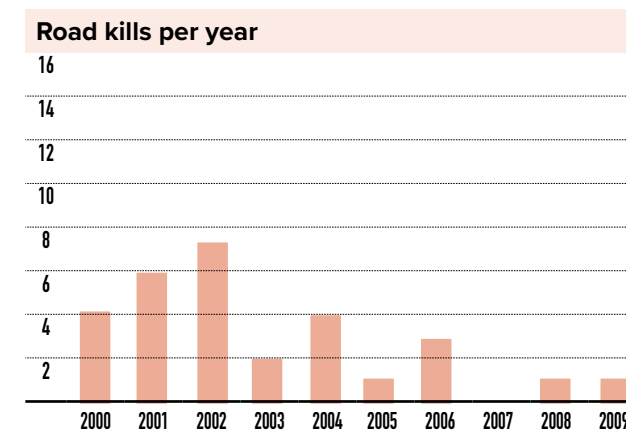
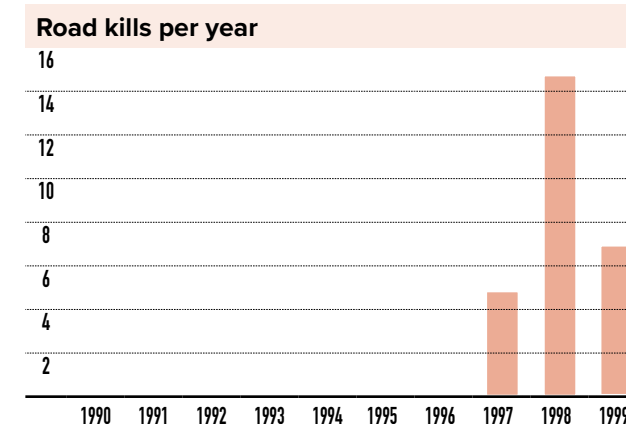
Road casualties

In 1998 thinning in the forest started, which accounts for the high mortality figure that year. Subsequent thinning and clear fells triggered more road kills. In more recent years, road kills have fallen. For instance, in 2020 the only reported casualty was an adult male found concussed on the main road at Bouldnor. He was treated and released. Ningwood Hill has also seen fewer road kills in recent years.

The data is predictable and to be expected given the forestry work. The conifers benefited from thinning as their crowns spread out and produced more cones. The negative impact is less canopy cover and more open areas, both leaving the squirrels liable to avian predation.

Any forest is a living, dynamic system and will change with time, impacting on the flora and fauna. Managing woodland in a sympathetic way provides better-quality habitat in the long run.

Graphs showing road kills, per decade, on Yarmouth Road for the length of Bouldnor Forest.



Acknowledgements and references for Part 2 Section 1

Brownscombe, J. 2014. *A Revision of the Isle of Wight Ancient Woodland Inventory*. 1st edn. Isle of Wight Biodiversity Partnership.

Quine, C.P., & Watts, K. 2009. Successful de-fragmentation of woodland by planting in an agricultural landscape? An assessment based on landscape indicators. *Journal of Environmental Management* 90(1): 251–259. doi:10.1016/j.jenvman.2007.09.002

Rushton, S.P., Lurz, P.W.W., South, A.B., Mitchell-Jones, A. 1999. Modelling the distribution of red squirrels (*Sciurus vulgaris*) on the Isle of Wight. *Animal Conservation* 2: 111–120.

The Countryside Commission Survey The Hedgerows Regulation Act

Forestry Commission website: Forest Research website www.forestresearch.gov.uk

The Isle of Wight Red Squirrel Strategy 1996

Isle of Wight BAP

CONTENTS

Part 2 Section 2

SCIENCE-BASED MONITORING

This section detailing science-based monitoring reproduces past reports. These give an insight into how red squirrels on the Isle of Wight have increased and spread over the years

	Page
Chapter 1 Monthly woodland monitoring	64
Chapter 2 Bi-annual squirrel monitoring walk	79
Chapter 3 Isle of Wight woodland surveys	111
Chapter 4 Corridors of Hope	121
Chapter 5 Corridors 30 years on from Corridors of Hope 1991/2	149

Chapter 1

MONTHLY WOODLAND MONITORING

RED SQUIRREL MONITORING on the ISLE OF WIGHT
Monthly Monitoring Walk Report September 1997 – October 1999
Produced by: Helen Butler BSc
January 2000

SUMMARY

- In 1997 Wight Squirrel Project initiated red squirrel monitoring on the Isle of Wight in accordance with the national monitoring programme.
- Volunteers monitored 21 woods across the Island for varying periods of time.
- Volunteers selected the wood they wished to survey depending on permission granted from landowners or public access.
- A suitable route was selected after carrying out an initial search for the areas with most squirrel activity. Dreys, feeding signs and squirrel sightings were recorded for each monthly walk. A map was drawn dividing the walk into sections.
- This report gives details of each wood monitored, i.e. habitat type, location, number of walks and duration of the walk, comments and observations by monitors and their findings.
- Data is presented as tables and graphs.
- Monitors were given leaflets showing how to distinguish a red squirrel from a grey squirrel in the event of a grey squirrel finding its way to the Island. No sightings of grey squirrels were reported.
- No supplementary feeding takes place in any of the woods but in some cases the squirrels are fed in nearby gardens. This is indicated in the report but not in the tables.
- Volunteers' comments and tree species identification have not been verified other than within the author's knowledge of the area.
- The majority of woods were monitored for only one year so there is insufficient data to draw any conclusions regarding population change.
- In accordance with the national programme, methodology changed in the autumn of 1999.



1 INTRODUCTION

Once widespread throughout the British Isles, 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 Great Britain (JNCC Red Squirrel Strategy 1995).

The Isle of Wight is unique in having red squirrels living in deciduous woodlands without a direct threat from grey squirrels as the Solent has so far proved an effective barrier against grey squirrel colonisation. Island woods total approximately 3,695ha (Isle of Wight Red Squirrel Strategy 1996). However, squirrels are not found in all woods. Some are very poor in terms of red squirrel habitat so it has been estimated that they can carry 2,000–2,500 (H. Butler pers. comm.) squirrels.

Monitoring the Island's red squirrel population and surveying its woodland has been a large part of Wight Squirrel Project's work over the last eight years. It was decided to adopt the national methodology so that the Island may contribute to the national red squirrel conservation programme.

Continuous monitoring will provide data which should aid decisions on where to direct conservation work on the Island. This will probably be aimed at habitat management and

reinstating corridor links. Ongoing vigilance for sightings of possible grey squirrel incursion is also paramount in the effort to maintain a 'red only' area on the Isle of Wight.

Wight Squirrel Project is an independent group of volunteers which took on the task of monthly monitoring walks in 1997.

Volunteers were recruited via press articles during NPI National Red Squirrel Week 1997. Three training walks were conducted at different times and locations.

Thirty-three volunteers were initially interested in participating but only 18 people completed more than three walks. Monitoring took place in a total of 22 woods across the Island. Reports were submitted for 21 woods. No report was submitted for Golden Hill Fort, Freshwater as the monitor saw no squirrels nor found any feeding signs or dreys.

Data and comments in this report are provided by volunteers who completed and returned monitoring sheets.

1.1 MONTHLY WALK METHODOLOGY

Notes for Monthly Walks

(Verbatim from instructions given to volunteers and provided by the UK initiative)

The main aim is to get an index of squirrel numbers, not a record of total population size. By observing how the trend in the index for a single wood increases or decreases over time, the health of the red squirrel population can be assessed. The most important point is that once the length of the route (distance) and time taken to survey the route is determined, it should remain so for as long as you continue surveying – this ensures maximum consistency in your results and will also enable comparisons between the same months of different years.

- 1

Before deciding the fixed route to take on the walk, have a thorough search of the wood first to see if there are any obvious areas to include within the walk, such as identifiable food sources or possible nesting sites.
- 2

Once the walk has been decided it may be useful to sketch it by hand. The walk can be divided into sections, for example where changes in the woodland type or structure occur, which will make recording sightings and feeding signs easier. Thus rather than plotting the sighting, the section number can be quoted.
- 3

Do not undertake the walk in heavy rain or high winds. If the weather changes too much within the course of the walk so that it becomes unlikely that squirrels will be seen, stop the walk and start from the beginning again at the next available opportunity.
- 4

The walk should not be more than three hours. The best time to start the walk is one hour after dawn as this is when squirrels are at their most active. If this is not possible, try and complete the walk by 10am in the summer and midday in the winter. If the wood is small, do not worry that the walk is short – the main point is to keep the walk consistent for each month.
- 5

It is best if the walk can follow natural paths or rides within the wood, as less noise disturbance will occur, and the recorder can concentrate on watching the canopy, rather than the path being taken. Along the walk the recorder should walk for 100m and then remain stationary for three minutes, all the time recording what is seen.
- 6

Once the walk has been completed the route can be retraced or walked on another occasion and the feeding signs recorded (e.g. freshly chewed pine cones). Record feeding signs in each section as none, few, several or many, and what species of tree the food is from, where identifiable.
- 7

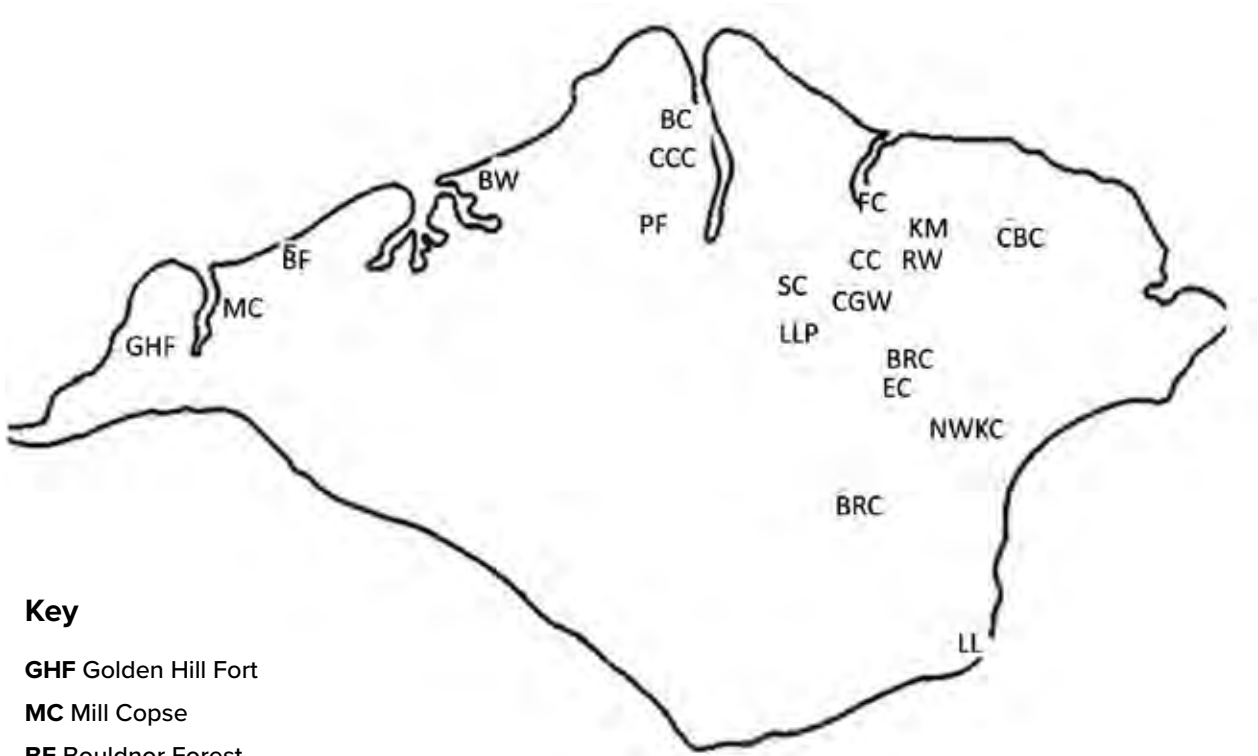
The aim is to have a summary sheet for the year of monthly squirrel sightings within a wood. Please do not be discouraged if the first few months produce no sightings, it may take a while to get accustomed to spotting ‘flashes’ in the canopy. Don’t be put off if there are only one or two sightings in a year – this is still useful information.

2.1 WIGHT SQUIRREL PROJECT MONTHLY WALK REPORT

List of monitored woods

Monitored wood	Nearest town/village	Grid reference
Firestone Copse (1)	Havenstreet	SZ 555 912
Firestone Copse (2)	Havenstreet	SZ 565 912
Burnt Wood	Porchfield	SZ 445 925
Borthwood Copse	Alverstone	SZ 570 845
Bouldnor Forest	Yarmouth	SZ 378 903
Cothey Bottom Copse	Ryde	SZ 607 907
Somerton/Calving Close/Bottom Copses	Northwood	SZ 497 939 SZ 495 945
Luccombe Landslip	Luccombe	SZ 584 800 SZ 581 782
Mill Copse	Yarmouth	SZ 358 889
Combley Great Wood	Havenstreet	SZ 545 894
Kemphill Moor/Rowlands/Chillingwood	Havenstreet	SZ 570 895 SZ 567 895 SZ 560 894
Staplers Copse/Longlane Plantation	Newport	SZ 525 885 SZ 528 897
Eaglehead/Bloodstone Copses	Ashey	SZ 580 876
Nunwell Wood/Kelly’s Copse	Brading	SZ 590 873 SZ 602 869
Parkhurst Forest (1)	Newport	SZ 475 917
Parkhurst Forest (2)	Newport	SZ 475 903
Parkhurst Forest (3)	Newport	SZ 477 907

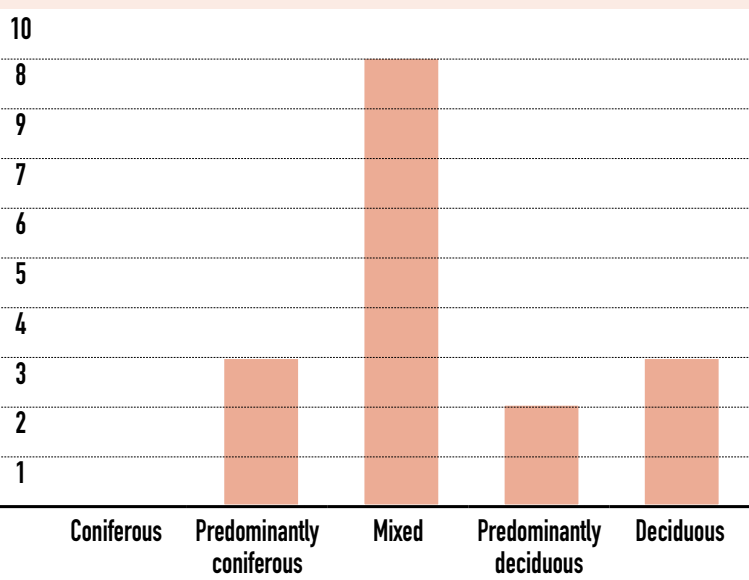
MAP SHOWING LOCATION OF WOODS MONITORED ON THE ISLE OF WIGHT



Key

- GHF Golden Hill Fort
- MC Mill Copse
- BF Bouldnor Forest
- BW Burnt Wood
- BC Bottom Copse
- CCC Calving Close Copse
- PF Parkhurst Forest
- RW Rowlands Wood
- CC Chillingwood Copse
- KM Kemphill Moor
- CGW Combley Great Wood
- FC Firestone Copse
- BRC Borthwood Copse
- BSC Bloodstone Copse
- EC Eaglehead Copse
- LL Luccombe Landslip
- CBC Cothey Bottom Copse
- NW Nunwell Wood
- KK Kelly's Copse
- LLP Longlane Plantation

Summary graph showing woodland type



2.1 WIGHT SQUIRREL PROJECT MONTHLY MONITORING WALK REPORT

Firestone Copse Monthly Walk Report

Firestone Copse is a 99.2ha mixed plantation managed by Forest Enterprise. Close to the village of Havenstreet, it is a very popular area for dog walkers. Two separate walks were conducted in the southern half of the Copse.

Firestone Copse walk (1)

Grid reference	SZ 555 912
Woodland type	Mixed
Monitoring period	September 1997 – December 1998
Number of monitoring walks	11
Duration of monitoring walk	1hr

Firestone Copse walk (1)

No walks were undertaken during December 1997, January 1998, July and August 1998 and November 1998. A young squirrel was spotted in the conifer section in May 1998. Four other sightings were of adult squirrels seen in October 1997, February, March and September 1998, again in the conifer section.

Average number of squirrels seen per walk: 0.5

Stripped pine cones were found between September 1997 and May 1998. A few hazel shells left by squirrels were found on walks conducted between September 1997and April 1998.

Tree felling was in progress during February.

Three dreys were found.

Firestone Copse walk (2)

Grid reference	SZ 565 912
Woodland type	Mixed
Monitoring period	October 1997 – September 1998
Number of monitoring walks	12
Duration of monitoring walk	1hr 15 minutes

Firestone Copse walk (2)

The area covered by this route is very popular with the squirrels. At least one squirrel was seen on each walk except during the May and August walks.

Average number of squirrels seen per walk: 1.6

Freshly split hazel shells and stripped cones were found on most walks. The volunteer found freshly dug hazelnuts during April and May.

Nine dreys were recorded.

Burnt Wood Monthly Walk Report

Burnt Wood is 49.5ha of mixed woodland managed by Forest Enterprise. Main tree species are pine with other conifers, hazel (*Corylus avellana*), beech (*Fagus sylvatica*) and oak (*Quercus robur*). The nearest village is Porchfield approximately one mile away. The walk was shortened after June 1998 as the paths became overgrown.

Grid reference	SZ 445 925
Woodland type	Mixed
Monitoring period	January 1998 – December 1998
Number of monitoring walks	12
Duration of monitoring walk	Approximately 50minutes

Burnt Wood walk

The only sighting of a squirrel was in a coniferous section, during the January walk. The volunteer talked to locals who say squirrels have declined over the last two years.

Average number of squirrels per walk: 0.08

Feeding signs were scant with only a few stripped cones found in the same coniferous section as the sighting and a few hazelnut shells in the deciduous sections. Many uneaten nuts were found.

One drey was found.

Borthwood Copse Monthly Walk Report

Grid reference	SZ 570 845
Woodland type	Predominantly deciduous
Monitoring period	October 1997 – September 1999
Number of monitoring walks	24
Duration of monitoring walk	1hr 30minutes

Borthwood Copse walk

Of the five sightings in May 1999, one was a young squirrel. Four adult squirrels were seen in an adjacent section. Tree species are predominantly pine in this section.

Average number of squirrels per walk: 97/98 0.8 98/99 0.7

A few stripped pine cones were found in the same section during August and September 1999. The monitor reports that green cones were being eaten as early as 28th June in 1998.

On 20th September she observed squirrels feeding in the beech trees.

Five dreys were located. Artificial dreys are provided in this wood, which the volunteer believes are in use.

Bouldnor Forest Monthly Walk Report

Bouldnor Forest is managed by Forest Enterprise and covers 110.45ha. It consists of mature Scots pine (*Pinus sylvestris*) and Corsican pine (*Pinus nigra*) with some hazel, oak, ash (*Fraxinus excelsior*) and beech. Bouldnor Forest is thought to have the largest density of red squirrels on the Island. Three monitors volunteered to work in the Forest but only one visited more than twice. The other two found their route became too difficult due to thinning operations.

Grid reference	SZ 378 903
Woodland type	Predominantly coniferous
Monitoring period	September 1997 – September 1999
Number of monitoring walks	23
Duration of monitoring walk	1hr 45minutes

Bouldnor Forest walk

Of the 23 walks undertaken, only on one walk, June 1998, were no squirrels at all observed. The most seen on one walk was in August 1998 when a total of 14 were spotted.

Average number of squirrels per walk: 97/98 3.5 98/99 4.0

An abundance of feeding signs (stripped cones) were found throughout the monitoring period. A squirrel was observed eating oak and ash leaf shoots in May 1998, April 1999 and May 1999.

No dreys were reported apart from one which had fallen.

Cothey Bottom Copse Monthly Walk Report

Cothey Bottom Copse is a privately owned wood which is currently being brought back into coppice rotation after approximately 50 years. Major construction work is also under way adjacent to the copse. Overstorey is predominantly oak and the understorey is hazel coppice.

Grid reference	SZ 607 907
Woodland type	Deciduous
Monitoring period	October 1997 – September 1998
Number of monitoring walks	24
Duration of monitoring walk	1hr

Cothey Bottom Copse walk

Only two squirrels were seen between October 1997 and April 1998 when large areas were being cut. Both sightings were on the March walk when there was no work taking place.

Sightings were again scant the following autumn when work resumed. It seems likely the squirrels move away whilst work is in progress.

Average number of squirrels per walk: 97/98: 0.6 98/99: 0.8

Volunteer reports that although the wood is heavily worked, the squirrels are still feeding as split hazel shells were found. A few hazel shells split by squirrels were found on every walk but many were found in August 1998.

Two dreys were found in the copse. One drey was blown down during October 1998.

Somerton Copse/Calving Close Copse and Bottom Copse Monthly Walk Report

Initially only Somerton Copse and Calving Close Copse were monitored. Bottom Copse was added to the walk in February. The woods are linked by hedgerows. They are situated adjacent to a residential area and the public paths are well used. People living nearby told the monitor that they feed squirrels in their gardens. All walks took place either mid-afternoon or evening.

Grid reference	SZ 497 939 and SZ 495 945
Woodland type	Mixed
Monitoring period	September 1997 – August 1998
Number of monitoring walks	12
Duration of monitoring walk	1hr 30minutes

Somerton Copse/Calving Close Copse and Bottom Copse walk

A total of 16 sightings over the year suggests that this area, although not prime squirrel habitat, is nevertheless supporting a small population. Breaking down the areas where squirrels were seen is interesting as seven were spotted in the row of trees that links Somerton Copse and Calving Close Copse. There were no sightings in Somerton Copse. In Calving Close Copse and Bottom Copse there were four and five sightings respectively.

Average number of squirrels per walk: 1.3

Many split hazel shells were found in August 1998, otherwise no feeding signs or dreys were recorded.

Luccombe Landslip Monthly Walk Report

A linear walk along this popular public footpath was undertaken for a year. The wooded area it traverses is, as the name implies, a landslip which has stabilised and regenerated with mixed tree species including beech and hazel. The woods are owned by the National Trust.

Grid reference	SZ 584 800 – SZ 581 782
Woodland type	Deciduous
Monitoring period	October 1997 – September 1998
Number of monitoring walks	12
Duration of monitoring walk	1hr 15minutes

Luccombe Landslip walk

There was a total of eight sightings over the year. All occurred in the same area, i.e. where the wooded part of the path is at its most dense.

Average number of sightings per walk: 0.6

Many split hazel shells were found in October 1997 and September 1998, otherwise only a few were found in March and August 1998. The volunteer watched a squirrel eating a hazelnut in August 1998 and a squirrel was spotted eating fungi on an oak tree in December 1997.

One drey was found in the same section as the sightings.

Mill Copse Monthly Walk Report

Mill Copse was formerly managed by Forest Enterprise but has now been taken over by Wight Nature Fund. The conifers are gradually being replaced by broadleaved species in order to return the copse to hazel coppice and native standards. The copse, although small, is linked by hedgerows to other small woods in the area.

Grid reference	SZ 358 889
Woodland type	Mixed
Monitoring period	October 1997 – September 1998
Number of monitoring walks	12
Duration of monitoring walk	1hr

Mill Copse walk

The volunteer was disappointed to see only one squirrel during the year. This was on the May walk in an area of mixed tree species.

Average number of sightings per walk: 0.08

Many freshly split hazel shells were found in two feeding places on the October 1997 walk. Otherwise no feeding signs were discovered for the rest of the survey.

No dreys were located.

Combley Great Wood Monthly Walk Report

Combley Great Wood is 83ha of mixed tree species managed by Forest Enterprise. Tree species include oak, beech, hazel and a variety of conifers. Although used by walkers, there are few squirrel sightings reported. The volunteer found heavy mud a problem during the winter months so the February and March walks were abandoned. No walk was undertaken during July and August.

Grid reference	SZ 545 894
Woodland type	Mixed
Monitoring period	October 1997 – November 1998
Number of monitoring walks	10
Duration of monitoring walk	1hr

Combley Great Wood walk

The volunteer was disappointed not to see a squirrel at all. No split hazelnuts were found but a few stripped pine cones were found on every walk in the same area.

No dreys were located.

Kemphill Moor/Rowlands Wood and Chillingwood Monthly Walks Report

Three woods were covered on one walk by a single volunteer who visited the woods twice a month. Data is given on a monthly basis.

Kemphill Moor contains mixed conifers, beech, oak, ash, hazel and other broadleaved species.

Rowlands Wood has been worked recently and the volunteer suggests the disturbance may be responsible for the disappointing amount of squirrel signs and sightings. Tree species include Corsican pine, Scots pine, ash, oak, and other deciduous species. Chillingwood Copse has mixed conifer species and mixed deciduous species including sweet chestnut (*Castanea sativa*), oak, ash and hazel. The volunteer reported that in all three woods hazel has been coppiced heavily in recent years.

Grid reference	SZ 570 895 / SZ 567 895 / SZ 560 894
Woodland type	Mixed
Monitoring period	September 1997 – August 1998
Number of monitoring walks	24
Duration of monitoring walk	3hrs

Kemphill Moor/Rowlands Wood and Chillingwood Walk

A total of 26 sightings are broken down as:
Kemphill Moor 6, Rowlands Wood 11, Chillingwood Copse 9.

Average number of squirrels sighted per month:
Kemphill Moor 0.25, Rowlands Wood 0.46, Chillingwood Copse 0.37

Feeding signs were scant with only a few green cones found in July. The hazel crop was described as poor.

Three dreys were found in Chillingwood Copse and two in Rowlands Wood.

Staplers Copse /Longlane Plantation Monthly Walks Report

A footpath running the length of two adjoining woods was the linear route taken to monitor Staplers Copse and Longlane Plantation. Staplers Copse is mostly oak, birch (*Betula pendula*) and hazel. The volunteer reported the wood is being heavily worked.

Grid reference	SZ 525 885 / SZ 528 897
Woodland type	Mixed
Monitoring period	October 1997 – May 1998
Number of monitoring walks	8
Duration of monitoring walk	3hrs

Staplers Copse/Longlane Plantation walk
No squirrels seen in this wood

Eaglehead Copse/Bloodstone Copse Monthly Walk Report

These two small adjoining woods have a public path running through them and the volunteers used this as their route. Both woods are deciduous with species including oak, ash, beech and hazel. Tree cutting was under way in Bloodstone during the January walk and it was evident more work had taken place in February and March.

Grid reference	SZ 580 876
Woodland type	Deciduous
Monitoring period	October 1997 – December 1998
Number of monitoring walks	11
Duration of monitoring walk	1hr

Eaglehead Copse/Bloodstone Copse walk

It was disappointing that there were no sightings but there was plenty of evidence of squirrels feeding on the hazelnut crop during August and September 1998. The monitor reports that the crop was good.

One drey was spotted.

Nunwell Wood and Kelly’s Copse Monthly Walks Report

Nunwell Wood is a predominantly deciduous woodland containing, oak, sycamore (*Acer pseudoplatanus*), ash, beech and hazel. Management is under way to improve the wood for red squirrels. The adjoining Kelly’s Copse is a traditional hazel coppice which has not been worked for many years but still produces a good crop of hazelnuts. The woods are small and isolated in squirrel terms but seem able to retain a stable population. Both woods are privately owned but have public access. No walks were undertaken in January, March, April or May 1998.

Grid reference	SZ 590 873 / SZ 602 869
Woodland type	Predominantly deciduous
Monitoring period	October 1997 – September 1998
Number of monitoring walks	8
Duration of monitoring walk	1hr

Nunwell Wood/Kelly’s Copse walk

The volunteer was disappointed to only hear, rather than see, squirrels but she did speak to people who regularly walk through these woods and they do see squirrels occasionally.

A few fresh, split hazel shells were found in October and November 1997 and again in August and September 1998.

No dreys were found.

Parkhurst Forest Monthly Walk Report

Parkhurst Forest is 403ha of mixed tree species including sweet chestnut, Scots pine, Corsican pine, beech and hazel. It is managed by Forest Enterprise. It is also a very popular forest for walking, cycling and horse riding.

Three volunteers undertook walks and the results of each are given separately.

Parkhurst Forest walk (1)

Grid reference	SZ 475 917
Woodland type	Mixed
Monitoring period	September 1997 – September 1998
Number of monitoring walks	12
Duration of walk	1hr 30minutes

Parkhurst Forest walk (1)

Squirrels were seen on seven of the 12 walks. Six were seen in September 1997 but none were sighted in September 1998; and none were seen on the March, May, June and July walks.

Average number of sightings per walk: 1.6

A few stripped pine cone cores were found in March 1998 otherwise no feeding signs were reported. No dreys were recorded.

Parkhurst Forest Walk (2)

Grid reference	SZ 475 903
Woodland type	Predominantly coniferous
Monitoring period	September 1997 – September 1998
Number of monitoring walks	12
Duration of monitoring walk	1hr 45minutes

Parkhurst Forest walk (2)

This was a rewarding route for the monitor as squirrels were seen on every walk except September 1998. Seven sightings in January and August 1998 were the highest numbers recorded. The route was through mixed conifer compartments with deciduous trees in one section.

Squirrels were seen in all sections.

Average number of sightings per walk: 2.5

A few split hazel shells were found in September 1997, otherwise all feeding signs were stripped cones. Stripped Scots pine and Corsican pine cones were abundant but a few western hemlock (*Tsuga heterophylla*) and larch (*Larix decidua*) cones were found as well.

One drey was spotted in the Corsican pine compartment.

Parkhurst Forest Walk (3)

Grid reference	SZ 477 907
Woodland type	Predominantly coniferous
Monitoring period	September 1997 – August 1998
Number of monitoring walks	12
Duration of walk	1hr

Parkhurst Forest walk (3)

This route is predominantly coniferous but included some sweet chestnut, oak and beech.

Sightings were recorded on seven of the walks, in the pine section and also in a stand of beech and oak. The sightings in the deciduous area were in September and November 1997.

Average number of sightings per walk: 1.25

The only feeding signs recorded were stripped pine cones in January 1998.

The volunteer recorded three possible dreys – all in the deciduous area.

3.1 CONCLUSIONS

With only one year’s monitoring in the majority of woods, it is impossible to draw any conclusions regarding population change. Findings are generally consistent with prior knowledge of the woods and ongoing monitoring which relies on sightings from the general public.

There was evidence that all the woods, with the exception of Golden Hill Fort, were used by squirrels. However, it is known that squirrels are in the area as they feed in adjoining gardens occasionally.

As volunteers wished to monitor a wood near their home and many people came from the same towns, some woods were chosen for their location rather than being a rewarding wood to monitor. The more interesting squirrel habitat, such as Hamstead Forest and Walter’s Copse, were not monitored because nobody in these areas volunteered.

The two years of monitoring data for Borthwood Copse, Cothey Bottom Copse and Bouldnor Forest could be compared. There was no significant difference in the total number of sightings but numbers peaked at different times of year. However, squirrel sightings are very much a matter of chance and I look forward to receiving more Monthly Walks data from these woods to compare the figures.

Cothey Bottom Copse data shows a lack of sightings correlated with work in the copse. Three more sightings recorded in the second year is probably down to chance rather than an increase in squirrels.

Thinning in Bouldnor Forest did disrupt the squirrels for a time and it is known that around 40 left the forest. This may account for the lower number of sightings at the beginning of the monitoring session that coincided with the thinning work.

When comparing the two different routes in Firestone Copse, it is apparent that the squirrels prefer the coniferous areas as there are far more sightings here. The same applies to the walks in Parkhurst Forest. Walk (2) has mixed conifer compartments with few deciduous trees whilst walks (1) and (3) are mixed areas. The volunteer reported 33 sightings on walk (2) but the other walks produced only 19 and 15 sightings respectively.

It was difficult for volunteers to commit themselves on a monthly basis. Seventeen completed one year but only two monitors, covering three woods, completed two years. Of the original monitors, after a years’ rest, seven started again using the new methodology. This commits them to three surveys within two weeks twice a year only.

3.2 FUTURE RECOMMENDATIONS

Given the problems with monthly walks commitment, monitoring methodology on the Island changed in 1999. This is also in line with the national monitoring programme. Furthermore, it was felt (nationally) that although trends within a wood could be monitored over time, the data cannot be used for statistical tests.

As the report shows, squirrel sightings vary greatly. It is therefore proposed that three walks are conducted within a period of two weeks. The average number of squirrel sightings is then calculated for each session. These sessions will be carried out twice a year, in the spring and again in the autumn. This will provide a snapshot of the status of squirrel populations in the monitored woods.

A uniform transect length and a set time to conduct the walk will make the data more accurate and more comparable within and between woods. Distance estimates have been introduced and the volunteers are given a training session on how to measure distance, length and time.

In the past, volunteers have lost forms before the year is up. The Bi-annual Monthly Walk forms are sent out a few weeks prior to the walks starting and sent in immediately the walk has finished. It is therefore easier to attain the volunteer’s feedback quickly and sort out any problems there may be.

The quality of the current volunteers’ work is high and they all seem enthusiastic. Two of the monitors are now starting their third year on the project and will continue with their Monthly Walks as well as the Bi-annual Walks. This will give a great deal of information about three woods (one volunteer monitors two woods) and a comparison can be made using all the Monthly Walks data. Monthly Monitoring Walks and Bi-annual Monitoring Walks data are not comparable.

Chapter 2
BI-ANNUAL SQUIRREL
MONITORING WALKS

WIGHT SQUIRREL PROJECT BI-ANNUAL WOODLAND MONITORING
For RED SQUIRRELS on the ISLE OF WIGHT
October 1999 – October 2019

INTRODUCTION

How to present so much data took a long time to decide. Originally, the Excel tables and all entries were included, taking hours of work to lay out. When it became obvious this was too cumbersome – over 100 pages – adhering to the main points proved the solution. Where walks were intermittent over the 20-year period or abandoned after one or two seasons, they are not included in the results. Bi-annual woodland monitoring started in Autumn 1999 and, although volunteers have dwindled, it is ongoing.

Bi-annual Squirrel Monitoring Walks consist of two sessions each year, the first in February/ March and the second in September/October. This timing optimises the chances of seeing squirrels. Each transect is walked three times within two weeks for each session. The repetition smoothens out chance variations in the number of squirrels sighted. By conducting the monitoring

walks in the same fashion and at the same time every year, it is possible to obtain information on the long-term population trends of red squirrels. This style of walk also enables squirrel density estimates to be calculated, given the appropriate computer programme. The methodology, training programme and forms were provided by the national red squirrel programme. Forms are in Appendix 1.

METHODOLOGY

The characteristics of each transect and wood are recorded, including the tree species in each transect section, i.e. conifer, mainly conifer, mixed, mainly deciduous, deciduous. The dominant characteristic of the wood as a whole is recorded in the same way. The three dominant tree species in the wood, weather conditions and time of walk are also recorded.

Monitors are asked to start their walk at dawn – around 7am. The maximum length of the walk was 1,200m but smaller woods have shorter transects and the larger woods can have more than one monitor. Walks are only carried out in good weather and if the weather deteriorates part way through a session, the walk is abandoned. Only good, main tracks are used so the monitors are looking at the trees rather than worrying where they are treading.

The transect is divided into 100m sections. Each section takes five minutes to walk and there is a five-minute stop at the end of each section. Food leavings and dreys are recorded and, of course, squirrel sightings and activity. The perpendicular distance of the squirrel in relation to the transect is measured by eye and takes some practice to achieve a degree of accuracy.

Schematic diagram of squirrel sighting, showing the perpendicular distance measurement



THE TRAINING SESSION

An hour’s training session is given to show each monitor how to:

- 1) Walk 100m in five minutes. Few people realise how slow this is and several attempts are always needed to get the timing right
- 2) Measure 100m using their own paces
- 3) Estimate perpendicular distance without ‘clumping’, that is giving all distances ending in 0 or 5
- 4) Identify squirrel food leavings
- 5) Identify squirrel dreys
- 6) Identify grey squirrels. A leaflet showing how to identify grey-coloured red squirrels from the grey species is given to each volunteer

People choose the wood they want to monitor, as long as landowner permission is given. Most choose a wood close to home. All selected woods are known to have a red squirrel population. Suitable routes are chosen after a search of the woods to look for squirrel activity and good paths. A map is drawn, dividing the walk into sections. This work is carried out before the first walk is undertaken.

When reporting the results, assumptions are taken that:

- The transects are accurately measured
- Perpendicular distances from the transect to squirrel are accurately estimated
- Squirrels are detected before they move in response to the monitor’s presence
- No squirrel is counted twice
- Squirrels on or over the transect are detected

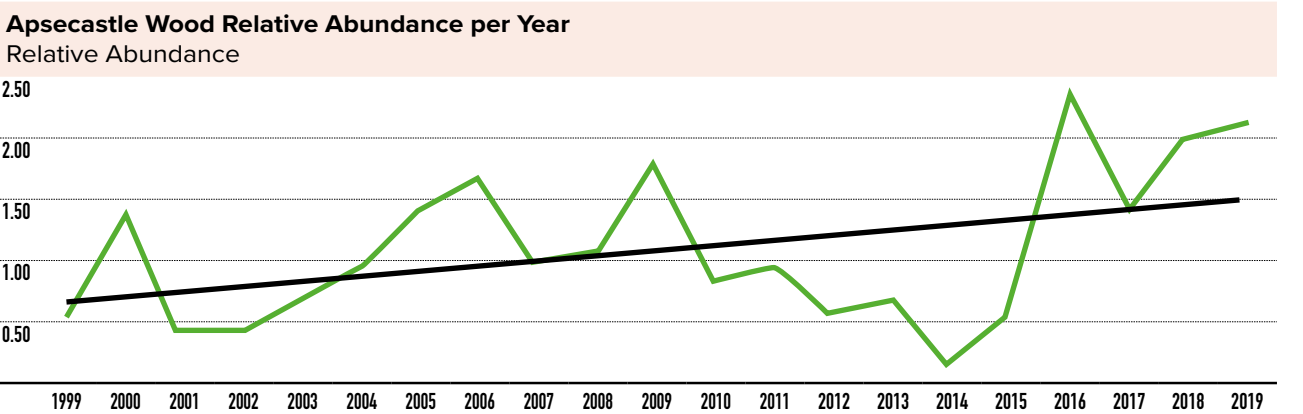
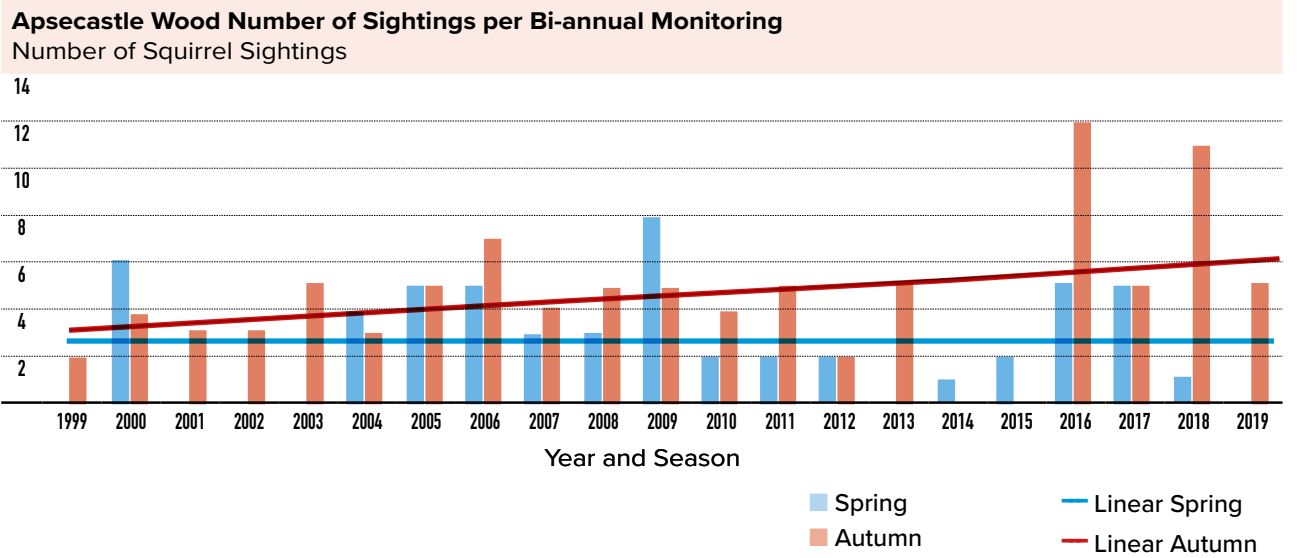
Relative abundance

Relative abundance figures for each wood are calculated by dividing the number of squirrels observed by the total length (km) walked. By comparing years, it is possible to build up a picture of red squirrel numbers in an area. Results for the most consistently walked routes are given if they show enough data for comparison over time. Other woods are listed but a relative abundance graph is not given. All data is included in the analysis in section 4.

RESULTS FOR EACH WOOD OVER 20 YEARS

Apsecastle Wood

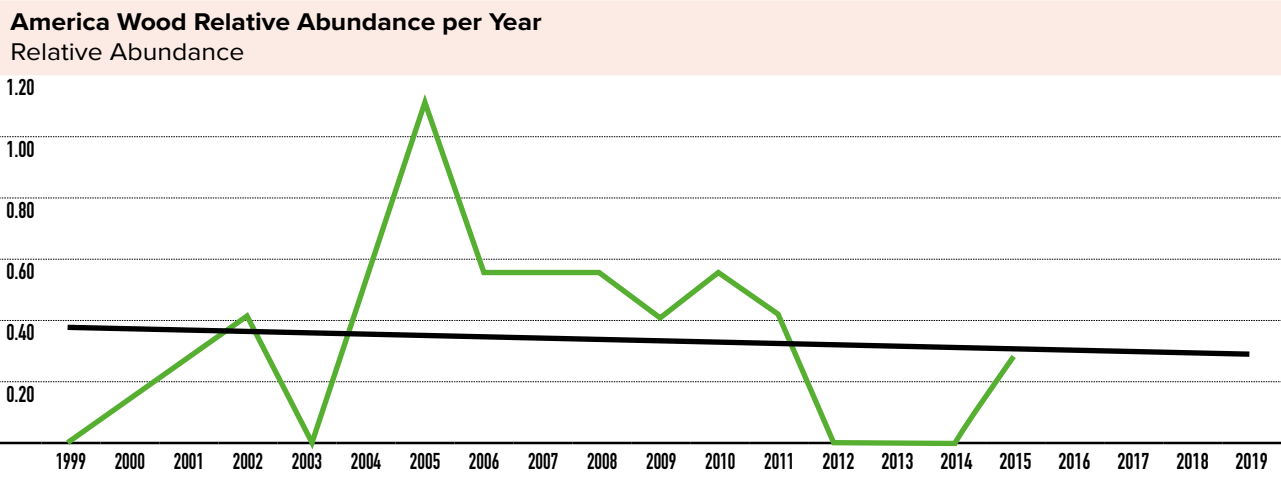
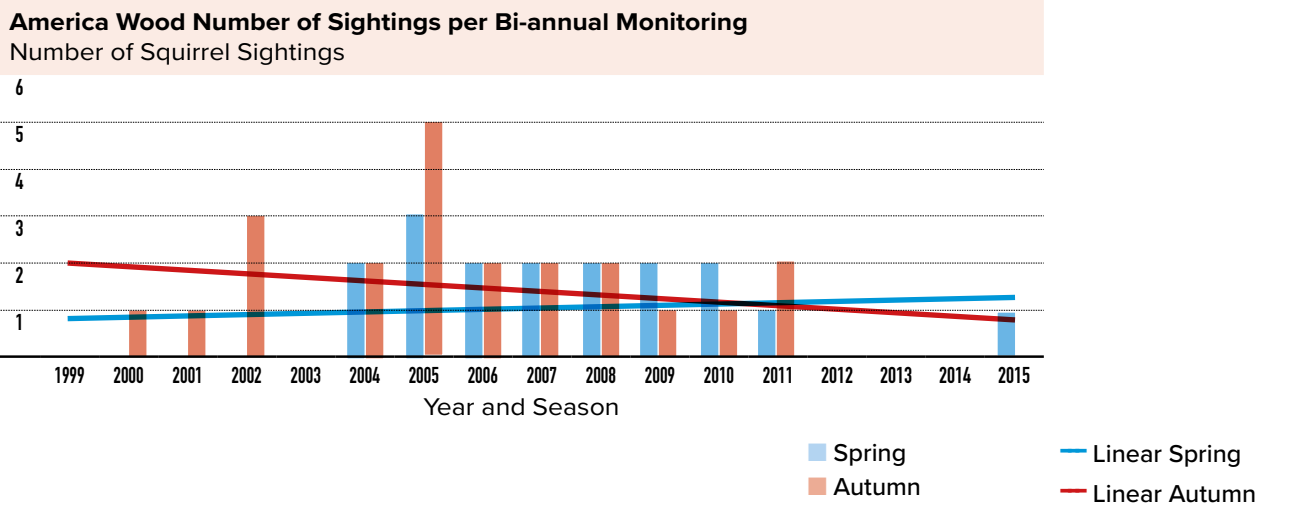
Grid reference: SZ 565 816	Transect details
Size: Unknown	Overall nature of wood: Deciduous
Monitors: Mrs J. Booth then Mrs C. Bratherton	Transect: Deciduous
Monitoring period: Autumn 1999 – Autumn 2019 Ongoing	Transect length: 1,200m
Landowner: The Woodland Trust	Total walks: 96
Supplementary feeding nearby: Yes	Total observations: 105
Corridor to next copse: Yes	Total kilometres walked: 115.2
	Relative abundance: 0.91



Note no walks:
Spring 2001
Spring 2003
Autumn 2015
Spring 2019

America Wood

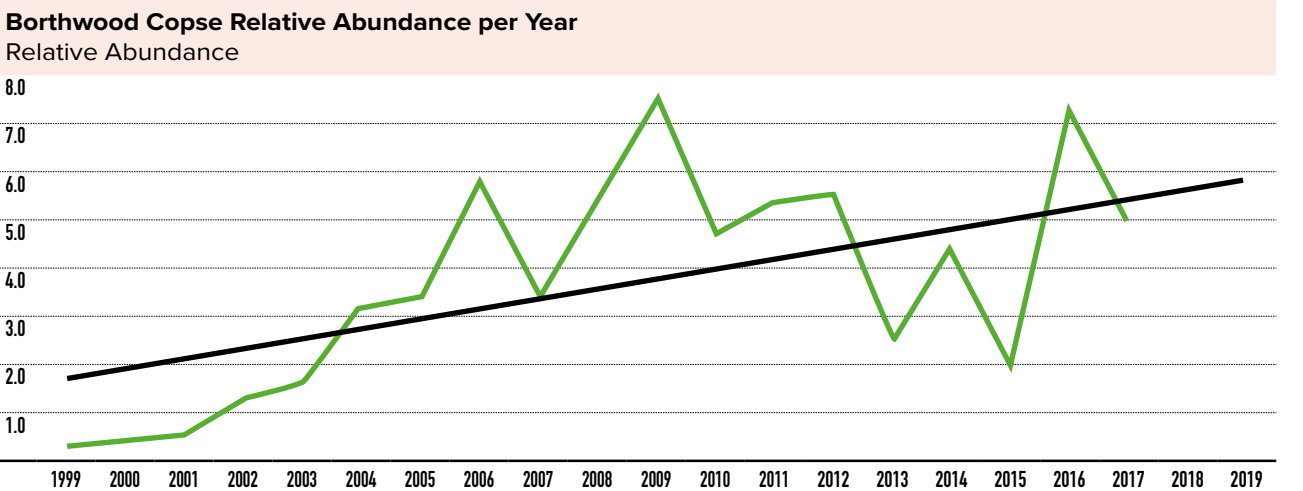
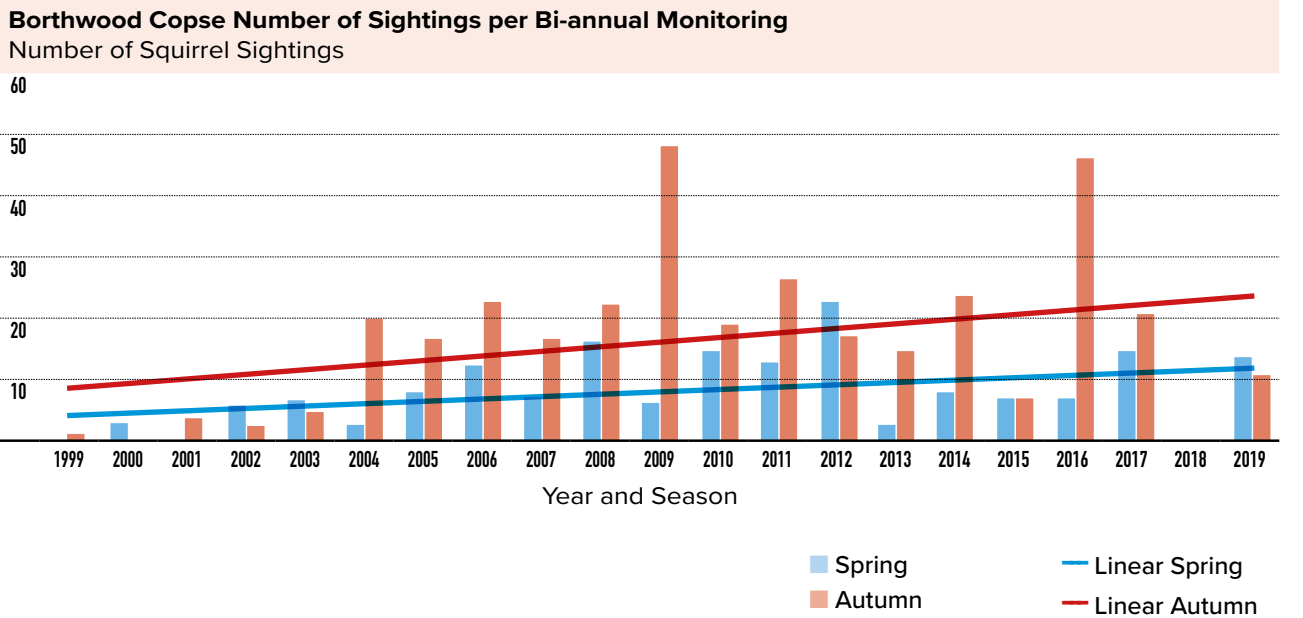
Grid reference: SZ 568 823	Transect details
Size: 10.98ha	Overall nature of wood: Deciduous
Monitoring period: Autumn 1999 – Spring 2015	Transect: All sections deciduous
Monitor: Mrs J. Booth	Transect length: 1,200m
Landowner: The Woodland Trust	Total walks: 112
Supplementary feeding nearby: Yes	Total observations: 84
Corridor to next copse: Yes	Total kilometres walked: 134.4
	Relative abundance: 0.63



Note no walks:
Spring 2001
Spring 2003

Borthwood Copse

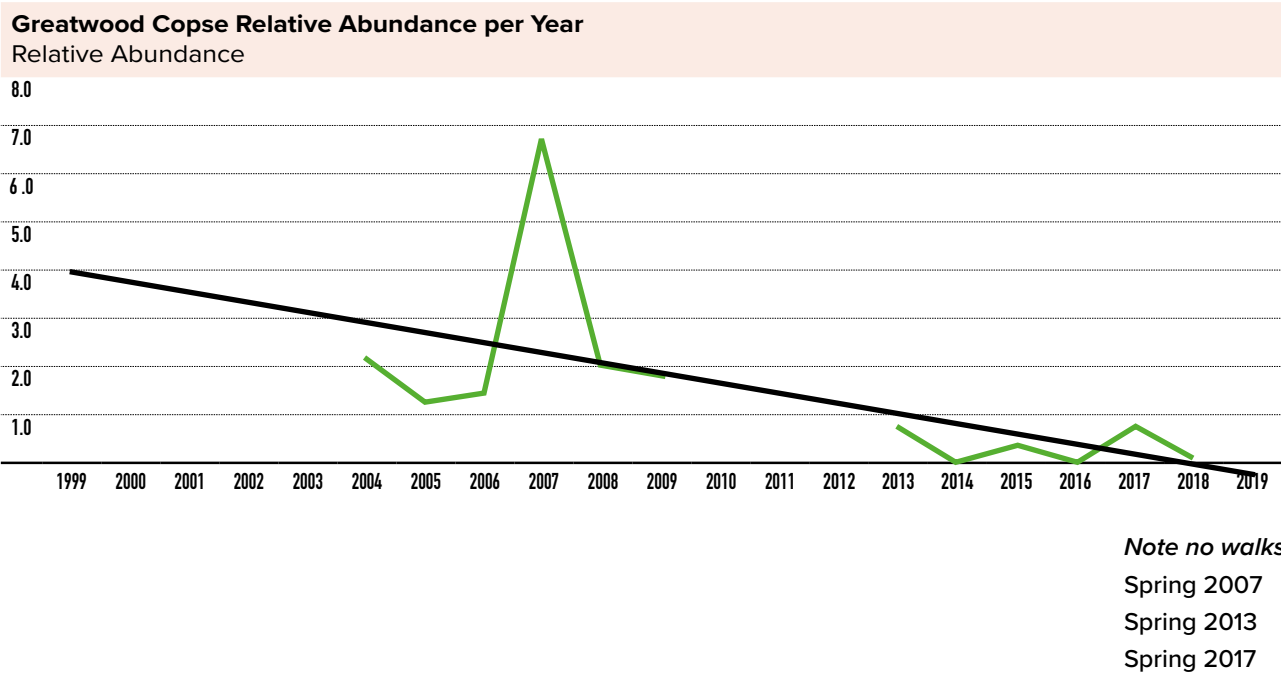
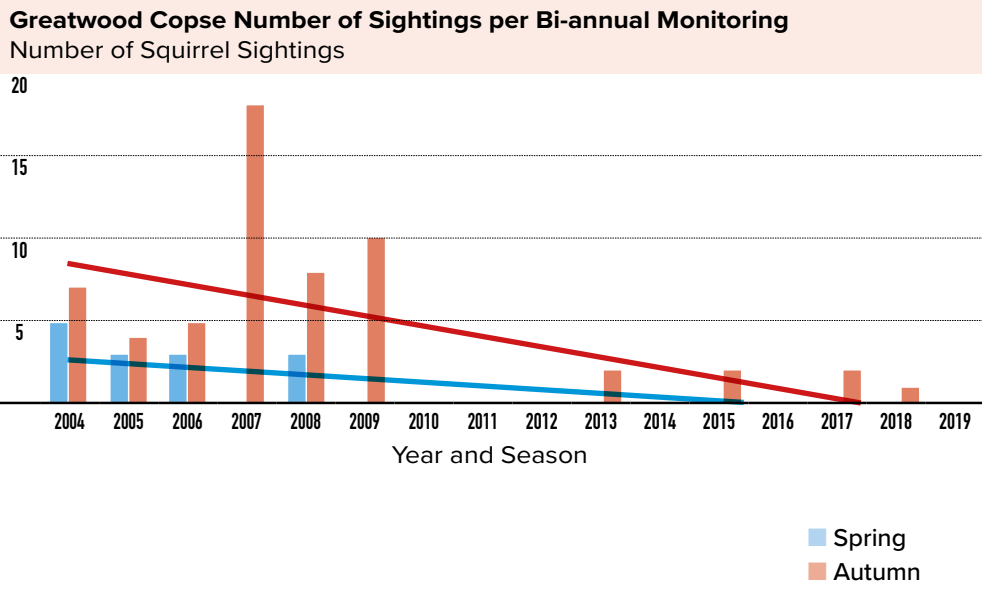
Grid reference: SZ 569 843	Transect details
Size: 24.29ha	Overall nature of wood: Predominantly deciduous
Monitor: Mrs J. Wilson	Transect: Mixed
Monitoring period: Autumn 1999 – Autumn 2019 Ongoing	Transect length: 1,200m
Landowner: National Trust	Total walks: 97
Supplementary feeding nearby: Yes, plentiful	Total observations: 167
Corridor to next copse: Poor	Total kilometres walked: 115.8
	Relative abundance: 1.44



Note no walks:
Third walk Autumn 2006
Spring and Autumn 2018

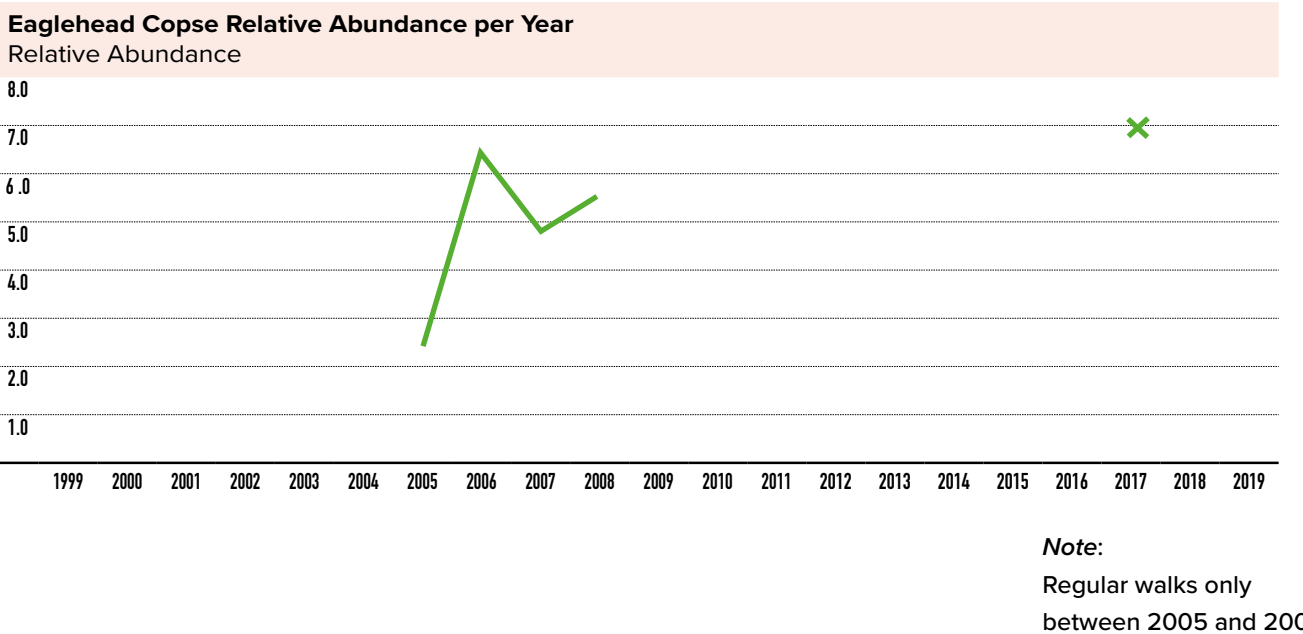
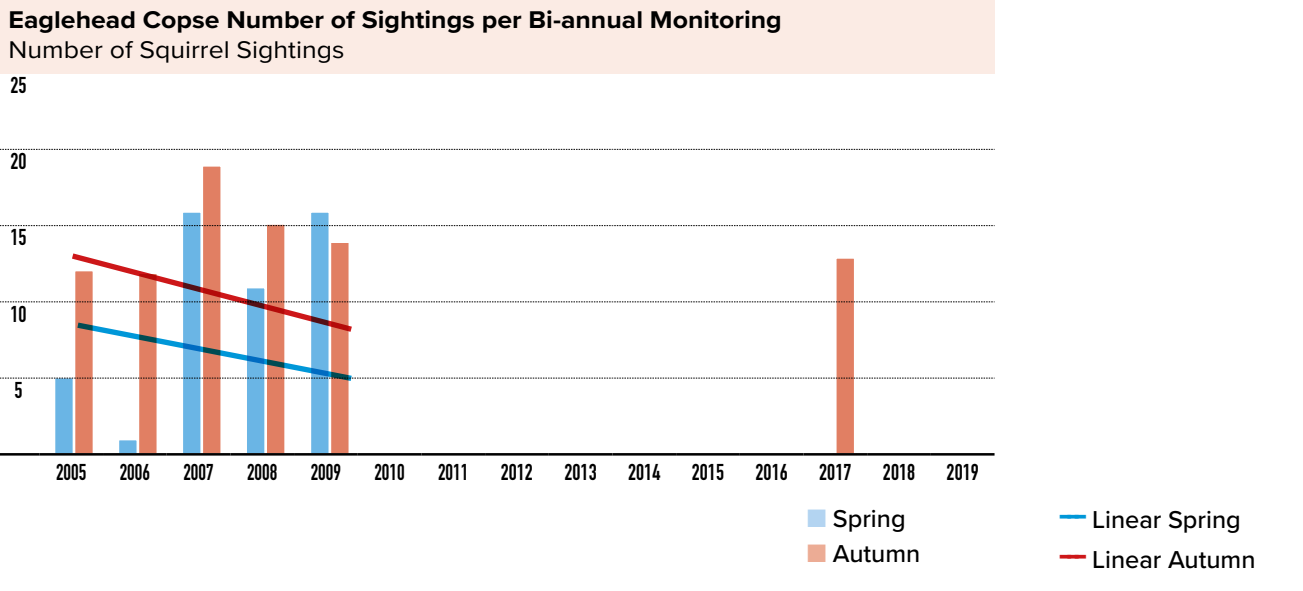
Greatwood Copse

Grid ref: SZ 573 801	Transect details
Size: 7.3ha	Overall nature of wood: Deciduous
Monitors: Mr D. Dana then Miss P. Dana	Transect: Deciduous
Monitoring period: Spring 2004 – Autumn 2009 then Spring 2013 – Autumn 2018 Finished	Transect length: 900m
Landowner: Private	Total walks: 63
Supplementary feeding nearby: No	Total observations: 73
Corridor to next copse: Yes	Total kilometres walked: 56.7
	Relative abundance: 1.29



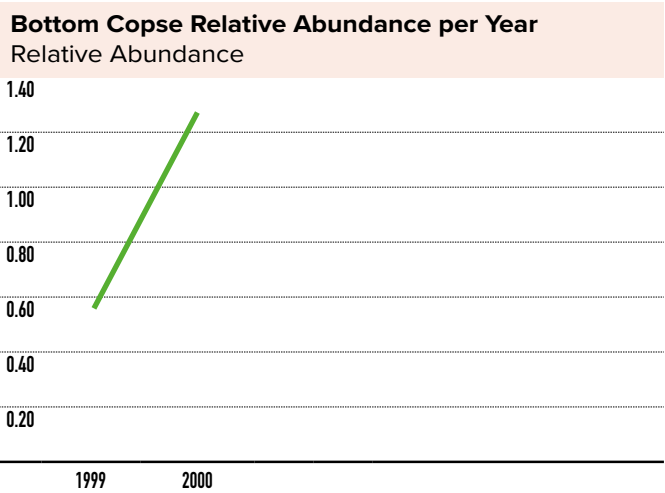
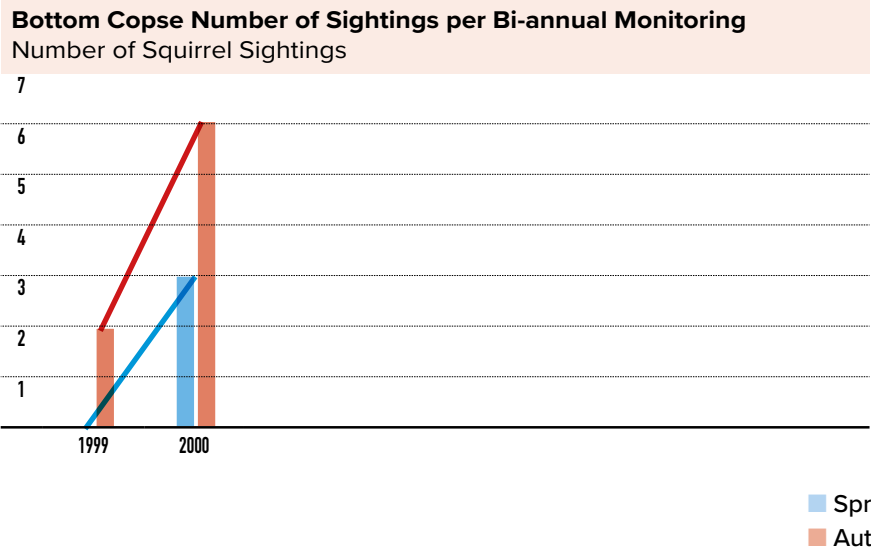
Eaglehead Copse

Grid reference: SZ 583 877	Transect details
Size: 9.2ha	Overall nature of wood: Deciduous
Monitoring period: Spring 2005 – Autumn 2009	Transect: Deciduous
One session 2017 Mr J. Baldwin	Transect length: 900m
Monitor: Mr D. Dana	Total walks: 33
Landowner: Hampshire & Isle of Wight Wildlife Trust	Total observations: 134
Supplementary feeding nearby: Yes	Total kilometres walked: 28.8
Corridor to next copse: Yes	Relative abundance: 4.65



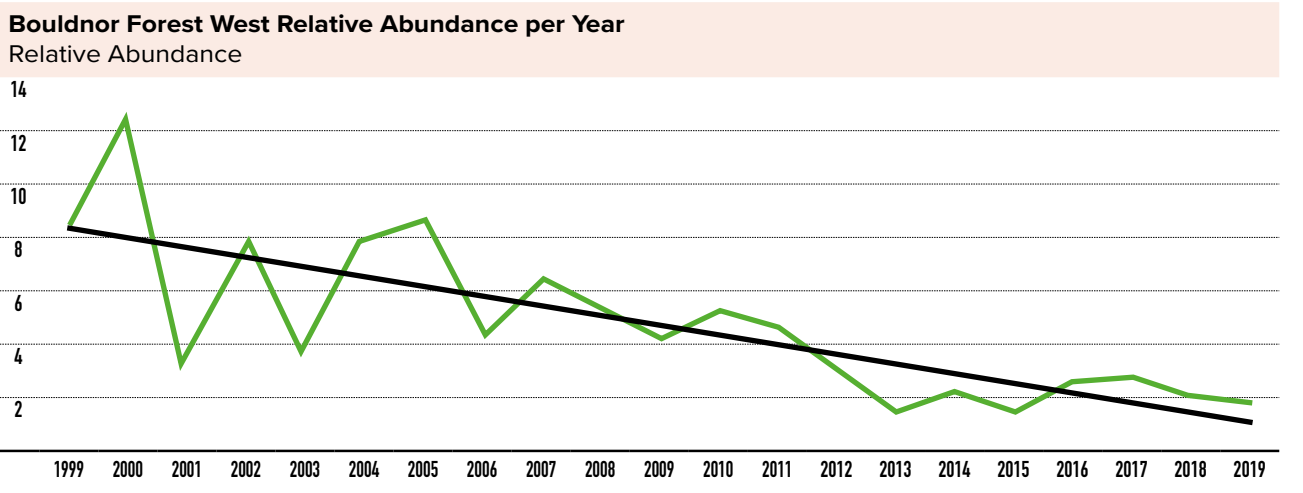
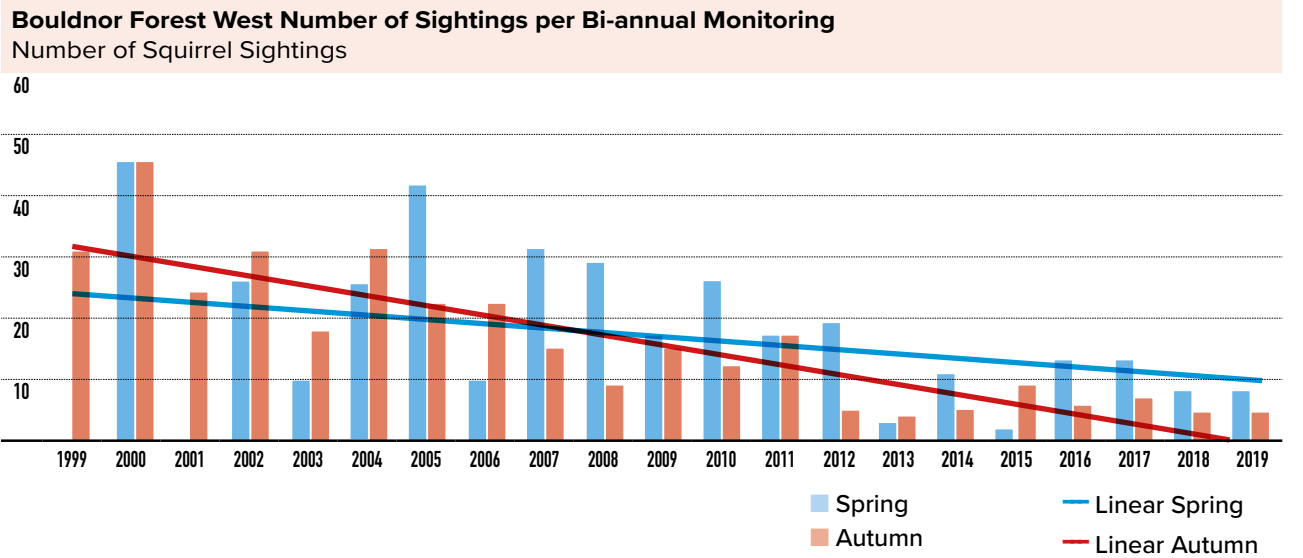
Bottom Copse

Grid reference: SZ 495 944	Transect details
Size: 4.82ha	Overall nature of wood: Deciduous
Monitoring period: Autumn 1999 – Autumn 2000	Transect: Deciduous
Monitor: Mr M. Shotter	Transect length: 1,200m
Landowner: Private	Total walks: 9
Supplementary feeding nearby: No	Total observations: 11
Corridor to next copse: Yes	Total kilometres walked: 10.8
	Relative abundance: 1.02



Bouldnor Forest West

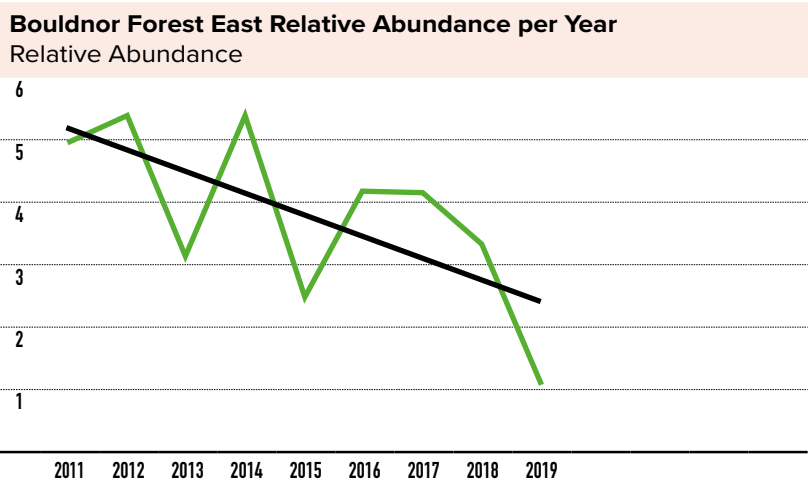
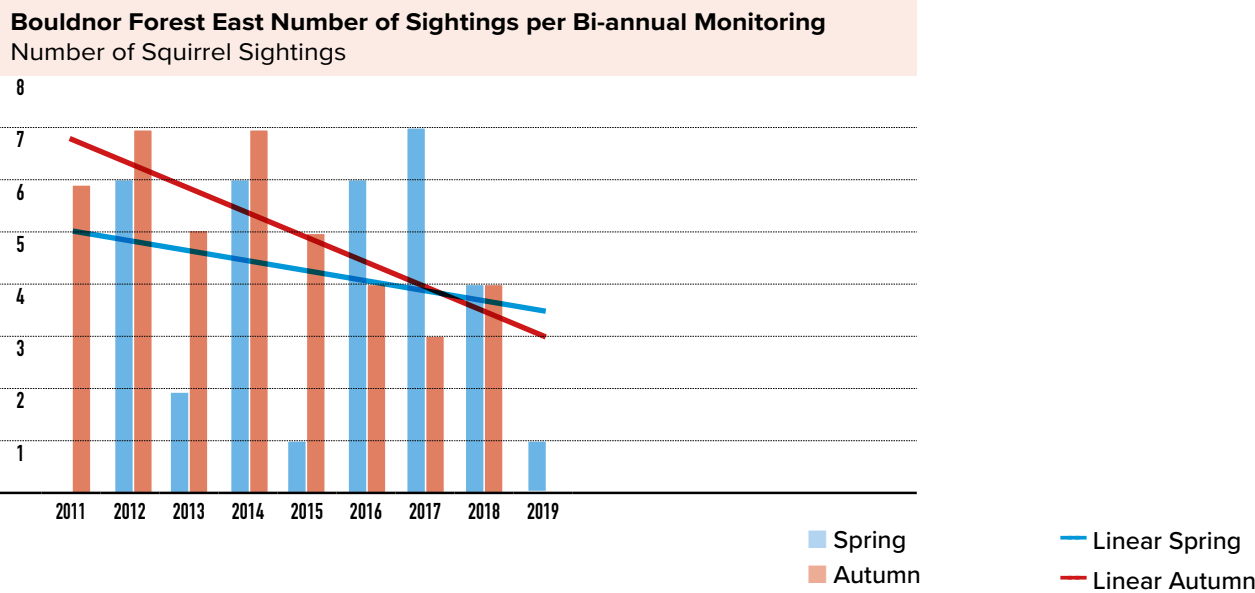
Grid reference: SZ 378 903	Transect details
Size: 38ha	Overall nature of wood: Mixed
Monitor: Mrs H. Higgins	Transect: Mixed
Monitoring period: Autumn 1999 – Autumn 2019 Ongoing	Transect length: 1,200m
Landowner: Forestry Commission	Total walks: 121
Supplementary feeding nearby: Yes	Total observations: 692
Corridor to next copse: Yes	Total kilometres walked: 144
	Relative abundance: 4.81



Note no walks:
Spring 2001
Third walk Autumn 2013

Bouldnor Forest East

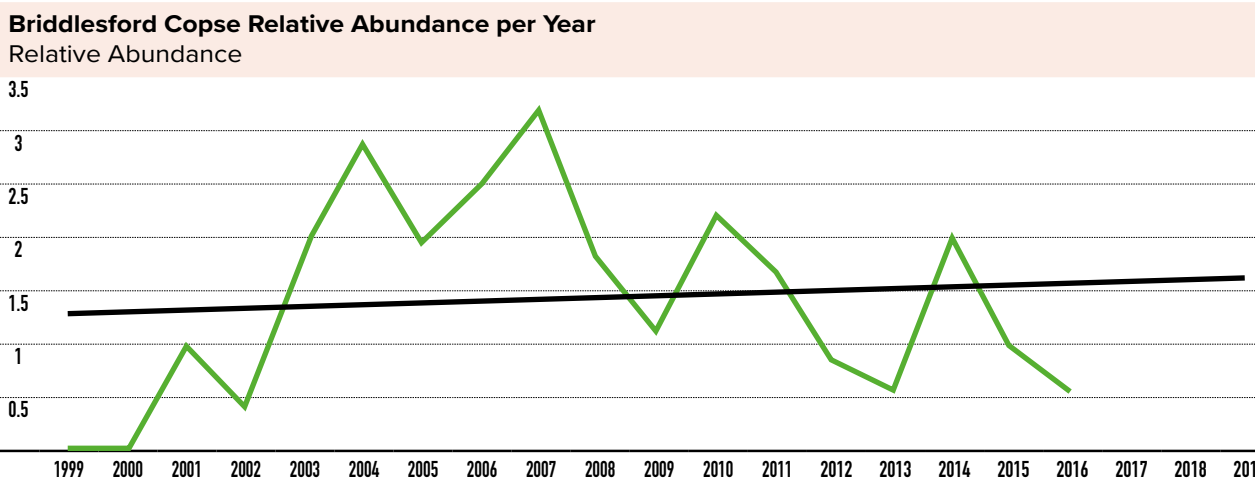
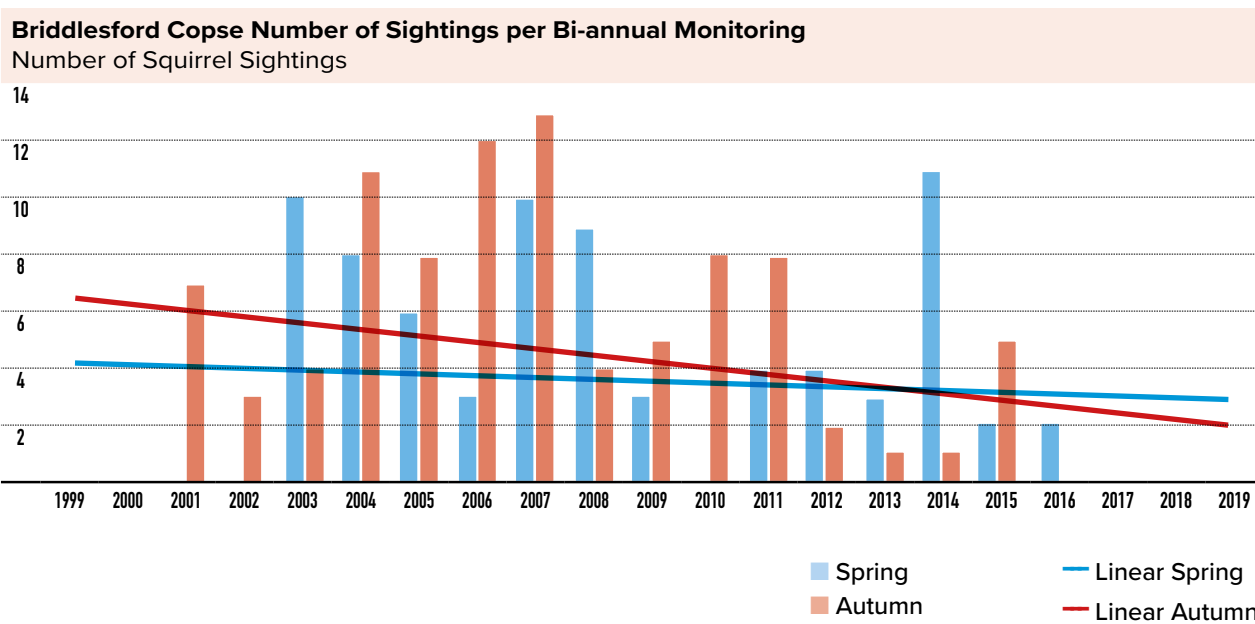
Grid reference: SZ 378 903	Transect details
Size: 38ha	Overall nature of wood: Mixed
Monitoring period: Autumn 2011 – Spring 2019 Finished	Transect: Mixed
Monitor: Mrs S. Owen	Transect length: 1,200m
Landowner: Forestry Commission	Total walks: 48
Supplementary feeding nearby: Yes	Total observations: 225
	Total kilometres walked: 57.65
	Relative abundance: 3.90



Note no walks:
Spring 2011

Briddlesford Copse

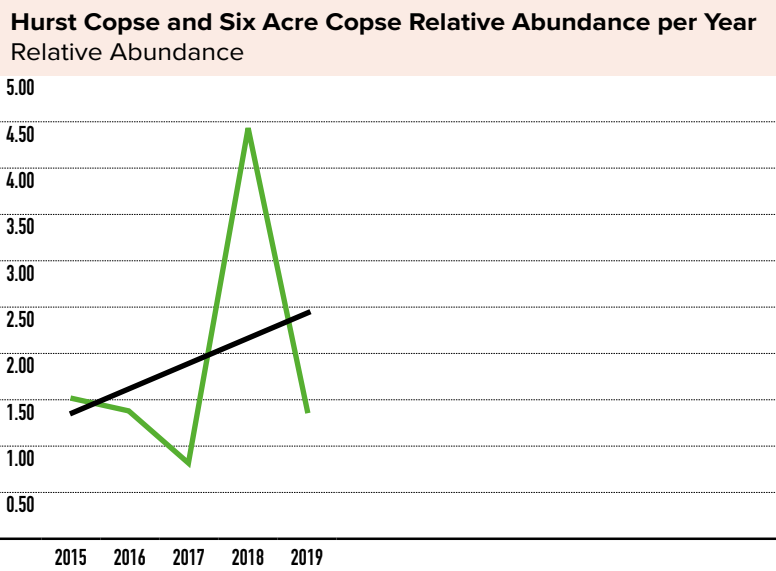
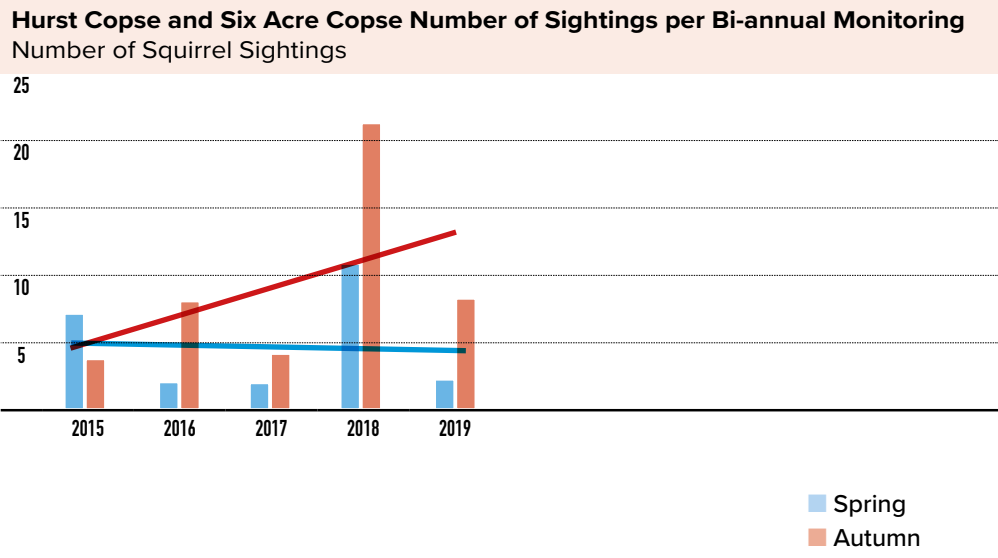
Grid reference: SZ 550 905	Transect details
Size: 10ha	Overall nature of wood: Deciduous
Monitor: Mr A. Redfern then Ms A. Broome	Transect: Deciduous
Monitoring period: Autumn 2001 – Spring 2016	Transect length: 1,200m
Landowner: PTES	Total walks: 97
Supplementary feeding nearby: No	Total observations: 167
Corridor to next copse: Yes	Total kilometres walked: 115.8
	Relative abundance: 1.44



Note no walks:
Spring 2002
Third walk Spring 2006
Spring 2010

Hurst Copse and Six Acre Copse

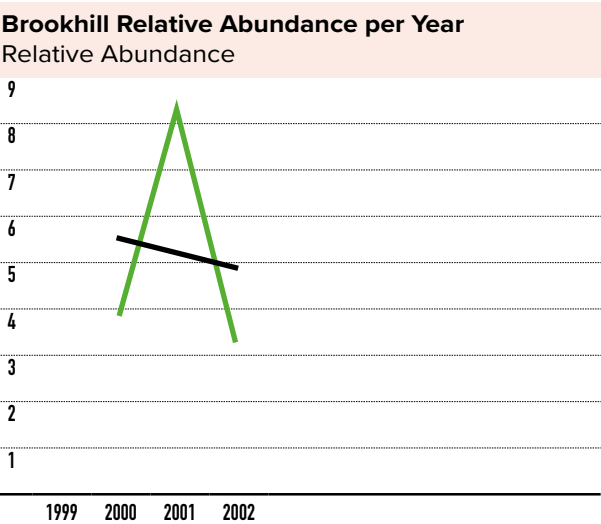
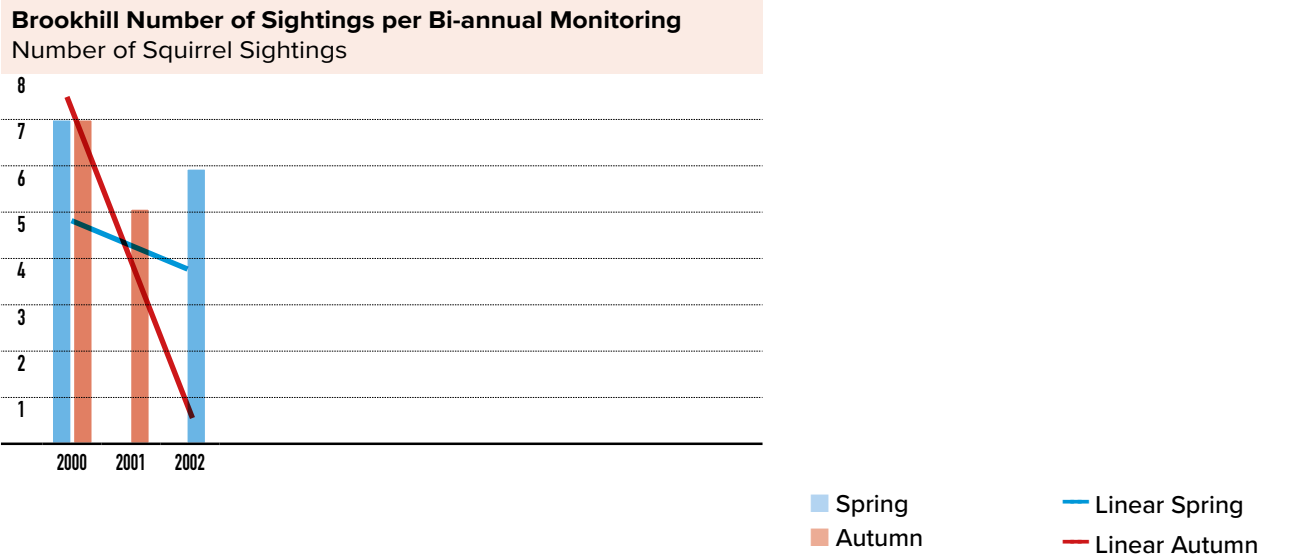
Grid reference: SZ 545 915	Transect details
Size: 11.68ha	Overall nature of wood: Deciduous
Monitor: Mr R. Wilson	Transect: Deciduous
Monitoring period: Spring 2015 – Autumn 2019 Finished	Transect length: 1,200m
Landowner: PTES	Total walks: 30
Supplementary feeding nearby: No	Total observations: 69
Corridor to next copse: Yes	Total kilometres walked: 36
	Relative abundance: 1.92



Note:
The grid reference is the middle of the kilometre square the two woods are in. The transect crosses open space, although it's not counted in the distance walked total.

Brookhill

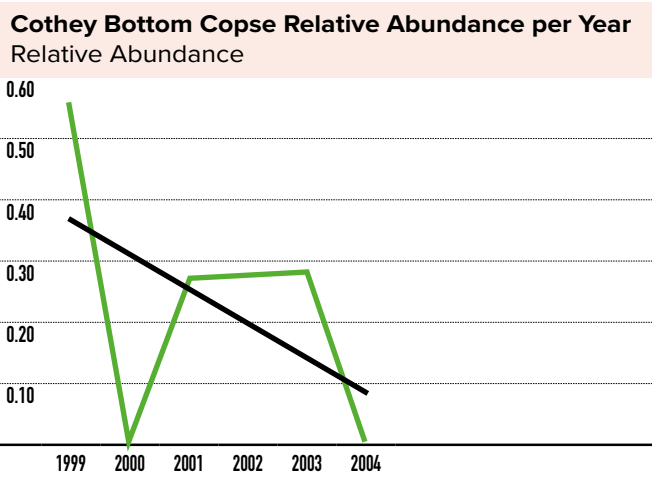
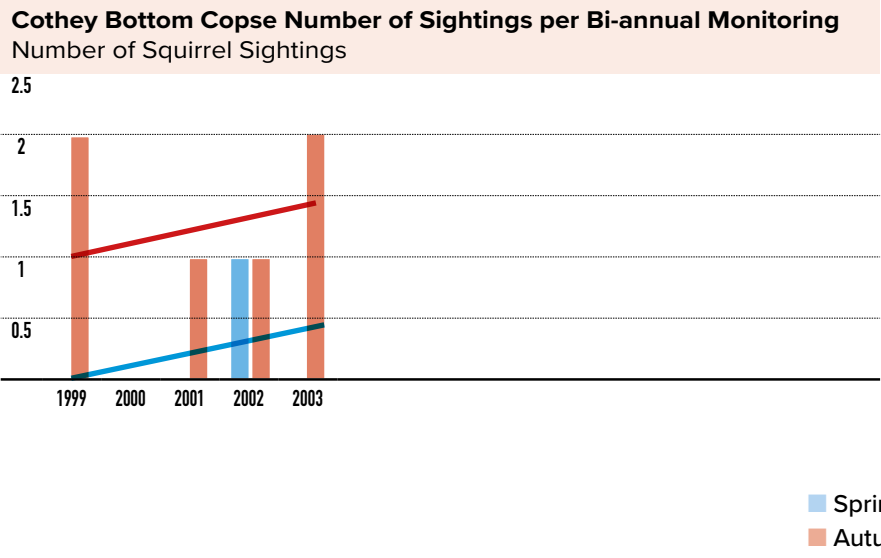
Grid reference: SZ 397 846	Transect details
Size: Unknown	Overall nature of wood: Mixed
Monitoring period: Spring 2000 – Spring 2002	Transect: Mixed
Monitor: Mr C. Marsh	Transect length: 600m
Landowner: Private	Total walks: 16
Supplementary feeding nearby: Yes	Total observations: 25
Corridor to next copse: Yes	Total kilometres walked: 6
	Relative abundance: 4.17



Note no walks:
Spring 2001

Cothey Bottom Copse

Grid reference: SZ 607 907	Transect details
Size: 10.14ha	Overall nature of wood: Deciduous
Monitor: Mrs J. Wilson	Transect: 1,200m
Monitoring period: Autumn 1999 – Autumn 2003	Transect length: 1,000m
Landowner: Private	Total walks: 28
Supplementary feeding nearby: Yes	Total observations: 7
Corridor to next copse: Yes	Total kilometres walked: 26.4
	Relative abundance: 0.27

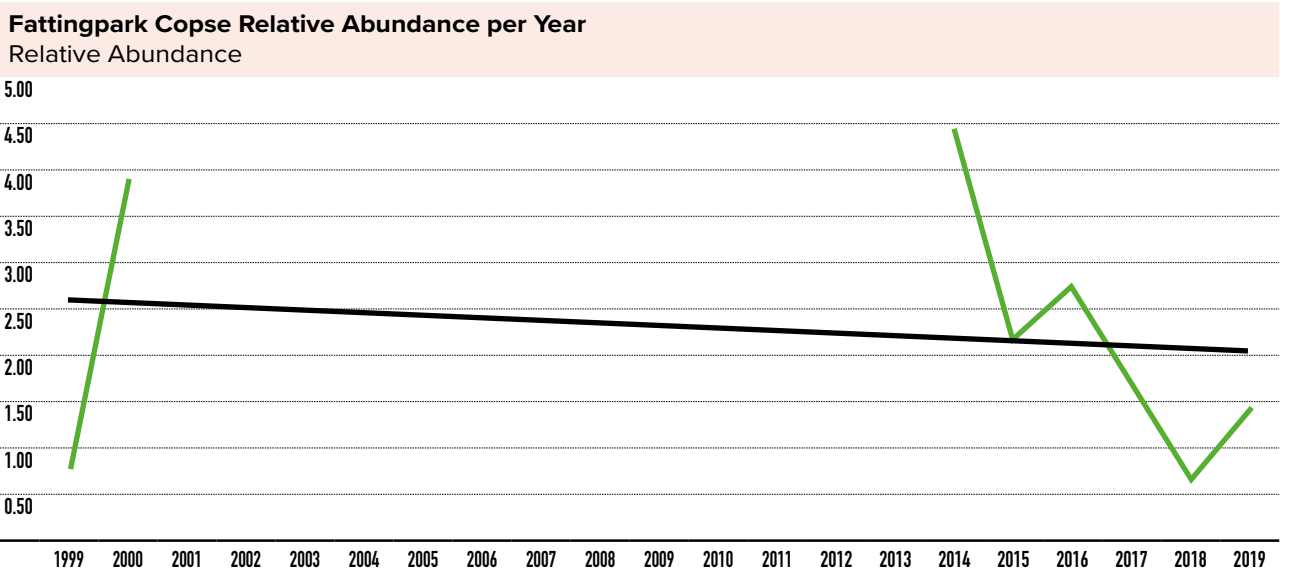
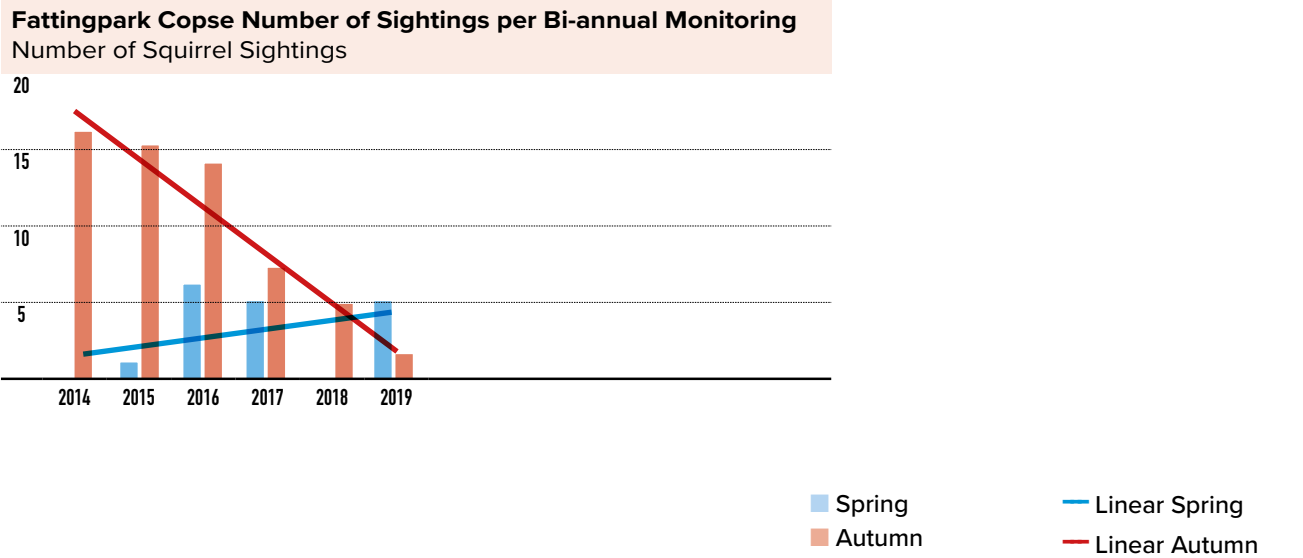


Note no walks:
Winter 2000
Spring 2001

At the time of the surveys, the woodland was undergoing thinning and coppicing. There are new-build houses adjoining the woodland now, so squirrels are doing well.

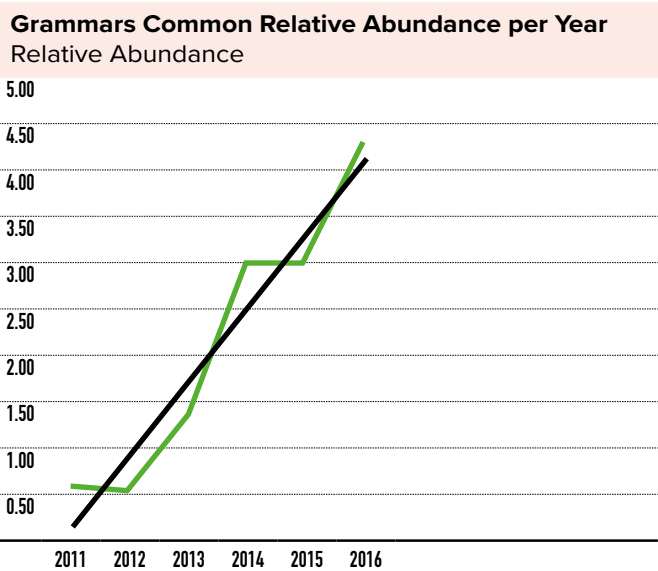
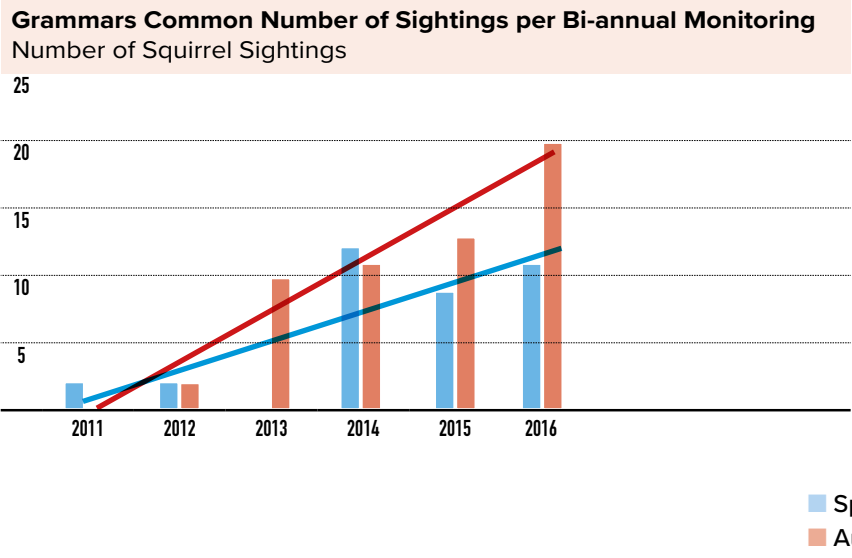
Fattingpark Copse

Grid reference: SZ 523 911	Transect details
Size: 42.62ha	Overall nature of wood: Deciduous
Monitors: Mrs M. Cheal	Transect: Deciduous
Monitoring period: Autumn 2014 – Autumn 2019 Ongoing	Transect length: 1,200m
Landowner: Private	Total walks: 37
Supplementary feeding nearby: Yes	Total observations: 93
Corridor to next copse: Yes	Total kilometres walked: 44.4
	Relative abundance: 2.09



Grammars Common

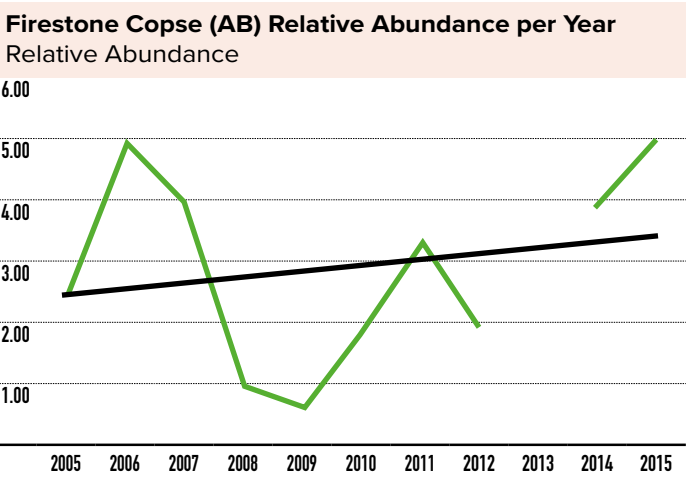
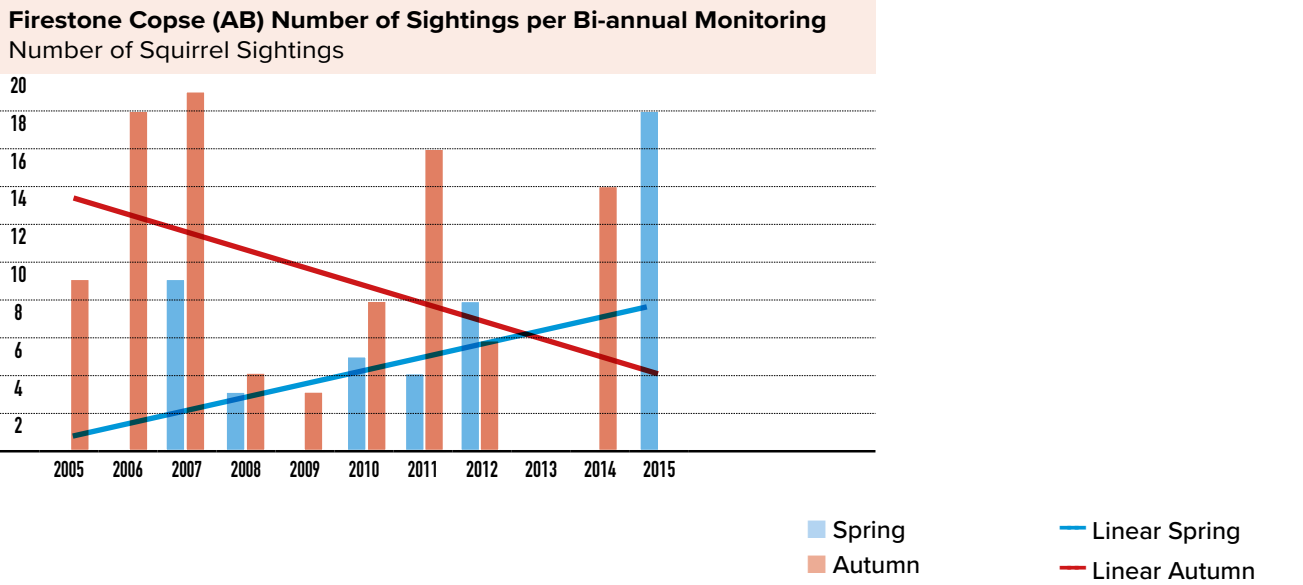
Grid reference: SZ 415 838	Transect details
Size: 9.93ha	Overall nature of wood: Coniferous
Monitor: Ms K. West	Transect: Coniferous
Monitoring period: Spring 2011 – Autumn 2016	Transect length: 1,200m
Landowner: Private	Total walks: 33
Supplementary feeding nearby: No	Total observations: 92
Corridor to next copse: Poor	Total kilometres walked: 40.1
	Relative abundance: 2.29



Note no walks: Autumn 2011
New planting has added broadleaf habitat to the north. This is not included in the acreage given.

Firestone Copse

Grid reference: SZ 555 912	Transect details
Size: 67.18ha	Overall nature of wood: Mixed
Monitor: Ms A. Broome then Miss T. Stack	Transect: Mixed
Monitoring period: Autumn 2005 – Spring 2015	Transect length: 1,200m
Landowner: Forestry Commission	Total walks: 45
Supplementary feeding nearby: Yes	Total observations: 144
Corridor to next copse: Yes	Total kilometres walked: 54.05
	Relative abundance: 2.66

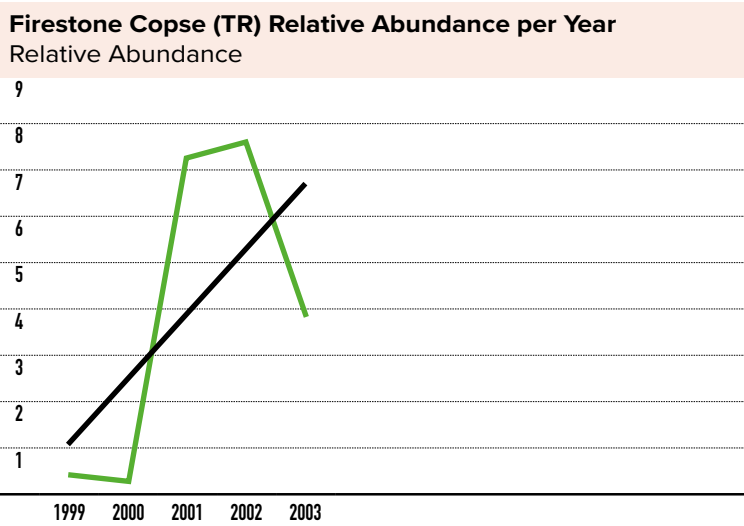
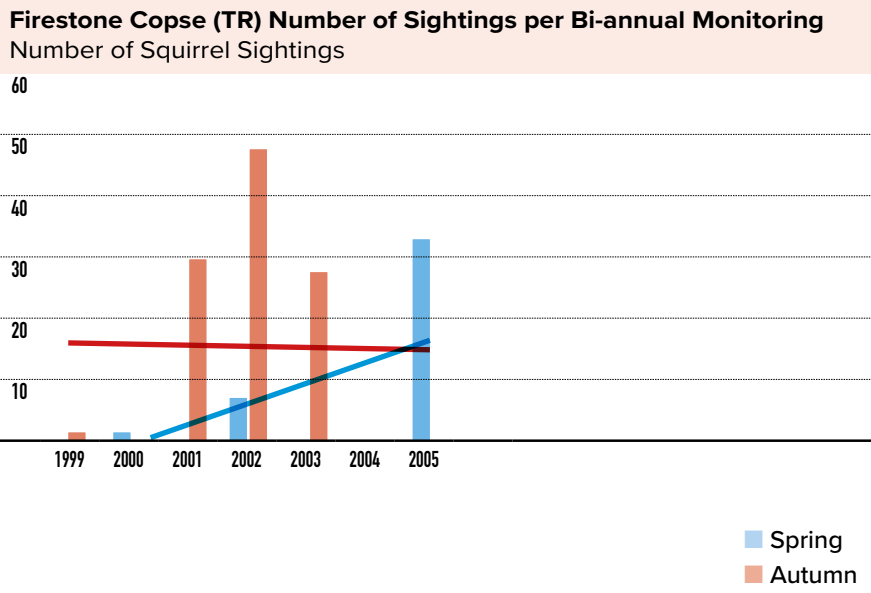


Note no walks:
Spring 2006
Second and third walk Autumn 2009
Spring and Autumn 2013
Spring 2014

Firestone Copse

Grid reference: SZ 555 912
Size: 67.18ha
Monitoring period: Autumn 1999 – Autumn 2005
Monitor: Mrs V. Wakely then Mr A. Redfern
Landowner: Forestry Commission
Supplementary feeding nearby: Yes
Corridor to next copse: Yes

Transect details
Overall nature of wood: Mixed
Transect: Mixed
Transect length: 1,200m
Total walks: 30
Total observations: 148
Total kilometres walked: 27.2
Relative abundance: 5.44

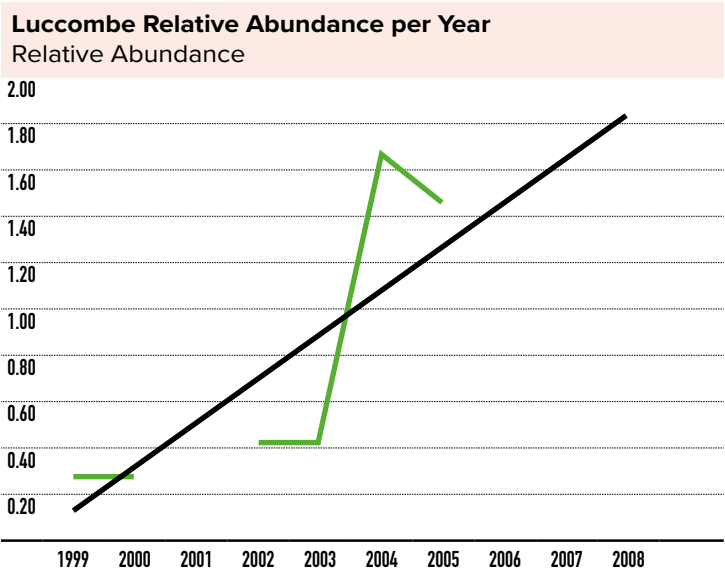
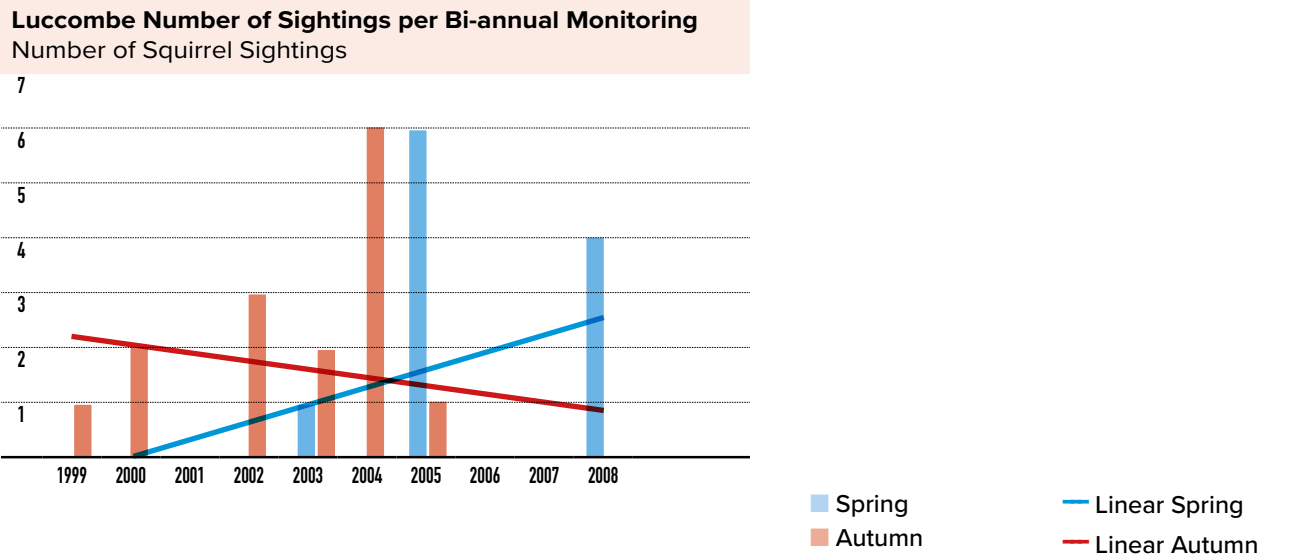


Squirrels can reach gardens in Havenstreet, to the south, from Firestone Copse. This transect is on the northern edge of the woodland.

Luccombe Landslip

Grid reference: SZ 582 788
Size: 29.25ha
Monitor: Ms Jenkins
Monitoring period: Autumn 1999 – Spring 2008
Landowner: National Trust
Supplementary feeding nearby: Yes
Corridor to next copse: Yes

Transect details
Overall nature of wood: Deciduous
Transect: Deciduous
Transect length: 1,000m
Total walks: 36
Total observations: 26
Total kilometres walked: 36
Relative abundance: 0.73



Mill Copse

Grid reference: SZ 357 889

Size: 5.72ha

Monitor: Mrs C. Dudley

Monitoring period: Autumn 1999 – Autumn 2019
Ongoing

Landowner: Wight Nature Fund

Supplementary feeding nearby: No

Corridor to next copse: Yes

Transect details

Overall nature of wood: Mixed

Transect: Mixed except for two sections which are deciduous

Transect length: 1,200m

Total walks: 107

Total observations: 252

Total kilometres walked: 128.4

Relative abundance: 1.96

Northwood Cemetery

Grid reference: SZ 495 947

Size: Unknown

Monitor: Ms A. Parker

Monitoring period: Autumn 2015 – Spring 2019

Landowner: IW Council

Supplementary feeding nearby: Yes

Corridor to next copse: Yes

Transect details

Overall nature of wood: Mixed

Transect: Mixed

Transect length: 900m

Total walks: 24

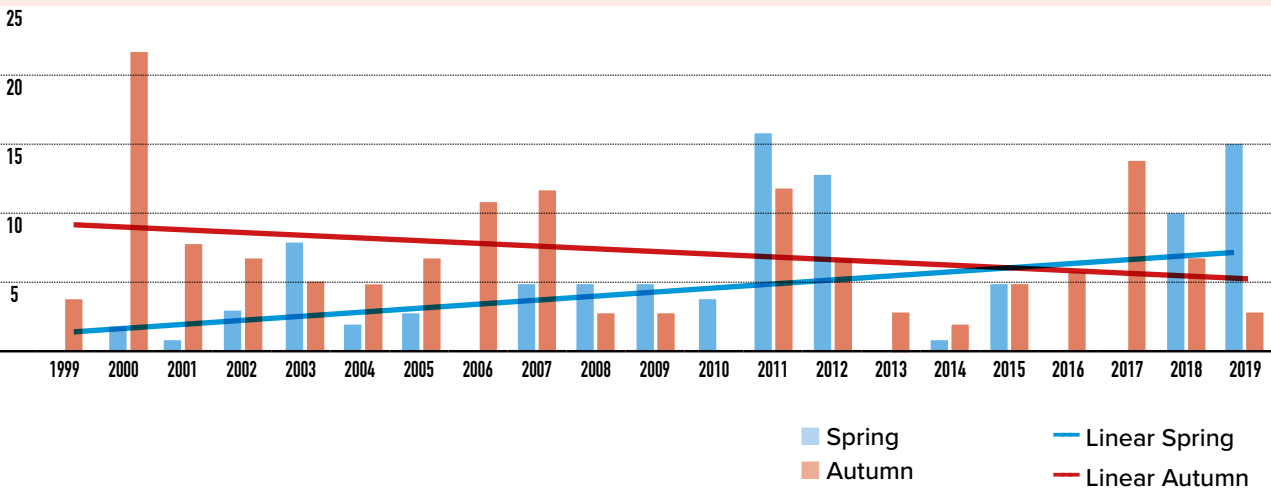
Total observations: 110

Total kilometres walked: 19.6

Relative abundance: 5.61

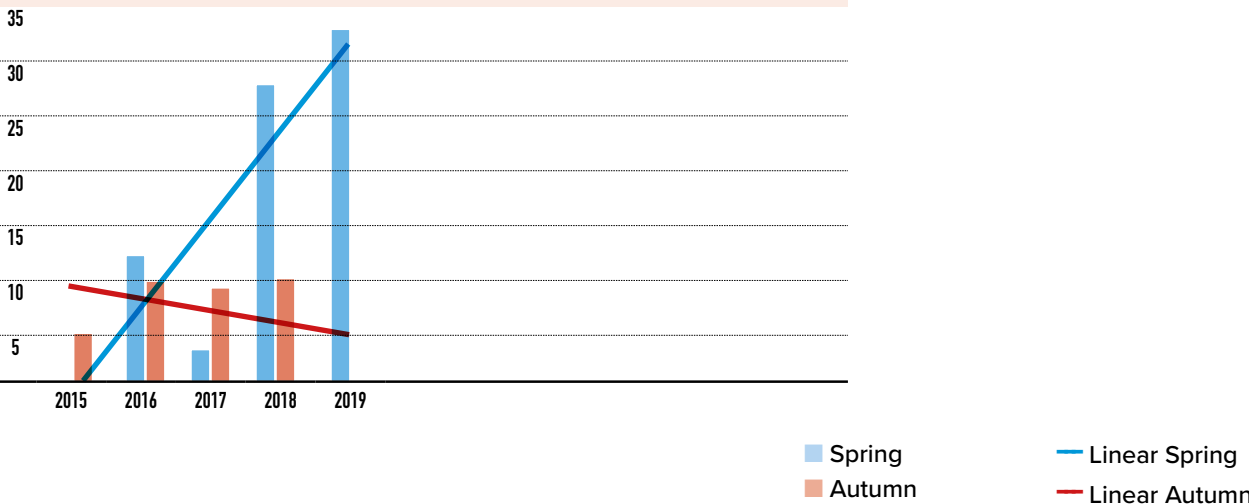
Mill Copse Number of Sightings per Bi-annual Monitoring

Number of Squirrel Sightings



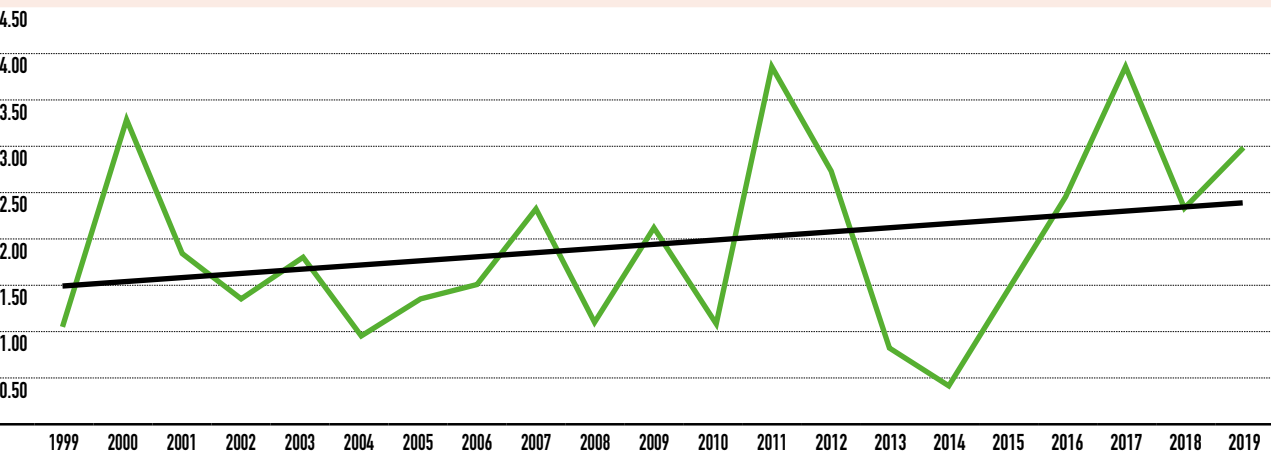
Northwood Cemetery Number of Sightings per Bi-annual Monitoring

Number of Squirrel Sightings



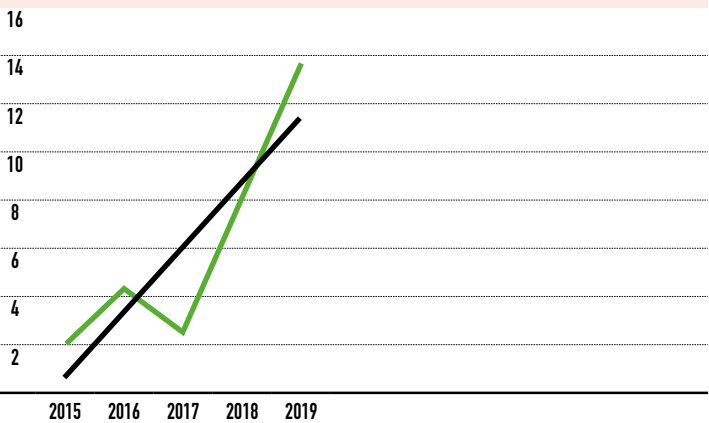
Mill Copse Relative Abundance per Year

Relative Abundance



Northwood Cemetery Relative Abundance per Year

Relative Abundance



Note no walks:
Autumn 2010
Spring 2013
Spring 2016
Spring 2017

Mark’s Corner, Parkhurst Forest

Grid reference: SZ 473 923

Size: 402ha

Monitor: Mr R. Wilson

Monitoring period: Spring 2004 – Autumn 2012

Landowner: Forestry Commission

Supplementary feeding nearby: Yes

Corridor to next copse: Yes

Transect details

Overall nature of wood: Mixed

Transect: Mixed

Transect length: 1,200m

Total walks: 53

Total observations: 86

Total kilometres walked: 63.6

Relative abundance: 1.35

Fishbourne Copse

Grid reference: SZ 565 929

Size: Unknown

Monitoring period: Autumn 2013 – 2019
Ongoing

Monitor: Mrs D. Pradhan

Landowner: Quarr Abbey

Supplementary feeding nearby: Yes

Corridor to next copse: Yes

Transect details

Overall nature of wood: Deciduous

Transect: Deciduous

Transect length: 1,200m

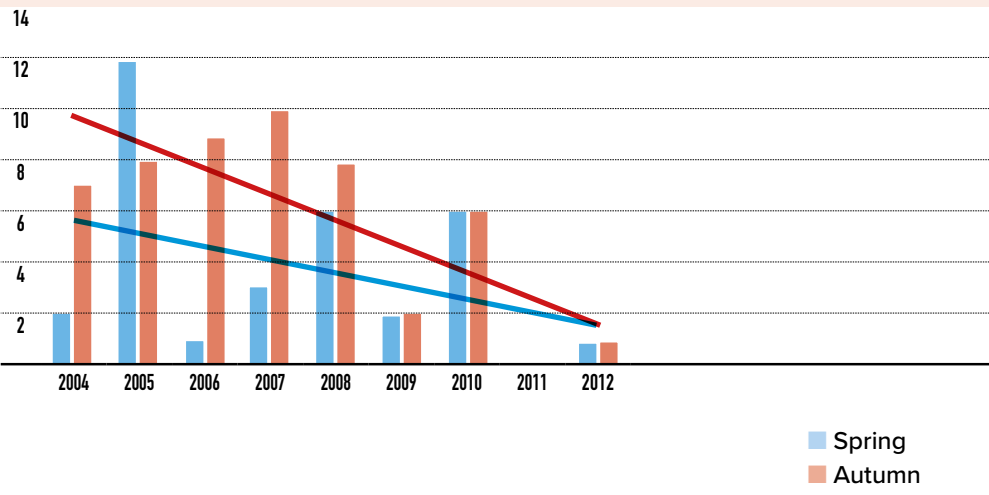
Total walks: 36

Total observations: 86

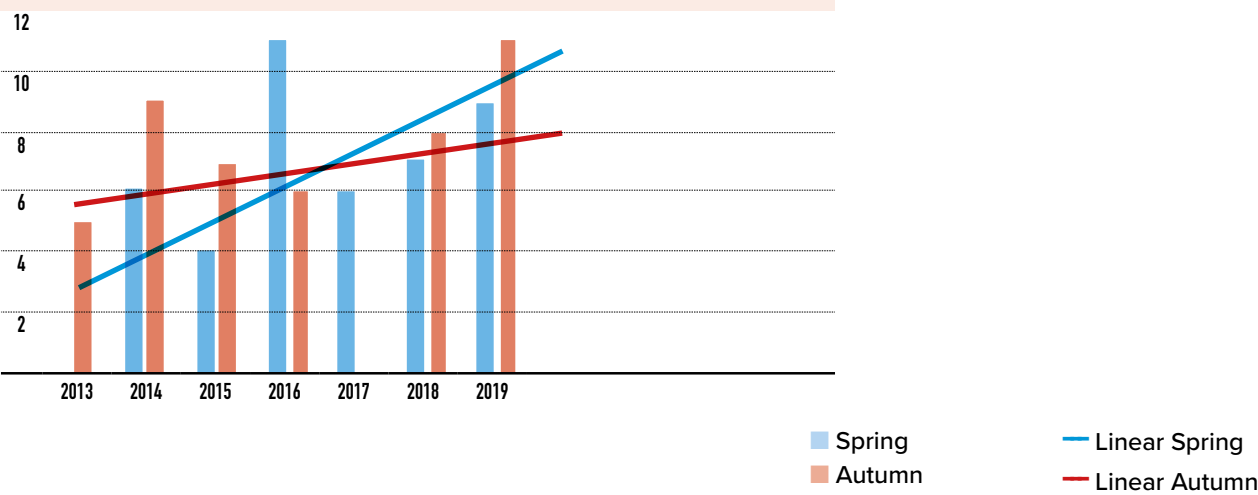
Total kilometres walked: 43.20

Relative abundance: 1.99

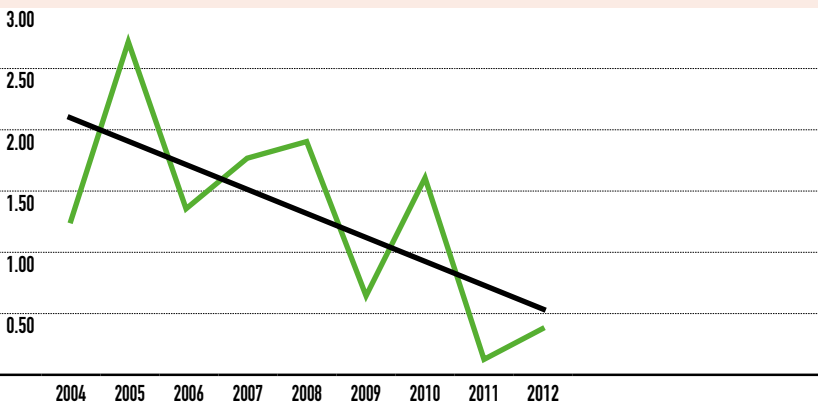
Mark’s Corner, Parkhurst Forest Number of Sightings per Bi-annual Monitoring
Number of Squirrel Sightings



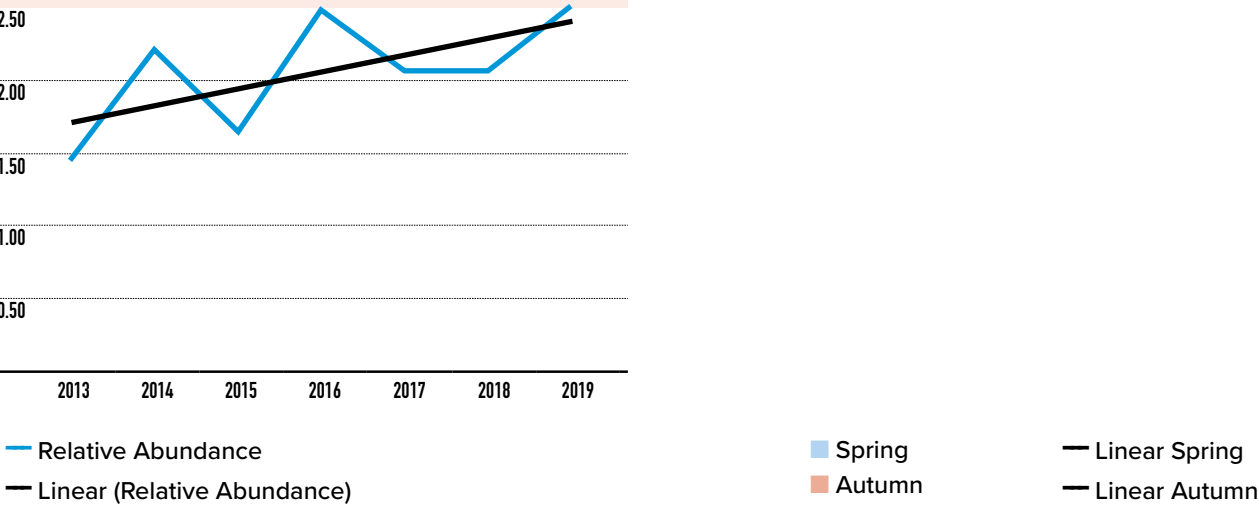
Fishbourne Copse Number of Sightings per Bi-annual Monitoring
Number of Squirrel Sightings



Mark’s Corner, Parkhurst Forest Relative Abundance per Year
Relative Abundance



Fishbourne Copse Relative Abundance per Year
Relative Abundance

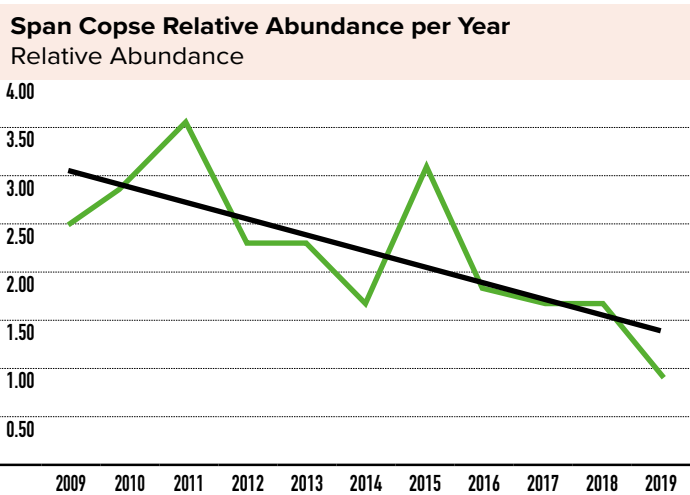
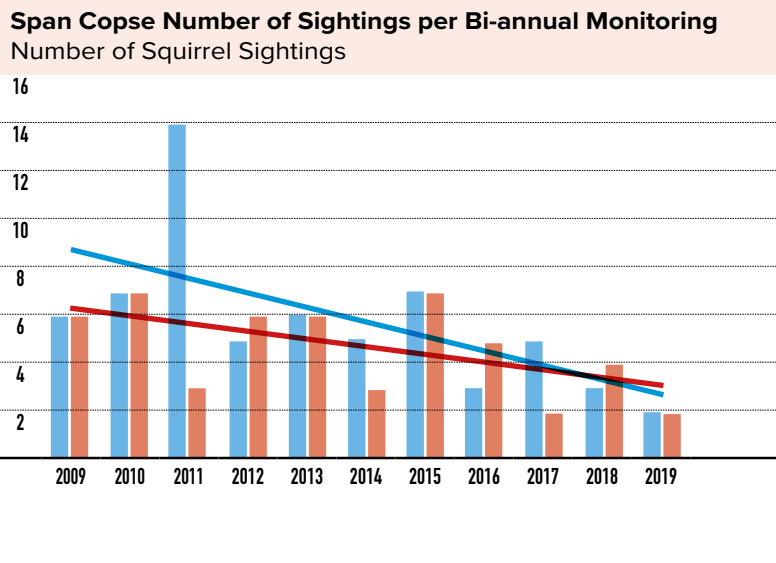


Note:
The grid reference is given for Mark’s Corner, rather than using a central point as given for the other woods.

Note: Fishbourne Copse is part of the coastal tree line which stretches from Ryde to Wootton Creek.

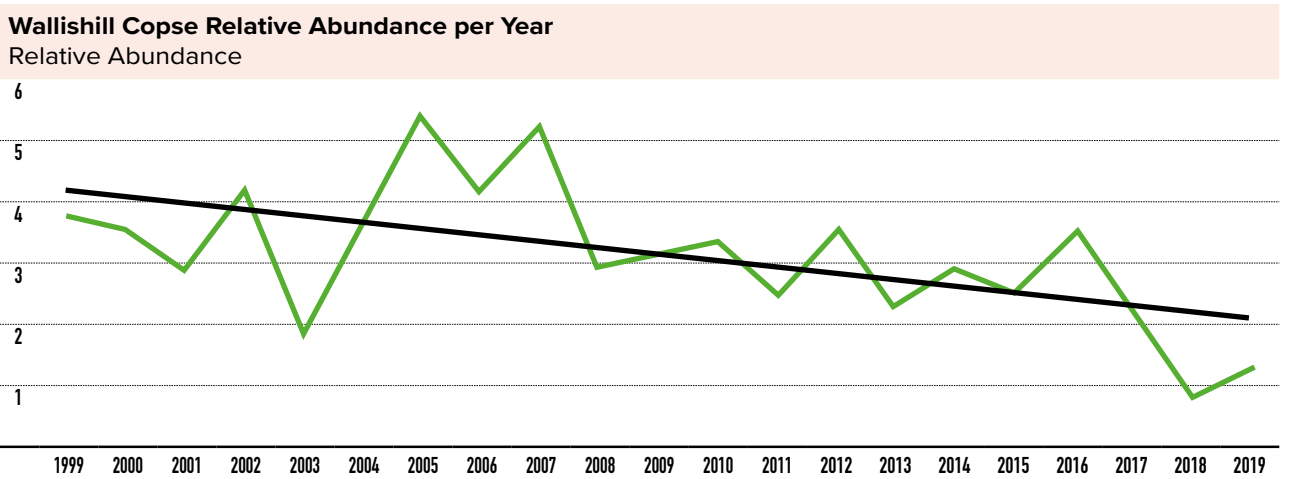
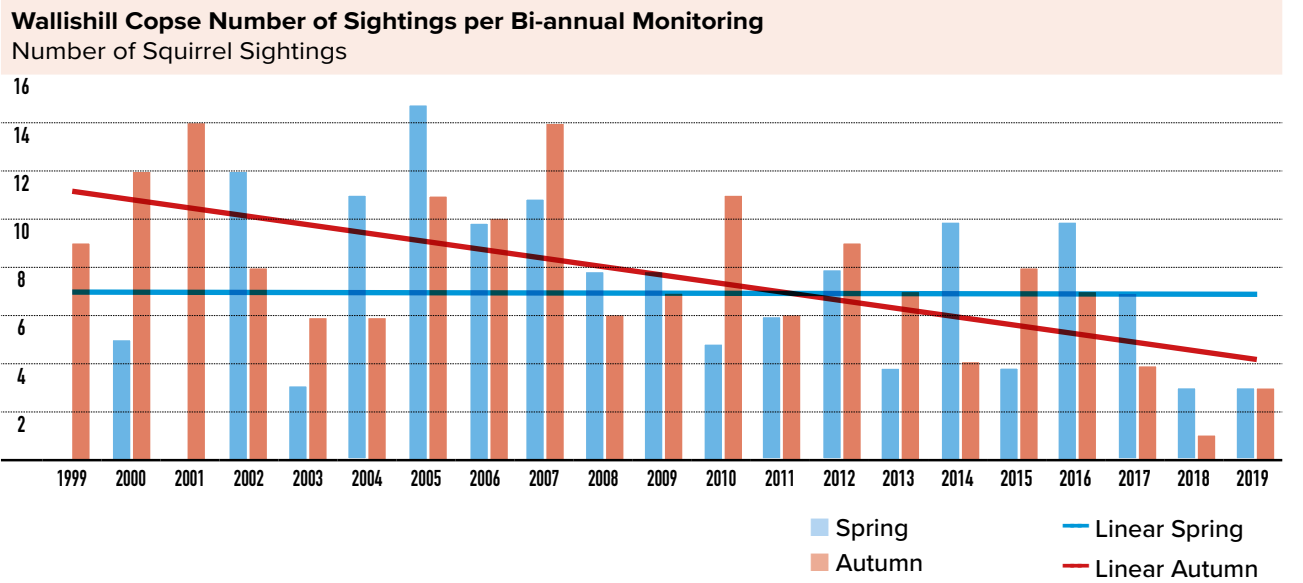
Span Copse

Grid reference: SZ 541 795	Transect details
Size: Unknown	Overall nature of wood: Mixed
Monitoring period: Spring 2009 – Autumn 2019 Finished	Transect: Mixed
Monitor: Mr D. Dana	Transect length: 800m
Landowner: Privately owned	Total walks: 69
Supplementary feeding nearby: Yes	Total observations: 114
Corridor to next copse: Yes	Total kilometres walked: 54.2
	Relative abundance: 2.1



Wallishill Copse

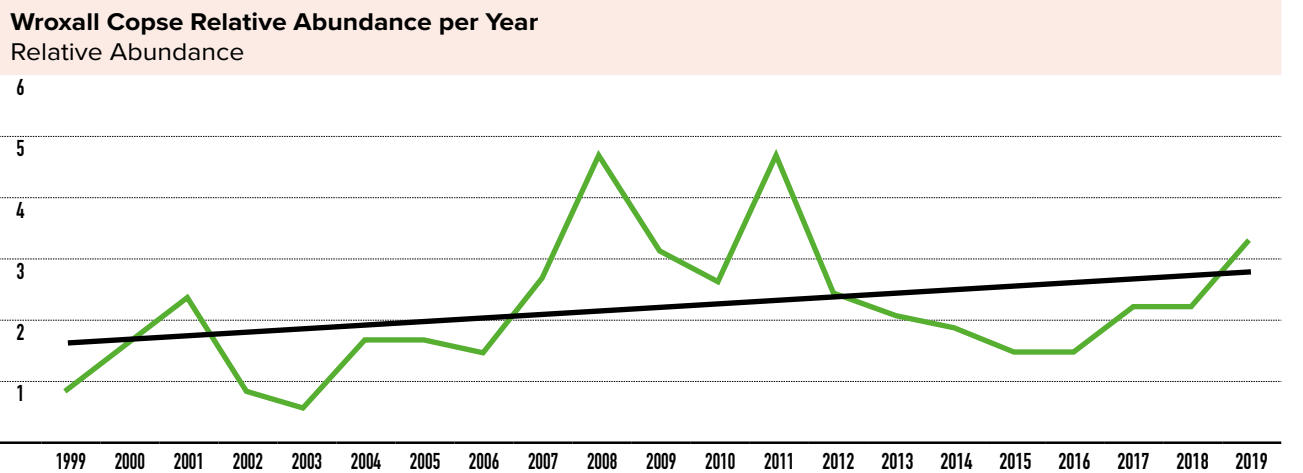
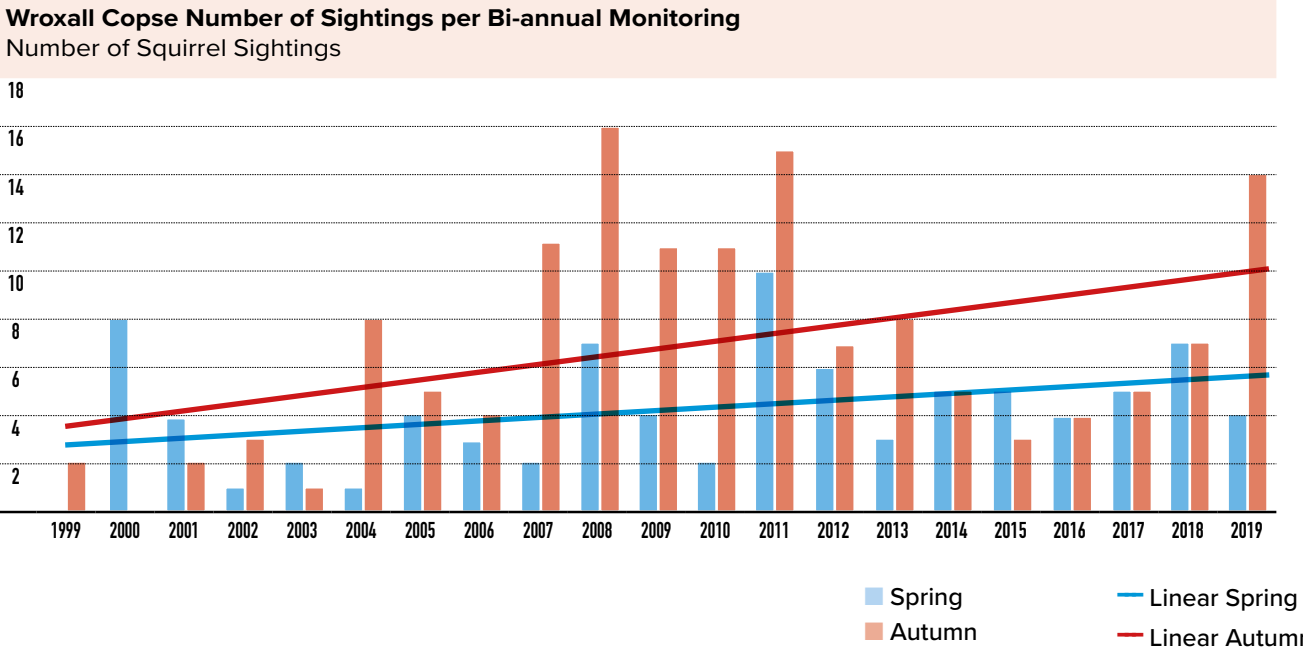
Grid reference: SZ 544 938	Transect details
Size: Unknown	Overall nature of wood: Deciduous
Monitor: Mr D. Dana	Transect: Deciduous
Monitoring period: Autumn 1999 – Autumn 2019 Finished	Transect length: 800m
Landowner: Private	Total walks: 123
Supplementary feeding nearby: Yes	Total observations: 306
Corridor to next copse: Yes	Total kilometres walked: 98.4
	Relative abundance: 3.11



Note:
Wallishill Copse is part of the coastal corridor from Wootton to East Cowes. There are many more homes in Woodside now, therefore a surge in supplementary feeding.

Wroxall Copse

Grid reference: SZ 563 787	Transect details
Size: 8.22ha	Overall nature of wood: Deciduous
Monitor: Mr D. Dana	Transect: Deciduous
Monitoring period: Autumn 1999 – Autumn 2019 Finished	Transect length: 900m
Landowner: Private	Total walks: 123
Supplementary feeding nearby: No	Total observations: 229
Corridor to next copse: Poor	Total kilometres walked: 103.7
	Relative abundance: 2.21



CONCLUSIONS

This scientifically based monitoring does provide useful data, often from woods that do not have public access. It therefore does fit into the overall picture of red squirrel activity on the Isle of Wight.

The methodology is tedious and it’s hardly surprising that most people either do not carry on for long or do not even start after receiving training. Concentration and resisting the temptation to talk to other people seen along the transect is essential for good results. Getting ‘your eye in’ and good observational skills will also improve results.

Technology is the most likely way forward and the majority of red squirrel monitoring in the UK is done using trail cameras. Wight Squirrel Project will try this method on the Island to see how the results compare to the bi-annual monitoring. Monitors wishing to continue with bi-annual monitoring are encouraged to do so.

Supplementary feeding will increase squirrel numbers and therefore sightings, as evidenced in Borthwood. Gardens border the copse so access to extra food is easy. Firestone Copse appears an unlikely place for squirrels to find supplementary food but there is a corridor via a footpath from the woodland to houses in Havenstreet. Residents witness squirrels coming to their gardens, using the trees. Once in a garden, the squirrels use trees to get to other gardens and then they cross the road; some do

not make it. Road kills are a regular occurrence for the length of Main Road, Havenstreet.

Another question must be ‘are there more sightings in coniferous or deciduous habitat’? This is hard to quantify as the observational skills of the monitor plus woodland structure are a factor in sighting squirrels. Also, the amount of supplementary feeding will skew the carrying capacity.

The monitor is asked to record weather conditions, although walks are not carried out when the weather is wet or windy. The weather can impact on sightings and occasionally walks are interrupted by dogs and on one occasion the monitor was bitten.

The bi-annual monitoring results are drawn together with other data sets in another chapter. Some of the woods monitored are privately owned and no data would be known without the efforts of the volunteers. Sightings from woods used regularly by dog walkers are not always reported because the assumption is that it is known squirrels are there. Regular reminders to the general public to report sightings are ongoing.

Appendix 1. Forms given to volunteers

Monitoring Transect					
Wood	Grid Ref			Monitor	
Walk Number	1	2	3	Session	Spring / Winter 200...
Time	Weather			Date	
	Distance	Tree species	Number, activity & comments		
Section 1					
Stop 1					
Section 2					
Stop 2					
Section 3					
Stop 3					
Section 4					
Stop 4					
Section 5					
Stop 5					
Section 6					
Stop 6					
Section 7					
Stop 7					
Section 8					
Stop 8					
Section 9					
Stop 9					
Section 10					
Stop 10					
Section 11					
Stop 11					
Section 12					
Stop 12					

Comments:

Bi-annual Walk Questionnaire

Please complete and return to : Wight Squirrel Project, PO Box 33, Ryde, IOW, PO33 1BH

1. General

Name of Wood:	
Grid Reference:	
Owner of wood:	
Local Group:	

2. Habitat characteristics

Please tick the habitat type which is closest to the habitat in each section:

Section	conifer	mainly conifer	mixed	mainly deciduous	deciduous
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A Health & Safety leaflet is given to each monitor plus a third party liability disclaimer.

Overall, which habitat type is represented by your wood:

conifer ☐ mainly conifer ☐ mixed ☐ mainly deciduous ☐ deciduous ☐

Please name the three predominant tree species in your wood:

1. _____
2. _____
3. _____

3. Feeding

Does supplementary feeding take place in your wood?

Yes ☐ No ☐ Don't know ☐

What type of feeders are set up and how many are there:

FA Metal Hopper _____ Plastic Drainpipe ('Rimmer Hopper') _____

DIY Feeder _____ other(please specify) _____

When did feeding first commence: _____

What time of year is food put out: _____

What kind of food is put out: _____

Comments and observations on use by red and grey squirrels: _____

Please mark location of feeders on the sketch of your route on page 4.

SAFETY FIRST FOR WOODLAND MONITORS

Woods are potentially dangerous places if you are not sensible. Always be aware of hazards such as loose dogs, hanging branches or treacherous ground. Never venture into the woods in the dark or in bad weather. Always concentrate on what you are doing.

DO NOT Cause any damage to property
Walk in the woods when it's windy, icy or very slippery
Deviate from clear-cut paths
Choose a route that takes you across marshy ground
Choose a route that is very uneven
Get into an argument with the landowner or other wood users

DO Let someone know where you are and when you should be home
Take a mobile phone with you if possible
Wear sensible clothing, especially footwear
Always shut gates
USE COMMON SENSE

-----cut here and keep top half-----

I agree to take every care whilst undertaking woodland monitoring for Wight Squirrel Project and understand Wight Squirrel Project will accept no responsibility whatsoever for any incident occurring during monitoring sessions.

Signed... _____ Print name... _____

Date... _____

ACKNOWLEDGEMENTS

Thank you to Dave Dana for taking over the training sessions until 2019

To landowners for giving permission to access their woodland

To all the monitoring volunteers. This project could not take place without you

To volunteers who input data

Ian Rennie for formatting the database

Sally Wiltshire for running the graphs

Chapter 3

ISLE OF WIGHT

WOODLAND SURVEYS

INTRODUCTION

This report is reproduced as it went out in 2017 to landowners, interested institutions and volunteers. The survey was undertaken between 1st September and 31st December 2016. All the findings from this report plus other survey results and discussion are drawn together in section 4.

The red squirrel (*Sciurus vulgaris*) is the only squirrel native to the British Isles. The species is disappearing from the mainland and being replaced by the introduced American grey squirrel (*Sciurus carolinensis*). 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.

Bi-annual woodland monitoring is carried out in accordance with national guidelines by Wight Squirrel Project volunteers and the general public provide ‘citizen science’. 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. To fill in the gaps, the Isle of Wight Red Squirrel Forum agreed that, as part of the Isle of Wight strategy for red squirrels, an all-island woodland survey should be undertaken every 5–8 years.

This survey, based on scientific methodology, confirms presence or absence of red squirrels in woodland blocks and isolated woods >1ha. The aim from previous surveys was ‘...to survey all woodland over 2ha in extent to discover the presence or absence of red squirrels and common dormouse (*Muscardinus avellanarius*).’ The last two surveys, in 2005/6 and 2010/11, were administered by the Hampshire & Isle of Wight Wildlife Trust and dormice were included. The 1997 survey was undertaken by a different surveyor and overseen by Wight Wildlife. Dormice were not included in the 2016 survey but any nuts found opened by dormice were sent to the

People’s Trust for Endangered Species to aid their documentation of the species.

Although there are large estates on the Island, there are also many small woodland owners with differing ideas on how to manage their woodland. There are also a variety of uses for woodland, traditional, recreational and commercial. Shooting features in some of the larger estates. Other owners just prefer to ‘let nature takes its course’ and not manage at all. Within certain parameters it is of course the owners’ prerogative to use their land for the purpose they choose.

The importance of corridors has been long known and is well documented. It is heartening to see landowners have taken advantage of schemes such as JIGSAW or, in some cases, have taken the initiative to plant trees themselves.

METHODOLOGY

Woods are surveyed between the beginning of September and end of March to give the best possible chance of finding hazelnuts opened by squirrels. Structure of the woods is recorded plus tree species, their abundance, management and fruiting age. Any changes were noted and entered on the survey sheet. Deer tracks are also noted if found. There are deer farms on the Isle of Wight, so therefore there is the possibility of escapees. Judging woodland structure is subjective; a different surveyor may view the abundant/frequent/occasional question differently. (Example sheet in Appendix 1.)

Once woodland structure is recorded and a sign of squirrels is found, the survey in that wood is completed.

The time taken to find the first sign is noted. Actually seeing a red squirrel is the best confirmation of presence but fresh dreys and fresh food leavings such as hazelnuts, fir cones and hawthorn (*Crataegus monogyna*) seeds are a good indication as squirrels access the seeds using a different method from other small mammals and birds.

As the hazel (*Corylus avellana*) seed crop was particularly poor in 2016, it was decided to complete the survey as quickly as possible before the few new nuts produced were buried under leaves or swept away by heavy rainfall.

In the majority of woods that support large shoots, access is not granted until February. However, as all these estates have public paths or roads through or beside them, it was decided to go ahead. In the event that the survey result was deemed unsatisfactory using this method then permission would be sought in February when shooting was finished. The 2016 survey is the only survey to apply this fast-track method. In other respects the methodology was the same. By using public paths, previously unknown (to the author) corridor links were found. Overall, it improved the survey and knowledge gained and prompted a wider study of habitat and corridor links.

Where corridor links were good and distances between woods judged to be short enough for dispersing squirrels, woodland was surveyed in blocks rather than individually as they appear on the Ordnance Survey map. In the larger blocks,

where there is no gap between named woodlands, or there is only a very short distance, or perhaps there are joining hedges, three or four points in the block were searched for squirrel evidence.

If there are no physical signs in the woods themselves or an appropriate tree species present, then a hedgerow containing fruiting hazel was searched, but only if it directly joined the wood. In some woods it was impossible to find signs as the tree species did not include hazel, a pine species, honeysuckle (*Lonicera periclymenum*) or hawthorn and there was no sighting of a squirrel or a drey spotted. Occasionally it was possible to find a corridor link to a neighbouring wood that did have the appropriate tree species.

RESULTS

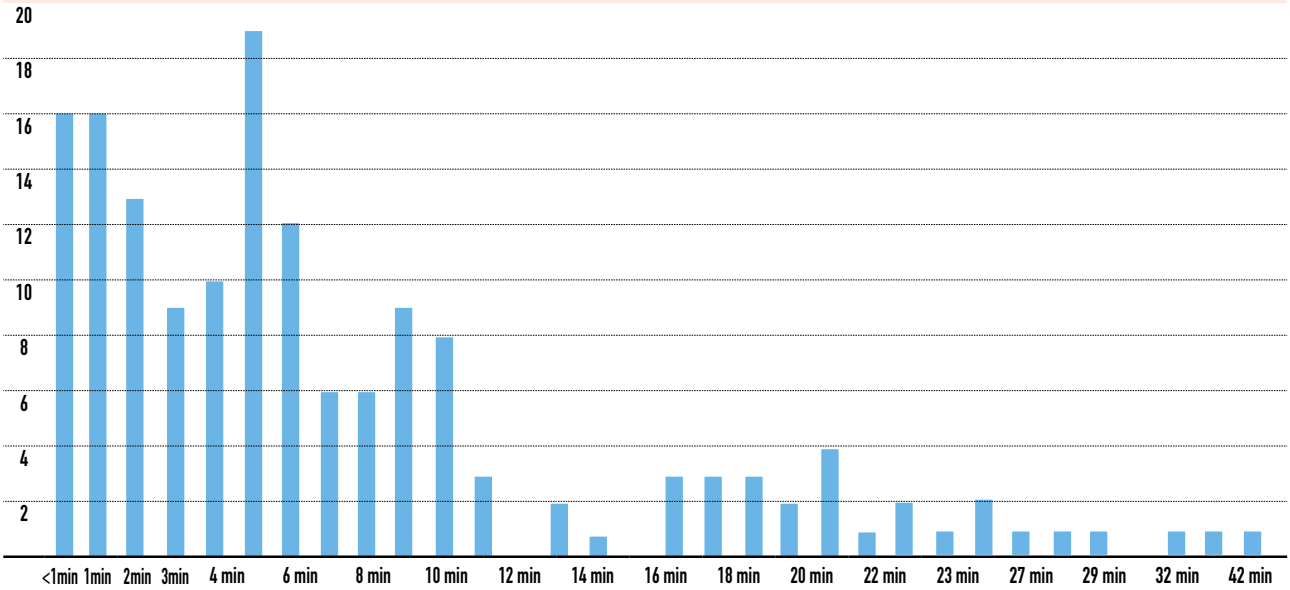
This survey confirmed red squirrels are widespread on the Isle of Wight and that connectivity between woodland blocks has improved thanks to schemes such as JIGSAW. Of the woods (or woodland blocks) sampled, 95% were positive for red squirrel presence. Comparison with previous surveys is given in the table below.

In spite of the very poor hazelnut crop, split nuts were found in 75% of woods, whilst in 11% stripped pine cones confirmed red squirrel presence. Only 10 squirrels were seen during the whole survey. The largest woodland blocks are at Swainston, Briddlesford, Combley, Bouldnor/Hamstead and Bowcombe. Also Kemphill, Rowlands and Chillingwood were considered one block from a squirrel's viewpoint.

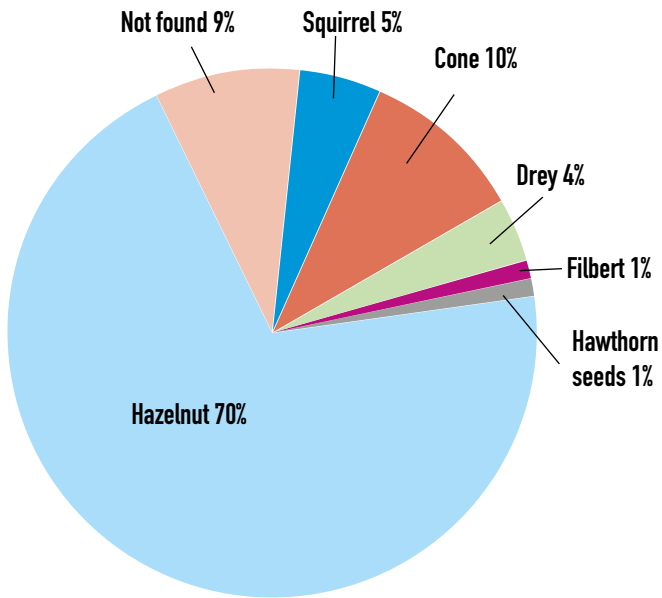
Table showing results for red squirrel presence in Isle of Wight woods from all comparable woodland surveys

1997	71%
2003	86%
2010	90%
2016	95%

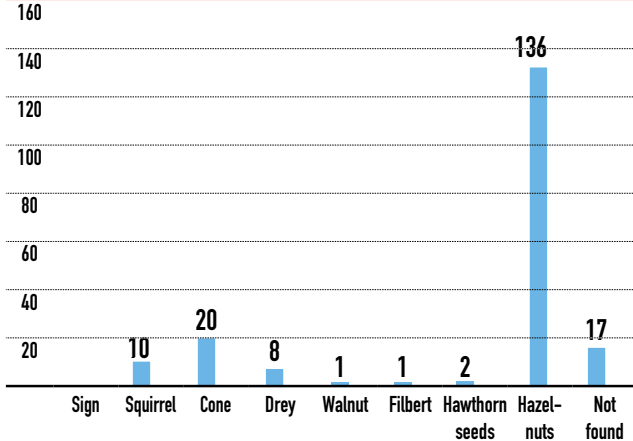
Time taken to find red squirrel presence
Number of woods



Signs of red squirrel presence



Signs of red squirrel presence
Number of woods



Woods in and around the area of Whitefield Wood are either very close together or joined by short hedgerows and well within dispersal distance. In other words, as a large forest that has clear-felled areas may look to a squirrel.

No signs of deer were found. The ground was very hard for most of the time taken to look at the woods but even outside the deer farm at Chale there were no signs, or any signs of deer in the enclosure for that matter.

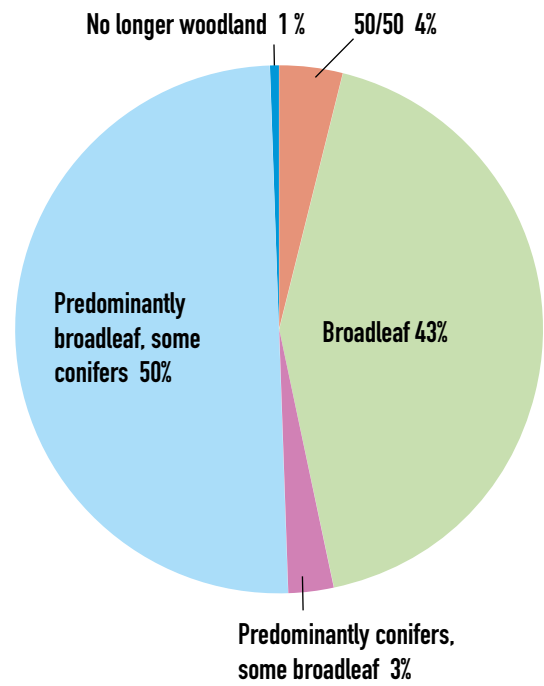
It was interesting to note that in a very poor seed crop year, the hazel that produced nuts were the large old stools. The smaller stools, particularly if shaded, do not produce a good nut crop even in average years. Edge stools of around 10 years usually produce a nut crop but, for the most part, even these did not do well in 2016. Graphs showing character of woods and tree species are given below.

Graphs showing tree species found throughout the 180 blocks of woodland surveyed. The numbers show the number of woods each species was found in, their frequency and how they are situated throughout the wood. See survey sheet in Appendix 1.

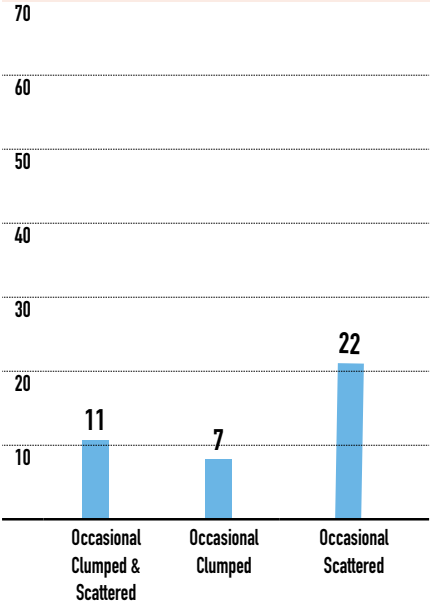
Breakdown of tree species in total of 179 woodland blocks

Tree species	
Tree species	Percentage
Scots pine	42%
Other pine	63%
Conifer	81%
Hazel	95%
Beech	47%
Oak	96%
Sweet chestnut	57%

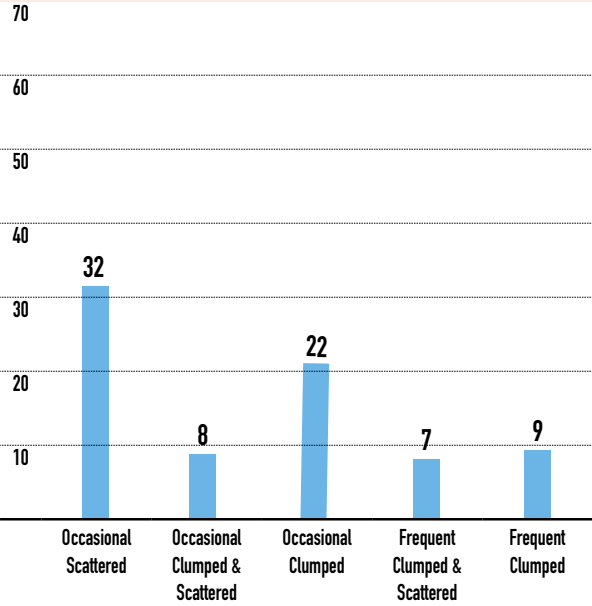
Woodland character



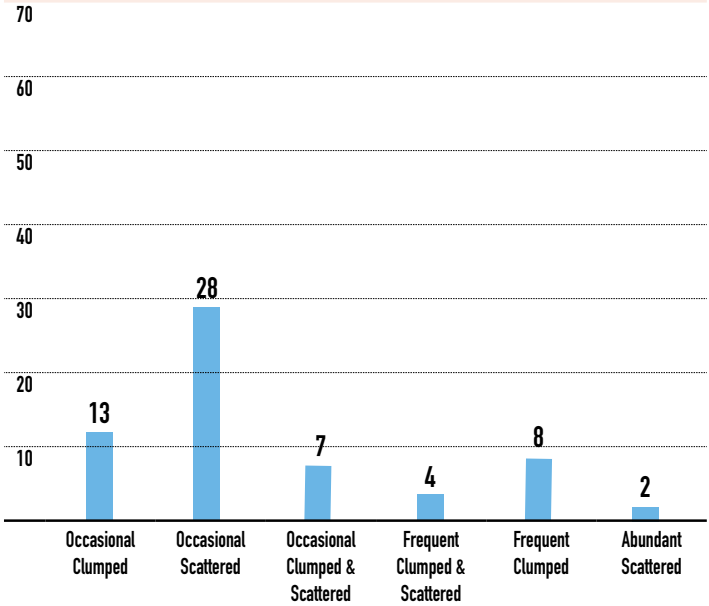
Scots pine
Number. of woods in which found

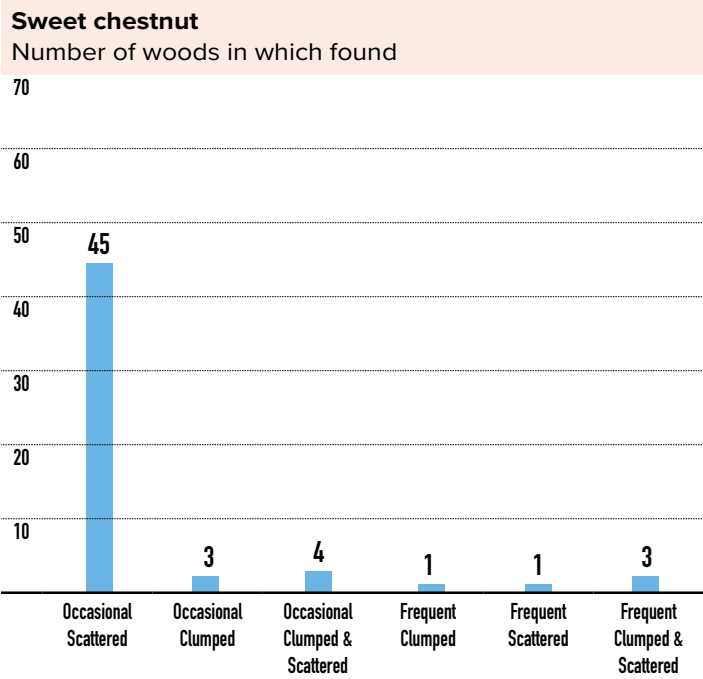
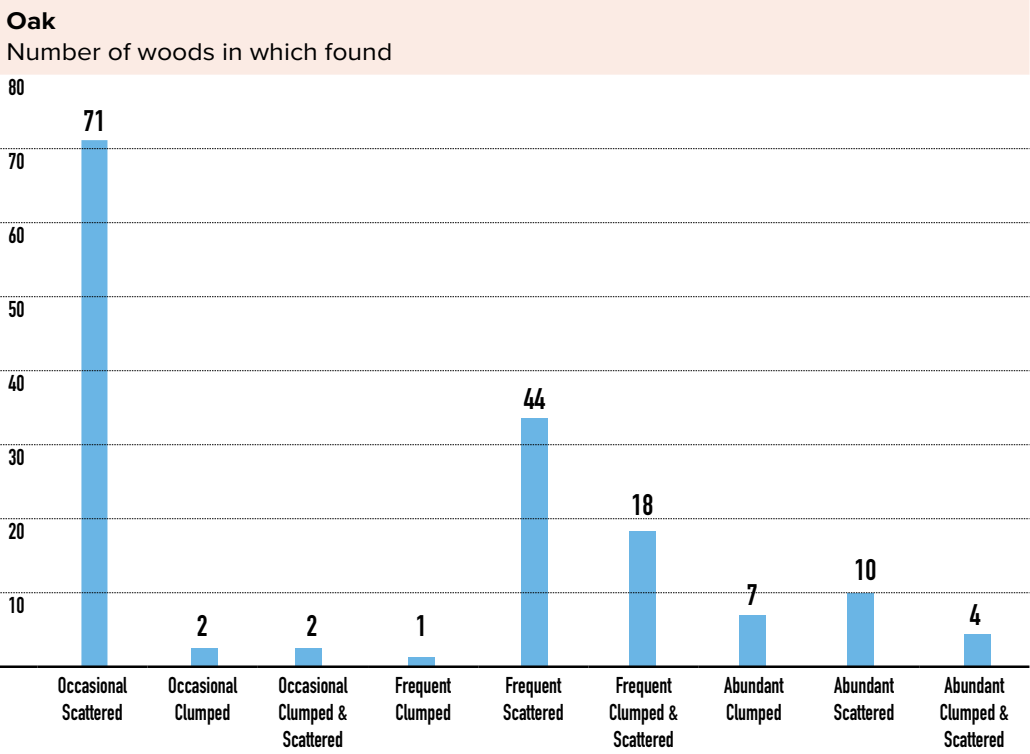
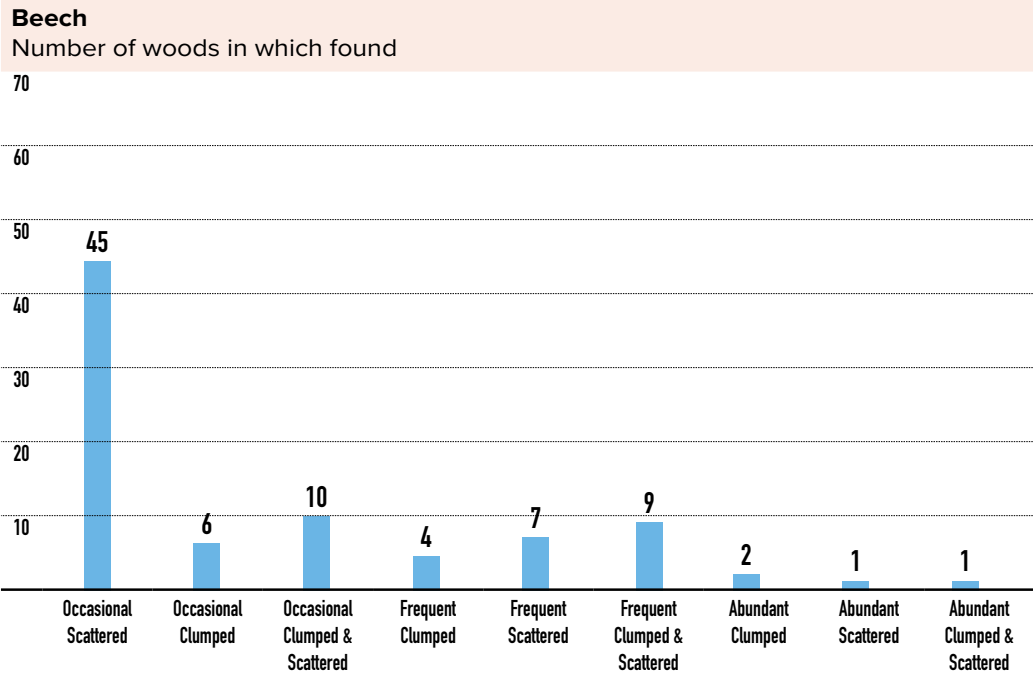
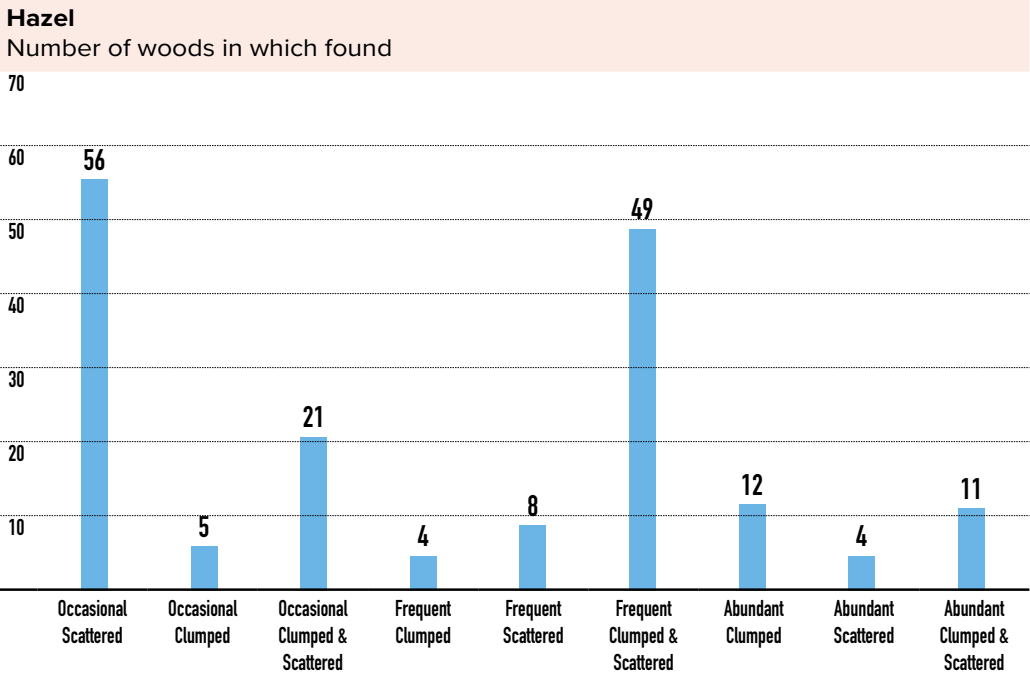


Conifer
Number of woods in which found



Other pine
Number of woods in which found





DISCUSSION

Red squirrels are ubiquitous on the Isle of Wight and although density (Wight Squirrel Project 'citizen science' data and bi-annual monitoring figures) is thought to have fallen since 2010, they are well spread out across the Island. This is contrary to 26 years ago when the author started red squirrel work. At this time, shortly after the 1987 Great Storm, numbers were low and distribution not as widespread. Results from this survey will be used in conjunction with other data sets to build up a picture of the Isle of Wight red squirrel population since 1990. Fluctuations in numbers and distribution, including perceived reasons for the differences, will be put together with DNA analysis and post-mortem results.

Management is not always obvious in a wood and clearly, in some cases, there was some form of management but not on an annual basis. Given the productivity of old hazel stools, particularly if they are unshaded, priority for woodland owners managing for red squirrels and other small mammals should be to retain these old stools, although there will come a time when coppicing is the best option so that they remain viable.

A further study of corridor links, and a survey of smaller woods, is planned to start in the autumn of 2017. As Isle of Wight woods are largely a mosaic of small woods with hedges linking them, this survey will show where possible new plantings might further boost connectivity. Saying that, JIGSAW has already vastly improved linkage between small woods enabling squirrels, and other species, to move more freely, and making previously isolated woods part of a larger complex.

Wight Squirrel Project will continue the study of red squirrels on the Isle of Wight by looking at smaller woods, the role of parks and large gardens in providing a red squirrel refuge and food supply. Supplementary feeding, although frowned upon by some, does appear to help our red squirrels survive in areas where they may not otherwise be found, such as parks and urban areas.

Overall, Isle of Wight red squirrels are using most woodland, although it superficially appears that the density levels are lower now than in 2009 and 2010 when they appeared to reach a peak. It is intended to analyse data collected since 1991 to look at trends relating to weather conditions and

nut production. The tree species in our woods, as can be seen from the graphs above, are quite mixed, which is good for any wildlife. Scots pine is a staple food for red squirrels but there is a paucity of this tree species in Isle of Wight woods and it is noted only as 'occasional'. Given that Scots pine is an important species for red squirrels, it's disappointing there are so few.

Given the Isle of Wight is seen as a national stronghold for our native red squirrels, we should feel duty bound to provide habitat conducive to their survival. Corridor links and sensitive habitat management must be key components of forestry plans if they are to thrive long term. With a few exceptions, red squirrels are not a priority for woodland owners. It is intended to map all areas and look at data held by Wight Squirrel Project to ascertain if there is any correlation between an increase in red squirrel numbers in good years, or a better survival rate in poor years, and areas where there is supplementary feeding and the red squirrel is a priority species in any management plan.

ACKNOWLEDGEMENTS

Thank you to landowners who gave permission to visit their woods

APPENDIX 1

Survey sheet

WIGHT SQUIRREL PROJECT

Isle of Wight red squirrel survey

Section 1. Location details

Landowner.....

Wood name.....

Ref no.....

Grid ref(centre).....

Area.....

Date of survey.....

Start time.....

Section 2. Species survey

Time to finding first sign

Signs (tick)

Sighting ☐

Fresh drey ☐

Freshly chewed cones ☐

Freshly opened hazel shells ☐

Other (specify) ☐

Total time searching if no sign found

Section 3. Woodland survey

General character of wood:

Broad-leaved ☐
Predominantly broad-leaved, some conifers ☐
Predominantly conifer, some broad-leaved ☐
Conifer ☐

Species	Relative abundance throughout wood (tick box)			Fruiting age (Tick box)
	Abundant	Frequent	Occasional	
Scots pine				
Other pine				
Other conifer				
Hazel				
Beech				
Oak				
Sweet chestnut				

Enter C for clumped trees (eg plantation)

S for scattered trees

Active coppicing in wood (hazel, sweet chestnut)?

YES NO

Active management in wood (planting, tree tubes, thinning, felling)?

YES NO

Signs of deer (sighting, droppings, slots)

YES NO

Surveyor.....

Chapter 4

**CORRIDORS
OF HOPE**

**Preliminary Report
1992**

By Helen Butler

This is a copy of the first red squirrel work undertaken by the author and pre-computer so diagrams and charts are hand drawn.

CONTENTS

Acknowledgements

	Paragraph numbers
Introduction	1 – 2
Methodology	3 – 5
Key and introduction to maps	
Map	
Chapter 1 The West Wight	6 – 24
Chapter 2 Bouldnor	25 – 32
Chapter 3 Cranmore & Hamstead	33 – 39
Chapter 4 Shalfleet	40 – 41
Chapter 5 Shalcombe, Brook, Grammars Common, Westover, Brighstone Forest, Rowborough Down & Westridge Down	42 – 50
Map	
Chapter 6 From Calbourne to Guyers Heath	51 – 54
Chapter 7 Newtown, Porchfield & Thorness	55 – 61
Map	
Chapter 8 Gurnard & Cowes	62 – 68
Chapter 9 Parkhurst Forest	69 – 76
Chapter 10 Newport & Carisbrooke	77 – 80
Chapter 11 Gatcombe, Rowridge, Chillerton & Rookley	81 – 89
Chapter 12 Shide & Blackwater	90 – 92
Chapter 13 East Cowes	93 – 95
Chapter 14 Wootton	96 – 103
Chapter 15 Staplers, Long Lane & Lynn	104 – 111
Chapter 16 Combley, Briddlesford & Firestone	112 – 118
Chapter 17 Quarr, Binstead & Ryde	119 – 125
Chapter 18 Seaview & Nettlestone	126 – 134
Chapter 19 Whitefield	135 – 140
Chapter 20 Brading	141 – 145
Map	
Chapter 21 Alverstone & Borthwood	146 – 153
Chapter 22 America Wood & Apsecastle Wood	154 – 159
Chapter 23 Shanklin	160 – 166
Chapter 24 From Shanklin to Blackgang	167 – 175
Chapter 25 Bembridge	176 – 179
Chapter 26 Findings in outlying areas	180 – 183
Conclusion	
Appendix 1 Results of Hazelnut Survey	
Appendix 2 Road signs to mark squirrel crossing points	
Appendix 3 Squirrel casualties 1992	
Appendix 4 Map showing squirrel distribution	
Appendix 5 Map showing dormouse distribution	
Appendix 6 How to identify which mammal has opened hazelnut shells	

ACKNOWLEDGEMENTS

Thanks to :

- The BTCV and Project Wight for funding the first year’s research
- Val, Beth, Muriel and John for their assistance and support throughout the year
- Grace and Sylvia for typing this report from hand written notes in 1992
- Sally Wiltshire for copying text digitally from hard copy in 2020
- Beth Greaves-Jones for turning the data into tables

Copyright © Helen Butler

INTRODUCTION

- 1. The initial purpose of the BTCV ‘Corridors of Hope’ project was to establish where woodlands and their red squirrel (*Sciurus vulgaris*) and dormouse (*Muscardinus avellanarius*) populations have become isolated and to indicate where corridors of trees could be planted to link these woods once again with areas of suitable habitat.
- 2. The Isle of Wight is the only discrete location in the British Isles where red squirrels are able to use both broadleaf and conifer woodlands without competition from grey squirrels (*Sciurus carolinensis*). This makes the Island population an excellent subject for research. The current status of the dormouse on the Island is unknown as there has been no up-to-date Island-wide survey. In recent years, concern has been expressed about the loss of hedgerows which has resulted in some squirrels and dormice becoming isolated. These isolated populations run greater risks of local extinction through disease, poor breeding seasons, etc, and once eliminated, re-colonisation in the absence of these links is unlikely. ‘Corridors of Hope’ with its emphasis on re-establishing squirrel and dormouse route-ways, aims, in some small measure, to prevent the potential decline of those legally protected species.

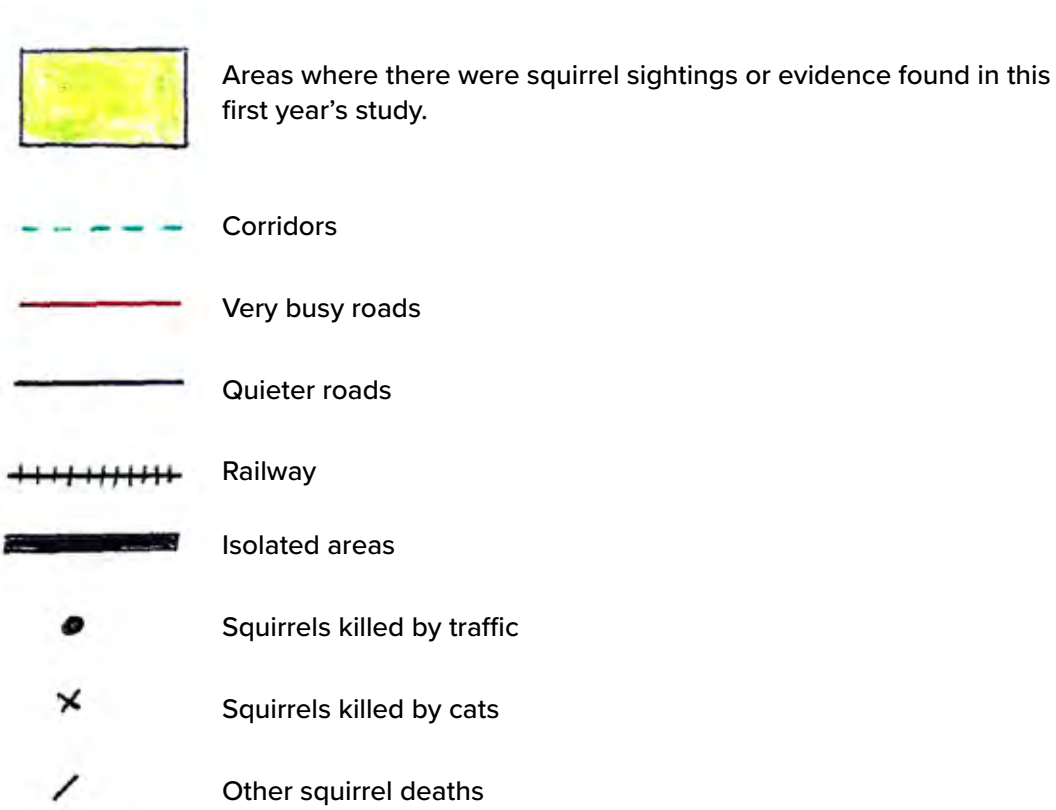
METHODOLOGY

- 3. A study of this size could not be undertaken without the assistance of the general public and I am indebted to them for both information on sightings, etc, provided and also for the hospitality received. The often made request for anonymity has been respected. I responded to all squirrel reports by visits, rather than conduct a systematic wood by wood survey of the Island. This has led to a lot of evidence being gathered for some areas with others receiving little coverage. The following research planned for subsequent years will fill in the gaps.
- 4. Evidence of squirrel presence was obtained in the following ways:
 - a) Personal observation
 - b) Reports from other individuals of sightings
 - c) Hazelnut evidence
 - d) Pine cone evidence
 - e) Presence of dreys

The characteristic way in which different species tackle hazelnuts to extract the kernel is diagnostic and for this reason the complete results of the hazelnut survey have been presented in Appendix 1.

- 5. Evidence of dormouse presence was obtained in the following ways:
 - a) Reports from other individuals of dormouse sightings
 - b) Hazelnut feeding evidence
 - c) Presence of nests

KEY TO MAPS



The sample of maps illustrates some of the points mentioned in the text.

At the end of the 5 year study, it should be possible to produce a full complement of maps, covering the entire Island, highlighting areas where squirrels are present, or absent, and where the existing and potential corridors are.

CHAPTER 1 THE WEST WIGHT

6. The extreme West Wight has small fragmented areas of woodland, with no obvious corridors to Bouldnor or Shalcombe, which are the next sizable habitats.
 7. Wilmingham Plantation with the adjoining Tapnell Furze and Withybed Copse is the only area large enough to sustain the core population.
 8. Wilmingham Plantation is mainly conifers, interspersed with hazel. Hazelnut shells found here in May were mainly opened by squirrels, with only 2 from the random sample used by dormice. No close inspection was made of Tapnell Furze or Withybed Copse.
 9. Squirrels are regularly seen crossing from Wilmingham Plantation to Blackfirs. From here they can reach Baskets Copse, Mill Copse and Thorley Copse via the hedgerows.
 10. Mill Copse is a mixture of broadleaf and conifers. The majority of hazel is losing the battle for light and the nut crop was poor this year. Nevertheless, nutshells left by squirrels and dormice were found.
 11. A good uncut hedge leads to Thorley Copse. This copse contains young oak, ash, field maple and plenty of good hazel. Being a private copse, it is virtually undisturbed and a good habitat for squirrels and dormice. Used hazelnuts were hard to find as the ground flora was so dense.
 12. The disused railway line from Yarmouth to Freshwater proves a good corridor, with a variety of trees, including hazel. Squirrel and dormouse evidence was found on the edge of Baskets Copse and in a group of trees on the riverside.
 13. This corridor leads to the Causeway, where up to 6 squirrels were reported to be seen regularly.
 14. The footpath from behind the Red Lion, at the bottom of the Causeway, leads to Saltern Wood. This is a possible route-way for squirrels. Some of the hedges were left uncut, but there were no hazel present, so I was unable to confirm this theory.
 15. A short distance below the Red Lion, a footpath runs all the way to Golden Hill Fort. This is a good route-way, containing hazel.
- Signs of squirrel and dormouse activity were found, the majority being dormouse.
16. At the beginning of this route is a small overgrown copse called Bow Bridge. Numerous hazel shells were found on the outskirts of the wood. A squirrel had used most of these.
 17. Around Golden Hill Fort is a lot of scrub and young trees. Hazels and conifers are scarce. This is not ideal squirrel and dormouse territory.
 18. A young squirrel was seen travelling from Golden Hill Fort through Silcombe Lane, Heathfield Road and past the Prince of Wales public house. This is a built-up area without trees. This squirrel then built a drey in a macrocarpa tree in Warden Road. Appearing on the 2nd of May, this animal was seen daily until the 22nd of May. The residents saw it eating macrocarpa seeds during its stay. They also watched it carry dried lawn mowing into the tree to line its nest. This squirrel was not seen in the area again after the 22nd of May.
 19. Crossing the main road and heading towards the shore at Totland are scattered trees and several parks. The only definite sighting of a squirrel in Totland this year is the one in Warden Road. Two people have said squirrels use Turf Walk as a corridor. No stripped cones were found along here, or elsewhere in the immediate neighbourhood. One morning was insufficient for a thorough look at Totland.
 20. Going back to Salterns Wood, the privately owned part I visited was a well maintained habitat containing oak, ash and hazel. Sightings were regular, with up to 3 squirrels visiting a garden at one time. Dispersal from Salterns Wood could be either via hedges to Freshwater (paragraph 14), or across the main road towards Fort Victoria Country Park and Westhill. A squirrel killed on this road in May confirms they do use this route.
 21. Fort Victoria Country Park, at first sight, does not look good squirrel habitat. The trees here are mainly wych elm, sycamore, holm oak and a few scattered conifers. Stripped cones were found beneath the conifers.
 22. Residents at Westhill, which adjoins the Park, have had squirrels in their gardens daily for the 6 years the houses have been there. The squirrels help themselves to peanuts and

also to the holm oak acorns. They always come and go in the direction of Fort Victoria Country Park. The resident pair bred this year and successfully reared 2 youngsters. There are now 4 squirrels surviving in this Park. The one I saw on my visit looked very well.

23. Squirrels are sometimes found in Yarmouth Town. One was spotted in the High Street in October and there have been several sightings in and around the Station Road area. They are also occasionally seen at the school. These squirrels are probably youngsters looking for their own territory.
24. The sycamore at Alum Bay looked very unhealthy (sea salt damage?) when I visited in September. It is highly unlikely that a squirrel could survive here. There have been no reported sightings since 1969.

CHAPTER 2 BOULDNOR

25. From Bouldnor right through to Shalfleet is an area of woodland large enough to sustain its own population. Habitat is mixed.
 26. Bouldnor is a conifer plantation with a broadleaf fringe. Walking along the Bouldnor coastal path from Cranmore, 2 dreys were found within a short distance of each other, with another substantial drey a quarter of a mile further on. All 3 were in Scots Pines. Squirrel activity, in the form of stripped cones, was found in this area. The hazel along this path is in poor condition and had borne only a few nuts. However, the majority of shells found had been cracked by a squirrel.
 27. Several people in properties bordering Bouldnor on the road side see squirrels daily. One resident, who owns their own coppice, claims they saw squirrels regularly before the hurricane, but have had only rare sightings since. A short distance away, however, up to 6 squirrels visit a garden daily. This number includes youngsters which appeared in May. Food is supplied and these squirrels are so used to people that they allowed me to approach within a metre, to take photographs.
 28. The other householder who contacted me about their squirrels, has them literally eating out of his hand. From having none at all from
- last winter (1991/1992), he now has at least 6 in the garden each day.
29. All three of these residents put out food, but only two of them attract squirrels (the 2 either end). It would be interesting to see the woodland adjoining these properties.
 30. It would be possible for a squirrel to reach Lee Copse from Bouldnor, providing the main Yarmouth road was safely crossed. Lee Copse is private, with no public footpaths and is therefore virtually undisturbed, except for shooting. Conifers and broadleaf trees grow here, including an abundance of good hazel. Plenty of squirrel evidence was found.
 31. The disused railway track on the southern border of Lee Copse provides a good corridor to a small woodland (no name given on the OS map) besides Mount Farm. A few nutshells left by squirrels were found. In this broadleaf woodland, although in the small area visited, there was more oak than hazel.
 32. To the south of the above copses are ploughed fields. Shalcombe is the next wooded area beyond them. Squirrels dispersing from Bouldnor can leave by the eastern route into Cranmore and Hamstead.

CHAPTER 3 CRANMORE & HAMSTEAD

33. Common to most places, squirrel numbers dropped heavily in Cranmore after the 1987 storms. Reported sightings of live squirrels have been rare here, but 10 have been killed this year 8 by cats and the remaining 2 met unknown deaths. This is hardly surprising given that the houses here have been built in what was essentially squirrel territory. The populated area of Cranmore is now more of a link between Hamstead and Bouldnor rather than a core squirrel habitat.
34. Hamstead is a mixed area. Woodland containing many types of trees is interspersed with open farmland and a number of dwellings.
35. The fringe of broadleaf seen on the seaward side of Bouldnor (paragraph 26) appears again at Hamstead. A few empty hazelnut shells (squirrels) were picked up, but the trees had not borne much fruit.
36. The private woodland between Hamstead Grange and the sea is a mixture of broadleaf

and conifers. Several dreys were located and there was no shortage of used pine cones.

37. A squirrel carrying dried grass in its mouth was spotted, but it was too quick to follow. However, a recently built drey was found in an oak tree nearby.
38. Squirrels feeding in the garden where the above squirrel was seen (paragraph 37) always use the northerly route. The next property several 100 yards away have their own squirrels (1 adult plus 1 youngster) visiting daily. These animals always use an eastern route.
39. The rest of Hamstead has yet to be explored, but residents say this is a good area for squirrels.

CHAPTER 4 SHALFLEET

40. Shalfleet has acquired a small resident population of squirrels this summer. It is yet to be established where they came from. To date, the only corridor I have followed from Shalfleet has been from the back of the Church through to Chessell. Used hazelnuts were found all along this route – near the sewage works, along the edge of Shishford Copse (dormice are here as well) and beneath hazels in the hedgerow which leads into Newbridge.
41. Chessell Copse provides a routeway to the core habitats in Brook and Brighstone, although some ground travel would be necessary as well. A pair of squirrels was seen twice in the Newbridge area last winter and a few hazelnuts were found in the copse, but I do not believe squirrels are resident here.

CHAPTER 5 SHALCOMBE, BROOK, GRAMMARS COMMON, WESTOVER, BRIGHSTONE FOREST, ROWBOROUGH DOWN & WESTRIDGE DOWN

42. Shalcombe Down has a large beech plantation, with a few firs on the outskirts – no used cones were found. Neither were there any dreys seen from the footpaths. Squirrels could easily reach here, but so far there is no evidence that they do so.
43. In contrast, Brook has a thriving population of squirrels. Residents feed daily and the

same animals visit each garden in turn. In line with most places this year, squirrel numbers increased in the spring.

44. It is probable that at least one of these squirrels is travelling between Brook and Brookhill each day. This particular squirrel was considerably smaller than average and was a light silvery colour, which made her noticeable. This was for 2 – 3 weeks in September. A cat on Brookhill caught her towards the end of the month and this coincided with her last visit to a garden in Brook.
45. Habitat and corridors end at Dunsbury. Afton Downs are to the west, Brook Down to the north, and the sea to the south. This leaves Brookhill to the east.
46. In the gardens at Brookhill, as many as 12 squirrels have been seen at one time. The hurricane caused havoc through Mottistone Plantation, which is to the east of those gardens, and squirrels have been pushed together into the block of remaining trees on Brookhill.
47. Seven dreys were found in the conifers and beech behind Brook House. All were in far closer proximity to each other than any others found. These squirrels are certainly reliant on people for supplementary feeding and some will feed from the hand.
48. Although I only had one morning in this area, the devastation seems widespread. A large proportion of Grammars Common is missing and virtually all of Coombe Plantation. There were regular sightings at Grammars Common between January and April this year, and then curiously, these animals disappeared.
49. The small part of Westover Plantation I saw on my morning's visit was predominately beech so no 'evidence' was gathered. However, squirrels have been sighted here.
50. The adjoining Brighstone Forest, Rowborough Down and Westridge Down, I have not visited yet, but other people have seen squirrels in these areas.

CHAPTER 6 FROM CALBOURNE TO GUYERS HEATH

51. On the outskirts of Calbourne, towards Swainston, is Pump Copse. Hazelnuts split by squirrels were found, but with such a small acreage, this copse is probably only a feeding ground or corridor.
52. Crainges, which can be easily reached from Pump Copse, is partially coppiced and contains some excellent hazel, which the squirrels have made full use of.
53. Nearby are Rushcroft Copse and Willy Wood. I have yet to look into the possibility of a corridor from Crainges to this area. Squirrels have been seen in Willy Wood and nuts split by them were found on the disused railway track which borders the wood.
54. The disused track provides a corridor to Guyers Heath. Squirrels have been sighted crossing the main Yarmouth Road to reach Three Gates Copse, which is opposite Guyers Heath. They do not always make the crossing successfully.

CHAPTER 7 NEWTOWN, PORCHFIELD & THORNESS

55. The remnants of Three Gates Copse is a corridor containing oak, ash, field maple, hawthorn and hazel. Squirrels are occasionally seen along here by local residents. Firs are absent from the neighbouring Corfheath Firs, but the broadleaf found in Three Gates Copse is continued here. Used hazelnuts picked up on the footpath had been mainly opened by squirrels.
56. Passing through Corfheath Firs, Newtown is reached. The broadleaf woods of Walters Copse are a good squirrel habitat. Visits to squirrel feeders in neighbouring gardens are commonplace. Squirrels were also sighted on the Green besides the Town Hall this spring. Several squirrels have been killed on the road at Newtown.
57. The Ranges, which is private and contains well-kept broadleaf woodland, can be reached from Newtown via Clamerkin. I am told there are squirrels and dormice here.

58. Passing through Porchfield towards Thorness is Little Whitehouse. A road runs through this copse but no footpath. The hazel growing near the road produced a good crop this year, among which were the characteristic split shells left by squirrels.
59. Several people have informed me that there is a colony of red squirrels at Thorness Holiday Camp, but I have not visited there yet. From the Holiday Camp, a line of trees lead to Burnt Wood.
60. Burnt Wood is private with no footpaths running through it. Trees are mixed. Two dreys were discovered in the conifers and stripped cones were found beneath them. Hazels are few, but shells discarded by squirrels were found eventually.
61. On the western side of Burnt Wood, I saw a squirrel run the short distance across the open ground to a hedge which leads to Hummet Wood. Hummet Wood is on private land and I have not yet been there.



CHAPTER 8 GURNARD & COWES

62. Using small coppices and hedgerows, squirrels should be able to reach Parkhurst, Northwood, Gurnard and Cowes from Porchfield. Looking from vantage points at the area, this theory seems feasible.
63. Ruffins Copse in Gurnard is broadleaf woodland with good coppiced hazel and sweet chestnuts. Squirrel and dormouse evidence was found here. Ruffins Copse is surrounded by fields and houses, except for a substantial corridor leading to Gurnard Pines.
64. Gurnard Pines Holiday Camp has a small wooded area, which includes some hazel. As the name suggests, there are also pines. No drey was found but squirrels are often found there. I visited at the beginning of August, the new hazelnuts, which were still soft and green, were being eaten by the squirrels. Life must be hard around here, as trees, except for a relatively small acreage of woodland, are scattered. This increases the dangers of travelling and a squirrel had been killed by a cat the day before my visit.
65. Other sightings in Gurnard were in Cockleton Lane and the Churchyard. It is possible that a squirrel travelled this way to Egypt Point, where it was seen last winter. There is a patch of scrubby woodland around the Point and a few split hazel shells were found there.
66. A resident in Cliff Road saw a squirrel outside his house several times. Once it was being pursued by a cat – the squirrel escaped this time. There are trees in the gardens and approximately one acre of parkland, but not enough to adequately sustain a stray squirrel. With the added risk of cats and cars, the chances of survival are slim, and it disappeared after a few weeks.
67. From the eastern side of Cowes, the cycle track leads into Newport. Between this track and the main Cowes road is a series of small coppices interlinked by hedgerows.
68. Numerous reported sightings indicate that squirrels inhabit every wooded area along here. The total acreage is too low to sustain a viable population and the nearest core habitat is Parkhurst, which involves a dangerous road crossing.

CHAPTER 9 PARKHURST FOREST

69. Noke Plantation, which adjoins Parkhurst, is an area of privately owned broadleaf woodland. Four dreys were located in the four acres I looked at. Sightings around the area are common.
70. At Hillis Gate and Marks Corner are areas of conifers and broadleaf. Squirrels are often seen in this part of the forest and two dreys were found in the conifers. A good range of broadleaf trees at Marks Corner includes sweet chestnuts, which are a favourite with squirrels.



CHAPTER 10 NEWPORT & CARISBROOKE

71. A short distance to the south of Marks Corner is a clearing. Beside this clearing was the only hazel I found (the whole of the forest was not searched). These trees were struggling for light and were not very productive. After a persistent search, empty shells were found. Squirrels had eaten most of the kernels.
72. From Marks Corner in a northerly direction is a corridor to Chalkclose Copse. In the two 'arms' of this copse is coppiced hazel. Every empty shell picked up had been split by a squirrel. In the narrow strip of trees leading to the road, hazel was absent, but there was plenty of oak, field maple, ash, hawthorn and holm oak.
73. Two years ago a squirrel was seen running along the road from Chalkclose Copse to the copse (no name) near Rolls Farm. There are hedges but the squirrels chose to use the road for approximately 75 yards.
74. The trees seen on one morning's walk in Parkhurst were predominately beech and a variety of conifers. The conifers were not all suitable squirrel fodder. Stripped cones were found and also another drey.
75. Parkhurst Forest is a good core habitat, with an acreage large enough to sustain its own population. Nevertheless, taking into account the clearings, and the fact that not all the trees are suitable squirrel fodder, I would doubt that the forest could maintain the basic 1 squirrel per 2 acres.
76. The obvious danger is the Forest Road. Several squirrels have been reported killed along this stretch of road over the last 12 months.
77. Squirrels have been known to have found their way into Newport. The pair that appeared briefly at St Mary's Hospital this summer, were probably from Dickson's Copse or Parkhurst Forest. Either way, there was not enough to sustain the pair in the hospital grounds and they soon left.
78. Those seen in Lugley Street and Caesars Road (not the same one) came either down the partially tree-lined footpath from Parkhurst or, more likely, along the Carisbrooke footpath. Split hazelnuts were found beneath the trees bordering this path. There have also been several sightings in this area. The route passes the eastern side of Carisbrooke Castle, where more nuts were found. These included shells left by dormice.
79. From the back of Carisbrooke Castle is the Shepherds Trail to Gatcombe. The hedges either side of the path contain hazel. The occasional split nut left by a squirrel was found at intervals for three quarters of the length of the path. This coincides with a small wood meeting the path on the Whitcombe side. Shells discarded by dormice were found the whole length of the path.
80. Open arable land meets the end of the footpath. The arboreal route to Gatcombe is probably via Whitcombe.

CHAPTER 11 GATCOMBE, ROWRIDGE, CHILLERTON & ROOKLEY

81. Reported sightings in Gatcombe are few. One half of a hazelnut shell was found above the kennels. Numerous shells were found along Newbarn Lane. Dormice had also fed here.
82. Prime habitat in Gatcombe is Tolt Copse. This deciduous copse has a plentiful supply of good coppiced hazel, field maple and dogwood with large stands of beech and ash. Squirrels and dormice are resident here.
83. To the west of Tolt Copse is Long Copse, Newbarn, Dukem Copse, Westridge Copse and several other small copses. There have been a number of reported sightings from these areas, but I have not visited any of them yet.
84. The next woodlands, still in a westerly direction, are Monkham Copse and Rowridge Copse. Both of these are favoured by squirrels and dormice. There was a good supply of unused hazelnuts left in May, with no shortage of used ones in evidence. I have not yet discovered if there is a corridor to Mudless Copse and Highwood.
85. Mudless Copse is a good hazel coppice where squirrels had left plenty of evidence. Adjoining Mudless Copse is Highwood. Highwood is predominately beech with a scattered hazel coppice found on the eastern boundary. The squirrels had taken advantage of these few nuts.
86. Arable land severs Highwood from Newbarn. Squirrels do cross the main road to reach Swainston from these habitats, as the two I found dead on the road confirmed.
87. Looking from the downs at the southern entrance to Tolt Copse, you can see Chillerton and Rookley. Hedges lead to both locations.
88. Hollow Lane in Chillerton is a narrow gully bordered by trees. The path leads to Ramsdown. Hazelnut shells left by squirrels and dormice were found along here. There is no adjoining woodland.
89. Towards Rookley, the hedgerows lead to Highwood Lane. The broadleaf copse on the south side of the lane is private, but hazels along the roadside provide evidence of squirrel and dormouse presence.

CHAPTER 12 SHIDE & BLACKWATER

90. On the southern outskirts of Newport is Shide. There have been several sightings along the disused railway track which runs from Shide to Blackwater. Trees bordering the track consist of willows, oak, ash, hawthorn and holm oak. Sandy Lane meets the other end of this track. Squirrels are frequently seen along this lane, Marvel Lane and around Whitecroft.
91. Squirrel habitat in this district is poor. The wood (no name given on the OS map) at the back of Whitecroft is uncoppiced and has suffered the loss of numerous trees, including firs.
92. A few squirrels must be covering a large acreage to survive here. This odd shaped wood extends to the previously mentioned Gatcombe (paragraph 81) and Highwood Lane (paragraph 89).

CHAPTER 13 EAST COWES

93. The 480 acres comprising the Osborne, Norris and Barton estates is large enough to sustain its own viable population. Trees were lost in the hurricane, but there was no noticeable decline in the population.
94. These adjoining, well managed habitats contain a wide variety of trees, from the rare ornamental type to the usual broadleaf and conifers.
95. This is one of the best and most secure habitats on the Island. Up to 6 squirrels were seen regularly at Osborne House this summer. They take no notice of the visitors.

CHAPTER 14 WOOTTON

96. From a vantage point at Wootton, trees and hedgerows appear to extend as far as Whippingham and Woodside. One squirrel is reported to come inside a workshop at Whippingham some afternoons.
97. Brocks Copse is an important link between Whippingham and Wootton. Squirrels are occasionally seen here and split hazel shells were easily found along the roadside.
98. On the seaward side of Wootton is Woodside. Houses have been built in former squirrel habitat here, but the squirrels have stayed. Unfortunately, residents have brought cats with them. One of these predators alone accounted for 5 squirrel deaths this summer. One of these was a lactating female.
99. Wallishill Copse is the largest wooded area at Woodside. It is privately owned, but from the outside it appears to be mainly broadleaf.
100. A resident at Woodside, who owns their own small coppice, was kind enough to allow me to look for hazelnuts here. The split halves, which are the squirrels work, were found and so was the neat work of the dormouse.
101. At the top of Wootton is Gravel Pit Lane. Squirrels are occasionally seen along here. A house standing in 4 acres at one end of the lane has had squirrels visiting regularly for the 29 years that the occupant has been there. She commented on how well they looked this summer.
102. The houses bordering Wootton Common and Quarrels Copse often have squirrels in the gardens. Used hazelnuts were easily found at both locations. I also saw a pair of squirrels leave a garden and enter Quarrels Copse.
103. Fattingspark Copse is a good broadleaf habitat for both squirrels and dormice. Looking from Fattingspark Copse towards Blacklands, there appears to be plenty of trees to travel by. As there are no footpaths, I have been unable to confirm this.

CHAPTER 15 STAPLERS, LONG LANE & LYNN

104. Staplers Copse is a broadleaf copse containing oak, field maple, hawthorn and plenty of hazel. A significant number of unused nuts were found in July, which is unusual. Old and new discarded shells found were predominately the split halves left by squirrels.
105. Squirrels do cross Staplers Road, because one slowly crossed in front of me, totally oblivious to the traffic.
106. Long Lane Plantation contains coppiced hazel and various firs. Many cones which had been stripped by squirrels were found beneath the conifers. Hazelnut remains left by squirrels and dormice were found in abundance.
107. Vipers Bog Copse to the east of Long Lane Plantation is relatively isolated, except for the two lines of oaks leading from the plantation and hedges leading to the remains of Lynnbottom Copse.
108. Some ground travel and a road crossing would be necessary to reach Twenty Acre Plantation, which is to the east of Vipers Bog Copse.
109. Vipers Bog Copse itself is largely undisturbed and somewhat neglected. Nevertheless, a good supply of hazel has ensured food for the squirrels and dormice here.
110. The remains of Lynnbottom Copse contains hazel and evidence of squirrels was found on the outskirts of the copse.
111. The two lines of oaks, Vipers Bog Copse, the hedges and Lynnbottom Copse, together form a corridor which links the Long Lane/Staplers Copse/Blacklands area to the Twenty Acre Plantation/Combley area.

CHAPTER 16 COMBLEY, BRIDDLESFORD & FIRESTONE

112. Combley Great Wood, Hoglease Copse, Ramscroft, Chillingwood and Rowlands are generally accepted as good, relatively undisturbed habitat. Together (they interlink) they constitute a large enough acreage to sustain their own population. However, I have not had the opportunity to look at this area yet, except to pick up hazelnuts at either end of Combley Great Wood. Squirrel and dormice evidence was found in both locations.
113. Reported sightings are few from these areas, but public footpaths are limited, reducing the likelihood of sightings.
114. Two squirrels have been seen to narrowly escape death crossing the Main Road, Havenstreet, from Combley to Moor Wood this year.
115. Moor Wood, Dunnage Copse, Vicarage Copse and Briddlesford Copse have been purchased by The People's Trust for Endangered Species. These areas comprise another large acreage of good broadleaf habitat, with no public access.
116. Firestone Copse is Briddlesford's neighbour, but whether a squirrel would cross the intervening marshland has not been established. Sightings in Firestone are numerous – it's a very popular walk. The trees are mixed deciduous and conifers.
117. Some ground travel would be necessary to reach Puckers Copse, which is the link between Firestone and Quarr. All the used hazel shells picked up here had been opened by squirrels.
118. The main Ryde/Newport road would need to be crossed to reach Quarr. A dead squirrel found in the road confirms they do try to cross at this point.

CHAPTER 17 QUARR, BINSTEAD & RYDE

119. Upon reaching Quarr a squirrel can turn towards Fishbourne or Binstead. A resident in Ashlake Copse Road, Fishbourne, said a squirrel was seen regularly in the copse here until building work disturbed it. Since the work has stopped, the squirrel has reappeared. A sample of hazelnut remains showed this to be true. Ashlake Copse is also favoured by dormice. Trees are mixed deciduous including hazel and sweet chestnut.
120. Turning towards Binstead from Quarr, is Quarr Wood. This wood, plus 2 private copses, extends to 17 acres. An average of 5 squirrels have been visiting a garden (with 4 acres of copse attached) for 24 years. Contrary to other places, the occupants did not notice a decline in numbers here after the hurricane. Squirrels are seen the whole length of Quarr Lane, in a small copse called 'The Keys' and in Church Road, Binstead.
121. The Church Road squirrels come from the opposite direction, ie the shore. A continuous line of trees (mixed) follows the coastline as far as Pelhamfield. Squirrels are seen regularly the whole length of this line of trees, even on Players Beach, which is part way between Church Road and Ryde House.
122. The 24 acres belonging to Ryde House has a wide range of trees including hazel and several ornamental varieties. According to information gathered from local residents, there are three squirrels here daily now, where there was only one a year ago.
123. St John's Park in Ryde is, at present, home for a squirrel. This small woodland is totally neglected. Trees include sycamore, oak, chestnut, holm oak, hawthorn and conifers. Old and new stripped cones were picked up recently. This squirrel's diet is supplemented with nuts from neighbouring gardens.
124. Three squirrels were seen in May this year so possibly one bred here. A neighbouring resident had previously said a squirrel had bred in her garden several years ago, adding weight to this theory.
125. Across Westhill Road from St John's Park is Appley. Since a heavy loss of conifers in the 1987 storms, squirrel numbers have understandably declined here. Appley may now be little more than a corridor, through Puckpool and into the Woodlands Vale/

Seaview/Nettlestone area. There have been no recent sightings reported from Appley.

CHAPTER 18 SEAVIEW & NETTLESTONE

126. Woodlands Vale, at the top of Calthorpe Road, has squirrels visiting the grounds daily, with a youngster appearing in the spring. Woodlands Vale is parkland rather than woodland.
127. Calthorpe Road, according to local residents, is a death trap for squirrels. This is a particularly wide road with fast moving traffic and squirrel evidence was found on both sides of this road (used nuts were found in a small copse opposite Woodlands Vale).
128. On the eastern border of Woodlands Vale is Oakhill Road. Several people feed squirrels down here. These are not the Woodland Vale squirrels as their route is from the opposite direction.
129. At one residence in Oakhill Road, the squirrels come into the porch to feed and have been doing so for over 20 years. The resident has not noticed any fluctuation in numbers over this period of time.
130. At the top of Oakhill Road is Westbrook, which has grounds totalling 20 acres. This is made up of parkland containing conifers and deciduous woodland. Hazel is scarce in the woods.
131. The five squirrels which regularly visited the grounds before the hurricane were not seen again after that night. Two have appeared in the last two years, but with no consistency. These are probably the same pair which feed in a garden at Pondwell Hill. The property borders Westbrook and the squirrels always take the Westbrook route.
132. Priory Wood – some 30 acres – is the largest single wooded area in Nettlestone. Trees are mixed and include hazel. Several half shells left by a squirrel were found with difficulty and a drey was also located.
133. The rest of Nettlestone is composed of small fragmented coppices and parkland. A population has been thriving here for a long time. More research needs to be done in Nettlestone.
134. Squirrels are occasionally seen in Bullen Road, which runs between Nettlestone and Ryde. Three sides of Cothey Bottom Copse (which

adjoins Bullen Road on the fourth side) is surrounded by open fields. As the people who have seen squirrels here say they are crossing the road, their route must be in the direction of Calthorpes. Cothey Bottom Copse is private but hazelnut shells were easily found along the roadside. The kernels had all been eaten by squirrels and dormice.

CHAPTER 19 WHITEFIELD

135. The main body of Whitefield Wood is sandwiched between the busy Ryde/Brading road and the railway line. From the little of Whitefield that can be seen from the road (there is no public access) it appears to be a mixture of conifers and broadleaf. Squirrels have been sighted on the outskirts – including crossing the electrified railway line and the main road to Beaper. There are a number of dispersal routes from Whitefield.
136. Hazelnuts which have been opened by squirrels were found at Beaper on the footpath. There are other small copses marked on the map but these are on private land.
137. The northern route from Whitefield leads to Pennyfeathers. Split hazelnuts all along here proved its use. Turning left and crossing Smallbrook Lane, there are hedges which lead to a small copse. This copse (no name on the OS map) is no more than a few acres of broadleaf trees but the hazelnut crop in the autumn of 1991 was excellent. The ground was strewn with empty shells left by squirrels and dormice.
138. On the opposite side of the road, the corridor continues to the west through Carters. There is hazel here, but at the time of my visit (November 1991), a few used nuts were found, but many were left whole. At the top of this road is a break in the corridor for several hundred yards before a small copse at Stroud is reached.
139. Again, squirrels and dormice had been at work. From here, to keep in the trees, Stroud Wood Road would need to be crossed. An arboreal crossing could be made but I am told by the owner of the copse that the three squirrels that were here several years ago were all killed crossing the road and none have been seen since.

140. The southern exit from Whitefield is through Peakyclose Copse. Evidence of squirrels was easy to find in this broadleaf copse. From here there is a problem. The hedges have been removed, leaving the route to Nunwell a dangerous proposition.

CHAPTER 20 BRADING

141. There are still squirrels living in the small woods at Nunwell, but dispersal from here is difficult. To the north and west are open fields and downlands. To the east is Brading with its busy main road and railway line. On the south side is the main Brading Downs road. Even if a squirrel crosses this road safely, there is very little food to be found on the other side for some distance. There have been no reported sightings or dead bodies to suggest that a squirrel has travelled in this direction.
142. The next copse to the west of Nunwell is Eaglehead Copse. Reaching here from Nunwell would mean crossing approximately a mile of arable land with little shelter from predators.
143. Among the deciduous trees in Eaglehead Copse is hazel. Empty shells left by squirrels and dormice were easily found.
144. Crossing the main road again on the south side of Eaglehead Copse and turning right for several hundred yards, we come to Knighton.
145. Knighton East Woods is 32 acres of privately owned woodland which was clear felled during the war. It has since been replanted with larch, sycamore, chestnut and beech. There is also some hazel, which the squirrels have made use of.

CHAPTER 21 ALVERSTONE & BORTHWOOD

146. Continuing in a southerly direction from Knighton, Alverstone can be reached via a reasonable corridor with only a few short breaks. The next small copse is Youngwoods. Both squirrels and dormice left hazelnut shells here.
147. A short distance to the east of Youngwoods Copse is a small unnamed copse with a footpath running through it. Oak, field maple, willow and hazel grow in this copse. Squirrels and dormice had left their evidence.
148. This small copse is the start of a circuitous line of trees which incorporates Sandown Golf Course (one sighting) and borders Fairway School, Safeways supermarket and Sandown Airport. Hazels and conifers were non-existent in this band of trees and no evidence of squirrels or dormice was found.



149. To the south west of the unnamed copse (paragraph 147 & 148) and approximately three quarters of a mile away is Borthwood Copse. The number of squirrels in Borthwood Copse has dwindled drastically since the hurricane. A resident on the northern edge of the copse has not seen a squirrel since the storms. There was some storm damage in Borthwood and trees have also been felled, so some loss of habitat has occurred.
150. A hazelnut count on the south and north sides of the copse in the autumn of 1991, proved that a squirrel had fed there. A subsequent count in May revealed a ratio of three nuts unused to one used – and these were not recently opened.
151. Ploughed fields surround Borthwood to the south and east. On the west side is a large housing estate. If a corridor were to be made, the paths and hedgerows to the north would be the most viable proposition.
152. Lack of corridors is the most likely explanation for the decline of the squirrel population in Borthwood Copse. However, at the beginning of August, a squirrel was seen crossing the main road at Apse Heath and heading in the direction of Borthwood.
153. When I visited the copse again at the end of October, new split hazelnuts were found and also a drey. Assuming it was the Apse Heath squirrel, which survived crossing the open field, then it was probably a youngster dispersing from America Wood.

CHAPTER 22 AMERICA WOOD & APSECASTLE WOOD

154. A good corridor through Ninham leads to America Wood, which continues into Apsecastle Wood and meets the main Shanklin road on the south side. This area of deciduous woodland has busy main roads to the south and north, open grassland to the west and the towns of Lake and Shanklin to the east.
155. Residents at Scotchells, which is on the northern edge of the area, have been feeding squirrels in the garden for the last two years. Two young squirrels appeared as well in May, so presumably the original pair bred. A dormouse also feeds in the garden.

156. At the bottom of the garden is a corridor consisting of a long narrow strip of withy bed, bordered on either side by hazel, ash, sycamore and hawthorn. This links Ninham, America Wood, Apsecastle Wood and through the Holiday Camp to Landguard. Squirrels have been seen in all of these areas. Evidence of dormice was also found.
157. Opposite the entrance to Apsecastle Woods is an acre of mixed trees. Neighbours see the squirrels here regularly as they use this route to reach the garden to feed. They also see a dormouse feeding on the bird table at night.
158. Crossing the disused railway track which adjoins the above area, is a footpath which leads to Shanklin Downs. Uncut hawthorn hedges along the path could be used to reach the trees at the base of the Downs. Squirrels do use these trees as the remains of hazelnut shells testified. Also a squirrel was seen in June running for approximately 50 yards through pasture and then climbing the steps in the cliff face to Shanklin Down.
159. The disused railway track is an alternative route from Apsecastle. Hazel shells left by squirrels and dormice were found. I have not yet explored paths leading from either side of the track, but there is a good possibility that a route to Shanklin will be found.

CHAPTER 23 SHANKLIN

160. I have had more sightings reported from Shanklin than anywhere else. Not because there are more squirrels here, but because there are more people to see them. They are regularly seen at Westhill, Hungerberry Close (the remnants of Hungerberry Copse adjoin properties here), Rylstone Gardens and Church Road. Occasional sightings have been reported from Sibden Hill, Tower Gardens, The Mead, Rectory Road and Skew Bridge.
161. Most sightings are from Rylstone Gardens, probably because they are more easily seen here, rather than a preference for the gardens. Stripped fir cones were found.
162. Bordering Rylstone on the northern side is Shanklin Chine. There have been no reported sightings from here and used hazelnuts were hard to find as paths are swept daily. A young squirrel was found dying after a heavy summer storm. It had apparently been washed

into the Chine by the force of the water. An arboreal crossing of the Chine could be made in several places.

163. Tower Gardens adjoin Shanklin Chine to the north again. This park is swept regularly but used hazelnuts (squirrel) were found. Holm, oak, beech, conifers and maple also grow here.
164. Following the Chine in a southerly direction, it passes through a garden. Squirrels have been visiting fairly regularly here. Unfortunately a number of youngsters have been killed crossing the busy Church Road, where this residence is situated.
165. The strangest sightings from Shanklin came from residents at Skew Bridge. There were only three sightings between the summers of 1991 and 1992, but there are no woods or parkland for one to one and a half miles. To the west is the busy main road and railway line. Adjoining the property in a northerly direction is an open park. Beyond the park is a built up area with no trees. This squirrel probably travelled along the Cliff Walk from Tower Gardens.
166. A closer look at this route revealed a surprising number of firs, sycamore, elder and hawthorn. Where the squirrel drey was, or why it was not seen more often, I could not discover.

CHAPTER 24 FROM SHANKLIN TO BLACKGANG

167. A corridor of trees leads away from Shanklin in a southerly direction towards Luccombe and Greatwood Copse. Greatwood Copse contains a variety of deciduous trees but very few firs. Hazel is plentiful but not coppiced. The majority of shells picked up had been split by a squirrel.
168. From Greatwood Copse, by crossing the road again, Luccombe, the Landslip and Bonchurch can be reached but not without some ground travel.
169. Squirrels are seen fairly regularly at Luccombe. The private land I visited in the summer had three resident squirrels at the time. Trees were mainly beech, ash and sycamore, with a few hazels.
170. A number of gardens in Bonchurch have regular visits from squirrels. These come from the broadleaf habitat of the Landslip, where there have been quite a few sightings.
171. From Bonchurch, a squirrel may possibly be able to reach Ventnor by using the trees on St Boniface Down, but there is no evidence to substantiate this.
172. No sightings have been reported from Ventnor or Wroxall. The only evidence I could find was a few used hazel shells I searched very hard to find. A squirrel and a dormouse had been to this location which was 50 yards from Ventnor Park.
173. Ventnor Park and Ventnor Botanical Gardens have conifers in the grounds, but no cones were found which would provide squirrel evidence. These gardens are also swept regularly. However, I believe squirrels come here as hazelnut evidence was found a short distance away at St Lawrence Well.
174. There is very little hazel in St Lawrence, but locals confirmed that squirrels are seen, although they are not numerous.
175. The coastal line of trees ends at Blackgang, but there has been nothing to suggest that squirrels are any further along the coast than St Lawrence.

CHAPTER 25 BEMBRIDGE

176. Bembridge is isolated. As yet I have found no corridor. The sea is to the south, north and east. To the west is the River Yar, the railway line and the main Brading road.
177. Steyne Copse, although small, is good habitat. There is plenty of coppiced hazel which squirrels and dormice have fed on. It does, however, have a busy main road severing it. There are no more wooded areas to the south of the copse, but a corridor to the north passes the windmill, runs through private grounds and joins another copse (no name on the OS map). Residents in Bembridge say that there used to be squirrels here, but one has not been seen for years. Trees in this copse are mainly oak and willow. No conifers or hazels were found.
178. Centurions Copse is the only other area of woodland in Bembridge. Again there is coppiced hazel here, which provided evidence of squirrel and dormouse presence.
179. In both Steyne Copse and Centurions Copse, the number of used hazel shells left by dormice was higher than those left by squirrels. There were also a high proportion of unused nuts. Sightings were rare and it seems unlikely there are more than a few squirrels left in Bembridge.

CHAPTER 26 FINDINGS IN OUTLYING AREAS

180. Other findings in outlying areas of the South Wight include hazelnuts used by a squirrel and dormouse in a tiny wood called Gotten Copse. These were found in the spring so they were the 1991 crop. In a sample of 1992 nuts picked up in the autumn, only dormouse evidence was found. This copse is isolated and miles from any sizeable habitat.
181. In May 1992, hazelnut remains left by a squirrel and dormouse were found at Wydcombe. Another sample of shells picked up in October revealed that dormice had eaten the 1992 crop.
182. Two old split shells were found at Bierley, so perhaps the stray squirrel's next brief stop. All of these small wooded areas are miles from any known habitat and this animal must have travelled a long distance trying to find new territory.
183. Godshill does not have a large acreage of woodland, but squirrel and dormice evidence was found in a beech copse. It would be interesting to explore this area further.



CONCLUSION

This is proving to be a successful and interesting project. I was able to establish that red squirrels were present in the vast majority of woods and wooded areas that I visited. Nut evidence, personal observation and reports from the public were very helpful here. However, there are some woods where squirrels had been regularly observed, but little or no evidence was found. This type of information needs to be followed up subsequently.

Nut evidence, personal observations and reports also helped to pinpoint important squirrel corridors. Some of these routes did not live up to expectations, being gappy and often having significant areas of open ground which had to be crossed. Road crossings were also identified. This is another area where further study would pay dividends.

Areas where more tree cover would improve the quality of the corridors were passed onto Frank Heap of the BTCV, to be considered as part of his tree planting programme.

Dormouse evidence obtained indicated that this animal is still widespread, although it was not found in woods as often as the red squirrel. The study also indicated that dormice show a preference for wood edges and thick hedgerows containing hazel. Dormice were found to be absent in some isolated woods but present in others. Continuous arboreal corridors are no doubt significant and the impact of their disappearance also warrants further investigation.

These conclusions are, however, tentative, as the one year study was not at all sufficient to investigate all the woods (and reports and sightings) and did not give an opportunity to follow up interesting developments. To complete the coverage of the Island, looking at all the woods, corridors and route-ways would, I estimate, take a further 4 years of study; after which time it should be possible to produce a definitive statement about the status of the red squirrel and dormouse on the Island and the importance to both species of maintaining and developing connecting corridors.

APPENDIX 1 RESULTS OF HAZELNUT SURVEY

Location	Grid ref	Opened nuts
Alverstone	SZ5785	5
Beaper Copse	SZ6089	16
Stroud Wood Ryde	SZ5790	10
Ashey Road	SZ5990	29
Carters Road	SZ5890	20
Smallbrook	SZ5990	23
Knighton	SZ5787	23
Brocks Copse	SZ5292	19
Steyne Copse	SZ6387	13
The Keys, Binstead	SZ5792	17
Borthwood	SZ5784	8
Borthwood	SZ5684	12
Chillingwood	SZ5689	7
Combley Greatwood	SZ5489	17
Combley Greatwood	SZ5488	15
Cothey Bottom Copse	SZ6090	14
Eaglehead Copse	SZ5887	15
Hardingshute	SZ5988	13
Nunwell	SZ5987	17
Quarr Woods	SZ5692	13
Rowlands	SZ5689	16
Youngwoods Copse	SZ5785	8
Woodside	SZ5493	14
Centurions Copse	SZ6286	8
Foot of Culver Down	SZ6286	0
Ashey Road	SZ5990	29
Carters Road	SZ5890	20
Smallbrook	SZ5990	23
Knighton	SZ5787	23
Brocks Copse	SZ5292	19
Gurnard Pines	SZ4794	17
Chalkclose Copse	SZ4692	19
Shepherds trail, Whitcombe	SZ4886	0

Gravel Pit Lane, Wootton	SZ5391	11
Chalkclose Copse	SZ4792	37
Dunnage Copse, Briddlesford	SZ5489	13
Vicarage Copse, Briddlesford	SZ5490	12
Briddlesford Copse	SZ5490	44
Havenstreet Station	SZ5589	30
Wootton Copse	SZ5589	19
Knighton East Wood	SZ5787	5
Luccombe	SZ5879	3
Pondclose Copse, Shalfleet	SZ4088	2
Shishford Copse, Shalfleet	SZ4188	11
Disused railway, Wootton	SZ5391	22
Mill Copse	SZ3588	48
Freshwater	SZ3487	5
Chessell Copse	SZ4086	2
Crainges Copse	SZ4287	6
Bouldnor	SZ3890	13
Wydcombe	SZ5078	1
Wydcombe	SZ5078	10
Kingates	SZ5177	2

Total of used hazelnuts found for each species

Squirrel	Dormouse	Wood mouse	Bank vole
5	0	6	11
16	1	3	0
10	8	2	0
29	14	0	3
20	2	2	0
23	0	3	5
23	3	5	0
19	0	0	3
13	2	2	0
17	2	1	0
8	0	15	0
12	3	4	3
7	0	13	0
17	2	6	4
15	5	12	0
14	12	0	0
15	13	3	0
13	3	7	0
17	5	0	0
13	3	4	0
16	0	4	0
8	2	12	0
14	2	8	9
8	8	4	0
0	7	9	30
10	8	2	0
29	14	0	3
20	2	2	0
23	0	3	5
23	3	5	0
19	0	0	3
17	0	3	0
19	0	1	0
0	0	0	19
11	17	0	2
37	0	0	0
13	0	0	0
12	3	0	0
44	0	0	0
30	0	0	0

Squirrel	Dormouse	Wood mouse	Bank vole
19	0	1	0
5	0	0	0
3	0	0	0
2	0	0	0
11	2	0	0
22	2	0	0
48	2	9	0
5	0	6	0
2	3	6	0
6	0	2	1
13	0	4	1
1	0	0	0
10	0	6	0
2	1	11	2
Total 808	Total 154	Total 186	Total 104

APPENDIX 2

ROAD SIGNS TO MARK SQUIRREL CROSSING POINTS

Whilst the study was being conducted it became evident that squirrels used regular crossing points where roads interrupted their corridors. These places are death traps for this endangered mammal and authorities might like to consider the installation of warning signs at the most important crossing places – much in the same way that toad crossings are shown. Crossing places where signs would be appropriated are listed below:

1. Either end of Calthorpe Road, Ryde
2. The crossing from Guyers Heath to Three Gates Copse along Yarmouth Road SZ 441 894 and SZ 438 894
3. The junction entering Newtown beside Windgate Copse SZ 435 903 and where Town Copse meets the road at SZ 428 905
4. At Swainston, Calbourne Road SZ 455 876 and SZ 443 875
5. Outside the WDF Plant SZ 468 896 and beside the cemetery, Forest Road SZ 489 900
6. Church Road, Shanklin at SZ 583 808 and SZ 578 805

APPENDIX 3 SQUIRREL CASUALTIES 1992

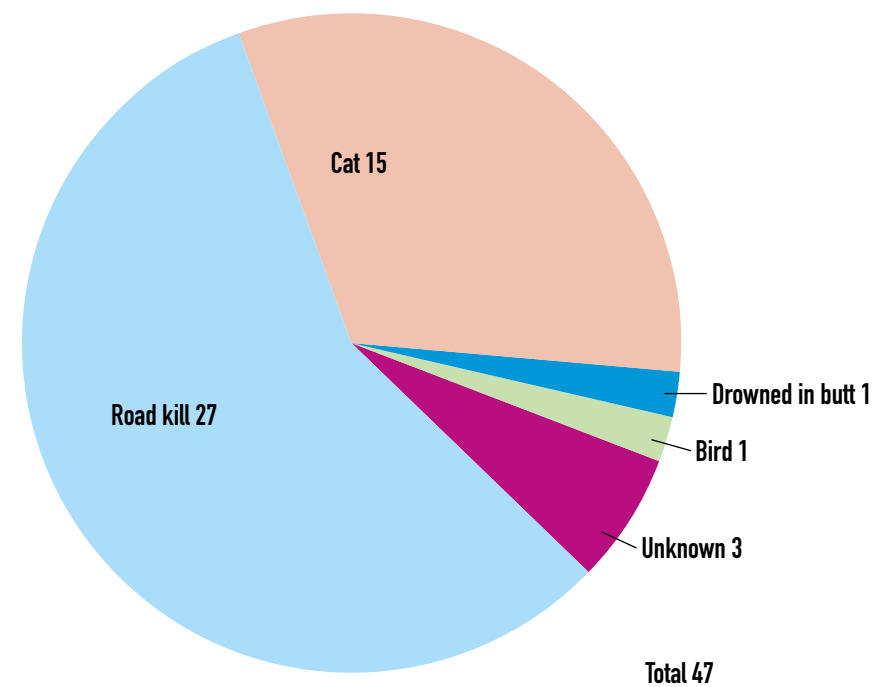
The highest proportion of deaths occurred between May and October. These were probably juveniles seeking their own territory.

There were 39 reported squirrel deaths this year.

The worst black spots on the roads are listed in Appendix 2. Several other places have also been identified.

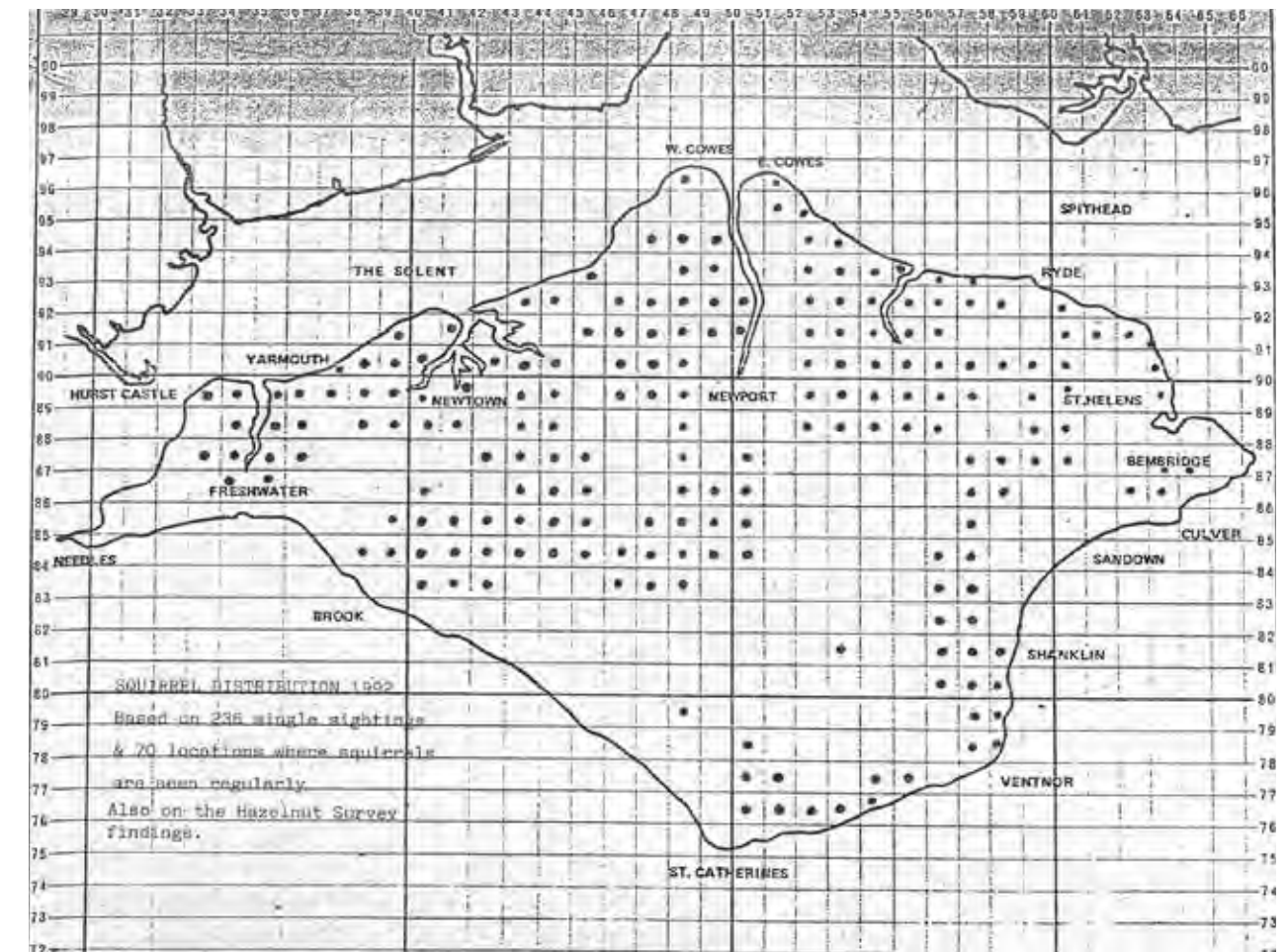
The worst places for cats killing squirrels are Woodside at Wootton and Cranmore.

The 'Unknowns' are bodies found away from a road and with no evidence of a predator nearby.



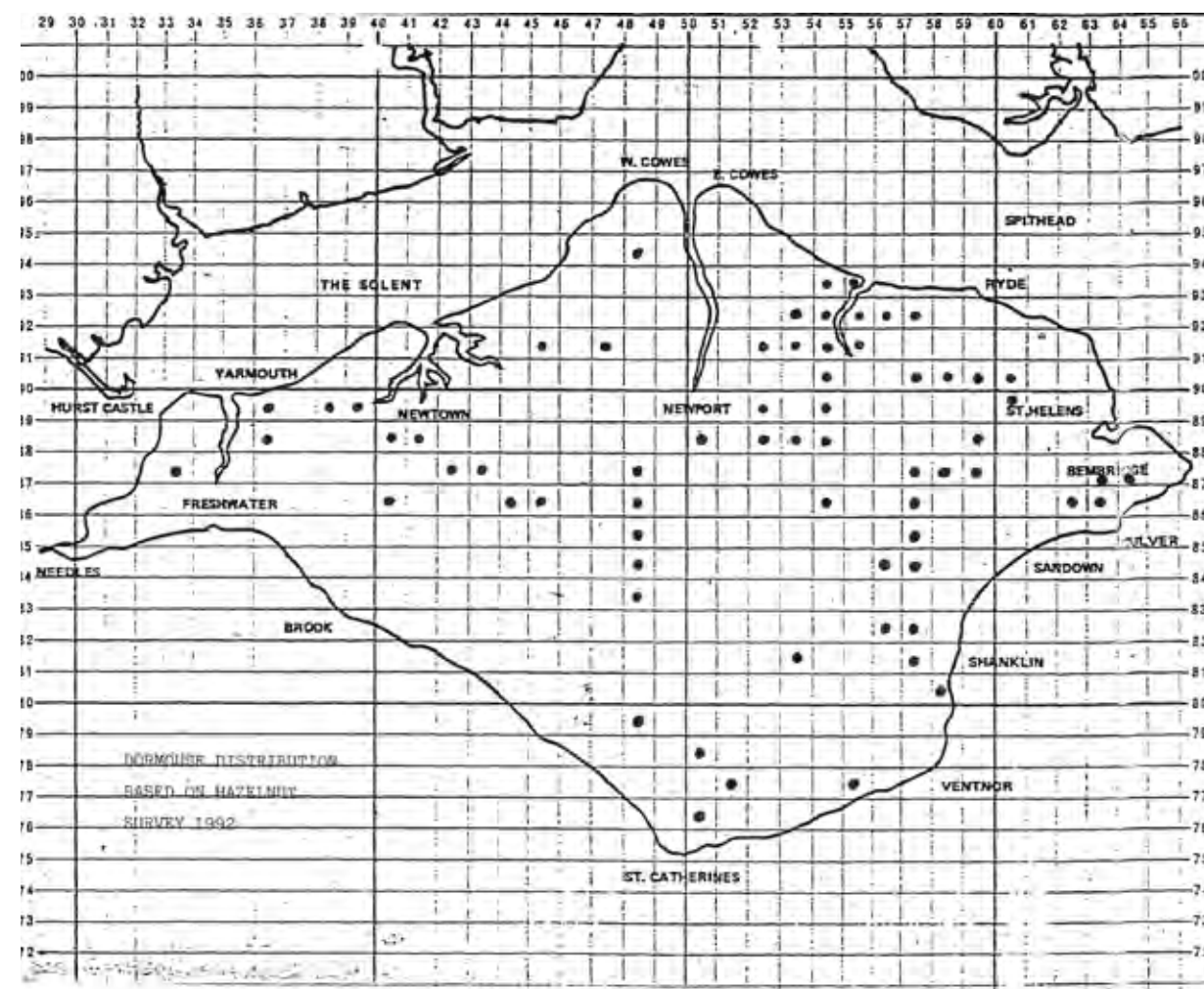
Pie chart showing red squirrel deaths on the Isle of Wight 1992

APPENDIX 4 MAP SHOWING SQUIRREL DISTRIBUTION



Map showing red squirrel distribution on the Isle of Wight 1992

APPENDIX 5 MAP SHOWING DORMOUSE DISTRIBUTION



Map showing dormouse distribution on the Isle of Wight 1992

APPENDIX 6 HOW TO IDENTIFY WHICH MAMMAL HAS OPENED HAZELNUT SHELLS



Red squirrel



Dormouse



Wood mouse



Bank vole



Chapter 5 CORRIDORS 30 YEARS ON FROM CORRIDORS OF HOPE 1991/2



CONTENTS

Introduction	151
Methodology	151
West Wight	152
Bouldnor, Cranmore and Hamstead	154
Shalfleet	155
Shalcombe, Brook, Grammars Common, Westover, Brighstone Forest, Rowborough Down and Westridge Down	156
Newtown to Calbourne Road via Guyers Heath	158
Newtown, Porchfield and Thorness	159
Gurnard and Cowes	160
Parkhurst Forest	161
Newport and Carisbrooke	163
Gatcombe, Rowridge, Chillerton, Rookley and Billingham	164
Shide and Blackwater	166
East Cowes and Whippingham	167
Wootton	168
Staplers, Long Lane and Lynn Firs	170
Quarr and Fishbourne	171
Combley, Briddlesford, Firestone Copse and Havenstreet	172
Binstead and Haylands	174
Ryde	176
Seaview and Nettlestone	178
St Helens	179
Whitefield	180
Brading and Ashe	181
Alverstone, Borthwood Copse and Newchurch	183
America Wood and Apsecastle Wood	184
Shanklin	185
Sandown and Lake	186
Bembridge	187
Whitwell, Niton and St Lawrence	189
Chale and Atherfield	187
Shorwell and Yafford	193
Wroxall and Ventnor	194
Cridmore	196
Godshill and Roud	198
Arreton and Merstone	200
Conclusions	202
Areas that would benefit from planting	206
Acknowledgements and References	207

CHAPTER 5.

CORRIDORS 30 YEARS ON

FROM CORRIDORS OF HOPE

1991/2

INTRODUCTION

A study to look at corridor links and the way red squirrels used them was started in 2017. Use of habitat other than woodland was also part of the project. Originally the plan was to divide the Isle of Wight into 28 zones, each with a core habitat and satellite areas. This entailed walking the Island extensively and it was envisaged it would take about three to five years to complete but the project was not finished when Covid-19 hit. However, the lockdowns provided a long-awaited opportunity to write up 30 years of data, so the intensive habitat study is on hold for the time being. There is enough information already gathered to put together an informative overview that enables a comparison to be made with the study carried out in 1991 and 1992. This chapter uses the template as outlined in chapter 4 but includes more areas and types of habitat.

In recent years, squirrels have used cemeteries and parks plus large gardens as a refuge. Although the 1991/92 study only looked at woodland and corridors between them, this latest study does not exclude any type of habitat. Northwood Cemetery has a bi-annual woodland monitor for example.

These are no longer 'outlying areas' as defined in the 1992 report as each area merits its own chapter 30 years on. The Forestry Commission sought to ameliorate the effects of woodland fragmentation by encouraging landowners to take advantage of a grant to plant corridor links and extend existing ancient woodland. This project was very successful and squirrels were recorded in 95% of the large woodland blocks surveyed in the autumn of 2016 as reported in chapter 3. The JIGSAW (Joining and Increasing Grant Scheme for Ancient Woodland) planting scheme plus private landowner initiatives have enabled the squirrels to disperse further, so there are populations in areas previously devoid of squirrels.

Methodology

Similar methodology was used as in the 'Corridors of Hope' survey and the all-island surveys, which is looking for signs of squirrels in hedgerows, small woods, parks and cemeteries. Sightings

from the bi-annual monitoring and general public are taken into account as well. Walking routes between woodland and looking for signs can confirm presence by finding food leavings, spotting a drey or seeing a squirrel. If no signs are found, the corridor is noted. Squirrels do not see roads as barriers but are killed on them, meaning that dispersal is unsuccessful. However, road kills are an indication that squirrels use a particular route and some animals do make it safely across a busy road.

To make the project relevant to red squirrels, it was looked at it from a squirrel's perspective. Animals do not recognise kilometre grid squares or if a woodland block has more than one name or owner. Therefore, when tracing routes the squirrels may take, plus understanding how they have extended their range, the author looked at the habitat as a squirrel would, that is, by looking at the trees and where they lead to.

Results are given as a written description plus a map. It is impractical to indicate every hedgerow used for dispersal, so please refer to the text when viewing the maps. Google Earth and an Ordnance Survey map are also useful tools. However, when carrying out this study, it was evident that neither told the whole story and walking the routes is far more informative.

SURVEY RESULTS

West Wight

Yarmouth, Freshwater and Totland Bay have seen a steady return of their red squirrel population since before the storms of 1987 and the first survey of 1991 and 1992. Development has increased over the years, fragmenting the habitat further but also providing a supplementary food supply in gardens. Garden trees provide a means of travel, albeit not the ideal corridor of mature native tree species.

Corridors have improved, with damaged trees replaced and hedgerows planted. The woodland, which is predominantly sycamore, at Alum Bay does not support a population of red squirrels but in the woodland at Headon Warren, evidence of squirrel presence is found in the form of split hazel shells. This is the farthest west that squirrel evidence has so far been found on the Isle of Wight.

Woodland below Tennyson Down is broadleaf but sightings here are scant. Moons Hill residents do have regular visits from squirrels, so presumably they come from this tract of woodland and, with difficulty, split hazel shells are found. The nearby areas of Middleton and Weston look unlikely red squirrel habitat but gardens are well stocked with mature trees and residents feed squirrels. Good hedgerows and hangers are also found here. During a survey walk around footpaths in the area, freshly nibbled fir cones and split hazelnuts confirmed presence. People also report squirrels visiting their gardens.



Coastal hedgerows and hangers link Totland to Colwell, Fort Victoria and Golden Hill Fort. Tree-lined paths provide a route around Yarmouth and Freshwater. Sightings are common along the disused railway track between Yarmouth and Freshwater. The small woodland areas between the railway track and Thorley to the east are frequented by squirrels. Dispersal between woodland is achieved via trees bordering the track over the majority of its length.

The core habitat for the area remains Wilmingham Plantation and Tapnell Firs. Wilmingham Lane has seen a high numbers of road kills since 2000, evidence of increasing numbers. None were recorded previously. There is supplementary feeding in gardens and also food put out for game birds in the woods.

Squirrels do visit gardens in the village of Freshwater, although not consistently. Crossing the River Yar at the Freshwater end is via the Causeway bridge, or across Afton Road, another road kill black spot. From Freshwater Bay towards Brook there are few trees and no sightings or signs are recorded. Between Freshwater and Brook would benefit from new planting. Genetic studies show West Wight needs a better connection for red squirrels to disperse to the rest of the Island.

Saltern Wood in Yarmouth does not have a good corridor link. Squirrels are often killed on Halletts Shute as they disperse towards Fort Victoria. By strengthening the hedge line from Saltern Wood towards the Causeway in Freshwater, squirrels would have a safer route to travel by.

Woodland at Headon Warren



From Tennyson Down, Bouldnor is in the distance to the left



Brook is in the distance to the right. If landowners are willing to plant corridors between Freshwater and Brook, it would benefit dispersing wildlife



Map data © OpenStreetMap contributors, CC-BY-SA

Bouldnor, Cranmore and Hamstead

Bouldnor Forest, Cranmore and the Hamstead Estate are an area of core habitat and have good dispersal routes. To the west of Bouldnor Forest, towards Yarmouth, corridors mentioned in the previous Corridors of Hope chapter are extant. To the east the forest is contiguous with woodland and heathland, with houses and gardens interspersed. The case study on Bouldnor Forest in Part 1 gives details of road kills and the impact of forest management.

Road kills are an indicator of squirrel numbers and Yarmouth Road is a black spot, particularly during dispersal times. Squirrel numbers are maintained through supplementary feeding and, for the most part, squirrels do well. Road kills on the main Yarmouth Road, from Cranmore Avenue through to Ningwood, indicate that some squirrels are dispersing south. As with Bouldnor, squirrels can reach Wellow and Thorley, and move on from here using woodland, hangers and tree lines.

By crossing the main road and heading south to Lee Copse, it's possible to reach Thorley via hedgerow corridors and hangers. Squirrel numbers have increased in Wellow and Thorley over the years. JIGSAW planting around Mount Copse has improved habitat and corridors and facilitates movement in and out of the area.

At each woodland survey, squirrel sightings and signs were recorded throughout the Hamstead Estate. The last visit in the autumn of 2020 again confirmed squirrel presence.

Heading east, the Newtown River is reached. As squirrels are excellent swimmers, the river would not necessarily present a barrier but by following hedgerows it is possible to reach Shalfleet.



Bouldnor, Cranmore and Hamstead map

Shalfleet

The small resident population noted in 1991 has remained stable within the range of natural fluctuations. Road kills occur through the village and road signs are erected here. Heading north from Shalfleet, there is an enhanced corridor to Corf Wood and on to Newtown. Corf Wood is the core habitat for Shalfleet. Local resident Val Gwynn bought the land around Corf and planted trees to increase and improve habitat in the area.

Small woods, such as Pondclose Copse, lead out of Shalfleet to the south-west, split hazel shells are consistently found. To the south, crossing the main road, squirrels can reach Newbridge via a tree-lined riparian corridor described in the previous chapter. Red squirrels are now resident

in gardens in and around Newbridge. Split hazelnuts were found along this route in every survey.

From Newbridge, squirrels can also reach Elm Lane in Calbourne via a hanger which borders Quarry Lane. Squirrels are living in this small hanger and visit a nearby garden. From here, Five Houses and the numerous woods in Calbourne are reached by following hedges and hangers plus gardens. Squirrels also frequent the woods in Pound Lane, which leads back to Shalfleet near Guyers Heath. Although the woods look fragmented on the map, the corridors are adequate enough to allow squirrels to move around the area.



Shishford Copse corridor to Newbridge



Looking across the estuary from Hamstead Quay to Newtown



Tree planting at Corf

Shalcombe, Brook, Grammars Common, Westover, Brighstone Forest, Rowborough Down and Westridge Down

Woodland blocks are large enough to sustain a good population of red squirrels and together form a mosaic of mixed habitat for squirrels and other species. There are open spaces for dispersing squirrels to cross to move between woodland habitat in this area; for example between Limerstone and Shorwell. New planting at Coombe Farm has made a huge difference to available habitat, plus corridor links to Limerstone and Brighstone Forest are enhanced.

It is possible to get from Brighstone Forest to Bowcombe Road and beyond, although it does entail crossing busy roads. There are road casualties on Bowcombe Road proving squirrels do try to cross. Road casualties in Lynch Lane confirm squirrel presence in Brighstone Forest and food leavings may be found in the forest. Actual sightings in this large forest are uncommon. This is not because squirrels are absent but without supplementary feeding, plus given the nature and size of the forest, sightings are less likely.

The previous chapter stated there was no evidence of squirrels in Shalcombe in 1991. Later surveys did confirm presence and an excellent corridor, planted by landowners, now provides a route from Wellow to Shalcombe. Feeding evidence, split hazel shells, confirmed that squirrels use this corridor link.

Brook and Brookhill still has a healthy population of squirrels, helped by residents feeding them. Tree cover heading west from Brook village

ends at Dunsbury. Although the downs between Brook and Mottistone were clear-felled around 30 years ago, there are now strong links, thanks to regrowth.

A good corridor loops from Mottistone Green to the bottom of Strawberry Lane. There is a hedge from Ridget Copse and on to Hulverstone, which then links into Brookhill. Tollbar Plantation in Hulverstone has a small population of squirrels. A dispersal route could be by crossing the road and following the hedge towards Brookhill. This area needs more study.

Rowborough Down and Westridge Down do have a population of squirrels and evidence found during each woodland survey confirms presence. The hazelnut crop is particularly good and, contrary to how it looks on the Ordnance Survey (OS) map, the woods are within dispersal distance via hedges and hangers or very short open distances. The OS map shows a mosaic of seemingly small divided woodland. Walking between the woodland showed short distances and linking hedgerows. This area is good red squirrel territory.

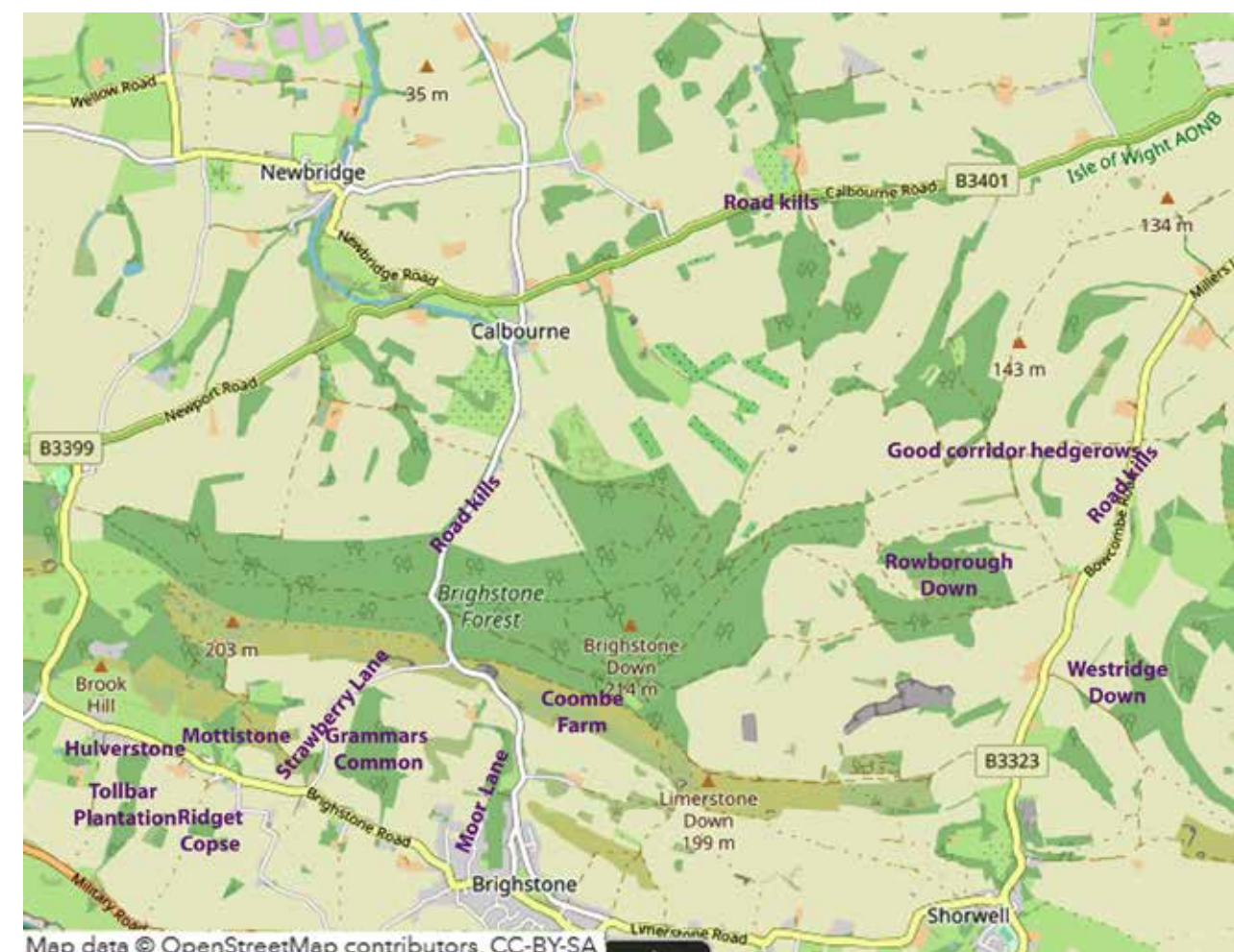
There is a mosaic of hedges and hangers between Grammars Common and the village of Brighstone with paths to Moor Lane, Gaggerhill and Hunnyhill. There is a small copse to the rear of Moor Lane where split shells and sightings confirm squirrel presence.



Looking across new planting at Coombe Farm towards Brighstone Forest



Corridor planting from Wellow to Shalcombe



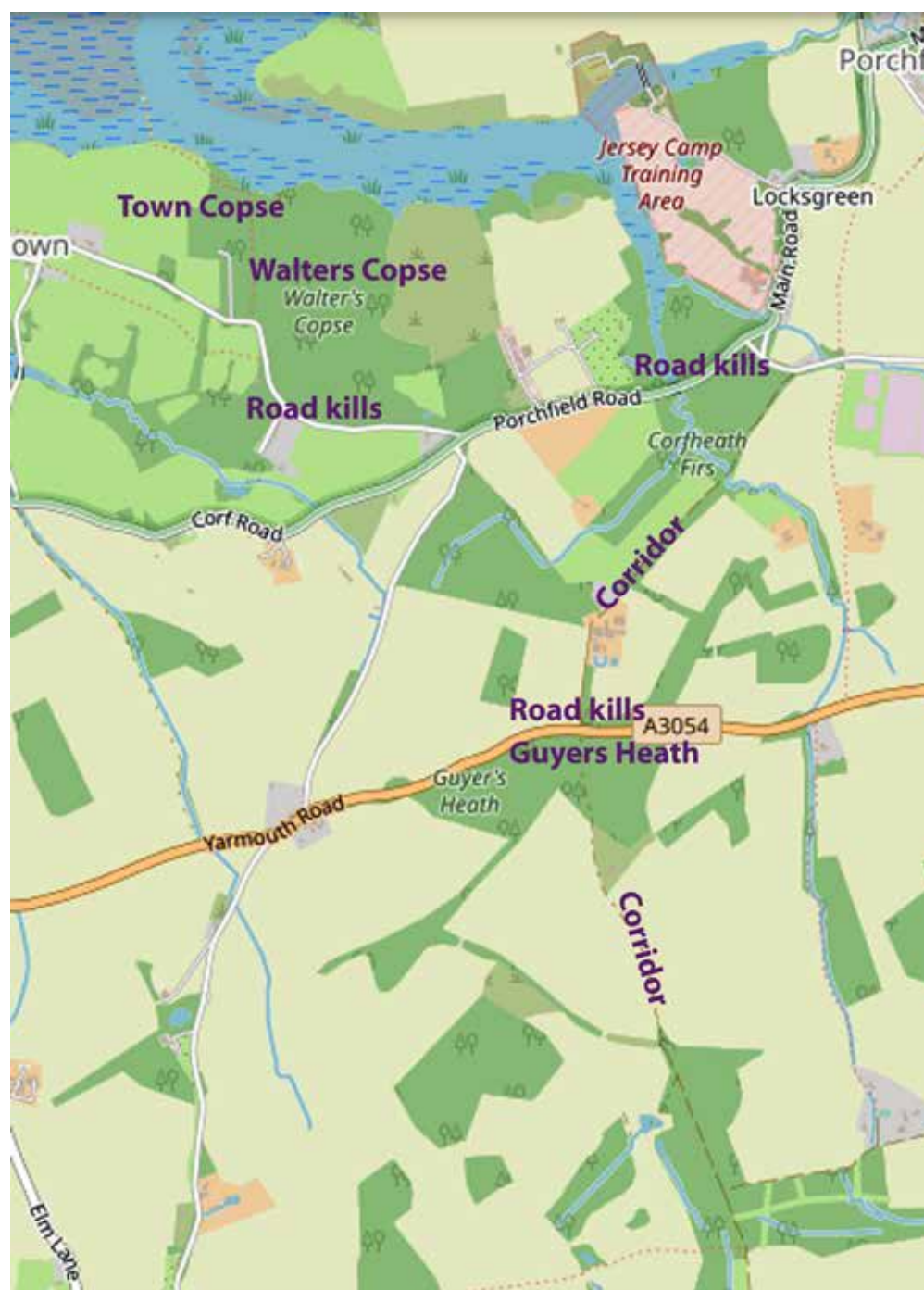
Shalcombe, Brook, Grammars Common, Westover, Brighstone Forest, Rowborough Down and Westridge Down map

Newtown to Calbourne Road via Guyers Heath

It is possible for a squirrel to arboreally travel between Newtown and Porchfield to Calbourne Road, although the main Yarmouth Road is along the route. Trees do meet across the road but road kills still occur as squirrels cross between Corfheath Firs and Guyers Heath.

There are woodland blocks between the main Yarmouth Road and Calbourne Road, although

somewhat fragmented at first sight. However, there are hedgerows and several gardens. From Calbourne Road squirrels can travel on to Bowcombe Road and from there to Gatcombe. Survey results, reported sightings plus road kills confirm that these routes are used by squirrels.



Newtown to Calbourne Road via Guyers Heath map

Newtown, Porchfield and Thorness

Newtown to Porchfield and on to Thorness has wooded corridor links and squirrel presence was found here for each survey. Reports of squirrel sightings, alive and dead, are not uncommon. Corridor links are good overall but do follow a country road with fast-moving traffic, resulting in regular road kills.

The MOD Ranges woodlands are good habitat with a mixture of trees. During each survey, squirrel evidence was found in all woods, including Hummet Copse, which now has a hedgerow leading from Burnt Wood. Coffin Copse is the only woodland with no record of squirrel presence.

From Porchfield and Thorness, a corridor largely follows the coast and meets up with Gurnard. Walking this route showed there is enough tree cover for a viable corridor, using wooded areas inland as well. Some planting to strengthen the route would aid dispersal.

Road kills on Rolls Hill indicate movement between Hillis Corner, to the north of Parkhurst, and Thorness. Thorness Holiday Centre has squirrels visiting caravans for food in the north of the site, where the remnants of deciduous woodland provide hazelnuts. Supplementary food provides a bonus supply of nuts but there are cats on the caravan site, which predate squirrels. The woodland adjoins Burnt Wood to the west.



Newtown, Porchfield and Thorness map

Gurnard and Cowes

Woodland is small and fragmented in Cowes and Gurnard but there are corridor links via gardens, where there is supplementary feeding. Squirrels are in the town of Cowes living in a small copse called Jenny's Wood in Baring Road, the golf course and Northwood Park. However, between Cowes and Gurnard, along the coast, is a larger woodland, Egypt Copse. Gardens in Gurnard also border Egypt Copse, so with a plentiful supply of food in adjacent gardens, squirrels in Egypt Copse are thriving. This is ancient woodland and core habitat for the Cowes area.

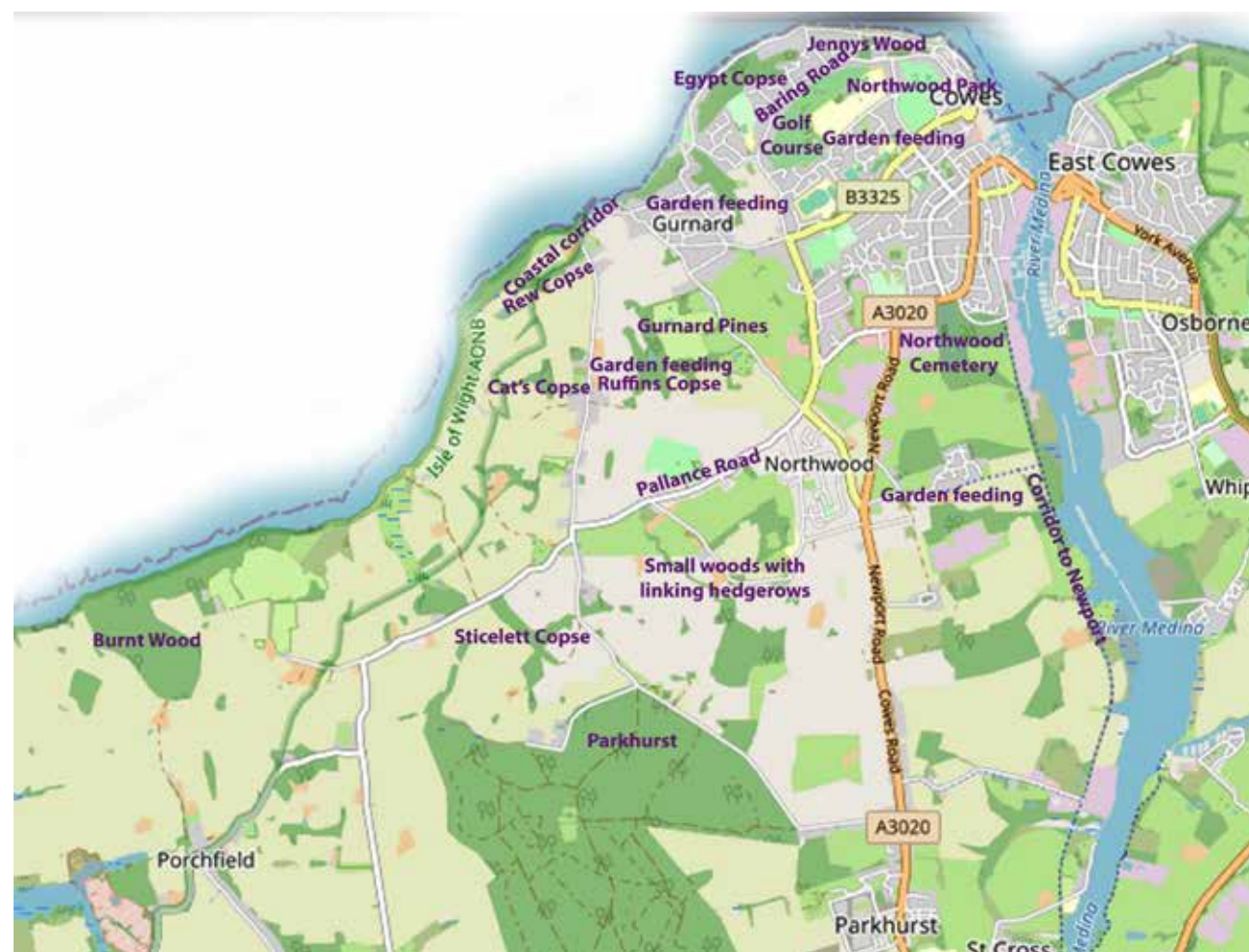
Road deaths in Baring Road are a regular occurrence, in spite of road signs and pinch points put in to slow traffic because of the high number of squirrel deaths. The road runs between Egypt Copse on the north side of the road and the golf course on the south. There is supplementary feeding in gardens either side of the road.

One-off sightings of squirrels passing through gardens in the town show that squirrels use the

trees as dispersal routes. For example, squirrels do travel via gardens to Northwood Cemetery and, once here, the woodlands that stretch from Cowes to Newport are reached. The squirrels have a tree-lined corridor along the cycle route, plus woodland and gardens. Sightings on the cycle track, in gardens and in Northwood Cemetery are common.

Gurnard Pines abuts Ruffins Copse to the south and links to Pallance Road. Hedges and hangers lead through to Parkhurst Forest from here. There are a high number of sightings from this area, including regular road kills in Gurnard Pines and Pallance Road.

Squirrels can reach Thorness from Gurnard along hedges, woodland such as Sticelett Copse, Cats Copse and Rew Copse, which meets the coastal path, plus hangers and hedges on the seaward side. From there, Burnt Wood is reached.



Gurnard and Cowes map

Parkhurst Forest

The previous chapter outlining Parkhurst Forest and surrounding area is still relevant today. Squirrel sightings in gardens have risen but so have road kills, especially on Forest Road. As a working forest, there are clear-felled areas and areas left clear to regenerate as heathland.

Road kills on Noke Common and Pallancegate Road plus squirrel feeding signs and sightings confirm squirrels also use these routes to exit the forest. Chalkclose Copse also leads out of Parkhurst Forest from Mark's Corner and meets Rolls Hill, where there are road kills. Thorness is reached once safely across the road and then there is a coastal route to Gurnard.

Tree cover can take squirrels to Wyatts Lane and Northwood taking a north-eastern route, via Ridge

Copse, Ward's Copse, hedgerows and hangers and on to Thorness to as stated previously.

There is a hedgerow from Parkhurst Forest to Whitehouse Road and on the opposite side of the road is a corridor to Porchfield. At present there is no data available to confirm this route is used. Squirrels that survive crossing Forest Road could travel through gardens to reach Carisbrooke and Newport town centre. Road kills and sightings confirm this occasionally happens.

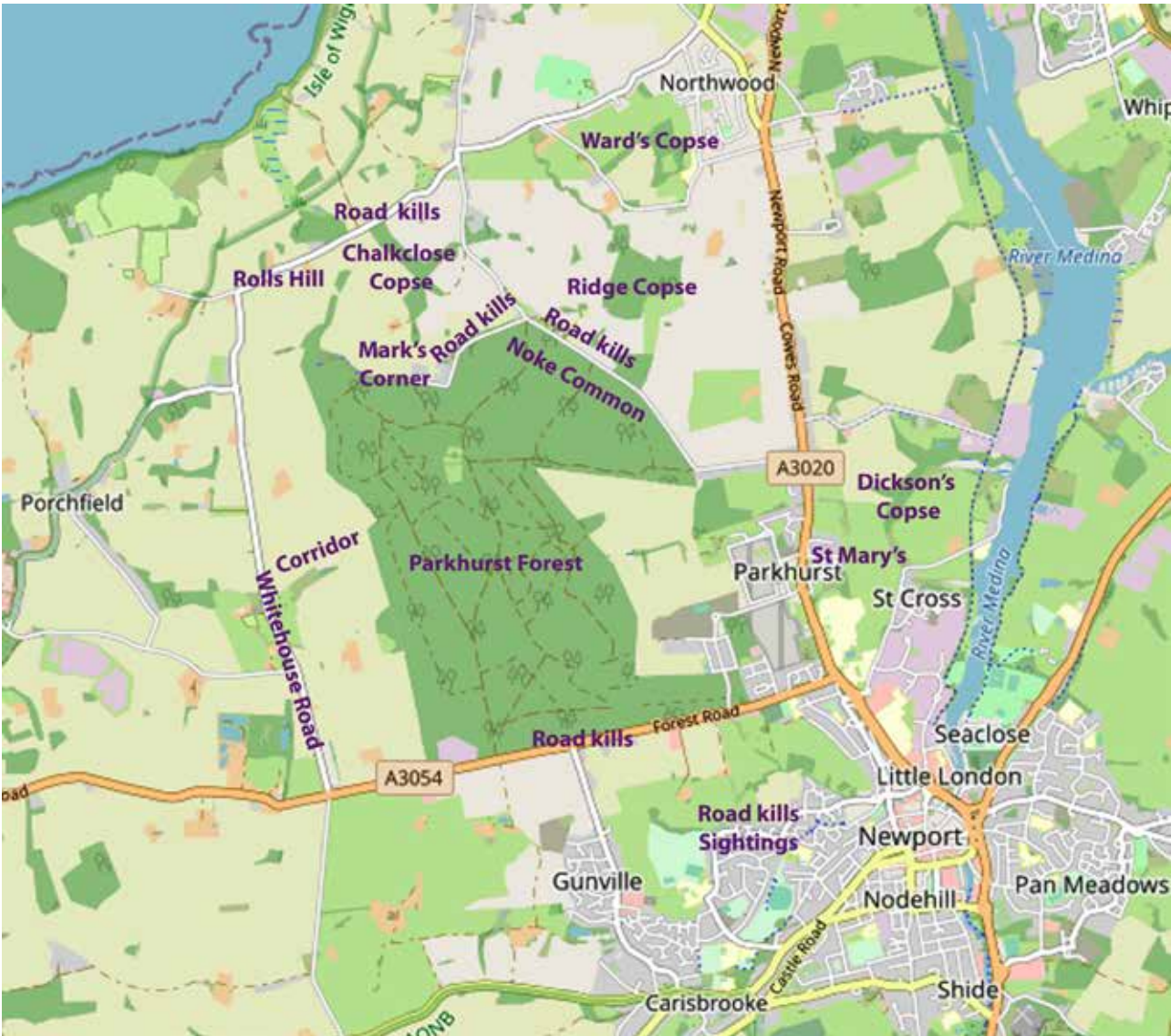
The grounds of St Mary's Hospital and roads on the estate to the north have had squirrels visit, although not consistently. A corridor leads from Dickson's Copse to the hospital grounds.



Work in Parkhurst Forest Photo: Bob Wilson



Good hedgerow from Parkhurst Forest towards Porchfield



Parkhurst Forest map

Newport and Carisbrooke

Newport is the centre of the Island and, similar to the roads, many corridor routes lead from – or to – it. There is no core habitat in Newport town, although occasionally red squirrels move in temporarily to the centre of the town such as Church Litten Park; they do not stay long. There are also, albeit rarely, road kills in the town centre.

The River Medina runs from Newport centre out to Shide with a corridor of trees on both banks and dispersing squirrels sometimes find their way into buildings and onto busy roads. In 2021 a squirrel was found running around a shop in the town centre. It was quickly caught and taken the short distance to Shide for release.

Around Carisbrooke Castle, split hazelnuts confirm presence. A blackspot for road kills is the bottom of Cedar Hill, which leads up to Carisbrooke Castle from the main road. Woodland runs parallel to Carisbrooke Road, which provides a corridor as well as habitat. The squirrels come out of the woodland and try to cross the busy road into Cedar Hill or, going the other way, from the castle area.

Road kills occur along the length of Blackwater Road, which is the main road out of Newport heading south. Wooded areas on both sides of the road, although not always along the road edge, would account for this movement.

Small woods joined by hedgerows link Long Lane with Burnt House Lane and then on to the Bembridge Trail and dropping down a corridor at Standen to meet the busy Blackwater Road. If a squirrel makes it safely across the road, the previously mentioned riparian corridor at Shide is reached. This actually runs from Newport town centre to Blackwater and across Blackwater Hollow (regular road kills) through to Merstone, on to Arreton and Heasley (road kills) and through to Newchurch. Most of the corridor is a cycle track. Reaching Newchurch, the tree-lined track runs to Alverstone and on to Sandown.

Well-grown hedges and hangers enable arboreal travel from Gunville to Calbourne. There is only the occasional sighting from the area. This is because there are fewer people walking this way to see squirrels. Split hazel shells were found during a survey in 2018.



Good hedgerows between Gunville and Calbourne



Newport and Carisbrooke map

Gatcombe, Rowridge, Chillerton, Rookley and Billingham

Most of the information for this area given previously still applies, except that there are more corridors and the squirrel's range has expanded to reach Billingham. Squirrels can reach Gatcombe from Tolt Copse. Tolt Copse has a corridor into Chillerton and Gatcombe House woodland via hedges. Sightings and feeding evidence confirm presence. Reported sightings have risen all around this area since the first study. Gatcombe Withy Bed links Sandy Lane in Blackwater and the woodland in Highwood Lane, Rookley.

Road kills in Highwood Lane, Rookley, are not uncommon. Squirrels frequent gardens at the western end of Rookley village; the copse in Highwood Lane is their habitat in the area. During the Island surveys, split hazelnuts were found in Pagham Copse, which is to the east of Rookley, where it joins Merstone Lane at Bohemia Corner, which is a road kill hotspot. Further investigation is needed to look at links between the east and west of the village.

There are dispersal routes to Gatcombe to the north but the southern route would benefit from extra planting. A corridor runs between Gatcombe House woods and the village of Chillerton. In places, it could do with bulking out but squirrels do use the hedge, as food leavings and sightings testify.

Walking from Hollow Lane in Chillerton to Berry Copse, where a squirrel was spotted on a survey visit in 2016, is a corridor linking Chillerton to Billingham. Several squirrels have been killed on the road in Billingham and they feed in gardens.

Split nuts found in Ramsdown Copse and Berry Copse during surveys provide further confirmation that squirrels do reach these outlying woods. More walks are needed in this area.



Stretches of the corridor between Chillerton and Gatcombe House woods



Billingham map



Looking across Gatcombe from Blackwater Hollow



Gatcombe, Rowridge, Chillerton and Rookley map

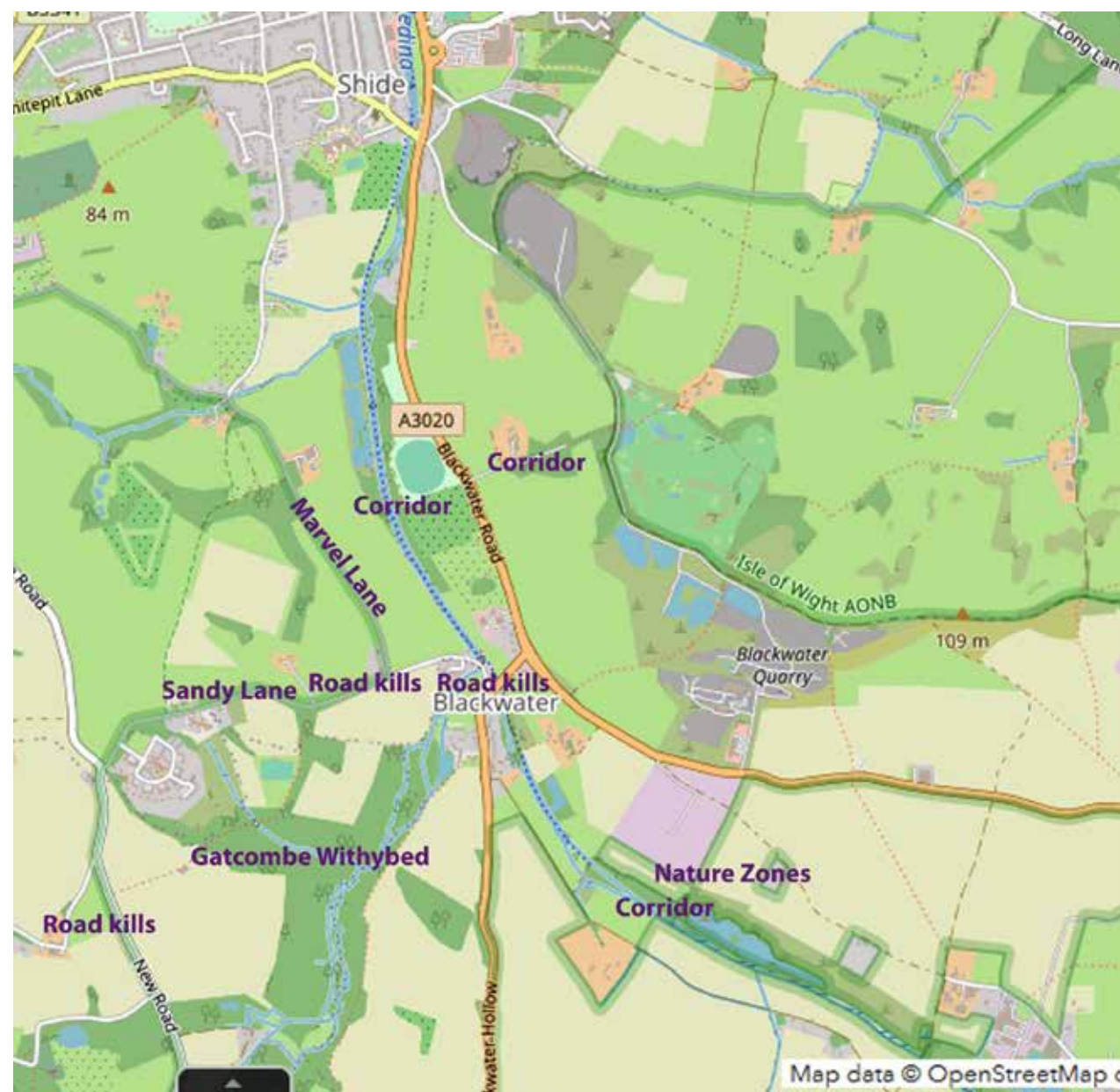
Shide and Blackwater

This area has seen a rise in squirrel numbers and improvement in habitat management since the first report in 1992 when the woodland was described as poor and unmanaged. Since then it has been well managed and supports a good population of red squirrels and dormice.

With a new, large development in the area, the area is busy with traffic and road kills are a regular occurrence. Blackwater Hollow and Sandy Lane are especially bad for road kills. There is supplementary feeding on both sides of the busy road through Blackwater Hollow, in Sandy Lane and also Marvel Lane. Road signs have only made a small difference.

Sandy Lane is narrow and lined with hazel, so the squirrels not only cross the road but forage beside it. Traffic moves fast along this narrow winding lane and road kills are common. Corridors are in all directions from here.

The route across Blackwater Hollow is also a corridor between Newport, Shide, Blackwater and then on to Merstone. Most of the route is a national cycle track, with good hedges, small woods and hangers. There is also supplementary feeding en route. Nature Zones nature reserve, for example, is along the route and has a consistent but small population of squirrels, which are supplementary fed.



Shide and Blackwater map

East Cowes and Whippingham

This area has seen a lot of development since the first study and small woodlands have been depleted in several places. Development now surrounds Kingston Copse but on a site visit in 2018, squirrel feeding evidence was found. New planting leads from the copse, past the power station and on to Kingston allotments and the cemetery. There is a line of trees along the river and past the industrial units. Squirrels do follow trees through gardens from Kingston Cemetery and on to Whippingham. Sightings and food leavings confirm the use of this corridor.

East Cowes core habitat is Barton Wood, Osborne Estate woodland, Norris Wood and Spring Copse. A survey undertaken by English Heritage is detailed in Part 2 section 3. Also in the next section is a detailed survey carried out by an East Cowes resident in Waverley Park, when squirrel numbers were at their height. Osborne House is a popular tourist attraction and, although the speed limit is 15mph, there are still regular road kills.

A continuous dispersal route from Barton Woods heads east along the coast, via Wallishill Copse and Woodside all the way to Wootton Bridge. From there, by crossing the main road, there is access to the large mosaic of woods around Havenstreet.

Gardens adjoining the aforementioned estates provide arboreal links and residents feed red squirrels. Records show that numbers of squirrel

feeding in gardens peaked in 2010 but have decreased since then. The map shows fragmented areas of trees but they do link up.

Residents in a complex of homes off Folly Lane, Whippingham, feed squirrels that filter down from East Cowes. From there, along the coastal path towards Newport, a drey was spotted and also split hazel shells. There are trees along the majority of this route, although there are short gaps which would benefit from tree planting.

Squirrels crossing the busy Whippingham Road into East Cowes do travel between woodland bordering both sides of the road, with the inevitable road kills occurring here. The trees are not shown on the map.



Whippingham



East Cowes and Whippingham map

Wootton

Wootton has a good population of squirrels. It also has more black spots for road kills than any other area. The main road from Ryde to Newport has more road kills than any other road on the Island. As it is a built-up area, food is plentiful courtesy of residents supplying supplementary food in gardens. There are many dispersal routes to and from Wootton.

From the end of Church Road, a tree-lined footpath leads to Woodside Farm. A coastal corridor route then leads to Barton Wood, Osborne Estate and Norris Castle woodland via Woodside and King's Quay.

Woodland runs most of the length of Brocks Copse Road on either side so inevitably there are road kills. The route into East Cowes is accessible from Brocks Copse and Timber Copse, on the east side of the road, and joins Lushington Copse. Road kills on Lushington Hill have occurred regularly since 1991 and probably before, although records were not collected before this time.

To the east, trees can take squirrels on to Firestone Copse and the mosaic of core habitat woodland which incorporates the Combley complex of woodland and extensive Briddlesford Estate woodland.

The area around Packsfield via gardens, woods, hedges and hangers leads from Briddlesford to Wootton. Feeding evidence is easily found.

From Station Road, Wootton Common leads to Park Road. Crossing Park Road is the old railway track which leads to Newport. The track is a good corridor, passing Fattingspark Copse and Belmont Copse on the way. Squirrels are fed in gardens where the track runs behind houses in Fairlee Road.

A strong corridor link between Lakeside and Station Road runs behind the estate. Road kills on Station Road are common.



Packsfield, where mature standards provide good corridor links



Corridor from Woodside to Kings Quay

There is a mosaic of hedgerows along footpath N115 between Fairlee Road and Staplers Road. Hazelnuts opened by squirrels were found along this route. Fattingspark Copse and Belmont Copse are to the north of this route, so Wootton is within easy reach. Road kills and sightings on Park Road confirm that squirrels do cross.



Trees between Fairlee and Staplers



Wootton map

Staplers, Long Lane and Lynn Firs

The description of this area is the same as given in the previous chapter, except that Vipers Bog Copse is smaller, although there is a new planting nearby. Expanding Lynnbottum municipal refuse tip has changed this area, although corridors are still intact. Movement between Combley Great Wood, Briddlesford Estate, Staplers Copse and Longlane Plantation is possible but does carry a risk crossing busy roads.

Sightings or evidence of squirrels are consistent in these areas. Road kills are regularly reported from the roads around Lynn Firs, Blacklands Lane, Briddlesford Road and Long Lane. From Longlane Plantation, by crossing the road and following trees and hangers, Burnt House Lane is reached. Burnt House Lane is another road kill black spot.

Road kills are found the length of Long Lane. Squirrels cross to, or from, Robin Hill at the top of the road, Longlane Plantation halfway down and from the small woods and hangers behind the houses at the bottom of the road.

Small woods, hangers and well-grown hedgerows between properties are found at the bottom of Long Lane as it comes into Newport. During a visit to the area in August 2021, freshly split hazel shells were found. Residents also report on squirrels visiting their garden. A large development, Pan Meadows, on green belt land, is still in progress but, as mitigation, 16,000 trees have been planted. Although the area is a mosaic of small woods and hedgerows, squirrel presence is consistent.



Corridor from behind Buckbury Lane towards Burnt House Lane and St Georges Down

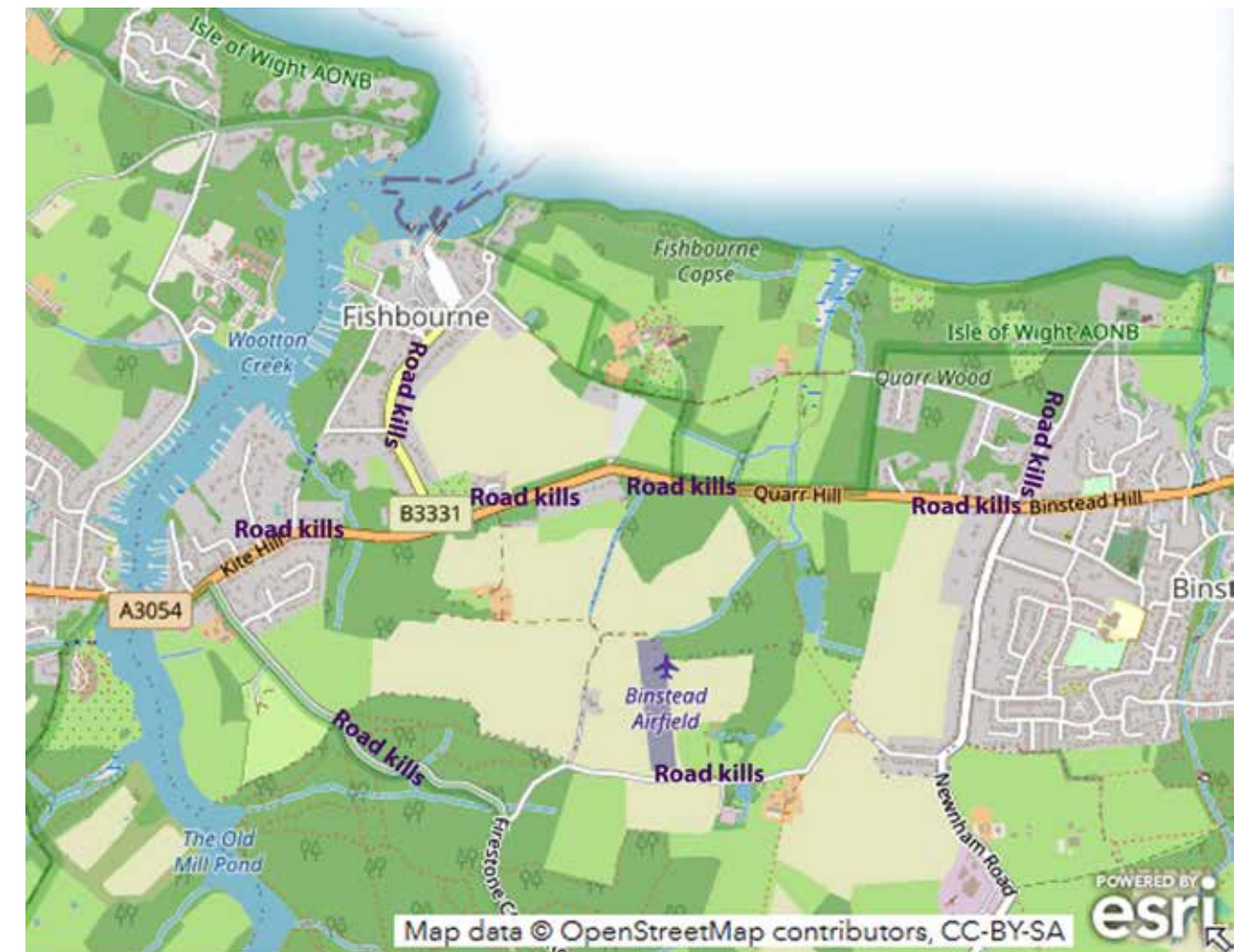


Staplers, Long Lane, Lynn Firs and St Georges Down map

Quarr and Fishbourne

Little has changed, regarding corridor links, since the first survey, so Fishbourne and Quarr remain well linked. Garden feeding in the Quarr and Fishbourne area is extensive and squirrel numbers remain steady, regardless of natural influences, such as weather and fluctuations in seed crop.

Traffic has increased in the last 30 years, so inevitably there are more road kills, particularly at the top of Binstead Hill and the bottom of Quarr Hill. More recently, several road kills occurred in Church Road as squirrels crossed to disperse towards Ryde, or came the other way. The traffic lights at the top of Fishbourne Lane, Fishbourne Lane itself and Kite Hill are also black spots for squirrel road kills.



Quarr and Fishbourne map

Combley, Briddlesford, Firestone Copse and Havenstreet

Not much has changed since the Corridors of Hope study, except there is more traffic and many road kills in the area. Despite the roads, the area is prime red squirrel core habitat, with plenty of dispersal routes and connecting woodland over a large area. Road kills confirm that squirrels cross the roads between the woodland blocks. In every survey, evidence of squirrel activity was quickly found.

Arboreal links from Firestone Copse to Puckers Copse have improved. It's also possible to reach Briddlesford Copse from Firestone Copse. Havenstreet residents report squirrels coming to their gardens from Firestone Copse via a footpath

which runs behind their houses on Main road, Havenstreet. This is a busy road and squirrels trying to cross to opposite gardens or to disperse, are often killed by traffic.

Wakelys Wood appears isolated if you look at a map but it does have corridors leading towards Binstead and Firestone. To the south, Kemphill Moor, Rowlands Wood and Chillingwood are reached by following the trees. Split hazel shells are found in all of these woods during surveys.

Regular road kills at the bottom of Quarr Hill confirm that squirrels cross between Puckers Copse and Quarr. From there, the route to Binstead and Ryde is unbroken.



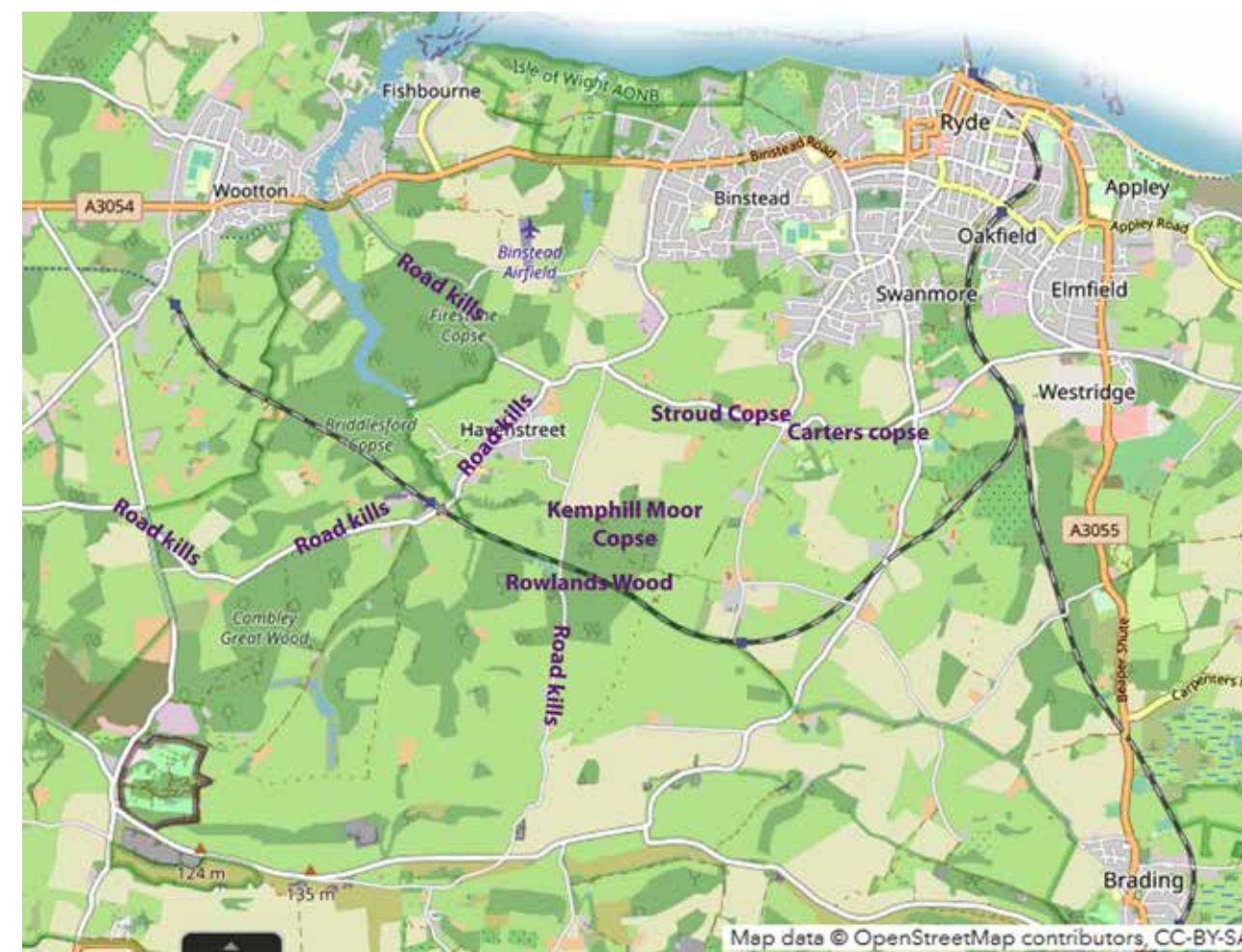
Photo taken from Firestone Copse. The tree line meets Newnham Lane and then across the road is Puckers Copse



Photo taken on the edge of Firestone Copse on the left, looking across to Briddlesford Copse on the right



Wakelys Wood taken from Firestone Copse, looking east towards Binstead and Haylands



Combley, Briddlesford, Firestone Copse and Havenstreet map

Binstead and Haylands

Squirrel numbers in Binstead have burgeoned in the last 30 years, largely thanks to secondary woodland. Dame Anthony's Common and the areas now named the Millennium Green and Binstead Wood were no longer cut for hay after the 1980s and natural succession has resulted in secondary woodland. As the woods border gardens in Binstead Lodge Estate, there is plenty of supplementary food available. From Dame Anthony's Common, mature hedgerows lead to Stroud Copse. Squirrels visit gardens in Newnham Road and Newnham Lane and from there, Puckers Copse is reached.

Mature hedgerows and gardens make good corridors from Quarr, Ryde House grounds and the golf course, where there are regular sightings. Crossing Binstead Road is hazardous and road kills are a regular occurrence. Once across the road, there is a bridle path, which is thickly tree-lined and almost a copse in its own right, that leads across Hillrise Avenue to Binstead Wood. Sightings, food leavings and road kills confirm that this route is used.

From Binstead Wood, the Millennium Green in Play Lane is reached, without a break in tree cover. The trees either side of Play Lane provide a corridor and food from hazel and other native species of tree and also nesting opportunities. A hollow branch used as a den is not the best of nesting sites, as several times kittens have fallen

onto the bridle path and had to be rescued.

A hedgerow at the bottom of gardens bordering the recreation ground leads to a small copse called the Red Squirrel Dell, which is in the corner of the recreation ground. From there, squirrels are seen travelling towards Ryde Cemetery and Pellhurst Road, where they have taken up residence in gardens. Two road kills in 2020 and one in 2021, plus sightings, confirm squirrels travel this way.

To the south of the Millennium Green, the tree line, hangers, emerging secondary woodland plus garden trees take the squirrels through Haylands and on to Stroud Copse. The map does not show the high hedges from Haylands to Stroud Wood, in Stroud Wood Road.

Stroud Wood Road is a very busy thoroughfare, where road kills occur regularly, even though trees meet across the road. Heading towards Ashey from here, it is possible to reach Ashey Cemetery and on to Kempfill Moor in Havenstreet.

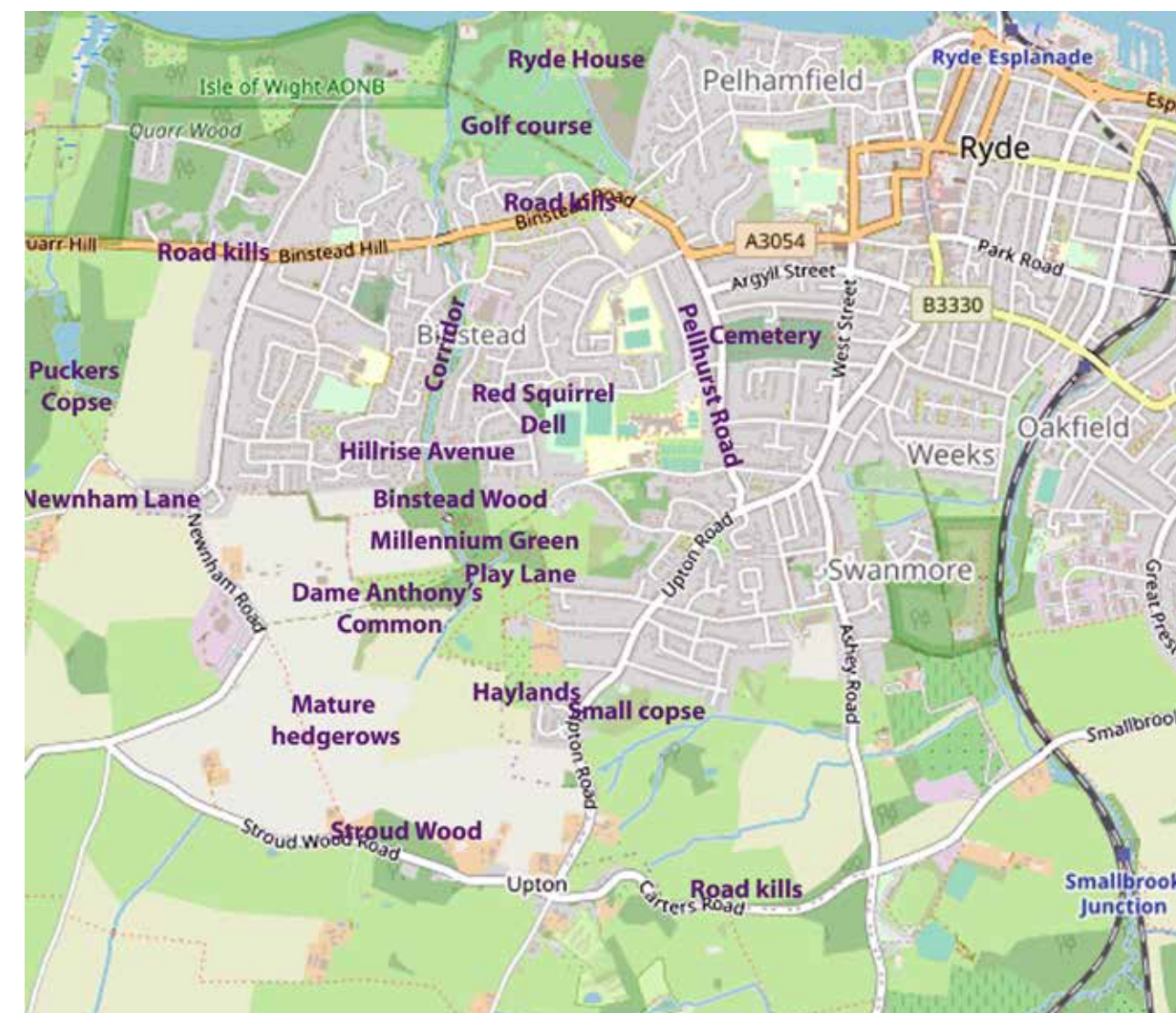
A small copse planted in Haylands about 25 years ago has matured and evidence of squirrels eating the nuts and cones was found in 2020 and 2021. The number of squirrels feeding in gardens in Haylands has grown steadily over the past 10 years. From Haylands, the woodland in Carters Road is also reached via mature hedgerows.



Corridor from Dame Anthony's Common to Stroud Wood



Entrance to the Millennium Green



Binstead and Haylands map

Ryde

The main change to this area is that the grounds in Ryde House have been developed, so inevitably trees are lost. There is still a corridor along the coast. Squirrel numbers in and around Ryde have increased over the years as squirrels have spread out and made full use of residents encouraging them into the garden. An interesting corridor is from the Millennium Green, through gardens and hedges to Ryde Cemetery.

A squirrel moved into Ryde Cemetery in 2020 and is still there in 2021. Adjacent gardens provide food and mature trees provide cover and drey sites. Stripped fir cones are found on regular walks in the cemetery and sometimes the squirrel is spotted (H. Butler pers. obs.).

St John's Park has consistently kept a small population of red squirrels, albeit with fluctuations. Road kills are inevitable given that the woodland is surrounded by busy roads.

St John's Church is approximately 300m from St John's Park, across two roads. Adjacent gardens have mature trees and residents feed the squirrels. Across the road from the church are extensive school grounds. Mature trees border the grounds and sightings are common. The wooded area to the east provides easy access to Appley Park and Appley Estate, where there is more garden feeding.

Appley Park adjoins Puckpool Park on the

seaward side, where there is a wooded area. Sightings are common here. From Puckpool Park, via small copses and hedges, Calthorpe Road is reached. Calthorpe Road leads from Appley Road towards Nettlestone and Seaview. Road kills in Calthorpe Road and Bullen Cross (top of Calthorpe Road) prompted the erection of the first rope bridge. The trees now meet across the road, so there is no need for a bridge. Road kills in all areas show that squirrels are active in Ryde and the routes they take. Pondwell Hill is another common black spot for road kills.

As the long seaboard corridor from Wootton to Ryde ends at the bottom of Union Street, animals taking this route are occasionally spotted running through the town or seen at Ryde Pier Head but, so far, no road kills have been reported.

Gardens and hedges link the Town Green in Rosemary Lane, woodland on Smallbrook roundabout and woodland in Carters Road. Smallbrook roundabout and Carters Road also see squirrels killed on the road as they try to disperse. Squirrels who successfully cross the roundabout and head south can reach Angels Copse and the woods in and around Whitefield Farm. From there trees lead through to Brading. Alternatively, by travelling west up Carters Road, squirrels can reach Ashey via Gatehouse Lane and Stroud Wood or head towards Haylands via gardens, grown hedges and hangers.



Ryde map



Stripped cones in Ryde Cemetery



Squirrel in Ryde Cemetery 2020

Seaview and Nettlestone

Core habitat in Nettlestone is Longlands Copse and Priory Woods. In Seaview, it must be the small woodland along the coast, in Pier Road, which filters into small hangers and large gardens. Numbers have remained steady and squirrels have spread out in Seaview and Nettlestone, using gardens as feeding places and occasionally drey sites. Footpaths around Seaview have good hedges, so coupled with garden trees and supplementary feeding, the squirrels do well enough in this unconventional habitat.

The Pier Road woodland also acts as a corridor, linking Seaview to the bottom of Gully Road, then on to Priory Woods, which takes squirrels to St Helens. Annual road kills indicate dispersal routes

are between Longlands Copse in Eddington Road and Gully Road.

A good corridor between Nettlestone and Whitefield Wood exists and hazelnut evidence confirms this route is used. A mosaic of hangers and high hedges links Nettlestone to the area in and around Bullen Road and is used by squirrels. A squirrel was witnessed by the author using this route plus split hazel shells were found on a survey visit.

There are also hedges to Fakenham Farm, the Duver and Nodes Point Holiday Camp, which adjoins Priory Woods. Split hazelnuts are found all around the area and sightings reported regularly.

St Helens

St Helens was not mentioned in the previous chapter as nobody reported seeing squirrels in the area. Reported sightings in and around the village started in 1996. Gardens in and around Mill Road have regular sightings of squirrels and occasionally there are sightings and road kills in adjoining Latimer Road.

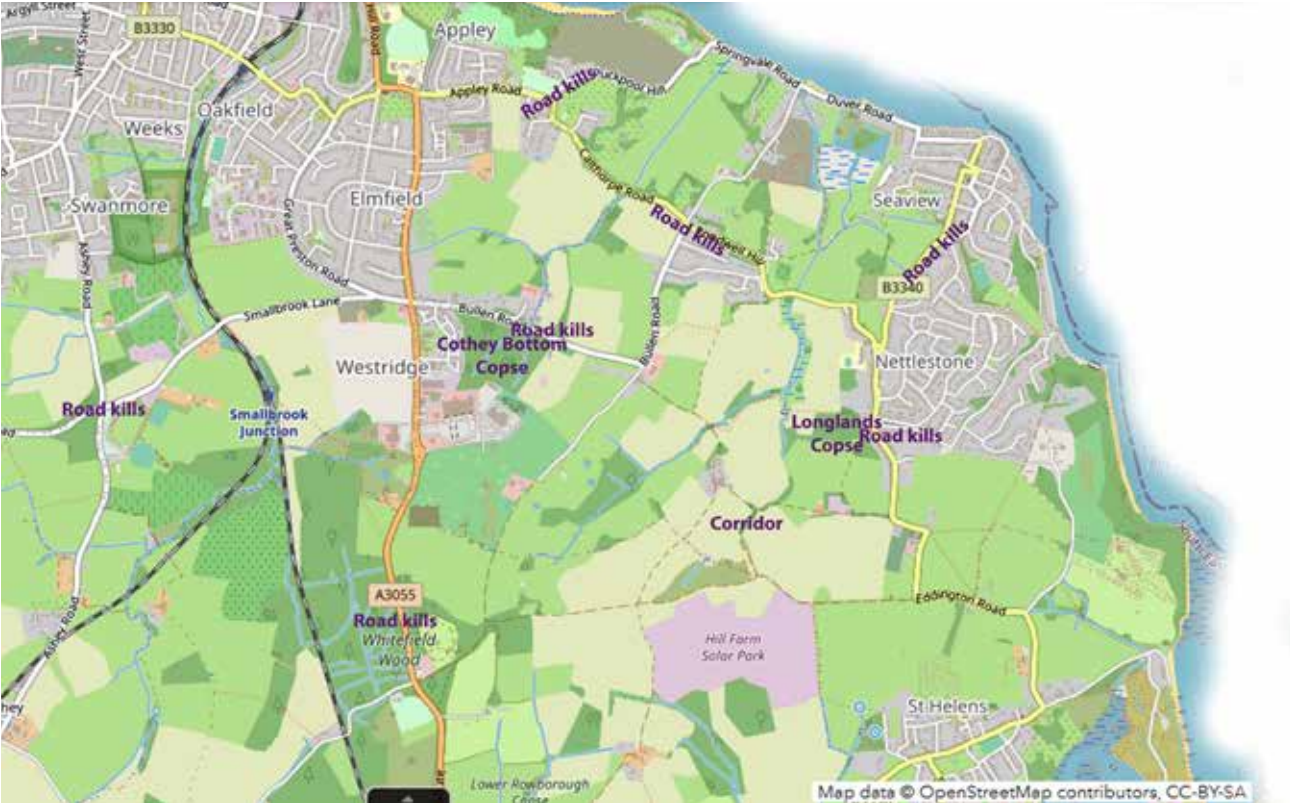
A split hazelnut was found during a survey along public path R82, which runs between Eddington Road and Upper Green Road. A dog walker also reports seeing squirrels there regularly.

A small copse on the western edge of the village and hedgerows from here link to the woodland at Hill Farm. From there, it would be possible to

reach Lower Rowborough Copse and Whitefield Wood via hedgerows.

The National Trust woodland leads down to the Duver and food leavings have been found there on every survey. There is also the occasional road kill. From here, there are hedgerow links to Priory Woods in Nettlestone.

Towards Bembridge the only route is along Embankment Road as it is bordered by the sea and marshland. There are some trees but it is a long stretch for a squirrel to safely reach Bembridge with so little cover. A new planting would be useful, although possibly not practical.



Seaview and Nettlestone map



St Helens map

Whitefield

Whitefield Wood, Roke Mead Copse and Peakyclose Copse is core habitat on the outskirts of Ryde and little has changed since the 1991 survey, except that Whitefield Wood has been managed. There are a few gardens and the squirrels do help themselves to supplementary food where it is available. Road kills are common in Hardingshute Road and the main Ryde to Brading Road. Dispersal opportunities are in all directions and corridor links are generally good.



Whitefield map

Brading and Ashey

From having no squirrels in the village in the 1990s, numbers have grown and they now visit gardens. Nunwell Woods and Kelly's Copse are core habitat for the area. Road kills on the Brading Down Road indicate squirrels cross from Nunwell Woods towards Adgestone. There is a good corridor, once across the road, and short expanse of downland. Large trees in gardens plus grown hedgerows allow arboreal travel around the area and on to larger woodland.

A corridor along footpath B69 from Sandown Road at Yarbridge, on the edge of Brading, heads towards Centurions Copse. A walk along this route found hazel in hedges and hangers. Split hazel shells proved that squirrels do use this area. Squirrels occasionally venture into gardens beside the railway line, as reported by a resident.

The most positive change has been in corridor planting from Nunwell Woods to Bloodstone Copse. From here, squirrels travel towards Ashey, as road kills on the main road testify. Those that survive the road crossing are presumably the squirrels who have taken up residence in the copse on farmland known locally as Ashey Racecourse. Until the survey of 2016, when feeding evidence was found, this copse drew a blank for squirrel presence.

Ashey has squirrels in the vicinity of Ashey Cemetery, where several road kills have occurred. Gardens in the hamlet of Ashey and the small copse behind Ashey Station also have squirrels passing through. The squirrels in Gatehouse Road may have come via hedgerows from Kemphill Moor Copse, Stroud Wood or the woodland in Carters Road.

Dills Copse looks isolated as it sits in the middle of a large open field; however, on every survey evidence of squirrel presence was found. There is a partial hedgerow from Rowlands Wood, which is the most likely way squirrels reach the copse.



Good corridor from Ashey Cemetery to Kemphill Moor Copse



Corridor between Nunwell Woods and Bloodstone Copse looking west



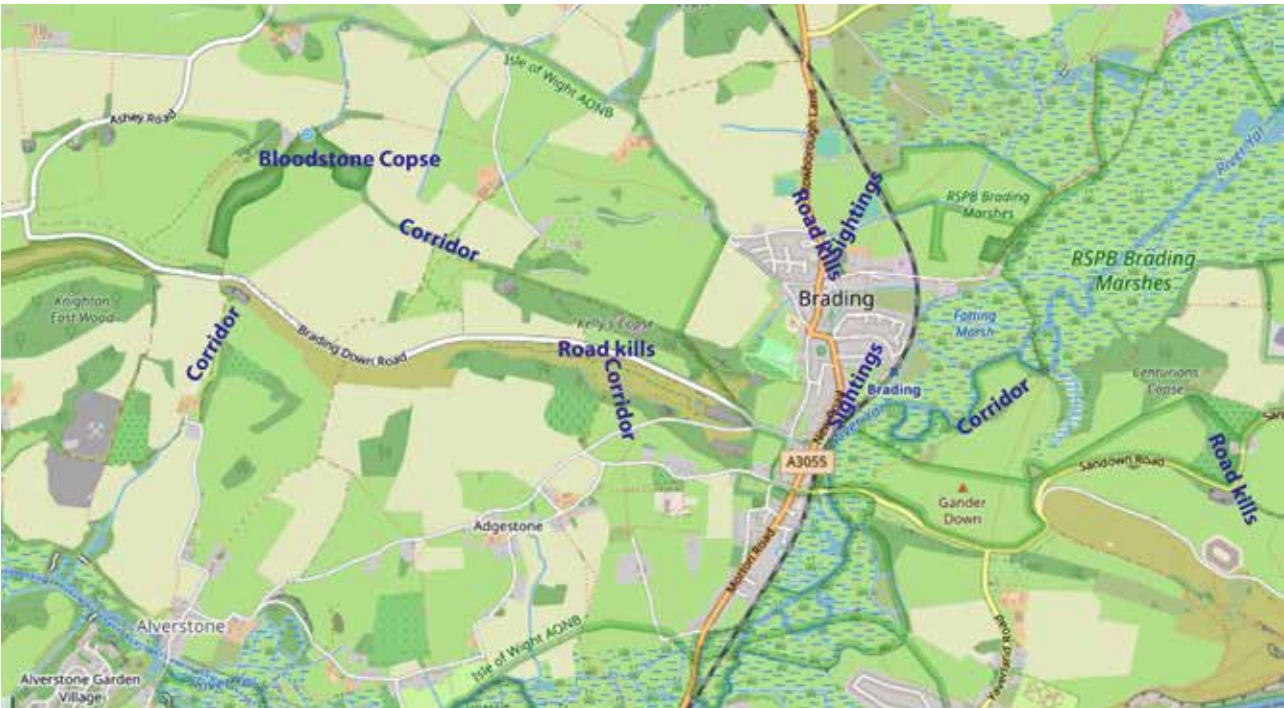
Isolated woodland at Ashey Racecourse



Partial corridor between Dills Copse and Rowlands Wood



Ashey map



Brading map

Alverstone, Borthwood Copse and Newchurch

This area is much improved from 30 years ago; squirrel numbers in Alverstone, Borthwood Copse and Newchurch have risen dramatically since 1991 and are kept high due to supplementary feeding. In 1991 it was hard to find squirrel food leavings in Borthwood Copse and sightings were rare. This has reversed and the woodland is now a ‘hotspot’ for squirrel sightings and mature hedges provide corridors for wildlife.

There are good hedgerow and hanger links to Mersley from Duxmore by crossing the Downs Road, where road kills occur. From Mersley it is easy for a squirrel to reach Newchurch, Knighton, Alverstone and Borthwood. Planting around the Garlic Farm has provided habitat as well as corridors.

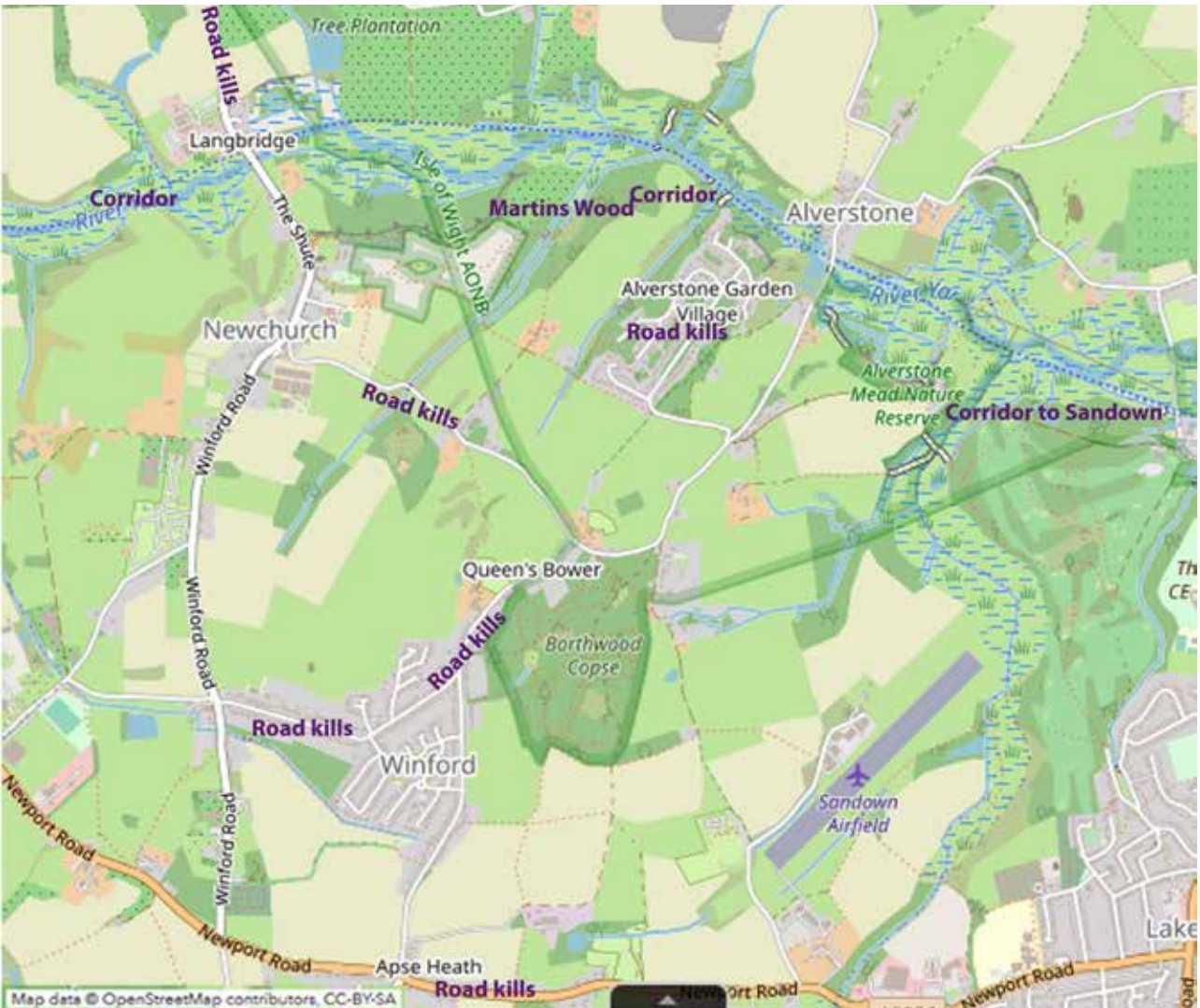
A large new planting in Newchurch, named Martin’s Wood, has matured and provides a good crop of cones and nuts. The wood sits between

Parsonage Wood and a strip of woodland linking to Alverstone.

From Newchurch, the cycle route follows a tree-lined corridor to Arretton to the west. Heading east, a series of woods and hedges lead to Sandown.



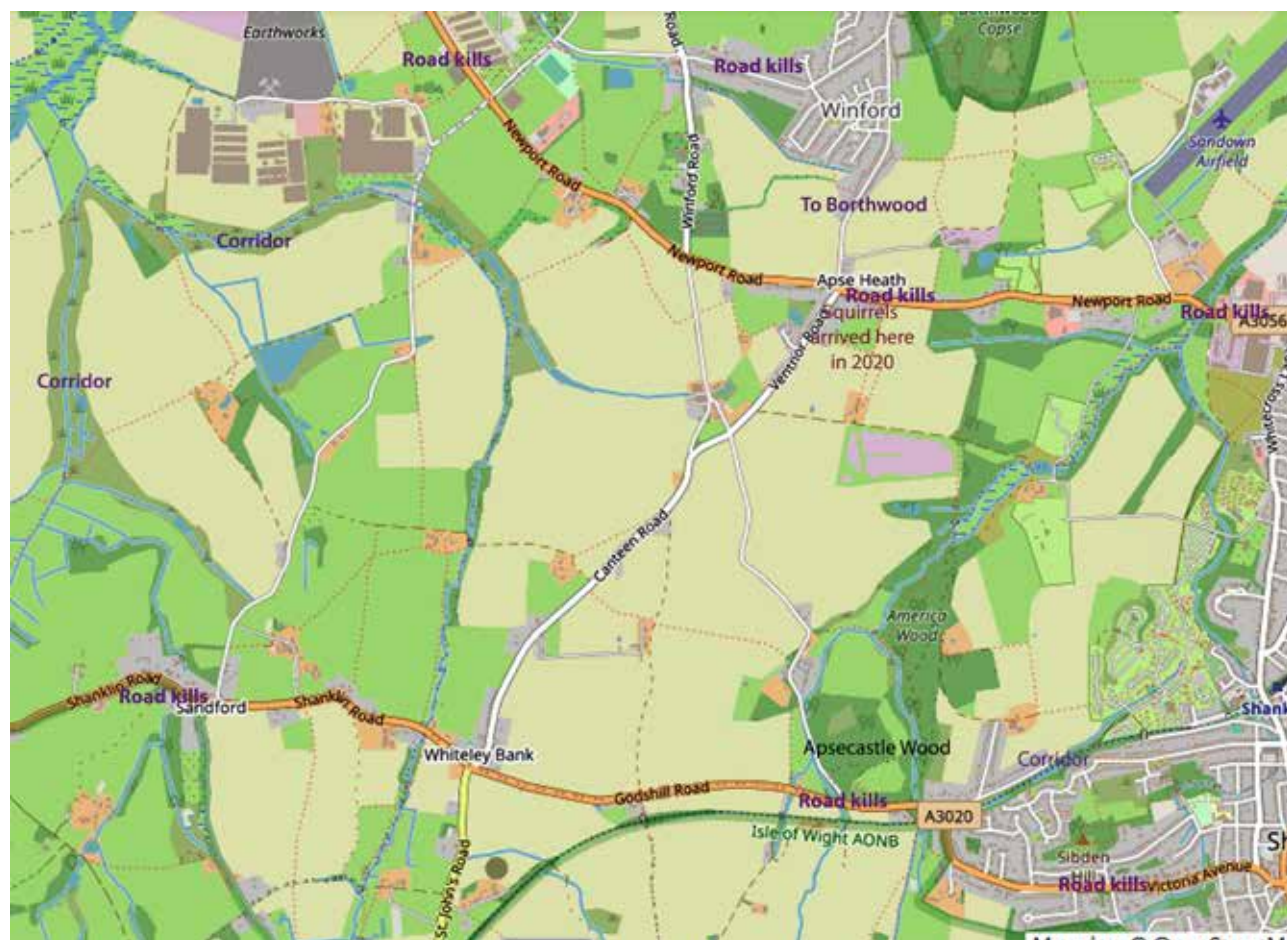
Looking from the Downs Road across Mersley and Newchurch



Alverstone map

America Wood and Apsecastle Wood

This area of woodland has not changed since the 1991/92 survey. It is also in the bi-annual woodland monitoring chapter and shows consistent squirrel sightings. Dispersal routes are in all directions as confirmed by road kills.



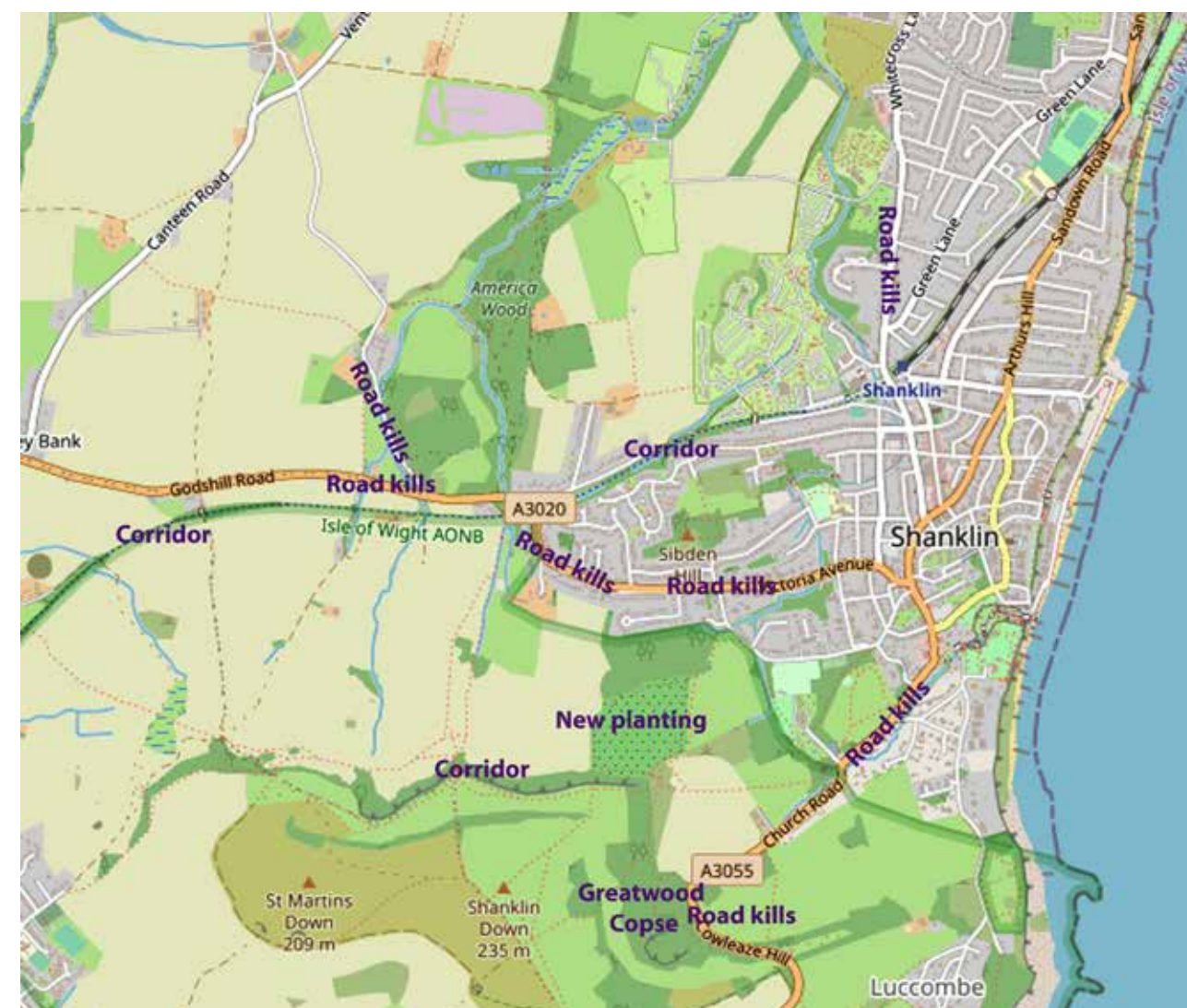
America Wood and Apsecastle Wood map

Shanklin

America Wood and Apsecastle Wood above demonstrates one route out of Shanklin, heading west. As reported in the previous chapter, Corridors of Hope, there are many sightings in the Shanklin area as the red squirrel population is living in parks and gardens. Numbers are stable in spite of regular road kills in and around Shanklin town.

The biggest change is that JIGSAW has added woodland in the area, joining Hungerberry Copse

to Greatwood Copse. Other corridors are via the old railway track to Wroxall in a south-westerly direction or through Apsecastle and America Woods heading north towards Borthwood. From the southern end of Shanklin, squirrels can either head for Luccombe, Bonchurch and Ventnor along a coastal route or through Greatwood Copse and follow woods and hedges to meet Wroxall and Ventnor. The safest route between Shanklin and Godshill is via the cycle track to Wroxall.



Shanklin map

Sandown and Lake

Road kills just before reaching the roundabout by Scotchells Brook in Lake are a regular occurrence. Corridors lead to this point from both directions, that is, from the Borthwood Copse/Alverstone area to the north and from Scotchells to the south. In the summer of 2021, a squirrel appeared for a short time in gardens in and around Whitecross Farm Lane. On the opposite side of Whitecross Lane is a corridor which leads to Landguard and joins with Scotchells and America Wood.

Squirrels arrived in Sandown in Los Altos Park, hotels in Melville Street and surrounding gardens in 2000. These are very much 'urban' squirrels that make a living in gardens and parks.



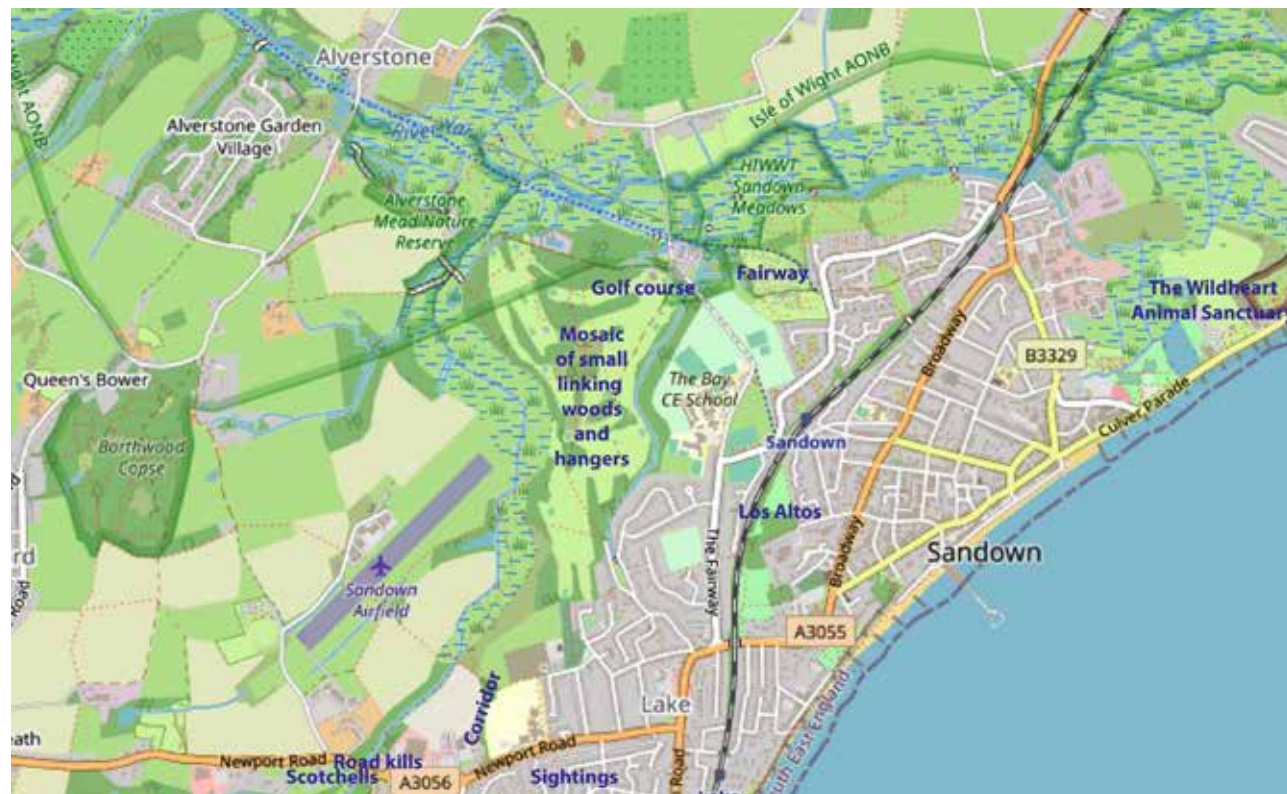
Los Altos Park. Picture taken in 2017

Moving to the outskirts of Sandown is Fairway Holiday Park, which has a population of squirrels, helped along by supplementary feeding. A golf course with its surrounding woodland is close by and within easy reach of Alverstone Mead, which is a hotspot for squirrels. All these areas do link to form a habitat; although it is not a typical woodland block, it does seem to work.

To the rear of the Wildheart Animal Sanctuary, situated on the seafront, there are good hedges and hangers leading back towards Adgestone and Brading.



Looking from Los Altos Park to the Downs Road in the far distance



Sandown and Lake map

Bembridge

No longer isolated, squirrel numbers have increased in and around the village. Numbers started to rise in gardens in 2007 and increased in range and number from then on. Corridors along the coastal path link into Forelands. Hazel is present and used nuts are found here. Thanks to supplementary feeding in gardens, most Bembridge residents now see squirrels, although not all are regular visitors.

Steyne Copse has a busy road running through it and the number of road kills has risen over the years. Contrary to comments in the previous chapter that dormouse food leavings were higher than squirrel, this is now reversed.

It seems an unlikely spot to encounter dispersing squirrels but sightings at the top of Culver Down, where there is no tree cover, are reported, the first being in 1997. Trees and hedges on path BB44 lead from the woods at Yaverland to the

foot of Culver Down on the south side and from Bembridge via a coastal corridor on the north side along path BB10.

Footpath BB20 also links to Bembridge via hedges, not apparent on map, from Centurion's Copse. JIGSAW planting has helped dispersal in this area. Split nuts plus sightings confirm squirrels do travel this way. Along public path BB37, at the foot of Culver Down on the north side, hazel is plentiful and split nuts were easily found. This corridor leads to the road, where road kills are occasionally reported.

The link to St Helens is tenuous. Squirrels are often at the bottom of Station Road where St Helens joins Bembridge Embankment and there are regular road kills here. However, no sightings along the Embankment are recorded, possibly because the hedges are sparse.



From Bembridge looking towards Ryde



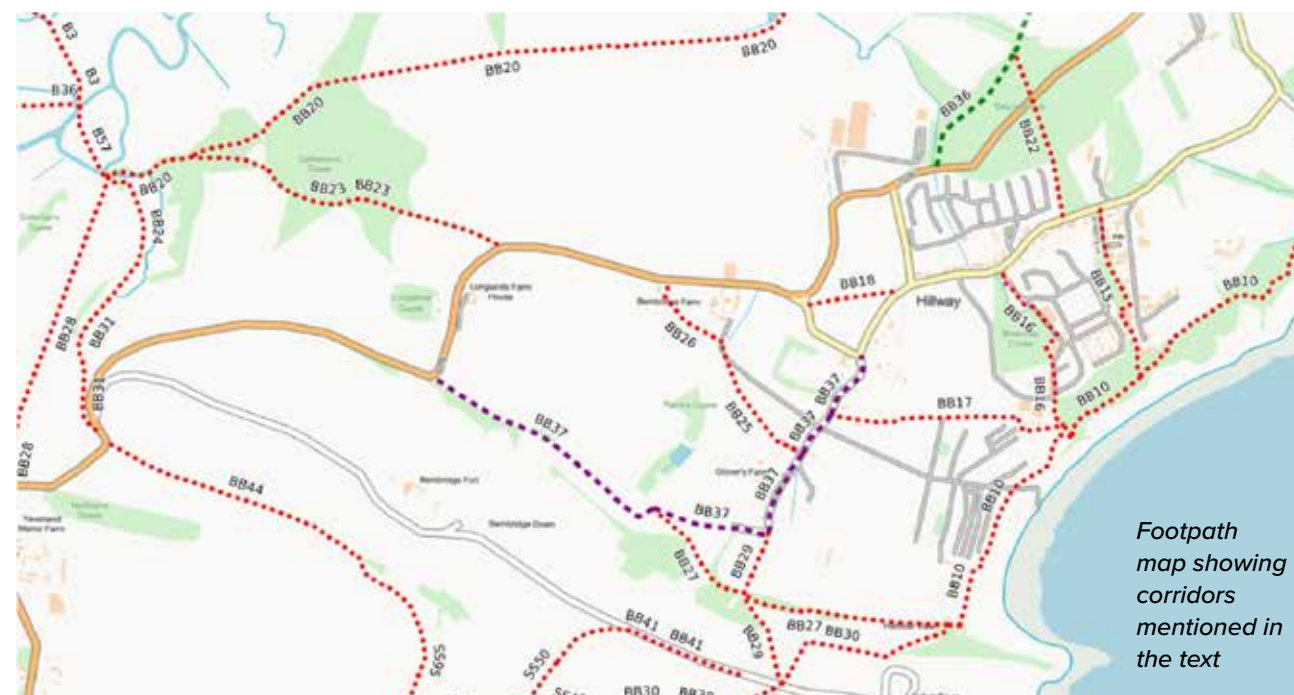
Coastal woodland at Forelands



From Culver looking towards Steyne Copse and Whitecliff Bay Holiday Park



Path from
Culver to
Bembridge
village



Footpath
map showing
corridors
mentioned in
the text



Bembridge map

Whitwell, Niton and St Lawrence

Niton and St Lawrence have become a particularly good area for red squirrels, helped by supplementary feeding in gardens. Squirrels can travel from Ventnor, Whitwell or Bierley via hedgerows and hangers. They can reach Blackgang Chine by following the coastal tree line and squirrels are resident in the Chine woodlands now. This is the end of the tree line along the coast, unless they manage to find their way into Chale from here. This possibility is still to be explored.

St Lawrence Undercliff is core habitat, which follows the coast from Ventnor to Niton. Although the tree species are not the best for squirrels and the area is largely unmanaged, many people living in the Undercliff feed the squirrels so there is always a food supply. Once the end of the Undercliff is reached, the area around Niton and Whitwell is a series of small woods with hedgerows. The squirrels appear to make use of the habitat but any extra planting would aid dispersal.

The first recorded squirrel sighting in Whitwell was in the autumn of 2006. Since then, numbers have grown steadily and, sadly, so have road kills. Kemming Road is particularly bad. From Kemming Road, Bierley can be reached and then on to Wydcombe via hedges, garden trees

and hangers. Core habitat in Whitwell itself is a small privately owned copse in Ashknowle Lane. Again, it is supplementary feeding that sustains the squirrels in Whitwell. Planting a corridor between Ashknowle Lane and Niton would benefit dispersal in this direction.

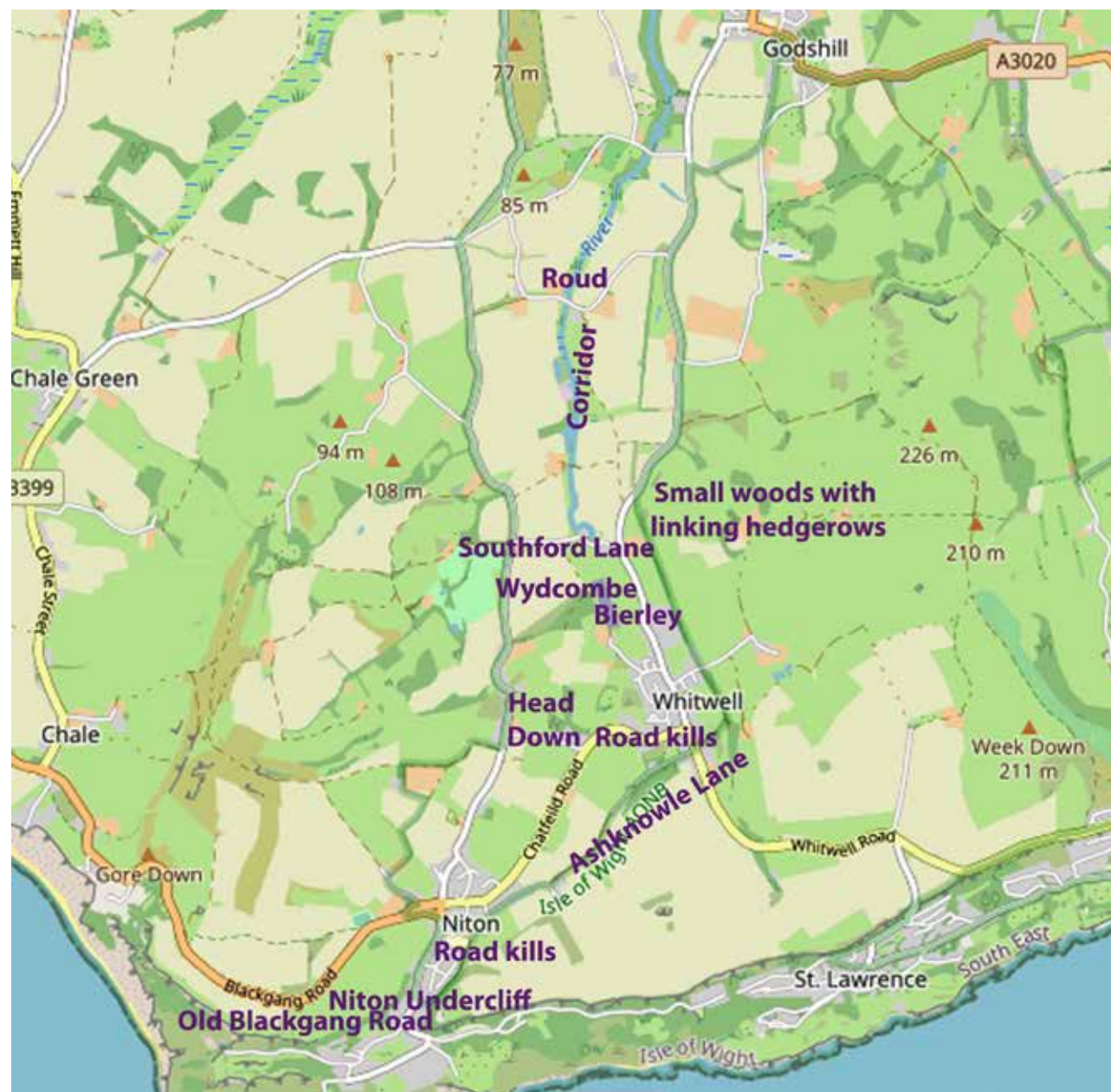
Squirrel sightings in Niton have risen steadily, with occasional sightings in the village centre. Heading towards the lighthouse and around Sandrock Road, sightings are regular as are the road kills. It does not show on the map, but there are a lot of trees around Old Blackgang Road and Niton Undercliff. Numbers have fluctuated in this area but squirrels have not disappeared.

Head Down has a good, stable population of squirrels thanks to residents feeding them. There are hedges leading from the small woodlands at Wycombe, so this is probably the way they arrived.

Looking north towards Godshill, small woodland linked with hedgerows provide a tenuous habitat on the east side of Whitwell Road. Sightings and the rare road kill plus split hazel shells confirm presence. On the west side, there is a riparian corridor running from Southford Lane through to Roud. Any of the area around Whitwell would benefit from extra planting.



Homemade sign in St Catherine's Road, Niton



Whitwell, Niton and St Lawrence map

Chale and Atherfield

Core habitat in Chale is Gotten Copse on the east side of Chale Green and Gladices Copse to the west. Squirrels did not reach Gladices Copse until around 2003 and it is uncertain where they dispersed from. Kingston Copse is one possibility or perhaps from Gotten Copse via the hedgerows and through gardens in Chale. Gotten Copse and Rew Copse lead to The Hermitage and its surrounding woodland via hedgerows and hangers.

Signs of squirrels feeding were found in the woodland beside the waterworks at Chale during most surveys. People living close to the woods reported seeing them in their garden. The woods are on Ashbridge Lane, which thanks to JIGSAW planting joins other woodland on the Cridmore Estate. A walk down Ashbridge Lane in 2019 was encouraging as a link ran from Cridmore Estate to the junction of Emmett Hill and Sandy Way. The road is not busy and it's a short distance along a hedge line to Kingston Copse.

Local landowners have planted a corridor from Pyle Shute to Corve Copse, where squirrels were first reported in 2018. It is likely that the squirrels visiting properties in Town Lane, Chale, came from here. Feeding evidence was found in the copse and hedgerows on a walk around the area. At the time of the survey, there was a break in corridor from Corve Copse to Emmett Hill along footpath SW33. However, the planting is growing well and the landowners are keen to further enhance corridors.

The owner of a property adjacent to Pyle Manor started seeing squirrels for the first time in 2012, having lived there since 1983. Once squirrels reached Chale they managed to hang on thanks to supplementary feeding.

Squirrels reaching Atherfield in 2019 is particularly exciting. There is a hedgerow link from Gladices Copse to a small copse at the farm. It would benefit dispersal if trees were planted or existing hedges were allowed to grow taller and thicker. Feeding evidence was found in Gladices Copse in the last two All Island Surveys. There the woods and corridors thin out and this is an area that would benefit from a new planting in order to strengthen the link to Shorwell. There is evidence of deer on the loose as fencing at the red deer farm in Chale, which borders Gladices Copse, is very poor. Three were seen running loose during a survey in 2018.

With some strengthening of the corridor links, in and around Atherfield, this area that was previously thought of as not viable for red squirrels could be brought into use as a satellite area and a corridor highway joining Chale, Atherfield, Yafford and Shorwell. Currently there is almost a circular ring of trees with fields in the centre and it is possible a squirrel could negotiate the space but with a little careful planting, this risky strategy would be safer.



Red deer in enclosure beside Gladices Copse



Deer tracks



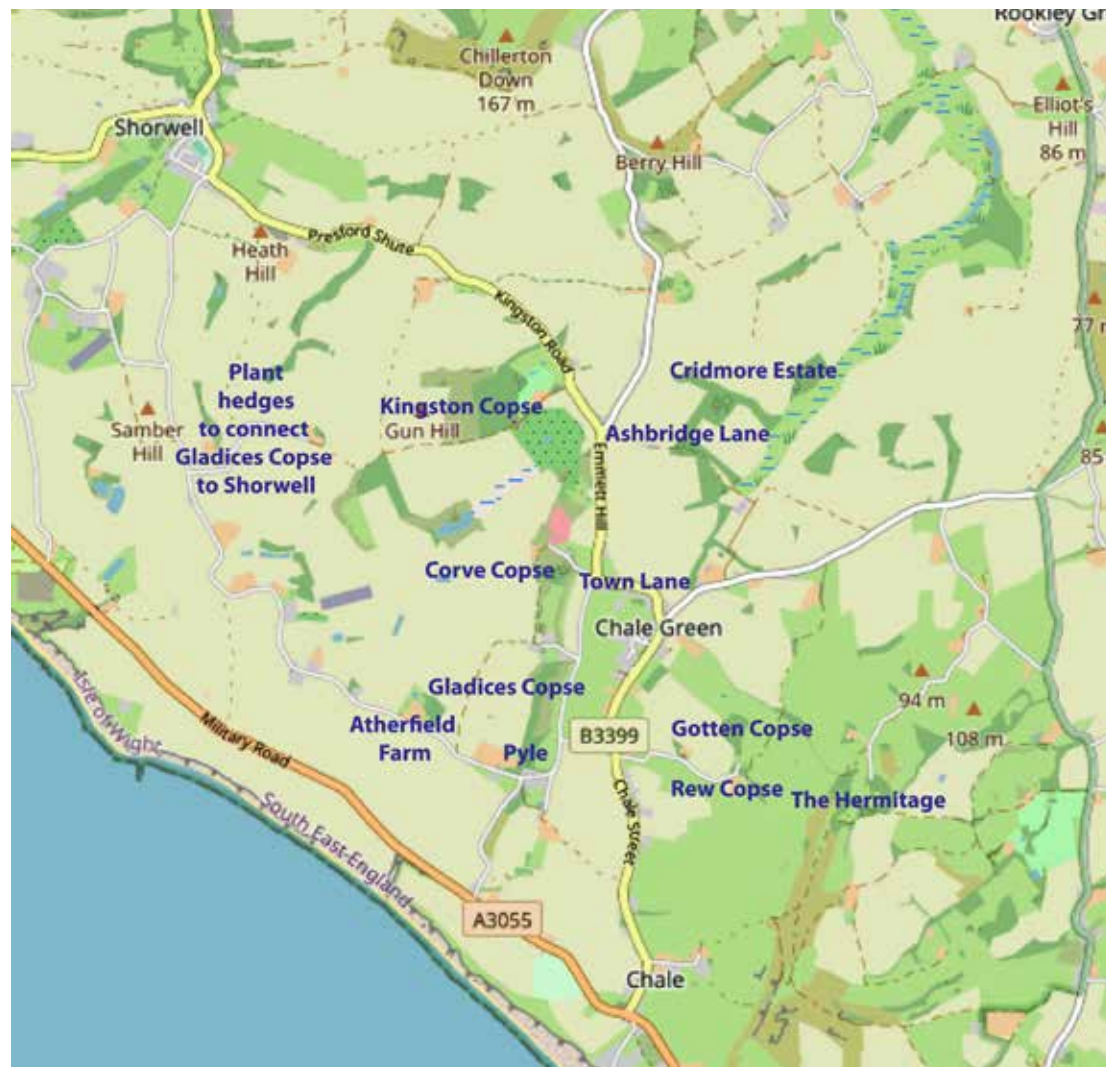
Hedgerow from Gotten Copse and Rew Copse to the Hoy monument



Looking south across Atherfield Farm



Looking across Atherfield Farm towards Shorwell and Brighstone



Chale and Atherfield map

Shorwell and Yafford

Shorwell is not mentioned in the previous chapter, although the first sightings of red squirrels in Shorwell were recorded in 1992. There is plenty of good core habitat, used for shooting, in the Shorwell area and there is no reason to suspect that squirrels disappeared after the storms that destroyed so many trees in the late 1980s. Their range has increased over the years and residents in the village of Shorwell now see squirrels in their garden. The area around Northcourt has improved thanks to tree planting.

Sheard's Copse on the outskirts of Shorwell has no close corridor links and, until 2016, no evidence of squirrels reaching the copse was found. However, during the last island survey, split hazelnuts were found. This area needs more exploration.

The first record of resident squirrels in Yafford was in 2010 but no more were reported until 2021. The only woodland in Yafford is Troopers Copse, which is very marshy and does not have a consistent population of squirrels. During the all-island survey in 2016, no evidence of squirrel presence was found in Troopers Copse. The

copse does lead from Shorwell village so it's possible a dispersing squirrel arrived in Yafford via this route. Dispersal routes to and from Yafford could be improved in every direction but unless more woodland is planted, there is little point.

Lorden Copse appears to be isolated but feeding signs prove squirrels have reached there. From the main road to the copse is a hedge, where feeding signs were found, so perhaps dispersal is across the road, rather than across the open field. There is a hedgerow on the opposite side of the road. This area warrants more exploration.



Open land around Yafford



Shorwell and Yafford map

Wroxall and Ventnor

Wroxall and Ventnor are not mentioned in the 1991/92 survey as nobody reported seeing squirrels here until September 1997 when one squirrel was spotted in Castle Road. Today, there are regular road kills in Mitchell Avenue in Ventnor and St John’s Road in Wroxall, plus reports of squirrels feeding in gardens.

Other than in Wroxall Copse, sightings were scant nearer to the village until the turn of the 21st century, when they gradually increased. Thanks to the JIGSAW project, a corridor planted between Span Copse in Wroxall and Rew Copse in Upper Ventnor now links the two woods. In 2003 it was confirmed that squirrels had reached Span Copse when split hazel shells were found during a survey. Squirrels visit a garden at the bottom of Span Lane; they are seen arriving via a hedgerow from the direction of Ventnor. This area needs further investigation.

From Wroxall Copse to Wroxall village is via hedgerows. The old railway track between Wroxall and Shanklin provides a link to Shanklin. An alternative route between Wroxall and Shanklin is via woodland on St Martins Down, which meets with a corridor of trees to Shanklin Down.

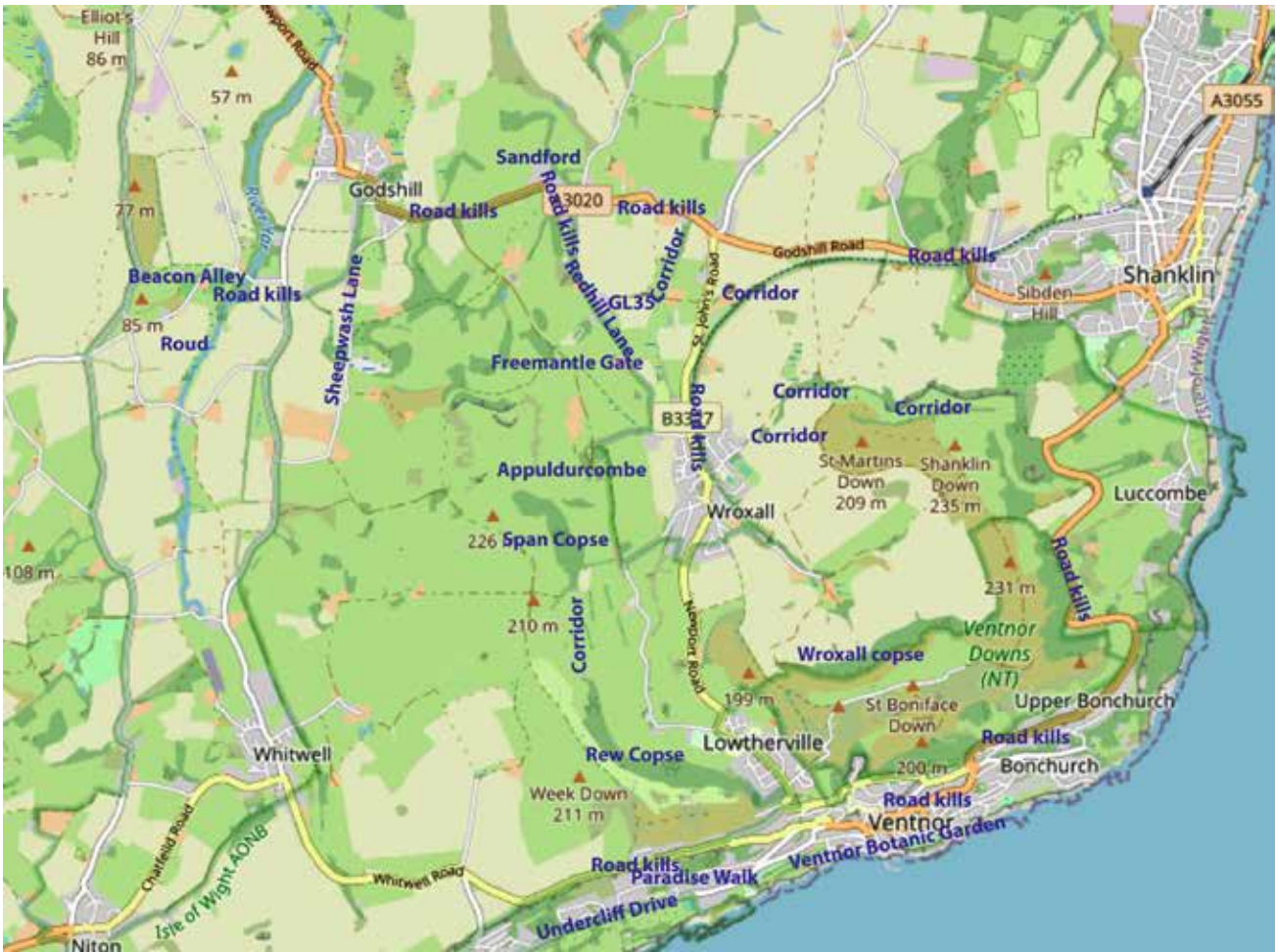
Sandford and Godshill are reached from Wroxall via small woods, hedges and hangers in and around Redhill Lane. Split hazelnuts were found on the GL35 footpath between Redhill Lane and the Donkey Sanctuary in autumn 2021, for instance. Residents in Redhill Lane feed squirrels in their gardens.

From Freemantle Gate, split hazelnuts in the hedgerow leading to Sheepwash Lane confirm that this route is used. From there, squirrels can travel on to Beacon Alley, Bagwich and Roud, although corridors are not strong for some of this route.

The public paths around Stenbury are lined with mature hedges which form a link to Whitwell, Godshill, Sheepwash, Nettlecombe and Sainham, all of which can be reached from Wroxall.

There is a link from Steephill Court Road to Pelham Wood and Paradise Walk (woodland). Paradise Walk borders the main road from Ventnor to Whitwell, where there are regular road kills.

Ventnor Botanic Garden has seen a steady rise in squirrel numbers. Regular road kills on Undercliff Drive confirm that squirrels cross the road at any point from Ventnor town all the way to Niton.



Wroxall and Ventnor map



North side of Span Down

Cridmore

Cridmore Estate has embraced the JIGSAW project and planted new woodland, added to existing woodland and planted in hedges to link woodland together. Previously the area was not the best red squirrel habitat as the woodlands were isolated. A survey in 2021 confirmed squirrels had reached all of the woodlands; a success for the JIGSAW project and a tribute to the estate.

The estate is large, in Isle of Wight terms, as it touches on Billingham, Appleford, Bleak Down and Rookley. Dispersal from the south-west is through Ashbridge Lane towards Kingston Copse. Surveys and reported sightings show squirrels will use this route. For example, in an un-named copse towards the end of Ashbridge Lane, a few split hazel shells were found on most surveys.

The first signs of squirrels reaching a new planting named Eds Wood were during a survey in the spring of 2021. Previously, there were no signs at all, even though the trees bore nuts and cones. High hedges are scant coming from the Appleford area, so perhaps the existing woodland plus new corridor links brought the squirrels to Eds Wood from woods within the estate. Improvement to corridors through Appleford to Dolcoppice and Head Down would aid dispersal.

Squirrels inhabit a strip of woodland between Godshill and Bagwich, which is large enough to provide some food and drey sites. Supplementary food is supplied in nearby gardens. To reach a copse on Cridmore Estate called 'The Wilderness', a gap in the corridor could be closed. Owing to the tree species in The Wilderness, plus the wet terrain in this copse, signs of squirrel presence are difficult to find during surveys. However, the gamekeeper does see squirrels here and in the small wood next to it.

Between Rookley and Cridmore Copse are well-grown hedgerows plus another small copse, reached by hedgerow from Highwood Copse. Used shells are found during all surveys in Cridmore Copse.



Ashbridge Lane



Well-grown conifers in Eds Wood, where it joins Appleford Road. Small woods and hedgerows can be seen in the distance



Cridmore Farm towards Chillerton



Another new planting with existing woods and corridors in the background



Overlooking Cridmore Estate



Cridmore map

Godshill and Roud

Food leavings were found in Beech Copse in 1992 and this woodland is the core area for the village. Squirrels have since spread and are found in gardens around the village. Also, surveys of the woodland at Godshill Park found that squirrel presence is consistent. From here, there are good well-grown hedgerows to Sainham and Wroxall. Split hazelnuts were found on the path from Sainham to Redhill Lane at Sandford via hangers and mature hedgerows. Road kills are a regular occurrence through the village.

The Budbridge area of Godshill is not so good for squirrels and one of the few places where the all-island surveys find scant evidence of squirrels feeding. There are boggy areas, where there are a lot of willow species, so not the best habitat for a red squirrel or for finding split hazel shells or stripped fir cones.

Garden sightings in gardens near Bridgecourt House plus food leavings during surveys prove squirrels are in this largely farmed area. Strengthening of the corridor between Whitwell Road and Bagwich Lane and towards Cridmore would aid dispersal. A landowner in Bagwich Lane is keen to plant a field with native trees to benefit red squirrels by providing a small habitat in the corridor link between Godshill and Cridmore. Partially tree-lined public paths lead squirrels to gardens on Newport Road; these are likely to be dispersing animals.

Heading south towards Whitwell, after crossing Beacon Alley, where they are regular road kills, there is a good corridor, albeit it poor for feeding as it's very wet and therefore comprises a lot of willows. This area could do with improvement.

Road kills at Sandford, on the outskirts of Godshill towards Shanklin, show that squirrels cross the road between habitat around Lessland and the woodland and gardens in Redhill Lane. JIGSAW planting has enhanced connectivity in this area and squirrels can disperse towards Arreton.

In 2021 a resident reported a small population of squirrels feeding in gardens in the hamlet of Roud, which lies to the south of Beacon Alley. The easiest route to reach Roud is from Godshill but squirrels could possibly arrive from the direction of Dolcoppice as a hedgerow extends most of the way to Roud. It would benefit dispersing animals to grow the hedges higher and thicker and plant more trees here. Roud joins the aforementioned corridor to Whitwell.



Roud to Beacon Alley corridor via public path



Good hedgerows in Roud



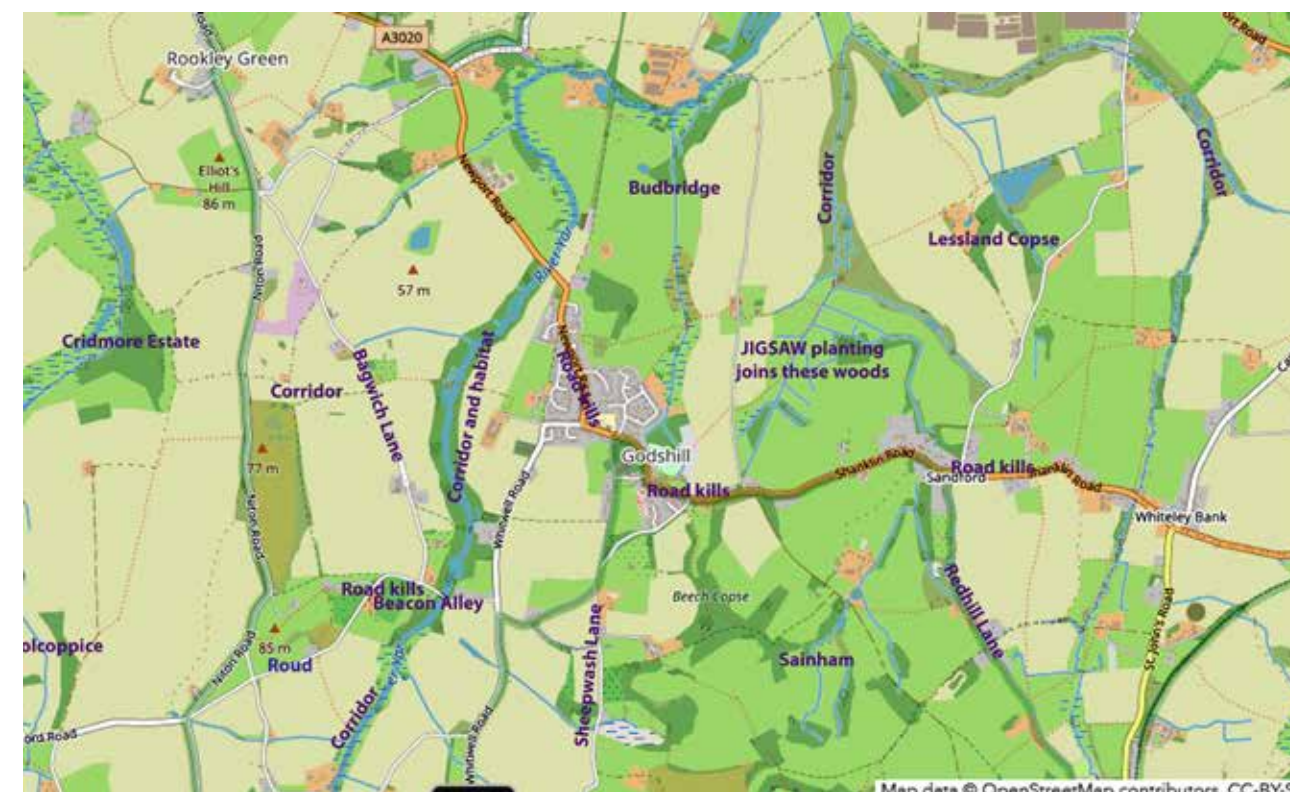
Riparian corridor from Roud to Whitwell



Corridor from Roud to Niton Road



From Niton Road towards Dolcoppice



Godshill and Roud map

Arreton and Merstone

This area is not mentioned in the 1991/92 corridor survey. Horringford Withy Bed is a long narrow strip of broadleaved trees with a stream that overflows into the copse in some places. Horringford Withy Bed is a good corridor link between Newchurch and Arreton and is of benefit to wildlife as an animal 'highway' as well as habitat.

There are hedgerows leading from the woodland, through the adjacent area of Wacklands to the east, reaching Newchurch and then on to Mersley. Planting hangers or enhancing hedgerows would help red squirrels and other animals disperse more easily.

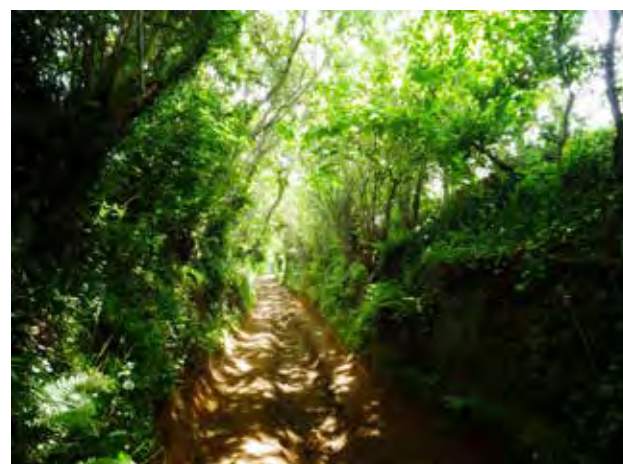
With open fields, hangers and hedges and a stream running through it, the area around the greenhouses in Macketts Lane looks an unlikely place to find squirrels; but they are here. A survey walk in the surrounding area in 2019, looking at corridor links, found a good link through to Godshill as outlined earlier. The mature hedgerows on the Macketts Lane site do contribute to this corridor link.

The byway from Arreton Cross is an excellent corridor with a good food supply in mature hedgerows and squirrels had taken advantage of the hazel crop here. The disadvantage is that it comes out onto a very busy stretch of road. Surprisingly, road kills are rare here. A series of hedgerows and hangers provide habitat and corridors towards Newport. Corridors link to the area of Standen, on to Shide and then into Newport. Road kills on Burnt House Lane are common.

Perreton Copse, which lies between Arreton and Merstone, is a small, isolated, broadleaved woodland. However, split nuts were found here in 2016. There is scattered woodland in the vicinity but the area is mostly open farmland.

Merstone has seen an increase in red squirrel activity and road kills are not uncommon, especially through the village, where squirrels are fed in gardens. The cycle route from Merstone heading towards Newport provides a corridor plus there are small woods where split hazelnuts are found on every survey. The cycle route also heads towards Arreton to meet up with woods where squirrel presence is confirmed.

At Bohemia Corner, where Merstone meets Rookley, road kills are a regular occurrence. This area is due to be explored further.



Arreton byway to Shide



Macketts Lane



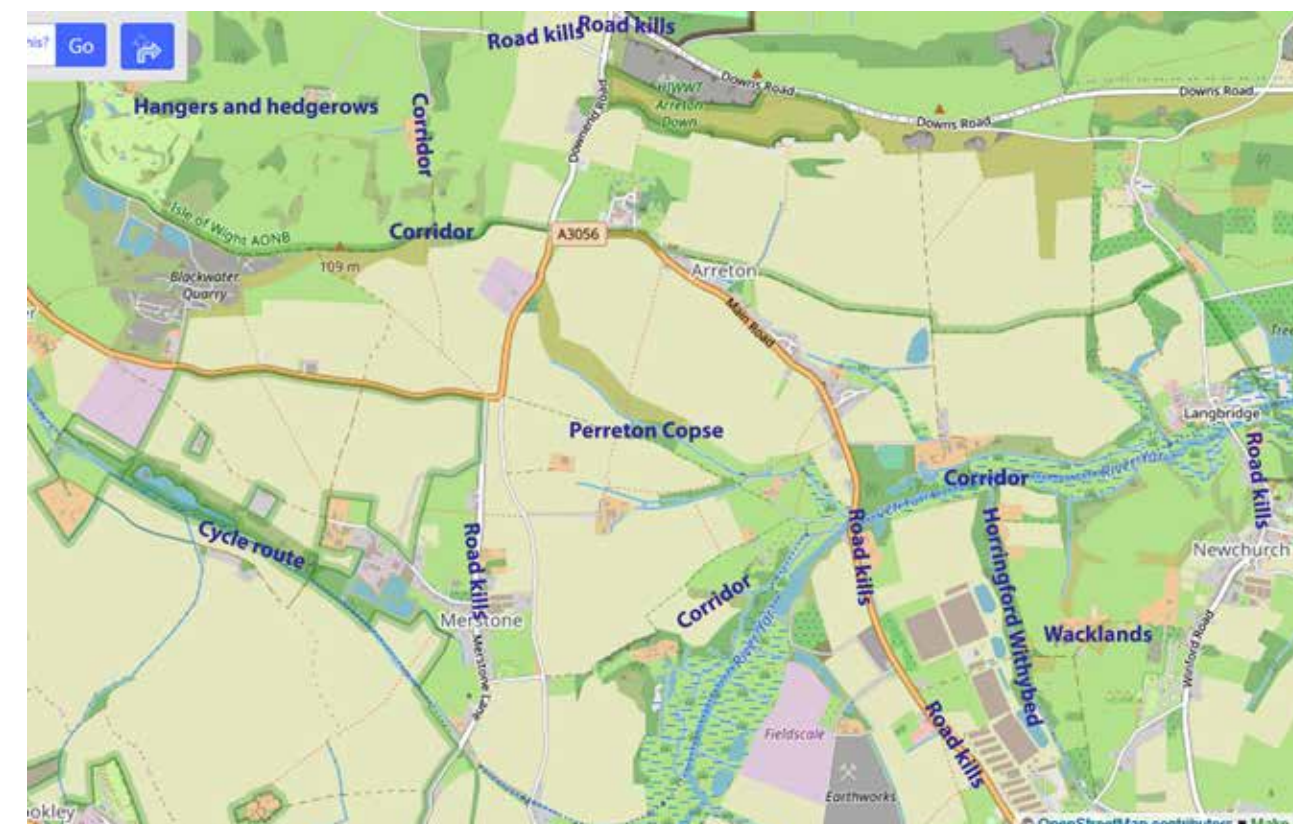
Looking across Arreton towards Newchurch and Shanklin



Uncut hedges, Wacklands



A more open aspect, Wacklands



Arreton and Merstone map

CONCLUSIONS

Although this is not the report intended when the study to look at corridor links started, it does provide enough insight into squirrel movement to be useful when determining where trees should be planted in future. This may be new woodland, corridors or simply bulking out hangers. Unquestionably, dispersal routes for red squirrels and other wildlife have improved over the past 30 years. Agriculture and housing must fit in with any planting schemes and landowners must be willing to accommodate trees for any project to succeed. However, JIGSAW has been a success and, encouragingly, there is news that there is more funding for tree planting. The author has been informed of plans for tree planting to significantly extend existing woods in West Wight and Central Wight.

Planting up corridors, both new and existing, with hazel in the species mix not only provides mammals with a food supply but also makes monitoring much easier. As the way that mammals open nuts is diagnostic, it's a very good tool for establishing where squirrels are, and split nuts in hedgerows identified corridors throughout this study. Hazel needs light to fruit, so hedgerows are perfect.

Since the rise in the common buzzard population, squirrel dreys are hidden far better than previously, so the method of locating squirrel dreys to indicate presence cannot be relied upon. Stripped honeysuckle is a useful indicator but is not found in all woodland. Hawthorn seeds are opened the same way as hazelnuts but not eaten as extensively as hazelnuts. Being much smaller also makes them much harder to spot in the leaf litter.

Camera traps are useful but liable to theft if used in a public area. Hairtubes are generally successful but more time- and labour-intensive. If tree planting is a priority, it should be possible to plant a few hazels in strategic places and it will save time for future surveyors.

What became apparent when annotating the maps, is how many road kill black spots there are on Isle of Wight roads. Places marked are only where more than one road kill has occurred in connection with corridor use, so the situation is actually worse. Traffic has certainly increased in the last 30 years and, coupled with the spread of red squirrels, road kills have inevitably risen and are likely to continue to do so as development on the island progresses.

Recent DNA testing (E. Hardouin et al. 2019, 2021) shows a distinction between the squirrel

population in West Wight and the rest of the island. The assumption may be made that woodland cover in the past has not aided squirrel dispersal across the whole island. A map from 1830 gives a clue to how this distinction may have occurred. There appears to be no sizeable woodland in the south of the island and the River Medina divides the northern part of the island. More testing is under way to see how far the squirrels have dispersed now that there are more wooded areas in the south and centre of the island.

Although all the intended survey walks were not completed, using other data, such as road kills and sightings, a picture is built to show how squirrels can disperse east to west and north to south, although not necessarily in a straight line. It will take a while before the benefits of JIGSAW are shown in DNA testing as squirrels will only move on to the next wooded area if there is food and they are not chased out by dominant animals. Therefore, DNA testing, say every five years, will tell how new corridor plantings are speeding dispersal.

The following examples explain how squirrels may, over time, disperse avoiding Newport, although it has been established that they do travel through the town centre. Looking at the maps will show that exiting West Wight to the east is through Bouldnor Forest and on to Shalfleet. Then via the riparian corridor from Newbridge and on to a hanger along Quarry Lane to Elm Lane and from there to Five Houses and Calbourne. Crossing the Calbourne Road, woodland leads to Bowcombe Road. Once across Bowcombe Road, Gatcombe is reached through various woods.

Crossing to Gatcombe Withy Bed, the corridor to Shide on the edge of Newport is reached. Crossing the main road is very risky and not all make it, but once safely across, hedges, hangers and small woods lead to Long Lane. From here, a route leads to Combley Great Wood, then, across the Havenstreet Main Road, Briddlesford Estate is reached. Firestone Copse is the next step from here. From Firestone Copse, squirrels can easily reach Puckers Copse and, if they make it safely across the main Ryde to Newport Road, Quarr is reached. From there an unbroken corridor reaches Ryde. From Ryde it is possible to travel on to Nettlestone. There are other routes and obviously it would take many generations of squirrels

moving in that direction to complete the journey.

From the north-west heading south, it's been established that squirrels can travel from Bouldnor Forest to Shalfleet and then there is a good corridor to Newbridge. From Newbridge, Calbourne is reached via Quarry Lane, Five Houses and then the complex of woods, linked by hedges, at Calbourne are accessed. Crossing the road at Swainston, the woodland at Rowridge meets hedges and woods the other side of the downs.

Once safely across the hazardous Bowcombe Road, hedgerows are short and there are gaps but they do lead to Gatcombe. Road kills on the Bowcombe Road indicate that squirrels use this route, however dangerous. Feeding evidence is also found. This route would benefit from new hedges and allowing the existing hedges to grow higher. From Gatcombe, Chillerton is reached and then it's on to the Cridmore Estate and Billingham area, where there is a link to Chale Green. From there, it's possible to travel on to Gladices Copse, Pyle Shute and Southdown, which runs to the coast.

On the eastern side of the River Medina, a coastal corridor starts from East Cowes in the north and runs to Wootton. Turning south through Brocks Copse and Lushington Copse, Lushington Hill is reached, where there are regular road kills. Once across the road, Wootton Common leads through to Station Road, where road kills are common. Across the road are corridors through Packsfield leading to Briddlesford Estate and, after crossing the Havenstreet Main Road, the complex of woods at Combley. Squirrels can travel to the Downs Road through Duxmore and cross towards Newchurch. There are occasional road kills here.

Tree cover is good through Newchurch and leads on to Alverstone. From Alverstone, the mosaic of small woods, hedges and hangers on the outskirts of Sandown are easily accessible bringing squirrels to Scotchells Brook and a busy roundabout where there are regular road kills. Squirrels making the crossing safely can travel through Scotchells to the holiday park at Landguard, where sightings are frequent.

Reaching Shanklin, where road kills in the town are common, there are woodland and parks to provide refuge. Travelling south along the coastal route, for example, the coastal corridor runs



1830 map showing few woodlands south of the River Medina or in the west of the Island

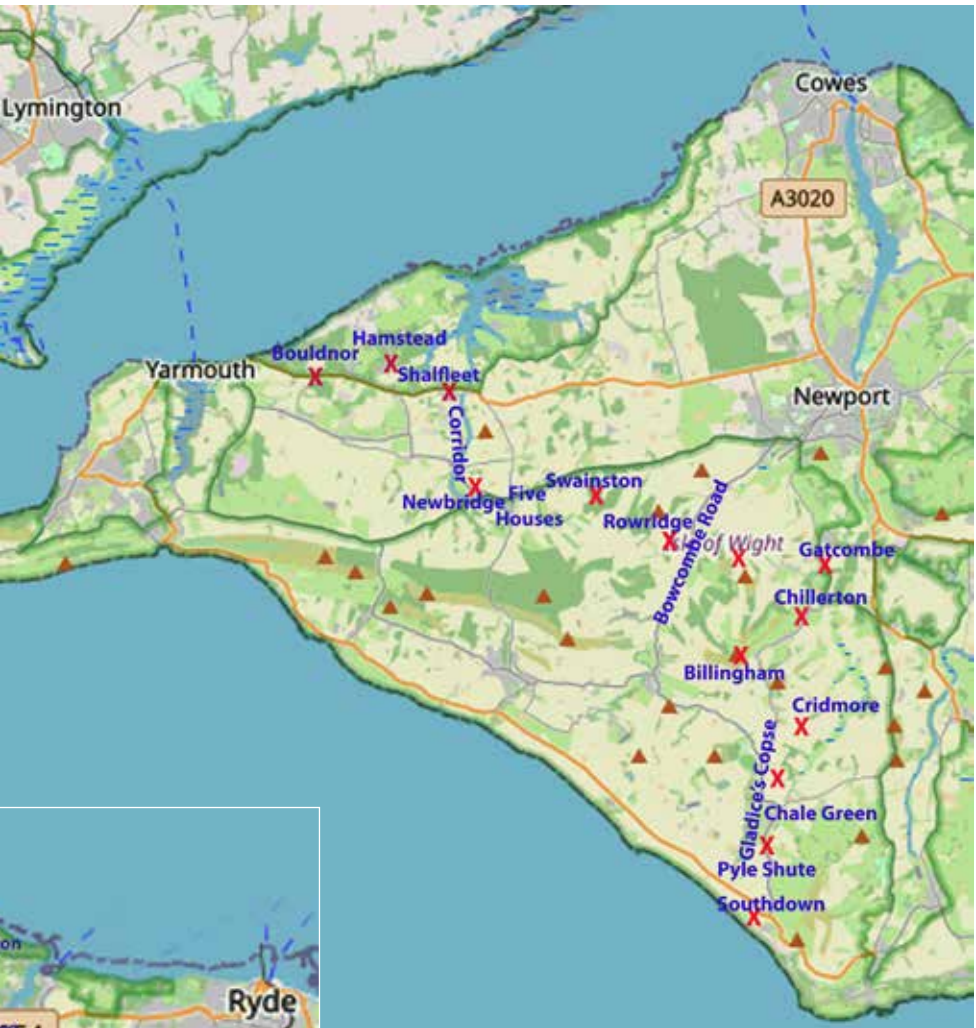
through Luccombe and Bonchurch to Ventnor.

Although great strides to enhance corridors and habitat have been made, it's evident that there is still room for more improvement. Tree planting schemes run through the Forestry Commission and the Woodland Trust, to offset climate change, should benefit any wildlife. It will be interesting to see how our red squirrels fare in the future. Other factors impacting red squirrels, such as human activities and urban living squirrels on the Isle of Wight, are discussed in later chapters.



One possible route west to east; there are several others

One possible route north to south, west of the River Medina



One possible route north to south, east of the River Medina

AREAS THAT WOULD BENEFIT FROM PLANTING

Suggestions are woodland or a corridor depending on landowner’s permission.

Saltern Wood, Yarmouth towards Freshwater

Atherfield to Shorwell

Brook and Shalcombe to Freshwater

Gurnard to Thorness

Whippingham to Binfield

Parkhurst to Porchfield

From Cothey Bottom Copse towards Bullen

Binstead (Dame Anthony’s Common) to Firestone

Thorley

Wellow

Newbridge

Swainston to Betty Haunt Lane

Hulverstone to Brighstone south of main road

Limerstone to Shorwell

Thorncross

Yafford

Berry Shute to Sandy Way, Shorwell

Rookley heading south

Godshill to Bagwich and on to Cridmore

Merstone

Wacklands, between Arreton and Newchurch

Adgestone

Over the top of Culver Down

Totland to Alum Bay and improve sycamore copse

From Tennyson Down woods to the north

Roud to Dolcoppice

Ashknowle Lane to Niton

Bowcombe Road area to Gatcombe

ACKNOWLEDGEMENTS

Copyright and Licence OpenStreetMap

“© OpenStreetMap contributors” data is available under the Open Database Licence.

REFERENCES

Hardouin, E. A., Baltazar-Soares, M., Schilling, A.-K., Butler, H., Garcia-Rodriguez, O., Crowley, E., Liang,, W.-J., Meredith, A., Lurz, P. W. W., Forster, J., Kenward, R. E., & Hodder, K. H. 2019. Conservation of genetic uniqueness in remaining populations of red squirrels (*Sciurus vulgaris* L.) in the South of England. *Ecology & Evolution*: 6547–6558.

Hardouin, E. A., Butler, H., Cvitanovic,, M., Ulrich, R. G., Schulze, V., Schilling, A.-K., Lurz, P. W. W., Meredith, A., & Hodder, K. H. 2021. Wildlife conservation in a fragmented landscape: the Eurasian red squirrel on the Isle of Wight. *Conservation Genetics* 22: 571–583.

PART 2
SECTION 3
CITIZEN SCIENCE



CONTENTS

Part 2 Section 3

	Page
Introduction	211
Chapter 1 Osborne House Estate, East Cowes	212
Chapter 2 Observations recorded in Firestone Copse by dog walker Christine Bowes	220
Chapter 3 Garden squirrels questionnaires	241
Chapter 5 A garden in Saltern Wood	246
Chapter 6 Garden squirrel observations by Lynn Hodges, East Cowes	249
Chapter 7 Observations by Peter Dugher in a garden adjoining Borthwood Copse	257
Chapter 8 Sightings from the general public	259
Chapter 9 Discussion	264
References	266
Acknowledgements	266.

INTRODUCTION

This section contains small-scale studies carried out by the general public, results from garden questionnaires and individual sightings submitted by members of the general public. Studies range from visitors reporting sightings on an estate, which is also a tourist attraction, to squirrels visiting gardens and daily dog walks in Firestone Copse. Although not strictly a scientific project, any snapshot of a location will always reveal an interesting insight and provide baseline data for a future study.

Citizen science is the catchy title used where individuals with no formal scientific training contribute to data collection or other research. Relating to red squirrels on the Isle of Wight, so many eyes spotting squirrels and reporting them has added a huge amount of data, which would otherwise be missed. It also may flag up problem areas that require further investigation. The people who submitted data for these studies did them without any prompting. This is rare.

Over the years, citizen science has rarely been contradicted by studies using scientific methodology. The majority of people sending in information have no specific scientific training but nevertheless are able to produce detailed studies. The Firestone Copse study in chapter 2 is an example of meticulous recording.

Chapter 8 in this section looks at single sightings sent in from the general public over 30 years from 1990. In section 4, all data, scientific and citizen science, is drawn together to build an overall picture of how red squirrels have spread across the island between 1990 and 2021. Anthropogenic influences are also discussed.

Judging how many squirrels are seen in a garden is subjective. Some people are very adept at distinguishing squirrels with different markings and behaviour, whilst others have difficulty. Time spent watching is also a factor influencing the results. The pros and cons of citizen science are discussed in chapter 9.

Road kills in particular rely heavily on people reporting the time and place a dead squirrel is seen. Equally, sick squirrels will visit gardens or a cat will kill a squirrel. Without the public reporting these incidents, knowledge would be far poorer. Red squirrels in attics and finding their way into houses and commercial buildings are also reported and indicate dispersal routes, albeit a flawed decision by the squirrel.

Apps are common nowadays, but 30 years ago it was telephone records or paper records collected at shows. The older generation are less keen on technology and still use the phone or tell us about their garden squirrels at shows. There is an online form on the Wight Squirrel Project website plus a downloadable app. However the entries come in, they are all entered into an Excel spreadsheet. A 1km grid reference is assigned to each sighting. Descriptions of where the squirrel was spotted are sometimes vague, so a best estimate is recorded, using information from the observer and local knowledge.

Chapter 1

OSBORNE HOUSE ESTATE, EAST COWES

Osborne House Estate, located on the coast in East Cowes, was home to Queen Victoria and Prince Albert. It is now a tourist attraction run by English Heritage. Habitat consists of mixed trees species in woodland and ornamental trees in a park setting. Scientific surveys over the past 30 years show that squirrels consistently use all parts of the estate. The six-month survey was carried out by visitors to Osborne House Estate.

English Heritage launched a red squirrel survey in 2012, aimed at engaging the general public in recording red squirrels seen in the grounds of Osborne House. As a visitor attraction there is plenty of potential for ‘citizen science’. The majority of visitors are from areas without red squirrels and are only too pleased to tell you they spotted a red squirrel.

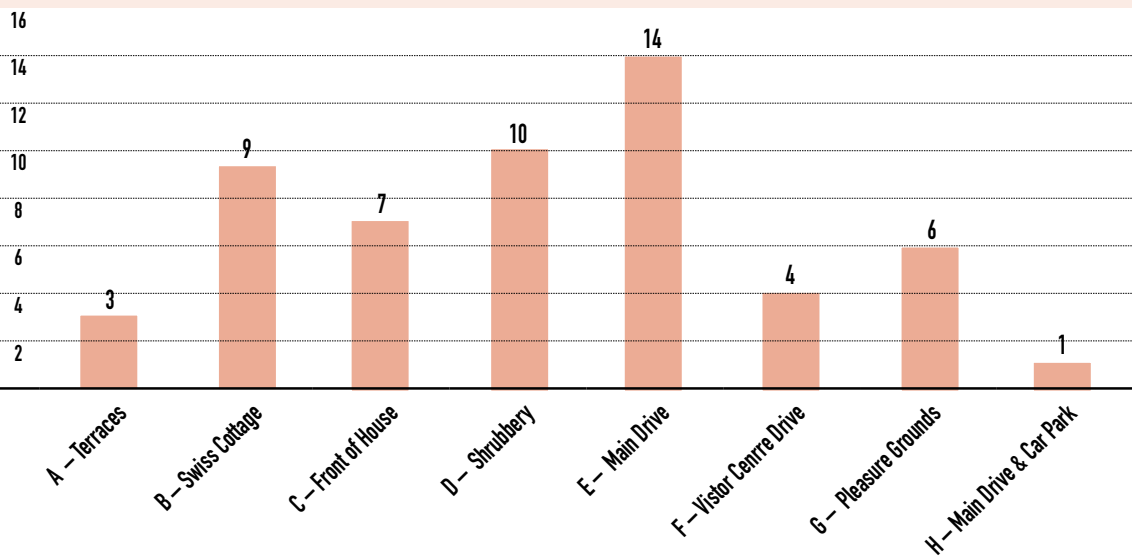
Cards were given to visitors so they could record where and when they saw a red squirrel. For many visitors, seeing a red squirrel at Osborne

was the first time they had seen a native squirrel and the highlight of their holiday. Several noted that the squirrels seemed quite comfortable around humans and seemingly struck a pose for the camera. Completed survey cards were handed back and the information input into an Excel spreadsheet by English Heritage, who sent it to Wight Squirrel Project so that the data could be added to the records.



Key to sections

Osborne House Estate results for March



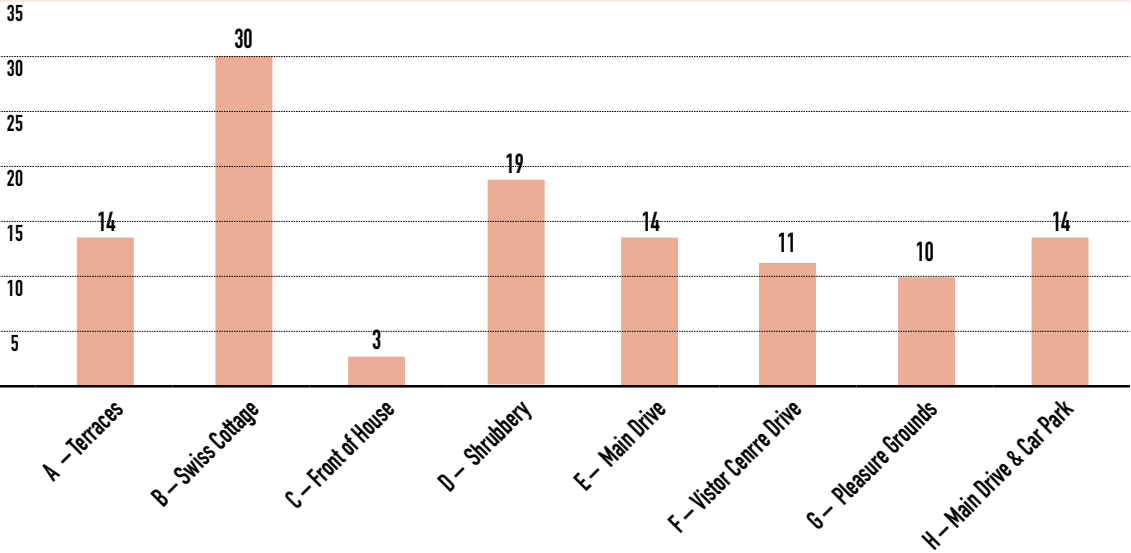
Osborne House Estate results for March

CARDS	49
SIGHTINGS	68
HOW MANY?	
A - Terraces	3
B - Swiss Cottage	9
C - Front of House	7
D - Shrubbery	10
E - Main Drive	14
F - Visitor Centre Drive	4
G - Pleasure Grounds	6
H - Main Drive & Car Park	1
WEATHER	
ACTIVITY	
Weather - sunny / Activity - walking or running	24
Weather - overcast / Activity - climbing or in trees	19
Weather - rainy / Activity - eating or digging for food	8
BEFORE 1PM	
AFTER 1PM	

March 2012 breakdown recorded by the general public for English Heritage

The numbers in all tables relate to how many times the public ticked a box for a particular activity and whether, or not, they recorded the weather. How many = 54. Weather = 51. Activity = 52. Time = 52.

Osborne House Estate results for April



Locations recorded by the general public

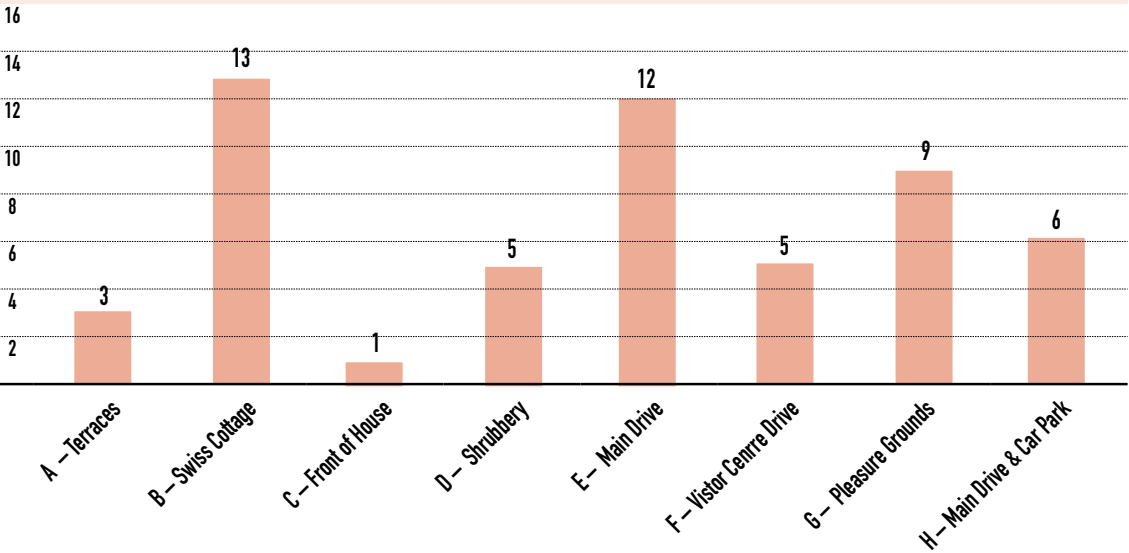
Osborne House Estate results for April

CARDS	108
SIGHTINGS	135
HOW MANY?	
A - Terraces	14
B - Swiss Cottage	30
C - Front of House	3
D - Shrubbery	19
E - Main Drive	14
F - Visitor Centre Drive	11
G - Pleasure Grounds	10
H - Main Drive & Car Park	14
WEATHER	
ACTIVITY	
Weather - sunny / Activity - walking or running	79
Weather - overcast / Activity - climbing or in trees	22
Weather - rainy / Activity - eating or digging for food	7
BEFORE 1PM	
AFTER 1PM	

How many = 115. Weather = 108. Activity = 115. Time = 112.

April 2012 breakdown recorded by the general public for English Heritage

Osborne House Estate results for May



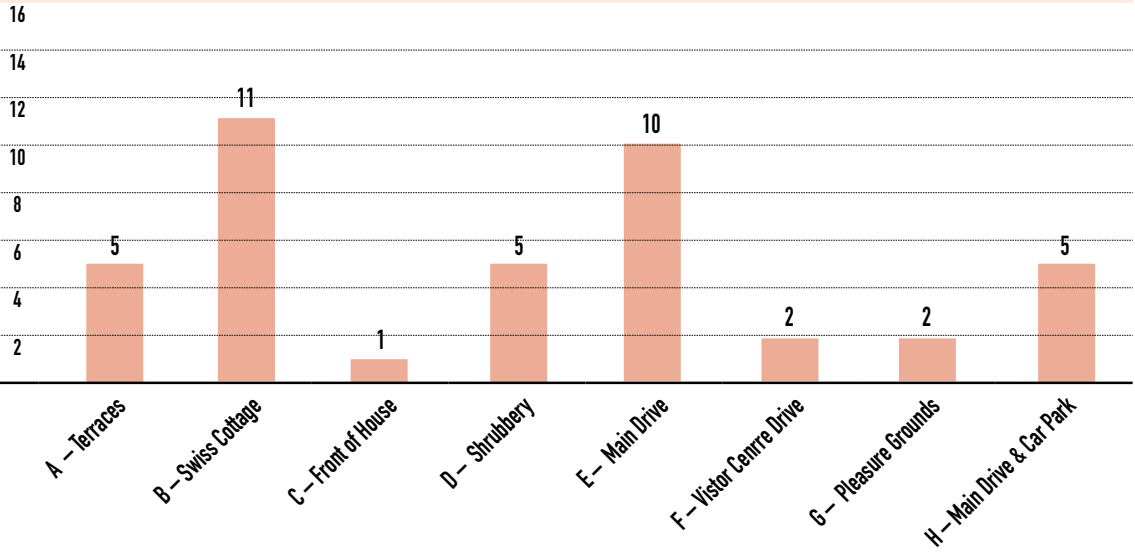
Osborne House Estate results for May

CARDS	54
SIGHTINGS	73
HOW MANY?	
A - Terraces	3
B - Swiss Cottage	13
C - Front of House	1
D - Shrubbery	5
E - Main Drive	12
F - Visitor Centre Drive	5
G - Pleasure Grounds	9
H - Main Drive & Car Park	6
WEATHER	
ACTIVITY	
Weather - sunny / Activity - walking or running	39
Weather - overcast / Activity - climbing or in trees	18
Weather - rainy / Activity - eating or digging for food	5
BEFORE 1PM	
AFTER 1PM	

How many = 54. Weather = 62. Activity = 62. Time = 62

May 2012 breakdown recorded by the general public for English Heritage

Osborne House Estate results for June

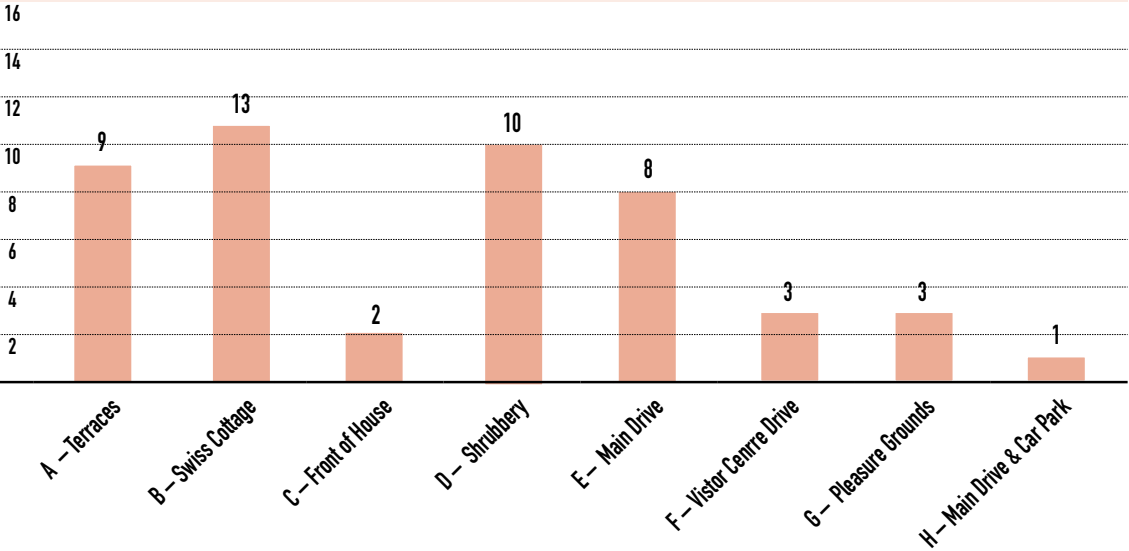


Osborne House Estate results for June

CARDS	41
SIGHTINGS	55
HOW MANY?	
A - Terraces	5
B - Swiss Cottage	11
C - Front of House	1
D - Shrubbery	5
E - Main Drive	10
F - Visitor Centre Drive	2
G - Pleasure Grounds	2
H - Main Drive & Car Park	1
WEATHER ACTIVITY	
Weather - sunny / Activity - walking or running	30 25
Weather - overcast / Activity - climbing or in trees	7 10
Weather - rainy / Activity - eating or digging for food	4 7
BEFORE 1PM	11
AFTER 1PM	30

June 2012 breakdown recorded by the general public for English Heritage
How many = 37. Weather = 41. Activity = 42. Time = 41.

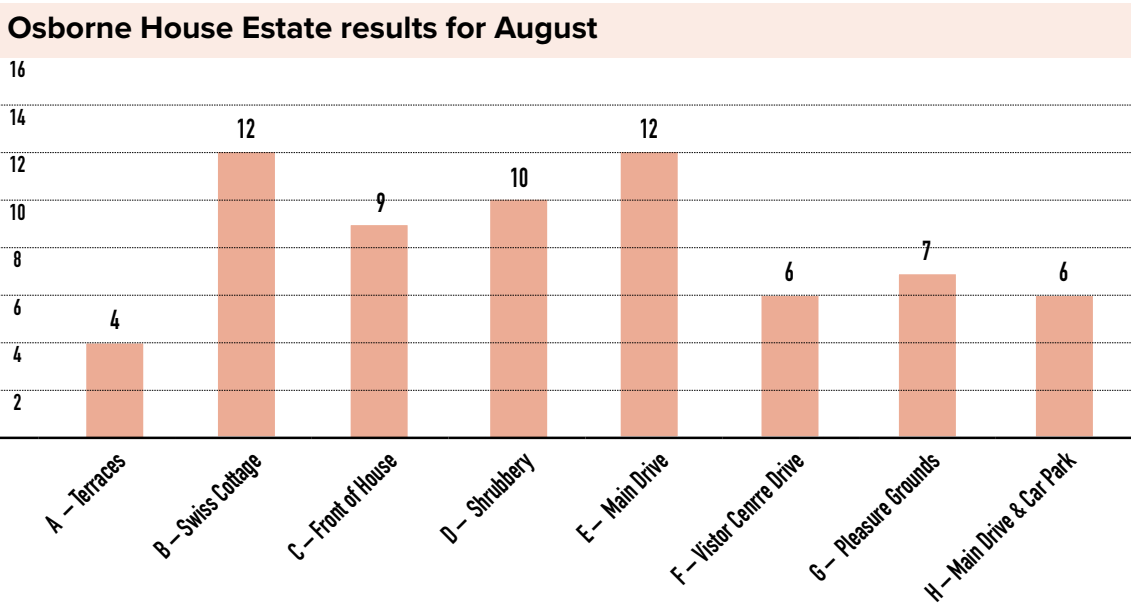
Osborne House Estate results for July



Osborne House Estate results for July

CARDS	47
SIGHTINGS	61
HOW MANY?	
A - Terraces	9
B - Swiss Cottage	13
C - Front of House	2
D - Shrubbery	10
E - Main Drive	8
F - Visitor Centre Drive	3
G - Pleasure Grounds	3
H - Main Drive & Car Park	1
WEATHER ACTIVITY	
Weather - sunny / Activity - walking or running	35 27
Weather - overcast / Activity - climbing or in trees	15 19
Weather - rainy / Activity - eating or digging for food	1 4
BEFORE 1PM	26
AFTER 1PM	26

July 2012 breakdown recorded by the general public for English Heritage
How many = 49. Weather = 51. Activity = 50. Time = 52



Osborne House Estate results for August		
CARDS	60	
SIGHTINGS	70	
	HOW MANY?	
A - Terraces	4	
B - Swiss Cottage	12	
C - Front of House	9	
D - Shrubbery	10	
E - Main Drive	12	
F - Visitor Centre Drive	6	
G - Pleasure Grounds	7	
H - Main Drive & Car Park	6	
	WEATHER	ACTIVITY
Weather - sunny / Activity - walking or running	32	38
Weather - overcast / Activity - climbing or in trees	32	29
Weather - rainy / Activity - eating or digging for food	2	5
BEFORE 1PM	19	
AFTER 1PM	47	

August 2012 breakdown recorded by the general public for English Heritage

How many = 66. Weather = 66. Activity = 72. Time = 66

Osborne House Estate Conclusions

The peak in April may be due to the first dispersal of young. During June and July natural food is generally short, so squirrels forage in gardens, or in this case, the adjacent golf course, where supplementary food is supplied. Given that this area is not open to the general public, sightings would be fewer.

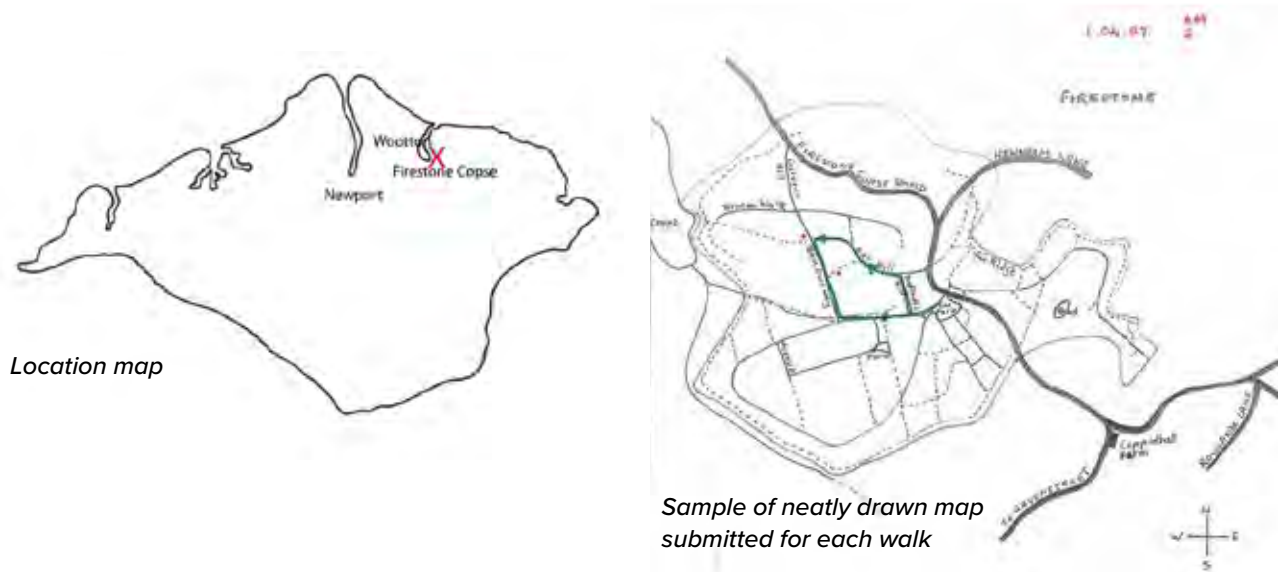
More than 350 people took part in the survey and recorded where they saw squirrels and what they were doing. Most squirrels were sighted alone and running on the ground, with the majority spotted in the quieter areas near Swiss Cottage. Almost as many squirrels were seen on the main drive – right in front of the house – indicating that Osborne’s squirrels have become habituated to human presence.

Weather will have an influence on sightings, either because the squirrels are keeping out of the rain or because visitors are fewer due to inclement weather. In 2012 the weather was particularly wet. As a visitor attraction, Osborne is busier during holiday time, so it is assumed that when more people are visiting the estate, more sightings are recorded.

Visitors do occasionally use Wight Squirrel Project’s online form or app to report sightings from Osborne Estate but they are scant compared to the 2012 survey. Without a concerted effort to encourage the general public, data collection is less successful.

Chapter 2

OBSERVATIONS RECORDED IN FIRESTONE COPSE BY DOG WALKER CHRISTINE BOWES



A regular dog walker in Firestone Copse, Christine Bowes, undertook to write down and map where she saw red squirrels. She then sent the results to Wight Squirrel Project. The maps showing the route and where squirrels were seen are very neatly drawn. Christine contributed well-documented sightings, with maps, relating to her dog walks in Firestone Copse.

The data started in April 2007 and ended in March 2010, with several breaks in this time. Firestone Copse is very well used by dog walkers but most people do not bother to send in sightings as they presume we know there are squirrels in the wood.

Firestone has seen bi-annual woodland monitors come and go over the years and this data is in the previous section. There are entries in the general sighting database, which is included in the overall picture in a later chapter.

Initially, an attempt was made to identify deciduous and coniferous areas but given the overall composition of the woodland, this could not be done with any accuracy. Firestone Copse is very much a mixed woodland, although there are small stands of coniferous trees and hazel coppice.



Conifer standards with broadleaf understorey

Results for observations recorded in Firestone Copse by dog walker Christine Bowes

Results are given in annual tables. There are gaps in the walks and in 2008 only one walk was undertaken. Walks are also sparse from April 2009 to 2010.

A total of 577 walks were recorded over the period. Eight times the weather was recorded, all given as wild and wet. On these occasions no squirrels were spotted. Squirrel sightings were higher in the morning than the afternoon but that is normal as it's their most active time, hence the bi-annual walks taking place at dawn.

A total of 644 sightings are recorded altogether. The highest number of squirrels spotted on one walk was 12, on both 3rd April and 5th June 2007.

On 50 days a Firestone walk was undertaken once in the morning and once in the afternoon. Otherwise, it was a random choice. Walk routes also varied.

Total walks 1st April 2007 to 31st March 2008	407
Total days (am and pm) with squirrel sightings	278
Number of walks with sightings am	147
Number of walks with sightings pm	131
Walks with no sightings	129
Total squirrels	596

Average per walk: 1.46

Total walks 1st April 2008 to 31st March 2009	1
Total days (am and pm) with squirrel sightings	1
Number of walks with sightings am	0
Number of walks with sightings pm	1
Walks with no sightings	0
Total squirrels	3

Average per walk: 3

Total walks 1st April 2009 to 31st March 2010	162
Total days (am and pm) with squirrel sightings	39
Number of walks with sightings am	29
Number of walks with sightings pm	10
Walks with no sightings	123
Total squirrels	45

Average per walk: 0.28

Total walks 1st April 2007 to 31st March 2010	570
Total days (am and pm) with squirrel sightings	318
Number of walks with sightings am	176
Number of walks with sightings pm	142
Walks with no sightings	252
Total squirrels	644

Average per walk: 1.1

Chapter 3

GARDEN SQUIRRELS QUESTIONNAIRES

Introduction

As this chapter relates primarily to data and statistics, the pros and cons of supplementary feeding is not debated. Whatever your opinion of feeding wildlife in gardens, parks or woodland, it will happen. If people are allowed to see and care for squirrels, they are far more likely to support them. The right diet is as important for red squirrels as for us – or any species. Wight Squirrel Project produces leaflets for people with ‘garden’ squirrels outlining the hazards found in a garden setting plus promoting a nutritious diet and how to keep feeders clean. Newsletters and the Wight Squirrel Project website also promote good practice when it comes to looking after red squirrels in the garden.

The people who dedicated themselves to logging their squirrels produced this data, which gives an insight into ‘garden’ squirrels on the Isle of Wight. It is not stand-alone data as it forms part of larger studies and data sets but it provides an interesting snapshot into the life of our native red squirrels.

Methodology

Questionnaires are a little more scientific than one-off sightings but do rely on personal observations from the general public, which are, at best, subjective. Few people consistently filled in the annual questionnaire, although neighbours sometimes did, therefore the data relates to the same population of squirrels.

Perception of colour, size or age may differ between observers, so although this is all useful information, it is not scientifically sound. It does, however, give an indication of population fluctuations and does accord with other data sets and surveys. It is important to know when squirrels stop visiting and follow up to ascertain the reason why. This is often due to trees being cut down or a predatory cat.

Garden Squirrels Questionnaire Please circle your answers. Thank you for your time.

Name & address.....

Postcode..... DATE.....

Do squirrels visit:	Most days	Most weeks	Occasionally
The average number in:			
Winter	1 or 2	2-5	Over 5
Spring	1 or 2	2-5	Over 5
Summer	1 or 2	2-5	Over 5
Autumn	1 or 2	2-5	Over 5

Over the last year have squirrels: Increased Decreased Remained Stable

Did you notice any juveniles? Yes No

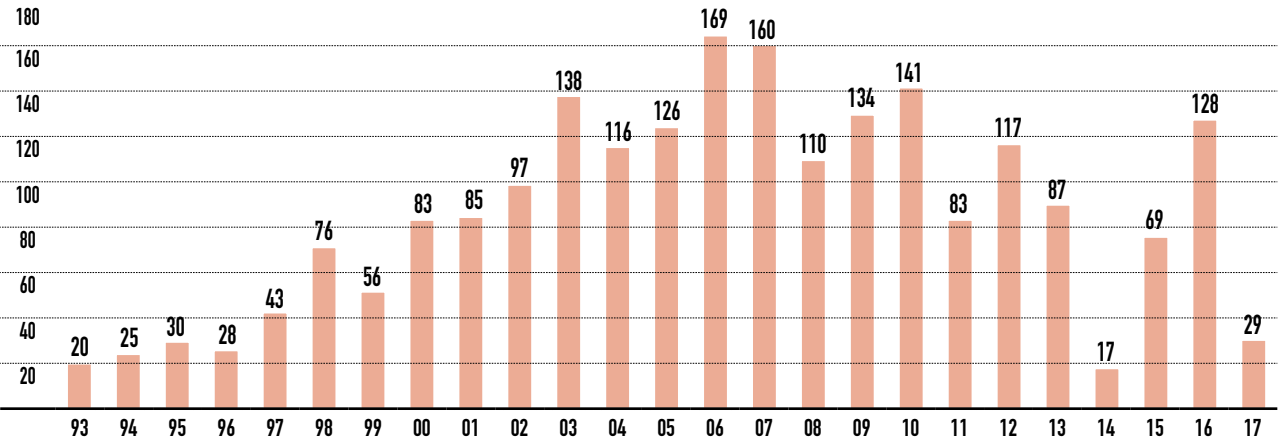
Please post to the address below. Alternatively, fill in the online questionnaire - www.wightsquirrels.co.uk

It's important to know if your squirrels have stopped coming. Disappearing temporarily in the autumn doesn't count!!!

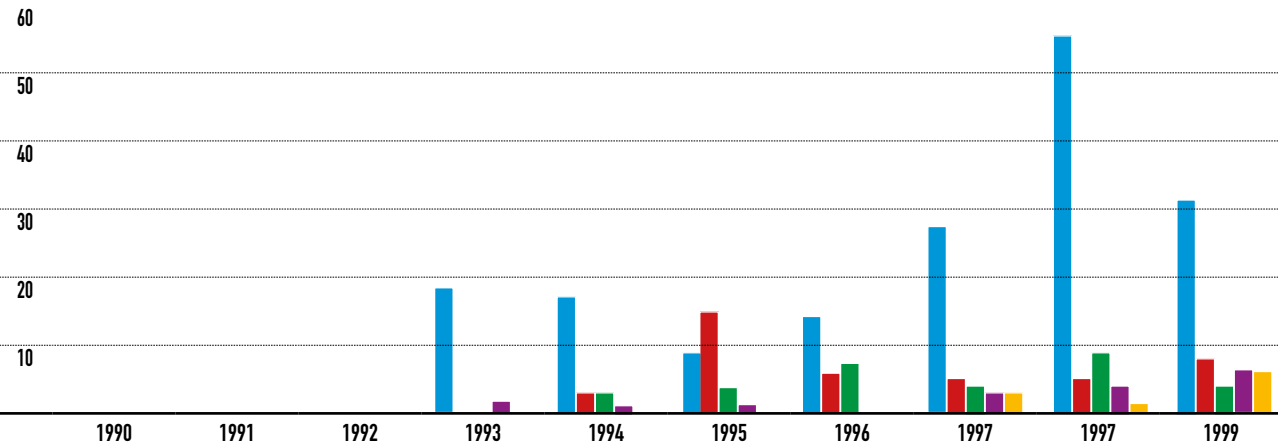
DON'T FORGET THE POSTCODE!

Example of questionnaire from the annual newsletter

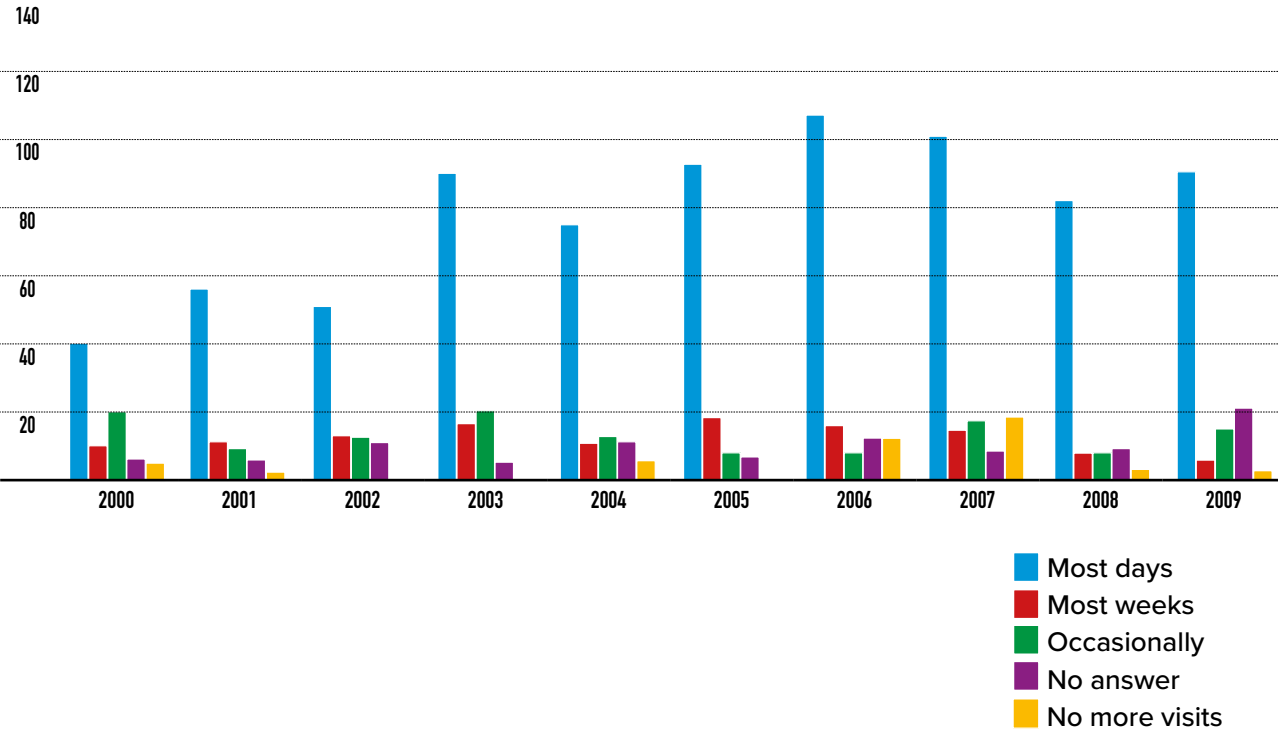
Garden questionnaire returns, 1993–2017



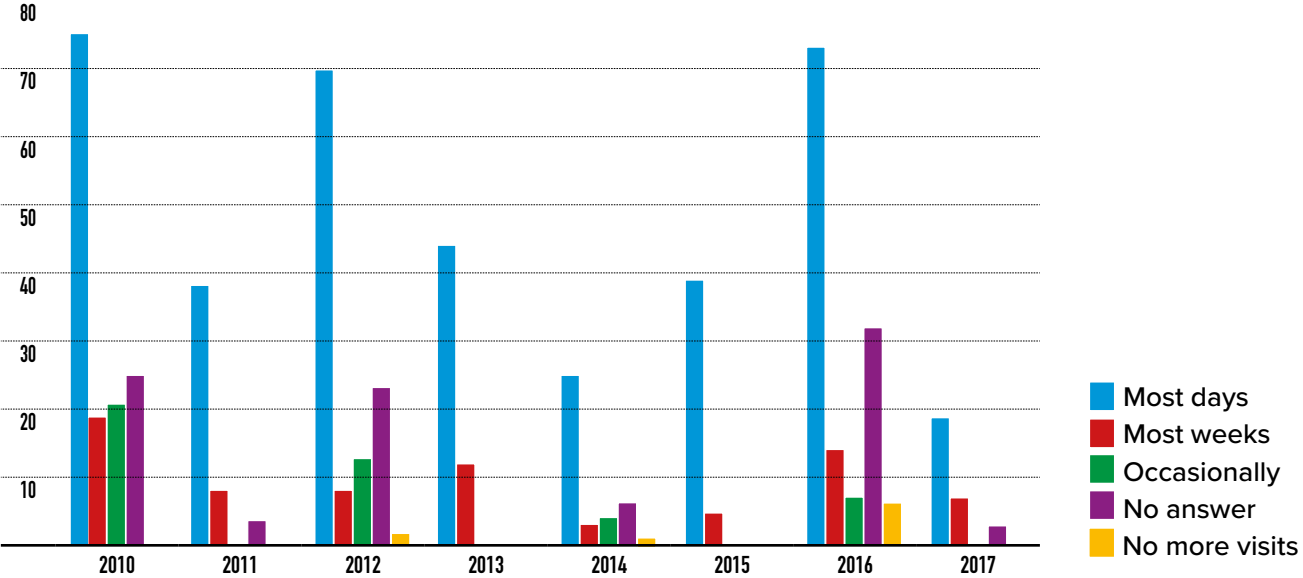
Frequency of visits to gardens, 1993–1999



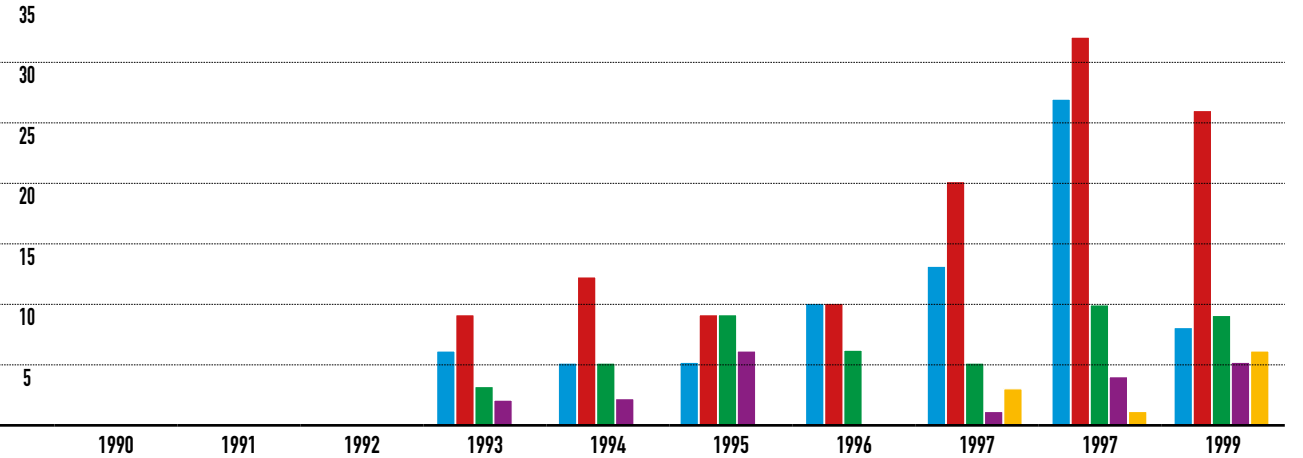
Frequency of visits to gardens, 2000–2009



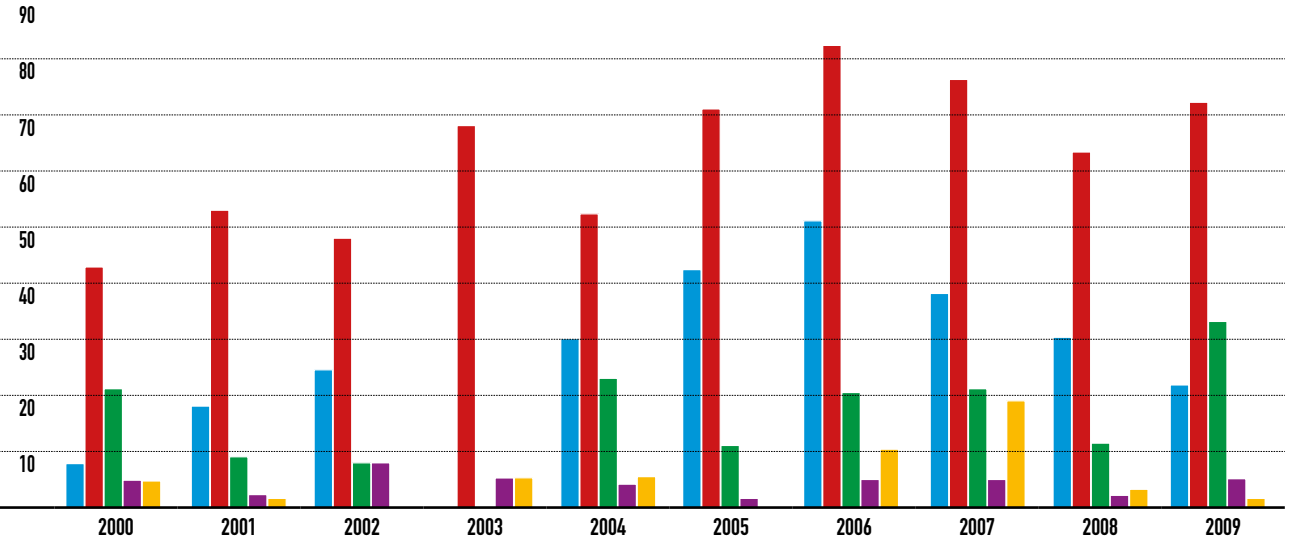
Frequency of visits to gardens 2010–2017



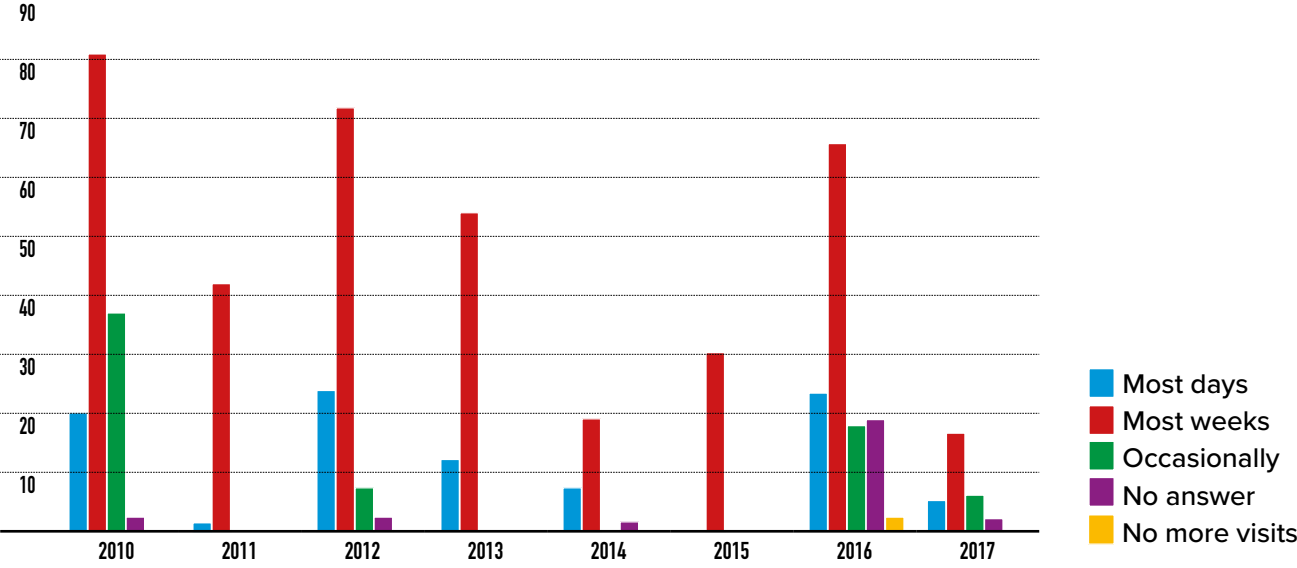
Changes in squirrel numbers for years 1993–1999



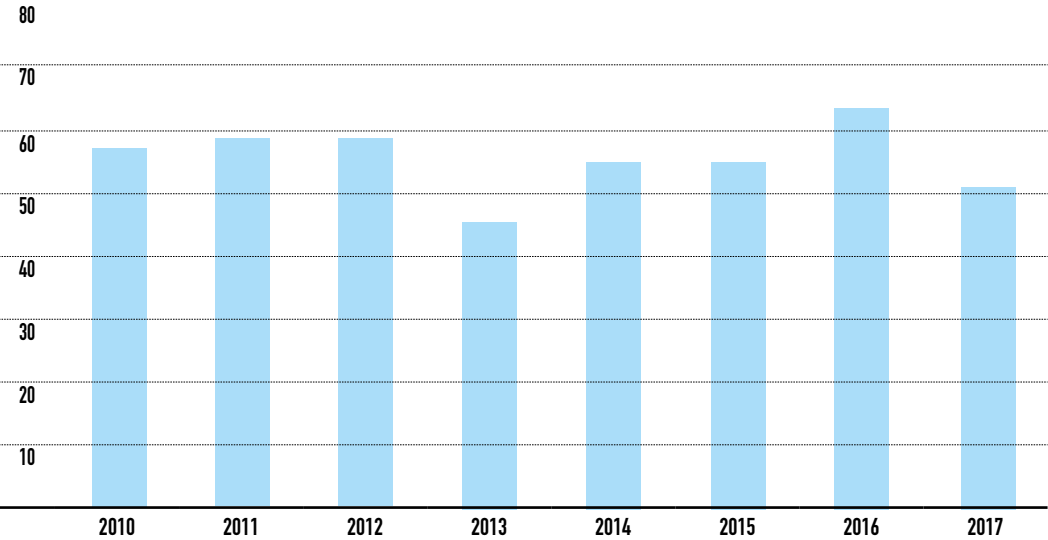
Changes in squirrel numbers for years 2000–2009



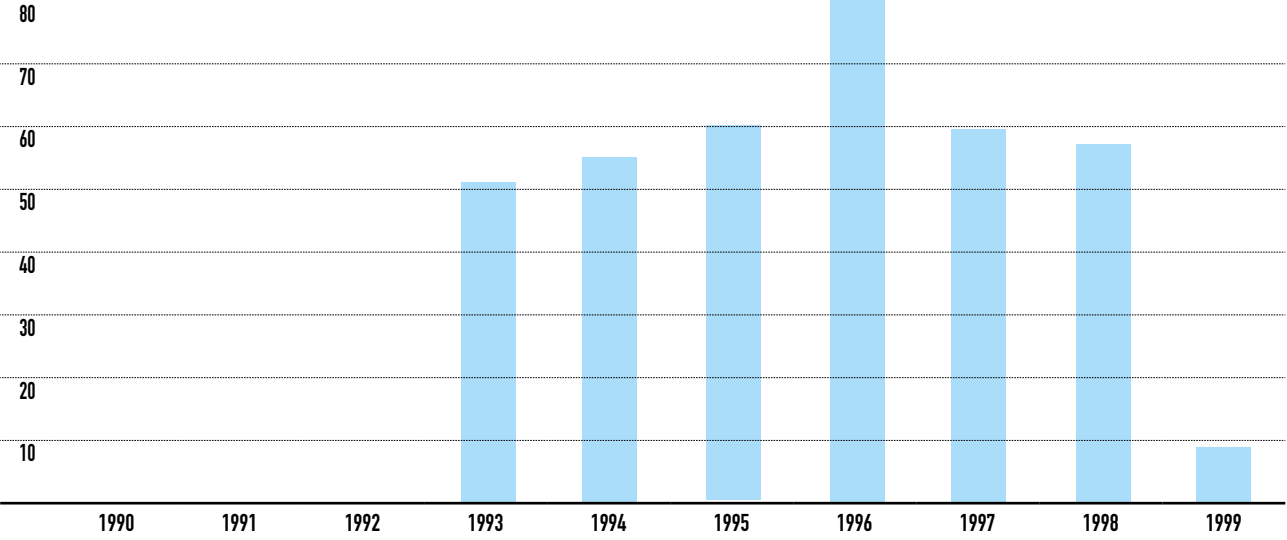
Changes in squirrel numbers for years 2010–2017



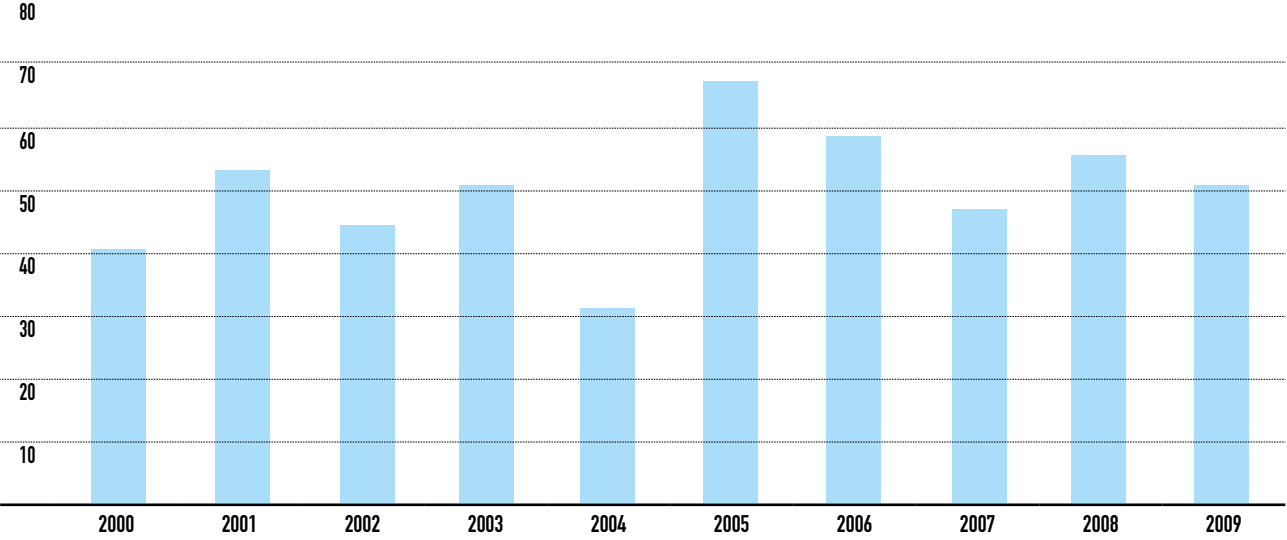
Percentage seeing young 2010–2017



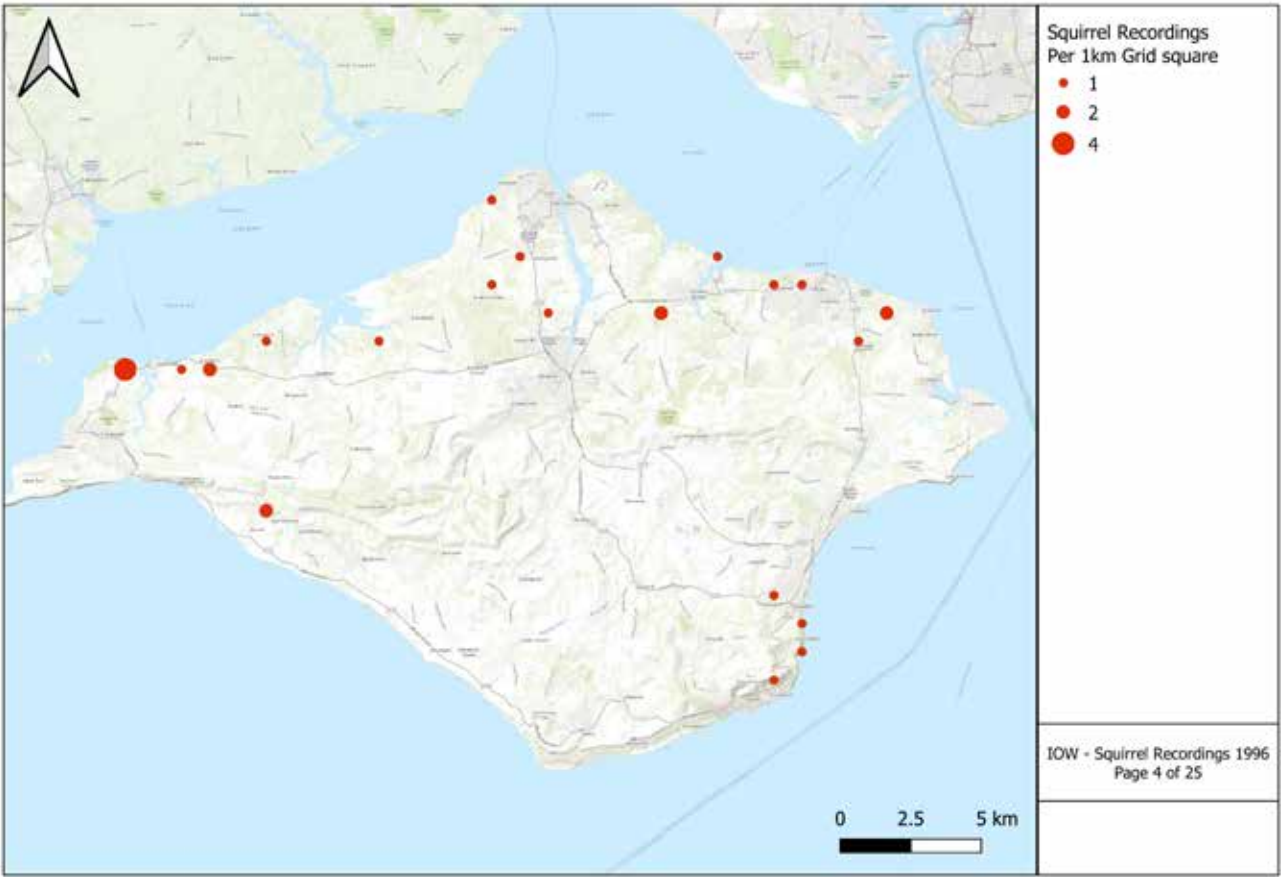
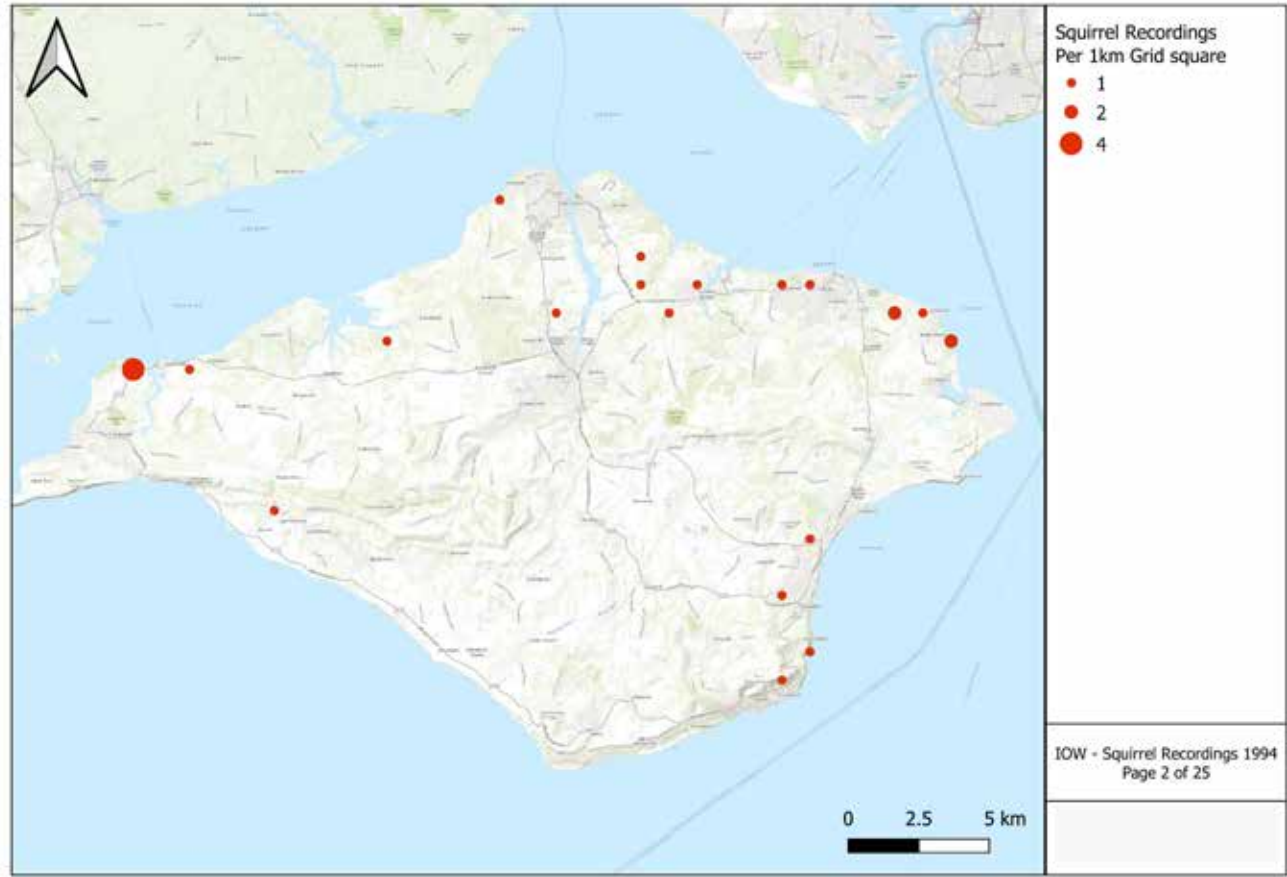
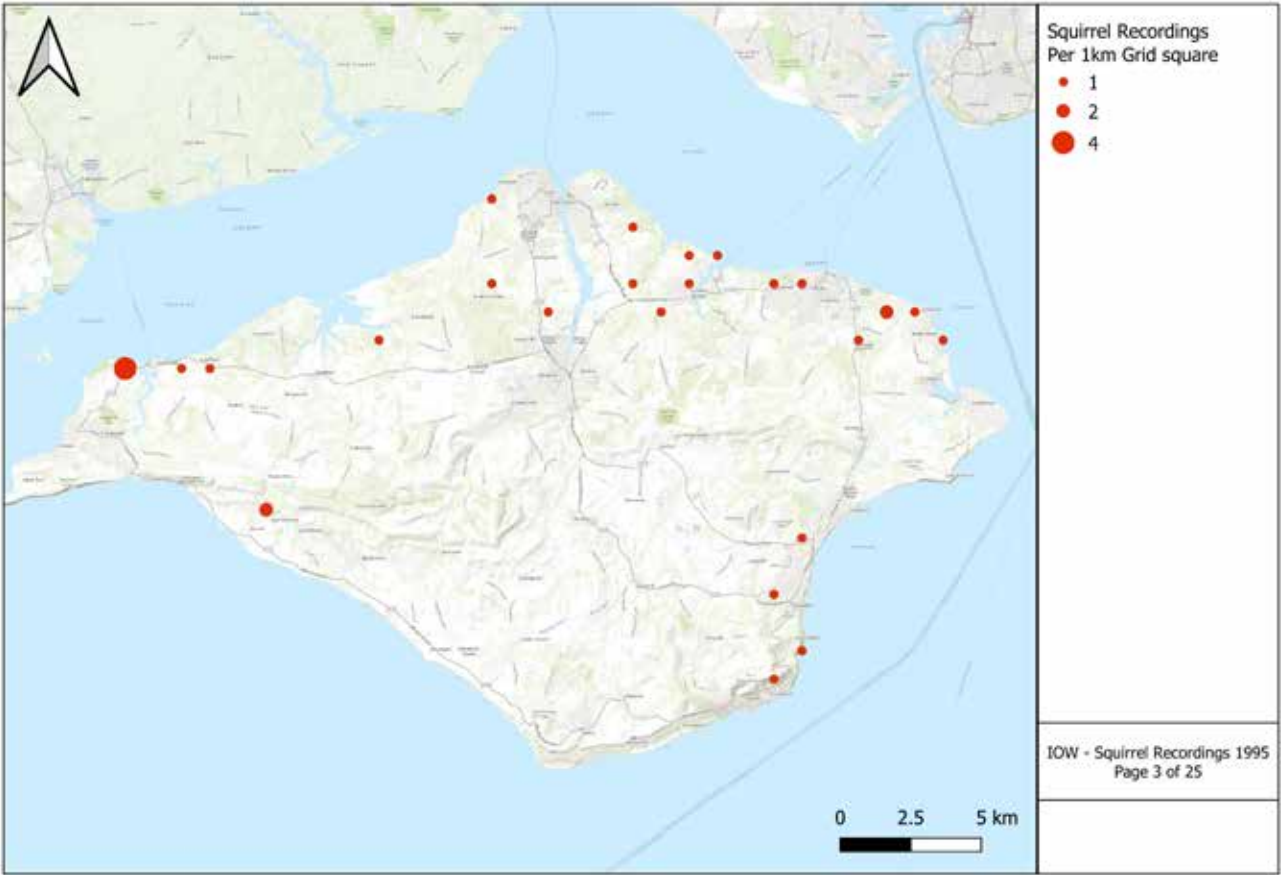
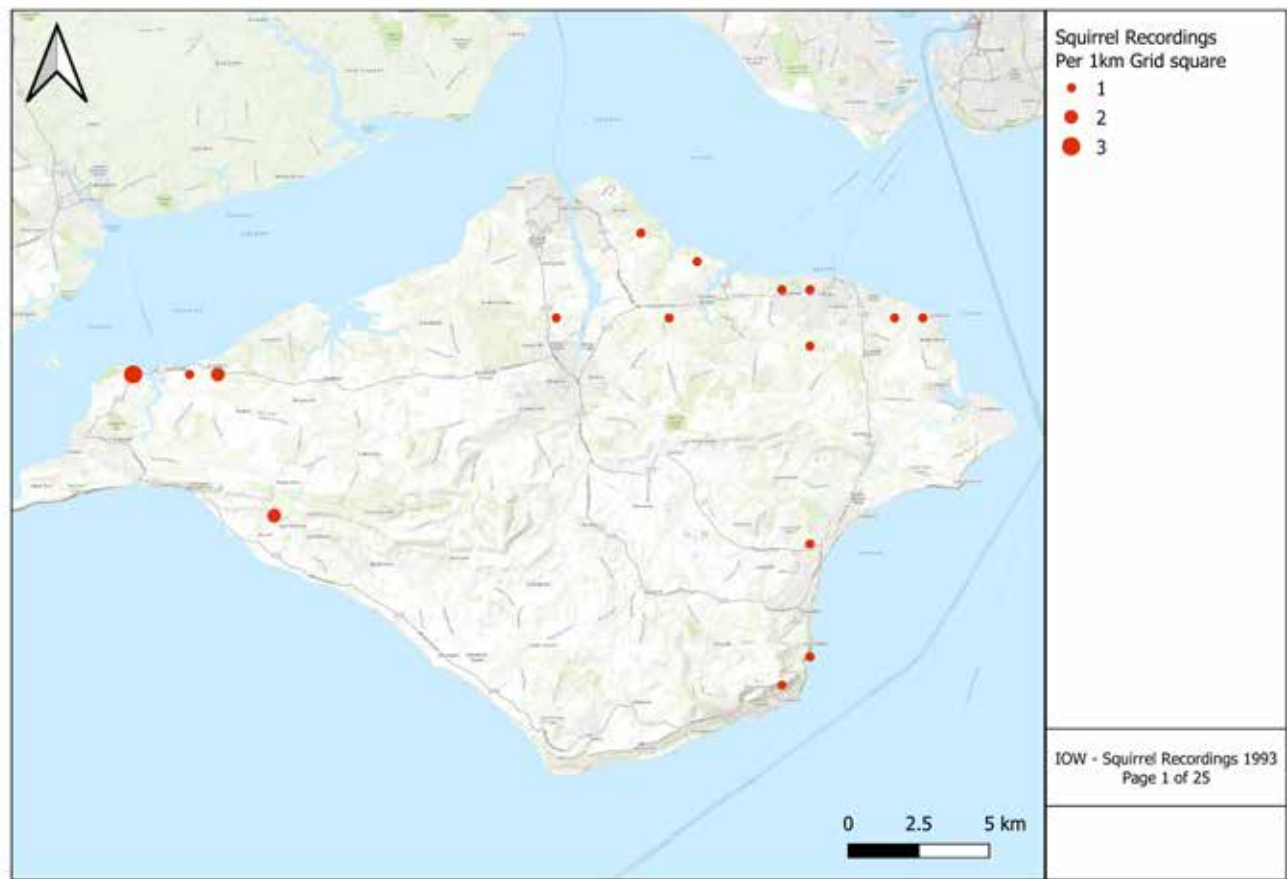
Percentage seeing young 1993–1999

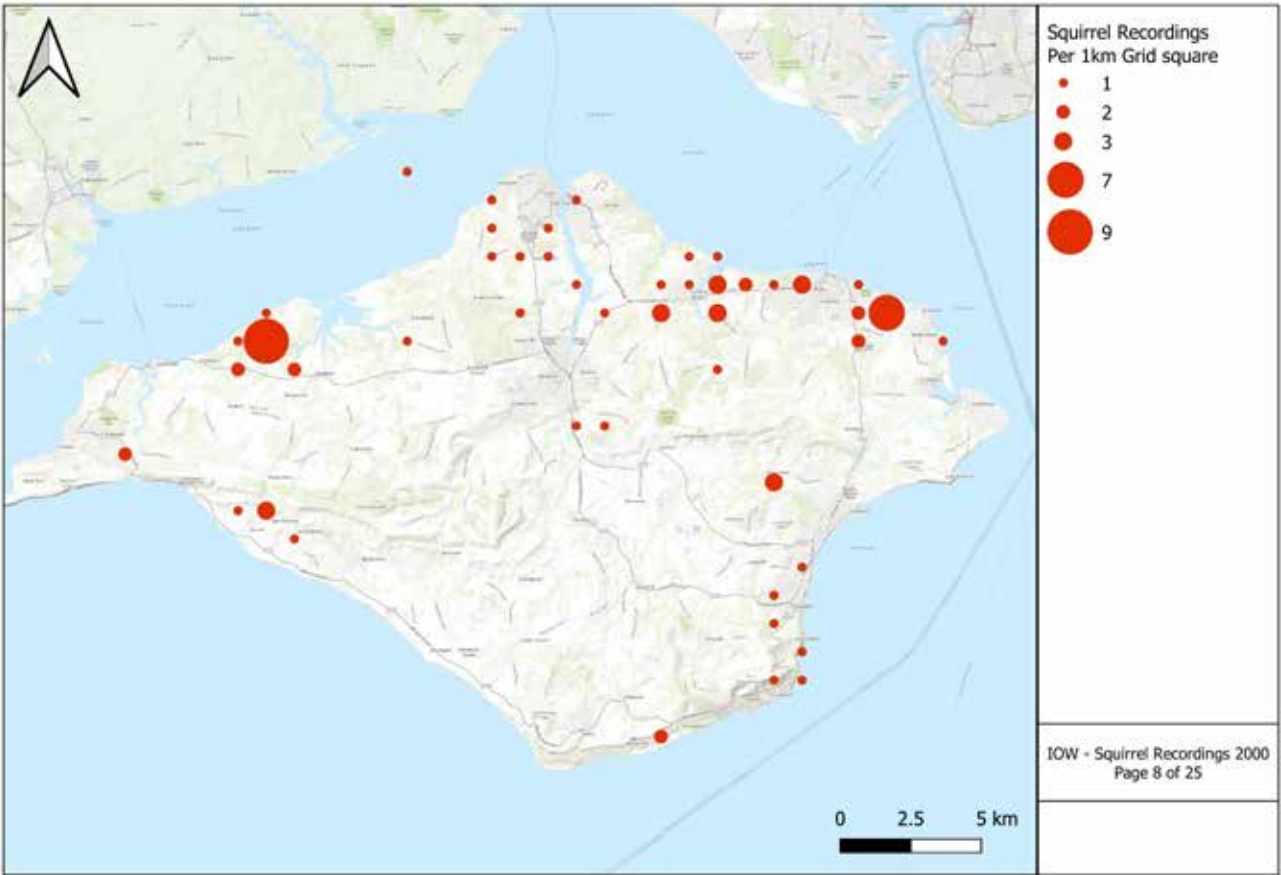
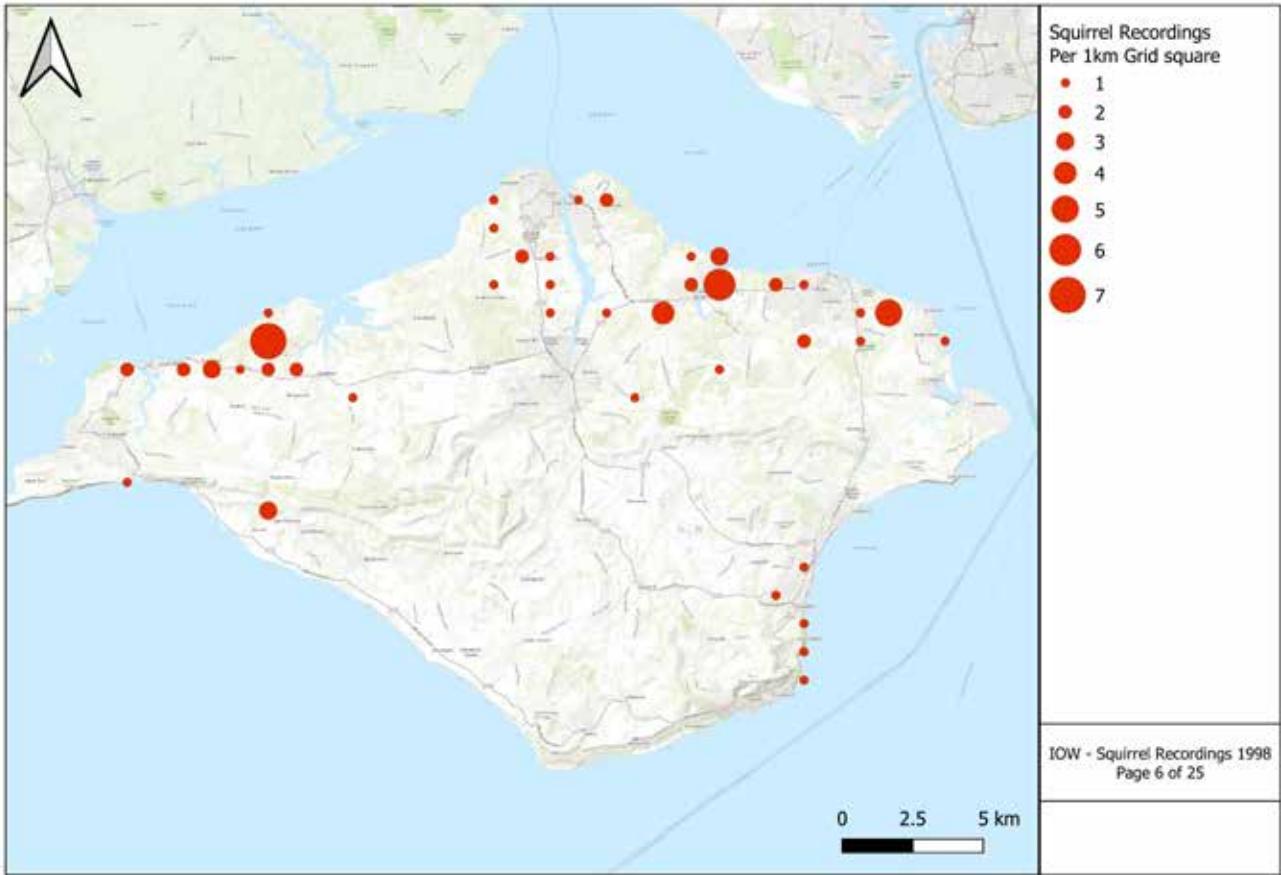
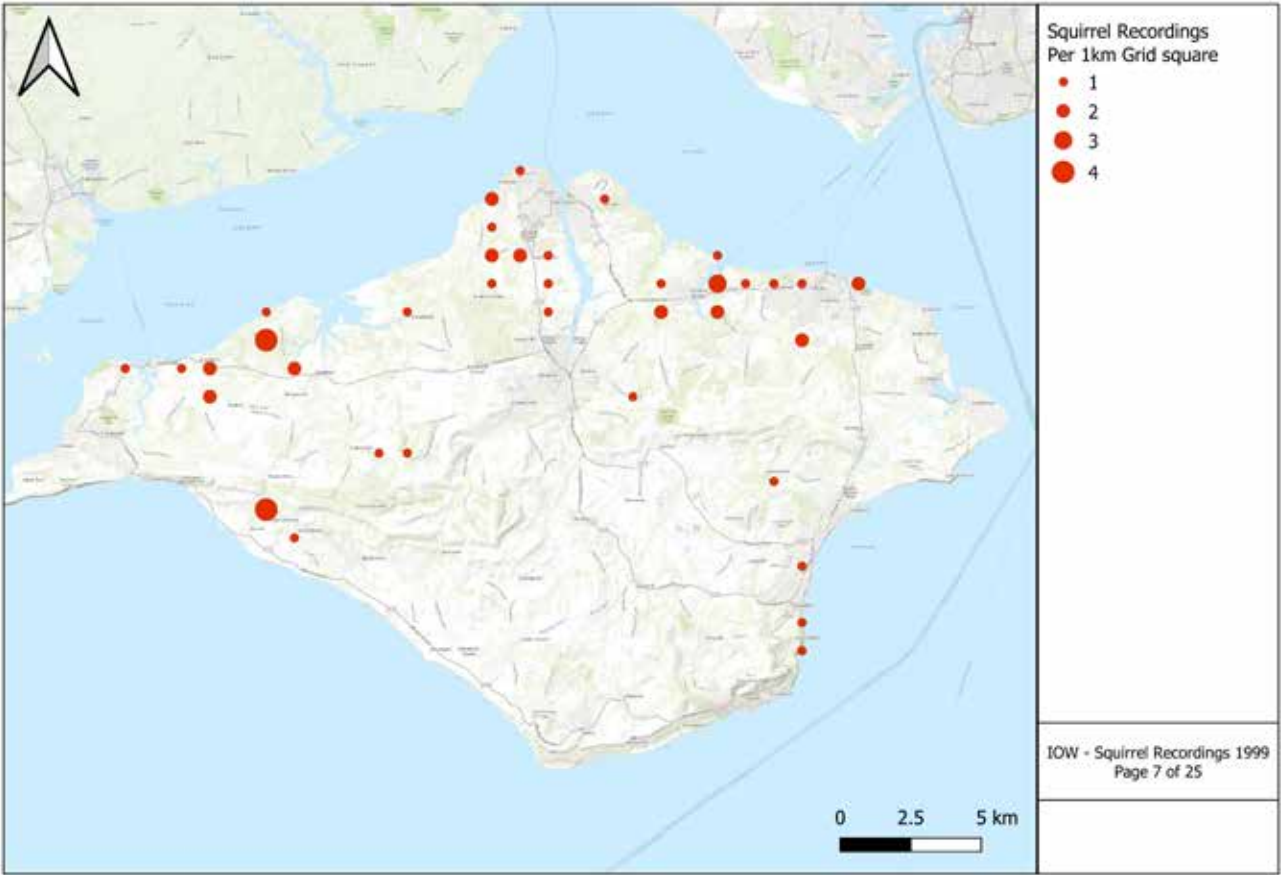
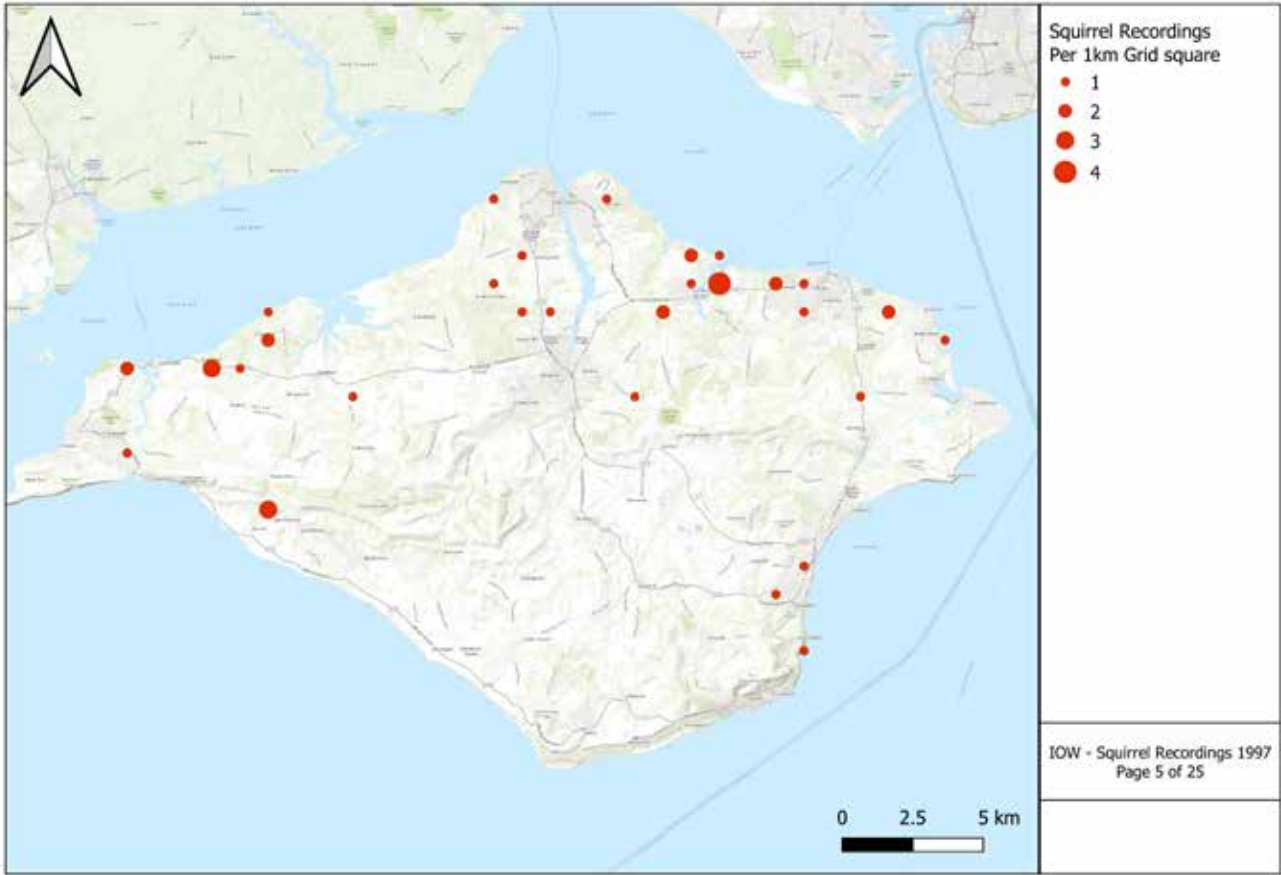


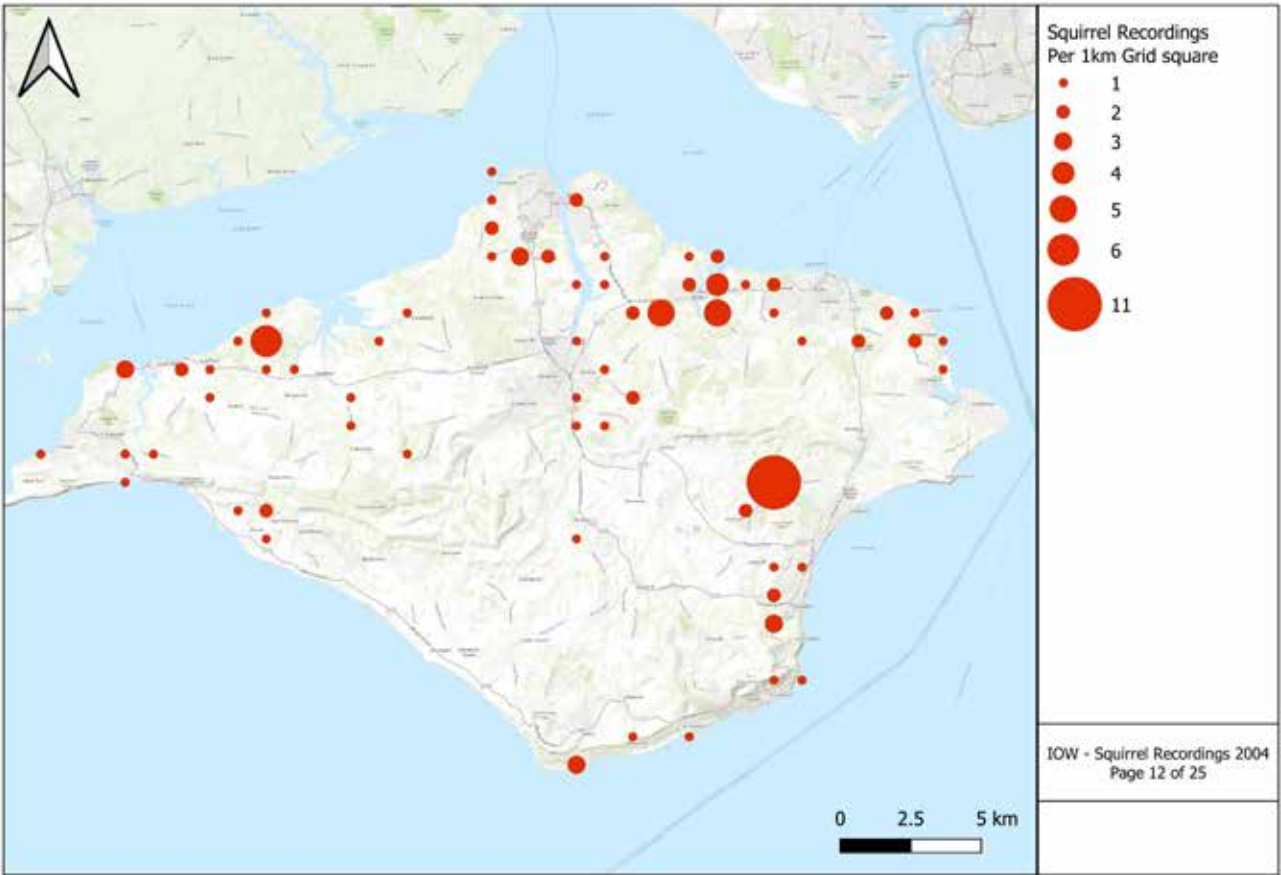
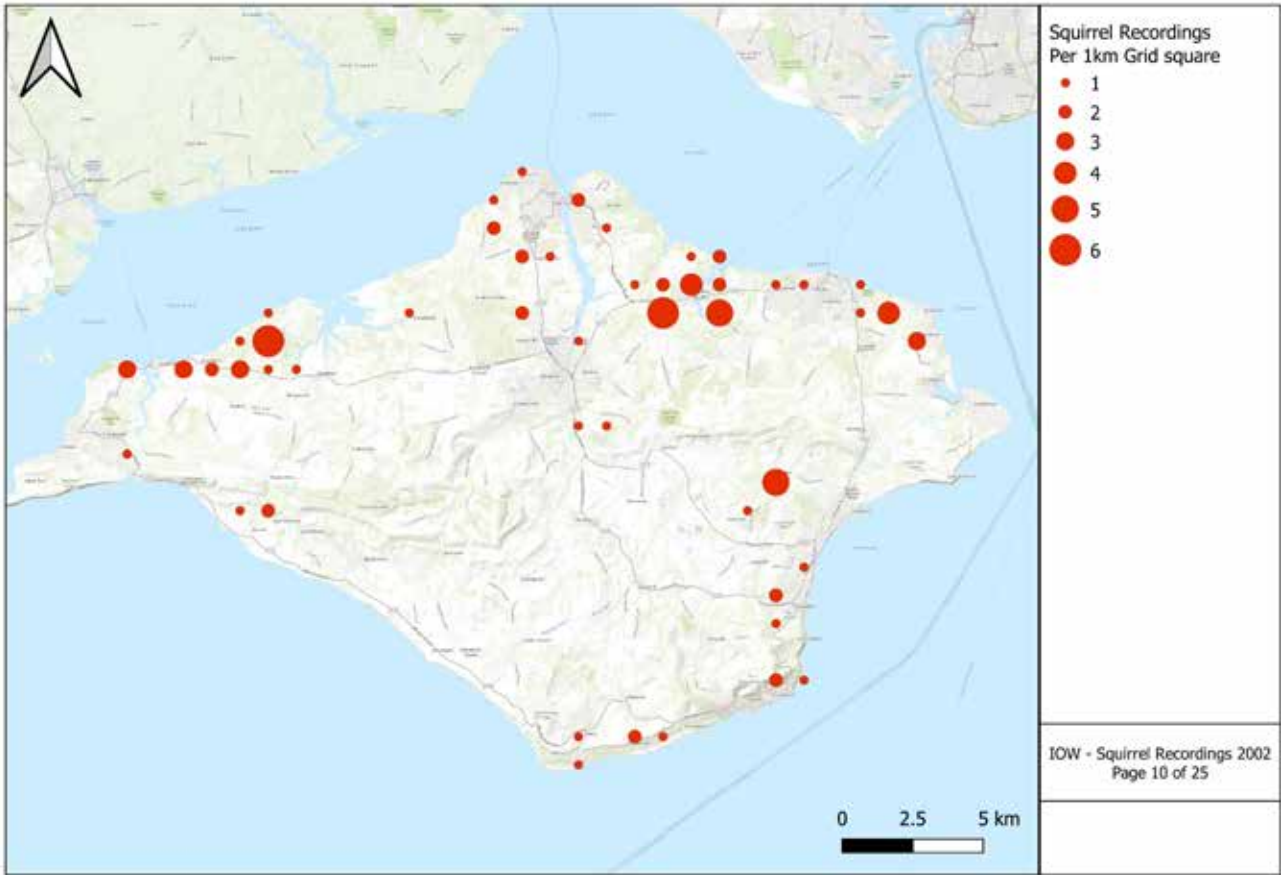
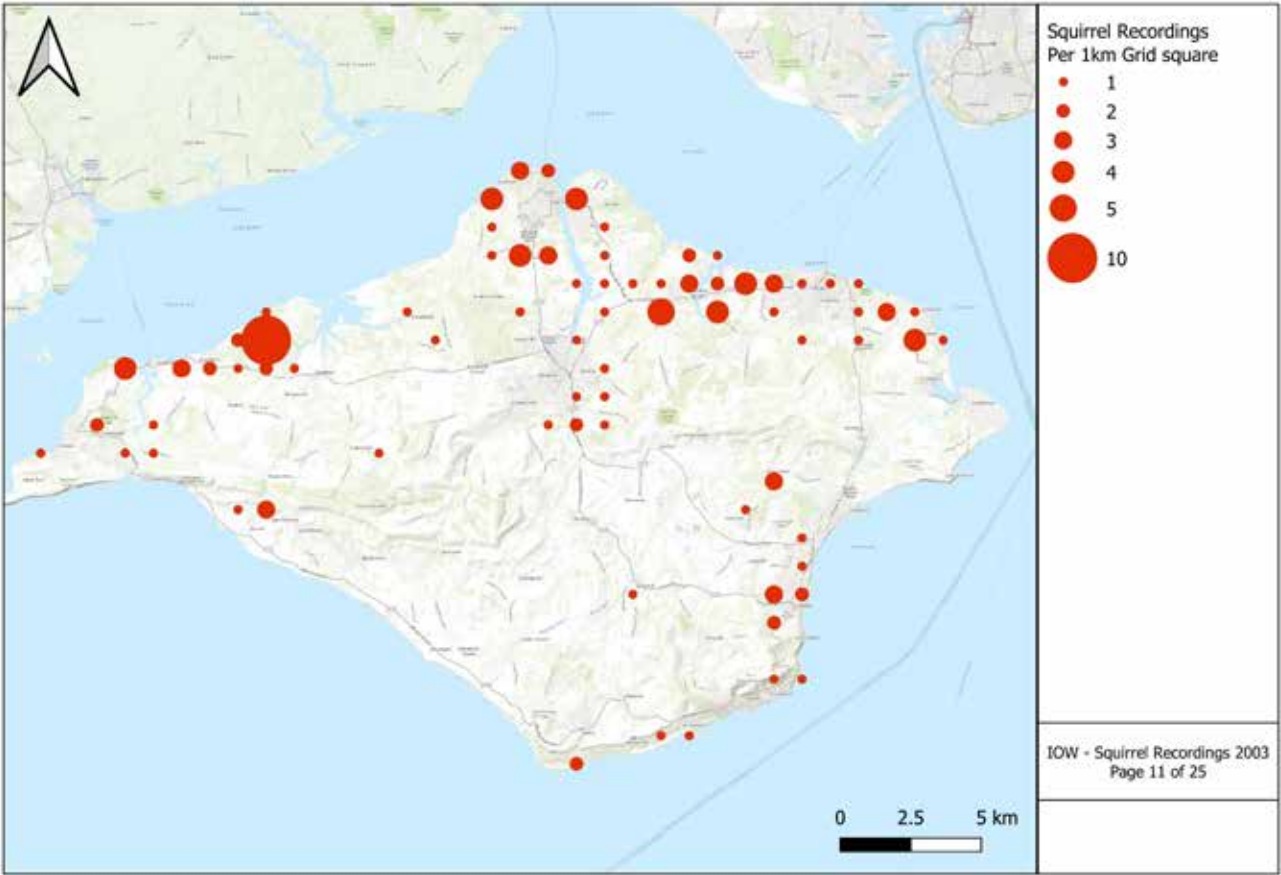
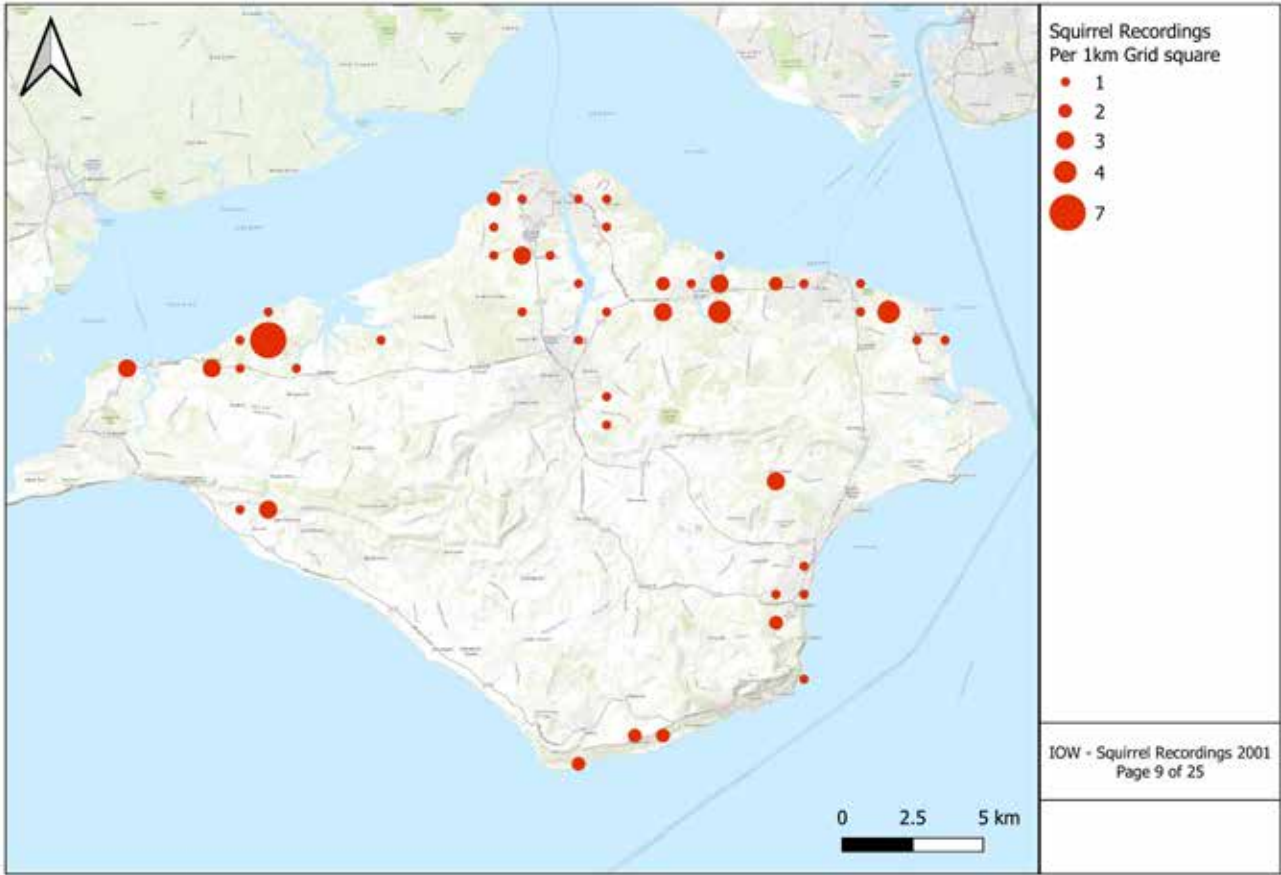
Percentage seeing young 2000–2009

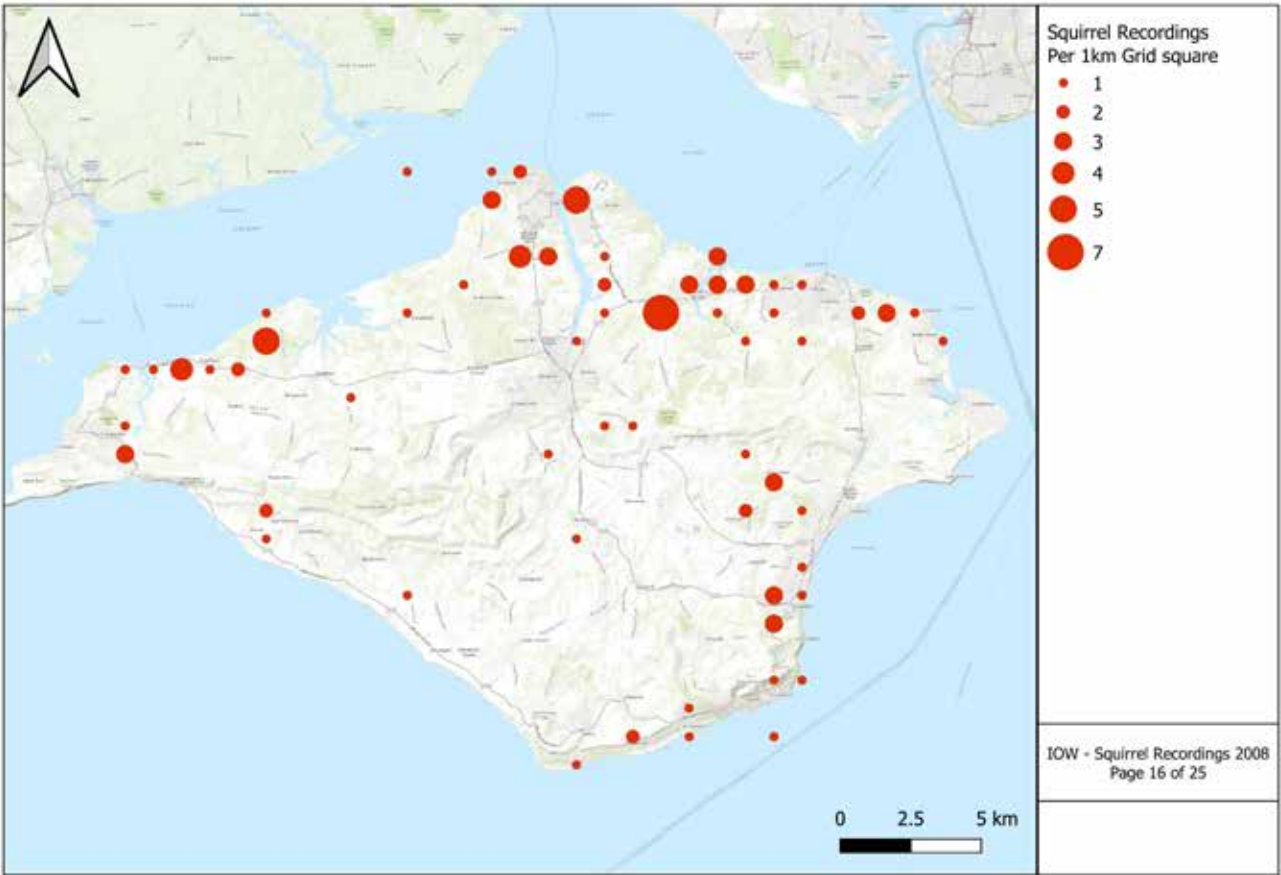
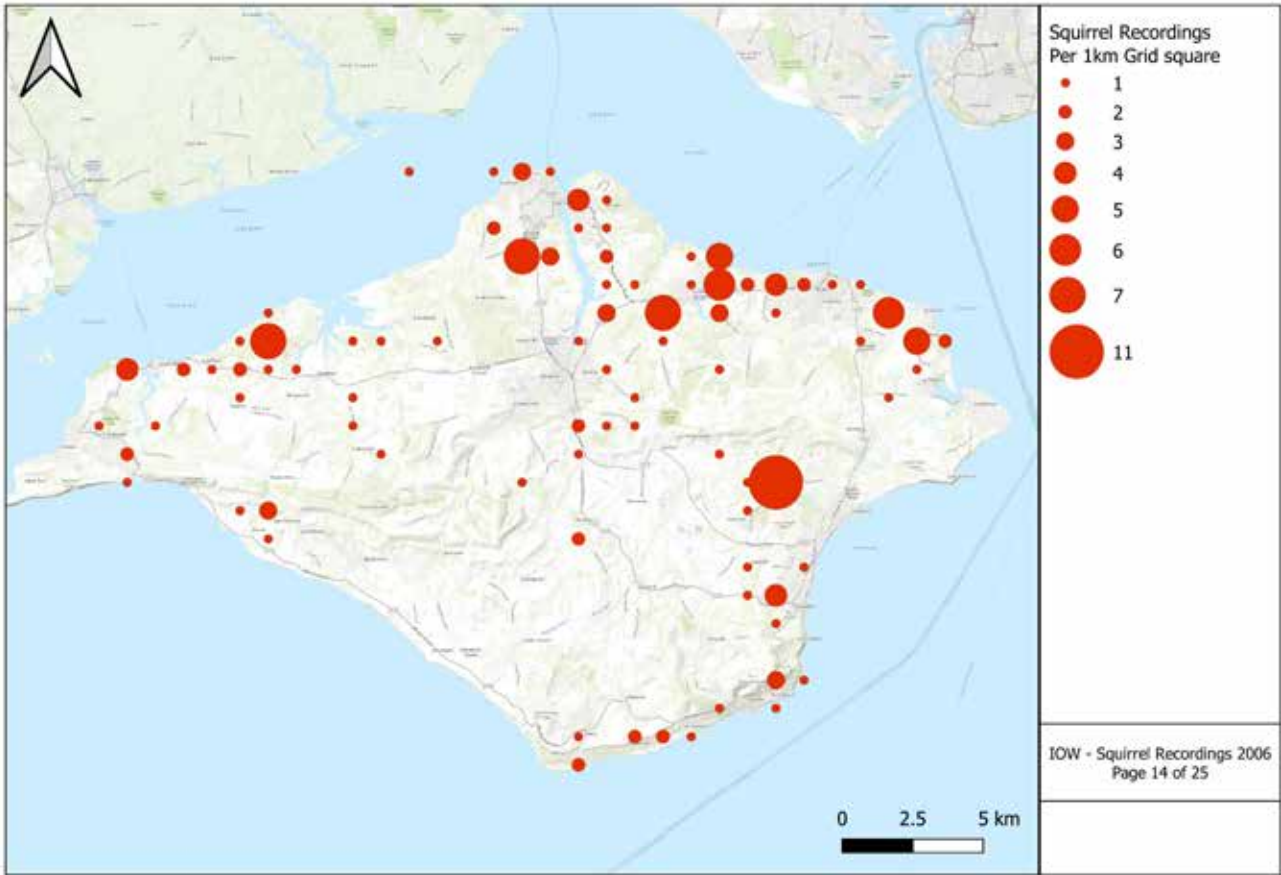
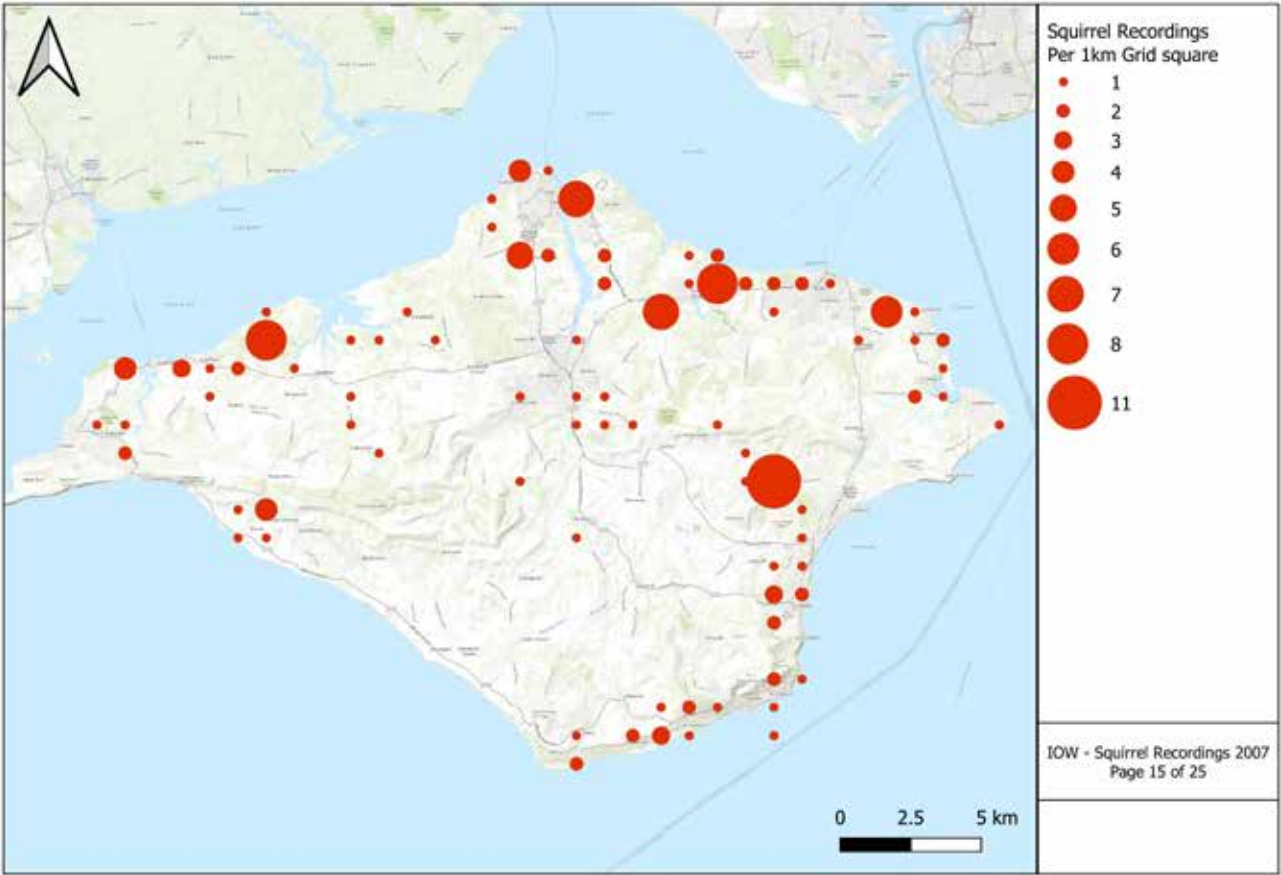
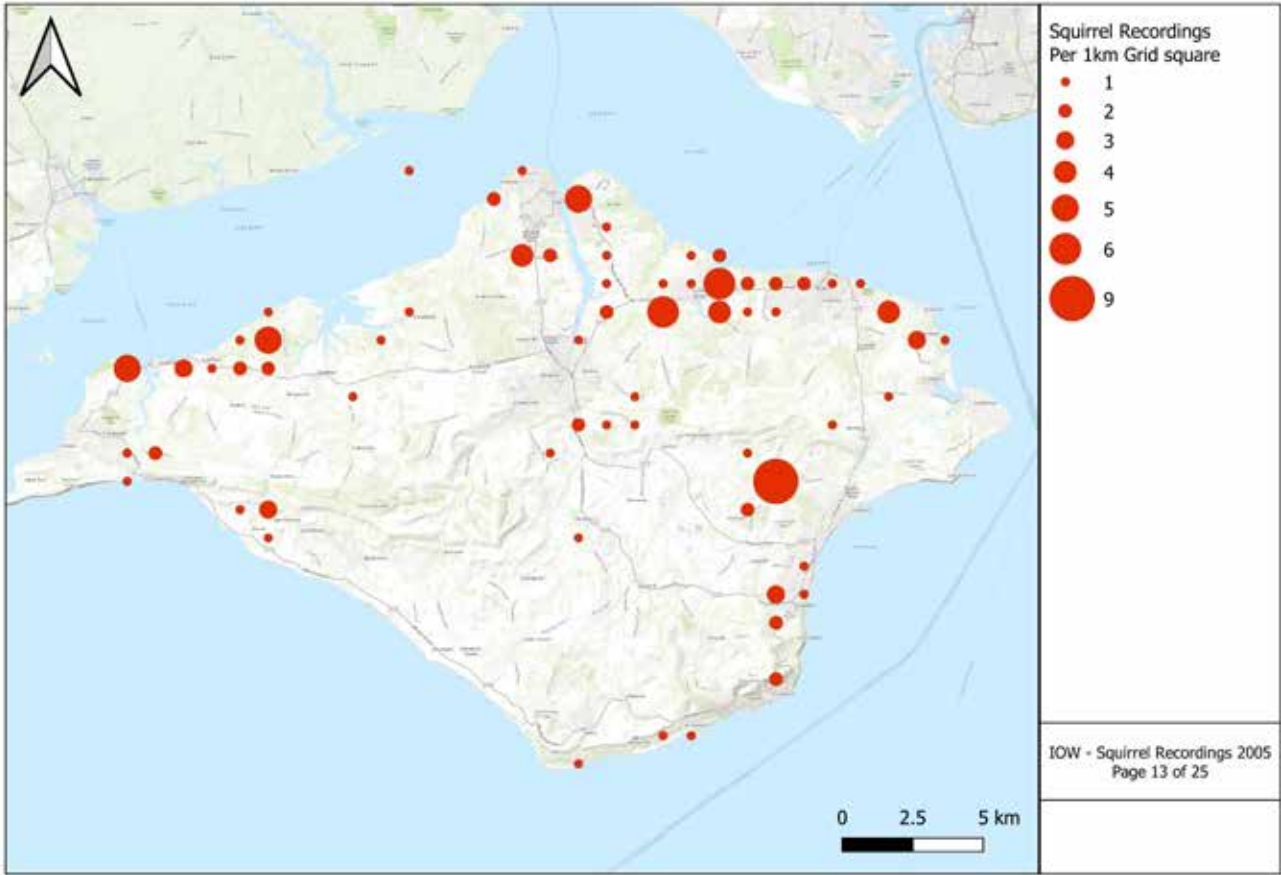


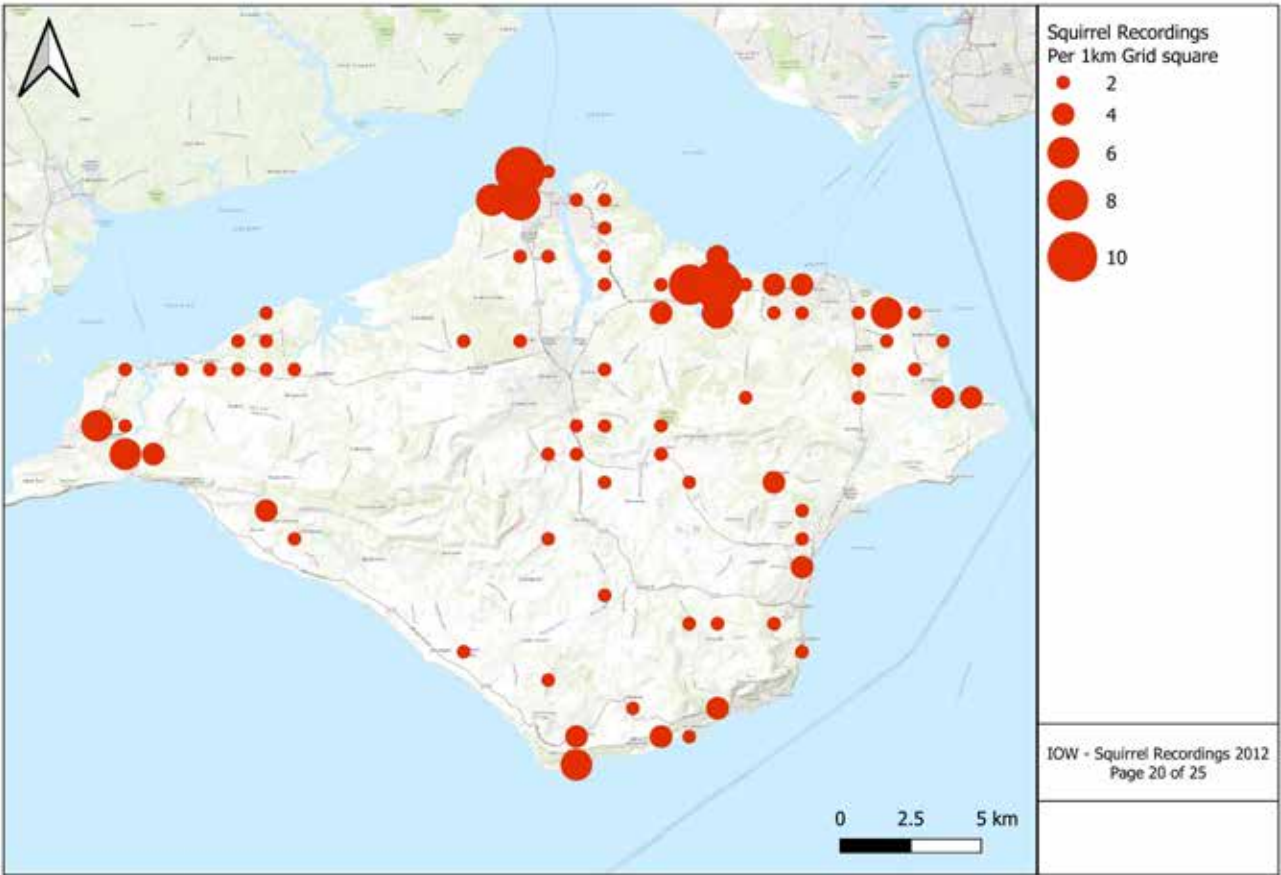
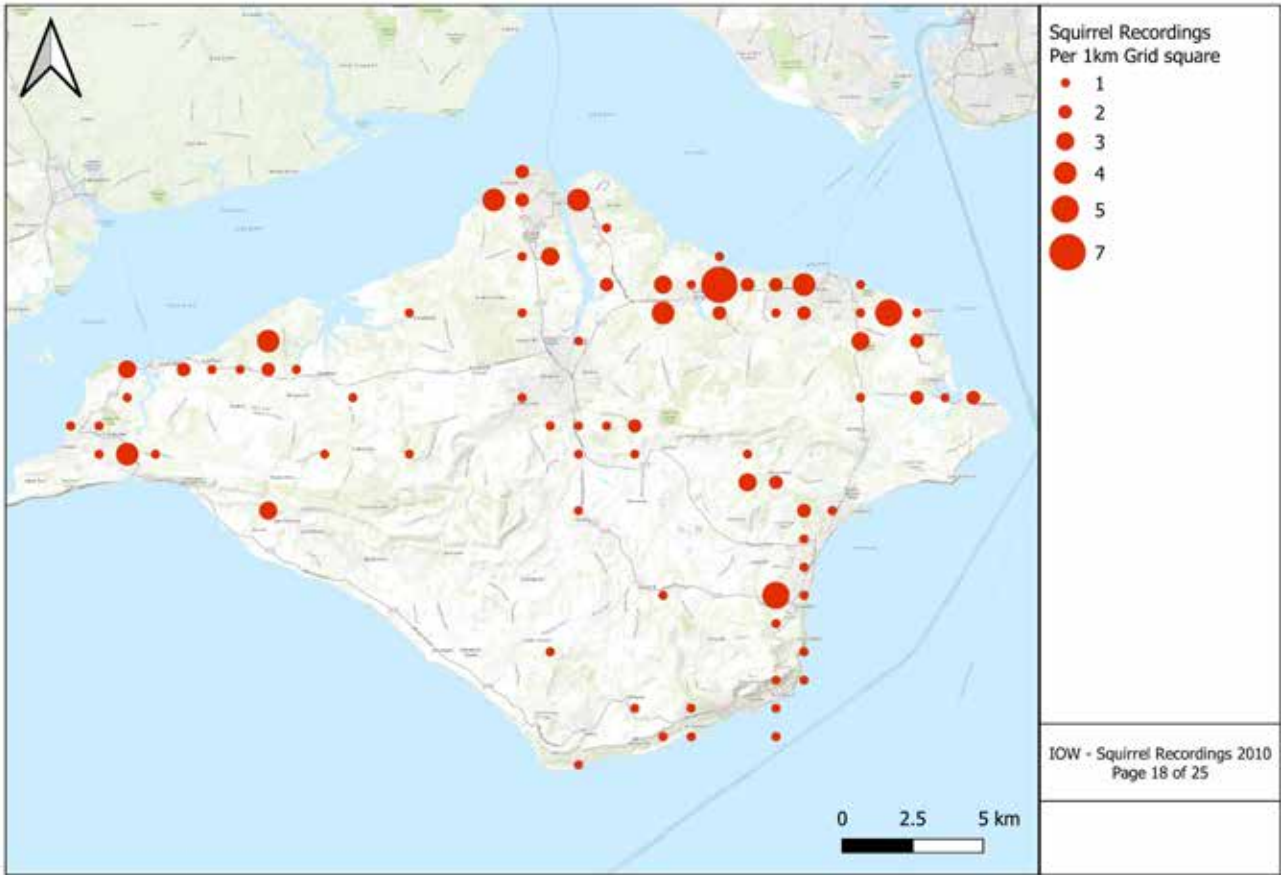
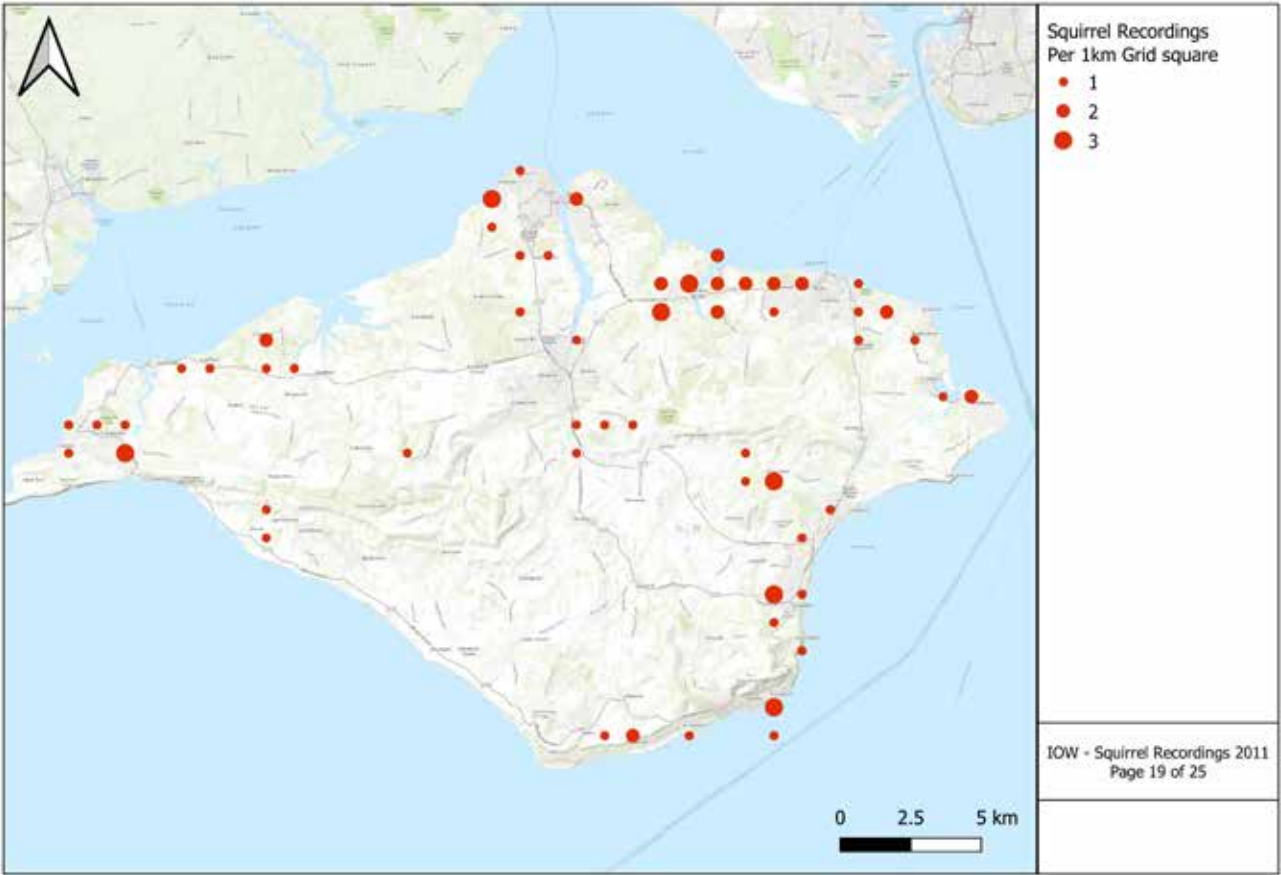
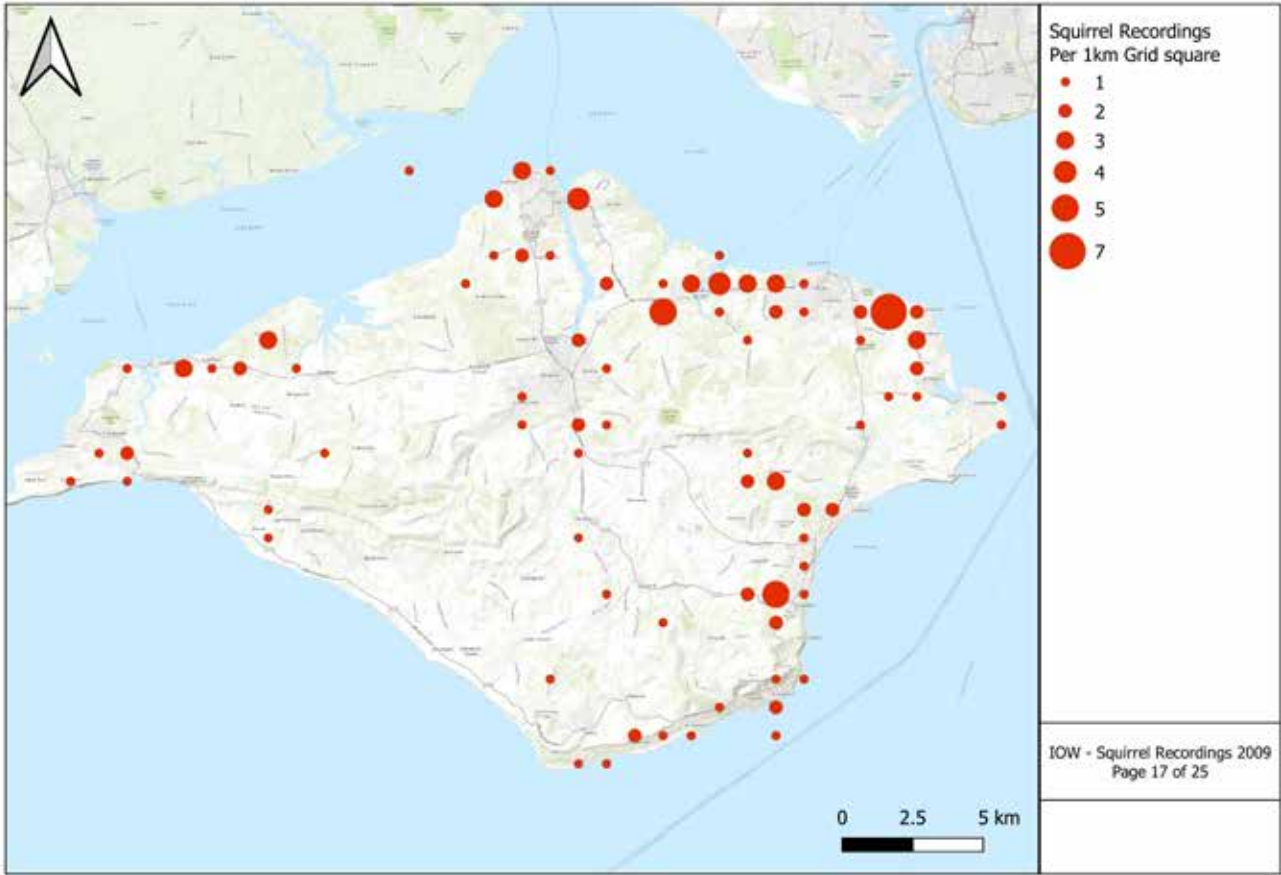
Location maps

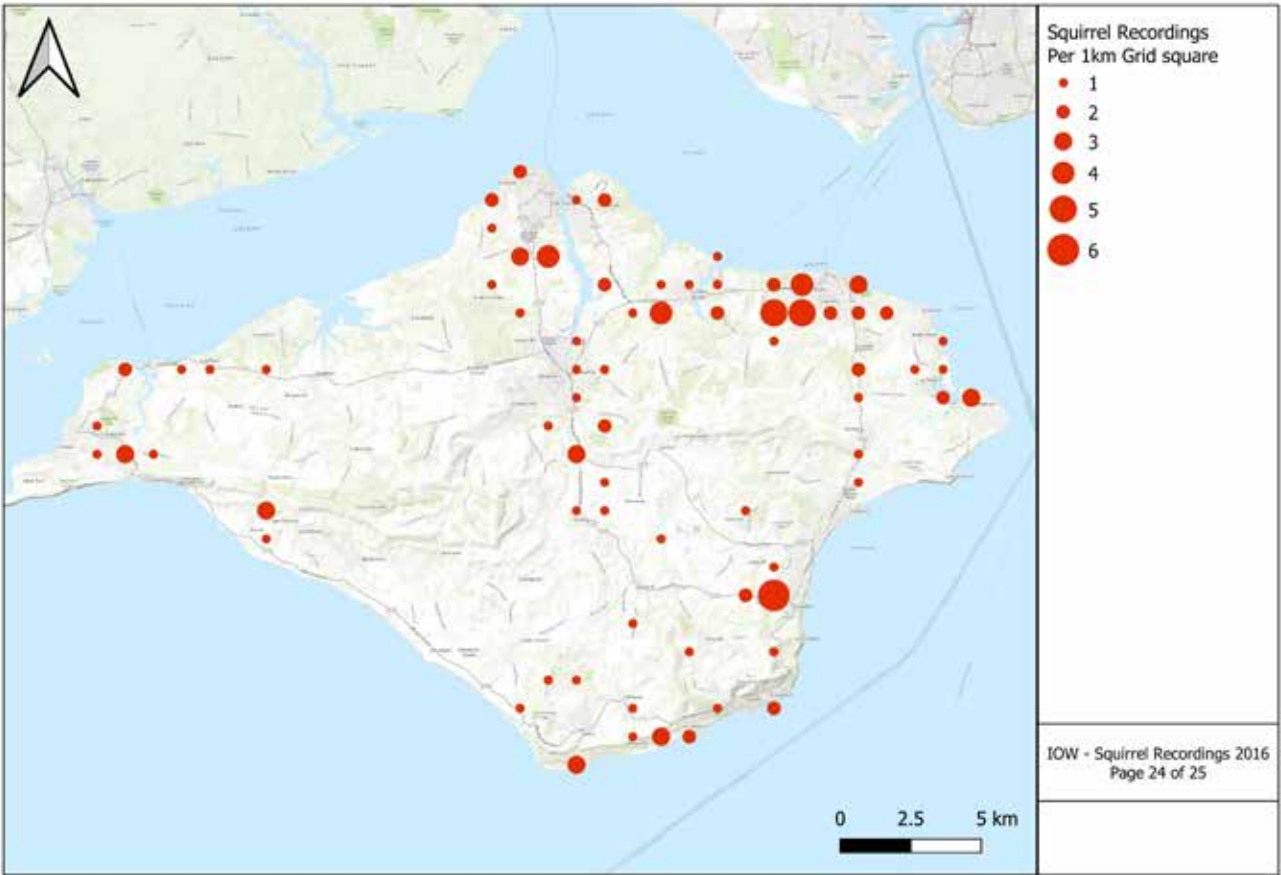
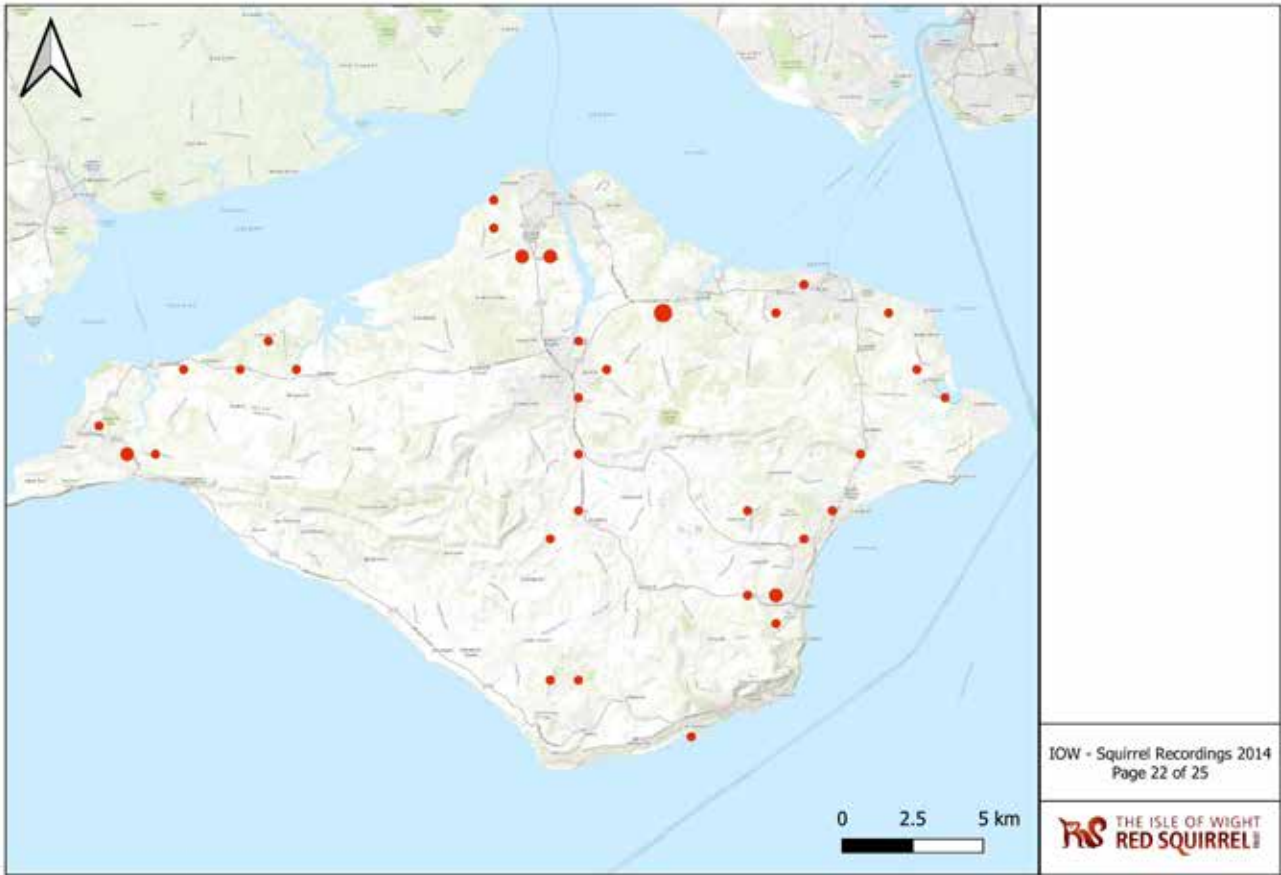
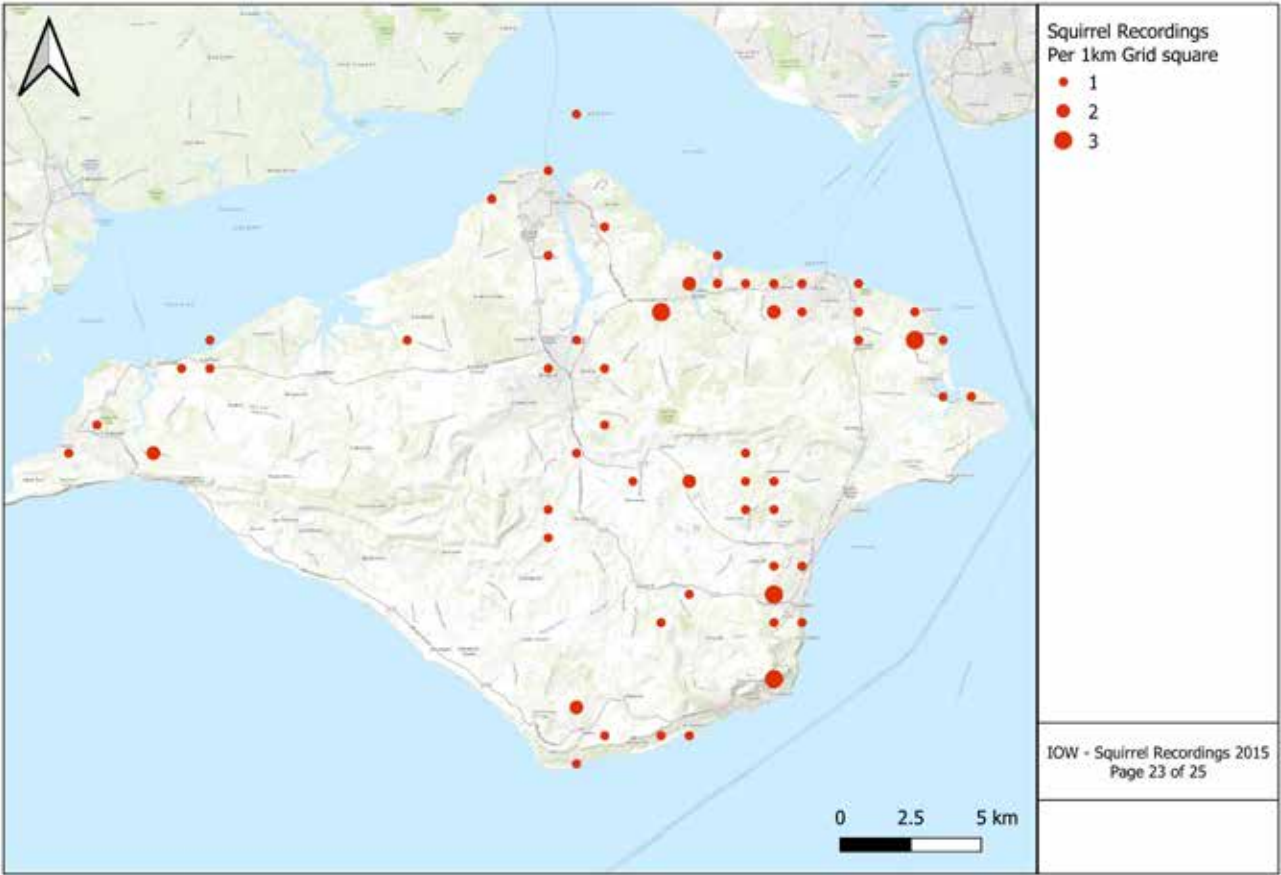
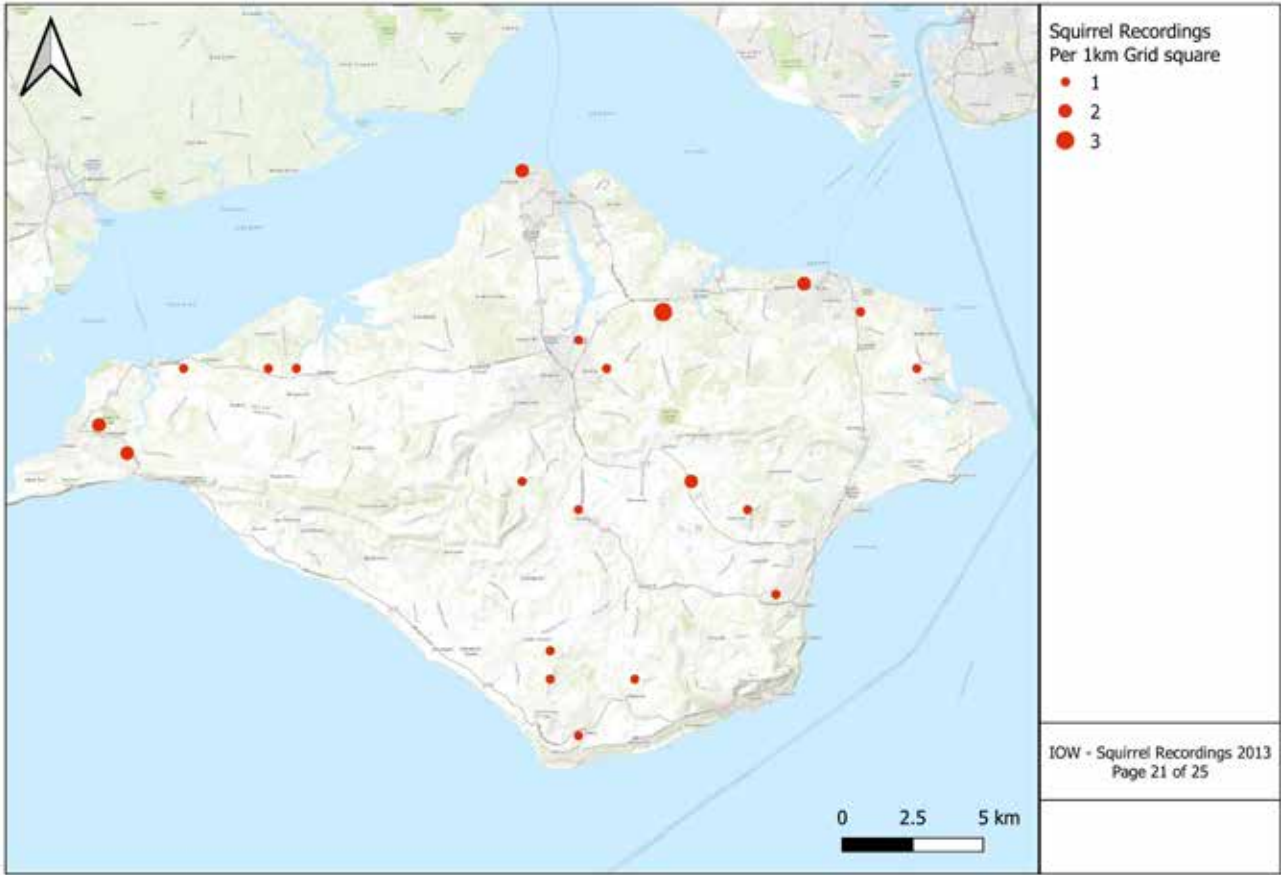


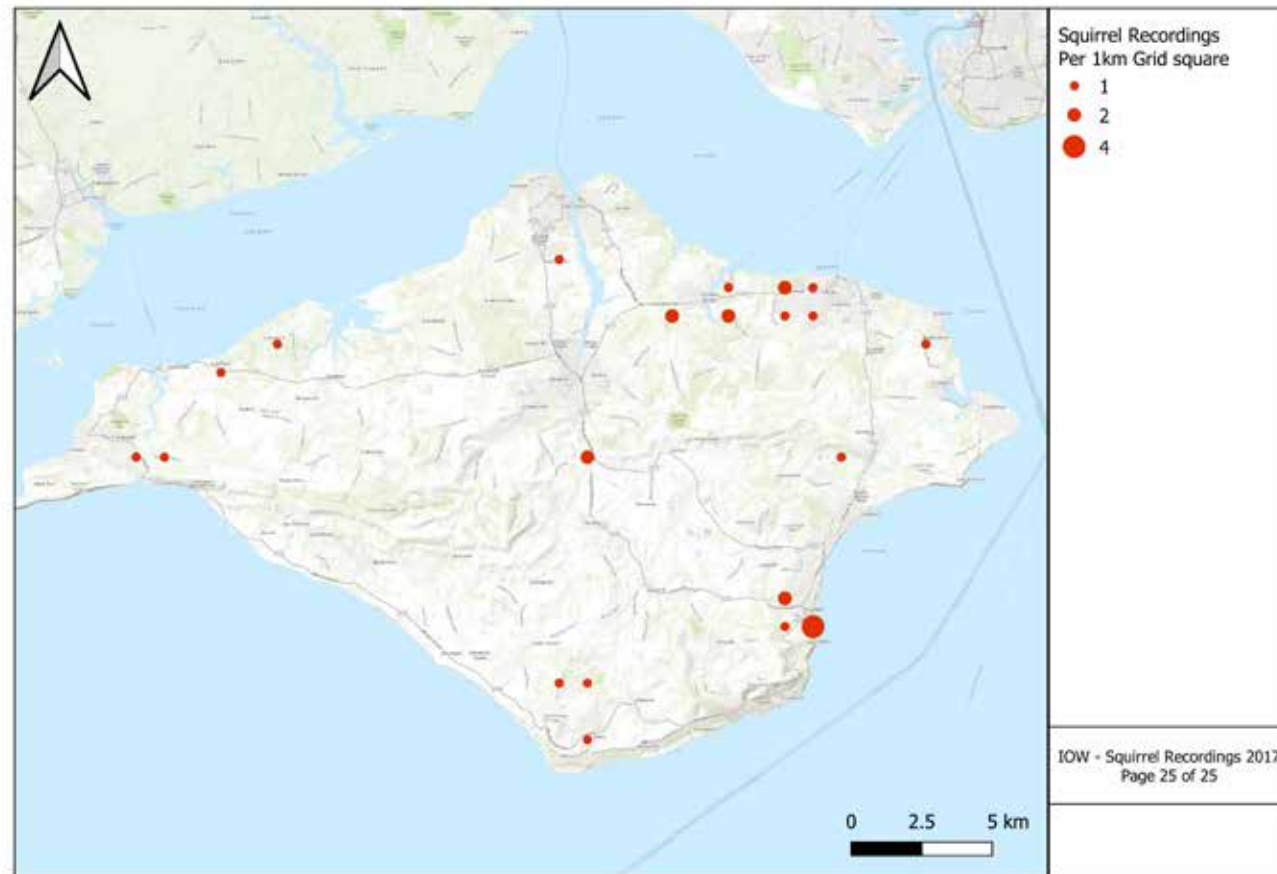












The maps for 2013 and 2014 show fewer entries, which may be because squirrel numbers did drop on the Island in these years. More about this dip in numbers in section 4. Little effort was put into collecting garden squirrels questionnaires once the annual newsletters went digital. This is reflected in the last map. An online questionnaire was poorly supported, so taken down when the website was updated. A survey intended to complement a wider study looking into how supplementary feeding influenced squirrel numbers and distribution started in 2019. The project will continue once this document is finished.

The future of garden questionnaires in this form will be part of the discussion on how to take monitoring forward. Apart from gathering data, keeping in touch with people does prompt reporting and is a consideration when designing monitoring methodology. Future methods will require consistency of effort put into collecting data.

Chapter 4

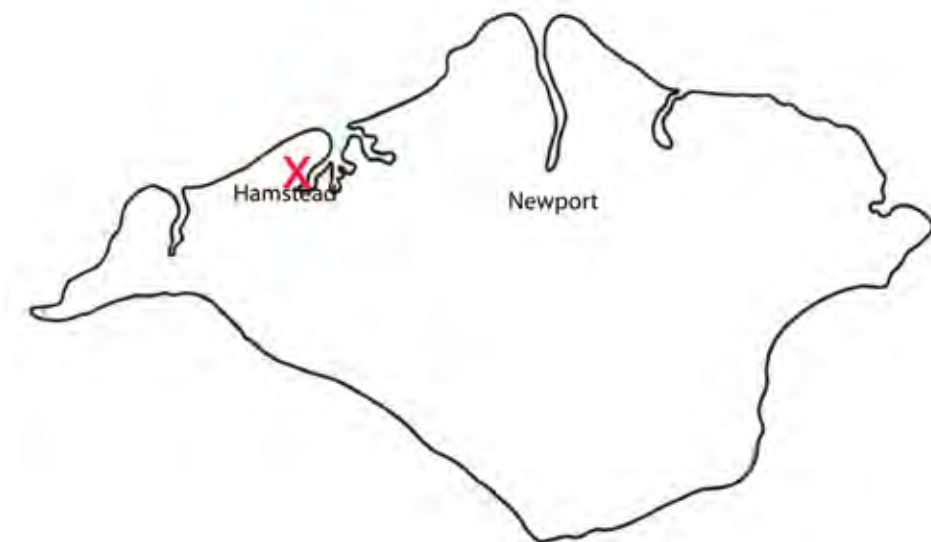
A GARDEN IN HAMSTEAD FOREST

Between selling one home and buying another, the author lived in Hamstead Forest for four and a half months and recorded red squirrels during the time at home. From January 28th 1999 until June 12th 1999, daily records of red squirrels visiting a garden adjoining Hamstead Forest, near Yarmouth, were recorded. A total of 1,092 entries were made over the time. Time spent watching depended on other work, hence inconsistencies and 'not recorded' entries.

Hamstead Forest is part of the complex of woodland which runs from, and is contiguous with, Bouldnor Forest in the west and follows the coast to Hamstead quay in the east. The plantation, from a red squirrels' perspective, is part of a much larger complex of habitat. There are no made-up roads and little traffic. Visiting squirrels generally came out of the conifer plantation, where they had their dreys. A residential area to the west provided a further supplementary food source in gardens, and woodland abutted most of the properties.

Individual animals were identified, aged and gender was determined. Identification was made by overall pelage colour, body size, tail colour (e.g. white tip), behaviour, head shape and gender. Easily identified and regular squirrels were given a name.

Arrival time, length of stay, behaviour, numbers at the feeding station and gender were recorded and later entered into an Excel spreadsheet and analysed. Some entries recorded more than one squirrel as they arrived together. Eleven individual squirrels were identified and given descriptive names, e.g. Ginger, Short Tufts. As work increased and time spent watching decreased, squirrel visits were still recorded but the individual animal was not always identified.



Results for a garden in Hamstead Forest	
Adult	1066
Sub-adult	25
Juvenile	1
Total	1092

Number of Visits / Length of Stay (minutes)

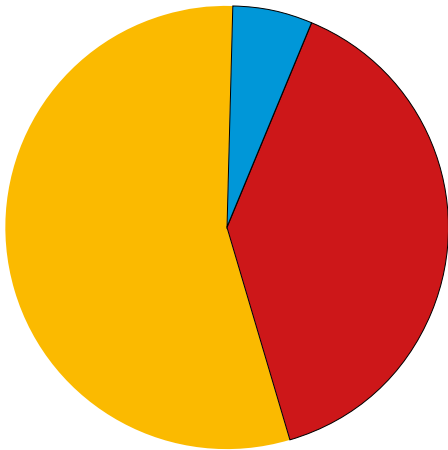
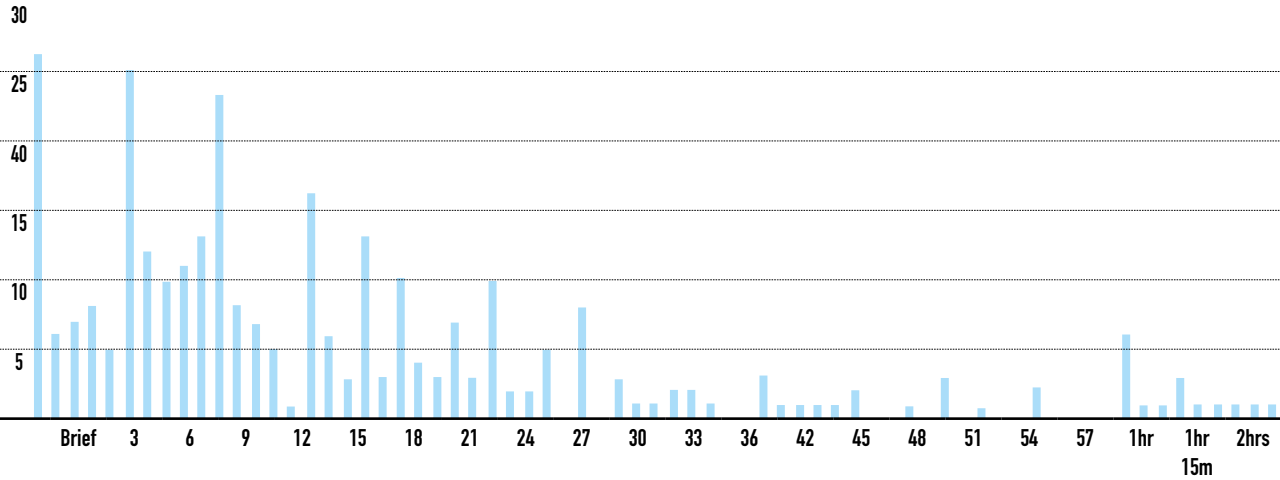
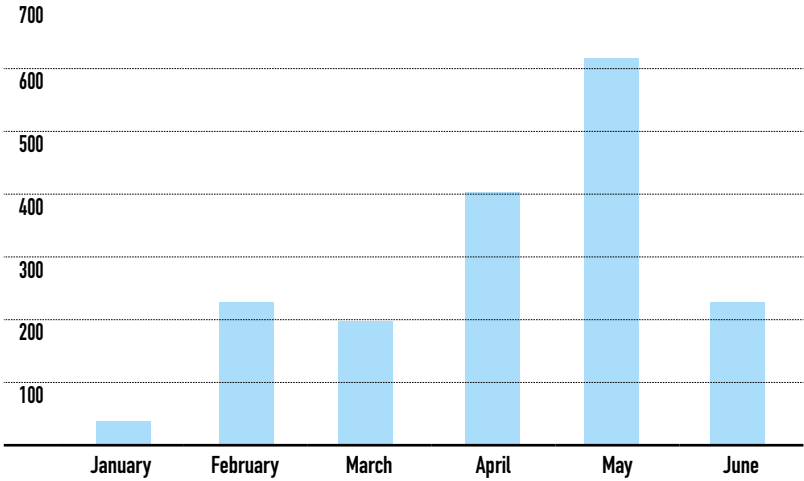


Table showing age breakdown

Gender identification on limited number of individuals in 299 entries. 'Both' relates to more than one squirrel of a different gender arriving at the same time.

- Both
- Female
- Male

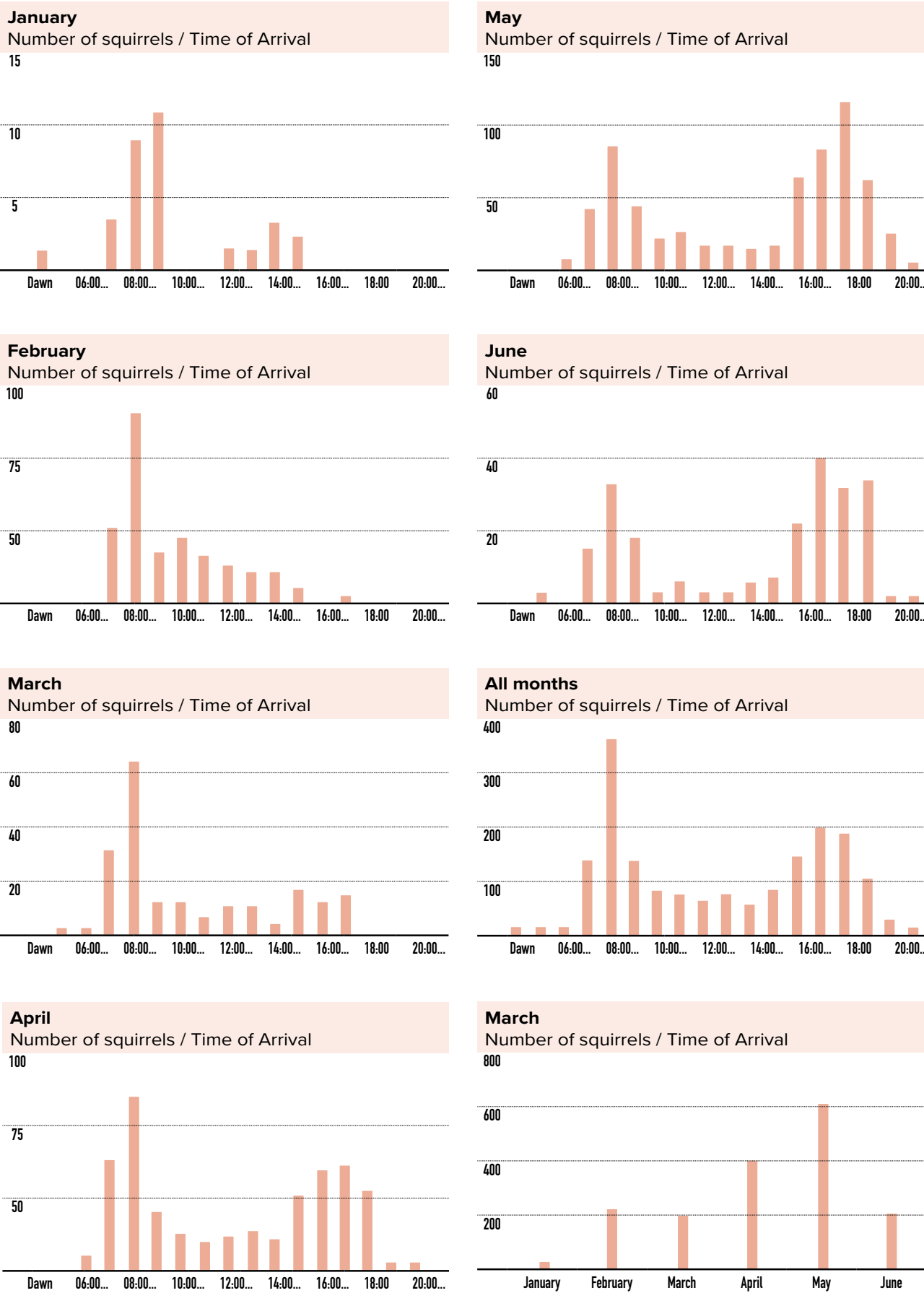
Number of squirrel visits per month



Note: January 4 days spent watching
June 12 days spent watching

Results for a garden in Hamstead Forest

Time of arrival



Observed behaviour

Naturally, squabbling sometimes occurred when squirrels arrived to feed at the same time, even though a minimum of three feeding stations were available.

Interactions with a cat proved interesting as the cat sat in the tree between the feeders and a squirrel came up to investigate the cat. A rap on the window sent the squirrel away. Most entries noted that the squirrels would not come to feed when the cat was in the tree. On one occasion a squirrel brushed past the cat when it was disturbed by the author coming home. On all other occasions, the squirrels would avoid feeding until the cat was taken indoors. She was a hunter but did not catch a squirrel.

As expected, on days when the weather was bad, fewer squirrels came to the garden to feed, preferring to stay in the shelter of the forest.

Food supplied was mixed. At this time, peanuts were not identified as harmful to squirrels, so were included in the diet. A pre-packed squirrel mix was rejected by the squirrels.

A young squirrel ate maize and wheat and scavenged pieces of food dropped on the ground below the feeders when adults occupied the feeders. Apple cores were a favourite.



Enjoying an apple core



Three squirrels feeding together without squabbling



Cat watching squirrel on feeder



Sub-adult female, Ginger, eating maize and wheat

Results for a garden in Hamstead Forest

On the whole, squirrels at this location were very nervous and had not habituated to human presence. Workmen next door, although not close, did deter squirrels from feeding. Squirrels were also put off coming through the trees to the feeders when the lawn was mowed, even though they didn't need to cross the ground.

No sick squirrels were observed but one adult female, named Warty, did have what appeared to be papillomas on her ears. Warty is a dominant female and angrily attacked an injured male (appeared to be a bite) on her favourite feeder. She had kittens and in every other way appeared healthy. The dominant male was Tufty, who didn't like anyone feeding near him even if other feeders were available.

A sample of other observations taken from shorthand notes:

- Skirmishes occurred and superficial injuries noted
- Noticeably fewer squirrels visited when the weather was wet or windy, preferring to stay in the shelter of the forest
- Drinking from a puddle was observed on several occasions
- Attacks by a crow and jackdaws are noted three times. The squirrels escaped unharmed.
- Scent marking
- Grooming
- The first lactating female, Brownie, appeared on 10th April. On 24th May two lactating females turned up together. From then on, lactating females appeared regularly through to the end of observations in mid-June.
- Squirrel with a swollen paw manages to limp to pear tree, then climbs a bit higher and eats lichen. Comes to feeders when other squirrels leave.
- Two squirrels feeding, including Bad Paw, when another arrives. Fighting occurs and injured squirrel, Bad Paw, is driven away. Bad Paw managing but is underdog.
- Moulting starts mid-April. One squirrel described as 'moth-eaten'.
- Dominant male, Tufty, still had long curly tufts in June.

Rope experiment

The experiment started on 28th May 1999 and the rope stayed until moving out in mid-June. An old mooring rope provided an opportunity to see how quickly the squirrels would understand that rope led to food. Initially the rope led to the feeders, which was no problem for them. Gradually, feeders were reduced and hazelnuts placed along the rope and the end of the rope was coiled. Once all the feeders were taken away, the smartest squirrels followed the rope and found the hazelnuts in the coil.

It was interesting to note that some gave up very quickly and ran back into the forest. Most squirrels used the rope and found the nuts. Dominant female Warty found the nuts first and took over the rope as her favourite feeding place. Once the squirrels found the food by associating it with a rope, then the feeders were replaced. It took three minutes for Warty to find the nuts hidden in the coiled rope. At one point a squirrel was eating nuts at one end of the rope whilst the cat sat at the other end.

On the whole, red squirrels are pretty smart when it comes to accessing food. People report squirrels pushing lids off dustbins to find food, so following a rope to find nuts wasn't too challenging for the majority of squirrels.



Some squirrels were bright enough to realise that rope led to food, others were not



Dominant female Warty. Papillomas are just visible on her ears. Swollen teats show she is lactating

Chapter 5

A GARDEN IN SALTERN WOOD

This residence was located in woodland and squirrel visits recorded by a by a gentleman red squirrel enthusiast. As with the other studies by the general public, there is no set methodology and they recorded what they observed.

This gentleman did not identify individual squirrels but did identify age and recorded the majority of times the squirrels arrived in the garden during 2002 and 1st January 2003 to mid-February 2003.

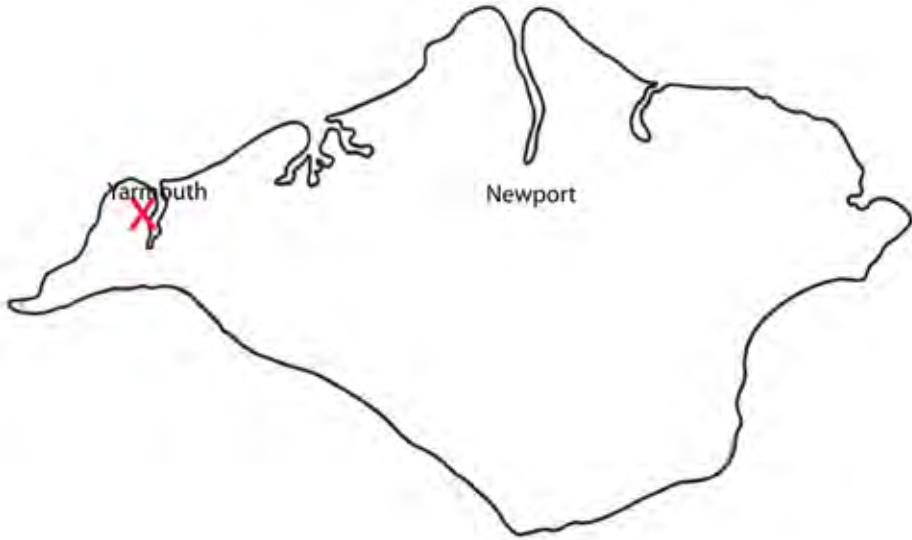
The woodland is native broadleaved standards with a hazel understorey. Dispersing squirrels often head west and try to cross a very busy main road. Over the 30-year period of recording data, this is a consistent road kill black spot. Dispersal to the next woodland is difficult from Saltern Wood. The River Yar is to the east, marsh and the sea to the north and hedgerows to the south.

Results

Visits to the garden dropped during August and September when the autumn seed crop ripened. Times of arrival to feed are, for the most part, consistent with the other garden squirrel visits recorded in this section. February 2003 is unusual in numbers peaking at 12 noon plus the time the largest number of squirrels arrived is 9am rather than 8am.

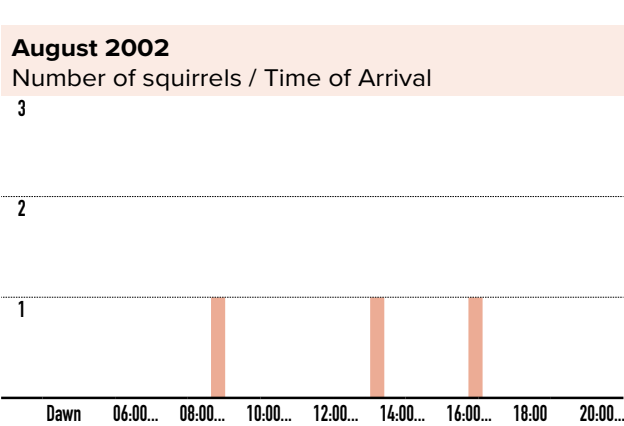
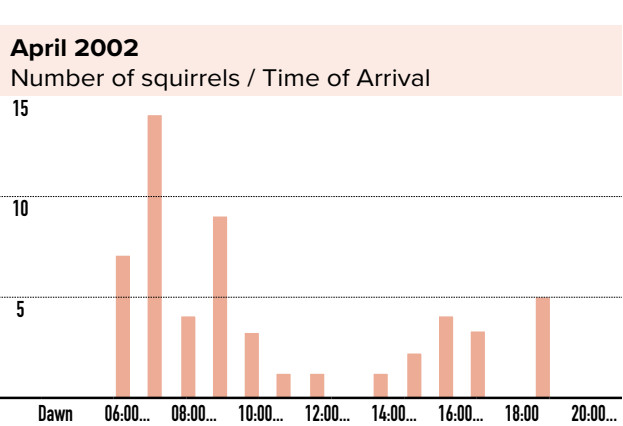
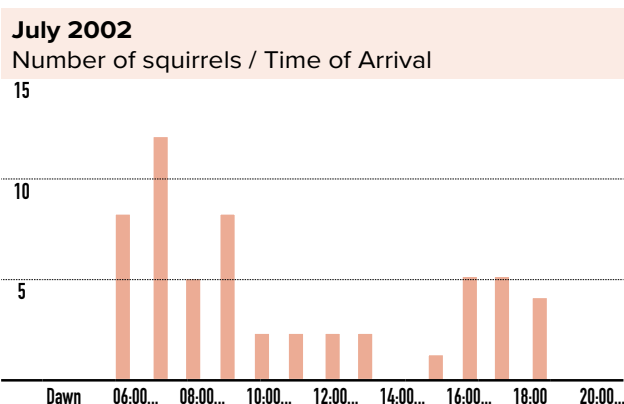
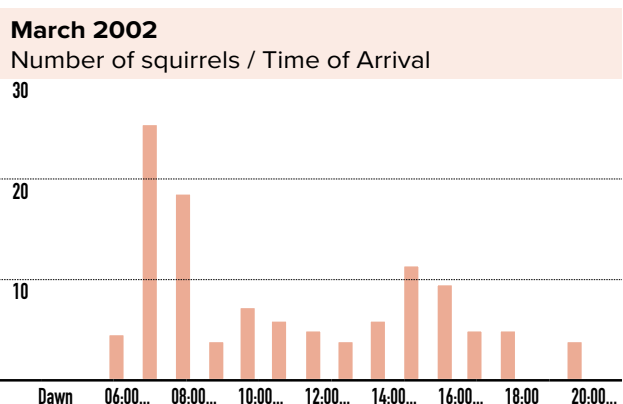
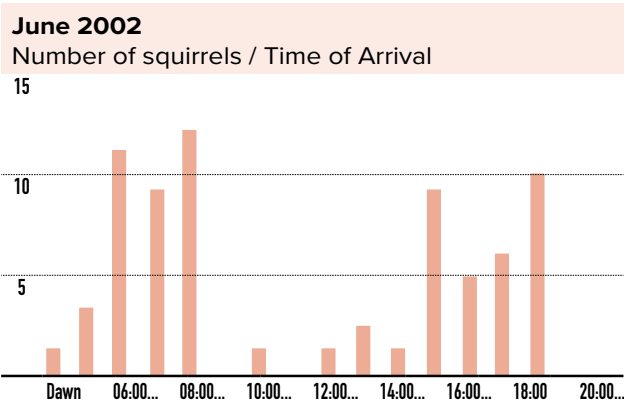
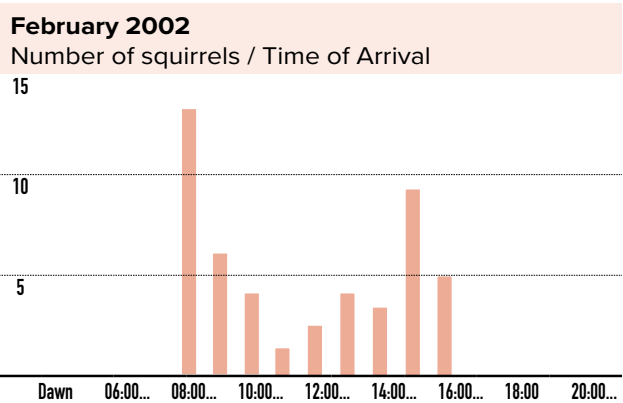
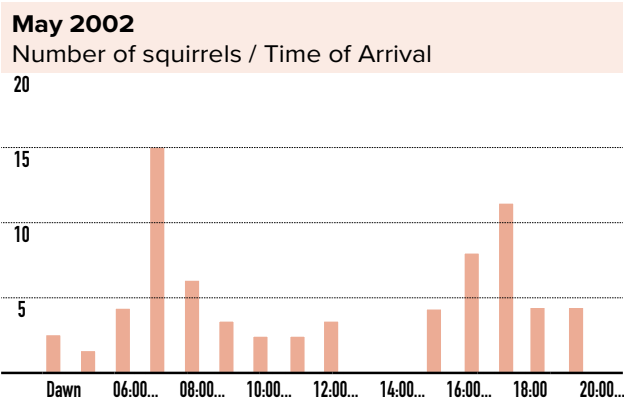
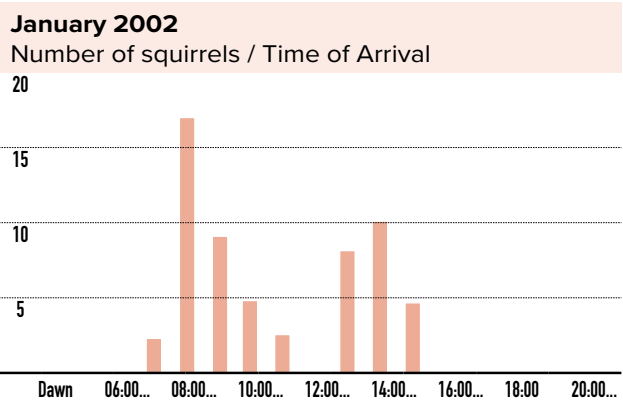
The majority of squirrel visitors are lone adults. On only two occasions an adult appeared with a juvenile, presumably a mother and kitten. No unusual sightings or activities are recorded.

Age breakdown	
Adult	562
Adult & juvenile	2
Adult & sub-adult	9
Juvenile	11
Sub-adult	32



Results for a garden in Saltern Wood

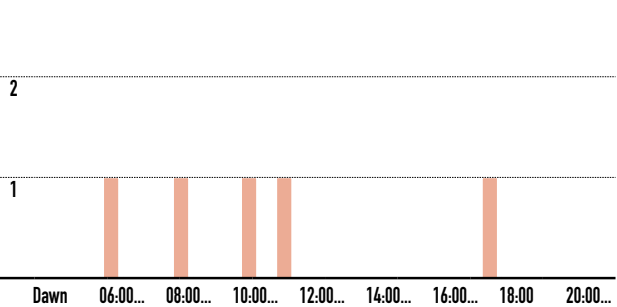
Time of arrival



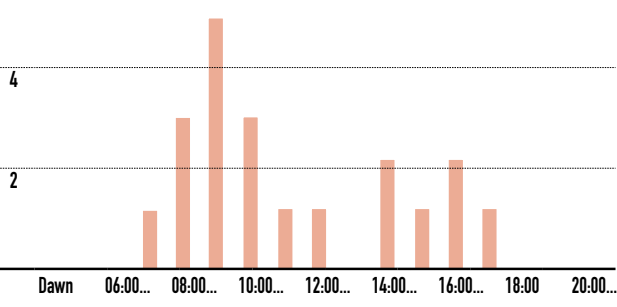
Chapter 6

GARDEN SQUIRREL OBSERVATIONS BY LYNN HODGES, EAST COWES

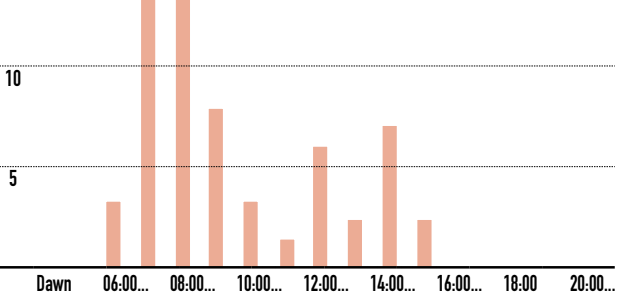
September 2002
Number of squirrels / Time of Arrival



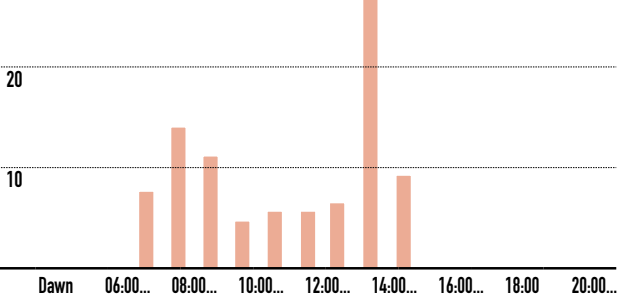
October 2002
Number of squirrels / Time of Arrival



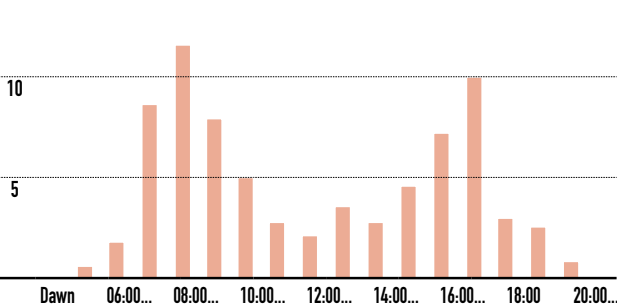
November 2002
Number of squirrels / Time of Arrival



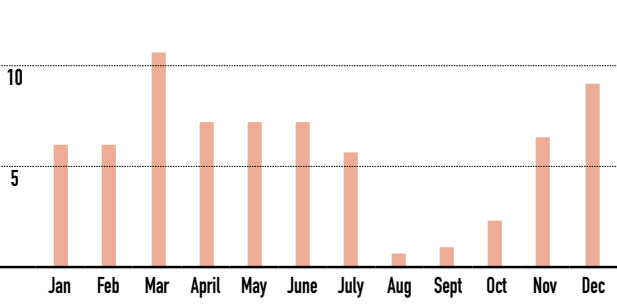
December 2002
Number of squirrels / Time of Arrival



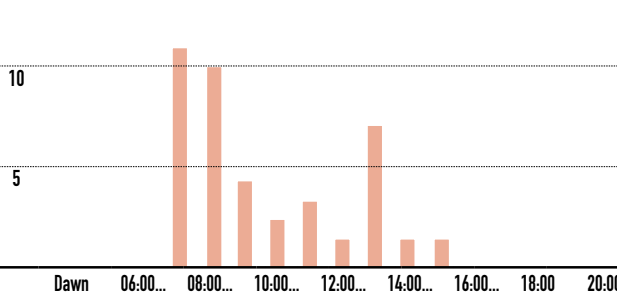
All months, 2002
Number of squirrels / Time of Arrival



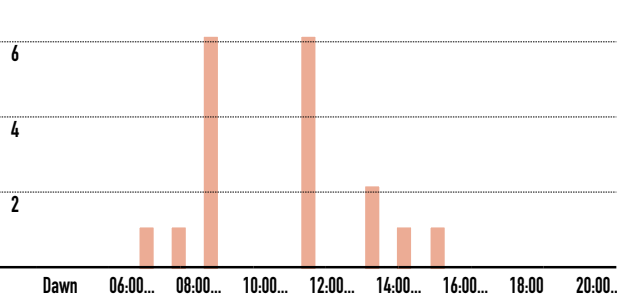
All months, 2002
Number of squirrels visits per month



January 2003
Number of squirrels / Time of Arrival



February 2003
Number of squirrels / Time of Arrival



Dedicated red squirrel enthusiast, Lynn Hodges, documented details of squirrels visiting her garden from January 2000 to April 2003. Individual animals are identified and given names. Arrival times plus behaviour and gender are given. The garden is at the bottom of Old Road, East Cowes and, at the time, was a hotspot for garden squirrel activity. Today (2021), very little is reported from the area as development and tree loss have impacted on squirrel numbers. Road kills were a regular occurrence in Old Road but reports of squirrels in the area, alive or dead, have been sparse in recent years.

Unshelled hazelnuts were fed to the squirrels; some were cached, others eaten. Coconut, sunflower seeds and peanuts were part of the daily diet plus bread, pear and biscuits. Gender is given occasionally and lactating females were identified on 22nd June 2001 and 5th April 2003. A pregnant squirrel was identified on 25th and 29th April 2001.

As individual animals were identified, descriptive names were given, such as Split Tail and Greyish. In 2000, nine squirrels were named but in 2001, only five were named. In 2002, 18 were named. In the four months recorded for 2003, six were named. Only three names appear in more than one year. Some of the descriptive names could apply to the same animal. Coat colour changes seasonally too. Eighteen is definitely excessive for the area.

Results

Arrival times are typical, that is, peaking in the early morning and decreasing towards midday, especially in the summer. Visits decreased in the autumn as expected in 2000, due to natural food availability. However, the following two years did not follow this trend. Squirrel numbers rose, possibly due to supplementary feeding or observation times rather than squirrel activity. In the long days of spring and summer, squirrels still rise at dawn, which may be 4am, whereas the observer's waking time did not change.

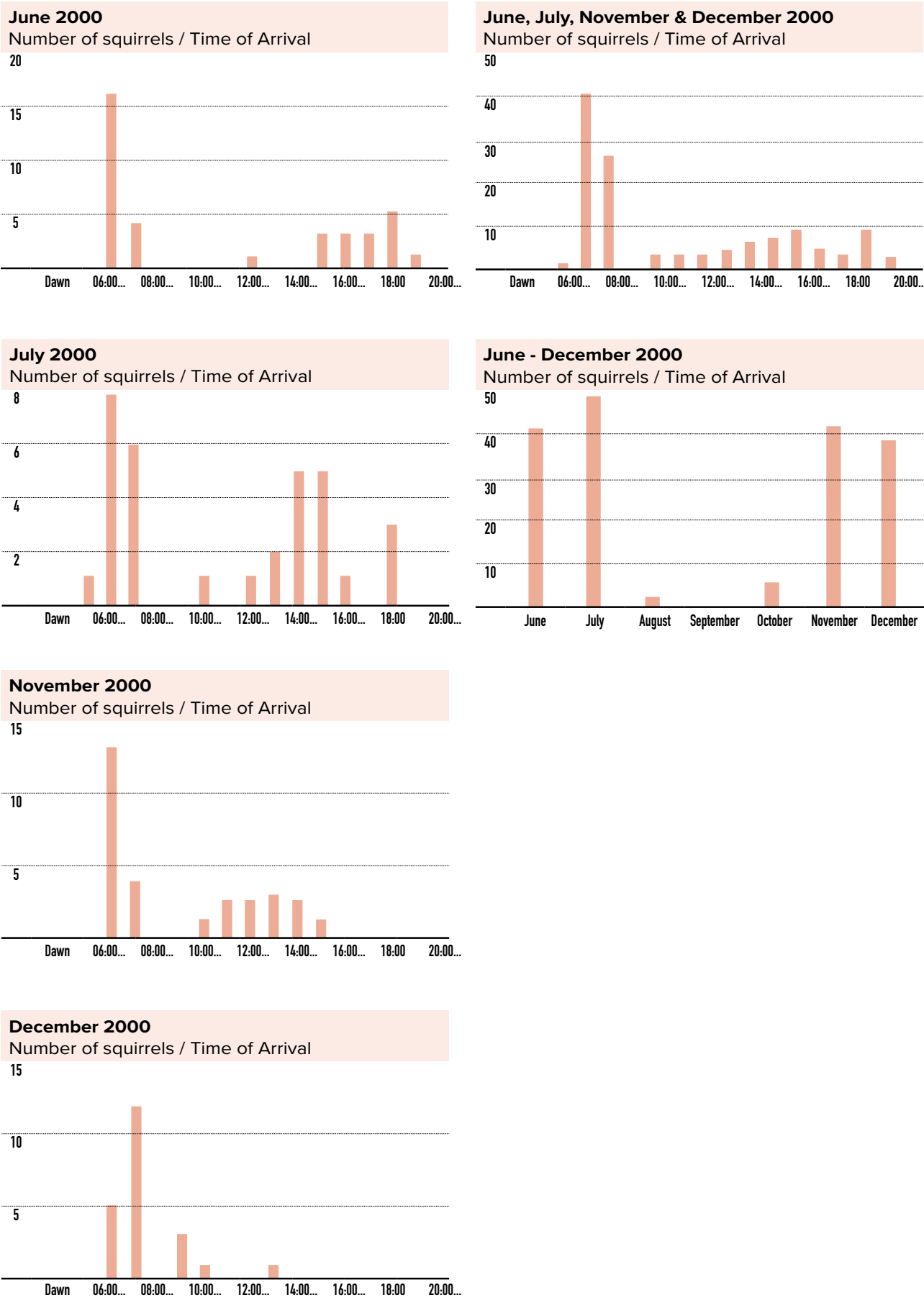
Weather extremes such as gales and thunder didn't deter the squirrels from coming to the garden for their food. Neither did hot, humid weather or rain. No correlation was found relating to number of visits and weather.

As expected, visits from adult squirrels are far more than from young animals. Squabbling is often recorded and squirrels with torn ears, digits or tails are noted. On 25th October 2001, a cat killed a squirrel and left it on the patio. On 21st November 2001, a squirrel was found dead and partially eaten with only the head, skin and back legs left. On 10th February 2002 a known and named squirrel was found dead. A post mortem found natural causes. The case is included in part three, mortality and morbidity.

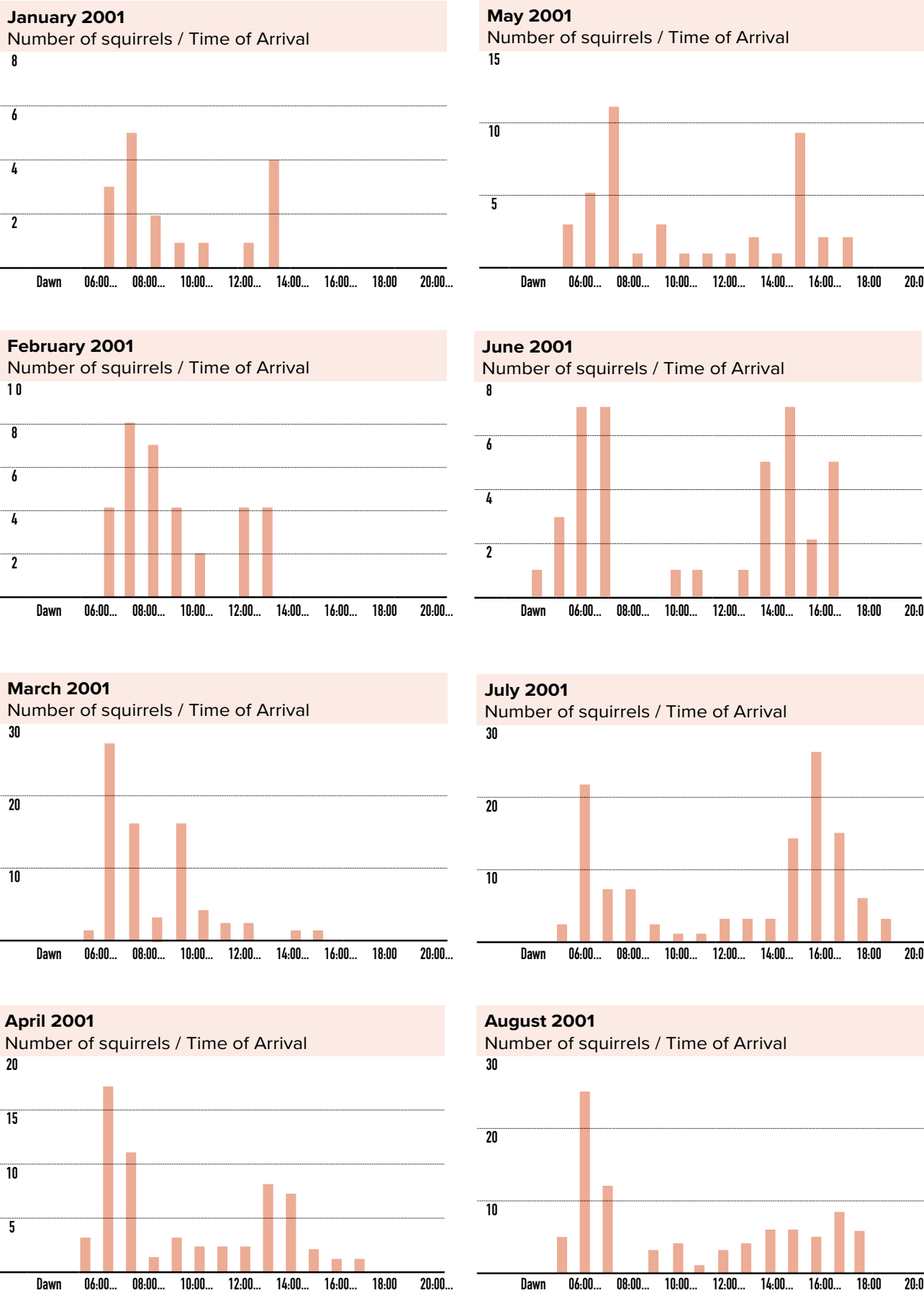
Colour description ranges from light sandy, greyish and through to dark. Tails vary from blonde to light tip, multicoloured and banded.

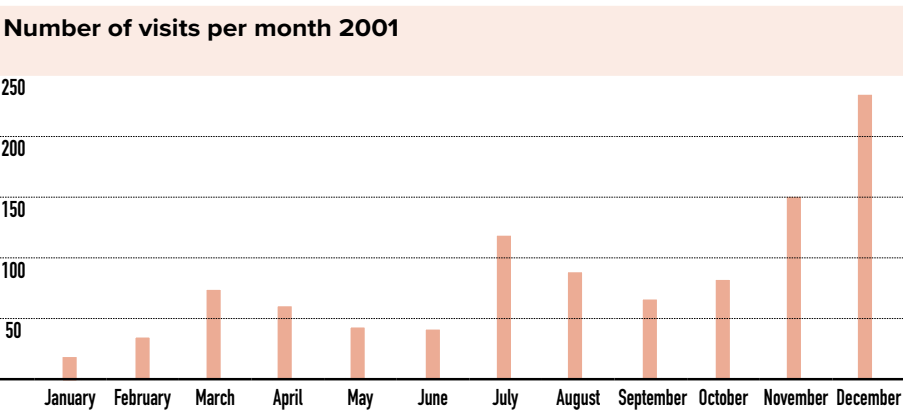
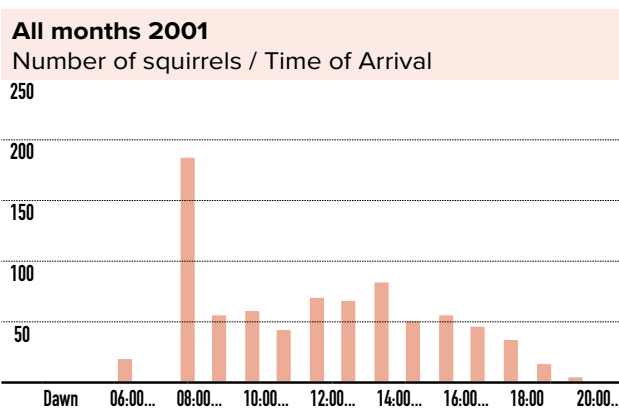
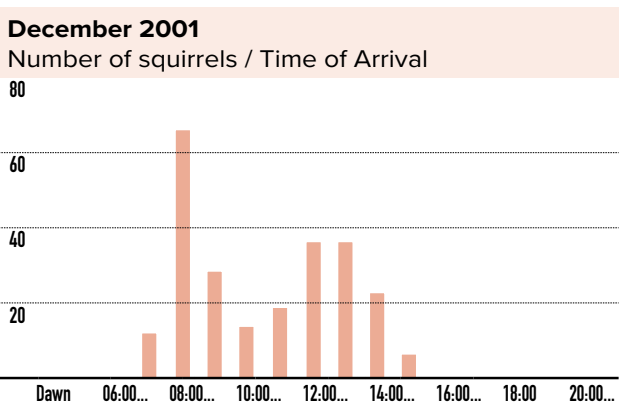
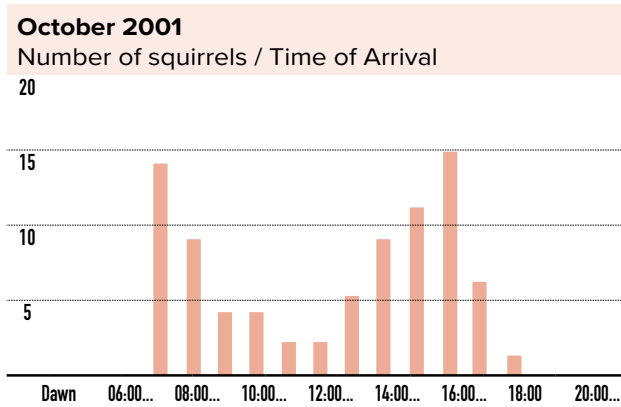
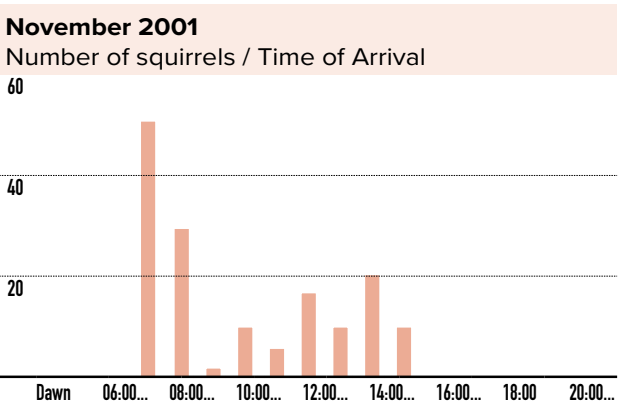
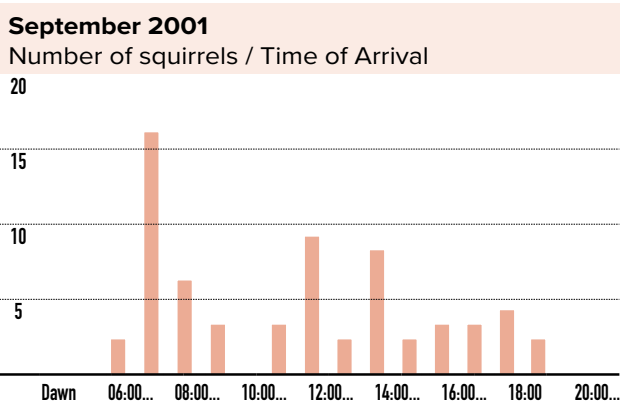


Results for garden squirrel observations by Lynn Hodges, East Cowes.
Time of arrival 2000

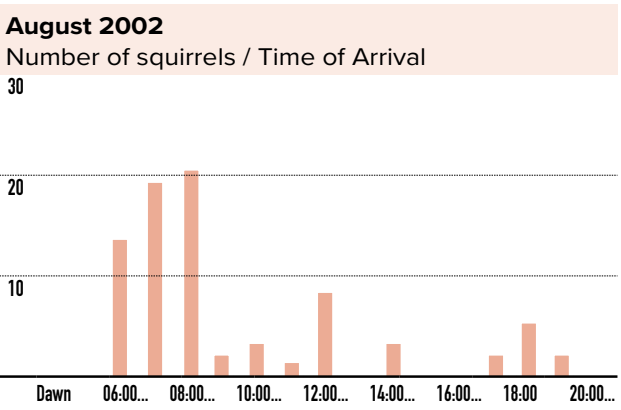
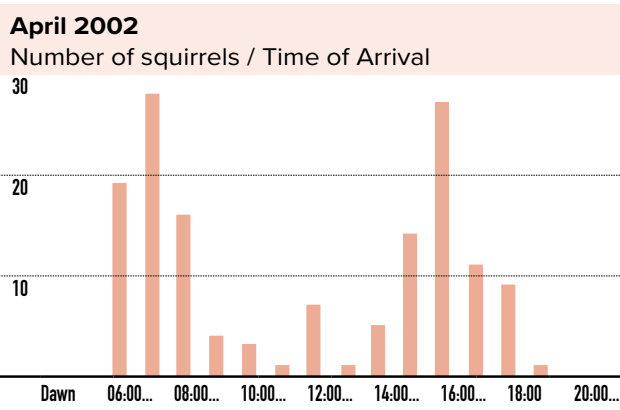
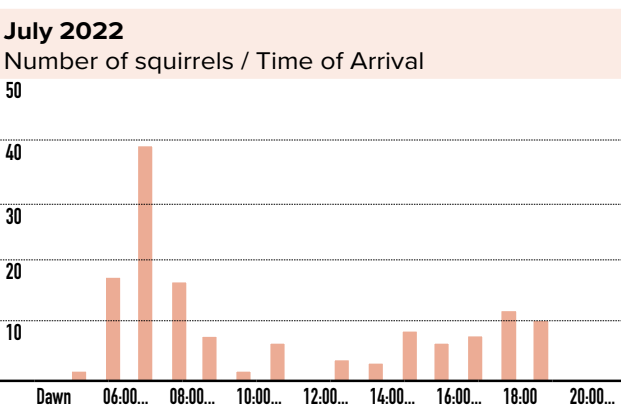
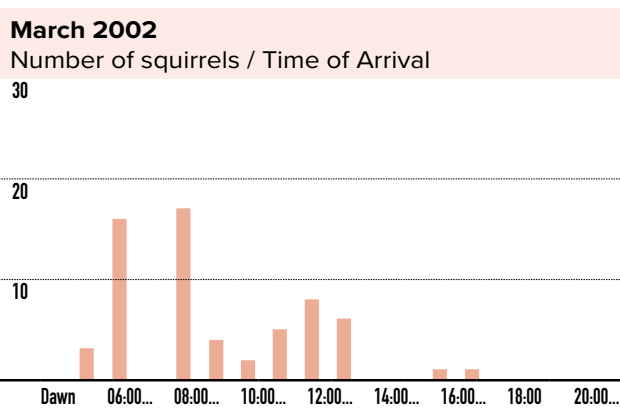
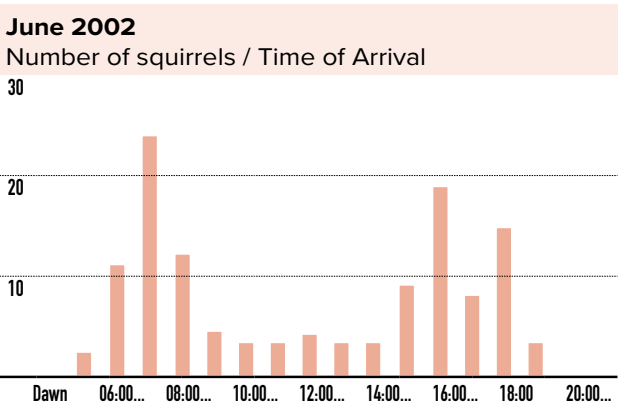
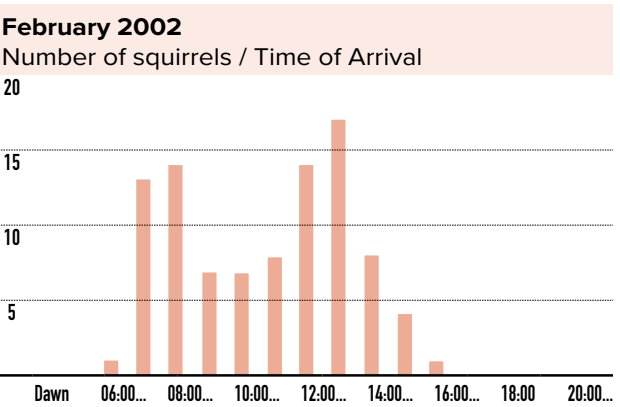
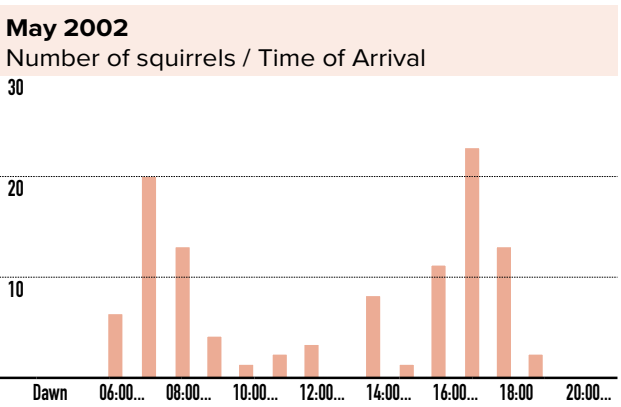
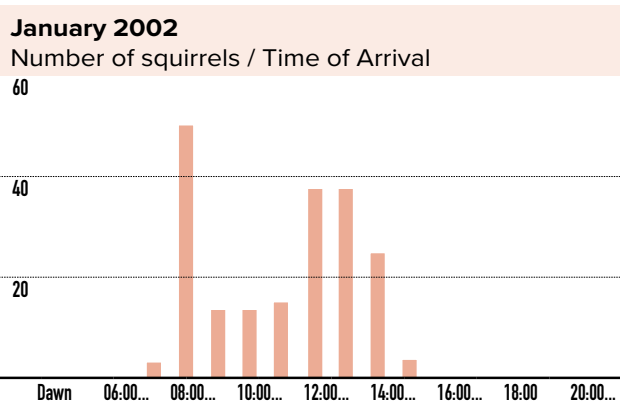


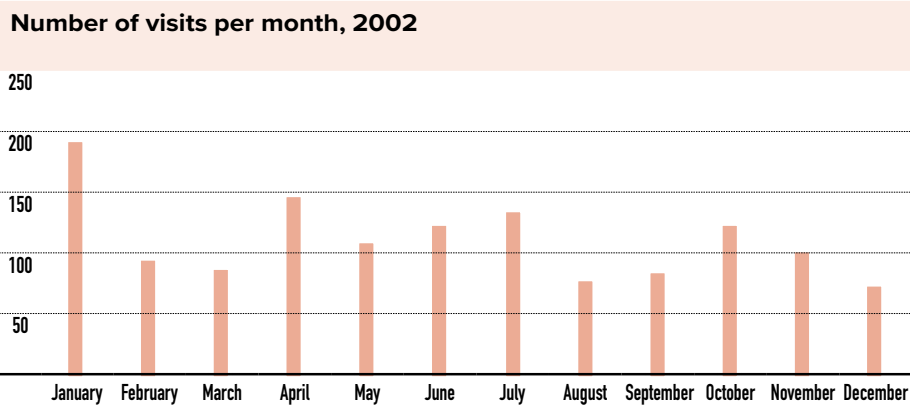
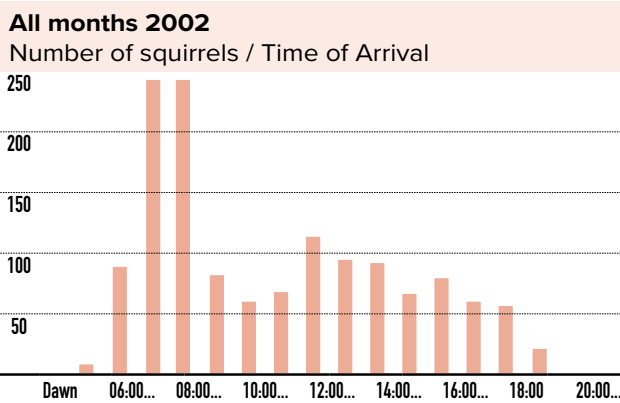
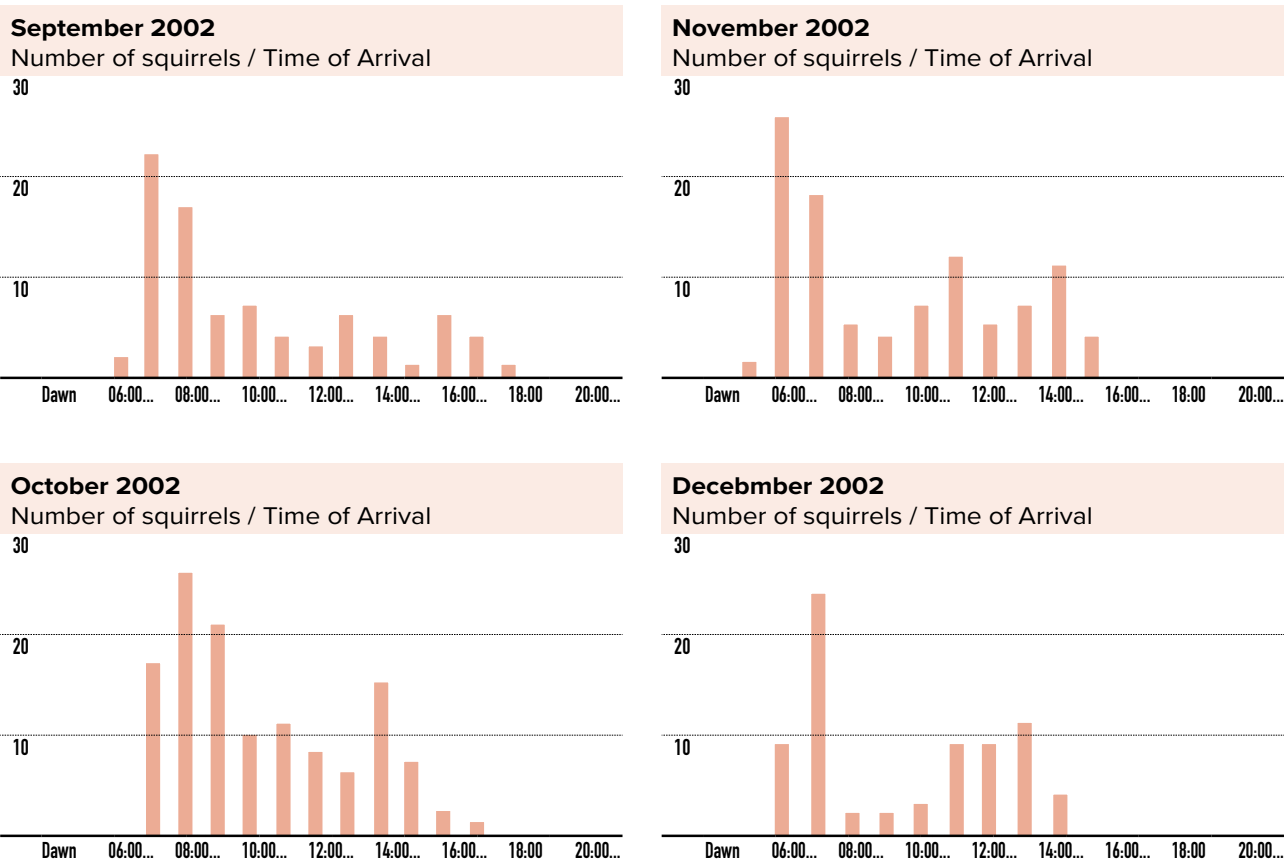
Results for garden squirrel observations by Lynn Hodges, East Cowes.
Time of arrival 2001



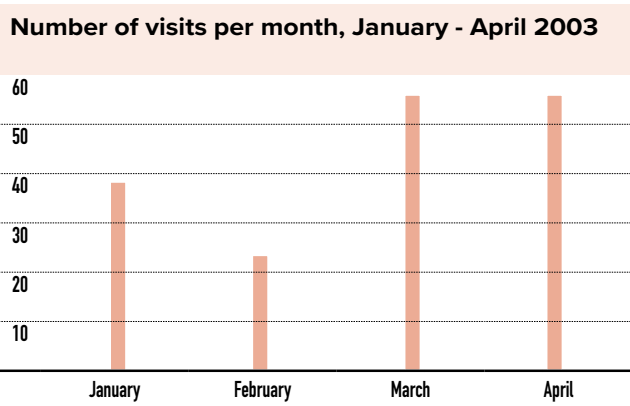
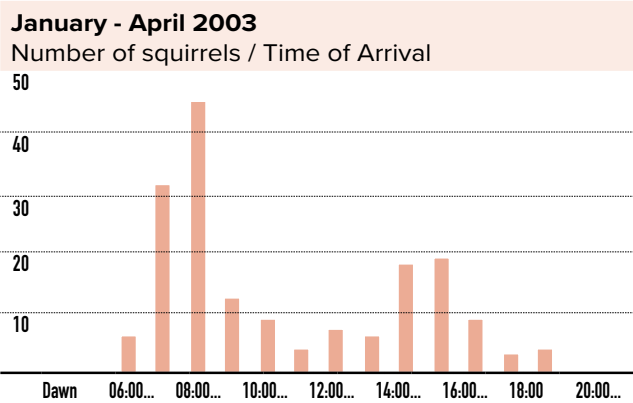
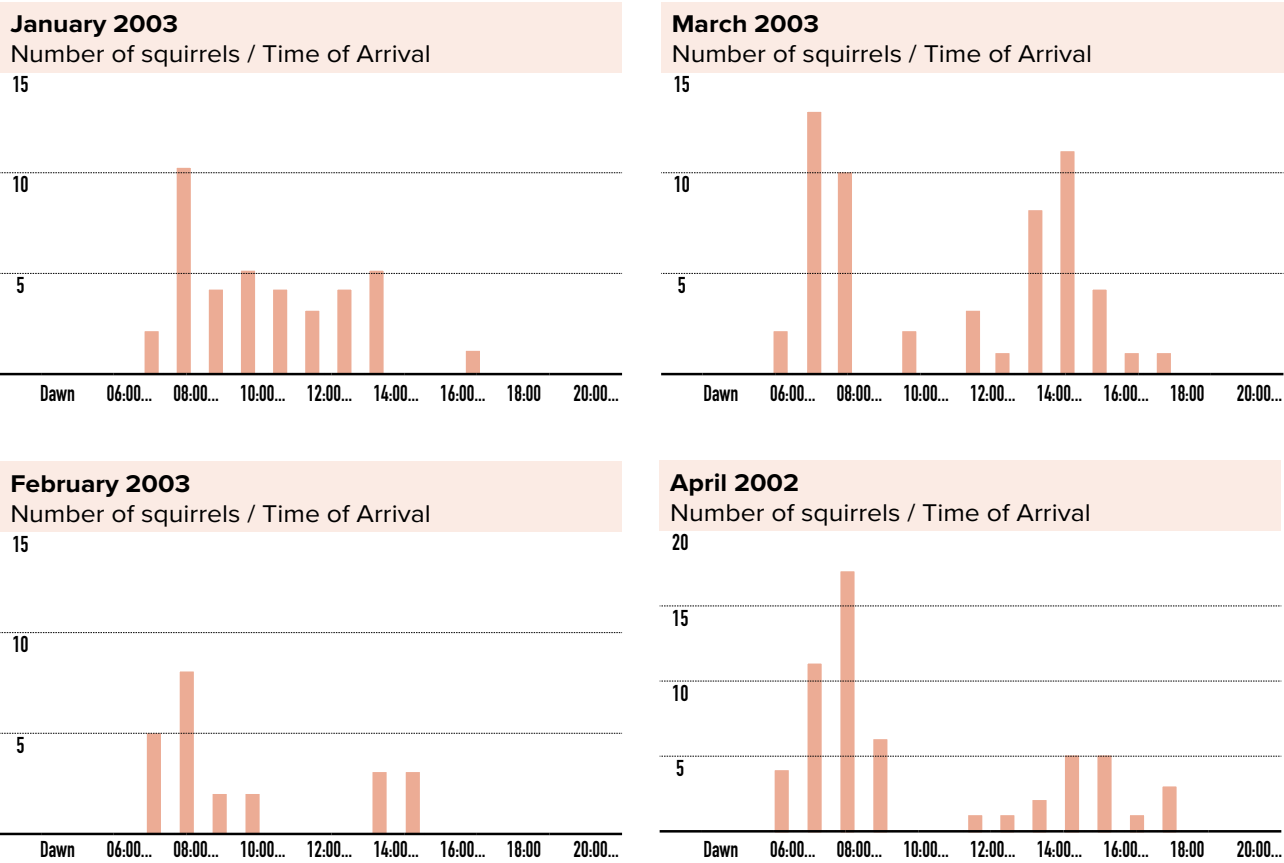


Results for garden squirrel observations by Lynn Hodges, East Cowes.
Time of arrival 2002

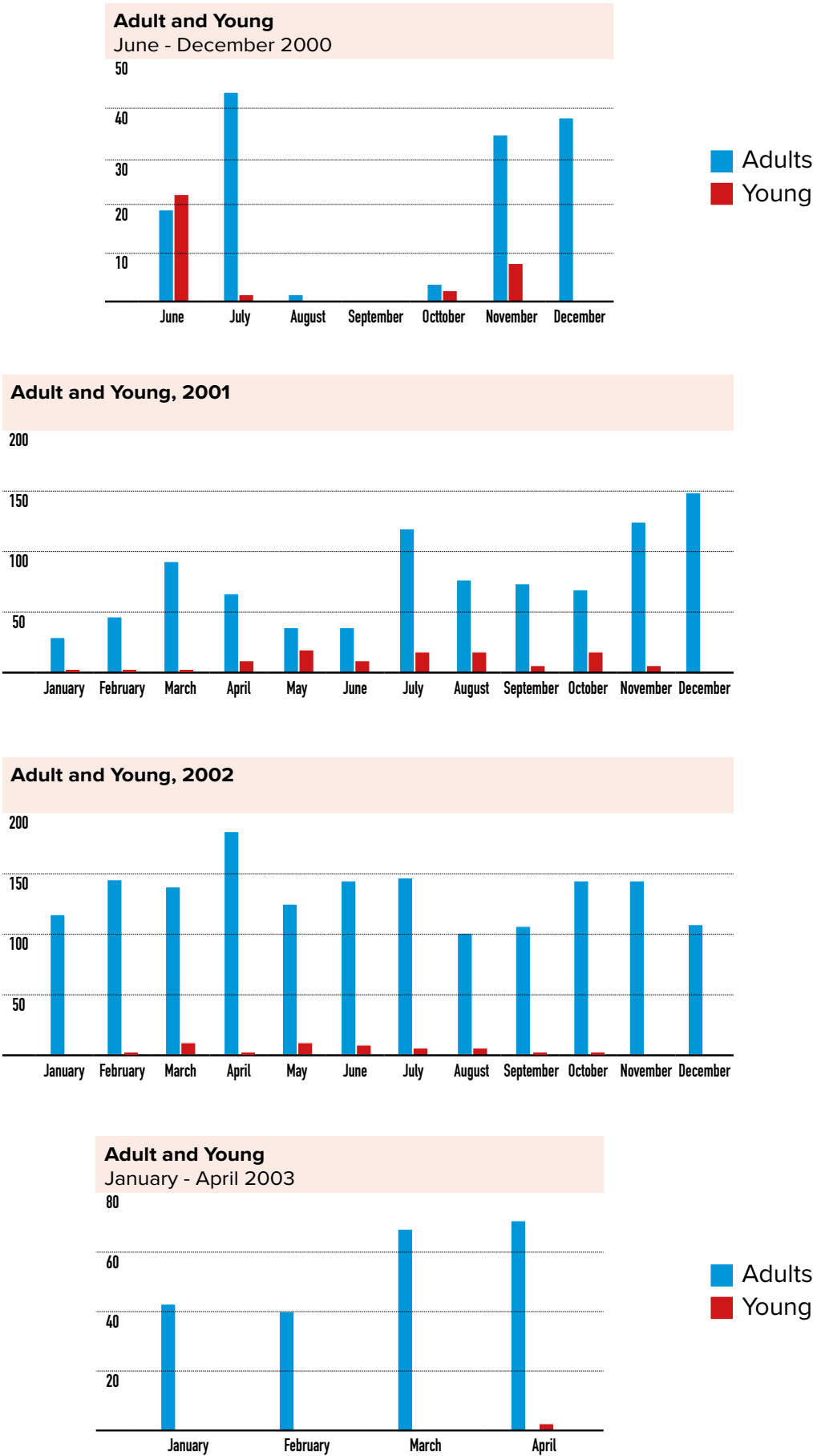




Results for garden squirrel observations by Lynn Hodges, East Cowes.
Time of arrival 2003



Results for garden squirrel observations by Lynn Hodges, East Cowes.
Bar charts showing breakdown of adults and young visiting



Chapter 7

OBSERVATIONS BY PETER DUGHER IN A GARDEN ADJOINING BORTHWOOD COPSE

It is inevitable that squirrels will be keen to partake of supplementary food in a garden adjoining Borthwood Copse. Owned by the National Trust, Borthwood Copse is a predominantly deciduous woodland of 23.34ha. Tree species include hazel, beech, Scots pine and sweet chestnut, which are all important foods for red squirrels.

Although many people go dog walking in Borthwood Copse on a daily basis and must see red squirrels, they do not report them. The assumption, as with Firestone Copse, is that they are so common in these woods that there is no need to report sightings as we must know squirrels are present.

Borthwood Copse has a dedicated bi-annual monitoring volunteer, giving valuable information, but Peter Dugher's daily records cover 365 days a year. Squirrels living on the opposite side of the copse will visit other gardens. Even though it appears that a high number of squirrels visit this one garden, many are the same squirrel making a repeat visit daily.

Results

Peter details dates, times of arrival, perceived age and activity; this study is ongoing. Timings followed the usual pattern of around 8am and late afternoon. Seven is the highest number seen together in the garden, although this was only twice recorded and the majority of entries record one or two squirrels at a time. As normal, squabbling did occur.

Given that many other owners of gardens adjoining Borthwood Copse feed squirrels, the squirrels visiting Peter's garden will also visit neighbouring gardens. Based on the recognised average of one red squirrel per hectare (Holm 1991), the copse should be home to around 23 squirrels.



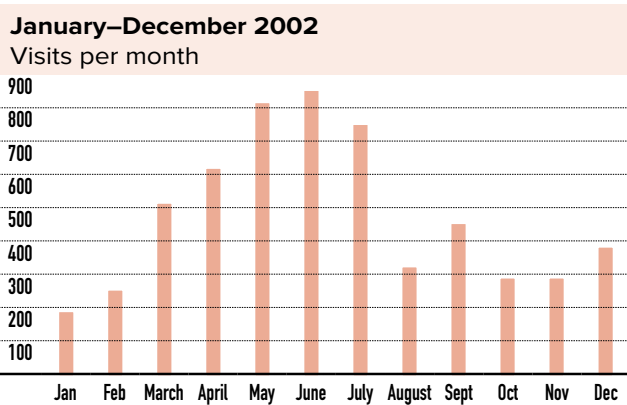
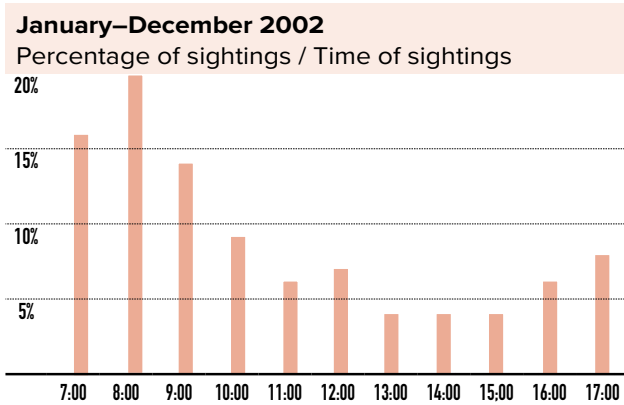
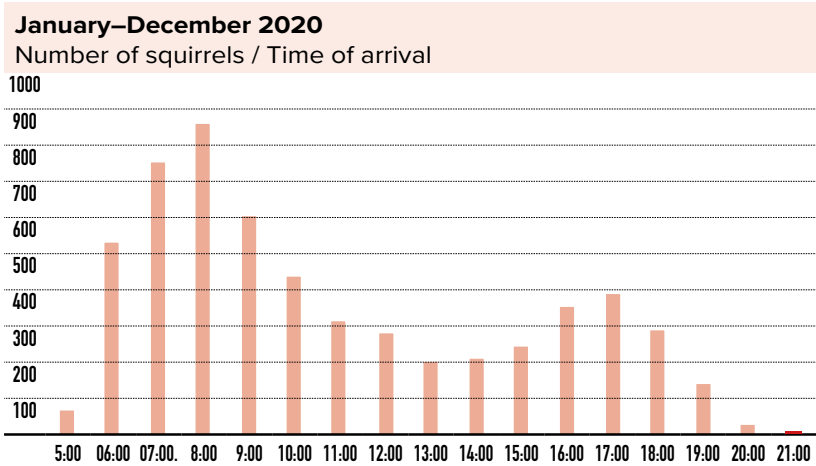


Coppiced sweet chestnut with Scots pine in the background



Beech

Results for observations by Peter Dugher in a garden adjoining Borthwood Copse.



Chapter 8

SIGHTINGS FROM THE GENERAL PUBLIC

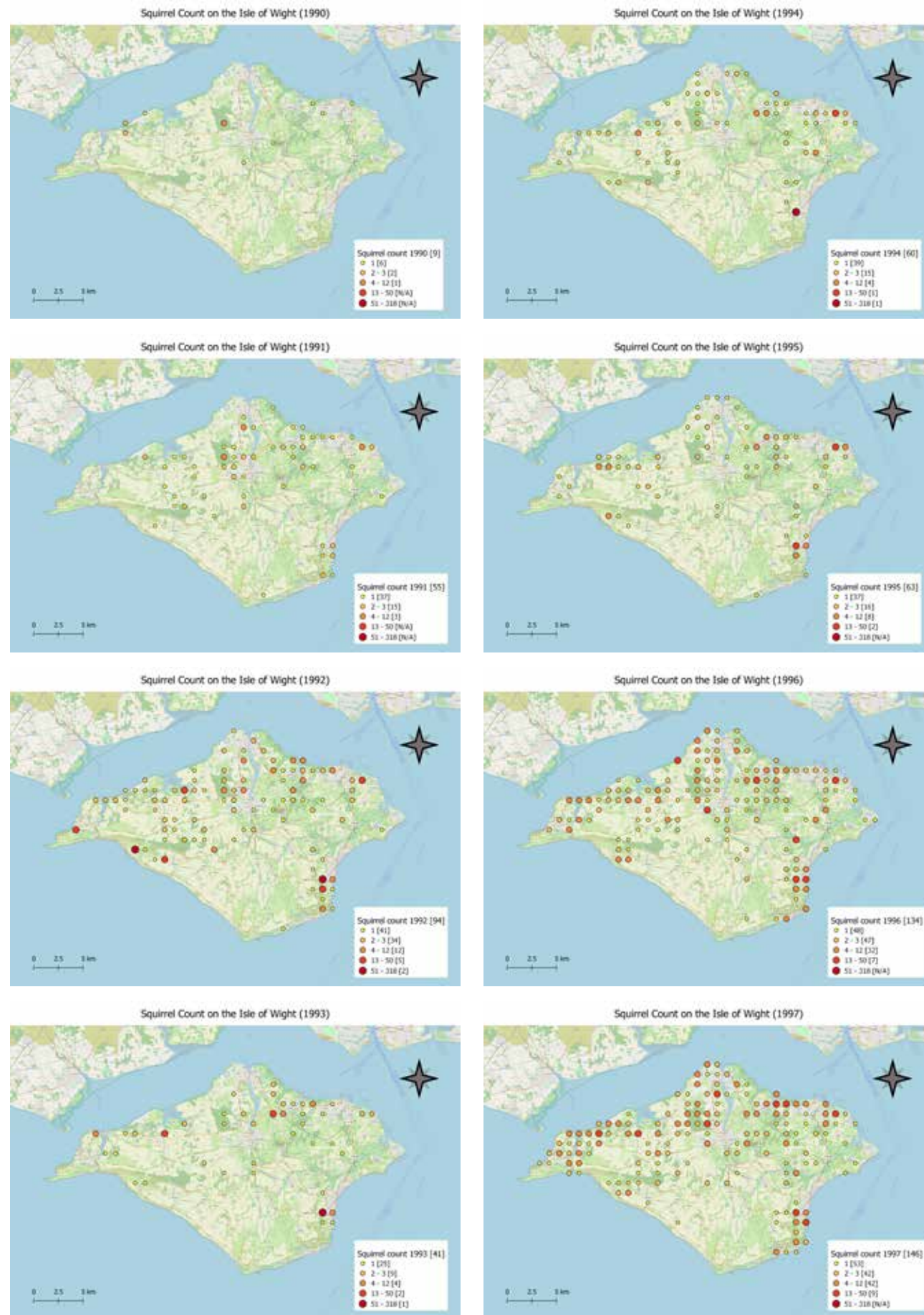
Sightings reported by the general public account for the largest number of entries on any of the databases. Sightings come in daily via an online form, app, email, phone calls or directly from face to face conversations with the general public at shows, meetings, etc. As squirrels have spread across the island and numbers have risen, so has the number of reported sightings. Naturally, the most sightings come from the areas where the human population is highest.

Regular publicity keeps data recording in the public eye as incoming reports drop off without a prompt. Fluctuations in the red squirrel population are natural and when numbers drop due to a poor seed crop or bad weather, calls from the general public escalate as concern for the red squirrel's welfare grows.

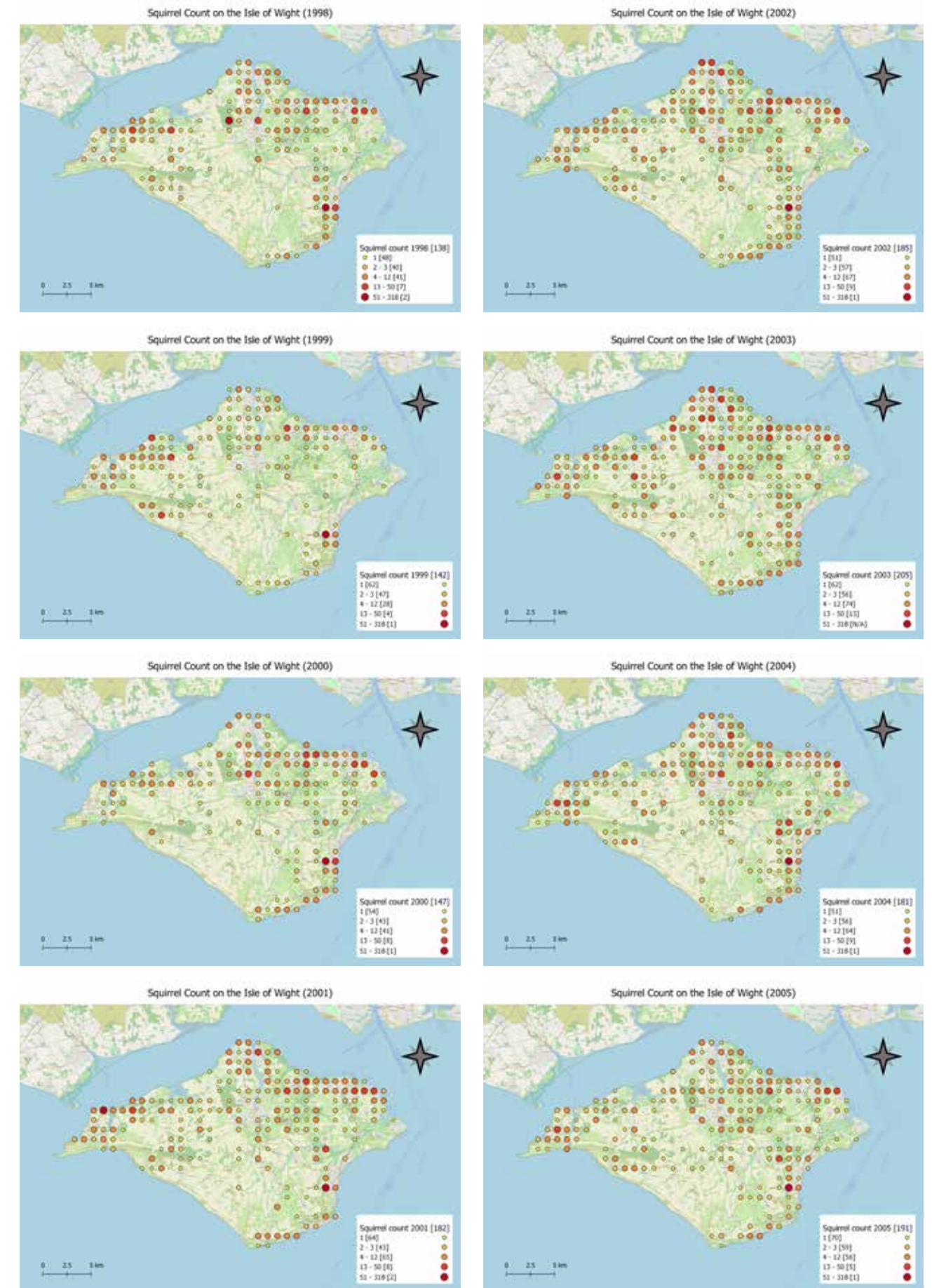
Shows and talks generate the most sightings. Some observations are discarded as the information is not clear. For example, a classic entry for 'where did you see the squirrel?' is 'the bottom of my garden' without saying where the garden is. Some volunteers are better than others when questioning the general public. Attempts to make the forms and questions 'foolproof' are not entirely successful. The intention is to run training workshops and tighten up on data collection.

Phone calls reporting sightings are fewer now that we have apps and an online form, but if there is a problem to discuss, a phone call gets a faster response. These calls are usually about tree felling, planning applications, squirrels in a roof or in a property and sick or injured animals.

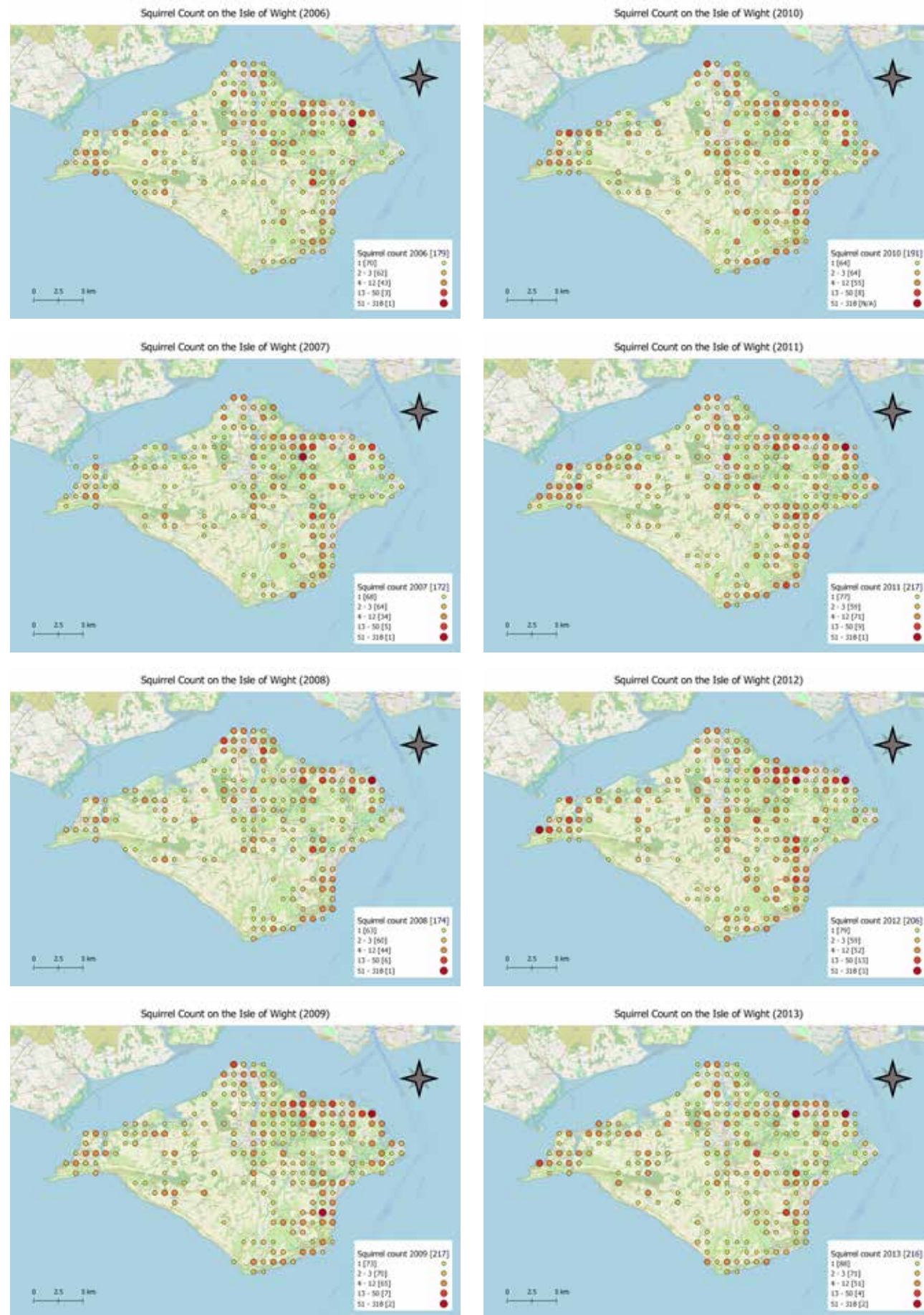
Distribution maps showing sightings reported by the general public General sightings 1990–1997



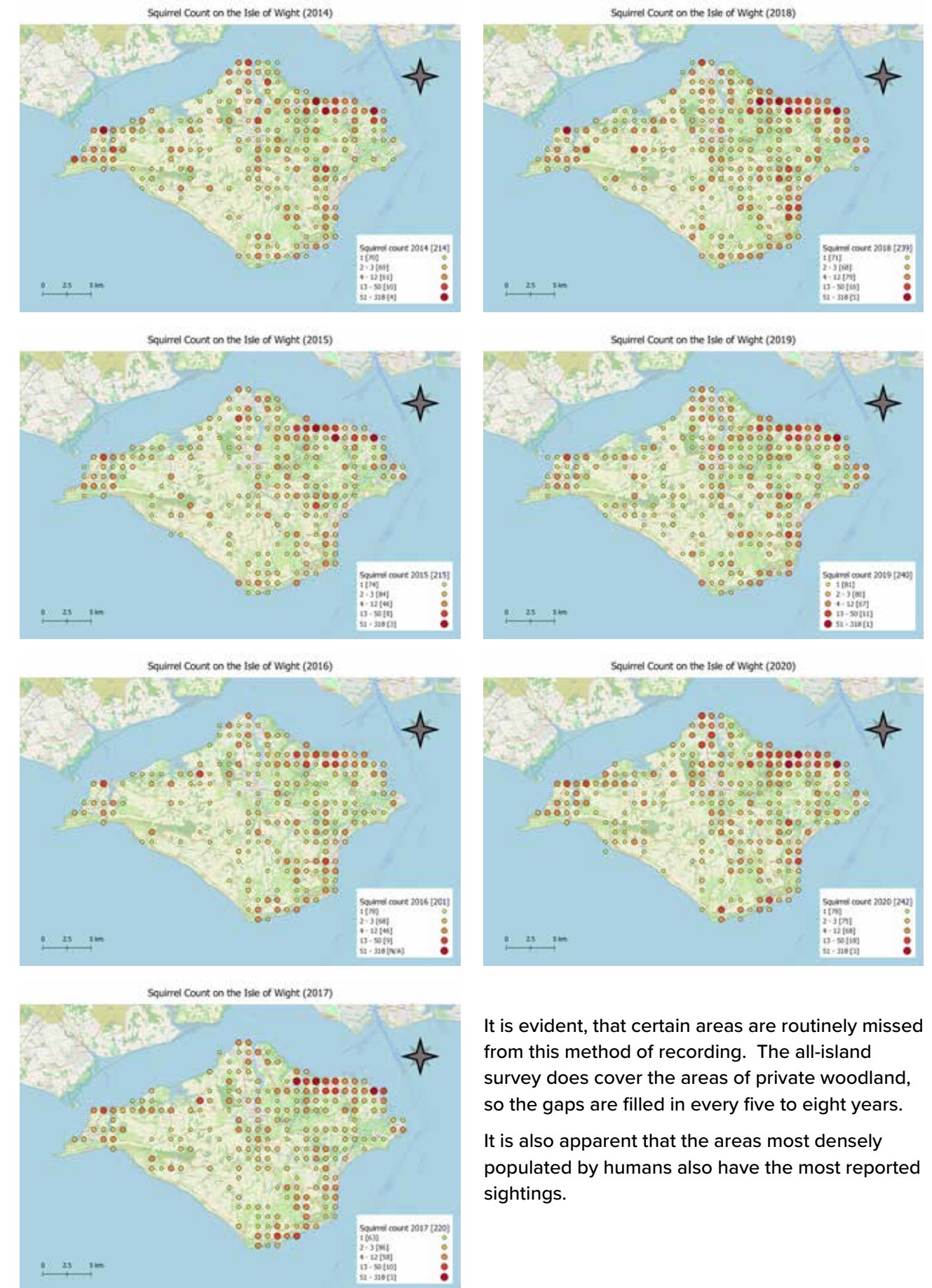
Distribution maps showing sightings reported by the general public General sightings 1998–2005



Distribution maps showing sightings reported by the general public General sightings 2006–2013



Distribution maps showing sightings reported by the general public General sightings 2014–2020



It is evident, that certain areas are routinely missed from this method of recording. The all-island survey does cover the areas of private woodland, so the gaps are filled in every five to eight years.

It is also apparent that the areas most densely populated by humans also have the most reported sightings.

Chapter 9

DISCUSSION

This chapter reviews the data in the previous chapters in this section. Areas where methodology could be improved and the pros and cons of the different methods are discussed. Any information is helpful and put together does paint a picture of how our red squirrels are coping. Fine-tuning methodology for the best results is currently the topic of meetings with volunteers who specialise in data collation and analysis. Methods and available tools have changed over the last 30 years, therefore so should the way we work.

Accuracy is not 100% in citizen science. The observer rarely gives a grid reference or postcode, so the location is worked out from a description. As 1km grid references are used there is latitude, thereby reducing error. Dates are sometimes sketchy and described as mid May or 'in the spring'. Early, mid and late are given default dates, which are 1st, 14th or 28th of the month. Asking when in a season the sighting occurred usually narrows it down to the month. As squirrels are mobile, 1km grid references are acceptable. Rather than lose an entry, a default in an area where squirrels are known to be is acceptable for citizen science.

Value of data and its application

Collecting data takes time and effort, so there must be a practical application for it. For instance, amalgamating all data sets will show how numbers have increased and how effective newly planted corridors are. Pulling all data together and looking at population dynamics is covered in section 4.

Recording and, when deemed sensible, potential grey squirrel sightings are followed up using camera traps, hairtubes, leaflets through letter boxes and social media. Up to the end of 2021, there have been no confirmed sightings of live grey squirrels. An example of how the system works started in January 2020. A call came in from a lady living very near Ryde Pier to say she thought a grey squirrel was visiting the garden. Camera traps were placed in the garden for two

weeks but no grey squirrel was recorded and no other sightings were reported.

On January 11th 2020, another call came from a resident living less than half a mile away. She also thought she had seen a grey squirrel. Letters were written and posted through letter boxes in the area and cameras put up. Again, no grey squirrel was seen. On 8th June, a video clip of two squirrels chasing around a tree was emailed to Wight Squirrel Project. The shot was very distant and indistinct but the sender thought one animal was grey. Again, it was less than half a mile further on from the last sighting and adjacent to Ryde Cemetery. The distance from the tree where the squirrels were chasing, to where the person took the film clip, was judged to be too far away to be certain which squirrel species it was.

On the first walk around the cemetery, used cones were found and a red squirrel spotted. During weekly walks over the next 18 months, only red squirrels were seen. On 6th November 2020, two squirrels were killed near the cemetery. The bodies were not retrieved and neither of the people reporting the road kills mentioned that the squirrels were an unusual colour. No reports of a grey-coloured squirrel in the area have come in since 8th June 2020.

Planning applications where woods and corridors will be impacted are common on the Isle of Wight. The Wildlife and Countryside Act 1981 plus the Isle of Wight Council's Red Squirrel Strategy should, in theory, afford some protection. In practice this is not always the case. Losing trees is not the only consideration, as development will border woodland and new householders inevitably bring in other hazards such as cats. Toxoplasmosis is widespread (Simpson et al. 2013) and squirrels do pick up the disease whilst foraging on the ground or caching nuts. Wight Squirrel Project will refer to records, scientific and citizen science when responding to planning applications and flag up the problems that cats pose to a protected species.

Identifying areas for tree planting is another use of data. The previous section, outlining corridors and squirrel dispersal routes, identified areas which would benefit from tree planting. All records and databases were used to compile the chapter. This is an example of how scientific and citizen science can work together to fill in the knowledge gaps.

Published papers are built on information gathered by all methods. Data recorded from post-mortem examinations has produced numerous papers and new information about red squirrels. Part 3 goes into detail relating to causes of mortality and morbidity in red squirrels over the last 30 years. Information on treating sick and injured squirrels is also included.

Where to place road signs, and initially rope bridges, was decided using reported sightings of road kills. These sightings also indicate dispersal routes. Where traffic is too fast and many road kills occur, plus posing dangers to others such as horse riders and walkers, a request for lower speed limits is applied for. For instance, citizen scientists reporting squirrel road kills in Wilmingham Lane, Freshwater is a case in point. From 1st January to 30th November 2021, nine red squirrels were killed on this quiet country road, where there is no speed limit.

There are woods either side of the road and squirrels gather seed from one side and cross the road to bury it on the other side (H. Butler pers. obs.). The autumn of 2021 saw the highest number of road kills (eight) as squirrels not only gathered the abundant autumn seed crop but dispersed as well. Thanks to these reported sightings by citizen scientists, an application to slow traffic is in progress.

Anthropogenic-induced causes of death, such as fenn traps (Butler & Simpson 2006) rat poisoning and complaints about cats regularly killing red squirrels are reported by the general public. This is discussed in part three.

The general public are interested in contributing to studies. For example, in the late spring of 2021, homeowners and a gamekeeper helped with a hairtube survey. The aim is to collect hairs from areas missed in an earlier genetic study. Isle of Wight residents are keen on their red squirrels, which is good news for the squirrels and groups looking after them.



Wilmingham Lane

The future of data collection

Methods of citizen science data collection certainly require improvement. As paper copies were the only means of recording at the beginning of the project, the backlog of thousands of entries was input by a number of volunteers, for which the author is thankful. The main problem with a number of different people inputting data is inconsistency of interpretation. Also, some volunteers decide they want to change the format, which then doesn't accord with the main spreadsheet, so the data must be input again. It all needs verifying and anomalies show up in analysis.

Improvement to data collection at shows will require volunteer training. The intention is to recruit volunteers and train them. Wight Squirrel Project currently has several highly qualified people to deal with data, once it has come in from the public. Online forms are useful but, from

experience, words should be limited as some people tend to write an essay in answer to a simple question. Drop-down boxes would focus observers on the question. It's surprising how many people do not read the question.

However, citizen science must take into account how readily the general public accept and use your app or online form. To this end, regular observers will receive a short questionnaire to ask how user-friendly the app and online form are and how we can improve these for them.

Science-based studies will have their own methodology depending on the aim of the study. There are more powerful tools evolving, such as QGIS, a good tool for mapping. Maps were hand drawn when the author started red squirrel work. Cameras are widely used now and improving in quality all the time. Any technique which gives information without disturbing the squirrels is welcomed by Wight Squirrel Project.

References

Butler, H., & Simpson, V. Limb amputations of red squirrels (*Sciurus vulgaris*) on the Isle of Wight attributed to fenn traps. *British Veterinary Zoological Society Proceedings* November 2006.

Holm, J. L. 1990. The ecology of red squirrels (*Sciurus vulgaris*) in deciduous woodland. PhD thesis. University of London.

Simpson, V. R., Hargreaves, J., Butler, H. M., Davison, N. J., & Everest, D. J. 2013. Causes of mortality and pathological lesions observed post-mortem in red squirrels (*Sciurus vulgaris*) in Great Britain. *BMC Veterinary Research* 9, 229. <https://doi.org/10.1186/1746-6148-9-229>

Acknowledgements

Thank you for the graphs and maps:

Sally Wiltshire

Simon Walker

Joel Rowlands

Marina Rupp

PART 2 SECTION 4 POPULATION DYNAMICS AND ANTHROPOGENIC INFLUENCES



Contents

Part 2 Section 4

	Page
Introduction	269
Chapter 1 Red squirrel population spread on the Isle of Wight 1991–2021	270
Chapter 2 Anthropogenic influences	279
Chapter 3 Negative influences	284
References and Acknowledgements	290

INTRODUCTION

This section on population dynamics describes the way the metapopulation of red squirrels on the Isle of Wight, between 1991 and 2021, has fluctuated and moved around the landscape. The results are stochastic and the aim is to show how the population has changed over time and gauge how successful our native red squirrels on the Isle of Wight have been. Factors that may contribute to the increase, decrease and stability, including human influences, positive and negative, which shape red squirrel welfare and distribution are also discussed. One question is whether supplementary food influences the natural balance and if the negative anthropogenic influences counter extra food supplies.

Section 4 draws together surveys from the previous chapters which cover a 30-year period and include some post-mortem results. Mortality is detailed in part 3. Methodology for the various datasets are described in previous chapters and not repeated here.

Although the Isle of Wight is unique in having an isolated population of red squirrels, the same ecological processes apply regarding carrying capacity for woodland. Recruitment into the red squirrel population depends on food availability and other factors such as the weather, which will influence success or failure

of the seed crop. On the Isle of Wight, the fate of the red squirrel population is not driven by the presence of grey squirrels, as it is in most of the UK.

A natural carrying capacity for red squirrels living in a healthy broadleaved woodland is one red squirrel per hectare (Holm 1991). Influences on carrying capacity, such as supplementary feeding, may disrupt this balance. On the other hand, the question is ‘do unnatural influences such as traffic, garden hazards, pets, traps and rat poison create a balance?’ Using data collected over 30 years, this question is explored here. Future studies are planned to look into this question further.

The maps relating to corridors, outlined in section 3, show how and where the squirrels moved around the landscape in 1991 and again in 2021, so are not repeated here. Core habitat is more likely to maintain a stable population regardless of natural fluctuations in food supply or weather events such as the storms in the late 1980s. Satellite populations are more likely to falter if recruitment is difficult due to poor corridor links or a small wooded area doesn’t have a sufficient number of suitable tree species to provide a good food supply for red squirrels.

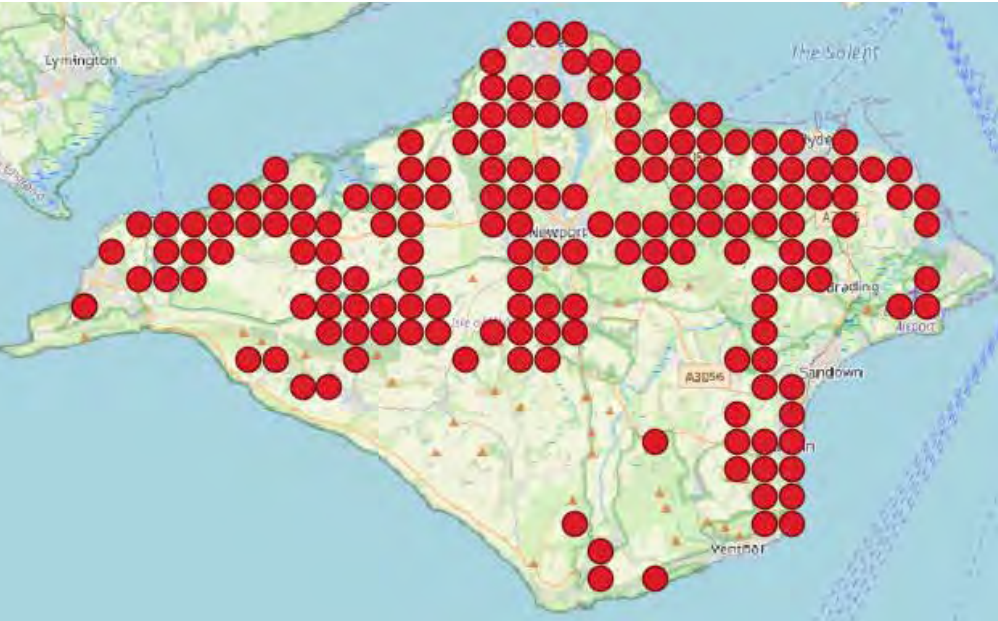


Chapter 1

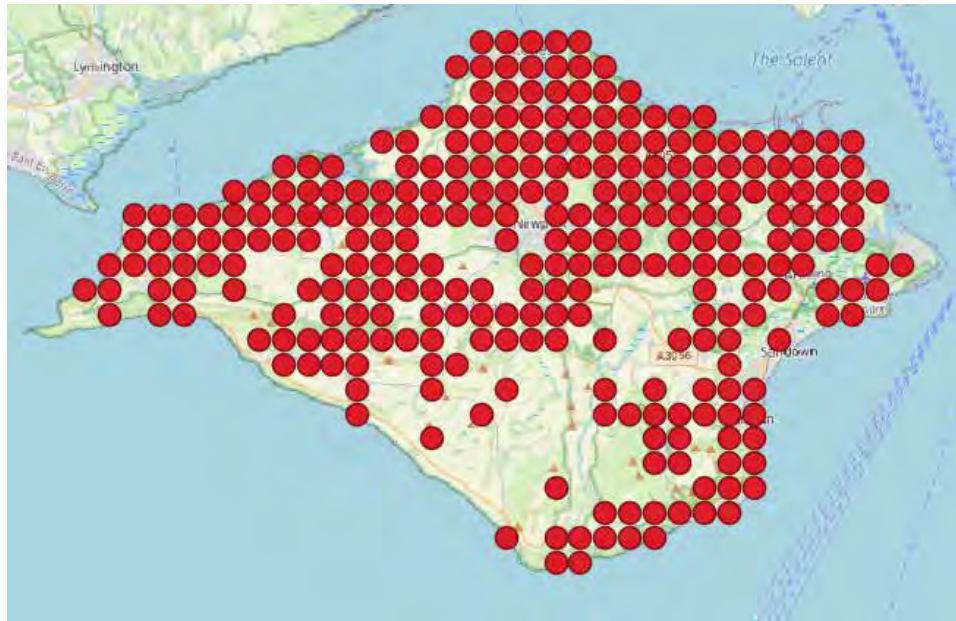
RED SQUIRREL POPULATION SPREAD ON THE ISLE OF WIGHT 1991–2021

Data from the previous chapters clearly show increased numbers over the 30-year period. By putting all data entries together and looking at positive and negative influences, a picture emerges which can inform where future red squirrel conservation efforts should be focused. Ongoing genetic studies will also add to the overall picture over the coming years. The following maps show an increase in range. All data is put together and therefore include signs of presence such as dreys or food leavings as well as sightings.

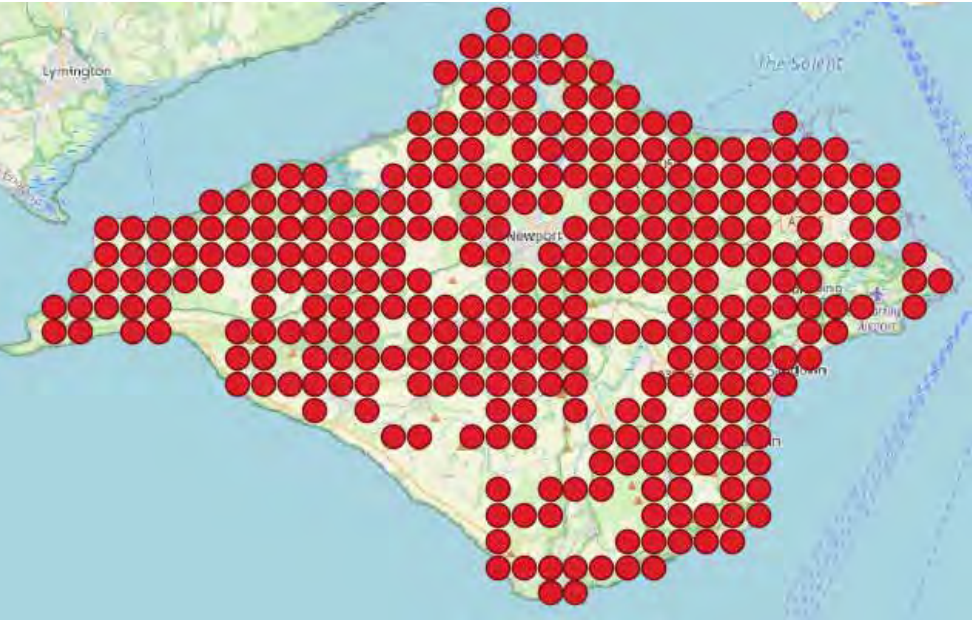
The following six maps each cover five years of data, using all methodology and datasets. It is noticeable there are areas where no sightings occur. These are areas of arable land and therefore trees and hedges are scant or absent. The dots represent 1km squares where squirrel evidence is found and does not relate to abundance. Therefore, there may be one sighting in a square or 50.



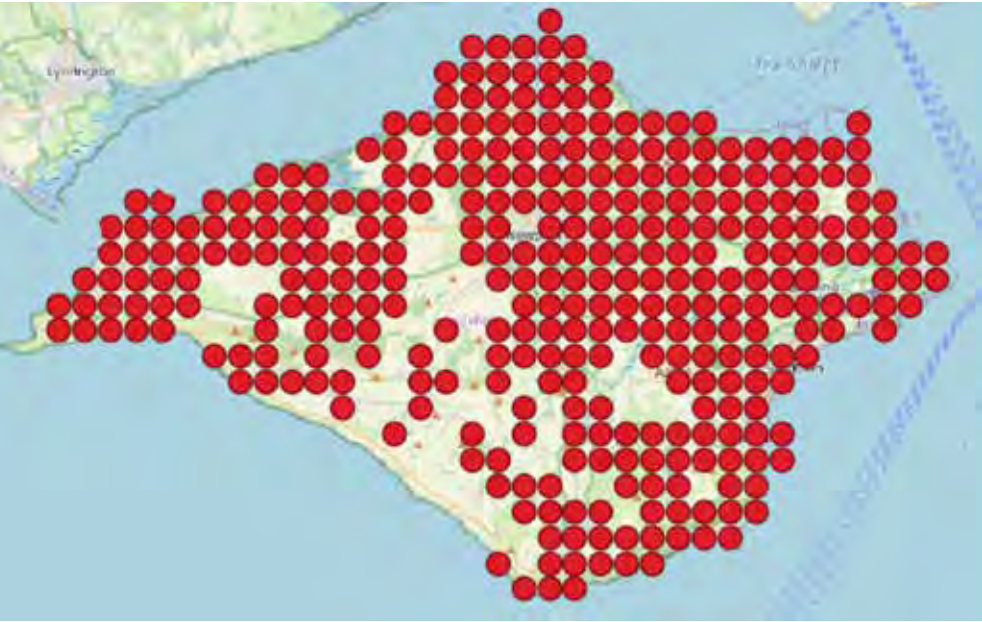
1991–1995
Datasets:
Corridors of Hope
Sightings from the general public
Two years garden squirrel questionnaires



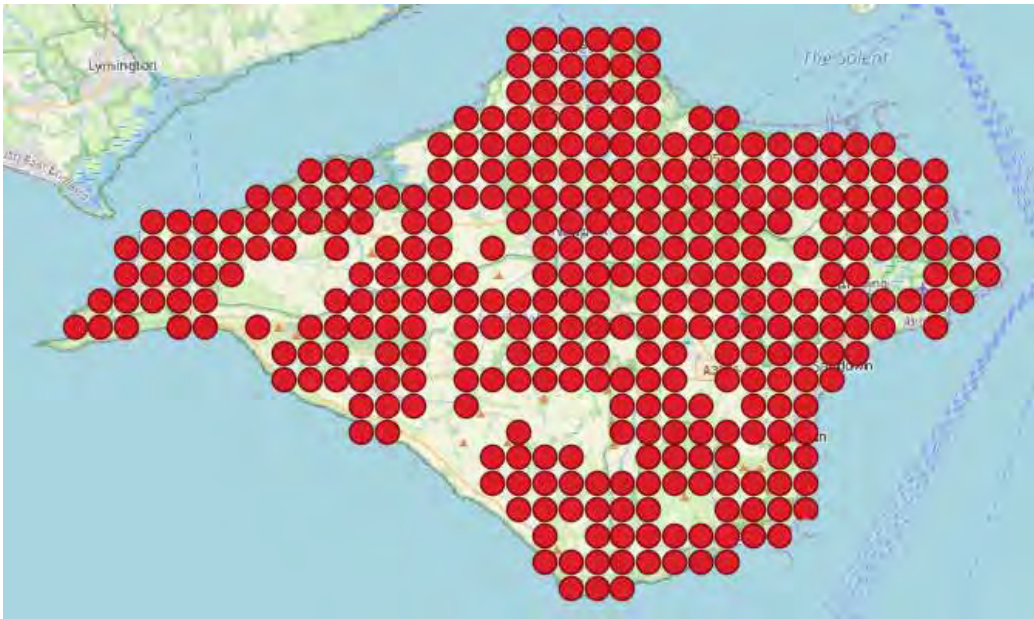
1996–2000
Datasets:
First all-island survey
Sightings from the general public
Garden squirrel questionnaires
Monthly monitoring, followed by
Bi-annual monitoring



2001–2005
Datasets:
First three months all-island survey
Sightings from the general public
Garden squirrel questionnaires
Bi-annual monitoring



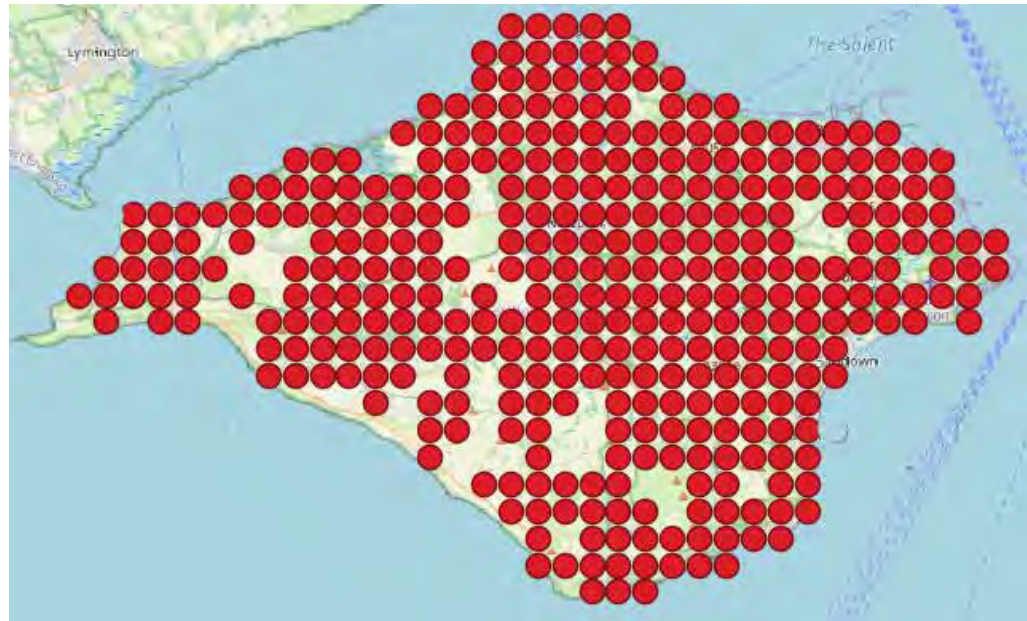
2006–2010
Datasets:
Second three months all-island survey
Sightings from the general public
Garden squirrel questionnaires
Bi-annual monitoring



2011–2015

Datasets:

- All-island survey
- Sightings from the general public
- Garden squirrel questionnaires
- Bi-annual monitoring



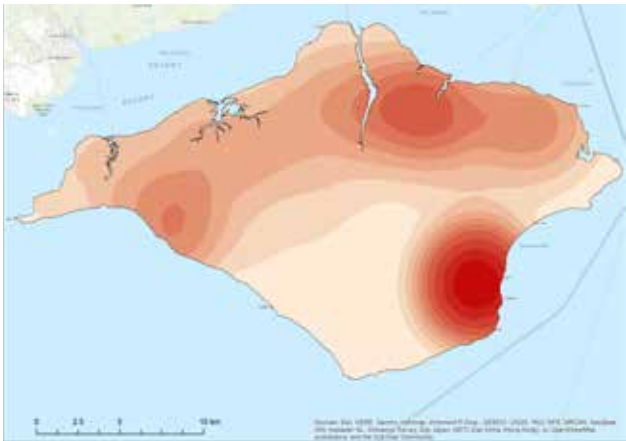
2016–2020

Datasets:

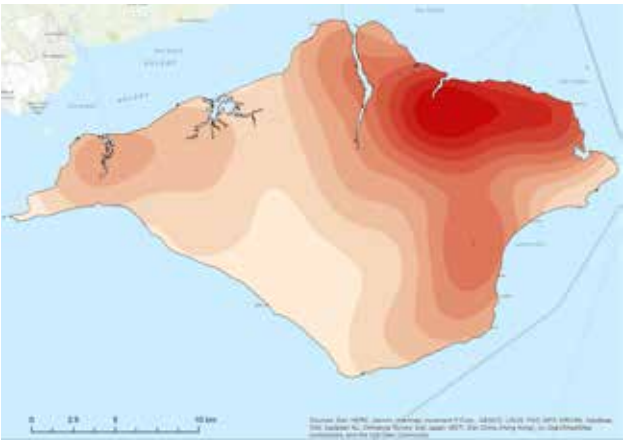
- All-island survey
- Sightings from the general public
- Two years garden squirrel questionnaires
- Bi-annual monitoring
- Corridors 30 years later

The maps below show where the different levels of reported sightings or signs of red squirrel presence occurred, therefore they relate more to human effort rather than to red squirrel abundance. The same data is used in these maps as in the dot maps on the previous pages. It is noticeable that the largely rural south-west shows consistently fewer sightings, whereas the larger residential areas take in more reports. Warmer colours indicate higher rates of reporting

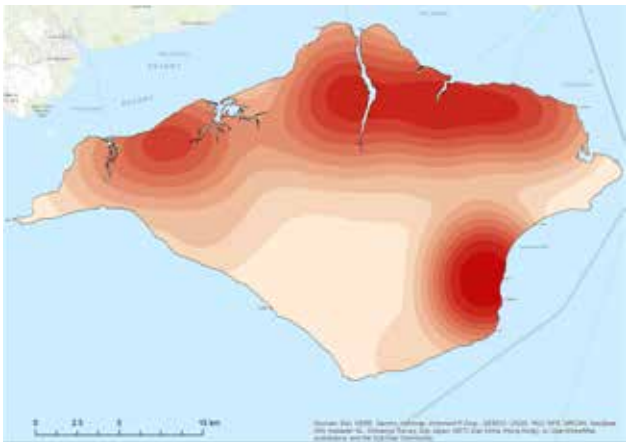
These maps are courtesy of Dr Marin Cvitanovic.



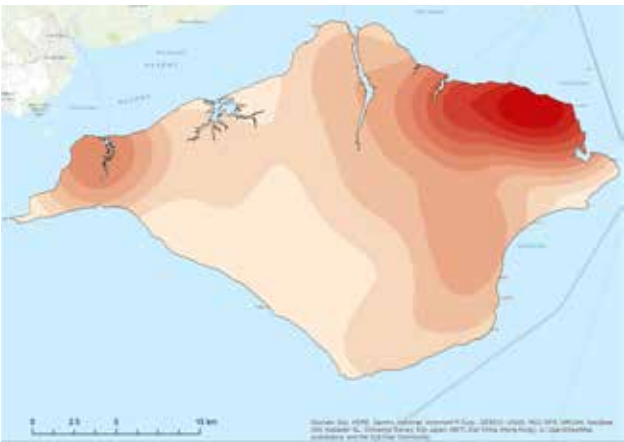
1991–1995



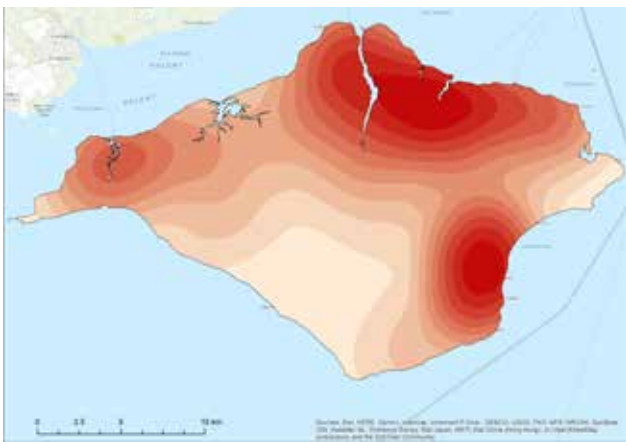
2006–2010



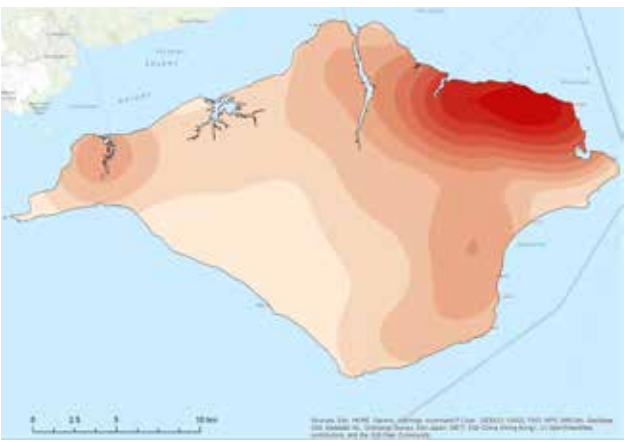
1996–2000



2011–2015



2001–2005



2016–2020

As earlier chapters explained, there are core habitat areas and outlying areas which dispersing animals may colonise. Where tree cover allows arboreal travel and tree species can provide shelter for dreys, then the squirrels will stay if the area can sustain a population. Where the area of woodland or other habitat type is too small, then the young animals will move on once they are mature enough to breed. In every area, supplementary feeding is close by, to different degrees. The following tables give examples of how the squirrels have spread into outlying areas since 1991 and the different type of habitat used.

Location	First confirmed presence	2022 status
Atherfield hamlet	June 2011	Spasmodic
Bembridge village	July 2006	Stable
Chale village	June 2004	Stable
Gladices Copse	2010 survey	Stable
Godshill village	July 2000	Stable
Niton village	January 1999	Low numbers
Thorley village	January 1997	Low numbers, spasmodic
Wellow village	November 1998	Low numbers, spasmodic
Whitwell village	July 2011	Stable
Wroxall village	May 2000	Stable
Yafford hamlet	June 2010	Spasmodic



Map showing area where no sightings occur as it's arable land and therefore trees and hedges are scant or absent. The area shows clearly on the distribution maps.

There are red squirrel sightings in cemeteries, parks and on golf courses plus dreys and food leavings are found here. Although not conventional habitat, red squirrels are able to utilise these spaces if the trees are mature and there is a corridor. Supplementary feeding also enables squirrels to use these areas. The locations listed are the most used but other cemeteries, golf courses and parks do have squirrels on occasion.

There are red squirrel sightings in cemeteries, parks and on golf courses plus dreys and food leavings are found here. Although not conventional habitat, red squirrels are able to utilise these spaces if the trees are mature and there is a corridor. Supplementary feeding also enables squirrels to use these areas. The locations listed are the most used but other cemeteries, golf courses and parks do have squirrels on occasion.

The dates are when a member of the public first reported a red squirrel or evidence such as split hazelnuts or a drey was found. In some cases, particularly Ryde Golf Course, squirrels were there before 1991. The 2022 figures are based on personal observations and public sightings.

Stable populations are, of course, subject to natural short-term fluctuations. There are numerous camping sites and visitor attractions bordering woodland where squirrels receive supplementary feeding.

Cemeteries			
Location	Grid ref	First reported sighting	2022 sightings
Ashey	SZ577 897	August 2013	Spasmodic
Northwood	SZ495 946	March 2008	Stable
Ryde	SZ587 921	July 2016	Stable
Totland	SZ325 861	November 1996	Occasional/Stable

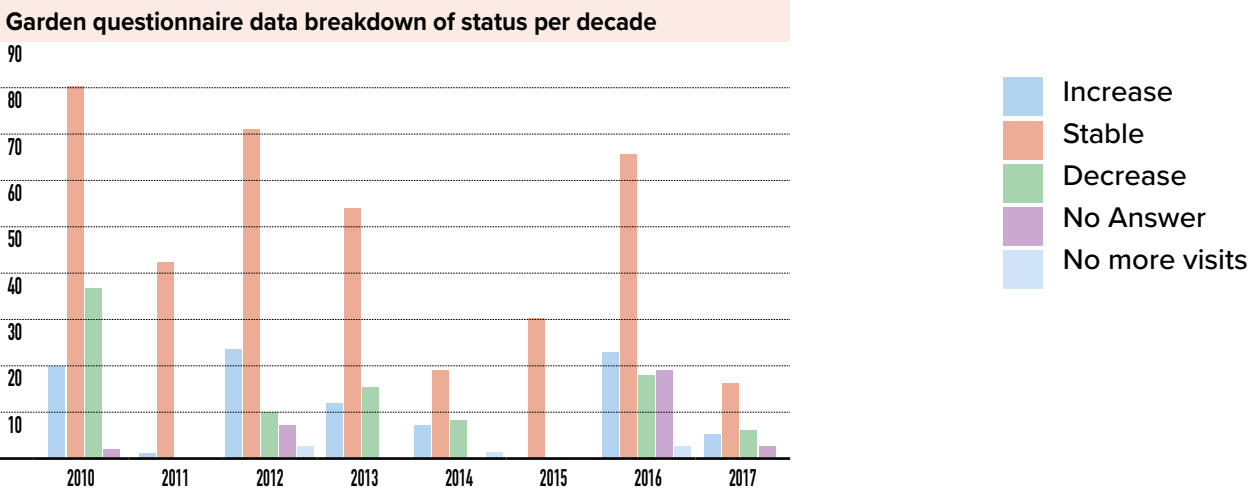
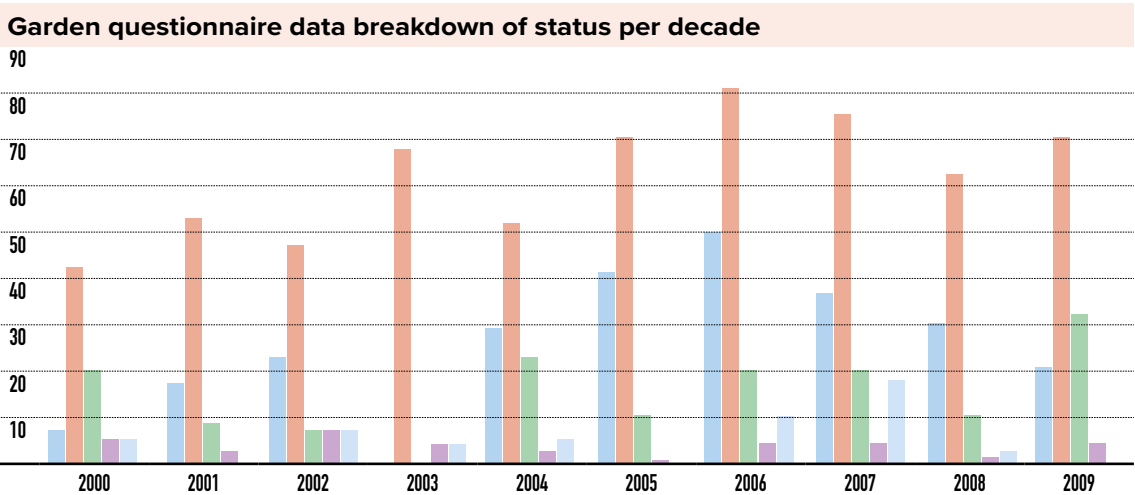
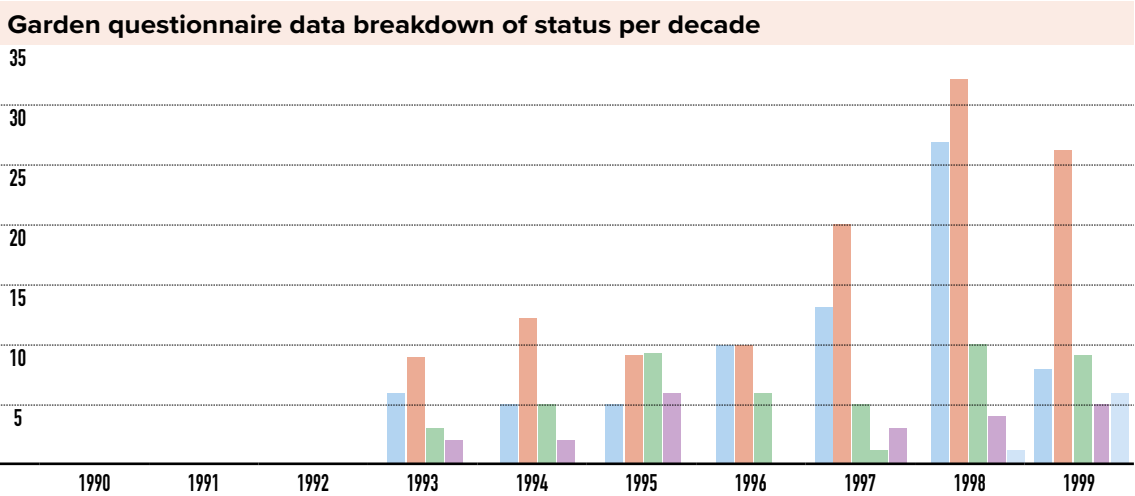
Golf courses			
Location	Grid ref	First reported sighting	2022 sightings
Newport	SZ515 870	May 2010	Spasmodic
Osborne	SZ515 953	June 1994	Stable
Ryde	SZ584 928	January 1998	Stable
Shanklin & Sandown	SZ585 846	October 2005	Spasmodic

Parks			
Location	Grid ref	First reported sighting	2022 sightings
Los Altos, Lake	SZ593 843	July 2001	Spasmodic
Northwood Park, Cowes	SZ493 962	January 2001	Stable
Rylstone Gardens, Shanklin	SZ584 809	March 1995	Stable
Tower Gardens, Shanklin	SZ584812	March 1995	Stable
Ventnor Botanic Garden	SZ547 778	January 2005	Stable

Garden questionnaire data breakdown of status per decade

The following graphs have been compiled using data on the status of squirrels visiting each garden over the previous year. Residents were asked whether their squirrel sightings had increased, decreased, remained stable or stopped visiting.

This is citizen science data and based on an individual’s perception. It is interesting to note the high number of people reporting their squirrel numbers are stable. Increases in numbers are more evident in the first decade and less so in the last decade. Citizen science data does broadly accord with more rigorous methodology.



Reproduction

Mating starts in January and carries on through to late summer and orphaned kittens have been brought in as late as October. The graphs are taken from the garden questionnaire data, that is, people watching red squirrels in their garden. A sample of the questionnaire is in part 2, section 3, chapter 3.

A red squirrel mother knows if her kittens have a weakness and will not raise them. Presumably, if she gives birth to more than she feels she can feed, then she will not raise them either. This was witnessed in 2019 when householders saw a mother squirrel drop her four kittens to the ground and severely bite two of them. The drey was very near their kitchen window, hence witnessing this behaviour. The two bitten squirrels were retrieved, barely alive, and given to the author. Bleeding was severe and the kittens died shortly after. They were 2–3 weeks old. The other two kittens were not found.

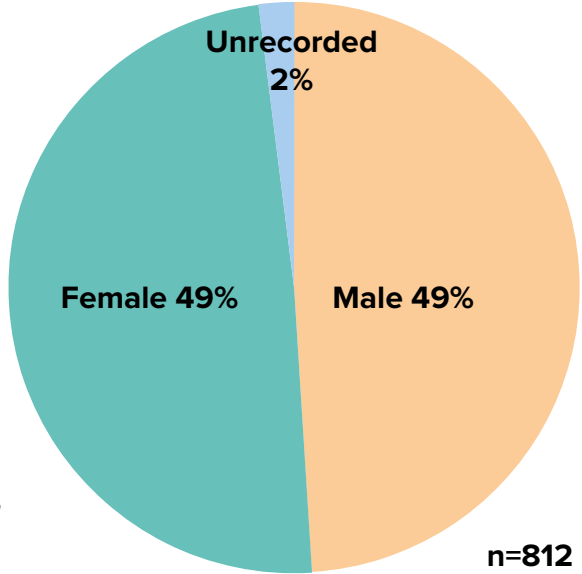
Kittens are reported every year. It was noticeable that numbers were lower in 2013 by recording comments from the general public. The garden questionnaires are citizen science and not filled in by the same people every year. Therefore, this data is only part of the picture.

The spring and summer weather in 2012 was cold and wet, so pollination was poor, resulting in a particularly poor hazel crop in the autumn. The general public commented that fewer squirrels visited in 2013 and the number of people reporting young squirrels in their garden is the lowest for the decade.

To keep a healthy balanced population, the ratio of male to female squirrels is important. Taking the data from dead squirrels brought in for post-mortem examination, the ratio shows a perfect balance.



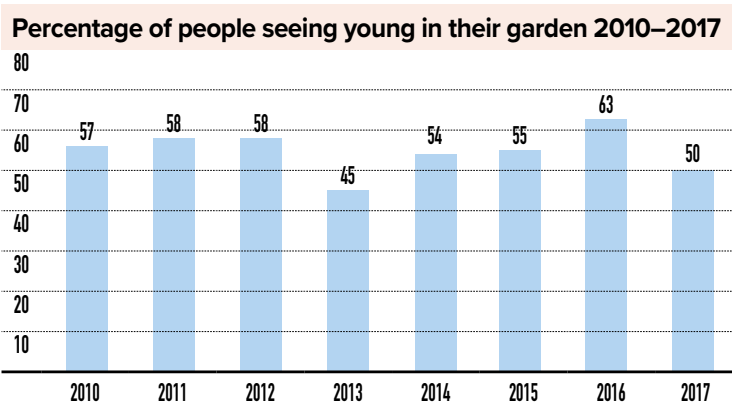
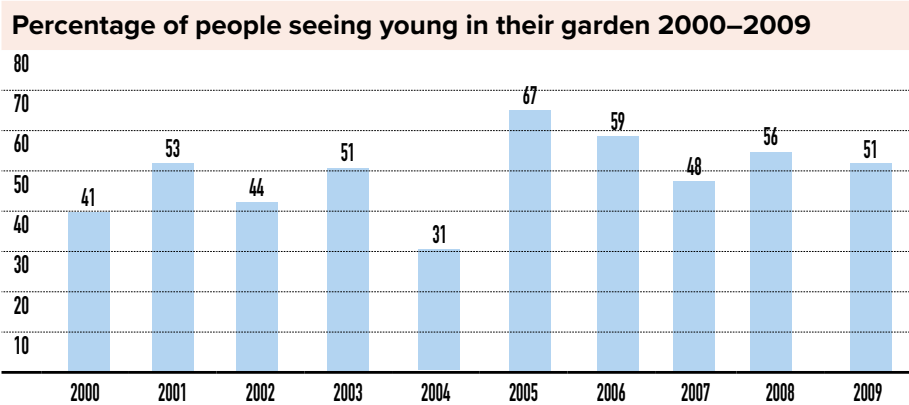
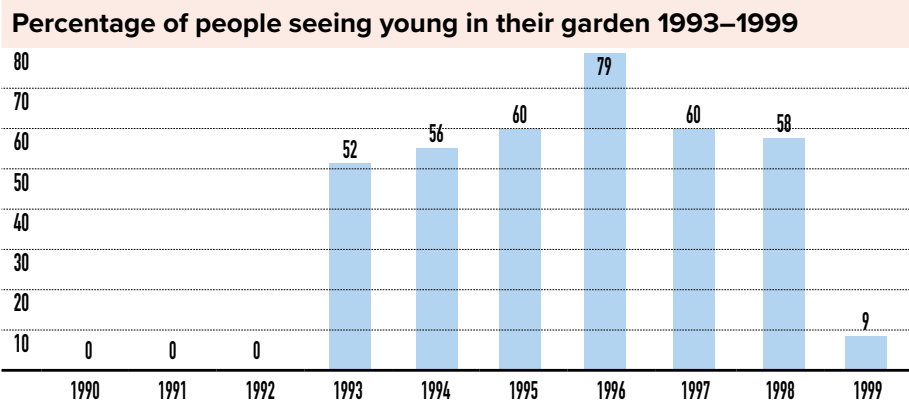
One of the kittens bitten by its mother



Data for the pie chart is taken from the post mortem spreadsheet.

No historical weather records were found online for 1999. An unusually high number of people (36%) didn't fill in the question regarding young in 1999. The highest figure relating to squirrel visits ceasing (12%) was reported for the decade in 1999. There is no obvious reason for the fluctuation in numbers of people reporting young squirrels in

the garden in the first two decades, other than inconsistency in recorders. Some people were fairly regular in sending in replies, whilst others would reply once or twice only. If squirrels are seen less, then the general public consistently report this fact, not just one or two people.



General sightings database 2012–2014

1,142 in 2012

929 in 2013

1,336 in 2014

Chapter 2

ANTHROPOGENIC INFLUENCES

JIGSAW, hedge reinstatement and new plantings

There are grants for planting and aftercare but success does depend on landowners' willingness to plant the trees and provide quality aftercare to ensure their survival. As reported in previous chapters, this has had a positive influence on dispersal success and wider distribution of red squirrels on the Isle of Wight by aiding the red squirrel population to spread across the island.

Supplementary feeding

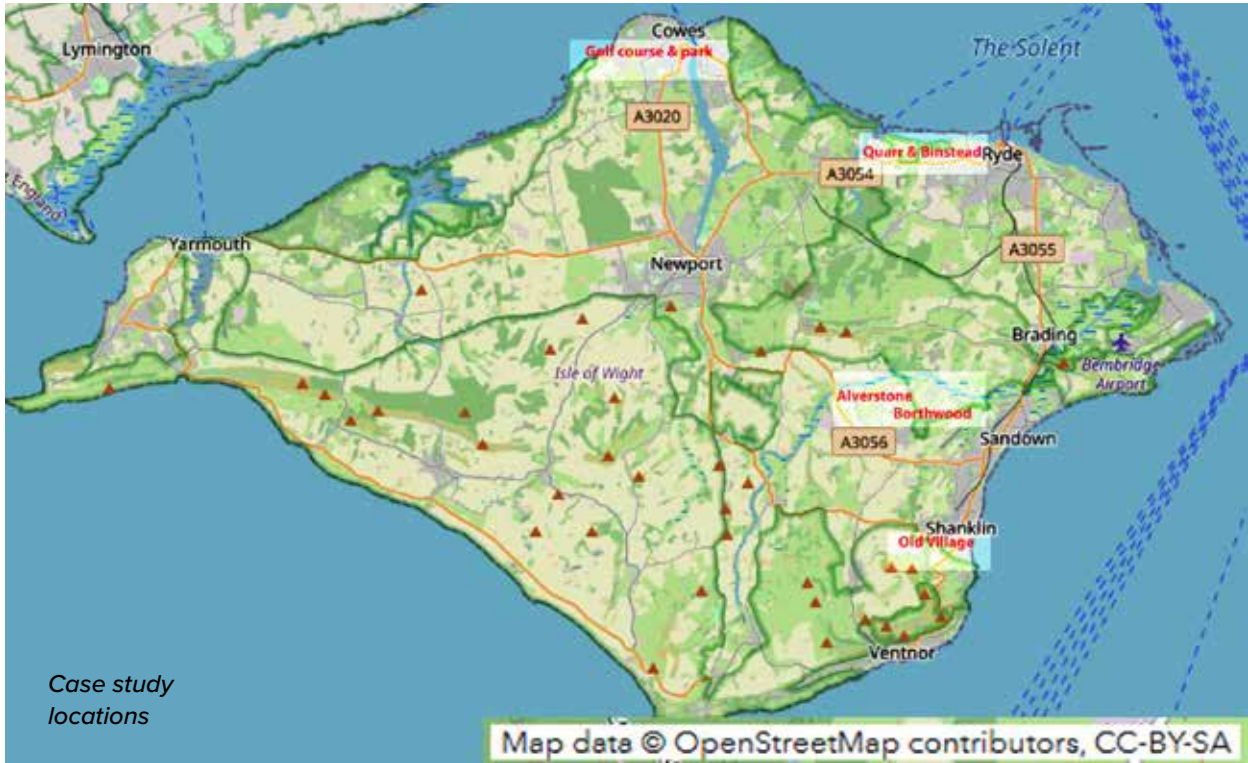
Supplementary feeding in gardens has greatly increased over the last 30 years. As squirrel numbers grew and their range expanded, more people had squirrels arriving in their garden to feed on peanuts and seed put out for birds. The hazards of feeding the wrong diet are discussed in the next chapter.

Overall, feeding a healthy diet will help squirrels through a time of food shortage, usually spring and early summer. As seed ripens in the woodland, gardens are abandoned as the squirrels take advantage of natural food to put on weight and cache surplus food for the winter.

Case studies

Borthwood Copse adjoins many gardens, so there is plenty of extra food. Section 3, chapter 7 details observations from a resident who feeds squirrels that come into his garden from Borthwood Copse to feed. It is also part of the bi-annual monitoring programme and the results are in section 2.

Sightings from the general public started in February 1994 with one observer reporting one sighting. Hazelnuts opened by red squirrels were found during the Corridors of Hope survey in 1991. Monthly monitoring walks started in 1997 and as



previous chapters show, the number of squirrels has grown overall. Numbers reached a peak in 2009 then dropped until another peak in 2016. Sightings in Borthwood levelled off in 2021 and are currently stable.

Keeping the population in check is natural selection, plus cats, dogs, buzzard kills and disease. Of course, these are only the incidents that are reported and many more are missed or not reported.

Borthwood Grid refs: SZ5684 & SZ5784

Road kills	18
Reported cat/dog kills	0
Reported buzzard kills	1
Natural causes	7
Other	12

Alverstone Grid refs: SZ5785

Road kills	22
Reported cat/dog kills	2
Reported buzzard kills	0
Natural causes	8
Other	16

Cowes Grid refs: SZ4895 & SZ4896 & SZ4995 & SZ4996

Road kills	34
Reported cat/dog kills	3
Reported buzzard kills	0
Natural causes	2
Other	10

Shanklin Old Village Grid refs: SZ5880 & SZ5881

Road kills	13
Reported cat/dog kills	5
Reported buzzard kills	3
Natural causes	2
Other	10

Binstead and Quarr: SZ5791 & SZ5792 & SZ5692

Reported cat/dog kills	2
Reported buzzard kills	4
Natural causes	16
Other	18

‘Other’ refers to a different cause of death such as drowning in a water butt. The breakdown of figures is given in a separate table.

Unless the body is retrieved for post-mortem examination, the age of squirrels killed on the road is unknown. The overall breakdown of road kill ages is taken from the post mortem database and is given in part three.

The garden village of Alverstone is built into a woodland and the squirrels have adapted to sharing their habitat with humans. Road kills occur as squirrels cross the road to travel between gardens where there is supplementary food.

Binstead and Quarr road kills are on the main Newport to Ryde road. As reported in earlier chapters, the whole length of this road is subject to numerous road kills.

There is a high population of buzzards in the Binstead and Quarr area and incidents of buzzards taking squirrels as they ran along a garden fence to access supplementary food were reported.

A squirrel with an ear torn off and partially scalped was seen in Quarr Wood in 2021. The next day two squirrels on feeders dropped to the ground and hid in the undergrowth as a buzzard swooped down (H. Butler pers. obs.).

Road kills in the busy town of Cowes are particularly high yet the squirrel population persists. The woods are small, but the squirrels live in a park and on a golf course and take food from garden feeders.

A sample of unusual places squirrels seen in, as reported by the general public, often in their own words

In 2021 three squirrels, presumably when dispersing, ended up in buildings. The first was a squirrel who had found its way into a bathroom. A bathroom is the easiest place to capture a very frightened, adrenaline-fuelled red squirrel and the squirrel was released back into the wild in accordance with the law.

The second squirrel wandered into a bike shop and was not so easy to capture. Experienced volunteers retrieved this animal and put it into the

nearest suitable habitat, which is probably where it came from in the first place.

The third squirrel probably dispersed from Northwood Park in Cowes as it found a way into a pizza shop in the town. With so many units to hide under it was impossible to locate it, so a thermal imager, bought for this purpose, was used. The imager did locate the squirrel, which was directed back into the street as it was not possible to catch it.

December 1992. An adult male had fishing wire round his back leg. The vet removed it and he was released next day. The scar was still showing in April 1993.

June 1996. A squirrel entered a lounge, climbed up the curtains and then ran back into St Thomas’ Street in the busy town centre of Ryde.

July 1996. A resident reported that a squirrel feeds from the dustbin and takes strawberries from the garden.

October 1996. A squirrel was seen swimming in a holiday camp pool. It had a swim round, then climbed out and ran off.

August 1997. Squirrels are taking the lid off the dustbin to take food.

October 1997. A squirrel went into Shanklin Liberal Club. This is in the heart of the town.

1997. Resident reported that a squirrel sits on top of Xpelair to keep warm in winter.

July 1999. Squirrel went into the office and bit Mr Smith when he tried to help it out.

August 2001. Squirrels living in loft for two months. Nests in insulation.

September 2001. Drey cut down in Fattingspark Copse and three babies ran out.

January 2002. Squirrel comes into kitchen for food in East Cowes.

1st & 14th June 2003. A squirrel was spotted in Union Street, Ryde. This is in the middle of town with few trees.

August 2004. In Yarmouth Harbour a squirrel ran round yachts and pontoon; then swam back to shore.

January 2005. A squirrel built a drey in a garage in Binstead.

February 2005. A squirrel was spotted in St Mary’s Hospital car park.

April 2005. Squirrel seen in busy Ryde High Street.

August 2005. Squirrel ran into coffee lounge, Riverside Centre, Newport.

February 2006 Cowes. A squirrel was spotted by Red Jet ferry terminal in the town centre.

June 2006 Newchurch. A mother squirrel moved four babies from our loft. She carried them across the garden and went into a copse.

September 2006. On Somerton Industrial Estate, a squirrel went into a warehouse and not for the first time.

November 2006. In St Helens, a squirrel went into a bedroom.

August 2007 Cowes. A squirrel had kittens in a loft and they fell down the heating system but survived.

July 2009 Newport. A squirrel came in through a cat flap in a house in the middle of town.

February 2010 Alverstone. A squirrel seen in a loft.

December 2010 Freshwater. Squirrel took up residence in a rabbit hutch.

September 2011 Gurnard. A squirrel found sleeping in a conservatory.

September 2011 Ryde. Squirrel entered a ground floor office.

June 2014 Ryde. Squirrel running along the track at Ryde Pier Head Railway Station. I was the driver of the train, it was early 06.40 (ish). I lost sight of the animal but didn't see it an hour later so hope it hid some place.

October 2014 Shanklin. A squirrel went into an antique shop in High Street, Shanklin and scampered around the shop. Someone eventually caught it and released it well away from habitation. (This was a member of the public, not Wight Squirrel Project).

June 2015 Ryde. High Street traffic has just been brought to a standstill as a red squirrel has been running up and down the road out front of Kevars Café, near Iceland, 49 High Street.

2016 Ryde. An escapee white-tailed hawk visited a garden and the resident witnessed the hawk taking red squirrels when they came to the feeder outside her window.

January 2019. Wootton. Squirrels taking materials from jumpers and curtains hung out on the washing line. Over 3 squirrels. We've been here 30 years and it's the first time they've done this.

June 2019 Ryde. Female nested in a tractor roof and had kittens there.

June 2019 Ryde. Squirrel caught in tennis net. People freed it.

April 2020 Cranmore. Mother squirrel seen taking her three babies from a bird box.

April 2020 Godshill. Four squirrels spotted running around in a car park in the centre of a busy village.

Sightings of buzzards preying on red squirrels, as reported by observers

Autumn 2010 Binstead. Three squirrels were witnessed killed by buzzards as they approached a garden along a fence in Binstead.

In 2010 someone rang the local paper to say that they had seen a buzzard attacking a squirrel. No location given.

2010 Ryde. Only occasional squirrel visits now and buzzards seen more often.

February 2013 Newport. Did have 10–12 squirrels daily; now only one. We have buzzards in our grounds with nest nearby. Saw buzzard feeding its chicks on a pheasant.

March 2014 Newport. Buzzard comes to my garden and watches squirrels. I chase the buzzards away.

September 2014 Blackwater. I thought you would be interested to know that I have witnessed two incidents of buzzards preying on squirrels in the last two months.

November 2014 Yarmouth. Last Sunday, I was in our garden, when I heard a frantic squeaking noise and glimpsed a buzzard taking off with something in its talons. It disappeared into the trees, flying very low, then reappeared again shortly after and I saw the distinctive red coat of a squirrel in its grasp.

2015 Lee Copse. First time a buzzard was seen taking a squirrel was two years ago plus four seen since. Always taken from the ground.

2015 Farm in Northwood. Squirrels not seen anymore. Did have lots of squirrels but there are many buzzards and ravens now.

2015 Burnt House Lane. Very few squirrels now but a lot of buzzards.

May 2016 Parkhurst. Buzzard seen taking live squirrel.

2017 Cranmore. Lady saw buzzard pick off babies as they crossed a telephone wire in Solent Road.

2019 Saw Buzzard taking live squirrel. Presumed it was killed.

2019 Eaglehead Copse. Buzzard killed squirrel.

Fewer sightings of buzzard kills were reported after 2019. Is this due to less kills as squirrels adapt to living with buzzards or do the general public think it is common place, so do not bother to report it? Another possibility is, because of lockdown restrictions, people are out and about less.

Chapter 3

NEGATIVE INFLUENCES

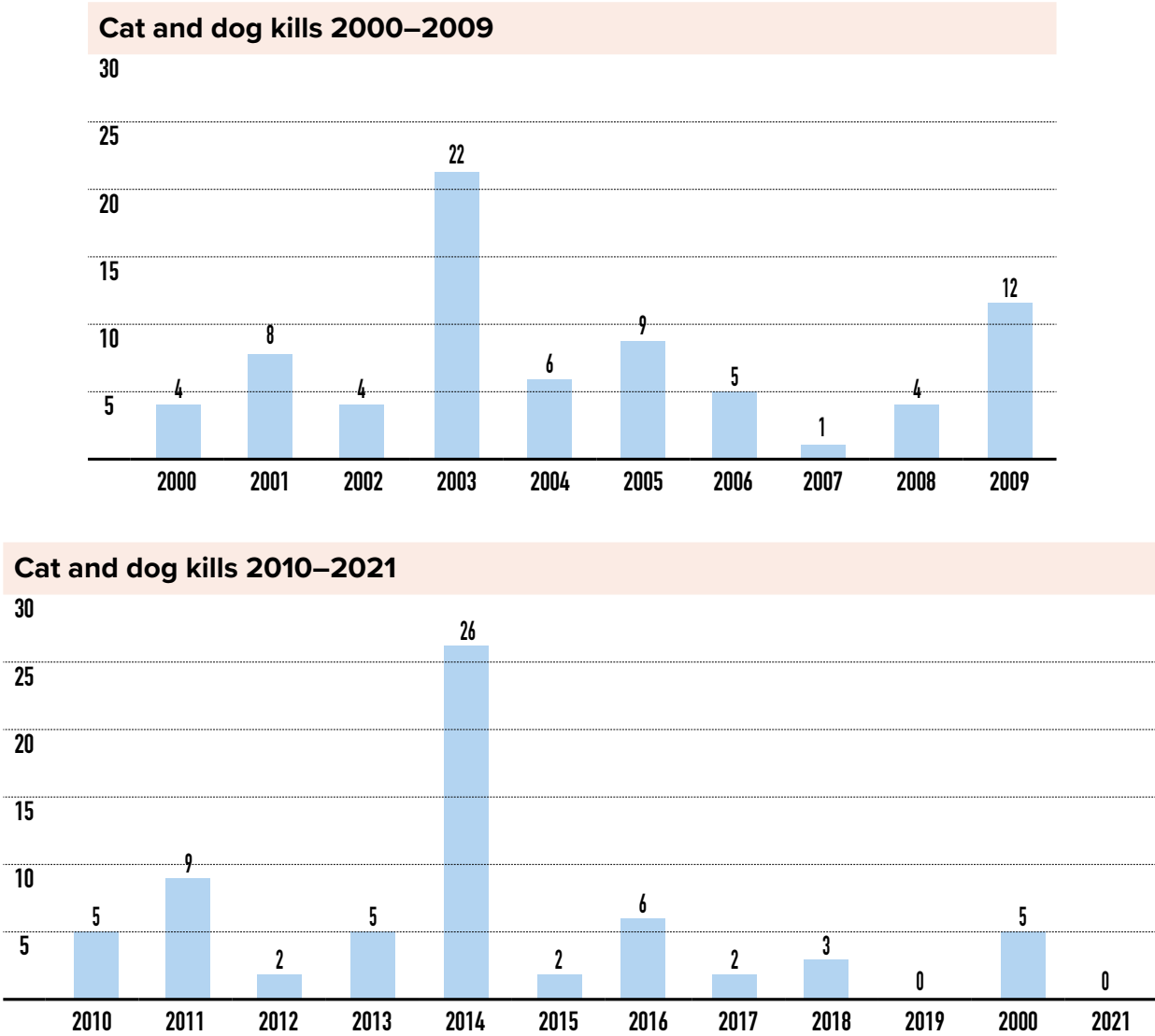
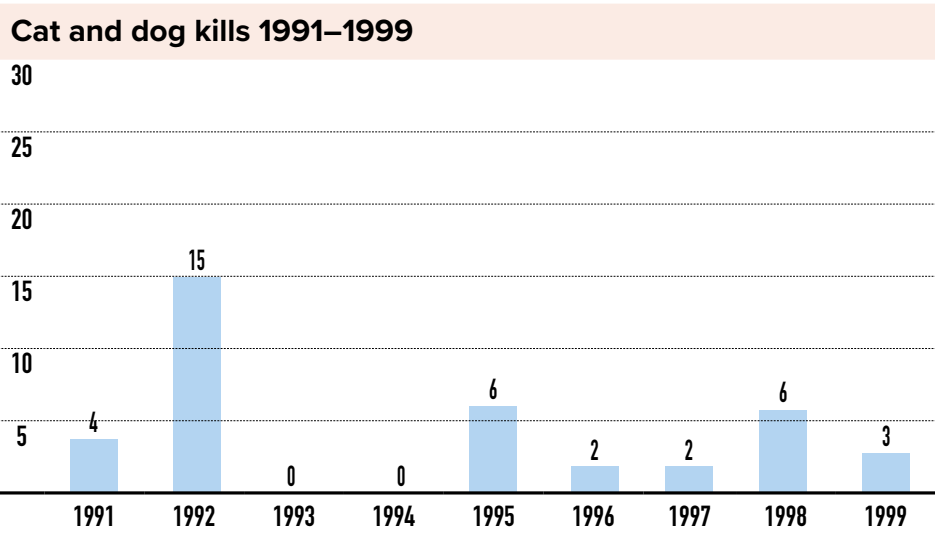
Hazards due to human influence related to development, range from toxoplasmosis (picked up from cats), to road kills and rat poisoning. Compared to other red squirrel areas in the UK, the Isle of Wight has a higher human population density and thousands of new homes are planned over the next 10 years. This obviously has implications for the pressure put on the countryside and the increased traffic. Increased development brings in hazards as well as supplementary feeding.

HUMAN POPULATION DENSITY IN RED SQUIRREL AREAS 2020 (www.plumplot.co.uk)	
Isle of Wight	374 per km²
Cumbria	74 per km²
Anglesey	97 per km²
Northumberland	65 per km²
Scotland	65 per km²
UK overall	278 km², third largest in Europe

Pets

Cats are far more likely to catch a squirrel than a dog, although dogs on occasion will too. Cats carry toxoplasmosis, which is passed on to the squirrels as they forage on the ground or cache nuts. It is prevalent on the Isle of Wight (Simpson et al. 2013).

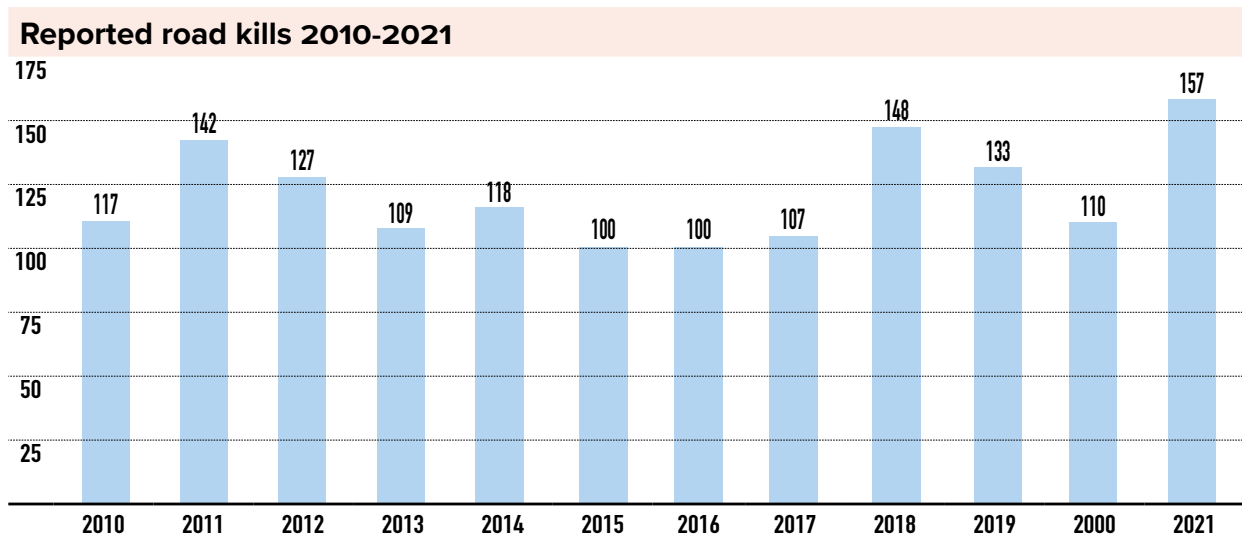
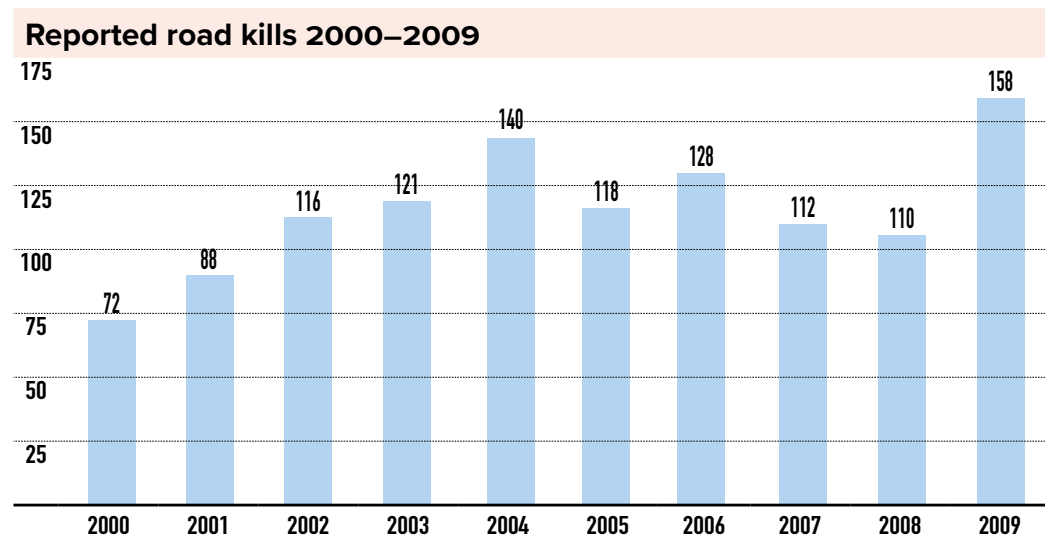
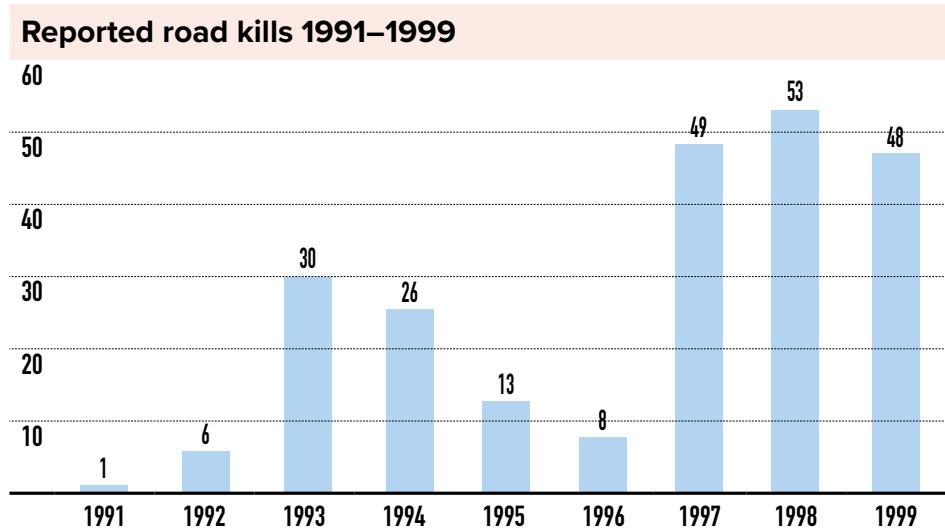
The graphs show direct kills and do not include toxoplasmosis infections. Toxoplasmosis is discussed in part 3.



Road kills

Mortality rate is lower through the winter as daylight hours are shorter and there is less visitor traffic on the Island. Dispersal peaks twice a year and this is the time when road kills rise, especially in the autumn. Graphs show trends over 30 years.

Graphs showing reported road kills 1990–2021



Rat poisoning and animal traps

Rats are attracted to any feeding station and this is a universal problem with no satisfactory solution. Every year red squirrels fall victim to poison and traps and, so far, little has been done to stop people putting down traps and poison where squirrels and other animals, including pets, can access it. It is a horrific death for any animal and watching red squirrels die after being poisoned is more distressing than any other cause of death.

In May 2003, two live squirrels with limbs missing were reported by members of the general public. The first was in a garden in Alverstone, in the east of the Island, and the other in Ningwood, in the west, again in a garden.

Both squirrels had one functional forelimb each, the remaining limbs either missing or severely damaged. The first squirrel was managing to climb up to a feeder with the one front limb. The other limbs had healed over. The second squirrel had fresh wounds with exposed bones. Both squirrels were caught and euthanised.

The bodies were taken to the late Vic Simpson at Wildlife Veterinary Investigation Centre in Cornwall, where post-mortem examinations showed that the limbs appeared to have been amputated by a spring trap, such as a Fenn trap. Enquiries at that time failed to confirm Fenn traps were used in the area.



Squirrel dead under electric pole in Parkhurst Forest

A squirrel spotted in Ningwood with two legs missing from the same side was seen in spring 2006. Two other squirrels, each with one foot missing, also appeared in a Ningwood garden. Three squirrels killed on the road in 2006, in the same vicinity, each had one foot missing. (Butler & Simpson 2006)

Drowning, electrocution and other garden hazards

Water butts, baths used as water troughs, dustbins without lids and reservoirs have also claimed red squirrel lives. Over the 30-year period covered in this publication, a total of 34 incidents were reported. One unfortunate squirrel fell from a feeder onto a particularly large pyracantha thorn, which killed her. Garden netting is another hazard as the animals cannot free themselves and are either strangled or, in one case, drowned, as the net was over a pond.

Electric transformers are an unexpected hazard and at least two squirrels were confirmed to have been electrocuted as they climbed a transformer. Other suspected cases were reported found below a transformer but the carcasses were not examined.



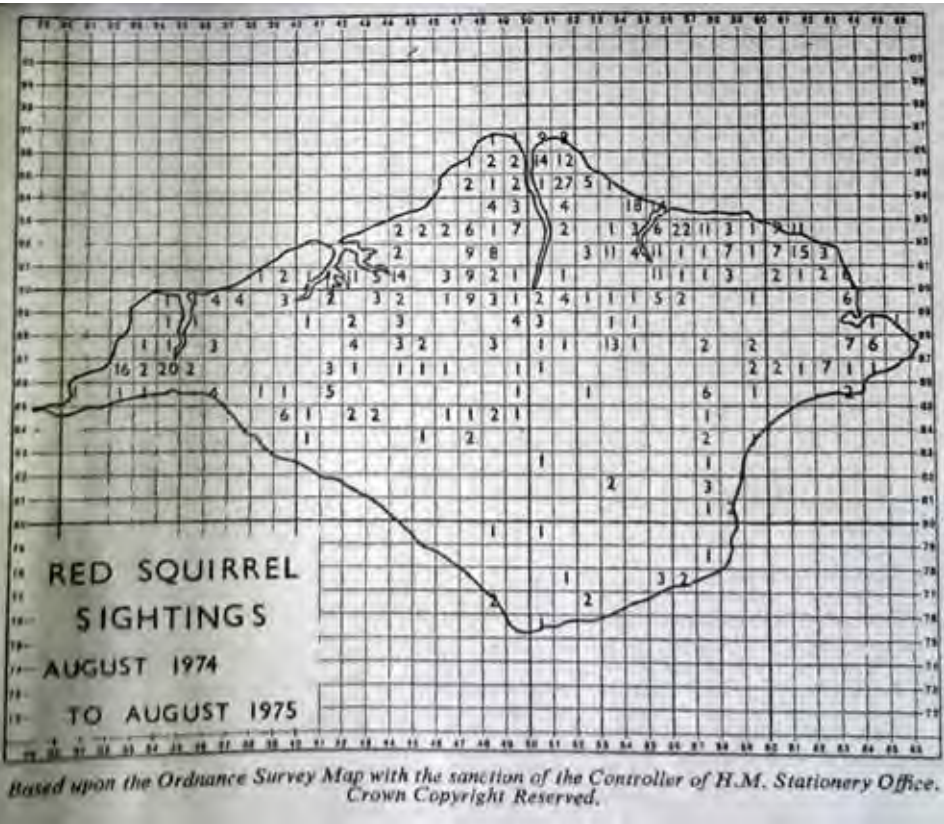
Amputation attributed to Fenn trap. Photo: Vic Simpson



Fenn trap. Photo: Vic Simpson

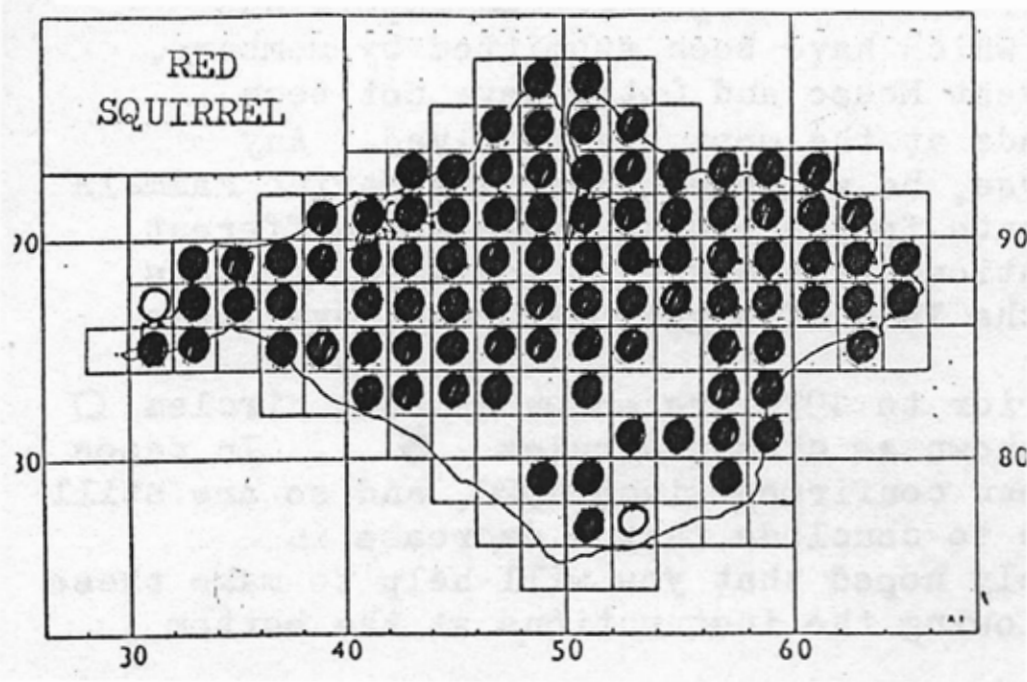
Discussion

It cannot be denied that red squirrels have increased their range and numbers over the past 30 years. Little intensive reporting over the whole island is documented before 1990. Pupils from Solent Middle School led by Clive Burland logged red squirrel sightings across the Isle of Wight from August 1974 to July 1975. It is interesting to see the pattern of sightings has not changed greatly. That is, where there are settlements, sightings are higher and where there is arable land they are lower or absent, which is what you would expect.



Map produced by Clive Burland for sightings August 1974–August 1975. 1km squares are used for this map.

Oliver Frazer recorded mammals for the IOW Natural History and Archaeological Society and his results are shown below. All records are post 1960. Sightings prior to 1970 are shown as an open circle. Sightings between 1970 and 1989 are shown as closed circles.



Map produced by Oliver Frazer for the IOW Natural History and Archaeological Society. 2km squares are used for this map.

It is apparent that red squirrels on the Isle of Wight have been successful over the timescale the data covers, that is, 1991–2021. From low numbers after the storms that occurred in the late 1980s, squirrels have spread back into their former territory and possibly increased their range, thanks to new plantings and corridor links.

Publicity has increased awareness of this iconic woodland species, resulting in the general public encouraging red squirrels into their gardens with supplementary feeding. The public also feel very strongly about red squirrels on the Isle of Wight, regarding them as part of the family and wanting to do what they can to protect them.

Our red squirrels have taken advantage of their popularity and the extra food supplies although, as the previous chapters have shown, it comes at a cost, but there does have to be a balance. In this section, anthropogenic hazards are explored and in part 3, all causes of mortality and morbidity are included. Red squirrels are stressed if their numbers grow too high, leading to health problems. There are always subordinate and dominant animals and the youngest or very old squirrels tend to be bullied. This is witnessed by anyone who has closely watched red squirrels in the garden.

The greater majority of sick squirrels brought in for treatment, and often die, are aged over 12 weeks but under a year old. Most animals brought in sick are from areas where there is a large human presence as they come into gardens, although they are also sometimes found in woodland or parks by walkers. The cause of death may be related to human activity but often it is natural causes. With or without humans supplying food, nature still prevails as the weaker squirrels succumb to natural causes of death. Mortality and morbidity statistics are in part three.

You could question whether squirrels with unlimited food have more breeding and recruitment success than those with little or no access to supplementary feeding. Do squirrels stay near food, rather than disperse is another question which affects population dynamics. Given the rise in road kills in the autumn, it would appear they do disperse, plus their range has expanded outwards from settlements as shown in previous chapters.

Woodland management and habitat type will also have an impact on natural fluctuations and the annual seed crop available. Other factors such as disease, a rise in predators, weather and global warming may also have an effect. Climate change could have a negative effect on trees and seed production, so the question is, will red squirrels be able to adapt?

Red squirrels have shown they are adaptable, so unless climate change is extreme, it is likely they will evolve to cope. It only took two or three years to adapt to the rise in buzzards by building dreys in safer, more hidden places. It doesn't take long to work out how to obtain food from a feeder with a lid or how to make a home in a loft. On the negative side, squirrels have not adapted to roads and fast moving traffic. Although naturally uncomfortable with human presence, if the reward is worth it, most will adapt and tolerate humans as long as they keep their distance.

Future conservation efforts should be concentrated on maintaining healthy well managed habitat and strong corridor links so dispersal is possible. Ongoing monitoring both scientific and from the general public must be seen as the most important tasks for red squirrel conservation on the Isle of Wight, especially as we effectively monitor for any grey squirrel incursion as well.

A list of studies already underway and future studies looking into some of these questions are listed in part 4 at the end of this publication.



References

Butler, H., & Simpson, V. 2006. Limb amputations of red squirrels (*Sciurus vulgaris*) on the Isle of Wight attributed to Fenn traps. BVZS conference 2006

Holm, J. L. 1990. The ecology of red squirrels (*Sciurus vulgaris*) in deciduous woodlands. Unpublished PhD thesis. University of London.

Simpson, V. R., Hargreaves, J., Butler, H. M., Davison, N. J., & Everest, D. J. 2013. Causes of mortality and pathological lesions observed post-mortem in red squirrels (*Sciurus vulgaris*) in Great Britain. *BMC Veterinary Research* 9: 229.

A survey of the red squirrels of the Isle of Wight by Clive Burland and a group of pupils from Solent Middle School, Cowes.

Oliver Frazer: Mammals of the Isle of Wight. Isle of Wight Natural History and Archaeological Society Mammal Report January 1990.

Acknowledgements

Dr Marin Cvitanovic

Dr Colin Pope

The IOW Natural History and Archaeological Society

Sally Wiltshire

PART 3

RED SQUIRREL
REHABILITATION,
MORBIDITY AND
MORTALITY



INTRODUCTION

As part of Wight Squirrel Project monitoring and research, the general public not only report live or dead red squirrels but pick up sick, injured, orphaned or dead red squirrels. Live squirrels are treated and released if they recover. Those that die or are euthanised are subject to a basic post mortem examination and if pathology is found, tissue samples are kept and photographs taken. Initially, bodies were posted to Zoological Society of London.

The author is not a trained vet but did receive training and a lot of help early on from qualified vets Mike Lewis, Dr Ian Keymer and Vic Simpson. From 2001 advice and collaboration from newly retired vet Vic Simpson meant that investigating causes of death for red squirrels on the Isle of Wight escalated. Vic formed the Veterinary Investigation Centre in Truro, Cornwall and until his sad death in 2018, samples and selected bodies, were sent to him.

The statistics are based on the histological findings, observation, experience and also reports from the general public. Road traffic accidents are by far the most common cause of reported human-related mortality as they are the most likely way to

find a dead squirrel. Sick squirrels also come into gardens and very occasionally a squirrel needing help is found in a woodland or park.

Apart from road kills, other human-related causes are cat or dog predation, rat poison and drowning in a water butt. Natural causes of death and disease are varied. In some cases the cause of death is undetermined, either because the post mortem was inconclusive, the body autolysed or too badly damaged to make a meaningful diagnosis. More often than not, bodies are reported and not recovered. These are generally road traffic kills. This is citizen science and included in some statistical analysis.

CONTENTS

Introduction to part 3	292
<hr/>	
Chapter 1	
Treating sick, injured and orphaned red squirrels	
<hr/>	
Introduction	295
Methodology	295
Treatment and care	298
Rescues	305
Food	306
Chapter 2	
Statistics relating to causes of mortality in red squirrels on the Isle of Wight	
<hr/>	
Appendix 1 Pro forma sheet completed during post mortem examination	307
Chapter 3	
Statistics, by body system, relating to red squirrels presented for post mortem examination	
<hr/>	
Introduction	315
Respiratory system	316
Consolidation and congestion	317
Liver	319
Skin	321
Musculo-skeletal system	322
Cardiovascular system	324
Digestive system	226
Lymphoreticular system	329
Reproductive system	331
Urinary system	333
Endocrine system	335

Chapter 4

Causes of mortality and morbidity in more detail

Introduction

Adenovirus

Hepatozoon, Bordetella and Bronchopneumonia

Toxoplasma gondii

Mycobacterium lepromatosis (leprosy)

Staphylococcus aureus and Fatal Exudative Dermatitis (FED)

Cancer

Misadventure

Road kills

Congenital abnormalities

Fenn traps

Rat poison

Abscesses

Parasites

Unusual cases

Chapter 5

The future

Acknowledgements

336

337

338

339

340

342

334

346

347

349

352

355

356

358

360

362

Chapter 1

TREATING SICK, INJURED
AND ORPHANED RED
SQUIRRELS

Introduction

Wight Squirrel Project takes in sick, injured and orphaned red squirrels with the aim of releasing them back to the wild. Given their sensitive nature and propensity to stress, the success rate is low. If a red squirrel is ill enough to capture, then more often than not, it does die. That said, there are some successes and much has been learned over the years. We are fortunate in having support from local vets, although visits are not always necessary but obviously we need a vet to euthanise animals, take x-rays or prescribe medication. Training is given and volunteers work as part of a team.

The number of animals taken in has increased as the population has risen and expanded. The early animals are not in the database as this wasn't set up until 2007. Jacquie Wilson has been a stalwart volunteer picking up and treating squirrels, for which I am grateful, and Jacquie did record three animals prior to 2007, which are included in the analysis. Jacquie recorded treatment details of animals that died within hours but the author was not so diligent and, other than recording the animals on the general database, did not record treatment details until 2015. Even then, treatment of animals that died within hours is not recorded, although post mortem examinations are carried out and details are in the necropsy database. We work on the premise that whoever takes the call and collects the squirrel looks after it.

Methodology

The general public pick squirrels up, either in their garden or when they are out and about. Animals are collected in carriers made by a volunteer. The carrier is made of plywood and measures 23cm wide, 25cm deep and 22cm high. The ventilation hole is 7cm in diameter and covered in 1cm square mesh. The handle is made of webbing. Fleece or hay is used as bedding.

We do not have a purpose-built hospital, so a

spare bedroom is turned into a hospital room for the squirrels in our homes. An outside aviary houses squirrels that recover enough to go outside but are not ready for release.

Cages of varying sizes accommodate the squirrels in the early stages of illness, from bird cages to a very large rodent cage which is on two levels. This will take either two sick squirrels or one lively squirrel. The levels may be used separately or opened up as one cage. Given the sensitive nature of the patients, foliage in the cage and natural bedding materials are used to provide familiar smells and textures.



Indoor cage with two levels

*Carrier box**Branch and rope in indoor cage**Young squirrel in fleece hat**Food table*

Kittens are happy in a fleece bed and particularly enjoy sleeping in fleece hats. Fleece is ideal as there are no loops for claws to become entangled in, as there is in towelling or knitted materials. Each case and every animal is different, so the rule is to provide treatment to achieve the best outcome for each case.

Water is provided in heavy but small containers and food either in a container or loose on natural materials such as wood.

Cleanliness is paramount. Food and water are changed at least twice daily. The cage is cleaned and bedding changed daily. Cardboard is placed on the bottom of the cage with hay on top. The cardboard soaks up urine, preventing staining and corrosion of the cage. A proprietary cleaning agent formulated by vets is used to disinfect the cage and dishes. As the squirrel grows older and becomes more active, so the mess increases and more care must be taken to keep pathogens at bay.

After each animal has been cared for, the cage and hospital room is deep cleaned. On occasions, if a young squirrel has had the run of the whole room, the room is also redecorated. Branches, logs, moss, leaves and other natural material create a natural way to learn about the outside world but are very messy indoors.

With hand-reared kittens, so far, imprinting has not occurred. It is left up to the kitten to interact and play with their human carer, which the majority do. Once they reach 12–14 weeks of age, their attitude changes and whilst some remain friendly, others do not. By then, they are generally ready for the soft release cage and there is no interaction with the carer. Indicators such as stereotyping and looking at the carer belligerently

*A large branch and rope in the room**A flowerpot to bury food in*

are a sign the animal is ready for release. Before going to the release cage, the ability to open hazelnuts and make a drey is a must.

On the rare occasion an adult squirrel is taken in and recovers quickly, the animal is released where it was found. For young animals reared in captivity, a soft release cage is used. The cage is 1m wide by 2m long and 2m high. For ease of transport on a car roof, the cage is in six pieces which bolt together. A box drey is attached high up at the back of the cage and used bedding, with a familiar smell, is placed in the box.

Substantial, leafy branches and rope recreates an arboreal setting. Leaves cover the bottom of the release cage and a feeding log weights down the cage. Cages are always within reach of human habitation, so the animal is easily checked twice daily. Locations and carers are carefully selected. A sheltered spot next to woodland is perfect so the squirrel can go straight into the trees when released.

The main door is padlocked, so for the purposes of feeding a small door is cut in the back of the cage with a platform next to it for food. A heavy container is placed on the ground for water. If it needs filling, then a watering can is used.

Once the door is open and humans at a distance, but observing, some squirrels will come out immediately and run up the nearest tree and start to map, whilst others dive under cover at ground level until human presence is gone. If a squirrel does not feel ready to venture into the wild, then it will not leave the safety of the cage. The door is locked and reopened again every five days until the squirrel decides it is time to leave. We wait

30 minutes to see if the squirrel ventures from the back of the cage before closing the door. If the squirrel moves towards the door but is wary about leaving, then the wait is longer, that is, until the squirrel leaves or goes to the back of the cage. We do not put tracking devices on squirrels but as they are usually released near or in a garden where there is supplementary food, they are monitored by observation.

*Release cage showing feed door**Release cage showing front door*

It has not happened to date but if a squirrel lost the sight in an eye, then it would not be released. We have seen that the loss of a limb does not appear to impede survival, but if an injury interfered with mobility or impeded survival in another way, then a squirrel will not be released. Damage to the tail may not be the disaster we may think. In the Isle of Wight red squirrel population is the gene for ‘stumpy’ tails. A dominant female was the first seen with a stumpy tail, which was thought to be the result of an accident – until she turned up with a kitten that also had a stumpy tail. Several other sightings have been reported over the years in other parts of the island. The tail on the adults appears to be around 6cm long, about one third of the normal length, but does not seem detrimental to agility

Only on one occasion has an injured squirrel that has been cared for been unfit to return to the wild. She was a timid squirrel who was injured by a bird when she was about seven weeks old. She had a mouth injury and could not open nuts but could feed on soft food. A lady with a huge aviary in which foliage grew naturally took her on. The carer was the only person the squirrel would tolerate and she lived for over 10 years.

Judging whether an injured squirrel would survive in the wild with a disability can be difficult and is always discussed with a vet. Only once has the decision been made to amputate an injured hind leg on an adult squirrel that had been hit by a car. She was put into a small aviary to recover and it soon became apparent that losing one back leg did not interfere with mobility as she moved at the same speed and with the same agility as you would expect. Once the wound had healed, she was put into a release cage for 10 days near to the town she was picked up in. She shot out of the cage at high speed once the door was opened and was seen regularly in the garden she was released in.



Female squirrel shortly after hind leg amputation

Treatment and care

The first step when taking an animal in is to assess age, condition, weight and any obvious signs of injury, parasites or pathogens. Rehydration fluid is the next step to replenish electrolytes and lost fluids. This may be a pre-mixed powder bought from the vet or made from half a pint of water, quarter teaspoon of salt and one-and-a-half level teaspoons of sugar mixed together and warmed to body temperature. The animal must be warm before giving rehydration fluid. The fluid is offered to the animal from a syringe which is marked in millilitres (ml). A heat pad is used for sick adults as well as kittens.

A broad spectrum antibiotic, such as Baytril, is administered under veterinary guidance if an infection is suspected. Wounds are cleaned in mild, warm, salt water and dried. Red squirrel wounds heal fast if they are not infected. For severe wounds or broken bones, the animal is taken to the vet. Anti-inflammatory medication and painkillers are used under veterinary guidance.

Abscesses are very nasty and can eat away at bone and tissue. The animal is lost if the bone is compromised. If abscesses are caught and drained early enough, then antibiotics can clear up the infection.

Kittens are reared on whole goat’s milk. If they scour, then a complementary paste, such as Canigest, is given in accordance with veterinary advice.

Concussed and/or shocked squirrels are put on a heat pad, given rehydration fluid and anti-inflammatory medication if advised by the vet. Painkillers and antibiotics may also be necessary. Adult squirrels are harder to treat as they are more likely to succumb to the shock of being in captivity and near humans. Adults become depressed in captivity, so getting them into an outside aviary is crucial to their survival. Once they can climb and behave normally, they are released where found.

Each case is different and there are too many cases to relate each one. Many squirrels do not survive and their cases are covered in the following chapters. The table shows a comparison of success between red squirrels and hedgehogs treated by Jacquie Wilson. Overall, more hedgehogs are brought in than red squirrels.

Year	Hedgehogs	Success	Squirrels	Success
2007	31	51%	3	66%
2008	13	46%	5	80%
2009	35	71%	11	33%
2010	36	56%	15	60%
2011	13	53%	19	37%
2012	43	65%	7	43%
2013	28	46%	10	0%
2014	18	56%	10	43%
2015	27	59%	7	43%
2016	37	54%	11	20%
2017	43	55%	8	62%
2018	37	82%	10	50%
2019	73	62%	25	28%
2020	100	69%	16	36%
2021	141	64%	10	50%

A sample of individual case studies for animals treated and released with comments taken from our notes

The first case study is a classic example with no problems. Behaviour and timings are typical for kittens.

Vic: male, 6–7 weeks old

Date	Weight	Details
29.3.15	134g	Found asleep in drey that had fallen onto lawn. Reluctant to take milk.
30.3.15	133g	Still not feeding without encouragement. Doesn’t urinate when stomach stroked.
31.3.15	139g	
1.4.15	136g	2pm feed, stomach wet and smelly. Changed bedding again. Climbed to top of cage for first time.
2.4.15		Still sleeping in my hand after feed and not active in cage. Feeding well.
3.4.15	141g	No sleeping after feed. Climbed cage and then me. Enjoyed exploring hallway. Went back to sleep after.
4.4.15		Explored hall for short time after feeds and urinated in corner each time.
5.4.15	144g	Scratching! More active. Urine and faeces normal.
6.4.15		Ate crushed hazelnut. Scratching but can’t see any fleas. More active.
7.4.15		Not interested in milk, just exercise. Ran up and down stairs easily.
8.4.15	144g	Eating nuts is easier. Won’t eat or drink in cage. Plays with me but does not play on his own.
9.4.15		Likes grapes. Very active. Didn’t want afternoon milk.
10.4.15	148g	Made 3ft mid-air leap. Ate grape and nuts. Wasn’t interested in milk.
11.4.15		Moved into own room upstairs. Lapping milk, eating apple and grape. Explored all corners of his room.

12.4.15		Not very good at tree climbing! Looked out of window – not impressed.
13.4.15	148g	Eating everything. Better at climbing.
14.4.15	149g	Climbing continues to improve. Investigated new feeder without hesitation.
15.4.15		Chewed log and lichen. Insists on getting inside my jacket. Confident in tree.
16.4.15	151g	Took hat away to wash so he wrapped sheet around himself instead. Manic playing.
17.4.15		Didn't like strawberry or mushroom and usually leaves almond. Still sleeping in sheet. Forages. Didn't like walnut but likes corn on cob.
18.4.15		Enjoyed oak branch and ate shoots and leaves. Fell asleep in my lap late pm.
19.4.15	170g	Weighted three times as this is huge increase. Nibbled cobnut but couldn't get into it. Caching food.
20.4.15		Ate black sunflower seeds without hesitation. Still prefers milk to water but did drink a little water. Managed curtain pole run.
21.4.15		Hiding food everywhere. Much better at curtain climbing and pole run. Added leaves and dried grass for drey material.
22.4.15		I was out all day and he wanted cuddles, not play. Drinks milk and water. Likes carrot. Didn't use drey materials put out.
23.4.15		Cleaned and aired room and put in more plants.
24.4.15	184g	Claws scratching my legs! Can't stop him getting in jacket; the more I try the more he persists.
25.4.15		Changed ropes to give more running length and he loved it! Put tree stump in room. Vic froze when delivery went to neighbour. Didn't move until man gone. Managed to get into squirrel feeder with lid closed.
26.4.15		I was out all day. He was in 'hat bed' and in no hurry to come out. Played rather than needed a cuddle this time.
27.4.15	187g	Frenetic playing and starting to stereotype. Don't like pumpkin seeds
28.4.15		Can feel his bite through leather gloves.
29.4.15	193g?	Too bouncy to weigh accurately. Hyperactive and destroying everything. Stereotyped when Jacquie went in. Subdued next time I went in.
30.4.15		Back to normal self. Gave him wire feeder with sunflower seeds in – no trouble at all with it. Very alert to outside sounds. Freezes when hearing crow.
1.5.15	189g	Likes 'King Alfred's cakes' fungus and beech mast.
2.5.15		Nibbled fir cone.
3.5.15	198g	Checked scales but they were OK. Huge leap in weight!
4.5.15		Decided he likes mushroom after all. Came out onto landing, quick look round and went back into his room.
5.5.15		Came out onto landing and then downstairs to look round hall. Not interesting so climbed me and went back to his room. Off carrot now!
6.5.15	208g	Won't make his own bed – left clean hay beside carrier box but he still went to hat in bay tree.
7.5.15		Mushroom current favourite food. Always buries hazelnuts.
8.5.15	212g	Took away bay tree to put in release cage.
9.5.15	213g	Made drey on windowsill. Used Lawson cypress, hay and strips of sheeting.
10.5.15	218g	Drey building late am. Very quiet, knew something was going on. Enticed him onto my hand and into carrier box.
		Very nervous in release cage.
Released two weeks later and seen taking nuts from feeder in the garden.		



Drey built by Vic



Bay tree and rope



Looking at the world outside



Logs – and sweetcorn – are good for chewing

The rest of these selected cases had complications such as injury or pathogens. Several squirrels appeared to be hopeless cases but did rally with treatment. One case, Alvin, was an elderly squirrel and looked as if he had been bullied. If squirrels are kept in cages, particularly adults, they do become depressed.

Samantha: female, brought in at 12 weeks old

Date	Weight	Details
17.6.08	167g	Taken to vet. Stunned, blood round nose, deformed/paralysed(?) back legs.
17.6.08	167g	Ate a little, climbs using front legs only. Unable to urinate or defecate unless manually stimulated.
18.6.08		Feeding milk mixture by syringe. Not eating, lethargic.
19.6.08		Ate a little by herself. Slight diarrhoea. More active.
20.6.08		Back to milk mixture. Diarrhoea still.
21.6.08	160g	
22.6.08	164g	Now able to defecate and urinate by herself.
24.6.08		Not eating much but droppings normal.
25.6.08		Taken to vet for x-ray. Physiotherapy advised.
2.7.08		Eating better, put outside in aviary.
23.7.08		Treated for lice and fleas. Can climb well using back legs now.
7.8.08		Able to open nuts now and making her bed in box.
12.8.08		Nibbling pine cones, much more active.
30/8/2008	199g	Put in soft-release cage
10/09/2008		Released

Sydney: male, approx. four months old

Date	Weight	Details
16.11.08	No scales	Found in garden writhing on the ground, blood from hole in neck, unable to stay upright, dazed but conscious. Right front leg not working, back legs OK. Taken to vet. Put on heat pad, gave Baytril (0.25 x 2 daily). Meloxidyl (0.1 mixed with water to 1 ml – 0.1 daily) and rehydration
16.11.08	guess 240g	As above. Very poorly.
17.11.08		A little Complian taken from syringe. Few dry droppings.
18.11.08		Egg added to Complian. Slight improvement.
19.11.08		Ground almonds added. More upright today.
20.11.08		Medication and food as before. Now properly upright and more alert.
21.11.08	246g	Ate a little apple by himself.
22.11.08	249g	Still hand feeding but adding in nuts, etc. for him to try himself.
23.11.08	261g	Eating better, droppings normal.
24.11.08	273g	Front leg much better.
25.11.08		Put outside in aviary for exercise.
12.01.09		Put outside for longer exercise.
12.02.09		Eating well, very active so released where found.



Diane

Herbert: male, adult

Date	Weight	Details
15.6.18		Baytril. Cleaned off pus from abscess on testicles and removed maggots.
16.6.18		Took to vet. Cleaned out more maggots.
17.6.18		Baytril. Eating OK. Droppings normal. Swelling worse.
18.6.18		Baytril. Ear gooey.
19.6.18		Baytril. Vet lanced abscess. Advised keep abscess open and bathe with cold tea.
23.6.18		Baytril. Bathed abscess in cold tea. Swelling smaller.
30.6.18		Baytril. Still some pus but swelling much smaller.
13.7.18		No more pus. Put out in aviary.
22.7.18		No sign of abscess re-pointing.
Released where found.		

Lily: female, adult

Date	Weight	Details
19.7.14	298g	Found by the side of road, dragging back legs. Taken to vets who gave a steroid injection.
19.7.14	298g	Collect from vet. Back legs under body now, but wobbly.
20.7.14		Metacam given. Moving better now, but spine twisted. Eating, urinating and defecating normally.
21.7.14		Stays still most of the time, but can move better. Spine straighter.
22.7.14		Can climb bars of cage so took to aviary – more active outside. One back leg not as strong as the other, but can climb well.
Released in garden near where found. Ran across grass and up a pine tree.		

Diane: female, sub-adult

Date	Weight	Details
2.7.20	245g	Found running in circles on the pavement. Suspected glancing blow from car. Didn't want to eat. Slept curled up.
		Rehydration and Baytril.
3.7.20		Rehydration and Baytril. Curled up sleeping most of the time. Drank from syringe. Nibbled apple core and pine nuts. Won't eat or drink while I'm there.
4.7.20		Baytril. A little brighter and fought a bit. Faeces normal. Food and water not touched overnight. Pushed me away forcefully when I tried to give her a drink from a syringe. Still not moving around cage and hasn't come out of box. Left food and water.
5.7.20		Baytril. Looks bright but still moving in circles – if she moves at all. Tiny amount of food and water gone. Faeces normal.
6.7.20	238g	Didn't want food or water, even with syringe.
7.7.20		Rehydration and Zolcal. Livelier by lunchtime and ate apple, walnut and pine nuts. More alert.
8.7.20		Looks bright and coat is glossy. Had eaten walnut and apple. Dislikes grape and strawberry. Moves well but just sits in corner. Depressed.
9.7.20		Eating OK. Urine and faeces normal. Sitting in carrier box.
10.7.20		Took to release cage. Lively now she is outside. Released 10 days later and she went into woods mapping trees.

Alvin: male, elderly

Date	Weight	Details
21.4.12		Found in garden, hunched up on ground. Some toes missing, scabby ears, noisy breathing, lethargic.
21.4.12		Baytril course started. Eating a little, but not cracking nuts – teeth look normal.
23.4.12		Livelier.
24.4.12		Not coming out of sleeping area much, but eating OK.
25.4.12		Put outside in aviary. Able to climb.
26.4.12		Breathing OK now but scabby around mouth.
27.4.12		Very active now. Using drey.
1.5.12		Scabs better. Able to crack nuts now.
11.5.12		Released where found. Went straight to feeder. Then into treetops to nibble shoots and buds.

Jane: female, adult

Date	Weight	Details
5.1.14		Fell off roof after skirmish with another squirrel. Brought here, but came round so well she was climbing the cage so sent home.
22.2.14		Brought in again, unconscious, but eyes open. Recovers within half an hour – not frightened of people when fitting but has a normal fear of them once fully recovered. Finders say she has had two or three other episodes in the last two months.
25.2.14		Phoned vet – monitor her and try Septrin. Possible further episode in our aviary. Upright and conscious on the ground, not afraid of me at first, later back to normal. No more episodes.
14.3.14		Released. She collected our pony’s hair and took it back to the drey in the aviary.
17.3.14		More pony hair in drey, but no sign of Jane.
18.3.14		Seen in paddock collecting pony hair, but not putting it in aviary. Making new nest?
20.3.14		Seen on feeder with another squirrel paying attention. In season?
21.3.14		Seen on feeder with two other squirrels in attendance. Both waited while she was feeding, then chased her once she had finished.
22.3.14		With one other squirrel – mid afternoon she went into a hole in the oak tree and the male kept vigil outside until it was dark.
23.3.14		At feeder am and pm – no males around. Seen regularly in garden – no sign of any more episodes

Rescues

Occasionally kittens are found by members of the public and are hand-reared. This does take time and dedication. Whenever possible, kittens are reunited with their mother. Four times a family of kittens, picked up by the public, have been reunited with their mother. The technique is simple. A drey box is erected in the nearest tree to where the kittens were picked up and the kittens, with the soft material from their drey, are placed in the box. Response from the mother squirrel is fast. She doesn’t leave them in the box but carries them one at a time to a new location, presumably to a drey she has already built. Then the drey box is removed.

The first time this was tried, the squirrel-made drey collapsed and fell to the ground in a garden, at dusk, and mother ran off. The kittens were kept warm overnight and a volunteer quickly made a drey box. At first light it was erected and the kittens placed inside. Mother arrived shortly afterwards to remove the kittens. Some years passed before this technique was used again.

The second time, the family were in a thick garden hedge low down. The hedge was due for cutting and the workers were amazed to find such a low drey. The kittens were removed and brought to the author, who put the kittens in a drey box, which the workmen attached to a post near the hedge. The mother came to rescue her offspring and took them away. Only a few weeks later, the drey box was needed again.

This time, the drey was low down in a hollow tree trunk by a public path. The tree was considered a health and safety hazard and again, the worker was surprised to find a drey there. Once the drey box plus kittens were safely in a nearby tree, it was a treat to see mother take them away, one at a time.

The same year, a drey in a garden, very low down in a bush, was accidentally disturbed by a gardener, who immediately stopped work and called Wight Squirrel Project. A drey box was put in a nearby bush with the kittens inside and again the mother retrieved them once humans were out of sight.



The drey box with kittens inside



The kittens with their bedding and fleece for extra warmth

Food

The list is not exhaustive and, like us, squirrels have their favourite foods. We have found the food listed below is favoured by young squirrels and adults. Yogurt and honey is given in very small amounts to squirrels who are sick or undernourished. It can also be added to kitten food in tiny amounts.

Starter food for kittens	
Skinless grape	
Apple	
Cooked peas	
Pine nuts	
Almond powder mixed with milk	
Natural yogurt	
Honey	
Then:	
Mushroom	
Sweetcorn	
Carrot	
Crushed hazelnut	
Followed by natural foods, depending on time of year and availability:	
Small fir cones	
Hazelnuts	
Hawthorn berries	
Ash, field maple and hornbeam keys	
Young shoots and buds	
Lichen	
Fungi	
Foods to avoid for all ages	
Peanuts	
Brazil nuts	
Fat-rich foods	
Dried food	

Looking after sick, injured or orphan squirrels is not for everyone and finding the right people is a huge challenge. Volunteers as dedicated as Jacquie come along very rarely. Ideally, we are looking for a retired veterinary nurse with a quiet spare room and space for an outside aviary. The carer also needs to accept that plenty of time and dedication is necessary and that removing maggots and a high death rate of animals goes with the job.

Much has been learned from taking in these red squirrels and there are highs when an animal is released back to the wild but many lows as well.

The Isle of Wight is an important stronghold for the species in the UK and every red squirrel is precious not just to the species but also to people on the Isle of Wight. Therefore, we must do all we can to protect them.

Chapter 2

STATISTICS RELATING TO CAUSES OF MORTALITY IN RED SQUIRRELS ON THE ISLE OF WIGHT

This short chapter covers general statistics not specifically related to pathology, which is discussed later. Sightings of dead red squirrels related in Part 3 were recorded between 1990 and 2021. Bodies collected between 1993 and 2021 were examined for gross pathology. Data has been analysed to look for trends in disease and other causes of mortality and morbidity in red squirrels on the Isle of Wight. Causes of mortality and morbidity are diverse, with some animals presenting with more than one cause of pathology.

Detailed causes of death are discussed in the following chapters. The aim in this chapter is to give a broad view of statistics taken from the general sightings database plus statistics from the squirrels given a post mortem examination. Squirrels that had a post mortem are also recorded in the general sightings database and therefore included in these statistics. The reported death from 1990 came from a member of the public who responded to the 1991 newspaper article and remembered the road kill. As you would expect, the majority of carcasses are picked up from roads.

The general public report dead or sick red squirrels seen in their garden or when they are out and about. They also pick up sick, injured, young or dead squirrels. Live squirrels are treated and released if they recover. Those that die or are euthanised are examined.

Not all bodies are retrieved, particularly road casualties that are very badly damaged; however, they are added to the general sightings statistics. A small number of carcasses were presented for examination but were far too damaged to glean useful data from.

Between 1993 and 2000, bodies were posted to the Zoological Society of London. Although a report was sent back to Wight Squirrel Project on the cause of death, no other details were given.

These animals are included in the statistics.

When pathology is found, tissue samples are taken and fixed in 10% buffered formal saline solution or deep frozen until a laboratory can test them. Occasionally, a frozen carcass is either sent or, very rarely, delivered to a laboratory.

The animal's age is estimated by overall size, weight, teeth, shin length, reproductive status and observer's experience. The bodily condition of the animal is categorised as fat, normal, thin or emaciated. This status is determined through experience and therefore subjective.

The coat, eyes, mouth, skin and limbs are examined prior to opening the body to examine the organs. Once the body is opened to expose the internal organs, a careful examination is undertaken before cutting away the ribcage and severing connective tissue to extract the organs for individual examination. Findings are recorded on a pro forma sheet, a sample of which is shown in Appendix 1. From September 2014 onwards, pinna from dead red squirrels on the Isle of Wight have been saved for future use in disease or genetic studies. This is ongoing so that tissue is available for future studies.



Bodies are either frozen by the member of the general public who retrieves them, or picked up by Wight Squirrel Project. Bodies are generally frozen at –20 degrees Celsius; only 40% were autopsied fresh. General condition is estimated from experience. ‘Body incomplete’ is recorded when a scavenger has taken part of the carcass.

Autolysis is often a problem given the time lapse between the squirrel’s death, picking the body up and deep freezing or examining it. In summer, bodies are rarely very fresh given that the ambient temperature is generally high on the Isle of Wight. An extreme example was a squirrel described as fresh by the member of the general public who picked it up, when it was full of maggots and smelled awful. This animal was not examined.

Autolysis is not always apparent from the smell, maggots or subcutaneous green tinge. If samples are taken and sent away and autolysis found, then it may not be possible to give a conclusive cause of death, which is very disappointing all round.

Opening the body to expose the internal organs

General condition	Number
Body incomplete	4
Decomposing	10
Emaciated	39
Fat	51
Normal	544
Thin	123
Unrecorded	32
TOTAL	794

Condition	Number
Fresh	320
Frozen	450
Refrigerated	12
Decomposed	9
Unrecorded	3
TOTAL	794

Overall statistics

Graphs visually illustrate statistics. These tables and graphs are taken from the post mortem database of 794 red squirrels.

Data analysis shows that the male to female ratio of red squirrels presented for post mortem examination was 49% per gender with 2% unrecorded. Unrecorded entries pertain to the animals where the body is incomplete or too damaged for positive identification of gender.

Gender and age breakdown

Gender	Number	%
Male	390	49%
Female	387	49%
Unrecorded	17	2%
TOTAL	794	

A breakdown of age statistics shows that two-thirds of submitted bodies are adults. Younger animals are generally found in gardens whereas the majority of road kills, the most often retrieved carcasses, are adults.

Road kill breakdown	
191 females	26 were under one year old
225 males	45 were under one year old

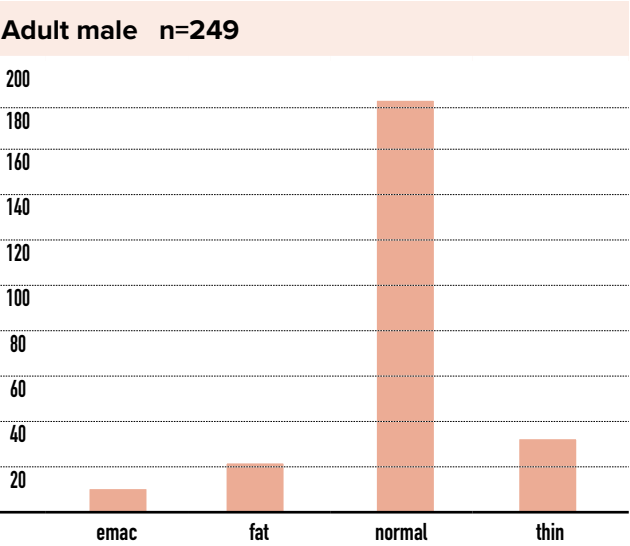
Gender	Number	%
Adult	525	66%
Sub-adult	154	19%
Juvenile	101	13%
Unrecorded	14	2%
TOTAL	794	

The following graphs show that the majority of animals presented in normal body condition.

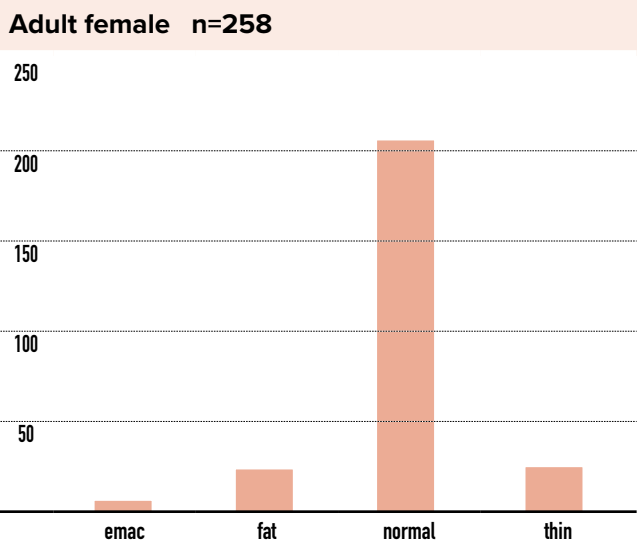
None of the juvenile males were judged to be fat and only one female juvenile was regarded as fat.

A total of 54 cases are unrecorded.

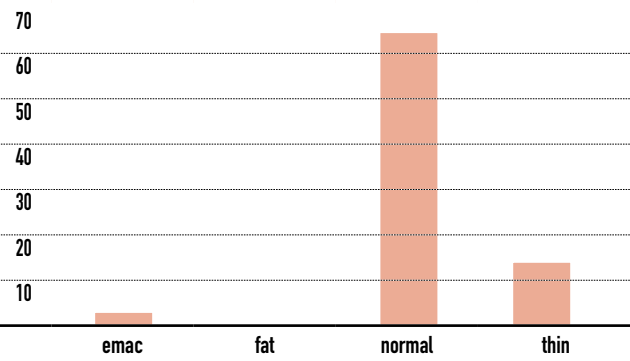
Condition of animal by age and gender: male



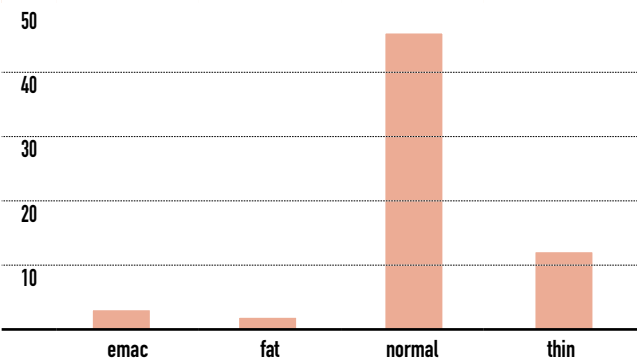
Condition of animal by age and gender: female



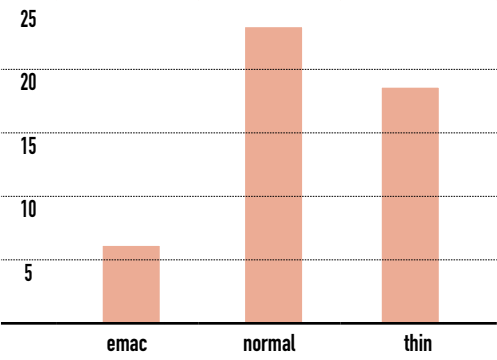
Sub-adult male n=79



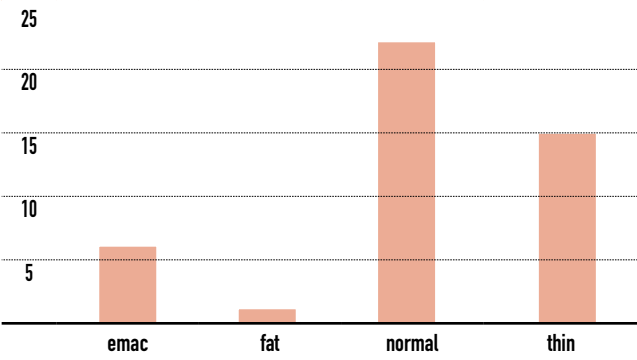
Sub-adult female n=63



Juvenile male n=47



Juvenile female n=44



Weight and shin length

Weight

Gender	Number sampled
Adult male	249
Adult female	252
Sub-adult male	80
Sub-adult female	65
Juvenile male	49
Juvenile female	51
Unrecorded	48
TOTAL	794

Shin length

Gender	Number sampled
Adult males	201
Adult female	212
Sub-adult male	57
Sub-adult female	59
Juvenile male	43
Juvenile female	45
Unrecorded	177
TOTAL	794

Males: n=388 Females: n=383

Sample numbers differ as not all measurements were recorded for every animal brought in.

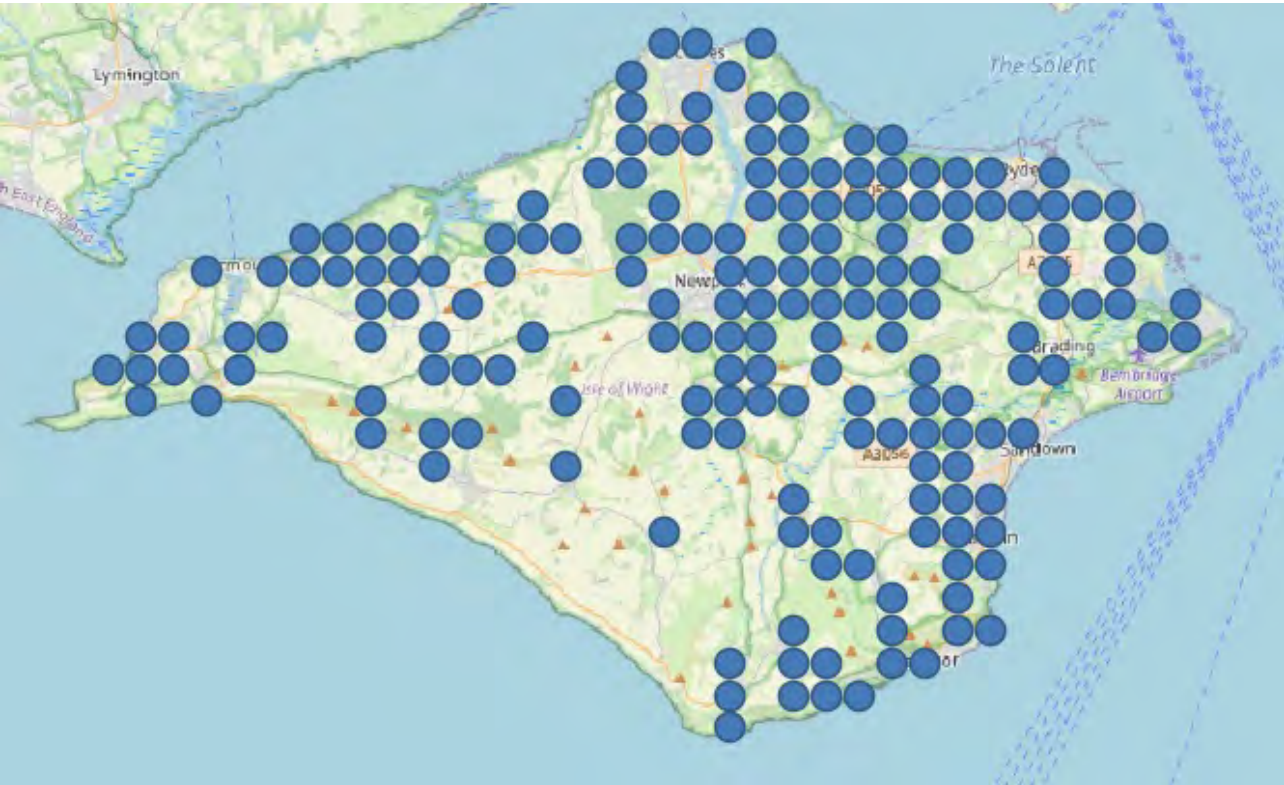
Age/ gender	Shin length (mean) (mm)	Range (mm)
Adult male	70.78	60–81
Adult female	70.89	55–81
Sub-adult male	66.72	53–72.5
Sub-adult female	66.66	51–72
Juvenile male	56.63	36–70
Juvenile female	58.12	36–69

Age	Median weight (grams)	Range
Adult male	305.48	200–435
Adult female	300.63	172–405
Sub-adult male	244.04	152–310
Sub-adult female	229.72	152–310
Juvenile male	120.79	49–237
Juvenile female	186.72	66–220

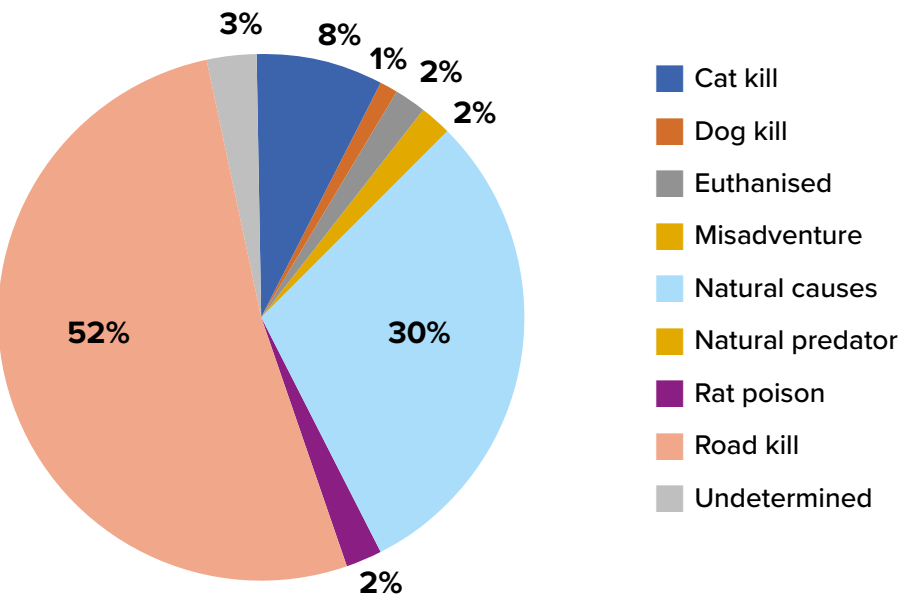
Table showing average weights from all conditions: emaciated to fat, pregnant and lactating. A juvenile is a squirrel judged to be 14 weeks or under; that is, until it has been weaned and left the family. A sub-adult is up to a year old

Location of death breakdown

The map shows the location of all red squirrels submitted for post mortem examination. The pattern broadly fits the maps showing where squirrels are sighted. That is, where humans live and the busiest roads are.



Maps showing location of animals submitted for post mortem examination 1993–2001



Breakdown of cause of death for all red squirrels presented for post mortem examination given as a percentage

Age breakdown relating to cause of death

Note: Ages are not always recorded

Juveniles

Cause of death	Number	%
Cat kill	22	15%
Dog	2	1%
Euthanasia	6	4.5%
Natural causes	48	33%
Rat poison	1	0.5%
RTA	65	44%
Undetermined	3	2%
Total	147	

Sub-adults

Cause of death	Number	%
Cat kill	22	21%
Euthanasia	2	2%
Misadventure	1	1%
Natural causes	69	65%
RTA	4	4%
Undetermined	8	7%
Total	106	

Adults

Cause of death	Number	%
Cat kill	19	4%
Dog kill	4	1%
Euthanasia	5	1%
Natural causes	107	20%
Unidentified predator	4	1%
Rat poison	11	2%
RTA	347	68%
Undetermined	15	3%
Total	512	

Where ‘natural causes’ is given as cause of death, it relates to any pathology not directly caused by human activities. The term as used in these tables includes starvation and old age for example. The diverse range of pathology and causes of death due to anthropogenic activities are discussed in later chapters.

Appendix 1. Pro forma sheet completed during post mortem examination

[illegible]

CHAPTER 3

STATISTICS, BY BODY SYSTEM, RELATING TO RED SQUIRRELS PRESENTED FOR POST MORTEM EXAMINATION

Introduction

Natural causes of morbidity and mortality are many and varied, which makes this area of red squirrel conservation particularly interesting. A number of published papers, including new discoveries such as leprosy, have resulted from this work. Given the time taken to put this publication together, cases have been added after some chapters are already finished, therefore the figures are not always consistent.

Chapter 3 looks at the statistics relating to body systems and touches on the wide variety of pathogens and injuries found in 813 red squirrels on the Isle of Wight between 1993 and 2001. Chapter 4 goes into greater depth and discusses specific diseases. As part 3 is about reporting data and not teaching, readers will require a basic understanding of the body systems and pathogens.

Some body systems have more data entries than others, so there is no set pattern to how the results of each system are written up. Pathology may show in one organ or multiple organs, therefore the same case will appear in more than one table.

Euthanasia (1.5% of cases) is included in cause of death tables as barbiturates do burn the internal organs they touch, usually the heart, lungs and liver but occasionally the kidneys and adrenals. All squirrels euthanised by the vet had extreme pathology and no chance of recovery and return to the wild, therefore euthanasia was the kindest outcome as the animal was suffering.

Misadventure (1.5% of cases) covers mishaps such as falling onto a large pyracantha thorn, electrocution or drowning in a water butt. Rat poison (1.5% of cases) affects all the organs, although as the varying figures for the body

systems show, the effects are not always apparent by eye in every organ. The wild predator entries (0.5% of cases) relate mainly to red squirrels killed by birds, generally buzzards, or in one instance, a fox.

Undetermined entries (4% of cases) speak for themselves. Even with testing, it is not always possible to positively identify the cause of death. Sending samples for testing was relatively easy in the beginning, until labs began to close. Although samples are kept for a while, if nobody wants them, they are discarded. This, sadly, leaves many questions unanswered.

Over half of the animals brought in for post mortem examination are adults but as road kills account for 67% of adult deaths overall, this is unsurprising. Sub-adults (squirrels up to a year old) often do not survive their first year and although some are killed crossing roads, many more are brought in sick or deceased due to various diseases or poor condition. Sub-adults and juveniles (squirrels not yet weaned) are more often found dead in gardens.

Cause of death	Number	%
Cat kill	64	7.9
Dog kill	6	0.7
Euthanised	14	1.7
Misadventure	13	1.6
Natural causes	244	30
Rat poison	14	1.7
Road kill	425	52.3
Undetermined	29	3.6
Wild predator	4	0.5
Total	813	

Table showing the breakdown of cause of death for all 813 cases recorded up to mid 2022

Respiratory system

The age breakdown relating to the respiratory system is no surprise as there are more adults presented for post mortem examination. Also, as mentioned previously, the highest percentage of road kills are adults. Significant diseases such as toxoplasmosis are discussed in detail in the next chapter.

The lungs are often damaged due to impact with a vehicle, although trauma to the head is generally the cause of death. Naturally, a road kill squirrel may also show pathology in the lungs – and other organs – even if it is not the cause of death.

A cat or dog kill does generally show trauma to the lungs due to asphyxiation, or by a dog holding the squirrel in its teeth, hence the high number in the table.

One case of a pulmonary carcinoma caused the death of a sub-adult female squirrel found dead in a garden. She was in poor condition and had a heavy flea burden. An extensive invasive mass in one lung was discovered after histological examination. The mass was composed of innumerable islands of pleomorphic epithelial cells¹ separated by a fibrovascular stroma². Enclosed within the mass were numerous alveoli, bronchial glands and foci³ of necrosis and inflammatory cells (V. Simpson *et al.* 2013).

¹ Pleomorphic epithelial cells: potentially cancerous cells
² Fibrovascular stroma: fibrous connective tissue associated with growths
³ Foci: cells in an organ that are different from surrounding cells

Age	Number	%
Adult	277	66%
Sub-adult	95	22%
Juvenile	52	12%
Total	424	

Age breakdown

Details	Number	%
Barbiturate damage	12	2.8%
<i>Bordetella</i>	3	0.7%
Congenital defects	3	0.7%
Damage to trachea	2	0.5%
Displaced or macerated lungs	44	10.4%
Hepatozoon	4	0.9%
Impact lesions	219	51.6%
Puncture wounds	17	4%
<i>Toxoplasma</i>	5	1.2%
No pathology	108	25.5%
Other pathology	7	1.7%
Total	424	

Table giving pathology found in squirrels mentioned in the respiratory system column of the database. Comparing this table to the table above shows that cause of death is not always due to disease

Cause of death	Number	%
Cat/dog kill	49	11.6%
Euthanised	12	2.8%
Misadventure	6	1.4%
Natural causes	118	27.8%
Rat poison	3	0.7%
Road kills	225	53.1%
Wild predator	2	0.5%
Undetermined	9	2.1%
Total	424	

Table showing cause of death where the respiratory system is mentioned

Ten of the 12 squirrels euthanised had lung damage due to barbiturate damage. The barbiturate missed the lungs in two animals. Reasons the squirrels were euthanised are varied and given in the table below.

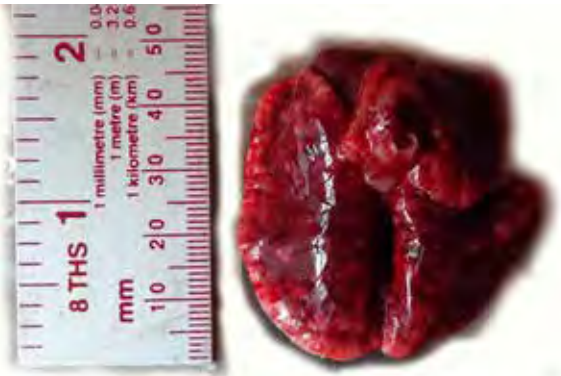
Consolidation and congestion

A variety of causes of death show either consolidation or congestion of the lungs. Congestion and consolidation may be partial, that is they may affect part of a lobe or a percentage of the whole lung. Congestion is seen as a result of an infection or irritant. If untreated, consolidation and death follow. In these cases the heart struggles and becomes enlarged.

The majority of casualties (225) are road kills and unless the lungs are tested for pathology, the likelihood is that in the majority of cases congestion is recorded as being caused by the animal being hit by a vehicle rather than pathology. Displaced or macerated lungs and damage to the trachea also relate to road kills. Puncture wounds are generally inflicted by a cat or dog, except in the case of an unfortunate squirrel that fell onto a large pyracantha thorn. *Bordetella*, *Hepatozoon*, *Toxoplasma*, congenital defects and other diseases are discussed in future chapters.

Location	Sex	Age	Details
Alverstone	F	SA	Caught in trap and lost limbs
Appuldurcombe	F	J	Blind in left eye. Euthanised due to congenital abnormalities
Blackwater	M	SA	Abscess
Brading	M	J	Euthanised due to skin loss
Firestone	M	A	Caught by dog
Freshwater	F	A	Broken bones in foot
Havenstreet	F	A	Osteomyelitis
Lake	M	SA	Poor condition. Displaced scapula
Ningwood	F	A	Caught in trap and lost limbs
Ryde	F	SA	Congenital defect
Shanklin	F	SA	Abscess
Wootton	M	A	Fractured cervical vertebrae

Table showing condition of the 12 red squirrels that were euthanised



An example of congested lungs



An example of a consolidated lobe

Key to all tables

F	Female	M	Male
A	Adult	SA	Sub-adult
J	Juvenile		

Sex	Age	Details	Final Diagnosis
M	A	Brown spots 3mm diameter on rt. lung. Numerous <i>Hepatozoon</i> schizonts. Heavy neutrophil infiltration of bronchioles & parenchyma	Pneumonia cause unknown
M	SA	2mm white irregular foreign body embedded behind right lung	Pneumonia cause unknown
M	SA	Badly congested lungs and small nodules on lobes	Poor condition
M	J	Collapsed, including cellularity, prominent alveolar macrophages, few <i>Hepatozoon</i> schizonts. Bronchioles contain degenerated cells plus coccal bacteria	Bacterial bronchitis suspected
M	SA	Congested, suspect protozoal schizonts	Pulmonary & cardiac failure due to unidentified protozoan
M	A	Diffuse foci of neutrophils, oedema	Suspect due to bacterial hepatitis/cholangitis leading to septicaemia
F	A	Displaced lobe (medial lobe displaced anteriorly). Discolouration indicates ante mortem	Gastritis
F	A	Enlarged & congested lungs. Focal necrosis. <i>Toxoplasma</i> schizonts	<i>Toxoplasma</i>
M	A	Lung congestion over whole lungs but not consolidated	Generally debilitated and possible toxoplasmosis
F	A	Lungs congested	<i>Bordetella</i>
F	SA	Lungs 100% congested	<i>Toxoplasma</i>
F	A	Lungs consolidated. Occasional schizonts	<i>Toxoplasma</i>
F	A	Lungs enlarged & congested. Irregular surface	<i>Bordetella</i>
F	A	Many macrophages full of yellow/brown pigment. No <i>Hepatozoon</i> or other protozoa	<i>Toxoplasmosis</i>
M	J	Numerous streptococcal colonies in lung	Streptococcal
M	A	Scattered haemorrhagic foci both lungs	Unidentified infection
F	SA	Several thrombosed vessels	Exudative dermatitis
M	A	Yellowing lungs. Jaundice through blood virus	Haemolytic icterus
F	A	Congested non-purulent fluid in bronchi, recent thrombus in one artery	Road kill (had cancer)
M	A	Left lung consolidated and right heavily congested. <i>Hepatozoon</i> 3+	Road kill

A sample of cases mentioning lung pathology

Liver

The majority of lesions seen in the liver are caused by impact trauma seen in road kills. Notable pathology involving the liver is a cluster of hepatitis cases, *Toxoplasma*, *Bordetella* and one case of suspected yersinia pseudotuberculosis as assessed by professional pathologist Dr Ian Keymer.

The liver may appear enlarged and pale with necrotic foci and *Toxoplasma* schizonts present if the squirrel has contracted toxoplasmosis. This description does appear in the database numerous times but unless the samples are sent to a laboratory for testing, all but a few cases are unconfirmed.

As a soft organ, the liver is often damaged in road kills. Damage ranges from lesions to maceration. On occasion, the organs, including the liver, are displaced within the body cavity. The gall bladder may also burst, spreading yellow bile onto adjacent organs.

A liver may appear spongy in texture, discoloured and dull if the squirrel has an illness. Spots on the surface of the liver, as in the case of suspected yersinia pseudotuberculosis, are also seen occasionally. Without laboratory testing, the cause of these lesions cannot be confirmed.

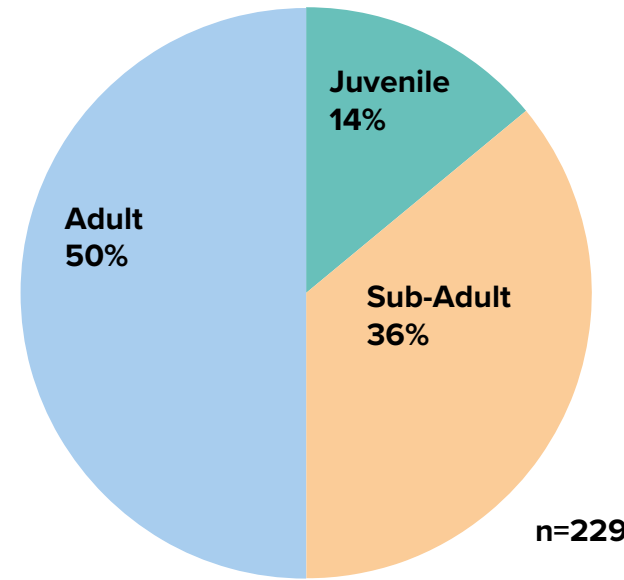


Liver with atypical appearance

Cause of death	Number	%
Cat/dog kill	0	4%
Euthanised	6	2.5%
Misadventure	2	1%
Natural causes	73	32%
Rat poison	4	2%
Road kill	130	56.5%
Undetermined	4	2%
Total	229	

Table showing cause of death where the liver is mentioned

Liver pathology. Age breakdown



Location	Sex	Age	Liver pathology	Cause of death
Firestone	F	A	Enlarged liver disintegrated when squeezed	Unidentified infection
St Lawrence	M	A	Multiple granulomas with <i>Capillaria</i> eggs & adult worms	Road kill
Alverstone	F	A	Multiple foci of necrosis with possible <i>Toxoplasma</i> schizonts in hepatocytes ¹ in margins	<i>Toxoplasma</i>
Wootton	F	A	Enlarged & pale. Necrotic foci, numerous <i>Toxoplasma</i> schizonts present	<i>Toxoplasma</i>
Wootton	F	A	Multifocal hepatic necrosis & clusters of tachyzoites ² in margins	<i>Toxoplasma</i>
Wootton	M	SA	<i>E. coli</i> and unidentified bacterium	Ectoparasites
Ningwood	F	A	Necrotic yellow area approx. 5mm diam. Remaining liver pale	Septicaemia
Ryde	M	J	Gall bladder black & hard. Bile leaked	Gastritis
Northwood	F	A	Solidified & enlarged liver	Hepatitis
Nettlestone	M	A	Yellowing liver. Bile duct unblocked. Jaundice through blood virus	Haemolytic icterus
Parkhurst	M	J	Possible peribronchial fibrosis plus mineralised foci in arterial wall	Inconclusive
Northwood	F	A	Surface mottled. Inside spongy	<i>Bordetella</i>
Northwood	F	A	Dark patches on liver	<i>Bordetella</i>
Gurnard	F	A	Focal necrosis throughout liver. <i>Toxoplasma</i> +ve	<i>Toxoplasma</i>
Northwood	M	A	Lymphocytic infiltration around bile ducts. Suspect due to bacterial hepatitis/cholangitis leading to <i>Septicaemia</i>	<i>Septicaemia</i>

A sample of cases mentioning liver pathology

¹ Hepatocytes: Cells making up the majority of the liver
² Tachyzoites: Rapidly multiplying cells in certain infections such as *Toxoplasma gondii*

Skin

Once again, road kills and adults account for the highest numbers of animals where skin lesions are recorded in the database. Rat poison cases may seem unlikely to have skin lesions but, as the table shows, they do, even though they are unrelated to the cause of death. The comments in the table below are taken from the ‘skin lesions’ column of the post mortem database.

Fatal exudative dermatitis and *Staphylococcus aureus* present with skin lesions and are discussed in detail in the following chapter. Fleas are a problem for red squirrels and ectoparasites are also discussed in the following chapters. It is vital to keep the flea burden down as they are a significant cause of anaemia. It is rare to find mites and very rare to see a tick.

Skin lesions mentioned in cases relating to rat poisoning
3mm x 15mm missing fur upper left groin
Coat wet. Nick on lower lip. 25mm x 3mm abrasion near side
Old abrasions on left foot
Scaly patches in armpits 4mm x 5mm
42mm x 22.5mm patch of fur regrowth on back
Puncture wound penetrated right ribcage due to bird scavenging fresh carcass
Lesions on tongue, lower lip and palette
Tail stripped of fur & some missing from rump

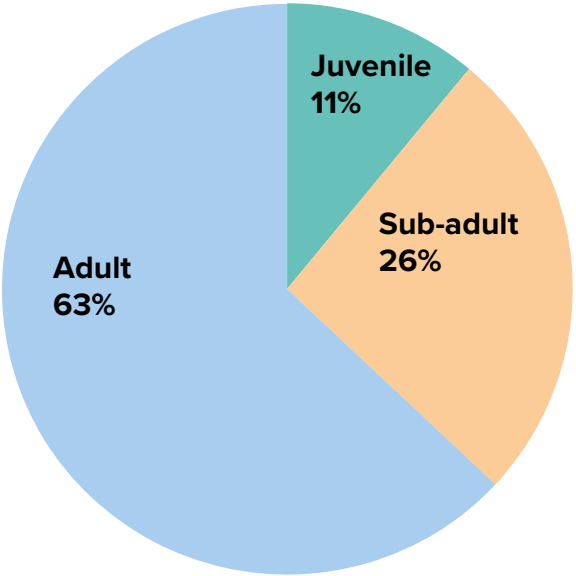
Cause of death	Number	%
Cat/dog kill	17	10.6%
Euthanised	9	5.6%
Misadventure	3	1.9%
Natural causes	74	46.3%
Rat poison	8	5%
Road kill	37	23%
Undetermined	10	6.3%
Wild predator	2	1.3%
Total	160	

Table showing cause of death where skin pathology is mentioned



Flea droppings on a squirrel with a high number of the parasites

Skin pathology. Age breakdown



n=160

Musculo-skeletal system

Pathology relating to the musculo-skeletal system is predominantly trauma injuries sustained in road traffic accidents. Minor concussion is rare and generally the squirrel recovers and is released. As usual, the high percentage of adults relates to road kills. Eighty-seven percent of road kill injuries are to the head, suggesting that the squirrel hit the car, as opposed to the car running over the squirrel.

If a squirrel is inactive due to illness, then muscle tone is poor. Unsurprisingly, all animals with severe anaemia had poor muscle tone. Teeth are occasionally missing due to trauma or, in some cases, there is a congenital defect. All seven congenital defects relating to the musculo-skeletal system were found in young animals. More on this subject in the following chapters.

The three squirrels ingesting rat poison were also in poor condition, with one animal missing five digits. This squirrel was caught by a cat and, as the injuries did not appear fresh, presumably were not bitten off by the cat. Twenty squirrels overall had missing digits, which were not attributed to road kills. In the case of Fenn trap injuries, whole limbs were missing.

In common with other species, bones and teeth show wear in old age. An emaciated male that had been feeding in the same garden for years presumably died of old age as no pathology was found. He had arthritis and very poor muscle tone. His bones, particularly noticeable in the ribcage, were yellowed and hardened.



Arthritic femurs compared to a young healthy femur

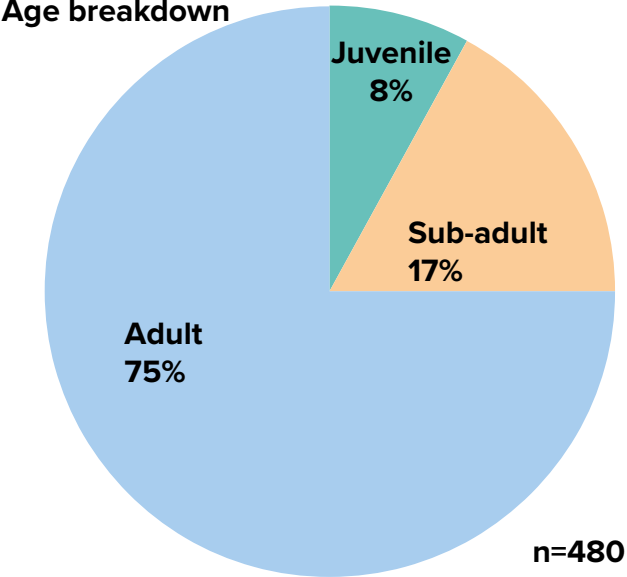
Cause of death	Number	%
Anaemia	14	3%
Cat/dog kills	11	2.3%
Euthanised	12	2.5%
Misadventure	3	0.5%
Natural causes	56	12%
Old age	1	0.2%
Rat poison	3	0.5%
Road kills	371	77.2%
Undetermined	9	1.8%
Total	480	

Table showing cause of death where the musculo-skeletal system is mentioned

Congenital defects	7	1.4%
Fractured skull	55	11.5%
Missing digits	20	4.2%
Multiple skull fractures	136	28.3%
Other injuries	91	19%
Poor muscle tone	45	9.4%
Skull mascerated	126	26.2%
Total	480	

Breakdown of musculo-skeletal injuries

Musculo-skeletal system pathology. Age breakdown



A juvenile female squirrel was found to have congenital hip dysplasia. That is, the head of the femur was unformed and too small to stay in the socket. She displayed normal behaviour in all respects and did adapt up to a point, but her back legs soon became sore, so she was euthanised.

An adult post-lactating female with a grossly enlarged forearm was brought in by a member of the general public. She was in good condition with a full stomach and no signs of disease. She was taken to a vet, who diagnosed osteomyelitis, so she was euthanised.

Osteomyelitis is a bone infection, causing swelling of the bone marrow. In turn, the soft tissue proliferates as the bone itself deteriorates. Peeling away the layers of excess flesh revealed that the left fore limb bones were crumbling and the fleshy mass extended into the shoulder. This is the only case found on the Isle of Wight to date.



Young squirrel with hip dysplasia



Grossly enlarged forepaw



Peeling away the tissue



Excess tissue extended into the thorax

Cardiovascular system

The majority of cases involving the cardiovascular system relate to damage or displacement of the heart due to impact trauma, severe anaemia or thinning of the blood due to ingesting rat poison. In 103 cases the heart was compromised by the cause of death but heart pathology itself was not the direct cause.

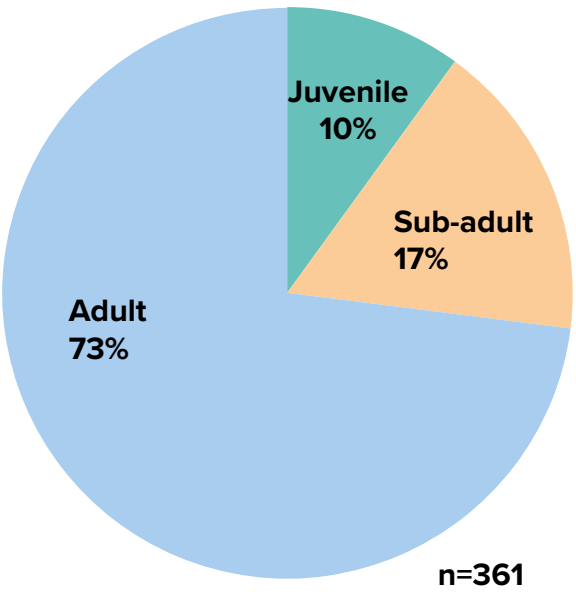
One juvenile had an obvious congenital heart defect. His mother had pushed him out of the nest and he was found alive but died shortly afterwards.

Anaemia, predominantly in young animals, contributed to 21 deaths. These were all sub-adults with a very heavy flea infestation. Adults with a slow debilitating illness also had a heavy flea burden and some degree of anaemia but not to the extent of the sub-adults; indeed, the sub-adults had no bleeding upon cutting with a scalpel or any discernible blood in the body cavity.



Congenital heart defect in juvenile male

Cardiovascular system pathology. Age breakdown



Details	Number	%
Anaemia	21	6%
Barbiturate damage	12	3%
Congenital defect	5	1.5%
Enlarged heart	29	8%
Impact lesions/organ displacement	160	44%
Mesentery blood vessel abnormality	5	1.5%
Thinned blood pooled in body cavity	14	4%
Various infections/conditions	115	32%
Total	361	

Table showing pathology in the cardiovascular system

Cause of death	Number	%
Cat/dog kill	22	6%
Euthanised	12	3%
Misadventure	7	2%
Natural causes	103	28.5%
Rat poison	14	4%
Road kill	194	54%
Undetermined	7	2%
Wild predator	2	0.5%
Total	361	

Table showing cause of death where the cardiovascular system is mentioned

Sex	Age	Details	Final Diagnosis
M	SA	Blood in pericardium. Blood-stained fluid in chest	Internal parasites
F	A	Congestive heart failure	Hepatitis
M	SA	Multiple foci of myocyte necrosis – heart	Pulmonary & cardiac failure due to unidentified protozoan
F	A	Few mononuclear foci. Internal haemorrhage	Road kill
M	J	Scattered mineralised foci	Possible peribronchial fibrosis plus mineralised foci in arterial wall
M	A	Fat accumulating around aorta	Road kill
M	SA	Few foci of necrosis in heart	Road kill
F	A	Haemorrhage into abdominal cavity. Blood thin. Mesentery vessels engorged with blood	Rat poison
M	A	Granuloma in one artery	Suspect due to bacterial hepatitis/ cholangitis leading to septicaemia
F	SA	Single focus of myocyte necrosis	Exudative dermatitis
M	A	Arteries from the heart appeared black and thicker than normal	Testicular cancer
F	A	Degenerative/necrotic myocytes, most right ventricle. Few Toxoplasma tachyzoites	Toxoplasmosis
M	SA	Foreign body attached to heart. White oval 2mm x 7mm	Unidentified endoparasite

A sample of cases mentioning cardiovascular pathology

Digestive system

The digestive system has the most entries in the database, not due to any pathological reason but rather that stomach contents are generally, but not always, noted. Only 9.3% had pathology relating to the digestive system. Stomach size varied from below average size (by eye), with a tough leathery texture as opposed to the normal elastic structure, to very large. Rarely, a full stomach was stretched the length of the body cavity. Pathology found in the digestive system of red squirrels is remarkably similar to that of humans, that is, due to parasites, cancer, ulcers and infections. More details are given in the next chapter.

In road kill victims, the stomach and intestines are often displaced, with the large intestines sometimes pushed between the femur and muscle and the stomach burst. Stomach contents were not analysed. Typically they consisted of an off-white paste as shown in the photograph. The assumption is that the paste is predominantly nuts. Occasionally, pollen or leaf material is found. This is in spring and early summer, of course. There is no obvious correlation between stomach contents and cause of death. A healthy squirrel with a full stomach is just as likely to become a road kill victim as an under-nourished or sick squirrel.



Typical stomach contents

Abnormal stomach in an adult male that was grossly underweight. Cause of death was a dog kill

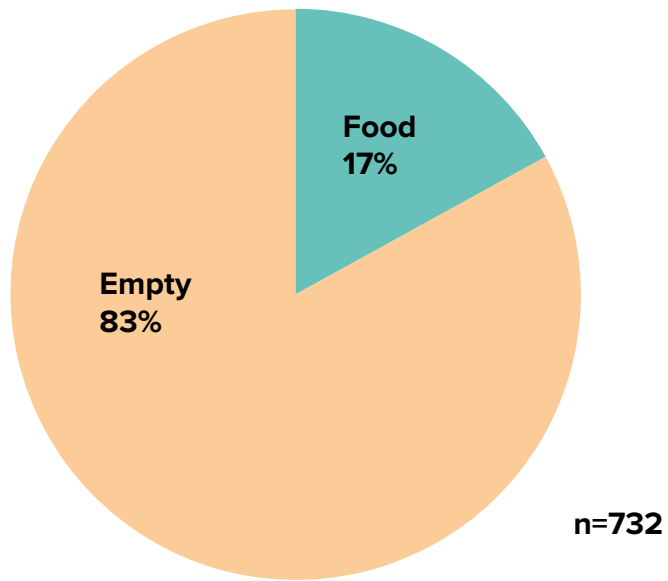
Cause of death	Number	%
Cat/dog kill	60	8
Euthanised	13	2
Misadventure	13	2
Natural causes	230	31.5
Rat poison	14	2
Road kill	371	50.5
Undetermined	26	3.5
Wild predator	5	0.5
Total	732	

Table showing cause of death where the digestive system is mentioned

Sex	Age	Details	Final Diagnosis
F	A	Exudate in abdomen. Necrosed rectum. Few contents in colon. Abscess between rectum & uterus	Septicaemia
M	SA	Yellow ingesta. Large int. semi-solid consistency. Large number of coccidial oocysts in intestinal contents	Endoparasites
F	A	Full stomach. Coccidae multiples in small intestine	Road kill
F	A	Stomach bloated with runny content and throughout gut. No infection but abnormal digestive function Possibly paralytic ileus – shock	
M	A	Some food in stomach. Hard faeces throughout gut. Twisted gut adj. caecum. Stomach lining inflamed	Twisted gut
M	J	Gastritis. Perforated stomach ulcer, discoloured intestines. Unformed faeces in gut & signs of diarrhoea	Gastritis
F	A	Hardened food in stomach. Loss of liver function caused bile in intestine	Hepatitis
F	A	Extensive tumour mass involving smooth muscle, mostly spindle types. Spindle-cell-type tumour involving lymph nodes: structure obliterated by tumour cells invading stomach and associated lymph nodes	Road kill
F	SA	Intussusception lower intestine approx. 35mm long. Necrosis of gut. Stomach empty except for pinkish mucoid fluid.	
		Enlarged lymph adjacent to intussusception	Endoparasites
F	A	Full stomach normal. Small quantity of yellow pus in duodenum & gut. Faeces normal	Bordetella
F	A	Full stomach. Unusual striations on colon. Watery fluid in gut. Two swollen mesentery glands	Endoparasites
M	A	Empty stomach. Hard faeces lower int. Inflamed stomach & mesentery tissue	Bacterial pneumonia
F	A	Full stomach. Gritty substance in intestines. Growth on mesentery	Toxoplasma
M	J	Large worms in abdomen. Yellow substance in lower bowel. Mass of faeces adhering to anus	Bacterial bronchitis suspected
F	A	Intussusception protruding through anus. Black/red smelly semi-fluid in small intestine in least-affected section. Rest disintegrating and 'gloopy'. Small amount of digested food in stomach	Unidentified infection
F	J	Empty stomach. Hard small faeces small int. Large int. black/green almost fluid substance leaking. Peritonitis	Gut infection
F	J	Stomach & intestines filled with gas. Yellow foreign bodies attached to outside of large intestine 15mm long	Endoparasites
M	SA	Stomach burst and adhered to spleen, liver, heart & pancreas. Very sticky, couldn't examine organs Sweet sickly smell. Diarrhoea around anus	Fungal infection
M	A	Large stomach full of grey granular material. Stomach lining bloody	Road kill

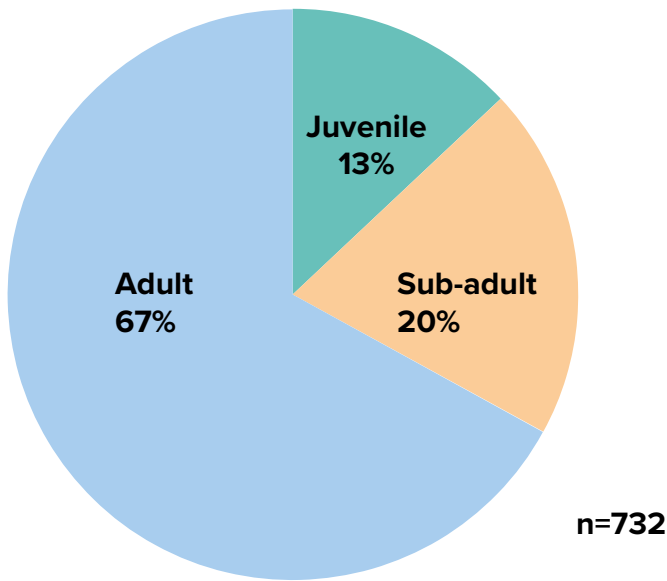
A sample of cases mentioning pathology of the digestive system

Stomach contents



Pie chart showing percentage of squirrels that had food in their stomach. Of those with food in their stomach, 28% were described as having a full stomach

Digestive system. Age breakdown



The pie chart relates to comments on the database, only 9.3% actually showed pathology

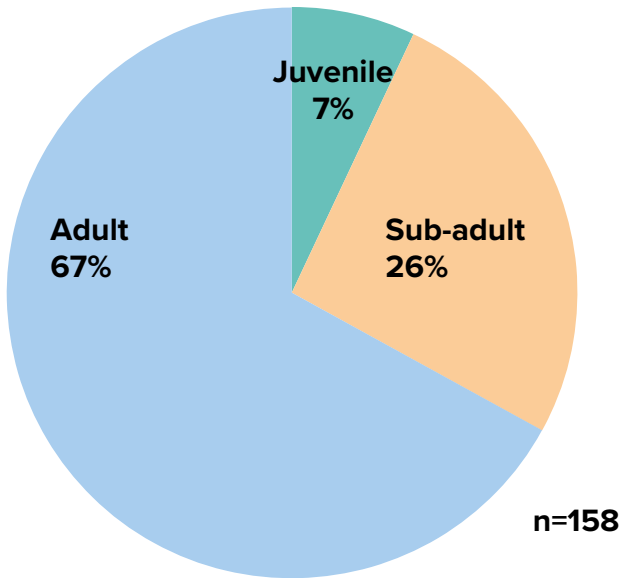


An example of intussusception where the bowel 'telescopes' in on itself. The likely cause in this case was internal parasites

Lymphoreticular system

The lymphoreticular system consists of the spleen, lymph nodes, lymphatic vessels, bone marrow and thymus. The bone marrow was not examined during post mortem examinations. A notable sign of infection is an enlarged spleen, although the nature of any infection is found only with laboratory testing. Spleen size does vary but a grossly enlarged spleen is not easily missed.

Lymphoreticular system pathology. Age breakdown



Cause of death	Number	%
Cat/dog kill	8	5%
Euthanised	3	2%
Misadventure	1	0.5%
Natural causes	89	56.5%
Rat poison	3	2%
Road kill	48	30.5%
Undetermined	5	3%
Wild predator	1	0.5%
Total	58	



Grossly enlarged spleen from a squirrel with a lung infection

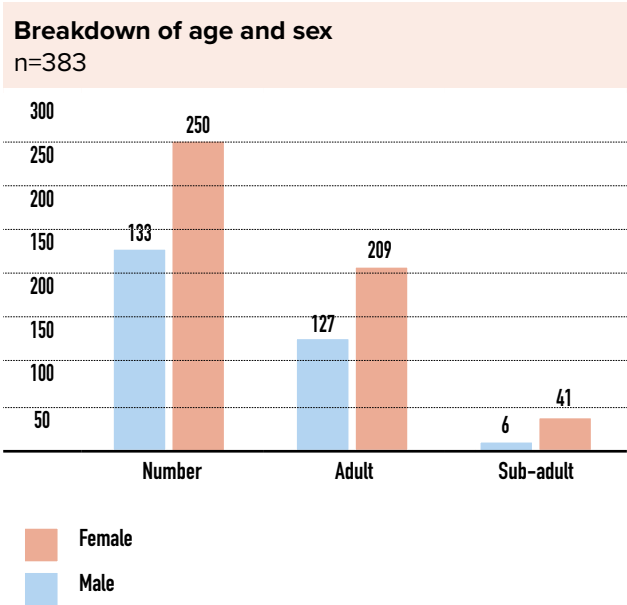
Sex	Age	Details	Final Diagnosis
F	A	Spots on spleen. <10 small yellow/white lesions <1mm. Suspected Y ersinia pseudotuberculosis	Road kill
F	A	Enlarged spleen	Hepatitis
M	A	Enlarged spleen	Unidentified infection
M	A	Yellowing spleen and lymph nodes	Jaundice through blood virus. Haemolytic icterus
M	SA	Enlarged & solidified mesentery lymph gland	Pulmonary & cardiac failure due to unidentified protozoan
M	A	Abnormally small. Inflamed stomach & mesentery tissue	Bacterial pneumonia
F	SA	Spleen twice normal size. Inflamed pancreas	<i>Toxoplasma</i>
F	A	Widespread cellular necrosis & tachyzoites	<i>Toxoplasma</i>
F	A	Enlarged spleen. Pus in lower abdominal cavity and organs stuck to each other	Abscess in left groin
F	A	Enlarged spleen	Kidney infection
M	A	Lymphocytic infiltration around bile ducts. Suspect due to bacterial hepatitis/cholangitis leading to	Septicaemia
M	A	Multiple granulomas with Capillaria eggs & adult worms	Road kill
F	A	Multiple foci of necrosis with possible <i>Toxoplasma</i> schizonts in hepatocytes in margins	<i>Toxoplasma</i>
F	A	Enlarged & pale spleen. Necrotic foci, numerous <i>Toxoplasma</i> schizonts present	<i>Toxoplasma</i>

Reproductive system

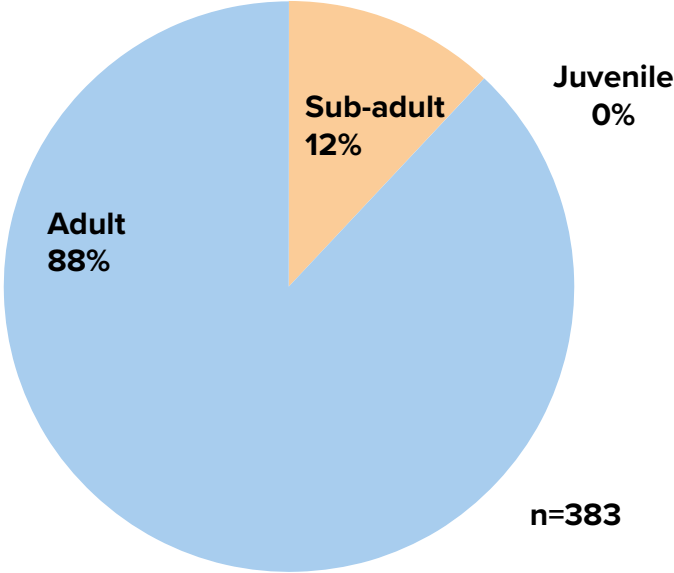
Pathology relating to the reproductive system is predominantly found in adults. Comments in the database generally apply to reproductive status but occasionally there is interesting pathology. Adult female road kills sometimes include pregnant animals with foetuses in various stages of development. Finding dead lactating females is particularly upsetting as, presumably, live kittens are left to starve. A total of 34 females presented for post mortem examination were pregnant, whilst 17 were lactating. Not all were road kills.

One adult female had extensive adhesions involving the abdominal organs and an unidentified mass in the peritoneal cavity. Histological examination showed the mass to be the necrotic remains of what was judged to be a foetus, which was possibly the result of an ectopic pregnancy.

Another squirrel had an enlarged, inflamed uterus containing the remains of a part-mummified foetus with trabecular bone evident. As autolysis had set in, the body was not suitable for further investigation. Both of these squirrels were examined by Vic Simpson (Simpson et al. 2013).



Reproductive system pathology.
Age breakdown



Four foetuses, nearly full term – three female, one male. The mother was attacked by a buzzard

Cause of death	Number	%
Cat/dog kill	21	5.5
Euthanised	6	1.6
Misadventure	5	1.3
Natural causes	82	21.4
Rat poison	9	2.4
Road kills	245	64
Undetermined	12	3
Wild predator	3	0.8
Total	383	

Table showing cause of death where the reproductive system is mentioned

A number of foetuses were preserved in formalin and later photographed to show development within the womb. It is interesting to note that they have different positions and expressions, even in the womb. The foetus on the far right was presumably full term as its sibling had been born shortly before the mother died. She had got into a water trough with steep sides and could not get out.



Foetuses in different stages of development. The discolouration is due to the preservation process

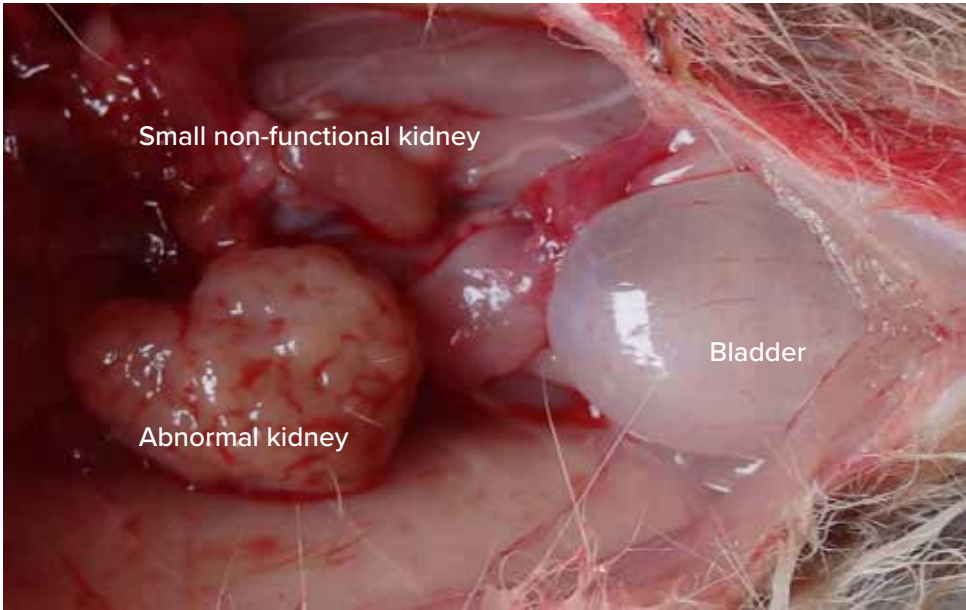
Sex	Age	Details	Final Diagnosis
M	A	Testes dropped. Blood on prepuce. Growth on testes. Vas deferens pale blue	Testicular cancer
F	A	Lactating. Found in netting around pond – strangled	Misadventure
F	A	Pregnant. Full-term foetus. One kitten born in water. Vulva distended. Died in water butt	Misadventure
F	A	Post lactating – or did milk dry up early? Kitten found in same place	Lung infection, possibly toxoplasmosis
F	A	Pregnant. Three embryos, approx. two weeks	Hepatitis
F	A	Uterus turgid. Greatly enlarged blood supply to reproductive system especially ovaries and distal end uterine horns	Splenic shock & paralytic ileus due to extensively pronounced oestrus or early pregnancy
M	A	Breeding condition. Vas deferens and sheath swollen and hardened	Undetermined
M	A	Inflamed prepuce	Severe ulcerative dermatitis associated with staphylococcal infection
M	A	Inflamed tip to penis/prepuce	Unidentified infection
M	A	Testes dropped. Blood on prepuce. Growth on testes. Vas deferens pale blue	Testicular cancer
M	A	Ulcerated scrotal lesion	Unidentified infection
M	SA	Warts on scrotum. Unidentified infection	
F	A	Pregnant, almost full term with one abnormal foetus that fell apart	Cat killed squirrel with unidentified infection

A sample of cases mentioning pathology of the reproductive system

Urinary system

The urinary system is mentioned in 229 cases, predominantly adults. Barbiturate damage after euthanasia and trauma due to impact with a vehicle are included in the figures. Abnormalities of the kidney include congenital defects and carcinoma.

Of the six animals euthanised, five sustained skeletal injuries, such as losing limbs in Fenn traps, and one squirrel had an abscess. Five cases where the kidney is mentioned in the pathology report are due to barbiturate damage. Also, one squirrel had scattered, small infarcts indicative of an earlier bacterial infection.

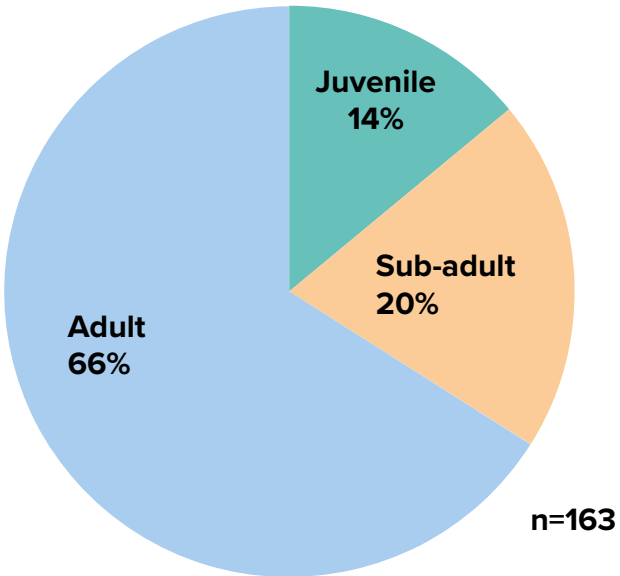


Abnormal kidneys in a juvenile

Cause of death	Number	%
Cat/dog kill	11	6.5%
Euthanised	4	2%
Misadventure	3	2%
Natural causes	83	51%
Rat poison	6	4%
Road kill	45	28%
Undetermined	11	6.5%
Total	163	

Table showing cause of death where the urinary system is mentioned

Urinary system pathology. Age breakdown



Sex	Age	Details	Final Diagnosis
F	A	30g fat around kidneys. Euthanised due to injury	Road accident injury
F	A	Abnormal growth on kidney. Pregnant. Poor condition	Cat kill
F	SA	Abnormal left kidney. Multiple abnormalities to organs	Natural causes
F	A	Abnormally small kidneys covered in fat. Poor condition	Cat kill
M	A	Bladder hard one end & thickened throughout. Growth & blood where it joins urethra	Cancer
F	A	Bladder thickened & empty. Enlarged kidneys	Unidentified infection
F	A	Excess fat around kidneys	Unknown cause
F	A	Fat covering kidneys. Inside of kidney appeared abnormal	Cat kill
M	SA	Foreign body attached to kidney. White, oval 1mm x 4mm	Unidentified endoparasite
F	A	Kidneys abnormal	Natural causes
F	A	Kidneys abnormally small	Gut infection or parasites
F	A	Kidneys approx. 50% larger than normal	Natural causes
F	A	Kidneys soft & spongy	Septicaemia
M	A	One pole of left kidney pale with mottled appearance. Enlarged spleen	Unidentified infection
F	J	Only one kidney and that was abnormal	Anaemia and kidney failure
F	A	Pustules on kidneys	<i>Toxoplasma</i>
M	A	Connective tissue around kidneys inflamed	Bacterial pneumonia

A sample of cases mentioning pathology of the urinary system



Excess fat (30g) accumulated in the lower abdomen of the road accident injury victim mentioned in the table

Endocrine system

The endocrine system is regulatory and comprises the hypothalamus, pituitary gland, thyroid glands, thymus, parathyroid, pancreas, adrenals and gonads. The hypothalamus and pituitary glands were not examined during basic post mortem examinations and the head was generally too badly damaged in road kill victims in any case. The gonads are discussed in the reproductive system section.

Enlarged adrenals are generally seen in stressed squirrels, often in animals picked up by humans, cat kills, rat poisoning, bird attacks and sometimes road kills. Not all squirrels are killed outright when in collision with a car.

‘Abnormal’ in the table relates to inflammation or discolouration. In one case of euthanasia, the barbiturates used had damaged the adrenals and the pancreas.

In one squirrel, fat deposits surrounded the adrenal glands. On the rare occasion fat deposits were found, they were generally around the kidneys or in the lower abdomen.

Details	Number	%
Enlarged adrenals	89	78.8%
Enlarged pancreas	12	10.6%
Abnormal adrenals	3	2.6%
Abnormal pancreas	9	8%
Total	113	

Table giving statistics relating to the adrenals and pancreas

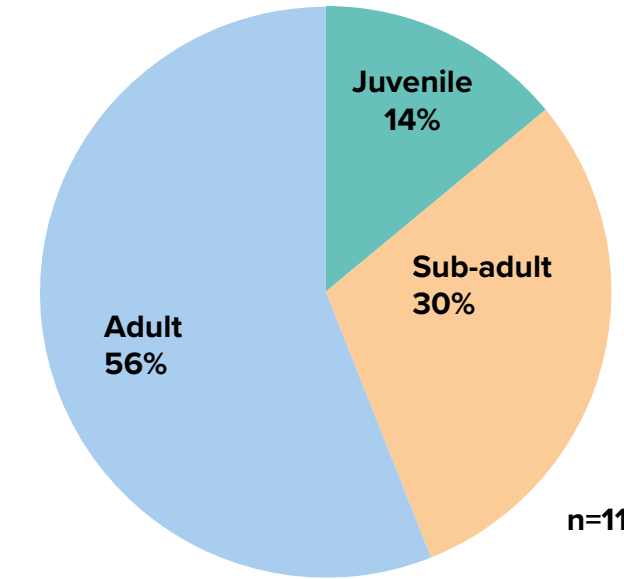
Cause of death	Number	%
Cat/dog kill	14	12
Euthanised	4	3.5
Misadventure	2	2
Natural causes	65	57.5
Rat poison	4	3.5
Road kill	21	18.5
Undetermined	2	2
Wild predator	1	1
Total	113	

Table showing cause of death where the endocrine system is mentioned



Fat accumulated around kidney

Endocrine system pathology. Age breakdown



Chapter 4

CAUSES OF MORTALITY AND MORBIDITY IN MORE DETAIL

Introduction

This chapter goes into more detail regarding causes of mortality and morbidity, especially where laboratory testing has found pathogens. Some of the content is taken from scientific papers written on the subject and then simplified for this report. The papers can be found online and are listed at the end of this chapter. Anthropogenic causes of death are also discussed in closer detail.

With over 800 cases in the post mortem spreadsheet, just a few examples have been selected to illustrate some of the more interesting pathology. Hundreds of pictures have been taken but the earlier photos were lost during several computer breakdowns. The photos, although graphic, are cropped and cleaned up so that they are not too disturbing. It was tempting to include pictures that were more graphic but as this report is aimed at the general public, not just the scientific community, it was decided not to.

It's frustrating that cases where pathology is found often cannot be investigated further. Once laboratories started to close, due to funding cuts, it was much more difficult to reach a firm conclusion regarding cause of death. Instances of several interesting cases are documented in detail, with photographs, but there are no conclusions. There is much more information contained in the database but without the ability

to test samples, a lot of questions will remain unanswered.

A way forward may be to purchase a kit to extract DNA and test samples using the polymerase chain reaction (PCR) method. These kits are now available in small enough units to take into the field. There is little point carrying on with post mortem examinations without some means of testing.

Ears are commonly taken from dead red squirrels and kept frozen for future requests from labs or any opportunities Wight Squirrel Project may have to further our knowledge of red squirrels on the Isle of Wight. It's thanks to the general public that tissue collection has been so successful. Wight Squirrel Project funds the provision of the samples for universities and labs by paying for transport to pick up dead squirrels and the cost of post mortem equipment.

ADENOVIRUS

The only sign of adenovirus infection in red squirrels is diarrhoea, which is also a clinical sign of other infections; therefore adenovirus can only be confirmed by laboratory testing. As far as we know, adenovirus is usually fatal.

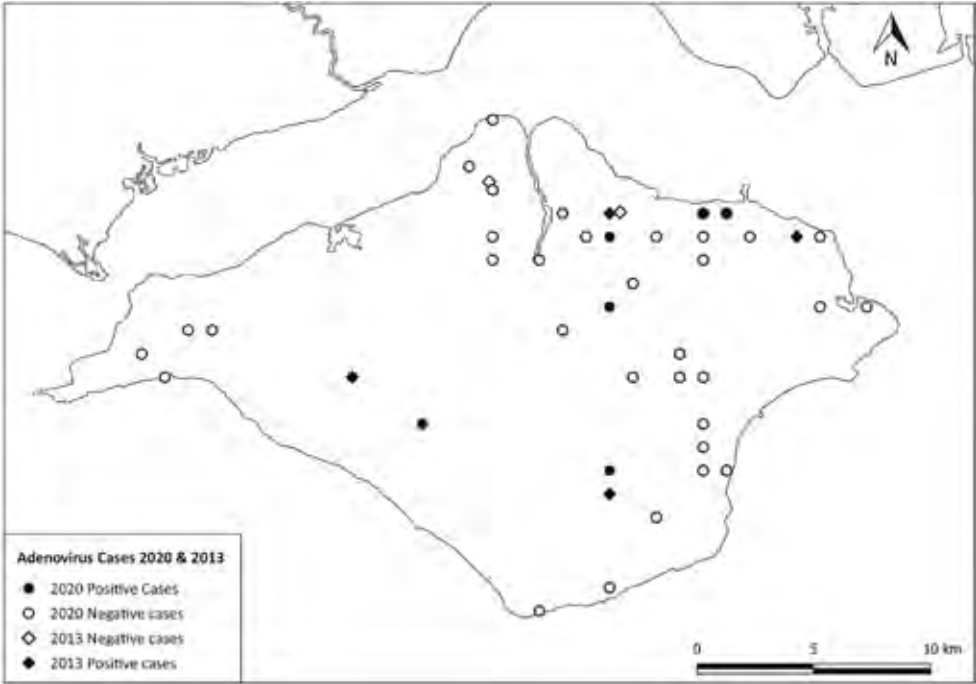
When the author was approached by Dr David Everest to supply intestinal samples and then DNA samples for studies to look for adenovirus and squirrelpox virus in red squirrels on the Isle of Wight, it was a good opportunity to find out the status of adenovirus in the red squirrel population and confirm that squirrelpox virus was not present. Squirrelpox virus is transmitted to red squirrels from grey squirrels, so it would be alarming to find a positive case. The samples did test negative for squirrelpox virus.

Adenovirus infection was first identified in 1997 in red squirrels that had died following a translocation programme on the mainland. Post mortem examination showed signs of enteritis and splenitis (Sainsbury *et al.* 2001). Cases from wild red squirrels and those in a captive breeding programme continue to be found. Spleen samples were taken from squirrels that had died of trauma, such as road kills. The samples were tested using a PCR assay for amplified viral DNA (Everest *et*

al. 2012), specifically designed to detect squirrel adenovirus.

In 2013 samples from 20 animals picked up dead on islands (Jersey: 12, Isle of Wight: 7, Brownsea Island: 1) were examined by the PCR methodology and nine (45%) were found to be positive for squirrel adenovirus DNA, with four of these coming from the Isle of Wight. The results confirmed the existence of adenovirus among red squirrel populations that had no contact with grey squirrels. Also, it's possible that adenovirus may have been present in these island populations historically, as obvious clinical or pathological signs are not readily observed in living animals (Butler, Blackett & Simpson, unpublished data).

In 2020, 50 samples of previously extracted DNA were sent to Dr David Everest to test for adenovirus and squirrelpox virus. No evidence of squirrelpox virus was found, which was expected as grey squirrels are absent from the Isle of Wight. However, some 14 per cent of animals tested did show as positive for adenovirus.



Map showing locations of red squirrels tested for adenovirus on the Isle of Wight

Map courtesy of Dr David Everest

HEPATOZOON, BORDETELLA AND BRONCHOPNEUMONIA

Red squirrels and other vertebrates, including other mammals, reptiles, amphibians and birds, suffer from a range of lung infections and among them *Hepatozoon* species. The vertebrate host ingests an infected vector, often an arthropod, and so the life cycle of the *Hepatozoon* begins. In August 2006 the *Veterinary Record* published a paper describing a *Hepatozoon* species found in the lungs of red squirrels on the Isle of Wight (Simpson *et al.* 2006).

Schizonts in tissue is a sign of infection, then gamonts are released, infecting cells in the haemolymphatic system. Arthropods then feed on a dead infected vertebrate host, completing the life cycle (Smith 1996)

Eighteen samples from Isle of Wight squirrels with lung pathology were sent for testing. Of these, 13 had lesions in the heart, liver, kidneys or spleen as well as the lungs. Not all of these species were *Hepatozoon* but a study in grey squirrels by Davidson & Caplin (1976) suggested that immune responses may be weakened by *Hepatozoon* infection, allowing other infections to take hold. If it does apply to grey squirrels, it could apply to red squirrels as well.

Large ovoid protozoal-type schizonts were present in the lungs, in some cases in very large numbers, generally in the alveolar walls or capillaries. Vic Simpson carried out histopathology on samples and concluded:

‘Generally, there appeared to be minimal inflammatory response to the schizonts, although in several cases the alveolar walls were thickened and oedema and fibrosis were present. It was noticeable that none of the five juveniles examined carried the infection but there were schizonts in seven of the 11 sub-adults and 11 of the 33 adults.’

There was a significantly higher prevalence of *Hepatozoon* species infection in squirrels found dead in gardens (75%) but fewer in animals that died in road traffic accidents (26%). Additionally, in 2003, bronchopneumonia was confirmed in two squirrels that died in gardens where they could access the same squirrel feeders. Before this study, bronchopneumonia does not appear to have been recorded in red squirrels. There was also a heavy *Hepatozoon* infection. Almost identical lesions were observed in a second case that died concurrently in the same garden; similar lesions, although with heavy neutrophil infiltration, were seen in a third concurrent case at the same location. Neither of these last two cases was examined bacteriologically (Simpson *et al.* 2013b).

TOXOPLASMA GONDII

Toxoplasma gondii is an intestinal coccidium which parasitises the cat family as definitive hosts. *Toxoplasma* can also cause serious disease in other species, including humans. A range of intermediate hosts include red squirrels. *Toxoplasma gondii* may be transmitted through eating uncooked infected meat, congenitally and via faeces (Dubey 1996).

The most likely way our red squirrels are contracting toxoplasmosis is from domestic cats. The parasite produces spore-like bodies called oocysts, which live in the intestines of cats. The oocytes are then passed out in the cat’s faeces. If an infected cat defecates in a woodland or garden and a squirrel digs for cached food in the same area, then the infection may be picked up. Given the amount of development in or adjacent to woodland, plus the number of squirrels feeding in gardens, it’s unsurprising that there is so much

lung pathology in Isle of Wight red squirrels.

Details of four cases in Isle of Wight red squirrels sent for testing are included in a paper by Simpson *et al.* (2013b). Once it was established that toxoplasmosis was causing squirrel deaths, further testing was not carried out on suspect tissue. Numerous deaths attributable to pathology in the respiratory system were not tested and it is highly likely that *Toxoplasma gondii* contributed to these deaths as well.

Vic Simpson, the veterinary pathologist who led the study, explained: ‘The parasite lives in the intestines of cats where it produces spore-like bodies called oocysts. These are passed out in the cat’s faeces. Squirrels become infected by foraging in contaminated areas, such as gardens.’ *Toxoplasma* can also cause serious disease in other species, including humans.



Caching food in a garden that cats frequent

MYCOBACTERIUM LEPROMATOSIS (LEPROSY)

Mycobacterium lepromatosis infection was first diagnosed in red squirrels on the Isle of Wight in 2015. Two squirrels which had unusual ear and skin lesions were tested using PCR analysis (Simpson *et al.* 2015). The first of the two confirmed cases of leprosy had died in 2004 and the second in 2011.

The discovery of *M. lepromatosis* in Isle of Wight red squirrels in 2015 was unexpected but answered the question as to the cause of some very nasty skin lesions observed over the years.

The infection persists at a low level in the Isle of Wight red squirrel population and has almost certainly been present on the Island for many years, although it is rare to see a red squirrel on the Isle of Wight with the pinna or skin lesions characteristic of squirrel leprosy. It is therefore unlikely that leprosy is a significant cause of mortality, especially when compared with those of anthropogenic origin (Simpson *et al.* 2015).

A wild red squirrel with typical signs of leprosy was photographed by the author at Quarr in 2017. In the mid 1990s, a very sick squirrel was found at Quarr, captured and taken to the vet, who had no idea what was wrong with the animal. The squirrel died but at this time samples were not taken or bodies given a post mortem examination. Looking at a photograph of the animal, it is very likely that it was suffering from advanced leprosy. The squirrels at Quarr are thriving with no signs of an increase in

mortality due to disease from leprosy or other cause.

Leprosy testing was undertaken at Moredun Research Institute in Scotland using standard DNA extraction methods and tested by PCR for both *M. lepromatosis* and *M. leprae*. Given the possibility of leprosy, samples of ear tissue were soaked in ethanol so that level 2 laboratory conditions could be used rather than level 3.

The 92 animals tested originated from all areas of the Island and causes of death varied widely. Natural causes or cause unknown accounted for 33% whilst 67% could be linked directly to human activity (Butler *et al.* 2017).

None of the carcasses from which tissue samples were taken to Moredun Research Institute for testing presented with classic signs of either *M. lepromatosis* or *M. leprae* but it is known that a positive result may be detected when the animal is asymptomatic (Avanzi *et al.* 2015).

Only one animal of the 92 tested proved positive by PCR for *M. lepromatosis*. None proved positive for *M. leprae*. The carcass was of an adult male red squirrel which had died in 2016 in West Wight. The body was very badly damaged due to being hit by several vehicles; therefore, detailed examination was not possible. The head was macerated but it was possible to salvage pinnae tissue for this study. No visible signs of leprosy were detected on the pinnae.



Red squirrel with typical leprosy symptoms photographed at Quarr in 2017. The animal was not seen again



Photo taken at Quarr in 1996. The squirrel was taken to the vet and euthanised. The vet had no idea what was causing the lesions

Whilst this chapter was being written up, a squirrel with lesions resembling leprosy was caught and brought in for treatment. He was an adult male and had an abscess on his rear end plus swellings to his right ear and nose. He was treated with a broad-spectrum antibiotic and the abscess cleared up. Adult squirrels in particular get very depressed in captivity and the leprosy lesions would not cause him discomfort for a long time, so he was released on the advice of Natural England. Leprosy is in the population and has been for a long time. It also does not transmit easily as the low number of infected animals found over the years will testify.

A swab was taken for testing but a lab or vet could not be found who would take it. Not because it was leprosy but because it is very difficult to get anything tested due to cutbacks in funding and staff, although Wight Squirrel Project offered to pay.



Adult male with lesions suspected to be leprosy July 2022

STAPHYLOCOCCUS AUREUS AND FATAL EXUDATIVE DERMATITIS (FED)

In a study put together by the late Vic Simpson, the most important skin disease was a fatal exudative dermatitis, which is associated with *Staphylococcus aureus* infection (Simpson *et al.* 2011).

As well as infecting squirrels, and other animals, *Staphylococcus aureus* is a common bacterium which colonises human skin and mucosa, usually without causing problems, unless it enters the body via a wound for example.

There are strains that can be zoonotic. This could have implications for feeding squirrels if humans handle their food. It is advisable to wash your hands before putting food out for the squirrels, and also before handling a squirrel, which generally concerns only vets and carers.

Five squirrels were affected from the Isle of Wight and displayed exudative scabby lesions around the mouth and/or nose and occasionally the eyelids. Inflammation and sloughing of skin on the feet, as shown in the photographs, is also seen and is sometimes associated with ischaemic necrosis of digits.

Histological tests found that there was an exudative, ulcerative, necrotic dermatitis with epidermal hyperplasia and hyperkeratosis. In addition, numerous colonies of Gram-positive cocci were present both in the exudate and within intradermal pustules. Skin lesions cultured from four of the squirrels found *S. aureus*.

A further study (Fountain *et al.* 2021) found that, on the Isle of Wight, two out of three tested red squirrels with clinical signs of FED also carried *S. aureus*.

The paper speculated that red squirrels on the Isle of Wight – and Jersey – acquire *S. aureus* ST49 strains from another species, possibly bank voles or rats. The squirrels will then rapidly develop fatal disease. At present, there is little evidence of transmission of ST49 strains between squirrels.

In recent years, it is common to see at least a few squirrels with *S. aureus* or FED. If caught early enough, it can be treated with antibiotic and the animal released.



Typical lesions associated with FED



Sub-adult female with Staphylococcus aureus.

She was treated with antibiotic, recovered and was released

These case studies show results of the post mortem examinations, carried out by Vic Simpson, where *Staphylococcus aureus* and FED were found.

Case 1. In April 2008 a red squirrel showing skin lesions was found dead near Wootton in the north of the Isle of Wight. A basic post mortem examination was carried out and tissue samples, including skin, were retained in 10 per cent buffered formalin. Case 1 was a sub-adult female in fair condition and weighing 214g. The skin over the nose was blackish, irregular and encrusted with dry scabby material. No specific lesions were seen on gross examination of internal organs and the stomach contained food.

In October 2008 a further two similar cases were found on the same day. Both carcasses were submitted to the Wildlife Veterinary Investigation Centre, in Cornwall, for detailed post mortem examination.

Case 2. A sub-adult male weighing 213g was picked up sick in Totland. He was thin with a poor coat and a heavy flea burden. The prognosis was poor and the squirrel was euthanised. The lip on the right side of the mouth and the skin over the point of the chin were markedly swollen and partly covered by a brownish dried exudate. The left lip was also swollen and there was a focal, inflamed swelling, about 2–3 mm diameter, on the left upper eyelid. The ears were normal. The skin over the medial and plantar surface of both fore feet was sloughing and ulcerated. There was extensive skin loss over the plantar surface of the right hind foot and ischaemic necrosis of digits two, three and four. The prepuce was inflamed but the anus appeared normal. Examination of skin by low-power microscopy showed the presence of numerous mites in the fur adjacent to the ulcerated areas. These were particularly numerous on the muzzle. Examination of internal organs showed no significant lesions.

Case 3. This squirrel was also a sub-adult male and found dead in a wood near Northwood in the north of the Island. The carcass was moderately autolysed and weighed 244g. The coat was in poor condition and skin around the mouth and over the bridge of the nose was swollen and sloughing. Numerous mites, as seen in Case 2, were attached to the base of the hairs around the muzzle but there was also a small cluster of bright

orange mites attached to the skin. The skin over the medial aspect of both front feet was sloughing and mites were present in the adjacent hair. There was subcutaneous bruising around the right axilla and lower neck. Blood was present in the trachea and the left lung was congested. The stomach contained a small amount of mucoid material. The intestines and pancreas were unremarkable.

CANCER

Cancer was found in just four red squirrels that had a post mortem examination. Only one cause of death is given as a road kill with the remainder given as natural causes with cancer as a contributory or main cause.

Case 1. An adult female squirrel was caught in a garden in Freshwater in March 2017 and subsequently euthanised as she had a squamous cancer on her face. Squamous cancers are a type of skin cancer. This case is not included in Wight Squirrel Project data as the author did not see the animal. The animal was taken to Vic Simpson, who carried out the post mortem examination in Cornwall. Samples were sent to Moredun Research Institute and tested for leprosy but the tests were negative. Other tests run on wart-like growths on the ears were tested extensively and all the results came back negative.

In humans, over exposure to ultraviolet light is the most common cause of skin cancer, so it is no surprise it has not been documented in an animal that lives in shady woodland. An internet search did not find any research on cancer in red squirrels.

Vic Simpson’s report of the findings for this squirrel

The margins of the pinna of both ears showed marked orthokeratotic hyperkeratosis and epidermal hyperplasia. No other signs of a possible viral infection were seen and there was no significant inflammatory cell response. There were sections through a small number of unidentified ectoparasites, possibly mites, on the surface of the skin.

There were several epidermal ulcers with a sero-cellular crust over the muzzle surface within which there were numerous fungal forms and some colonies of Gram-positive coccal bacteria. The dermis beneath the ulcers was heavily infiltrated by inflammatory cells, mostly lymphocytes.

The outer surface of the cheek was composed of a sero-cellular exudate containing colonies of Gram-positive coccal bacteria and discrete masses of fungal structures. Beneath this there was a large mass of necrotic tissue adjacent to areas infiltrated with radiating cords of squamous epithelial cells. Morphologically the cells were typical of a neoplasm.

Two toes had lesions. One toe sample showed an area of necrosis and inflammation around the base of the nail covered by a sero-cellular exudate containing fungal elements and colonies of Gram-positive coccal bacteria. The other toe showed thickening of the epidermis associated with a superficial abscess.

Orthokeratotic hyperkeratosis: thickening of the skin
Epidermal hyperplasia: an abnormal increase in epidermal cells



Photo taken by John Craddock before the squirrel was caught



Photo taken by Vic Simpson prior to post mortem examination

Liver. The cytoplasm of many hepatocytes appeared vacuolated. Put very simply, the liver was compromised and not functioning well.

Kidney. There were multiple cortical foci of infiltration by lymphoplasmacytic cells and tubules that were dilated and contained acellular casts. Simply put, abnormal cells.

Samples of ear pinna, face skin, toes and spleen were examined by the author at Moredun Laboratory and tested by PCR for *Mycobacterium* sp but all proved negative.

Case 2. An adult male found dead at Duxmore in December 2008 was underweight (281g) but otherwise outwardly appeared normal. The adrenals were enlarged, the bladder full and stomach was full, although the faeces in the large intestine appeared hard. There was also an unexplained small white powdery deposit around his mouth. Testes were external and a substantial growth was found on the right testicle. Blood was found on the prepuce. The vas deferens appeared abnormally pale blue in appearance. The cause of death is given as testicular cancer.

Case 3. In January 2018 an adult male picked up dead in Wootton was found to have a growth in his caecum. Although there was food in the stomach and intestines, he was in poor condition. The spleen was enlarged, which suggested a possible infection, but no tests were carried out.

Case 4. An adult female killed on Firestone Copse Road in 2002 had classic injuries: a macerated skull, multiple limb fractures and internal haemorrhaging. At 340g her weight was good and, apart from the injuries, outwardly she looked normal. An internal examination, however, revealed congested non-purulent fluid in bronchi with recent thrombus in one artery.

The liver showed scattered foci of necrosis with inflammatory cells. In the digestive system, the lymph nodes were obliterated by invading tumour cells and an extensive tumour mass involving smooth muscle, mostly spindle types. Put simply, the cause of death was road kill but she did have cancer.

MISADVENTURE

Misadventure is a cause of mortality that does not involve a pathogen, domestic pet or wild predator or road kill. Road kills could be seen as misadventure but given the scale of this cause of death, it has its own category.

A squirrel was found dead after trying to access a tree hollow but by the time the body was found it had deteriorated too much for examination. The head and shoulders were inside the hollow and the rest of the body outside when the animal became stuck. Presumably it died of suffocation or starvation.

Electrocution seems an unlikely scenario but where there are unguarded electric transformers, squirrels are killed if they climb up the pole and sit on the unguarded coil. Two squirrels were reported killed from one garden plus one in Parkhurst Forest, one at Gurnard and one at Alverstone.

In May 2016, one unfortunate adult female squirrel in Cranmore fell from a feeder onto a pyracantha thorn in the bush below. She had puncture wounds to the lungs from the 2-inch thorns and internal haemorrhaging filled the body cavity. She was post-lactating and had a full stomach. The feeder was moved.

Water butts, ponds and garden netting are obvious hazards and precautions should be taken to minimise risk to all wildlife. Although red squirrels are good swimmers, they can become exhausted and die. Figures are given in a previous chapter.



The second squirrel found dead after climbing this transformer



A squirrel drinking from a water butt protected with wire so there is no danger of falling in

ROAD KILL LESIONS

Impact lesions due to vehicles vary from a glancing blow that may result in recoverable concussion, to head maceration and multiple injuries to all body systems. Very rarely are squirrels actually ‘run over’. This would lead us to believe that the squirrel hit the vehicle head on. Given the size of a red squirrel, it would actually be difficult to hit a fast-running animal mid-body. Red squirrels appear to use different tactics to cross a road, some will run fast, while others dither and run backwards and forwards. For an animal that has evolved to run fast through branches, crossing a road and avoiding traffic would seem alien to them.

Where people feed squirrels in the garden on opposite sides of a road, inevitably there are road kills as a squirrel’s instinct tells it to forage in more than one place if the food is readily available.

The autumn is a peak time for road kills as the young are dispersing and squirrels are foraging for hazelnuts on the side of the road. Occasionally a squirrel has died on the road with a hazelnut firmly gripped in its mouth. Isle of Wight roads are narrow and many have hazel growing on roadside banks, providing good but dangerous foraging for the squirrels.

Higher numbers of road kills in adults is predictable as adults are seen all year round but sub-adults are dispersing spring and autumn and this is when the road kill numbers peak. Only 14% of all reported road kills are presented for post mortem examination, so bodily condition, gender and age are not known for the majority of squirrels.

There are certain injuries common to road kills, as given in the graph below. Apart from one instance

of prolapsed testes and one of the intestines, the remainder of cases involving prolapse are prolapsed eyes.

Displacement of organs is not uncommon and can range from all organs (although rarely the kidneys) to the lower intestines being forced in between the muscle and skin in the thigh. Unsurprisingly, internal bleeding is common in these cases and is the most prevalent non-skeletal injury in the graph.

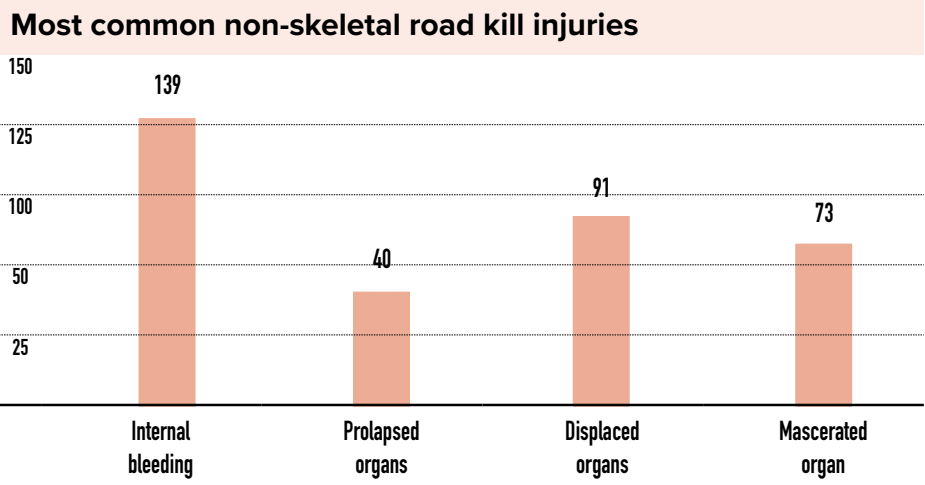
Skeletal fractures, especially of the skull, are the most common injury as the tables show. The ribcage is pliable and rarely damaged, even though the lungs may be, as they are a soft organ.



Prolapsed eye



A road kill black spot where squirrels are killed foraging



The graph and tables show statistics relating to injuries caused by impact with a vehicle.

Tables showing breakdown of skeletal injuries due to road traffic accidents involving sub-adult and adult red squirrels. Data from post mortem examinations only.
Thank you to Chantelle Biggs for compiling the tables from the spreadsheet

Sub-adult road kills	Injury	Number
Head	Fractured skull	27
	Skull macerated	18
	Tooth breakage, loss or abnormality	4
Vertebrae/Neck	Dislocated cervical vertebrae	1
	Fractured cervical vertebrae	2
Legs/Joints	Fractured hind limbs	4
	Fractured fore limbs	4
	Bone exposed foreleg	1
Thorax	Thoracic maceration	1
Less specific injuries	Limb fractures	3

Adult road kills	Injury	Number
Head	Fractured skull	149
	Skull macerated	123
	Fractured jaw	5
	Displaced jaw	1
	Tooth breakage, loss or abnormality	12
Vertebrae/Neck	Fractured cervical vertebrae	10
	Severed cervical spine	1
	Fractured lumbar vertebrae	2
	Fractured thoracic vertebrae	3
	Spinal fracture	2
	Broken neck	2
Legs/Joints	Fractured hind leg/ankle	25
	Muscular damage to hind leg	1
	Trauma to hind leg	1
	Dislocated hind leg/foot	6
	Missing hindquarters (Predation)	1
	Fractured foreleg/ankle	13
	Muscular damage to foreleg	1
	Dislocated foreleg/hand	2
	Fractured hip	1
Thorax	Dislocated shoulder	1
	Fractured ribs	9
	Hole in ribs	1
	Thoracic muscular lesion	1
	Fractured collarbone	1
Pelvis	Dislocated collarbone	1
	Fractured pelvis	3
	Separated pubis symphysis	1
Less specific injuries	Tail lesion	2
	Limb fractures	2
	Multiple fractures	3

n= 342
Male 178
Female 164
Note: Some adults sustained injuries to more than one part of the body, hence the numbers in the table are higher than the total of animals

CONGENITAL ABNORMALITIES

Only 11 cases out of 813 had congenital abnormalities. The cases are spread over the Island, so there is no obvious ‘hotspot’. These animals are generally found in gardens, or at least somewhere near human habitation, rather than in the woods. The kidneys and bones appear to be the most prone to congenital abnormalities. The cases are outlined below. Tests for pathogens were not carried out.

Case 1. A thin female, assessed as an adult or well-grown sub-adult. Shin length was measured at 70mm. She was brought in alive from a garden in Godshill in May 2014. Musculature was poor and she had a heavy flea burden.

The heart was enlarged and she was anaemic. The lungs were excessively inflated and very pale. The adrenal glands were enlarged. The empty stomach was distended with gas, as were the intestines. Faeces in rectum were normal.

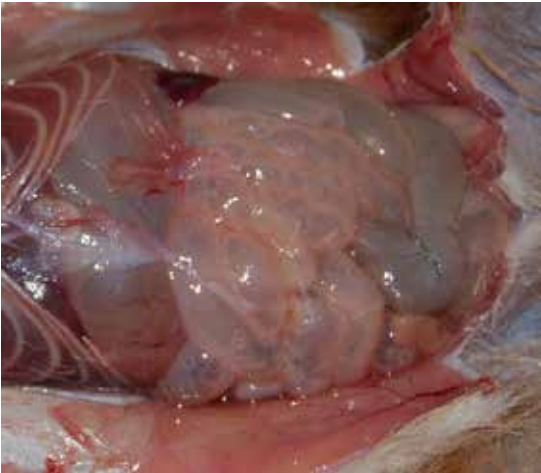
The only incisor had grown through the lip into the nasal cavity. There was no sign of any other incisors, so presumably they had not broken off. It is odd she survived to this age with a tooth abnormality.

Case 2. A sub-adult female, described as thin, although the stomach was full and digested food found in the intestines, was found dead in Alverstone in February 2017. The left ear was severed 5mm laterally and she had a heavy flea infestation, with flea droppings throughout the coat.

The liver was abnormally soft tending towards gelatinous. The spleen was described as semi-gelatinous.

Abnormal left adrenal. Abnormal left kidney. A lower incisor was missing, that is, not growing and no root found rather than the tooth was broken.

Case 3. In May 2010 a female juvenile from Appuldurcombe with curvature of the spine was brought in. She had a bony growth on the right side of her skull which pressed on the brain. The mouth and teeth were also twisted and she was blind in the left eye. The adrenals were greatly enlarged. She was euthanised due to congenital abnormalities.



Gas in the intestines



Overgrown tooth in case 1



Missing tooth in case 2

Case 4. A juvenile picked up alive in Wootton during June 2011. He died shortly after. The bladder, stomach and intestines were full and the internal organs were unremarkable. He couldn't move his rear end and his head leaned to the left. A post mortem examination revealed curvature of the spine.

Case 5. A juvenile female picked up alive in a garden in Ryde in 2013 was found to have hip dysplasia and subsequently euthanised. The socket measured 14.75mm but the ball was too small to engage with the socket, immobilising the back legs. She also had lesions on her hind legs. She had difficulty urinating and the post mortem examination found the bladder was compressed due to an abnormally small lower abdominal cavity.

Case 6. In May 2016 a thin female juvenile squirrel was found dead in Cranmore. She was carrying a heavy flea burden and showed signs of anaemia. The stomach was abnormally thin-walled and had burst. She had one very small non-functioning kidney and the other was abnormal and unlikely to function properly.

Case 7. A sub-adult male found in Borthwood Copse in November 2008 had only one very small kidney. His body was found in a barn with its head chewed and a puncture wound to the near-side thoracic region. The near foreleg had been severed at the elbow but had healed. The off-side hind leg was missing altogether. It's possible he was a Fenn trap victim.

Case 8. In 2003 an adult male killed by a predator, probably a dog, as evidenced by puncture wounds and internal injuries, was found in Binstead. His abnormality, a small odd-shaped stomach with a leathery texture, is discussed and illustrated in the previous chapter. Due to the predator attack, he had a subcutaneous oedema and internal haemorrhaging. The lungs and liver were macerated. Three toes were broken on the near hind foot.



Squirrel with hip dysplasia



Although a squirrel with 'stumpy' tail has never been brought in, a frame from a video shows this adult female's unnaturally short tail. She went on to have young, some of whom also had a 'stumpy' tail. It is very rare but occasionally one is reported from West Wight, where this female was filmed, and also in East and central Wight. As these squirrels grow to adulthood and breed, it's unlikely that the lack of a long tail, used for balance, affects them enough to compromise survival.



Map showing where squirrels with 'stumpy' tail were found

FENN TRAP INJURIES RELATING TO RED SQUIRRELS

In spring 2003, two squirrels were reported with limbs missing. These animals had one functional fore limb each, the remaining limbs were either missing or severely damaged. The first was in a residential area in Alverstone, in the east of the Island. The second was in a garden in Ningwood a day later. Both were caught and euthanised.

Both bodies were frozen and taken to Vic Simpson in Cornwall in June. Vic said these were the worst trap injuries he had seen and probably caused by a Fenn trap. Findings are given in the tables below.

Alverstone

- Sub-adult female, 174g in weight, thin but had full stomach
- Liver: Scattered small infarcts indicative of earlier bacterial infection
- Off-side foreleg: Severed at carpal joint. Tissue necrosis proximally and then healing muscle
- Near-side foreleg: Abrasion and hair loss proximal to carpal joint. First digit missing
- Off-side hind leg: Tissue necrosis lower off-side tibia, bone exposed to tarsal joint, foot necrotic, toe bones amputated laterally
- Barbiturates had damaged heart and lungs

Ningwood

- Sub-adult female 220.75g in weight and with fat reserves
- Off-side foreleg: Normal
- Near foreleg: Tissue healing but proximally amputated at carpal joint
- Off-side hind leg: Amputated at lower tibia, tissue healing over stump
- Near hind leg: Healing fracture of tibia with callus formation proximal to tarsal joint, open ulcer on anterior aspect, localised tissue swelling
- Full stomach. Intestines autolysed due to freezing



Fenn trap Photo: Vic Simpson



Alverstone squirrel

Further reports followed. Squirrels are often killed between Shalfleet and Yarmouth but these were the first amputees reported. The wounds had healed well.

In January 2006 a sub-adult male was picked up as a road kill in Shalfleet. The near hind foot was amputated and had healed. Then in February 2006 an adult female was killed on the road at Bouldnor. All toes were amputated on the off-side hind leg. This was an old wound which had healed. In spring 2006 a squirrel with two legs missing from the same side, plus two other squirrels, each with one foot missing, visited a garden in Ningwood. These squirrels were never caught.

The police tracked down the source of the traps and spoke to the landowner and, thankfully, there have been no further reports from this area. However, as publicity went out, two other reports of squirrels with missing limbs were received from the Wootton area. It wasn't the same squirrel as the injuries were different. The traps had probably been put down by a householder with a rat problem. Natural England and the police were informed. These squirrels were not caught.

In November 2008 a sub-adult male squirrel was found in a barn at Borthwood. The near foreleg was severed at the elbow but healed and the off-side hind leg was amputated. The head was chewed and he had a puncture wound in the near-side thoracic region. He had an empty stomach and one abnormal kidney. It's likely that a predator took advantage of a weakened animal.

In June 2010 a sub-adult female weighing 227g was found in Ningwood with exposed bones on all four feet and halfway up all four legs. She was euthanised.

In 2017 a squirrel with an amputated foot was reported in a Porchfield garden. Also in Porchfield, another squirrel with two limbs amputated was filmed. Neither of the squirrels was caught. The squirrels with one or even two limbs missing did adapt but losing three limbs was too much to adapt to.

Fenn traps are legal and used to catch vermin such as rats. There are serious welfare issues associated with Fenn traps, and any other trap. They can be fatal to red squirrels – and



Healed amputation on a road kill



Amputee at Ningwood 2006

other species of wildlife – some of which are also protected by law. Therefore, it is illegal to use traps or poison where a red squirrel can access it. This means putting the trap or poison underground and covering it in such a manner that a squirrel cannot get to it.



Map showing location of Fenn trap injuries

RAT POISON

Four cases mention rat poison but this is only confirmed if tests are made and lesions suggestive of cholecalciferol rodenticide poisoning are detected. Death by rat poison has been attributed to ten adults and two sub-adults.

The only squirrel tested showed extensive mineralisation of the proximal tubule basement membranes and mineralised castes in the medullary tubules but no significant inflammatory reaction; in sections stained by Von Kossa stain the mineralised deposits proved positive for calcium ions (V. Simpson *et al* 2013).

Subsequent suspected cases were diagnosed by eye. Thinned dark blood seeping out of all organs and pooling in the body cavity strongly suggesting a blood-thinning agent had been ingested. A classic sign, before confirmation by post mortem examination, is the squirrel lying flat on it's stomach with limbs outstretched and fists clenched in agony. Another outward sign of ingesting an anti-coagulant is blood around the eyes.



Clenched fist typical of red squirrel dying of rat poison. They are always found lying stretched out on their stomachs



A typical sign of ingesting anti-coagulant is blood around the eyes



Map showing locations where squirrels died of rat poisoning

ABSCESSSES

Abscesses can occur when a bite, or other trauma breaking the skin, becomes infected. An abscess manifests as a pus-filled cavity beneath the surface of the skin and forms when the tissue encapsulates the infected area. If caught early enough, draining the pus away and giving a broad-spectrum antibiotic clears up the infection and the abscess will heal. If an abscess is not treated early on, then it can infect surrounding tissue, including bone, eroding it away.

The rear end and face are the most common places red squirrels on the Isle of Wight are found to develop abscesses. Here are a few examples.

Case 1. In July 1995 a thin adult female found dead in Ningwood was sent away for a post mortem examination at London Zoo, courtesy of Dr Tony Sainsbury. She had multiple health problems, including abscesses, leading to septicaemia.

Lungs: Patchy congestion

Liver: Necrotic yellow area approx 5mm diameter. Remaining liver, pale.

Adrenals: Enlarged 9.55x4mm

Kidneys: Soft and spongy

Uterus: Large and engorged

Digestive system: Food in stomach. Small intestine adhered to peritoneal wall: abscess here. Large masses of fibrinous exudate in abdomen. Necrosed rectum. Few contents in colon. Abscess between rectum and uterus

Skin: Few fleas. Some alopecia left shoulder/ back

Case 2. A thin adult female squirrel was picked up alive in a garden in Wootton during June 1997 and taken to the local vet. She had an abscess on her eye, which was removed. However, she was too debilitated to recover and died. Dr Tony Sainsbury also examined this squirrel.

Heart: Enlarged. Right ventricle wall very thin

Lungs: One area of consolidation

Uterus: Well developed

Spleen: Enlarged 39x11mm

Adrenals: 9.5x5 and 8.5x4mm

Malocclusion of incisors

Case 3. A sub-adult female was found dead in Fishbourne in September 2009. Her weight was normal.

Her head appeared enlarged due to a burst abscess on the near side of her face. Her tongue was pale and her lower right incisor fell out when her mouth was opened for examination.

Heart: Enlarged

Lungs: Left lung 30% consolidated

Spleen: Enlarged

Adrenals: Enlarged

Kidneys: Pale

Digestive system: Little food in stomach. Hard faeces in lower bowel

Skin: Fleas

Case 4. In September 2020 an emaciated sub-adult female was picked up alive in a garden in Shanklin and taken to the vet. She had a large abscess on her right jaw, which had eroded the bone away, so she was euthanised. Barbiturates had damaged the heart, lungs and liver. The spleen and adrenal glands were enlarged and she had food in her stomach.



An abscess which had eroded the jawbone

PARASITES

Carrying a flea burden (ectoparasites) is universal in red squirrels. The species of flea is *Ceratophyllus (Monopsyllus) sciurorum*. Experience has found that these fleas are very tough; they can survive at –20% in the deep freeze for up to a month. When defrosted, they start moving about and it takes a good dose of flea spray to kill them.

Sub-adults are most often found with anaemia due to a heavy flea burden. Sick adults, who are not well enough to build clean dreys, are also found with a heavy flea burden although, unlike sub-adults, anaemia is not the cause of death.

The only other ectoparasites that have been found on Isle of Wight red squirrels are mites and one tick. One post-lactating female squirrel killed on the road in 2017 in Brighstone had both.

Sarcoptic mange is caused by tiny mites (*Sarcoptes scabiei*) and not often found in red squirrels on the Isle of Wight. One juvenile female brought in sick in 2015 did have mites and was successfully treated with a fluid bought from the pet shop and meant for hamsters with mites. The hair did grow back and she was released back into the wild when she was around 14 weeks old.

The photograph shows a tick found on the post-lactating female mentioned above and remains the only tick found to date.

Evidence of mites was found in two cases sent for histological examination by Vic Simpson. The most interesting of these cases was a sub-adult male found dead in Northwood. The squirrel was suffering from exudative dermatitis associated with *Staphylococcus aureus*. Parasitological examination found three types of mite on the face and feet. The majority of these were *Dermacarus sciurinus* nymphs. Harvest mite larvae *Neotrombicula autumnalis* were also found plus an unidentified mite.

Endoparasites are not easily identified and only samples sent to a lab for testing can be described with any accuracy. A sample of cases are outlined below.

Case 1. In May 1994 a sub-adult male found in Wootton was sent to the Veterinary Investigation Services for examination. He was thin and the left elbow had a subcutaneous oedema. Fleas and a bite just below the tail were also found.

There was blood in the pericardium and blood-stained fluid in the chest. The lungs showed patchy congestion in all lobes. *E. coli* and an unidentified bacterium were found in the respiratory system and the liver. In the digestive system yellow ingesta was evident. In the large intestine, the faeces were of semi-solid consistency. A large number of coccidial oocysts were found in the intestinal contents. Infected animals pass the oocysts (spores) in their faeces, from where another animal can pick them up. The species belonging to this parasitic family of protozoa live and reproduce in the host's cells.

Case 2. The whole carcass of a sub-adult female that was picked up alive in East Cowes, in 2019, was sent to the Animal and Plant Health Agency in Shrewsbury as adenovirus was suspected as the cause of death. She had produced a very smelly, wet ball of faeces which resembled a blackberry in size and appearance. The animal had been captured and brought in for treatment but died two days later. Her case is not included in Wight Squirrel Project's database.

The cause of death was not adenovirus but a heavy worm egg burden. A bacterial culture found a very heavy pure growth of *Clostridium sordellii*, which is commonly found in soil. The intestines were described as thin-walled and friable. The intestinal tract contained a thick brown liquid, some of it appearing slightly mucoid.



Post-lactating female with a tick and a mite



Juvenile female with mite infestation

UNUSUAL CASES

These are a selection of cases that may not be included in any papers, are particularly interesting, or unsolved.

This sub-adult female squirrel was found dead in Newchurch in December 2013. Her weight was normal for her size and there were no indications as to the cause of death until the body was examined internally, although she was carrying a large number of fleas. Some lung congestion was found and she had a little food in her stomach.

However, histology found that the kidneys, spleen, pancreas and adrenal glands were all heavily infiltrated with amyloid. Amyloid is an abnormal protein which, if it builds up on organs, can damage them. This was the first and – to date – only case of amyloidosis found on the Isle of Wight. There was also a degenerating mass of tissue which may have been a tumour.

An adult female picked up in Arreton in June 2009 was examined by Vic Simpson. She was thin (235.5g) and had poor musculature. She also had maggots in her fur, around the anus and vagina, where the tissue was missing. Her off hind leg had a dry disc-like body around 5mm in diameter attached to the skin.

Liver: Multiple fine irregular whitish lesions were found throughout the liver. Testing revealed a large number of nematode eggs typical of *Capillaria hepatica*. These were not numerous enough to be of clinical significance, however.

Adrenal glands: Focal subcapsular haemorrhage

Reproductive: Uterine horns long and convoluted

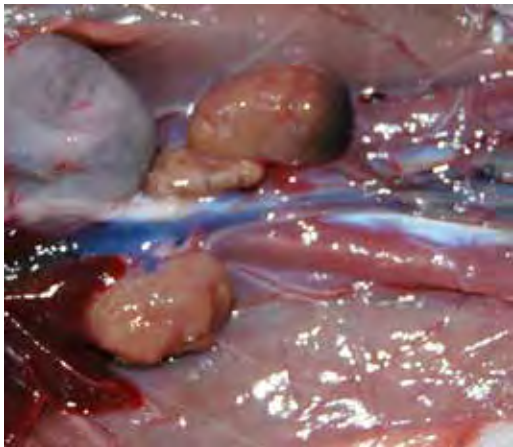
Digestive: Empty stomach. Intestines showed small nematodes resembling *Enterobius* sp. and a small number of coccidial oocysts

Skin: Facial abscess with heavy pure growth of *Yersinia enterocolitica* infection

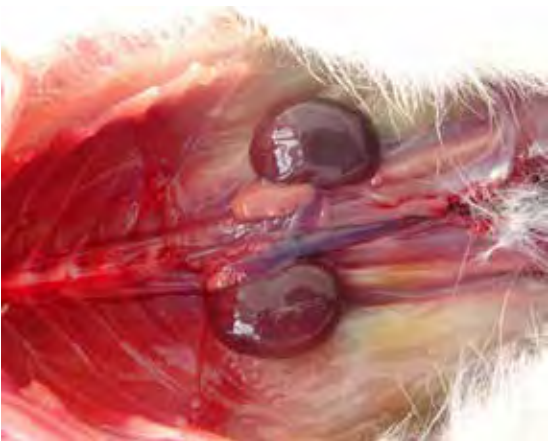
Summary and conclusions: She was an old adult. The right lower incisor was missing, which probably caused osteomyelitis in the right jaw. The most significant lesion was the large abscess on the right side of the face.

Capillaria hepatica is the one nematode that in the adult phase inhabits the liver

Yersinia is a genus of bacteria. Rodents are a reservoir of *Yersinia*



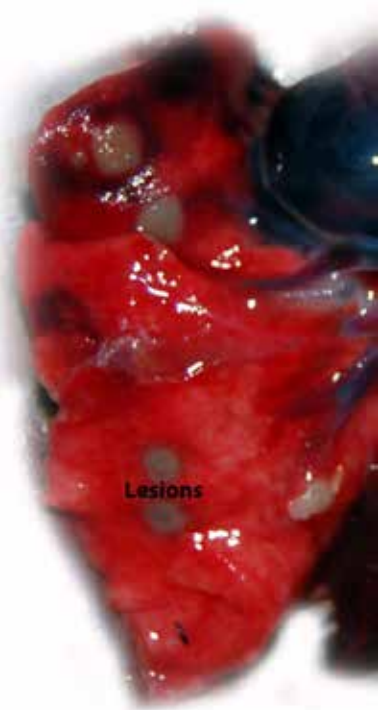
Amyloidosis and tumour on the kidneys



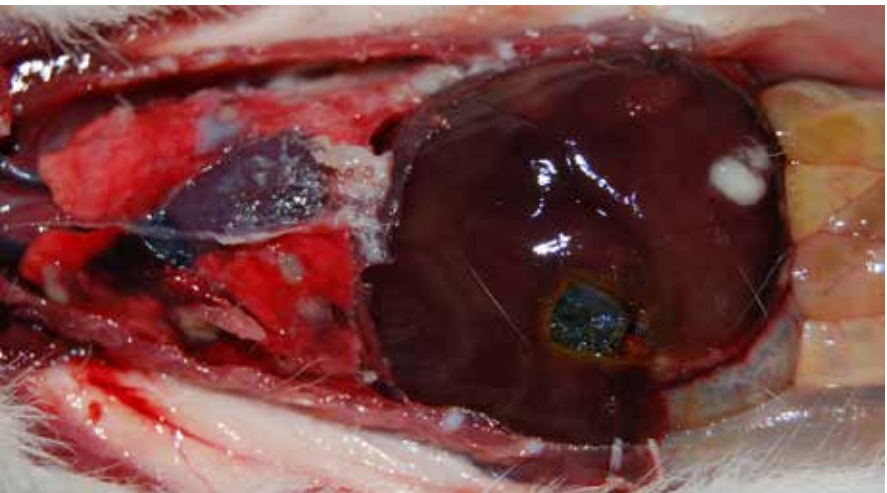
Normal, healthy kidneys

In July 2014 an emaciated sub-adult male was found sick in a garden in Blackwater and subsequently died. External examination revealed three fractured digits on the left foreleg and two on the off-side foreleg. Both radiocarpal joints were also fractured. Unsurprisingly, his muscle tone was very poor. His nose was swollen and one eye damaged. Warts were found on the scrotum and diarrhoea adhered to the anus.

Internally, the stomach was burst and a very sticky substance adhered to spleen, liver, heart and pancreas, making it very difficult to examine, or even separate, the organs. There were lesions of approximately 3mm in diameter on both lungs and a lesion 6mm in diameter on the liver. Although samples were kept for a while, frustratingly, no histology was undertaken. A vet did suggest it was a fungal infection as there was a sweet sickly smell upon opening the body.



Lesions on the lungs



Sweet-smelling sticky substance covering the organs



Forepaw lesions



Warts on the scrotum

Chapter 5

THE FUTURE?

This report is for future reference and a means of assessing how red squirrels on the Isle of Wight are coping with climate change, development and anything else that comes along. It is very apparent that squirrel numbers have increased, mainly thanks to the JIGSAW project joining up and extending woodland on the Island. Overall, they are doing well and the population is stable.

Research techniques have improved over the years covered by this report and we are now using genetics more than ever to find answers. As this report is in the finishing stages, a PhD student has been invited to test hundreds of tissue samples from squirrels brought in to Wight Squirrel Project for post mortem examination. The project is with Bournemouth University and funded by the IOW Area of Outstanding Natural Beauty and Wightfibre.

The study will use genomic tools to investigate the impact of supplementary feeding, which must aid survival. The question is whether or not there is a downside, given that some unsuitable food, such as peanuts, is consumed by the squirrels. The study will also investigate the long-term viability of the Isle of Wight population of red squirrels, including problems that may occur due to inbreeding where there are bottlenecks. Sometimes squirrels are brought in with genetic abnormalities but this applies to other species as well, including humans.

There is also the threat that climate change brings and it's impossible to predict the future accurately but given that the red squirrel population on the Isle of Wight has been here for thousands of years, the squirrels have shown their adaptability and tenacity to survive. It's been noticeable over the years that hazelnuts are ripening earlier. Starting in the early 1990s over time, the nuts have ripened earlier and earlier and over the last two years the squirrels have started eating the hazelnuts during the first week of July.

All research helps to build up a picture, including citizen science. Citizen scientists provide many

eyes covering the whole Island and alert us to any potential threats. Further survey and research on the ground builds on this information and laboratory and analysis work fine-tunes it.

The Isle of Wight provides important habitat for our native red squirrels, so grants to plant woods and hedgerows – and to look after them – are essential to the success of keeping a good population of squirrels. Development is ongoing and will encroach into woods. Keeping the Isle of Wight Red Squirrel Forum going and updating a red squirrel strategy for the Isle of Wight are also of prime importance for long-term conservation efforts.

Walking corridor routes will continue as will the bi-annual woodland walks and all-island woodland survey.

Camera traps can only be used for monitoring purposes where there is no public access as, from experience, the cameras are stolen. Hairtube surveys will continue as a way to obtain material for genetic testing.

Wight Squirrel Project is looking for suitable people to help with welfare of sick, injured and orphaned squirrels. This is not the easiest of jobs and the success rate is low. The right home conditions and time commitments are also a drawback for most people. It is not a cosy job and often heartbreaking. Without help, this part of our work will falter.

Keeping a high profile encourages people to report sightings and so keeps citizen science ticking over. We would like to expand on citizen science techniques and come up with new ideas. Any feedback or ideas are welcome. If you would like to help conserve red squirrels on the Isle of Wight, please go to the website www.wightsquirrels.co.uk and look at the list of volunteer opportunities. If you do not have time for volunteering, you can help our conservation effort by becoming a citizen scientist and telling Wight Squirrel Project when and where you have seen squirrels on the Isle of Wight.

Watch out for our leaflets and the annual newsletter. Leaflets are distributed around the Island and newsletters can be picked up at shows or read on the website. If you would like to become a 'Friend of the red squirrel', you can join via the website: www.wightsquirrels.co.uk.

To end this report, here are prettier pictures of red squirrels than those included earlier in part 3. It's a reminder of the charismatic nature of our native red squirrels and what we are striving to save. Red squirrels are second to none when it comes to the cute factor. Enjoy the pictures!





References

Avanzi, C., Del-pozo, J., Benjak, A., Stevenson, K., Simpson, V. R., Busso, P., McLuckie, J., Loiseau, C., Lawton, C., Schoening, J., Shaw, D. J., Piton, J., Vera-Cabrera, L., Velarde-Felix, J. S., McDermott, F., Gordon, S. V., Cole, S. T., & Meredith, A. L. 2016. **Red squirrels in the British Isles are infected with leprosy bacilli.** *Science* 354(6313): 744–747.

Butler, H. M., Stevenson, K., McLuckie, J., & Simpson, V. 2017. **Further evidence of leprosy on the Isle of Wight.** *Veterinary Record* 180: 407. doi: 10.1136/vr.j1920

Davidson, W. R., & Caplin, J. P. 1976. **Hepatozoon griseisciuri infection in gray squirrels of southeastern United States.** *Journal of Wildlife Diseases* 12(1):72–76. doi: 10.7589/0090-3558-12.1.72

Dubey, J. P. 1996. **Chapter 84: Toxoplasma Gondii.** In: Baron, S. (ed.), *Medical Microbiology*. 4th edition. University of Texas Medical Branch at Galveston, Galveston.

Everest, D. J., Butler, H., Blackett, T., Simpson, V. R., & Shuttleworth, C. M. 2013. **Adenovirus infection in red squirrels in areas free from grey squirrels.** *Veterinary Record* 173(8): 199–200.

Everest, D. J., Dastjerdi, A., Davies, H., Shuttleworth, C. M., Odgen, R., Butler, H., & Sapsford, B. 2022. **Non-invasive genetic studies and virus epidemiology.** *Veterinary Record* 190: 204–205.

Fountain, K., Blackett, T., Butler, H., Carchedi, C., Schilling, A.-K., Meredith, A., Gibbon, M. J., Lloyd, D. H., Loeffler, A., & Feil, E. J. 2021. **Fatal exudative dermatitis in island populations of red squirrels (Sciurus vulgaris): spillover of a virulent Staphylococcus aureus clone (ST49) from reservoir hosts.** *Microbial Genomics* 7(5): 000565. doi: 10.1099/mgen.0.000565

Sainsbury, A. W., Adair, B., Graham, D., Gurnell, J., Cunningham, A. A., Benko, M., & Papp, T. 2001. **Isolation of a novel adenovirus associated with splenitis, diarrhoea and mortality in translocated red squirrels, (Sciurus vulgaris).** *Verhandlungs Bericht über die Erkrankung der Zootiere* 40: 265–270.

Simpson, V. R., Birtles, R. J., Bown, K. J., Panciera, R. J., Butler, H., Davison, N. 2006. **Hepatozoon species infection in wild red squirrels (Sciurus vulgaris) on the Isle of Wight.** *Veterinary Record* 159: 202–205. doi: 10.1136/vr.159.7.202

Simpson, V. R., Blackett, T., Butler, H. M., Borman, A. M., Hargreaves, J., & Davison, N. J. 2012. **Respiratory disease surveillance in geographically remote populations of red squirrels (Sciurus vulgaris).** In: *Proceedings of the Joint 61st WDA/10th Biennial EWDA Conference “Convergence in Wildlife Health”, Lyon 23–27 July 2012*, p. 46. Lyon, France.

Simpson, V. R., Davison, N. J., Kearns, A. M., Pichon, B., Hudson, L. O., Koylass, M., Blackett, T., Butler, H., Rasigade, J. P., Whatmore, A. M. 2013a. **Association of a lukM-positive clone of Staphylococcus aureus with fatal exudative dermatitis in red squirrels (Sciurus vulgaris).** *Veterinary Microbiology* 162: 987–991. doi: 10.1016/j.vetmic.2012.10.025

Simpson, V. R., Hargreaves, J., Butler, H. M., Davison, N. J., & Everest, D. J. 2013b. **Causes of mortality and pathological lesions observed post-mortem in red squirrels (Sciurus vulgaris) in Great Britain.** *BMC Veterinary Research* 9: 229. www.biomedcentral.com/1746-6148/9/229

Simpson, V. R., Hargreaves, J., Butler, H. M., Blackett, T., Stevenson, K., & McLuckie, J. 2015. **Leprosy in red squirrels on the Isle of Wight and Brownsea Island.** *Veterinary Record* 177(8): 206–207. doi: 10.1136/vr.h4491

Smith, T. G. 1996. **aHepatozoon (Apicomplexa: Adeleina).** *Journal of Parasitology* 82(3): 565–585.

Acknowledgements

This is a list of the people who helped this report to progress faster (it still took nearly three years) by typing out old reports, sorting data, running graphs, teaching QGIS, reviewing the document, providing photographs, giving permission for copyright use, proofreading, or offering advice. Many thanks to you all.

- Lisa Banfield (Wildheart Animal Sanctuary)
- Chantelle Biggs
- John Craddock
- Dr Marin Cvitanovic
- Dr David Everest
- Beth Greaves-Jones
- Dr John Fishman
- Dr Emilie Hardouin
- The late Canon Michael Hodge
- Kevin Hutchby
- The late Dave Maidment
- Professor David Martin OBE
- Pat Ready BA PhD
- Ian Rennie
- Joel Rowlands
- Marina Rupp MA
- Jane Simpson
- The late Vic Simpson
- Simon Walker
- Jacquie Wilson
- Bob Wilson
- Sally Wiltshire

- Thanks also to:**
- AONB
 - Bournemouth University
 - English Heritage
 - Forestry Commission
 - Google maps
 - IOW Council
 - The Hampshire & Isle of Wight Wildlife Trust
 - The National Trust
 - Open Street maps
 - Members of the public who took the time to report red squirrel sightings on the Isle of Wight
 - Landowners who allow access to their woods



This book is a record of red squirrel conservation work on the Isle of Wight from 1991 to 2022. It is based on science but written so that non-scientific people can understand it. The aim is to provide a reference document for future red squirrel workers to use, so they can continue to map the progress of this important population of red squirrels.

Red squirrel enthusiasts will find it interesting as it covers such a wide range of topics, including the many ways red squirrels meet their end. Corridors, habitat management and tree planting in general all contribute to keeping our red squirrels thriving on the Isle of Wight and there are whole sections dedicated to research and surveys, which will prove useful to foresters and landowners. There is plenty of material for educational use as well.

Whilst copyright does remain with the author, please feel free to use research and pictures as long as they are credited to the author.

