

Big Scilly Bat Survey



Bats of the Isles of Scilly
2022 - 2024



Isles of Scilly
National
Landscape



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Wildlife Trust



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Citation

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Introduction

The Big Scilly Bat Survey has been a multi-year citizen science project working with volunteers in the community to discover more about bats on the Isles of Scilly.


The Isles of Scilly Bat Group have been undertaking surveys, monitoring and recording of bats on the islands for many years. We started out with a good baseline understanding of the populations. Bats are very difficult species to understand, but with new techniques we are constantly learning more about their behaviours and distributions. For example, it was only in the 1990s that it was discovered that the most common species in the UK – the pipistrelle – was in fact two separate species which have completely separate roosts and social groups!


The Isles of Scilly Wildlife Trust (IoSWT) and Isles of Scilly Bat Group got together to undertake widespread monitoring of bats across the islands in 2022 to run this three-year project in order to answer key questions:

- **How many species of bat are resident on the islands?**
We knew of four, but could there be more flitting silently un-noticed around the islands after nightfall?
- **Are there any migrant or vagrant species which stop off on the islands?**
Scilly is a hotspot for migrant birds, could there be bats which behave likewise?
- **How do the bats behave throughout the year?**
With our uniquely mild winters, do they still follow mainland rules and go into torpor during the darkest months?
- **Which habitats do they favour?**
With such a lot of coastline and so little woodland, the habitat mosaic of the islands is quite unusual – where do our bats spend their time?
- **Do the bats spend time on the smaller uninhabited islands, or are they constrained to the inhabited islands where buildings and trees provide roosting habitat?**

This report provides the results of our surveys and analysis, answering as many of these questions as we can and a few more along the way.

The Survey

The Location	
<p>The Isles of Scilly are an archipelago of over 140 islands located 28 miles off the south-western tip of Cornwall in the UK. Five of these are inhabited. The largest is St Mary's where the majority of the population live, along with Tresco, St Martin's, Bryher and St Agnes.</p> <p>The remainder of the archipelago is made up of uninhabited islands ranging from large islands such as Samson to smaller islets and rocks with little or no vegetation.</p>	 <p>Figure 1 - Illustrating the location of the Isles of Scilly off the south-western coast of Cornwall.</p>

Bat Detectors	
	<p>The survey protocol relied on the use of static bat detectors which pick up and record the ultrasonic echolocation calls which bats use when moving around the islands and hunting for prey.</p> <p>These small detectors run for a week on AA batteries and passively record the ultrasonic sounds they hear whilst on deployment. They are programmed to start recording just before sunset and stop just after sunrise, saving the files to an SD card for downloading and analysis.</p>

Echolocation
<p>Many people are familiar with the idea of echolocation – similar to sonar, this is where bats emit sounds (known as echolocation calls) and interpret the returning noise as it bounces back from objects in their environment. This could be a line of trees they are following to navigate from one place to another, or a moth they are intent on hunting on the wing.</p> <p>What makes our survey technique possible is the fact that echolocation frequencies and sound characteristics vary between different species of bat. For example, common pipistrelles echolocate at a peak frequency of 45 kilohertz (kHz) whereas the aptly named</p>

soprano pipistrelle echolocates at a higher pitch of 55 kHz. Humans can't typically hear above around 20 kHz so these sounds are out of our range, but if they are recorded and adjusted so that we can hear them, the soprano pipistrelle calls would be higher pitched like a soprano in a choir, whilst the common pipistrelle would be lower, more like a tenor or an alto.

As an added bonus, the bat detectors also pick up noises from a select number of non-bat species including crickets and small mammals, so the survey can provide extra information about these species too!

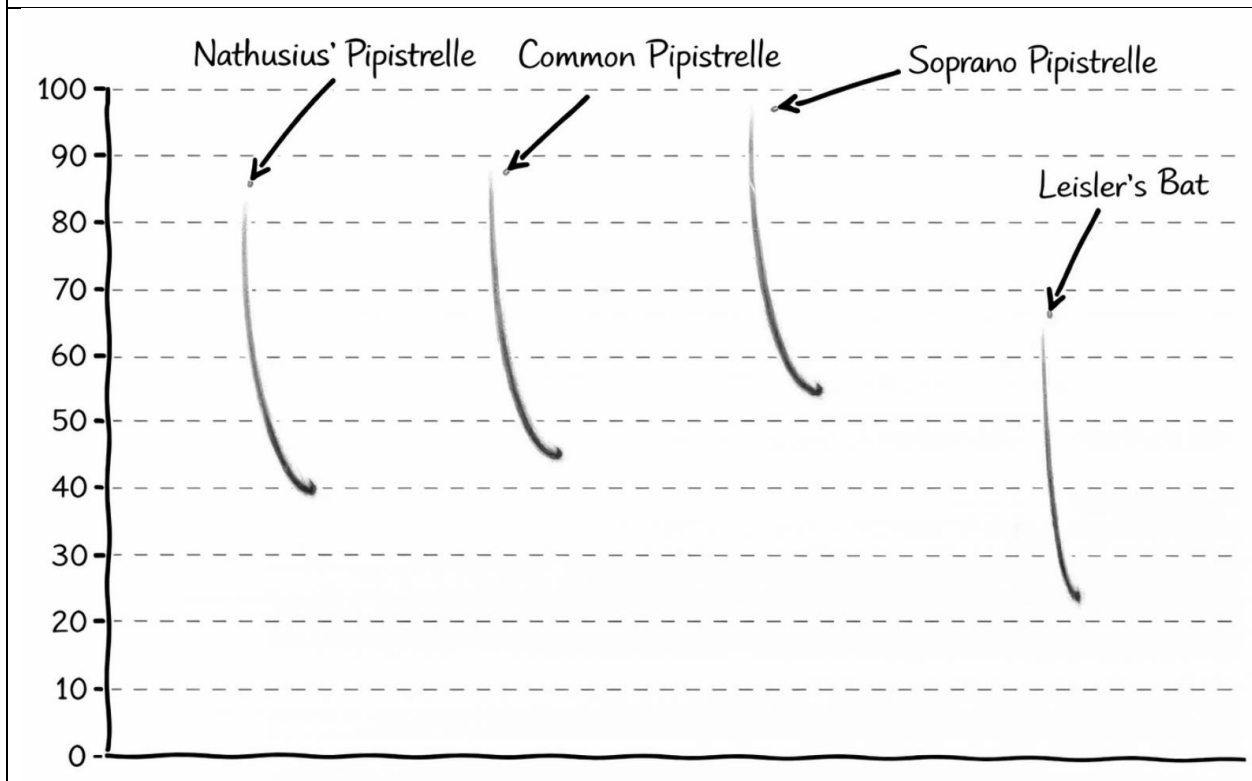


Figure 3 - This is an illustration of a sonogram which shows the different call shape and frequencies of the four bat species we detected on the Isles of Scilly during the Big Scilly Bat Survey. A fifth species, the brown long-eared bat, is known to occur on St Mary's and Tresco but was not detected during the survey. This species is known as the 'whispering bat' due to its very quiet echolocation and is often missed or under-recorded in these kinds of surveys.

The scale on the left of the sonogram is kilohertz (kHz), a measure of sound frequency which we experience as higher or lower pitch. Humans can typically hear between 0.02 kHz and 20 kHz, but this is where the bats are just getting started. Did you know: the lesser horseshoe bat (which can be found across the water in Cornwall) has echolocation calls all the way up at 110 kHz!

The Team

The survey was initiated and coordinated by Darren Hart with support from James Faulconbridge who completed the data analysis and reporting. Carol Williams and others in the Isles of Scilly Bat Group provided technical expertise and support. Stuart Newson at the British Trust for Ornithology (BTO) was indispensable, providing help with survey design as well as the data analysis and verification using the BTO Acoustic Pipeline¹. The IoSWT staff team provided support throughout the survey.

Most importantly of all, we had an amazing team of volunteers who set out bat detectors for us throughout the summer on all five inhabited islands, and even a few intrepid explorers who allowed us to survey on the uninhabited Eastern Isles and Teän! We could not have undertaken this project without this enthusiastic support from islanders.

Survey Seasons

Bats in the UK are most consistently active between May and October. This encompasses the seasons when the weather is better and there are more insects for them to eat, so this is when females give birth to their babies who then grow, wean, learn to fly and become independent before the winter sets in.

Our surveys therefore ran throughout this period in 2022, 2023 and 2024. We were also interested in whether bats were active during the winter months, so a winter monitoring period was also undertaken between January and April in 2023.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022												
2023												
2024												

The figure is a calendar grid with 12 columns for months (Jan to Dec) and 4 rows for years (2022, 2023, 2024). Yellow shading covers the months of May, June, July, August, September, and October for all three years, labeled 'Main Survey Season'. Blue shading covers the months of January, February, March, and April for the year 2023, labeled 'Winter Survey (St Martin's)'. All other cells are empty.

Figure 4 – The survey windows when the bat detectors were deployed between 2022 and 2024

Survey Aims and Deployment

Year 1: Our aim in the first year (2022) was to get a bat detector out in each 1km grid square across the islands twice during the season, once in early summer and again in late summer. This was our scoping year where we wanted to establish an understanding of the bat species present on the islands and to look for new species or data which might warrant further investigation. Up until this point, we knew about some of the species of bats on the islands, but we weren't sure if other species were quietly existing under the radar!

Year 2: In the second year (2023) we wanted to maximise geographic coverage of the islands, so every 500m square of the inhabited islands was surveyed once throughout the season, with Teän and some of the Eastern Isles also included. Our aim now was to be able

to investigate patterns of habitat use and species distribution to understand if different species had preferences for different habitat types.

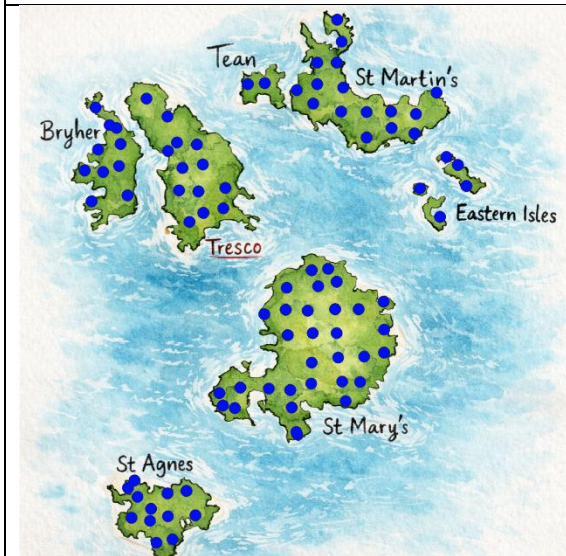


Figure 5 – The distribution of bat detector locations around the islands in 2023. Every 500m square was sampled along with two locations on Teàn and five locations in the uninhabited Eastern Isles. In some cases, the pattern had to be adjusted a little from the perfect grid layout to find suitable locations (especially around the coastline) and individual detectors sometimes failed – however the final coverage was very comprehensive!

Year 3: In the final year of the project (2024) we opted instead for consistent season-long deployments in key locations to understand how habitat use changed through the season. We chose some sites for the following reasons:

- where soprano pipistrelle were recorded in earlier years to better understand how rare this species is on the islands;
- a paired deployment in two different habitats (heathland vs shoreline) to assess whether bats had consistent preferences for one habitat over another;
- a shoreline site to see how bats used this habitat in relation to tides.

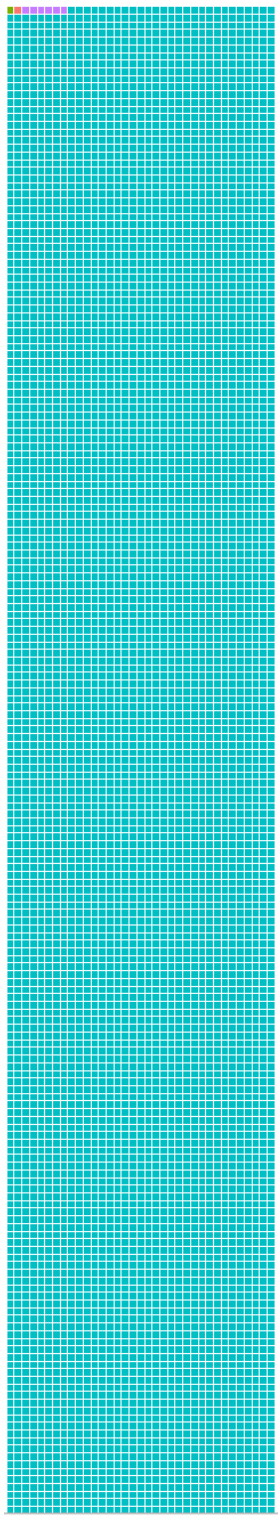

Winter: In addition to these wide-scale studies during the summer seasons, we also left a bat detector running on St Martin's in the winter in early 2023 to see whether bats were recorded in the colder months. Some species of bat hibernate in the UK whilst others reduce their activity and go into torpor. With Scilly experiencing such mild winters, we were curious to see how active bats remained on the islands.

A note on reporting...

This survey was made possible by a large number of volunteers. Our aim in producing this final report was to make it accessible for a wider audience, using the results of the survey to explore more about the bats on the Isles of Scilly. Analytical and supporting information on methodology and results can be found in the separate Technical Appendix document.

This means that in some instances the data is used as a narrative structure e.g. Seasonal Variation: The Bat Year. In such sections, the limitations of the data are made clear and whilst trends and patterns are presented and statistically supported where appropriate, the interpretation is based on published research which is referenced in the text.

Bat Species on the Isles of Scilly

Overview	
	<p>A total of four species of bat were identified by the survey across the three survey years. There is one additional species which we believe to be present on the islands but which was not picked up by the survey – the brown long-eared or ‘whispering bat’ often evades detection due to its quiet echolocation!</p> <p>The grid to the left is an illustration of how many calls were recorded for each species over the three year survey period – one square represents 100 calls.</p> <p>In the very top left corner, represented by a single green dot, are the calls of the Leisler’s bat. This was one of the most exciting finds of the survey – there were previous records suggesting this species might be found on Scilly, including sightings of bats flying in off the coast, but this is the first time we have been able to conclusively confirm that this species is present on the islands. It was however the least recorded in the survey, with only a handful of individual recordings.</p>  <p>Next is a single orange dot for the Nathusius’ pipistrelle, another exciting result! This species has been previously identified in harp trap surveys on St Mary’s, but has not been recorded on the islands for several years. As well as being recorded by the static bat detectors each year throughout the survey, this species was also recorded foraging on the vineyard on St Martin’s in 2023, representing a visual sighting of this bat on the islands.</p> <p>Still not moving beyond the top line, there are seven purple squares representing the soprano pipistrelle records. This is a species which was known to be on the islands, with historic roosts recorded on St Mary’s. With just a few hundred records over the three year survey, this species was very infrequently recorded.</p> <p>Finally there are 7,224 blue squares representing the >700,000 common pipistrelle calls recorded during the survey – this species certainly lives up to its name on the Isles of Scilly representing the overwhelming majority of bat encounters!</p> <p>Confirming the species assemblage on the islands was a key aim of the study, and each is considered in turn in the following pages.</p>

Common Pipistrelle

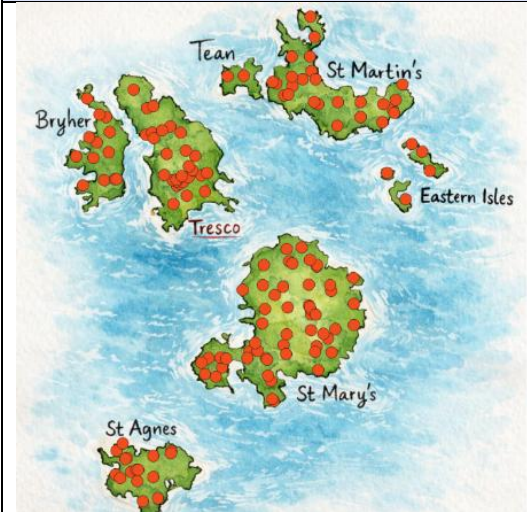


Figure 6 – Common pipistrelles were confirmed in every location where a detector was set out, including all five inhabited islands, Tean and the Eastern Isles.



Figure 7 – A common pipistrelle bat. Their darker face is one of the key characteristics which helps differentiate them from the visually similar soprano pipistrelle.

The common pipistrelle bat was widely known across the islands prior to this survey and the results confirm that they are the dominant species on Scilly accounting for over 99.99% of recordings.

In the hand, the common pipistrelle is tiny, between 3.5cm – 4.5cm long and weighing between 3 – 8g (around the same as a 20p piece). Their wide wingspan of around 20cm makes them look much larger in flight.

The records gathered over the years by the Isles of Scilly Bat Group record this species breeding and raising their pups in multiple maternity roosts on the islands.

Did you know: unlike rodents such as mice and rats which can raise many babies each year, common pipistrelle bats typically have a single pup (or occasionally twins) which they spend the whole summer raising before the young take to the wing and become independent in September. This careful nurturing of individual infants makes bats much more susceptible to population decline than other small mammals; as each female can produce only one pup in a given year, it takes much longer for a population to bounce back from harm.

Common roosting locations on Scilly include gaps behind fascia boards, behind drop tiles and under slates (especially at the edges of roofs). They will also roost in cracks in trees, cavities in rocks and in bat boxes, but they can turn up in some unexpected places – one was recently encountered snoozing behind the wooden sign on the front of the Reading Room on St Martin's.

Common pipistrelles are an excellent form of natural pest control – they typically eat small flies, midges and mosquitos which they hunt on the wing using their echolocation.

Soprano Pipistrelle

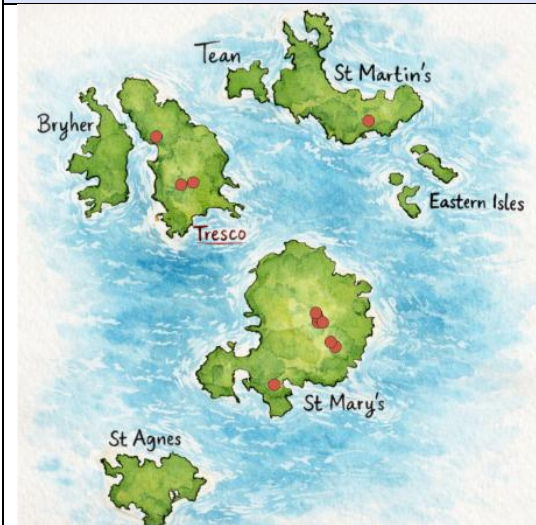


Figure 8 - Soprano pipistrelles were only recorded on three islands between 2022 and 2024 - these are St Mary's, St Martin's and Tresco.



Figure 9 - A soprano pipistrelle bat. Their lighter face is one of the key characteristics which helps differentiate them from the visually similar common pipistrelle.

The soprano pipistrelle was the second-most frequently recorded bat during the survey, albeit orders of magnitude less frequently than common pipistrelle, with only 555 confirmed calls compared with the latter's >700,000. This species was previously assumed to have a breeding population on the Isles of Scilly, but the consistently low encounters over three years suggest that there may no longer be a viable breeding population on the islands.

Common and soprano pipistrelles were only identified as two separate species in the 1990s². Before this, they were both recorded as a single species which means that historical records from the data collected over the years by the Isles of Scilly Bat Group are unable to tell us much about the historic populations of soprano pipistrelles. This makes it difficult to understand if their current low numbers reflect a recent decline or a long-standing low prevalence.

Soprano pipistrelles gather in larger maternity colonies than common pipistrelles³. In small, geographically isolated locations such as Scilly, this can make them even more susceptible as the loss of a maternity colony in a single location could wipe out a large proportion of the breeding population.

The survey identified soprano pipistrelle from three islands - most records are from St Mary's with a handful from Tresco and a single encounter on St Martin's. These records span all three years which indicates a long-term presence. The repeated encounters around Lower Moors and Porthellick Pool on St Mary's suggest that they are resident or that they frequent hunting grounds in this area. There were no records of this species on Bryher or St Agnes.

This species is visually and behaviourally very similar to the common pipistrelle, with a similar diet of small flies and midges.

Leisler's Bat

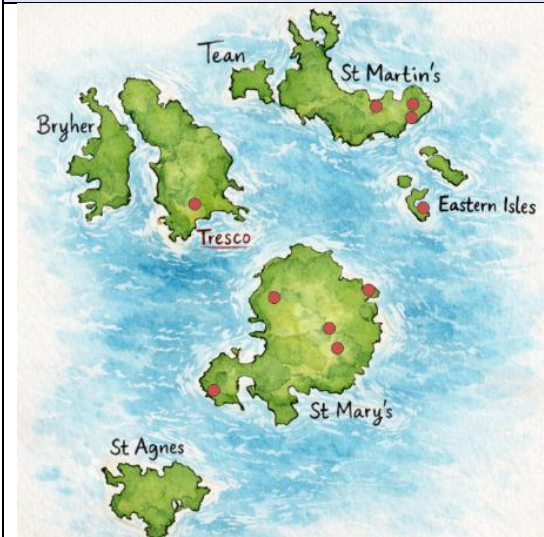


Figure 10 – Leisler's bats were recorded on four islands between 2022 and 2024 – these were St Mary's, St Martin's, Tresco and Great Arthur, one of the uninhabited Eastern Isles.



Figure 11 – A Leisler's bat. They are a different genus to the pipistrelle species recorded in the survey and are one of the three species commonly referred to as the 'big bats' in the UK alongside noctule and serotine.

Leisler's bat is a species which was confirmed on Scilly for the first time by the Big Scilly Bat Survey.

This species wasn't recorded at all in 2022 but their echolocation was recorded at six different detector sites between September and October in 2023; and at a further four sites in May and September 2024. Overall numbers of recordings were low – a total of 81 individual calls over the course of two years.

Leisler's bat is considered to be a migratory species in Europe, known to fly long distances with individuals ringed in Germany recorded in Spain before returning back to Germany⁴. The UK population is not known to migrate regularly between Europe, with genetic studies supporting a general separation between the populations⁵, but there are records of this species being encountered at sea which suggests they undertake at least occasional sea crossings to or from the UK⁶.

The coincidence of the 2023 records⁷ with an influx of vagrant bird and insect species blown off course during autumn migration suggest that the Leisler's bat is only present transiently on Scilly. The acoustic survey technique doesn't differentiate between individuals, so it's not possible to tell if this was a single bat recorded multiple times, or a small number of bats recorded separately. The data would suggest individuals stopping off during long distance flights, either as part of an otherwise unrecorded regular passage, or blown off course as vagrants. Based on the historical absence of records, the low numbers of encounters, and the absence of records through the main summer period, it is very unlikely that there is a breeding population on the islands.

Nathusius' Pipistrelle



Figure 12 – Nathusius' pipistrelle bats were recorded widely across the Isles of Scilly between 2022 and 2024 including all of the inhabited islands (except Bryher) as well as the Eastern Isles.



Figure 13 – A Nathusius' pipistrelle bat. This species is related to the common and soprano pipistrelles, but is almost twice their size at 4.5cm – 5.5cm in the hand with a wingspan of up to 25cm.

Nathusius' pipistrelle is a larger relative of the common and soprano pipistrelle which was previously identified on the islands in 2011 but has not been recorded since.

Unlike Leisler's bat which was recorded first at the end of 2023, Nathusius' pipistrelle bats were recorded between May and October each survey season between 2022 and 2024. The number of calls recorded each time are often small, with a total of 75 records made throughout the three years. The geographic distribution of these records is wide – recordings were made at nine sites each in 2022 and 2023, and at all five recording sites in 2024.

Nathusius' pipistrelle is a known migrant species whose flight between the UK and Europe is widely confirmed through ringing re-captures and radiotracking⁸. The patterns of detection here on Scilly would be consistent with migrating bats 'stopping off' on their flight between the UK and Europe. However, other explanations such as a small resident population or an itinerant presence limited to when bats are blown off course cannot be ruled out.

A further indicator of migratory or itinerant presence on the islands is the wide distribution for such a small number of recordings. Resident bats will often have favoured foraging habitats which they frequent night after night. In contrast, there were few records of Nathusius' pipistrelle from any one location, whilst there were records from multiple locations across St Mary's, St Martin's, St Agnes, Tresco and the Eastern Isles.

Brown Long-eared Bat

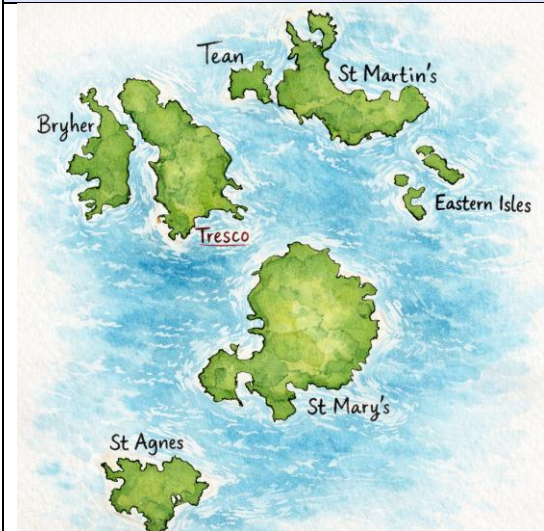


Figure 14 - Brown long-eared bats were not detected during the Big Scilly Bat Survey across the islands, but we suspect the population is still present.



Figure 15 - A brown long-eared bat which, as its name suggests, has much larger ears than the other species found on Scilly. This acute hearing allows them to echolocate very quietly, which is why they are often overlooked in acoustic detector surveys.

The brown long-eared bat is notable by its absence from the survey results. A breeding population of this species was confirmed in 2011 when a pregnant female was caught and radio-tracked to a roost in a split Monterey pine tree on St Mary's – prior to this, there had been no record of the species on the islands for 40 years! DNA evidence from droppings taken for analysis on Tresco in 2020 also confirmed the species to be present there. The most recent evidence of their ongoing presence on the islands comes from DNA analysis of droppings found in an attic in Holy Vale in 2023 which suggests that hopefully it is their quiet echolocation which means they are absent from the Big Scilly Bat Survey, rather than the loss of the populations from the islands.

Brown long-eared bats are considered a woodland species⁹ on the mainland – they are strongly associated with higher tree cover and can forage in tree canopies. Their historic distribution on Tresco and around the more wooded areas of St Mary's such as Holy Vale and the Garrison would fit the known habitat preferences of the species. It seems likely that they may be absent from the off-islands with less tree cover such as St Martin's, Bryher and St Agnes though this is speculative at this stage.

The long ears which give this species their name afford them excellent hearing which lends itself to two hunting strategies. Firstly, they can forage by 'gleaning' where they will pluck insects off surfaces such as leaves or soil rather than catching them on the wing – their excellent hearing allows them to hear the sounds of insect feet on plant leaves and execute a successful capture¹⁰! Secondly, moths are an important part of their diet; a number of their favoured prey species can hear bat echolocation and take evasive action to get out of the way¹¹. By keeping their echolocation as quiet as possible, long-eared bats have more chance of detecting and successfully hunting a moth before it knows that it is in danger!

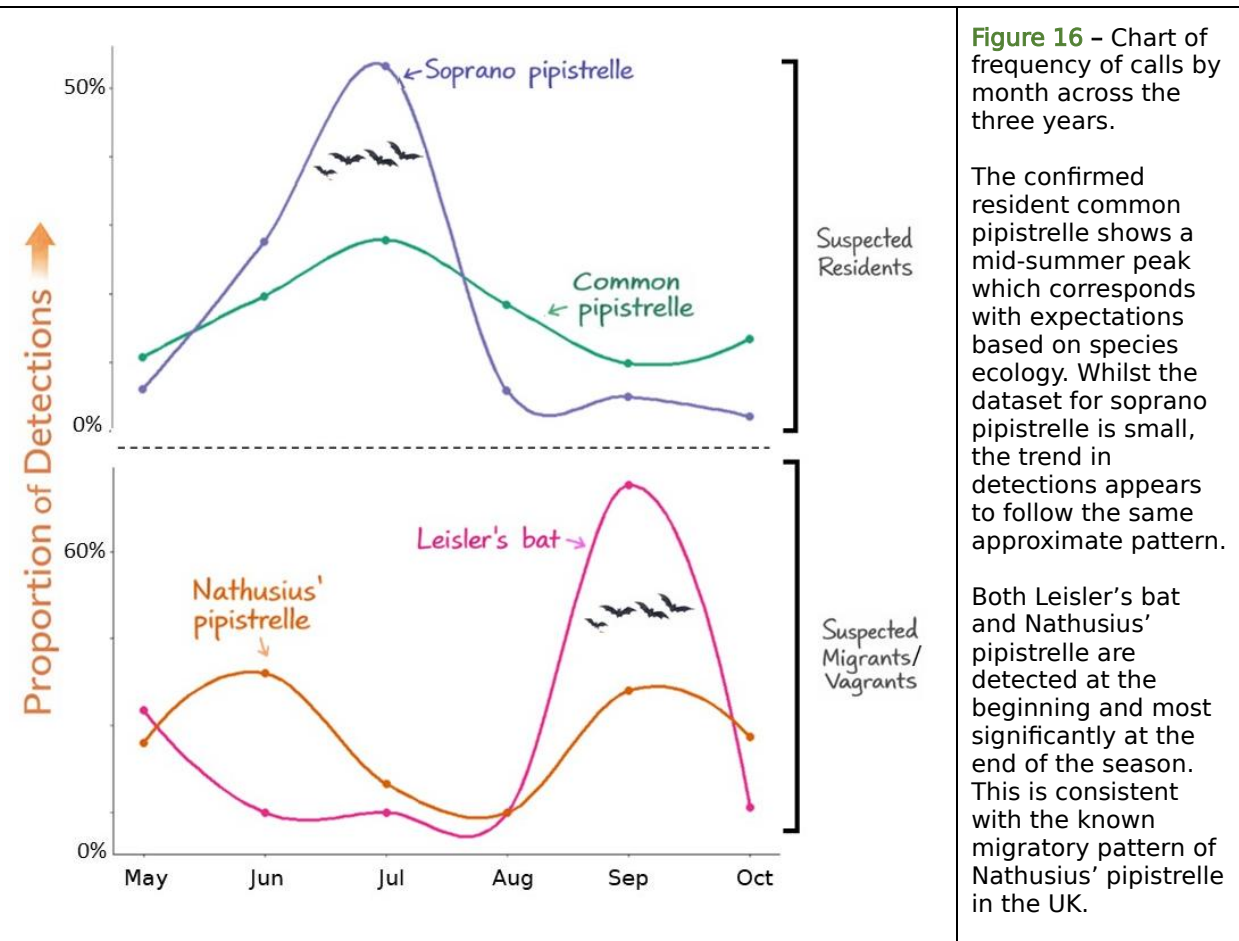
Residents, Migrants or Vagrants?

Confirmed Residents

The status of the different species can be considered in terms of the background information we have, and the patterns of data collected during the Big Scilly Bat Survey.

We have strong evidence that the **common pipistrelles** are resident and breeding on the islands based on multiple records of maternity roosts, young bats observed on the wing, and young bats taken into care to be rehabilitated when they have ended up out of their roosts.

We do not have any recent evidence of breeding for **soprano pipistrelle**, **Nathusius' pipistrelle** or **Leisler's bat**. The numbers of records from the Big Scilly Bat Survey are felt to be inconsistent with a sustainable breeding population of any of these three species on the islands.



Suspected Residents

Historically, soprano pipistrelle have been assumed to be both resident and breeding on the islands. However, the very small number of echolocation calls across the three years is not consistent with a viable breeding population, especially given the habit of this species of occurring in larger colonies than the common pipistrelle.

Soprano pipistrelle bats (along with common pipistrelles) can fly long distances across open sea as evidenced by static detector studies on Pembrokeshire islands¹² and over the Baltic Sea¹³. An element of regular migration or occasional vagrancy cannot be ruled out for these two species.

Comparing the seasonal trends for each species, as seen in Figure 16, shows that the data for soprano pipistrelle follows the same trend seen for common pipistrelle with activity increasing from early- to mid-summer, before declining into autumn. This would seem consistent with soprano pipistrelle being a resident species but further study would be required to understand the status of soprano pipistrelles on the islands.

Suspected Migrants

The absence of Leisler's bat in 2022 (with the species only being recorded in 2023 and 2024) and the low detection rates for both this species and Nathusius' pipistrelle, coupled with their known migratory behaviour in some locations, supports the assumption that these are not year-round resident or breeding populations.

The seasonal plot for Nathusius' pipistrelle and Leisler's bat detections (Figure 16) shows a bimodal seasonal pattern, meaning there are two distinct peaks at the beginning and end of summer. Whilst the dataset is small, this pattern is consistent with the known migratory periods exhibited by these two species.

Nathusius' pipistrelle is a regular migrant between the UK and Europe, with a recent scientific paper¹⁴ identifying peak migration to and from the UK occurring primarily in April/May and then again in September (though there is variation in the precise timings reported, including a sex-based delay with males typically following females around 25 days later). The data recorded on Scilly above shows this exact pattern, with one peak in May/June and a second in September.

There is less data on Leisler's bat migration, as their movements between the UK and continental Europe are considered occasional rather than routine, an assumption backed up by the genetic studies which show UK populations to be reasonably distinct. The current state of knowledge identifies limited evidence for migration of the 'big bat' species (noctule, serotine and Leisler's bat) to and from the UK. However, the strong peak of Leisler's bat activity recorded by the Big Scilly Bat Survey in September 2023 and 2024 strongly points towards these bats being migratory or vagrant – the only other month when Leisler's bat was recorded is May, matching the bimodal peak seen in the migratory Nathusius' pipistrelle.

The terms migratory and vagrant may sound similar but have an important ecological distinction. Migration is an intentional movement and may be important to the ecology of

the population of a species. Vagrant individuals are those which have been blown off course, and thus less likely to be able to return to the breeding areas of the species concerned.

The data cannot identify whether the bats are likely to be migrants or vagrants, but it is interesting to consider where a potential migratory route might be. None of the suspected migration routes for these species proposed by Natural England include passage across the Isles of Scilly. The majority of research has been focused around the North Sea (bats moving between the UK and Scandinavia) or the south-east (bats hopping the channel between the UK and the nearest point of continental Europe). Potential routes which a migrating bat might take to pass through the Isles of Scilly, can be inferred from the much more abundant data on migrating birds. The three key routes identified are:

- South-western England to Europe. Species such as curlew have been confirmed in moving between Dartmoor and Iberia via the Isles of Scilly;
- Northern England and Wales to Spain and Northern Africa. Species such as willow warbler and chiffchaff take these routes which would pass over Scilly;
- Ireland to France. Species such as Sandwich tern have been recorded making journeys which pass across the south-west of the UK, including Scilly.



Figure 17 – Potential migration routes between the UK, Ireland and continental Europe which are of relevance to the Isles of Scilly. These potential routes are informed by bird ringing, radiotracking and recording work on migrant bird species.

Winter Activity

Hibernation or Torpor?

The common imagination of hibernation is a long period of uninterrupted winter sleep, but the reality is a little more complex and involves periods of torpor with brief rousing. This is true for all of our hibernating mammals in the UK such as hedgehogs and hazel dormice as well as bats.

Torpor is a physiological state in which metabolic activity, body temperature, breathing rate and heart rate are greatly reduced. Bats can remain in this state for many nights without flight, but they will rouse to fly during suitable weather conditions throughout the winter. Some species enter a more prolonged and unbroken torpor than others, with common pipistrelles typically being one of the 'lighter sleepers' in the UK.

Scientific studies have found that their decision to rouse and take to the wing is often linked with a need to drink to prevent dehydration¹⁵, and they are also likely to choose nights when the weather is more clement and there is a higher chance that their prey of small insects will be on the wing¹⁶. Rousing from torpor uses up energy, so choosing nights when there is food available will ensure they don't come back hungrier than when they went out!

Winter Activity on Scilly

To gain an insight into how common pipistrelles behave here on Scilly, where the winter weather is unusually mild in contrast to the rest of the UK, a bat detector was set up to record every night between 20th January and 30th April 2023 on St Martin's Vineyard, just a few metres away from a weather station.

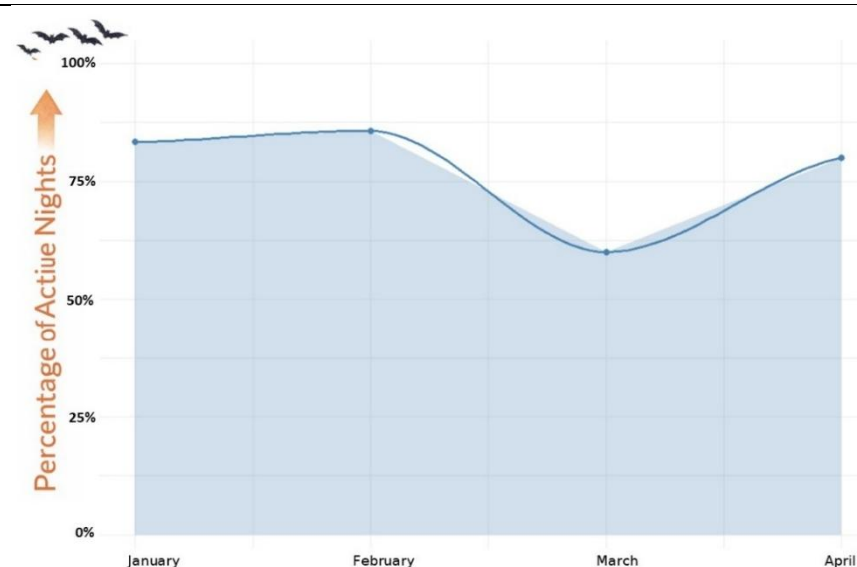


Figure 18 – This graph shows the percentage of nights when bats were recorded on the wing on St Martin's each month between January and April 2023.

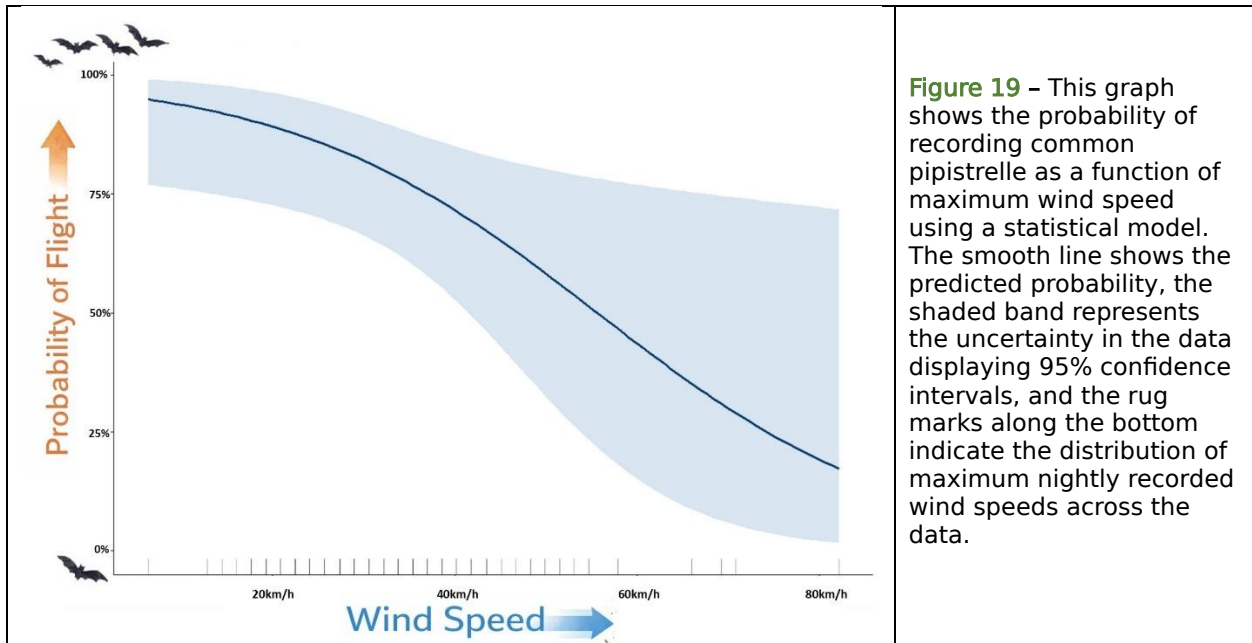
Bats were recorded on 78% of nights over this period with high numbers in every month except for a dip in March which coincided with a period of bad weather. The activity throughout the whole survey period indicates that they remain meaningfully active throughout the winter, whenever weather is suitable.

Factors affecting Activity

Work on Alderney, one of the Channel Islands, found that common pipistrelles were on the wing on most nights when temperatures were above 7°C¹⁷. Derbyshire Bat Group have undertaken similar multi-year studies and found similar weather-related patterns in activity – in a mild, wet February they recorded flight in 50% of nights, whereas another winter period when the temperatures were colder and frequently hovering around zero, they were recorded on just 3 days¹⁸.

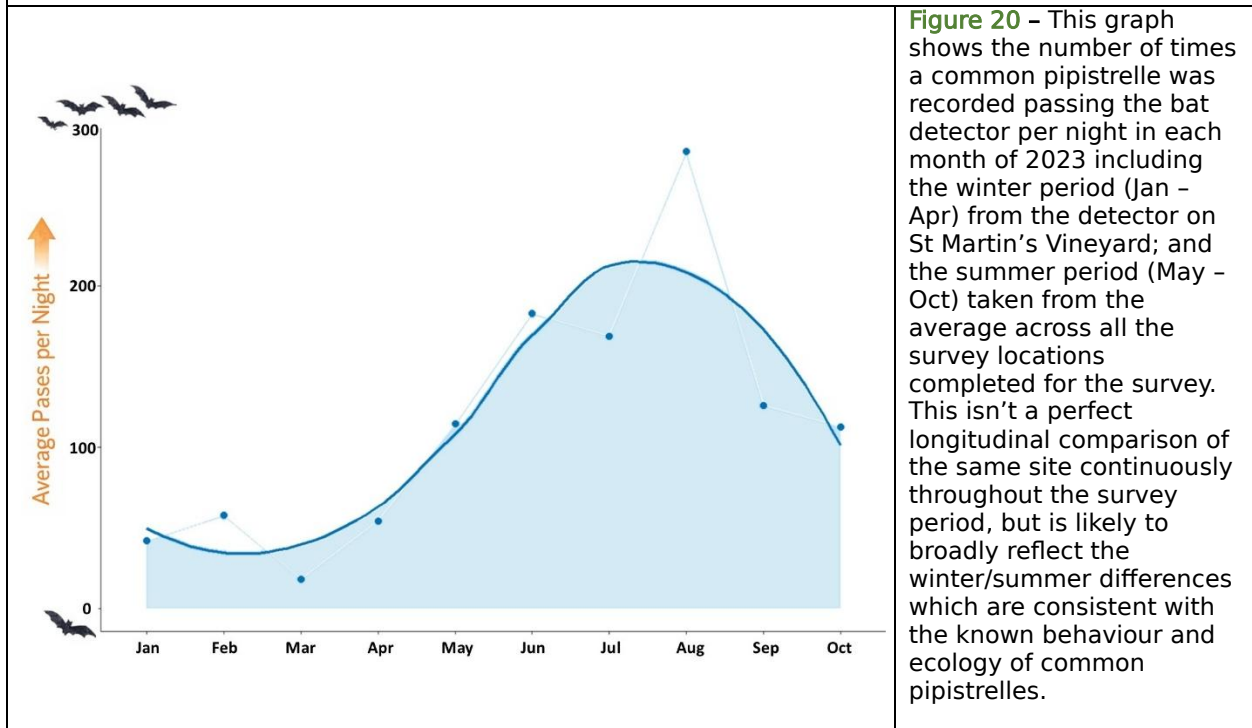
The temperatures rarely fell below the 7°C threshold here on Scilly during the survey period, but an analysis of the results revealed a trend which anybody who has spent a winter on Scilly will be familiar with – storms are the main weather which affects behaviour! Strong wind speeds were a statistically significant predictor that bats were unlikely to be recorded on the wing that night. There was a trend to suggest that lower temperatures also correlate with a decreased probability of activity, but this fell short of statistical significance and would need more data to assess with confidence.

The summer behaviour of common pipistrelles is relatively well understood in the literature, especially for females who have dependent young and must forage every night to support them. There are several possible explanations for the winter activity we see, and the reasons for flight on a given night may vary more between individuals. The fact that the detectors only record passes but can't differentiate between individual bats limits our interpretation; winter records could be multiple bats 'taking turns' to emerge and forage every few nights, or it could be one particularly hardy bat which doesn't much feel the cold and heads out for food every night. It could also be that they were flying, but happened not to pass the detector by chance; or that strong winds made them seek a sheltered foraging locations in the lee of a hedge away from their usual habits that night. Bats are individuals and whilst this data can tell us information such as 'can bats be found on the wing in the winter', it does not provide this richer narrative detail.



Winter vs Summer Activity Levels

Whilst flight remains fairly consistent throughout the winter, as seen in Figure 18, the overall activity levels are significantly reduced compared with the summer 2023 dataset. From May onwards, bats were recorded on the wing every night that a detector was set out until a couple of nights at the other end of the season in October) and activity levels throughout the night were much higher, as seen in Figure 20 below.



Seasonal Patterns: The 'Bat Year'

Introduction

Most people know that bats fly at night, but did you know that their activity varies between species and between seasons?

Some mainland species such as noctules can be seen in flight even before the sun sets – you can sometimes see them alongside birds like swallows during the 'changing of the guard' between the birds which hunt insects by day and the bats which take over at night.

At the other end of the spectrum, species such as brown long-eared bats can wait up until an hour after sunset before they leave their roosts which makes them tricky to spot as the light has generally gone by the time they are on the wing. This might partly explain the lack of known brown long-eared bat roosts on the islands as you need a keen eye to spot them in the darkness.

Common pipistrelles, the species for which we have most data on Scilly, fall somewhere in between – they typically leave the roost around 20 minutes after sunset and return around 20 minutes before sunrise. This is only an average however – when the roost is large and there are lots of bats queuing to emerge from a single exit point, the first bats will often leave around sunset to get ahead of the rush and emergence activity can take half an hour!

Bats will not necessarily stay on the wing all night either – there can be a period of feeding at first, after which they might either return to the roost for a while or occupy a night-roost closer to their feeding grounds for a rest. In the summer, females will return to feed their pups several times a night.

The amount of time they will need to spend on the wing will be dictated by metabolic requirements – how much food they need – and this varies both through the year, and between the sexes. Males live a bachelor lifestyle through the summer period, feeding only for themselves as they take no part in the maternity colonies or raising of the pups. The females on the other hand will need increasing calories as they move from pregnancy through to lactation to support nursing pups which are gradually weaned before reaching full independence in late summer.

The duration of the night is another important factor affecting bat activity. Whilst we are all enjoying the longest days in June and the extended summer evenings in July and August, the bats have to fit all of their foraging into the shortest nights which coincide with the times when the females need food the most. In mid-June in Scilly, the shortest night is around 7.5h long, but by September the nights are nearer 10h. If bats were to take a 'fixed' amount of foraging, in spring or autumn bats can spread this over a longer night, or get all of their feeding out the way early and take the rest of the night off! In high summer however, a female with a dependent pup will need to make the most of every hour of darkness available to provide for them both.

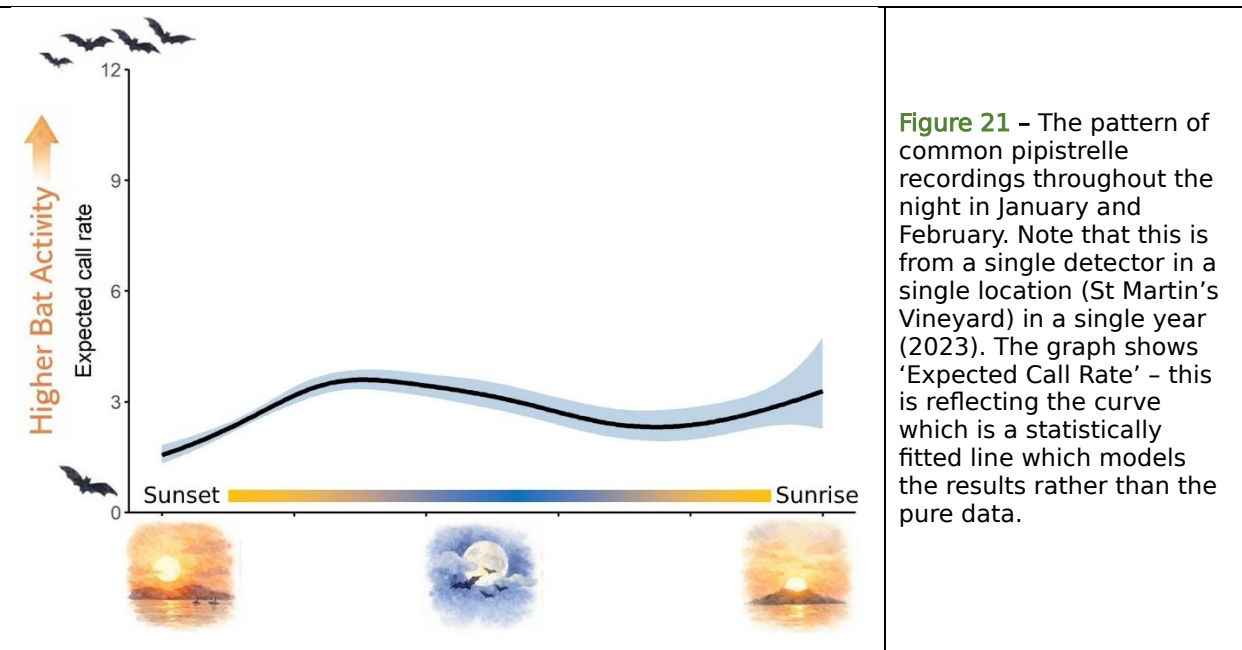
These factors affect when bats can be found on the wing as the season progresses, and can be seen in the data gathered during the Big Scilly Bat Survey.

Winter

During the darkest months of the year, in January and February, common pipistrelle flight has been found to be more likely linked to rehydration, rather than routine foraging. Roost switching is another possibility – bats may move to a roost more sheltered from the prevailing wind when it decides to swing east after a month of south-westerlies, for instance. There are bat box roosts on St Martin's Vineyard where individual common pipistrelles will come and go throughout the winter months.

Activity levels are low and the time of night when bats are recorded on the wing seems to have little pattern, being evenly spread as can be seen in Figure 21. This, combined with the very low number of calls in January and February, suggests that flight by common pipistrelle during this period is not as routine or predictable as it is in summer. The decision to fly in January might be more like waking in the middle of the night and needing to get a glass of water, rather than your alarm clock going off in the morning and getting up for breakfast and your morning routine.

The blue shading around the trend line in the graphs is a measure of the variation present in the data – tighter blue shading indicates a more consistent and reliable pattern in activity at that time repeated from night to night, but wider shading suggests more variation. This data is only a snapshot from a single location in January and February 2023, so the data must be treated with caution – it is not nearly as reliable as the summer data where we have multiple detectors in multiple locations.



Spring Transitional Period

March and April are traditionally known as the Transitional Period in the bat world. This is a broad term and its precise timing will depend on the conditions that year but it describes the season when nights start to get shorter, temperatures rise, flight increases and bats move from their winter roosts to their transitional roosts.

Figure 22 shows how the number of recorded passes begin to pick up during the transitional period as bats become more active and hunt most nights. In March and April, bats will need to put on weight after the winter, but the number of insects is still quite low. However, nights are relatively long at this time of year – certainly compared with mid-summer – and the pattern we see is consistent with bats emerging from roosts after sunset, spending a few hours on the wing, and returning to their roosts with lower activity through the rest of the night. The balance will change at the end of the transitional period – females become pregnant around the beginning of May so from that point onwards, their metabolic requirements increase as the pups gestate before they are born in late June or early July¹⁹.

As with the January and February data, this data is from a single detector in a single year. However, the notable trend is ecologically expected, equivalent to the late-summer/autumn transitional period which is supported by much stronger data.

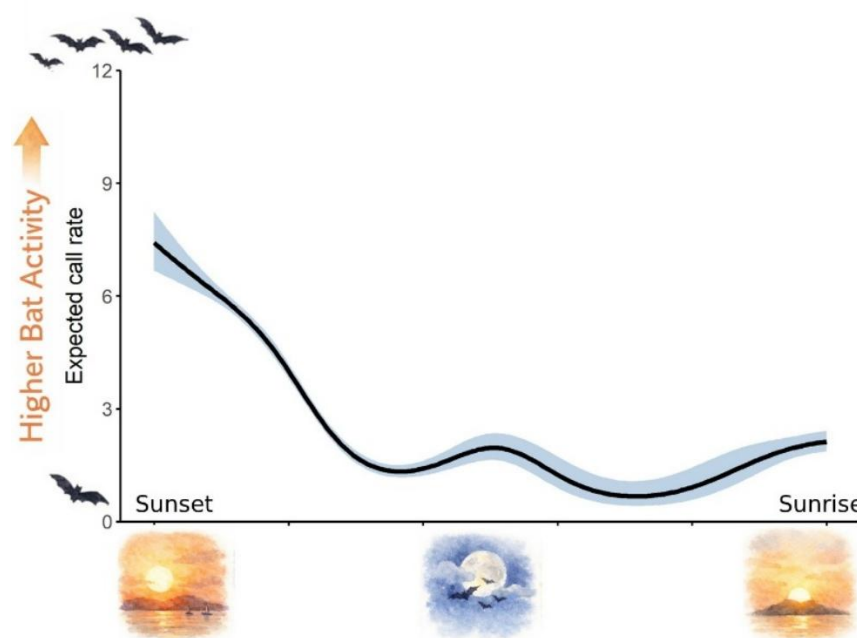


Figure 22 – The pattern of common pipistrelle recordings throughout the night in March and April. There is a definite peak just after sunset which is the time common pipistrelles will emerge from their roosts, but this tails off significantly as the night goes on suggesting early activity which is not sustained across the long night. Note that this is from a single detector in a single location in a single year.

Mid-Summer: Pregnancy and Lactation

The months of May to July are considered to be the beginning of the main 'active season' when bats are busiest foraging through the night, and this is borne out in the Big Scilly Bat Survey data. Figure 23 shows that the number of recorded calls peak in these three months which coincides with the most metabolically demanding time for the female bats.

Throughout May, females are pregnant before giving birth in late June or early July. The pups are fully dependent on their mothers for milk for the first four weeks, but are able to forage for themselves after six weeks²⁰. During much of July therefore, female common pipistrelles will make 2-3 trips out to forage, returning to the roost (often for an hour at a time) to feed their pups and perhaps warm them up during the night²¹. Males begin establishing and defending mating roosts from July to September, flying and calling for females which means they too are spending more time on the wing by July.

The survey data for this period shows a clear peak in the first part of the night, consistent with all bats leaving their roost after sunset. Activity then stays high throughout the rest of the night, though at a slightly lower level than after sunset – this might be linked to females returning to the roost to feed their pups or the lower foraging requirements of the males who only have one mouth to feed! The continuity of activity throughout the night is also likely to be linked to how short the nights are in mid-summer so they have to make the most of what darkness is available. The need to forage and support their young makes foraging non-negotiable for females who will fly in all weathers as they are responsible for hungry mouths back at the roost.

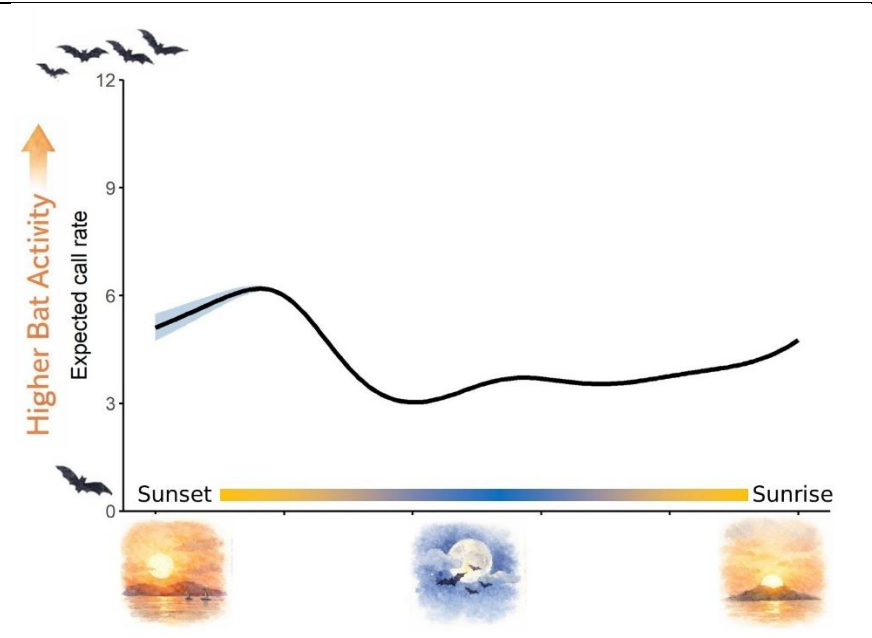


Figure 23 - The pattern of common pipistrelle recordings throughout the night between May and July. There is an initial peak just after sunset which continues for the first quarter of the night, but activity remains constant throughout with a final peak at sunrise.

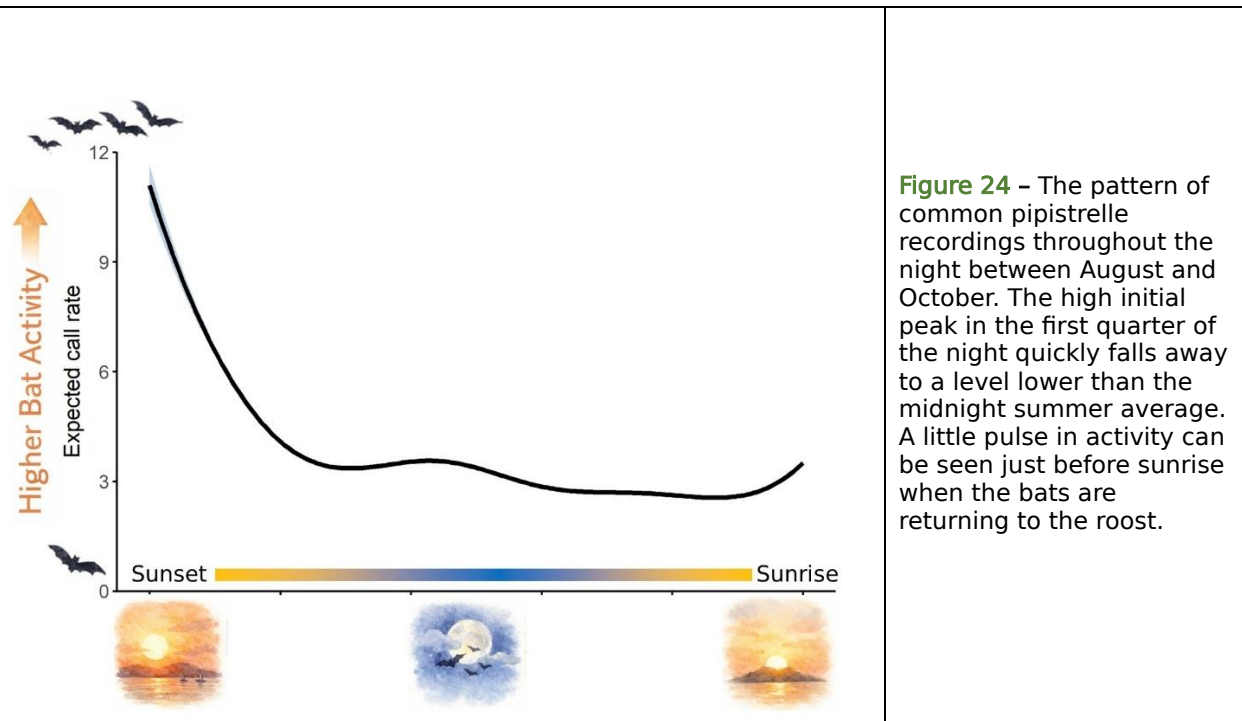
Late-summer: Weaning, independence and mating

Common pipistrelle pups can fly at around four weeks old, and are independent after six weeks. This means that from around the beginning of August they are starting to take their first flights, and by the middle of the month they will be weaned and able to forage for themselves. Watching a maternity roost emerge at this time of year, you can often spot the slightly smaller and weaker fliers amongst the bats as the pups take their first training flights.

Through September and October, the bats are feeding and fattening up to get through the leaner winter²², but for the first time since they became pregnant at the beginning of May, the females have only one mouth to feed. Moreover, nights are getting longer which means that not only do the females need to feed less, but they have more time in which to do it.

The males in the meantime are getting a little busier – common pipistrelles mate in the autumn and the females store the sperm over winter to allow fertilisation to occur in spring. The males will be maintaining mating roosts and engaging in song flight, calling to attract females to join them. You can read more about this in the section on Socialising and Foraging.

The activity pattern in this period is similar to the spring transitional period, returning to a strong early peak when all of the bats emerge around sunset, and a continuous but lower activity sustained through the remainder of the night. The end of this seasonal window in October and November reflects the autumn transitional period when bats move from summer to winter roosts and their activity reduces.



Island Patterns

Inter-island Differences

The Big Scilly Bat Survey design from 2022 and 2023 aimed to get detectors out on each of the islands in a strategic pattern – this was to sample every 1km grid square twice in 2022; and to sample every 500m grid square once in 2023. This allows us to compare activity levels between islands.

The average activity levels were plotted for each island in 2022 and 2023 along with the ‘error bars’ which show how tightly or widely spaced the records were around this average.

The error bars show that there is a large amount of variation between the nightly averages on each island. There are lots of other factors which can affect activity between sites and between nights such as habitat and weather which aren’t controlled for in this simple analysis but we’ll dig into these next!

The graph reveals that Tresco and St Mary’s have 3 to 4.5x higher activity compared with the other three islands and a statistical test confirms that this is significant. Whilst there are slight differences between the three smaller islands, St Agnes, Bryher and St Martin’s, the variation is too wide for this to be statistically significant and we must assume they are roughly the same.

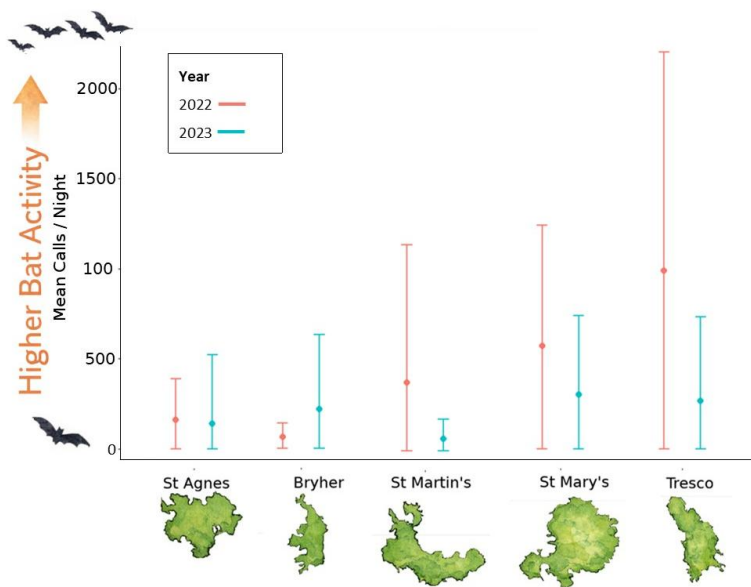


Figure 25 – The mean number of calls per night at static detector locations on each of the five inhabited islands. Data is shown for 2022 and 2023 and is weighted by the number of nights deployed on each island to account for differences in sampling effort on each island. Error bars show standard deviation around the mean.

It is important to remember that static bat detector recordings of activity levels are **not** reliable indicators of population size. They only record passes, not individuals, so 100 calls could reflect 100 bats zipping past the detector in a hurry, or just one bat who stops to chase insects right in front of the microphone. Confidence increases when the pattern remains statistically significant when scaled across two years and multiple habitats on each island. In this case therefore, it would be interesting to speculate on the reasons why

the two larger islands appear to have higher activity levels than the three smaller inhabited islands. This could be explained by several factors, some of which form the basis of the next few sections of this report:

- **Better Quality Habitat supports Larger Populations:**

There are differences in the habitat makeup of each island. Tresco and St Mary's have higher tree-cover than the three smaller islands. They also have the largest inland waterbodies and wetlands with Great Pool on Tresco, and Lower and Higher Moors on St Mary's. Woodland and wetland are excellent habitat for the invertebrates which common pipistrelles feed on and is likely to help sustain a larger population.

- **Better Quality Habitat Attracts Commuters:**

There is also the possibility that bat activity might be highest on Tresco and St Mary's because bats are commuting there from other islands in order to forage. There is good evidence that common pipistrelles usually establish their roosts close to good quality habitat²³ so a larger resident population is the more likely explanation, but there are plenty of case studies showing that bats will commute to higher quality habitats to forage.

- **Large, Stable Roosts supports Larger Populations:**

Tresco and St Mary's are the only two islands where large maternity roosts are known and it could be that these safe, reliable roosts help support a larger population over the years. In each case, 100+ common pipistrelle bats can be reliably counted in and out of these larger maternity roosts each year. However, the possibility can't be excluded that similarly large roosts could still be present on the other islands, but have so far escaped detection.

Habitat Associations

Bat Habitat Preferences

We know much about habitat preferences of UK bat species from decades of work on the mainland. Foraging habitat is linked to hunting which means that the distribution of prey affects the distribution of the bats. Whilst all bat species in the UK eat small insects exclusively, they vary in the type of prey they focus on and this affects the definition of 'good' habitat²⁴:

- **Common pipistrelles** forage on small flying insects (particularly flies) which are widely found in the landscape, however certain habitats support more insects which will often concentrate in places of shelter in open countryside²⁵. Common pipistrelle are often found foraging along these natural 'edge' habitats – where grassland meets woodland or where a hedge intersects a field²⁶. However they are flexible generalists and will respond to the local conditions – a strandline of seaweed might be ideal one night, whilst the vicinity of a compost heap or pond might provide excellent foraging habitat another.
- **Daubenton's bat** has not been found on Scilly. Daubenton's bats are strongly associated with water where they generally eat insects with aquatic larval stages (midges/caddis/mayflies)²⁷. They have a specialised hunting technique called 'trawling' where they pluck insects off the surface of the water. They are common along rivers and canals and around lakes and ponds.
- **Greater horseshoe bats**, found just over the water in Cornwall, feed on larger insects like dung beetles, cockchafers, moths and craneflies²⁸. They are often associated with dung-rich grassland habitats which support these species, such as cattle-grazed pasture.

Scillonian Habitat Associations

In the Big Scilly Bat Survey, we only have enough data on common pipistrelles to look at their habitat preferences – the other species were too infrequently recorded to make any meaningful assessments of habitat associations. The survey design employed in 2023, covering every 500m square, allows us to look at whether particular habitats are associated with higher levels of activity.

To complete this analysis, we took the following steps:

- Habitat within a 150m radius of each detector was defined using David Mawer's habitat maps, originally produced for The New Flora of the Isles of Scilly²⁹ and kindly made available for this research. For each location, the three most dominant habitat types were identified within the radius.
- The 2023 activity data were "seasonally normalised" using information from fixed monitoring sites operating in 2024. As described in the Seasonal Patterns section

above, bat activity naturally varies through the year, with some months showing much higher activity than others. To allow fair comparison between sites which were surveyed at different times in the season, the 2023 data were weighted using the seasonal pattern observed at the fixed sites in 2024.

- A statistical model was then used to test whether differences in bat activity could be explained by the habitats surrounding each detector. This allowed us to assess whether common pipistrelles were more active in certain habitat types than others across the islands.

We found the following results which are illustrated in Figure 26 below.

- **Woodland and wetland** were both associated with higher levels of activity – this is consistent with our expectations based on the well-known habitat preferences for this species;
- **Heathland** was the only habitat consistently associated with lower activity levels – this is an important finding given the dominance of heathland on the islands;
- Other habitats common across the island such as **grassland, bracken, settlements and coastal habitats** were equally distributed in the middle and associated with average activity levels.

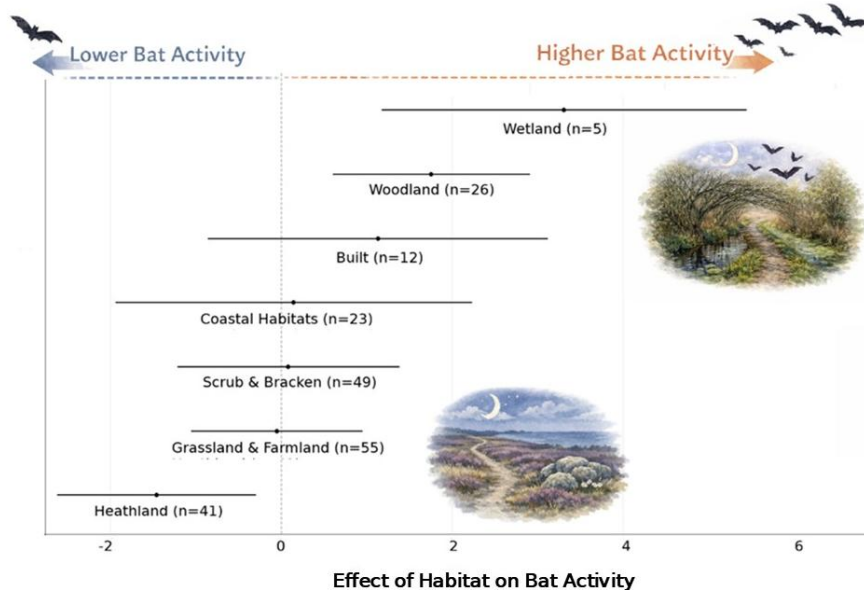


Figure 26 - The effects of habitat type on the levels of bat activity. Data is taken from 2023 when a stratified geographical spread across every 500m square of the islands was surveyed. The scale on the x-axis is Effect vs. Sea on $\log(1 + \text{activity})$.

Habitat and Islands

The statistical analysis confirmed that the differences between islands which we saw in the section on Island Patterns above can be well explained in terms of habitat preferences. Tresco and St Mary's have plenty of 'average' habitats, as well as less preferred heathland, but it is the higher activity levels within the woodland and wetland habitats which better explain the results we saw on Tresco and St Mary's.

To help visualise this, using the analysis above, we can broadly identify habitat quality as:

- **Good** – Wetland and Woodland
- **Average** – Grassland & Farmland, Scrub & Bracken, Coastal, and Built;
- **Poor** – Heathland

The islands are of different sizes so a simple area-by-area comparison is not very helpful to understand the habitat differences. St Mary's has more heathland by area than St Martin's for example, but as a proportion of its overall size, it is a lower percentage. The habitat composition of each island was therefore defined proportionally so that each pie chart in Figure 27 below represents the whole island area, subdivided by the prominence of each habitat.

What stands out most in the charts is that Tresco and St Mary's have significantly more of the 'Good' quality habitats – Wetland and Woodland – than any of the other islands. This is likely to be the key to understanding the data.

This could have some important implications for bats on the islands – heathland represents around a quarter of the habitats on the four off-islands and a large proportion of the semi-natural habitats which are not used for residential use or agriculture. By contrast, there is a very low tree cover on the three smaller islands and very little which could be classified as 'woodland'. There are many factors affecting land use and conservation priorities, and different reasons to conserve or promote different habitats, but increasing woodland cover or creating wood pasture mosaics within grassland or heathland might have a positive impact on the bat populations on the islands.

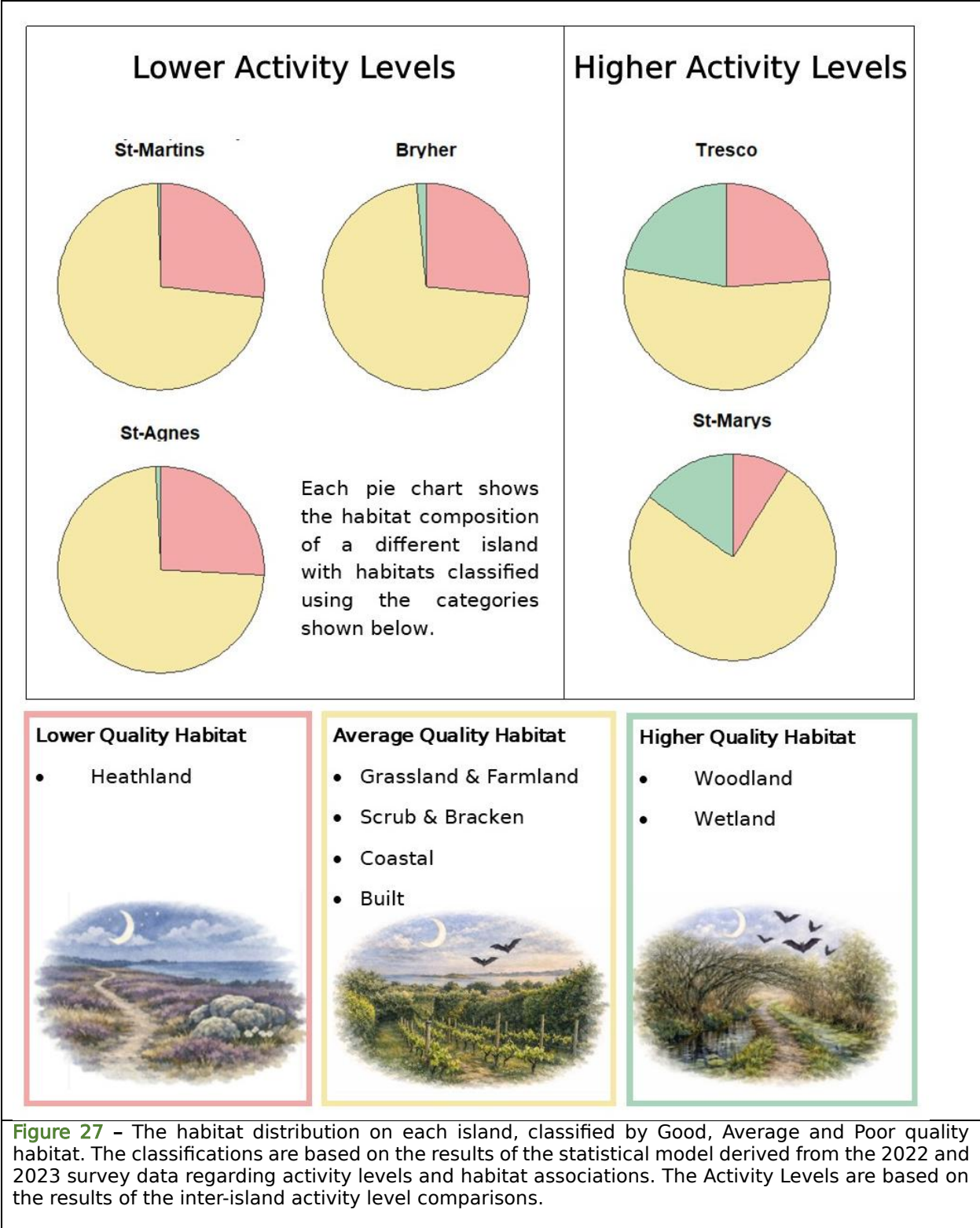


Figure 27 - The habitat distribution on each island, classified by Good, Average and Poor quality habitat. The classifications are based on the results of the statistical model derived from the 2022 and 2023 survey data regarding activity levels and habitat associations. The Activity Levels are based on the results of the inter-island activity level comparisons.

Shorelines

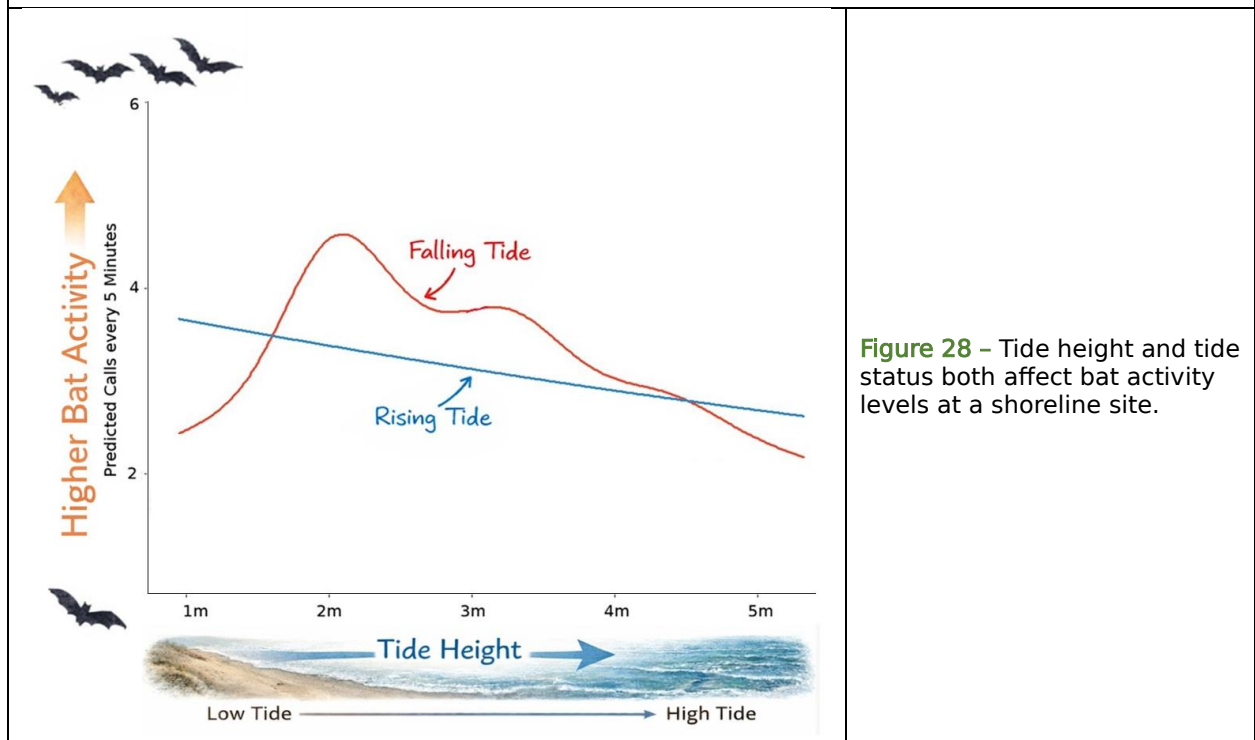
Strandline Foraging

One way in which Scilly stands apart from many other parts of the UK is the sheer amount of coastline relative to inland habitat in Scilly. We were interested to find out how common pipistrelle bats use the beaches and shorelines as part of our study in 2024.

Tides affect everyone here on Scilly – whether it’s picking the best time to enjoy the beach or dictating which quay the boats can access on the off-islands. For bats and many birds, the beach and shoreline are potential foraging grounds which the tide affects in significant ways. Our hypothesis was that falling and low tides would be the best time for bats to forage on the shoreline:

- A **falling tide** will retreat from the land and leave behind lots of flotsam and jetsam – think seaweed and dead crabs – which are attractive to insects, which in turn become prey for bats.
- A **rising tide** on the other hand will cover the sand and wash away all of these attractants making it less suitable as a habitat for insects and therefore as a habitat for bats.

To test this hypothesis, we deployed a bat detector in a coastal location overlooking Little Porth on St Mary’s, and two at inland wetland sites – Lower Moors and Higher Moors. The detectors ran consecutively from the beginning of May to the end of October in 2024, allowing night-by-night comparison of activity and patterns at the different sites.



Results

The results showed that there is indeed a tidal influence on activity at the Little Porth site. This is a pattern which is not present at the inland comparison sites (as seen in Figure 29 below):

- Bat activity is at its lowest when the tide is at its highest – this is when there will be very little of the beach to be seen;
- Activity is at its highest in the mid-ranges of a falling tide – there is a strong increase in activity levels around the 2-4m when the sea is retreating, leaving exposed sand and all of the debris which could attract insects;
- Activity is also a little lower at the very lowest tides – this might be an artefact of the survey design. The bat detector was positioned above the high-tide mark but when the tide is out, the detector would not have picked up as many bats if they were largely foraging along the water's edge, relatively far from the bat detector at low tides.
- When the tide is rising, the pattern is much more linear than when it is falling and you don't see the same peaks and troughs. There is instead just a general trend of the higher the tide, the lower the activity.

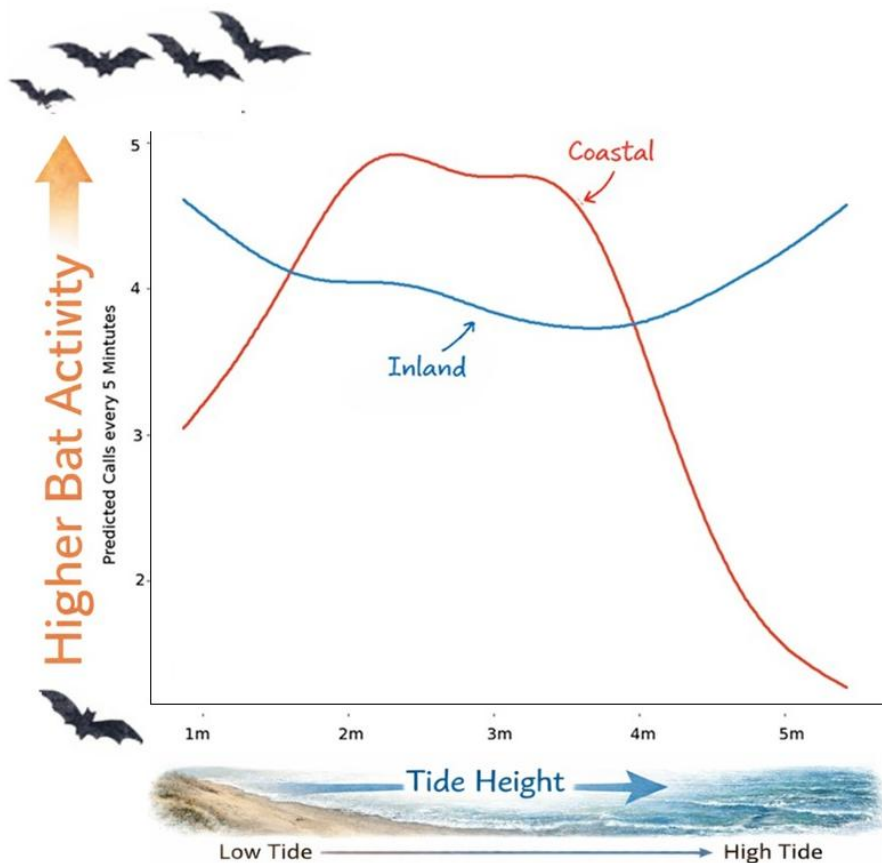


Figure 29 - Tide height differentially affects bat activity levels at a coastal site vs inland sites. The strong influence of the tide - especially at low and high ebbs - is absent from the inland wetland sites, although the data from these inland wetland sites could suggest a slightly reduced activity at the mid-tide period due to bats preferring to feed coastally in those time periods.

The results of this study correspond with the behaviour recorded on Devon beaches in a 2019 study³⁰ which found the same pattern of increased bat activity with receding tides, though they were lucky enough to have many more species of bat joining the common pipistrelles for a night on the beach! The researchers in that study hypothesised that the bats were probably foraging on seaweed flies which congregate on the shoreline as the tide goes out.

Checking the behaviour of bats at the inland sites was an important way to ensure that the pattern we were observing really is linked to the tides rather than some other variable we were overlooking – the strong pattern identified is indeed only visible on the shoreline.

Interestingly there is a slight inverse to the relationship so that higher activity levels at the coastal site correspond with slightly lower levels at the inland wetland sites. These inland wetland sites are in close proximity to the coast, so bats could be moving from these wetlands to spend time on the shoreline when the conditions there are optimal.

Heathland

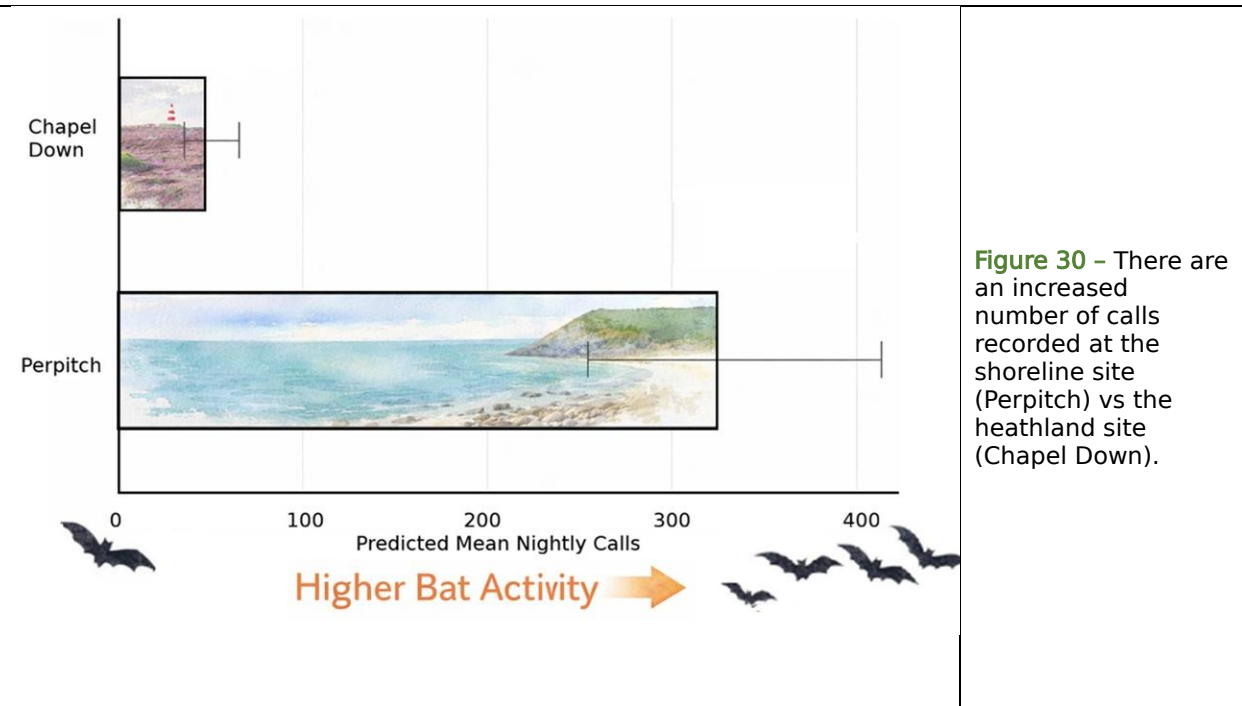
Overview

The analysis of the results from the 2023 dataset suggested that heathland – one of the most common semi-natural habitats on Scilly – is less favoured by common pipistrelles so we decided to investigate this further in 2024.

On St Martin's, we placed a static bat detector at a heathland site (Chapel Down) and another just down the coast on a rocky shoreline site (Perpitch) on the same island from May to October to compare activity.

Results

Overall, the shoreline site showed significantly higher activity levels compared with the heathland site. Over the course of the six-month deployment period, activity levels at Perpitch were nearly seven times higher than they were at Chapel Down. This result was statistically significant.

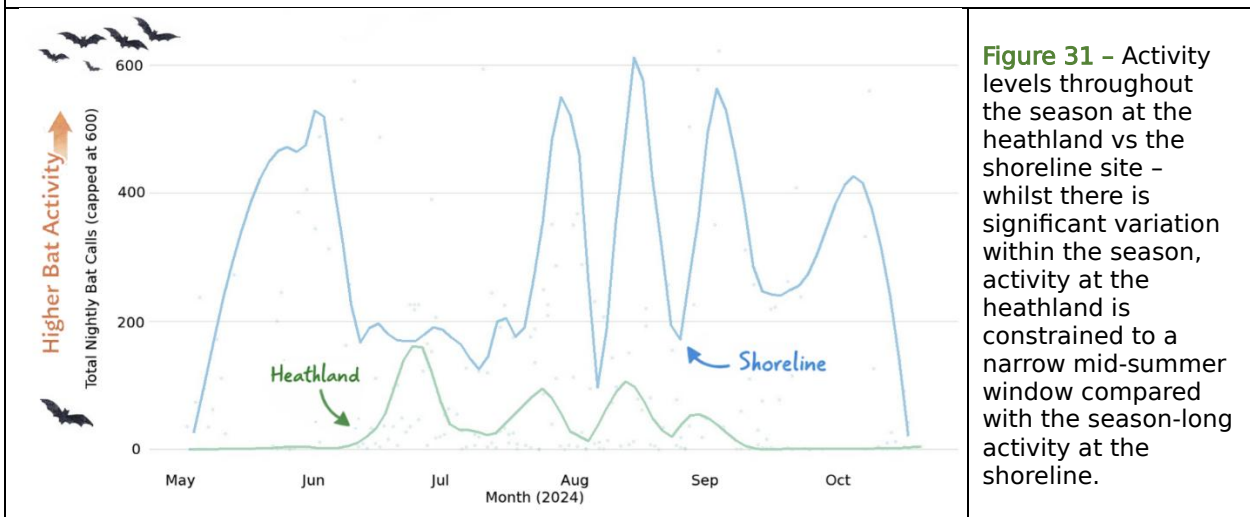


There is also a clear seasonal difference in activity patterns between the two sites:

- At the **shoreline site**, activity quickly picks up at the beginning of May and fluctuates significantly throughout the season but does not reduce until the end of October. Activity remains fairly constant. The time of year is not a statistically significant explanation of the variation seen in activity levels.

- The **heathland site** on the other hand doesn't begin to see regular activity levels until the middle of June, around six weeks into the study, and it drops off in mid-September. These differences in seasonal activity are statistically significant. This means bats are using the two locations differently and within a shorter window at the heathland site compared with the shoreline site, even after you account for the much lower levels of bat activity at the heathland site.

A note on the rollercoaster line at the Shoreline site: the smoothed activity levels in the graph are influenced by some individual nights with very high activity which create some artificial peaks and troughs – there might be some interesting reasons for this but it is a question which cannot be answered by our dataset. It could also be an artefact of the limited data – if the data spanned over more sites or over more years, the variation in the graph line for the shoreline site may be less pronounced.



The BTO Acoustic Pipeline analysis in 2024 was able to pick out the distinctive ‘feeding buzzes’ which common pipistrelles make when they are zoning in on an insect. This is a sound they only make when foraging, so can be used to understand a little more about how bats are using a site.

On Perpitch, feeding buzzes accounted for almost 8% of the records throughout the season, whereas on Chapel Down, this was just over 2%. This means foraging behaviour was recorded almost four times more at the shoreline site as compared with the heathland site.

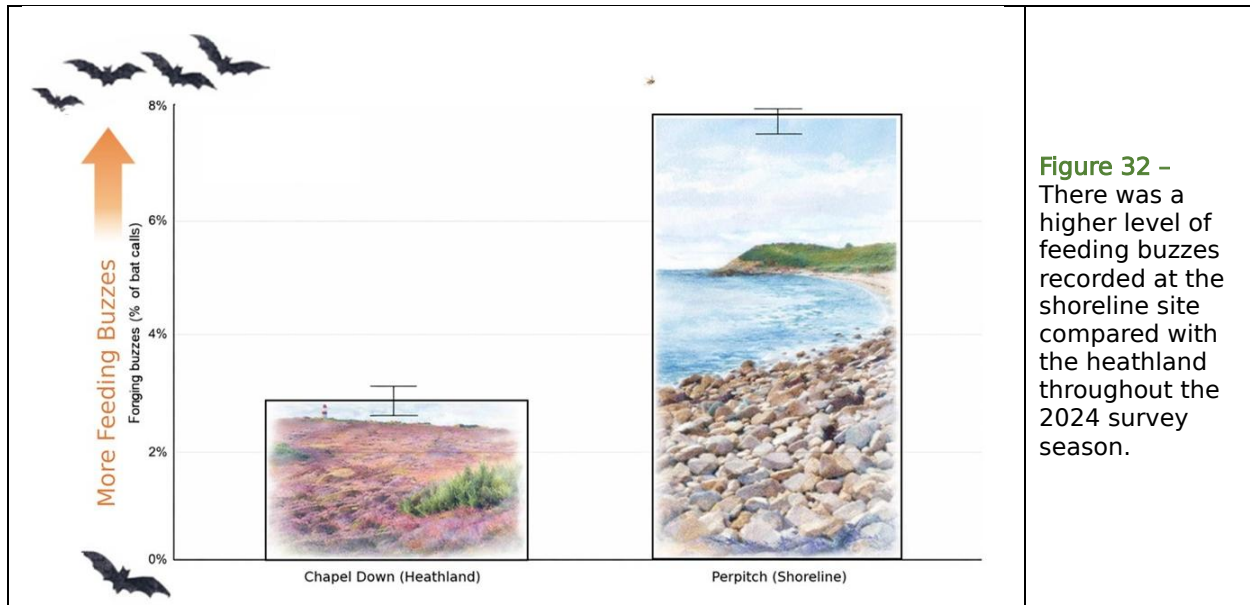


Figure 32 – There was a higher level of feeding buzzes recorded at the shoreline site compared with the heathland throughout the 2024 survey season.

Overall, this analysis appears to support the results of the habitat preference analysis results from the 2023 data where heathland such as Chapel Down was found to be poor quality habitat compared with other foraging sites on the islands, whilst coastal sites such as Perpitch were found to be average. The findings of the 2024 paired detector survey is not conclusive – it is only a single pair of sites on one island – but is consistent with the wider findings across all islands in the wider survey of 2023.

More importantly, the survey results suggest something about the use of these habitats – there was much more foraging as a proportion of activity at the shoreline site compared with the heathland – and with a stronger seasonal pattern in use.

Heathlands on Scilly, such as Chapel Down, are relatively botanically poor with heather representing the dominant species in this location, and gorse and bracken are also abundant. An assemblage of smaller wildflowers can be found such as tormentil, lousewort and milkweed, but the diversity is significantly lower than a good quality grassland habitat. Activity at the heathland site was found to be low throughout the survey season, but the peaks which are present appear to correspond with the summer season and the flowering phenology of wildflowers. Both bell and ling heather typically flower from July to September whilst other flowering plants such as honeysuckle may start earlier in June.

Species such as gorse flower year round, and create more structure and ‘edge habitats’ for common pipistrelle to forage along. The location of the Chapel Down detector was more open and heather-dominated but heathland ecotone habitats with a little more structural variation in the vegetation may represent better foraging habitat.

Foraging and Socialising

Overview

The BTO Acoustic Pipeline software was able to detect additional behavioural cues from the 2024 data. These social calls and feeding buzzes can help us understand what the bats are doing at our different sites throughout the year.

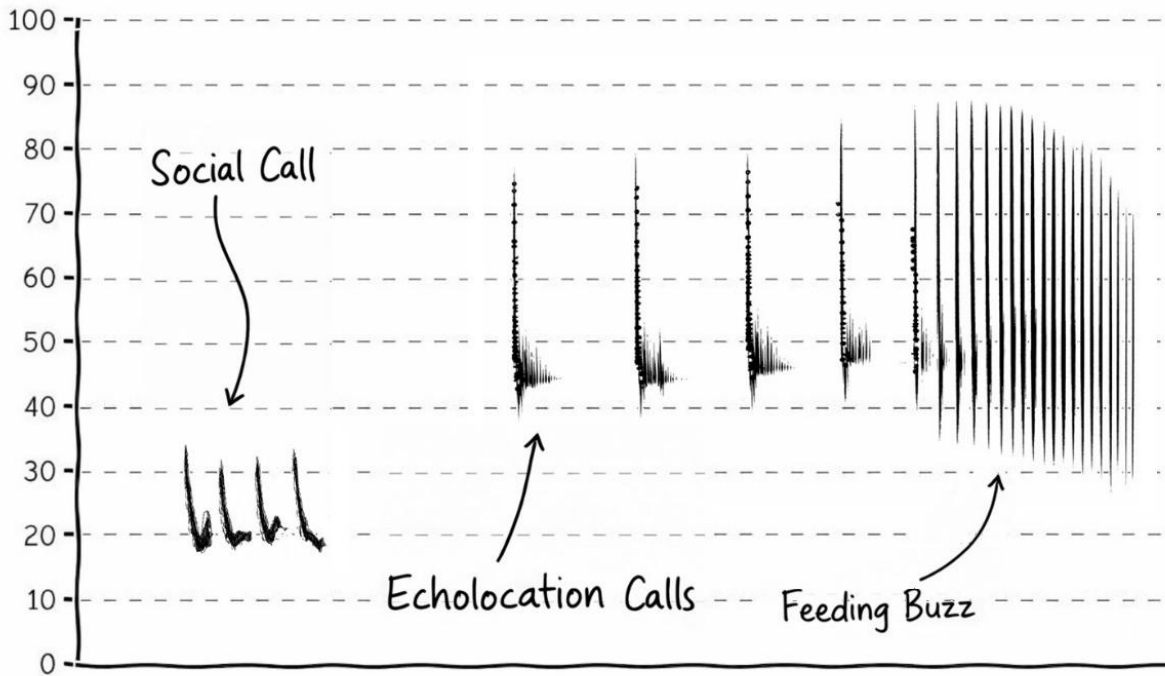


Figure 33 - This is an illustration of sonograms which show the different call shape and frequencies of social calls, echolocation calls and the feeding buzz of common pipistrelle. There are a range of different social calls which are used in different situations but the example above is one of the most commonly recorded examples in the field.

Echolocation Calls

A total of five sites were monitored throughout 2024. These were:

- **Lower Moors** - a wetland/woodland site in the centre of St Mary's
- **Porth Hellick Pool** - a large brackish lagoon within the Higher Moors nature reserve on St Mary's
- **Little Porth** - a sandy shoreline site in Hugh Town, St Mary's
- **Perpitch** - a rocky shoreline site on St Martin's

- **Chapel Down** – a heather-dominated heathland site just up the hill from Perpitch on St Martin’s.

Looking first at echolocation calls alone – those sounds emitted when bats are in flight but which don’t have an associated feeding or social call – the activity levels show a peak around July/August and decrease into autumn as the winter approaches. The data shows a lot of variation however from day to day and this will reflect weather conditions, prey availability and other influences on bat behaviour.

The graph below shows the data from all five sites combined; comparing each of the sites individually, this pattern is consistent, although there are inter-site variations in scale.

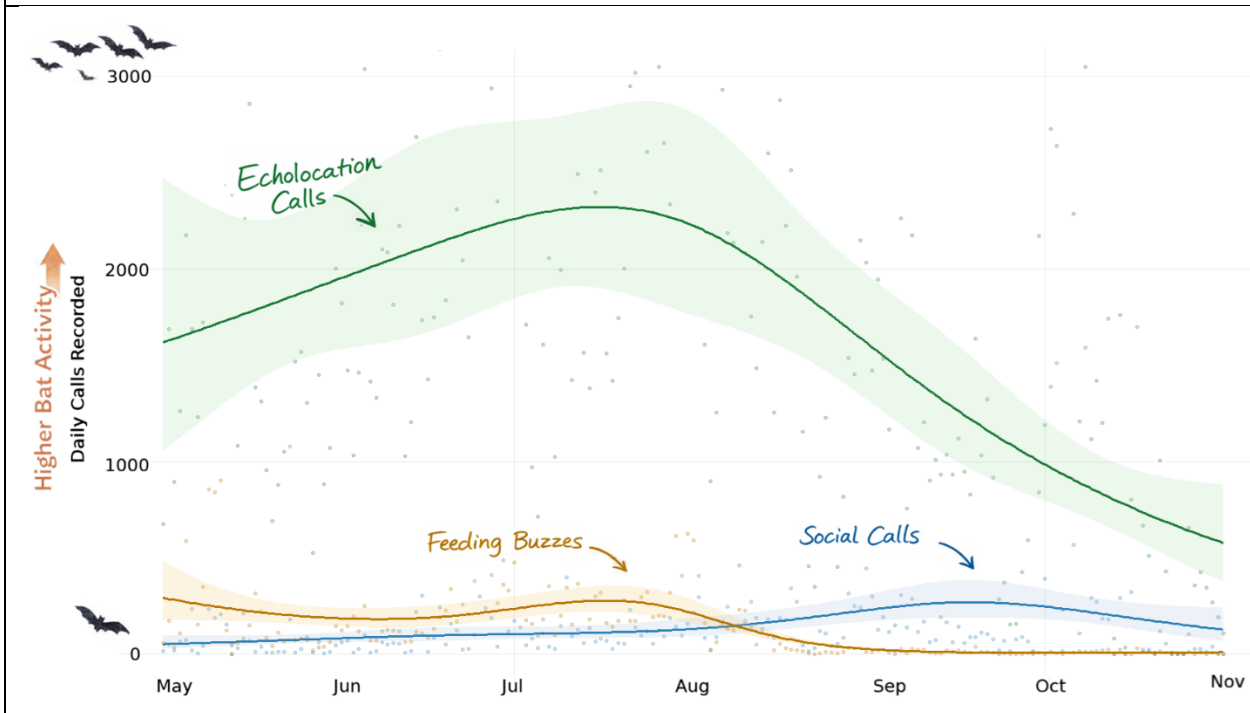


Figure 34 – Combined data from all five 2024 study sites to reveal seasonal trends in call types. There is a mid-summer peak in echolocation calls (without any behavioural indicators), representing higher general activity levels which decline into autumn. Foraging buzzes are more frequent between May and August, falling away in September and October. Social calls were recorded at a lower level in the early part of the year and increase in September and October.

Social Calls

Social calls are ultrasonic calls which are made to be heard by other bats and to convey information. Whilst an echolocation call is understood to be a single bat navigating its way through a landscape and understanding its surroundings, a social call might be intended to attract a mate, call for help or warn off a rival. There are different types of social call, but one of the most common forms (as shown in Figure 33) is just on the threshold of human hearing – younger people tend to be able to hear them better but if your hearing is keen,

you might have noticed the very high pitched chirrups of their calls overhead at night, especially in late summer and early autumn.

The proportion of social calls, compared with echolocation calls, shows a strong increase in the autumn when data is pooled across all sites recorded in 2024. The call rate is fairly constant through the summer, typically representing only 3-4% of all calls recorded, but this begins to increase noticeably in September with a strong peak in October when an average of 15% of calls are identified as social but there are nights when over 50% of recorded calls are social at the October peak.

Interesting, although this trend is statistically significant when looking at all the sites together, it's clear that the strong October peak is driven by activity at the Lower Moors and Little Porth sites. This suggests that these two sites are locations where higher levels of social activity occur in autumn. The two sites on St Martin's don't show an uptick in social calls in the autumn. The Porthellick Pool site on St Mary's shows a little blip, but not to the same scale as the other two St Mary's sites.

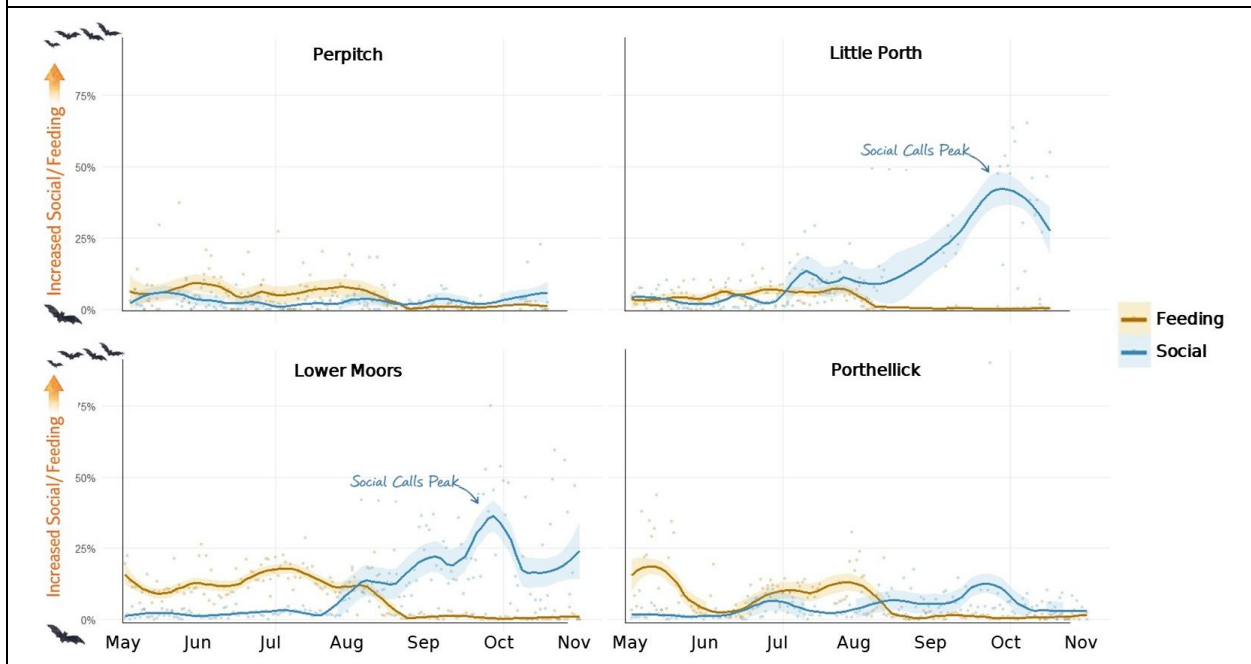


Figure 35 – Number of social calls and feeding buzzes each recorded as a proportion of echolocation calls at four sites where season-long recording was undertaken in 2024. Note that, as the activity levels were so low, Chapel Down was excluded from further analysis as no meaningful seasonal patterns could be determined with such little data.

Peak social calls can be seen in September and October at the Lower Moors and Little Porth sites. These two sites appear to be driving the overall trend in increased social activity seen when the data is combined. A small increase is seen at Porthellick Pool but no change can be detected at Perpitch.

The decline in feeding buzzes occurs at all four sites, including those two where no significant increase in social calls is identified. This would support the hypothesis that a relative scarcity of food later in the season may be a factor in explaining the reduction in feeding buzzes – however, a switch from foraging flight to social flight would not fully explain the data shown in all sites.

Studies in the UK have identified several reasons why the social calls might increase in the autumn and whilst the data from the Big Scilly Bat Survey isn't enough to determine which of these is the case here, we can consider the possibilities:

- **Mating:** Common pipistrelles mate in the autumn and the females store the sperm over winter before fertilisation occurs in the spring; they become pregnant around early May. In the autumn, males will perform 'song flights' where they fly and emit social calls to attract females and establish territories. These are often a complex sequence of at least 10 social calls at regular intervals³¹. Although these have not been decoded, they could include information about the sender's sex, age, weight and size.
- **Foraging Territories:** Common pipistrelles will also defend territories, especially when food is concentrated in a particular place or when insects become scarcer³² – both of which are likely to be true in these higher quality foraging sites as the prey abundance of summer declines in September and October. A 'resident' bat will announce their claim over a territory using complex social calls which they broadcast widely as they are flying as a warning to others to stay away; but they will also use different targeted high-frequency social calls when chasing a rival off their turf!

Other types of social calls also occur in bats but are unlikely to be the cause of the seasonal increase we've seen in the Big Scilly Bat Survey data:

- **Distress:** If a bat is in trouble, they will emit distress calls³³. This might simply be a pro-social warning to others, but these calls will often attract other bats to come and investigate and they may help the distressed bat by confusing or mobbing a predator;
- **Maternal:** There are particular types of social calls between mothers and pups when in flight³⁴, though these are likely to be at their peak around August/early September when the young take to the wing for the first time;
- **Information:** It may be that some of the social calls produced by bats are sharing information, for example regarding foraging resources or hibernacula though this is a little more speculative.

Feeding Buzzes

The other behavioural signal revealed by the 2024 data is foraging activity – touched on briefly in the section on Heathland habitats.

A 'feeding buzz' is a unique signature which is produced when the bat homes in on an insect, so is directly linked with feeding. Standard echolocation calls are produced during flight regardless of the behaviour in which the bat is engaged. As the bat gets closer to their prey, they need finer and finer scale information to be able to catch it on the wing. The calls therefore get closer together as the bat gets millisecond updates on the precise location of

their target, and the change in call shape with precise pulses of sound over a broad spectrum provides the clearest form of echolocation to discern fine detail. You can see the transition from echolocation to a feeding buzz in the sonograms illustrated in Figure 33.

Looking at the ratio of foraging buzzes compared with the echolocation calls shows that foraging activity as a proportion of overall flight decreases across the survey period from the highest levels in midsummer to much lower levels into the autumn. Unlike the social calls, this pattern is seen across the four sites.

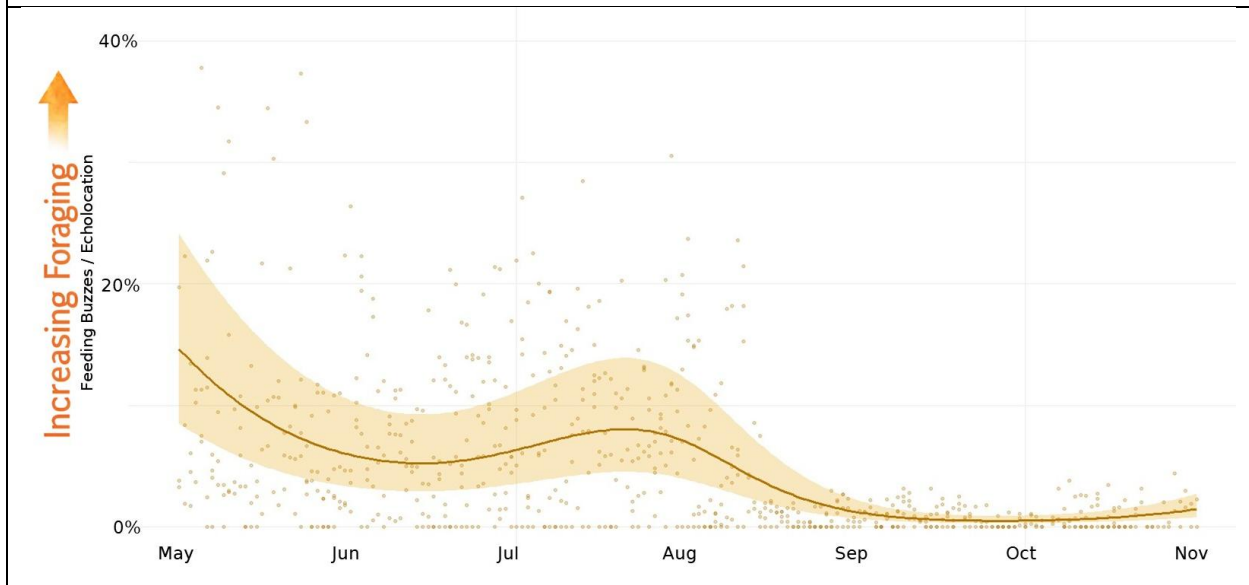


Figure 36 – Decline in feeding buzzes as a proportion of echolocation calls (those without any behavioural identifiers) throughout the season. This shows that, independent of the decline in overall activity seen across the sites, there is strong decline in feeding buzzes in September and October.

The foraging buzzes shown in Figure 36 are modelled in proportion to the number of echolocation calls to ensure that this isn't simply reflecting an overall decline in bat activity. This demonstrates that, even though the overall activity levels decrease into the autumn, the foraging signals decline by an extra order of magnitude – there is a 10-fold difference between the proportion of feeding buzzes in summer and autumn, from 7% to 0.7%.

This pattern could be partially explained by a change in **why** bats are on the wing – if lots of the echolocation in the autumn is produced by males who are busy advertising their mating potential in song flights, they will be busier producing social calls than foraging. This would be partially consistent with the data as Figure 35 shows how the foraging and social lines cross over in autumn – feeding buzzes decrease as social calls increase.

It is however noticeable that the two sites without the significant increase in social calls also see the same decline in foraging, so the trend is also likely to reflect the reduced prey numbers in the autumn which means bats might need to spend more time in flight between captures.

In reality, it is unlikely to be an either/or situation but linked responses to a decrease in insect availability. One of the reasons for increased social calling is to defend scarce foraging resources, so as insect numbers drop and it takes more effort to catch them, bats

may also be more vocal in defending their patch against rivals. This is to be expected at higher quality foraging habitats which are likely to remain the prime spots as autumn draws towards winter.

Uninhabited Islands

Overview

One aspect of bat ecology on the Isles of Scilly which has been less well understood historically is whether bats are present on the uninhabited islands. Remotely deployed static detectors are the ideal tool for this kind of research as they can be set and collected in the daytime but record continuously for several nights. Before this technology was available, a surveyor would have to camp out for the night to see if any bats flew past!

In 2023, the detectors were set out on four of the Eastern Isles – Great Arthur, Little Ganilly, Great Ganilly and Nornour – along with Teän which lies between Tresco and St Martin's, and White Island which is connected to St Martin's only at low tide.

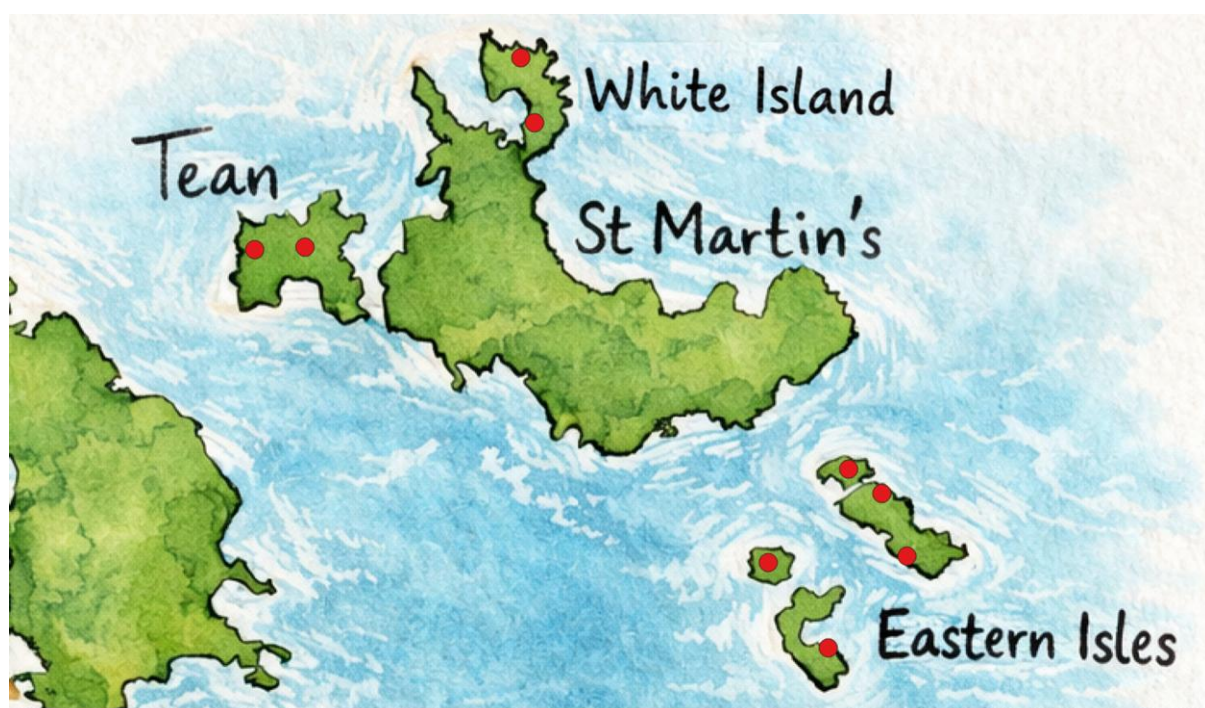


Figure 37 – Illustrating the locations of static detectors on uninhabited islands around St Martin's in the 2023 survey.

Results

Each island was surveyed for just a few nights as part of the wider survey effort to sample each 500m grid square, but this was enough to confirm the presence of common pipistrelles on every island, as well as Leisler's and Nathusius' pipistrelle on the Eastern Isles.

These islands are all uninhabited and do not have buildings or trees which might be used by roosting bats. Common pipistrelles will roost in natural crevices in the rocks where suitable structures occur³⁵, but it is considered likely that bats are flying between the islands to forage.

Comparing activity levels on the uninhabited islands from detectors placed on inhabited island sites within the same season showed only 15% lower activity on the uninhabited islands. However, the sample sizes were small and there was wide variation between recordings so this result was not statistically significant. This suggests regular foraging activity on these uninhabited islands.

Interpretation

Understanding how frequently and easily bats move between the islands has important implications for how the population exists and how resilient it might be. The survey data confirms regular common pipistrelle activity on uninhabited islands, but we are not yet able to determine where these bats roost or how they behave on a night-by-night basis.

Some of the best data on common pipistrelle foraging ranges comes from radiotracking data on the mainland. In these studies, bats are captured and temporarily fitted with trackers which reveals their location to surveyors who follow them over the course of several nights until the tracker falls off. Surveys in good quality habitat in the south of England found that common pipistrelles do most of their foraging within a 2km radius of the roost³⁶; however, data from a northern study found bats flying further, up to 10km from their roost to reach a high quality foraging habitat³⁷. These bats flew across poor quality farmland to reach high quality woodland habitats, and the researchers hypothesise that the habitat patchiness resulted in the bats travelling longer distances. When considering the results on Scilly, our islands of higher quality foraging habitat, separated by the sea, might result in very similar movement patterns.

The distances required to travel between the inhabited and uninhabited islands in the northern part of the Scilly archipelago would be easily within the routine radius that bats forage from their roosts, even in high quality habitat. The only impediment would be the exposed flight over the sea which could pose risks in poor weather, but researchers conducting surveys on Hilbre Island³⁸ in the mouth of the River Dee in Liverpool concluded that a number of species, including common pipistrelle, were flying 2km from the mainland to forage on the island on a routine basis.

Common pipistrelles are typically thought to fly at between 5-8m/s³⁹ – this would allow them to fly from St Martin's to the Eastern Isles in under 2 minutes and to St Mary's in around 5 minutes. Provided conditions were reasonable, it is therefore consistent with the

known flight characteristics, ecology and resource partitioning of this species that they could routinely fly between all of the islands of the archipelago.



Figure 38 – Illustrating the mean-tide distances between islands within the northern part of the Scilly archipelago, including the uninhabited islands where bats were confirmed in 2023.

Population Dynamics

Common pipistrelles are a social species. The females form maternity roosts throughout the summer. This is not a static situation however – some colonies switch between different maternity roosts throughout the season and these will sometimes splinter with satellite roosts forming before they come back together. We can see evidence consistent with this in Scilly – the numbers of bats in the larger maternity roosts in Maypole and Tresco will fluctuate between counts just two weeks apart in June as bats join or leave the group.

This species is generally thought to exist as a population network on the mainland with nearby colonies having overlapping foraging territories and females occasionally switching between colonies. Males are likely to provide a reproductive link between different nearby groups. A key research question for Scilly is whether the presence of the sea between the islands affects this population structure.

Three key hypotheses might exist for how common pipistrelles behave on Scilly and, as is almost always the case in animal behaviour, the true status might fall somewhere in between these neat categories and may shift over time:

- **Isolation Hypothesis:** Bats might exist in reproductive colonies on their individual islands or island groups and rarely travel beyond them to forage or reproduce. This could be comparable with the findings of the survey if, for example, the Eastern Isles might be the exclusive resource of the St Martin's breeding population but never used by bats from St Mary's. This would result in a collective of largely separate populations. It is perhaps unlikely given the spatial proximity of the islands and the evidence to suggest that bats are likely to routinely fly between the islands;
- **Population Network Hypothesis:** Bats might exist in reproductive colonies on their individual islands or island groups much as they do on the mainland, but routinely fly between the islands to forage, resulting in occasional mating and mixing between groups. Populations would be linked but distinct. This seems to be the most likely situation if we assume the sea represents a partial barrier when the weather is poor;
- **One Big Population Hypothesis:** Bats might exist in a single functional population where bats routinely move between islands, potentially including switching roosts between islands so that a maternity colony on St Martin's might switch to St Mary's when the weather changes. This is less likely given the known ecology of the species on the mainland and the barrier (although limited) that the sea is likely to create.

Island populations of species are often susceptible to inbreeding due to a small pool of individuals, especially where populations are small or suffer declines as occurred with the increased use of toxic timber treatments on the islands between the 1960s and 1980s. More linked populations between the islands are likely to be less at risk of this because they can exhibit metapopulation dynamics where there is genetic mixing between groups, and a nearby population can re-colonise an area if a local population suffers a loss.

Further research to better understand how the population on Scilly operates would be valuable to understand the level of resilience that our bats are likely to show.

Discussion

Findings

The Big Scilly Bat Survey has been successful in inspiring a wide range of volunteers from the islands to get involved with a citizen science project and learn more about our resident bat population.

From a research perspective, it has provided valuable information which can help us understand the populations and tailor future research and conservation works. Key findings are:

- A new species – Leisler’s – was confirmed on Scilly for the first time;
- Soprano pipistrelle activity was found to be much lower than expected, raising concerns over the status of this species on the islands;
- Nathusius’ pipistrelle is suspected to be stopping off on the islands on migration;
- Common pipistrelle was confirmed to be the most abundant species in Scilly;
- It is now highly unlikely that undetected populations of other species are present on the islands;
- Common pipistrelles were confirmed to be regularly active throughout the mild Scillonian winters, though they appear to stay in their roosts on stormy nights;
- The two largest islands – St Mary’s and Tresco – recorded higher levels of activity compared with the three smaller inhabited islands of St Martin’s, Bryher and St Agnes;
- Habitat preferences appear to be the strongest explanation of the inter-island variation, with Tresco and St Mary’s having higher proportions of the woodland and wetland habitats which are favoured by common pipistrelles as hunting grounds;
- Heathland appears to be less favourable as a habitat for common pipistrelles – an important finding given that it represents a significant proportion of the semi-natural habitat on the islands;
- Common pipistrelles were found to forage on the shoreline more at low tides and when the tide is receding;
- Activity levels of common pipistrelle peak in mid-summer and decline into the autumn when the amount of foraging behaviour declines further;
- There is a significant increase in social activity at some sites in the autumn;
- Three species of bats were recorded on the uninhabited islands surveyed, indicating likely commuting across the sea.

Next Steps

The Big Scilly Bat Survey was designed to run for three years and came to an end in 2024; however the results and analysis highlight key areas for future research:

- **Soprano Pipistrelle**
The status of soprano pipistrelles is of concern as the results are not consistent with a viable breeding population. Future research might attempt to understand where roosts still occur and confirm the number of bats present. Given the geographical isolation of the islands, supporting this population may be challenging in the absence of re-introduction work;
- **Brown Long-eared Bat**
The absence of brown long-eared bats from the survey data is likely to reflect the presumed low population size and restricted geographic range of this species, combined with the low detection distance of this species with its quiet echolocation characteristics. Complementary survey techniques would be useful to improve our understanding of the population and distribution of this species on the islands. These techniques could include mist net or harp trapping surveys. Identification of active roosts would be another way to better understand the distribution of this species on the islands, and it is hoped that the additional public awareness and engagement raised by this project may aid in this.
- **Leisler's Bat**
Ongoing monitoring of this species could be valuable in understanding whether these records are vagrants, migrants or even the beginning of a new population. The pattern seen on Scilly has echoes of the colonisation process which took place on the Isle of Man⁴⁰ where the species was historically absent with the first record in 1990 and increasing records in subsequent years. It now accounts for around 20% of all bat records on the islands. Are we seeing the beginning of a similar pattern on Scilly?
- **Genetics**
There has been recent work on the Isle of Man⁴¹ which suggests that the population of common pipistrelle found on the island are morphologically different from those found on the mainland. Given the isolated nature of the Isles of Scilly and the presumption that the common pipistrelle population is resident, it would be interesting to investigate whether they represent a genetically or morphologically distinct population in comparison with the mainland population.
- **Diet**
Dietary analysis using DNA sequencing of bat droppings would help us understand more about the importance of different foraging resources around the islands. Different insect species are associated with different habitats so a high proportion of seaweed flies in the droppings would indicate foraging along the shoreline, whereas dung flies or other species associated with livestock would suggest foraging predominantly around grazed farmland.

- **Heathland**

The evidence gathered in the study suggests that heathland is a less favourable foraging habitat for bats on the islands. Further static detector deployment at different sites, including open heathland and areas which are either bounded by trees or where a gorse mosaic exists, might help understand how these heathlands could be managed to maximise their value for our bat populations.

- **Inter-island Movements**

The confirmation of bat activity on the uninhabited islands is most likely to be explained by inter-island movement for foraging. Measuring the extent to which bats move between the islands would help us to understand how the population is structured and give an indication of their resilience. This could be conclusively achieved through radiotracking work or ringing. Further supporting evidence might be gathered through deployment of detectors on inter-island buoys to separate sea-crossing from foraging activity, and further assessment of activity on uninhabited islands outside of the current study area.

Acknowledgements

The costs of the survey were managed by Isles of Scilly Wildlife Trust in all three years. In 2022/23, funding was received from the Isles of Scilly Area of Outstanding Natural Beauty (supported by funds from Defra, Council of the Isles of Scilly, the Duchy of Cornwall, Tresco Estate and the IoSWT). The AONB is now known as Isles of Scilly National Landscape. In 2023/24, the Trust received invaluable support for the bat survey from Jenny Griffiths. In 2024/25, IoSWT received generous funding from the Cornwall Community Foundation which administers the Phoenix Tanner Fund. We are deeply appreciative of the funding and time volunteered which has enabled this work to be undertaken.

The Isles of Scilly Wildlife Trust and Isles of Scilly Bat Group wish to recognise the huge contribution made by James Faulconbridge and Darren Hart. Without them, this visionary and ambitious survey just could not have happened.

We would also like to thank all the volunteers who took part in Big Scilly Bat Survey. This is your project – it has transformed our understanding of the bats of the Isles of Scilly. Just as important has been the work of Stuart Newson and the British Trust for Ornithology, who provided the acoustic analysis of the huge amounts of ultrasound data that was collected. Carol Williams has also provided great help to the team.

We are also very grateful to the tenants that gave volunteers access to their land, including Tresco Island Limited and the Duchy of Cornwall.

Special thanks should also go to our funders – Isles of Scilly National Landscape, Jenny Griffiths and the Tanner Phoenix Fund.

Thanks also to those who contributed information to compile data on the existing baseline populations on Scilly and those who provided photographs to inform the illustrations including Brendan White (lesser white-toothed shrew); Martin Goodey (long-winged conehead; house cricket; large conehead); Ren Hathway (grey bush-cricket); David Dimmock (great green bush-cricket) and James Faulconbridge (wood mouse; brown rat; speckled bush-cricket).

The production of this report has been an undoubted labour of love by James Faulconbridge, for which the rest of the team, and Isles of Scilly Wildlife Trust and Isles of Scilly Bat Group, are greatly appreciative. Darren Hart, Julian Branscombe, Stuart Newson and Carol Williams have all contributed to the editing of this report.

You've all been fantastic; this collaborative project just wouldn't have been possible without your contribution.

Appendix A: Crickets

Overview

The bat detectors pick up any ultrasonic sounds in their vicinity, and this includes cricket calls which the BTO Acoustic Pipeline is able to identify.

There are some important differences between bats and crickets in terms of what the survey can tell us. Bats fly between roosts and habitats and can cover several kilometres in a night so there are lots of opportunities for them to pass a static bat detector and be recorded. Crickets tend to move little throughout the season, and though their calls are loud, they will only be recorded if the detector is located close to them. The survey data can therefore tell us whether there is a cricket calling in the precise location where the detector is placed, but is unlikely to record a nearby cricket who might call night after night just out of earshot of the detector. In this sense, it is more like a series of spot-checks for these species, rather than an island-wide survey.

A total of five species were recorded. There two notable exceptions which have been recorded on the islands:

- Short-winged bush-cricket has only been recorded historically on St Agnes but was not detected in these surveys. However, the limitations on the survey technique means it's quite possible this species was present but not detected;
- House cricket is a true cricket rather than a bush-cricket, and produces lower frequency calls. These are not likely to be recorded on the bat detectors used here so their absence from the survey data cannot be used to infer absence of the species. Populations are known on St Mary's and may be present on other islands, but their longevity and sustainability are unclear as they are believed to be established from escaped live food for pets.

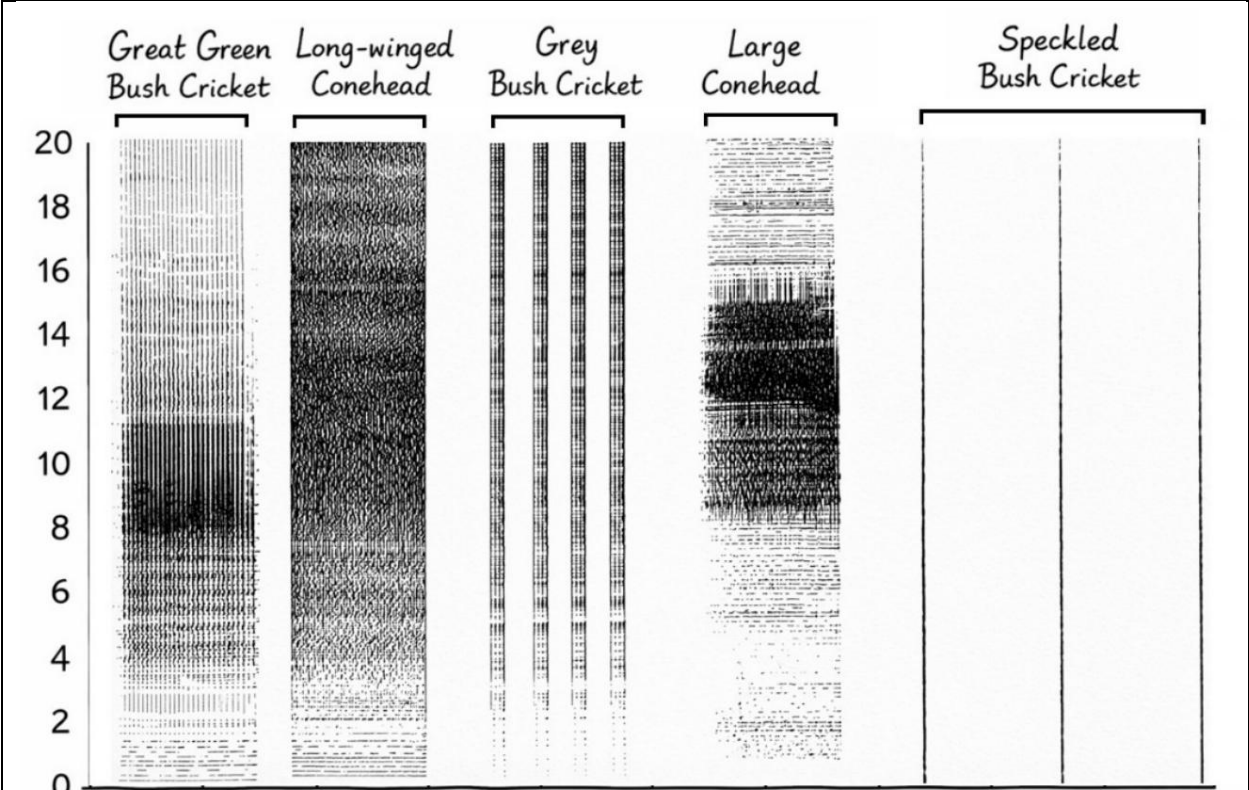
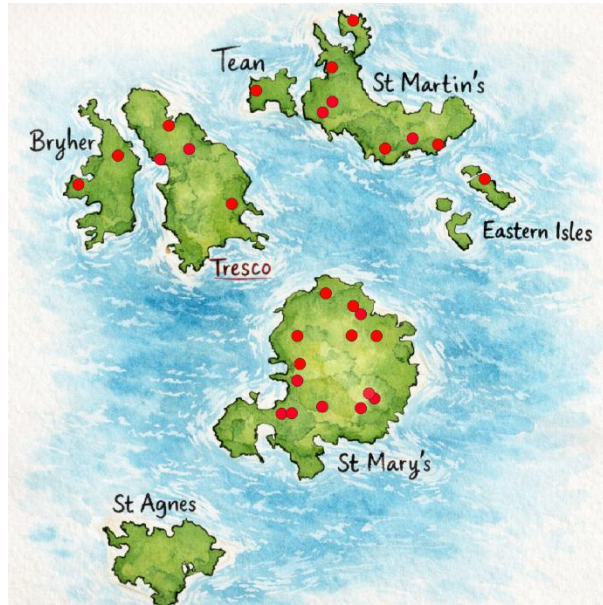


Figure A1 - Illustrative examples of the ultrasonic calls produced by males of the five cricket species which were detected during the survey on the Isles of Scilly⁴².

Long-winged Conehead



Long-winged conehead is a small species of bush-cricket typically found in rough grassland, dry heaths and woodland rides, as well as damp and coastal habitats. It is largely herbivorous, feeding on grasses, but will also eat small invertebrates.

The survey recorded this species on four of the five inhabited islands – Tresco, Bryher, St Martin's and St Mary's – as well as on the Eastern Isles, Teän and White Island to the north of St Martin's.

Figure A2 – Long winged conehead distribution on the Isles of Scilly. Data from 2022 – 2024 is combined to create this map.

Speckled Bush-cricket



Speckled bush-cricket is found mainly in central and southern England, favouring rough grassland, scrub and garden habitats. They are readily identified through the covering of black speckles on their green body which also gives them their common name.

This species was recorded as widely distributed on St Mary's, St Martin's and the Eastern Isles

Figure A3 – Speckled bush-cricket distribution on the Isles of Scilly. Data from 2022 – 2024 is combined to create this map.

Grey Bush-cricket

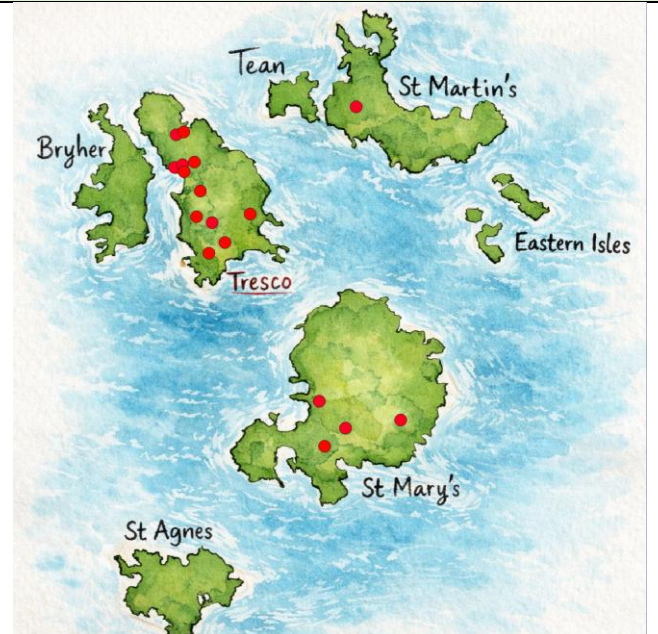
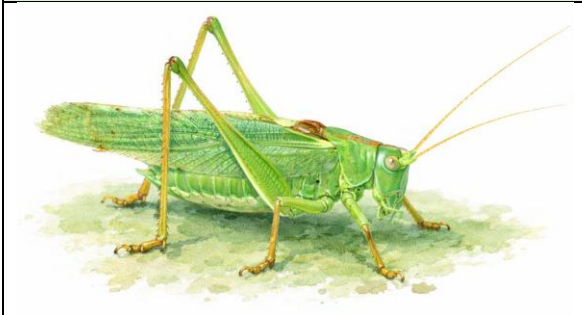


Grey bush-cricket is considered to be a coastal species, found almost exclusively along the southern coast of England and Wales. It favours coarse grass and rough vegetation on sand dunes, shingle banks and south-facing cliffs.

The surveys identified this species as present only in the southern portion of Bryher in 2022 and 2023. No detectors were set out on Bryher in 2024.

Figure A4 – Grey bush-cricket distribution on the Isles of Scilly. Data from 2022 – 2024 is combined to create this map.

Great Green Bush-cricket

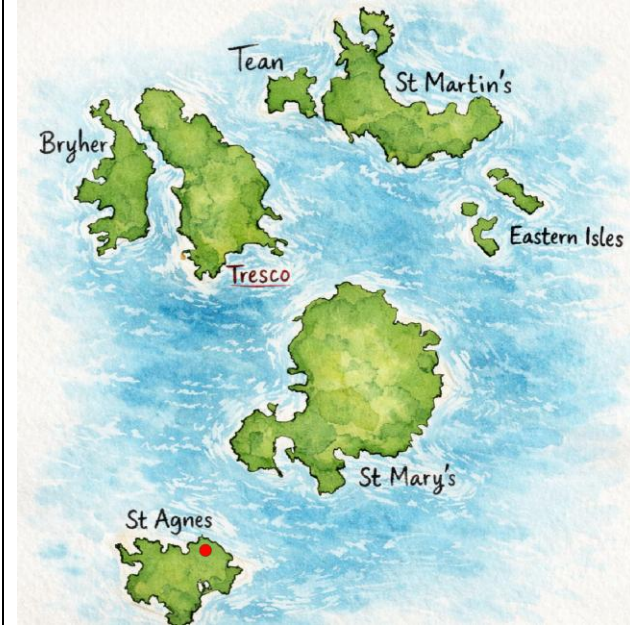


The great green bush-cricket is the largest species of bush-cricket in the UK, with females growing up to 7cm long. It favours rough grassland dotted with scrub and trees and shows a preference for light, dry soils in which the eggs are laid.

This species was recorded on St Mary's and extensively on Tresco, with a single record from St Martin's in 2022.

Figure A5 – Great green cricket distribution on the Isles of Scilly. Data from 2022 – 2024 is combined to create this map.

Large Conehead



This species is a large, slender, bright green bush-cricket whose native range is central and southern Europe where it occurs on riverbanks and other wet habitats. In Britain it is considered a scarce vagrant in the south or an accidental import.

Historic records of this species have been on Bryher and St Mary's – the 2023 survey confirmed the species on Gugh as well, and additional sightings on Tresco, Bryher and St Martin's in 2025 (outside the Big Scilly Bat Survey period) suggest that this species may be establishing a breeding population on the islands.

Figure A62 - Large conehead distribution on the Isles of Scilly. Data from 2022 - 2024 is combined to create this map.

Appendix B: Small Mammals

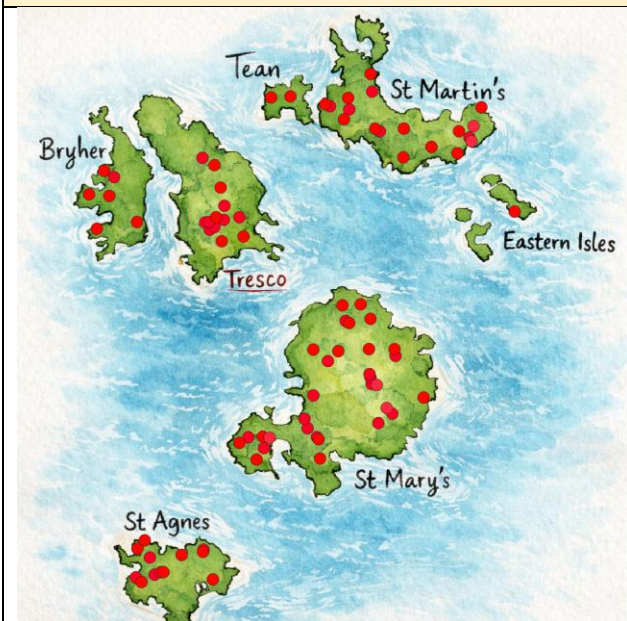
Overview

The third group of species which the detectors can record, alongside bats and crickets, are rodents including mice, rats and shrews. They can make a wide range of calls, many of which are audible to humans, and their calls can be identified by the BTO Acoustic Pipeline.

There are three further small mammal species known to be present on the islands but which the survey methodology may not detect – these are:

- **House mouse** is known to be present; they are common in places on St Mary's (including Little Porth, surveyed in 2024), but their wider distribution across the islands is unclear;
- **Hedgehogs** are present on St Mary's only;
- **Rabbits** are present on all inhabited islands.

White-toothed Shrew

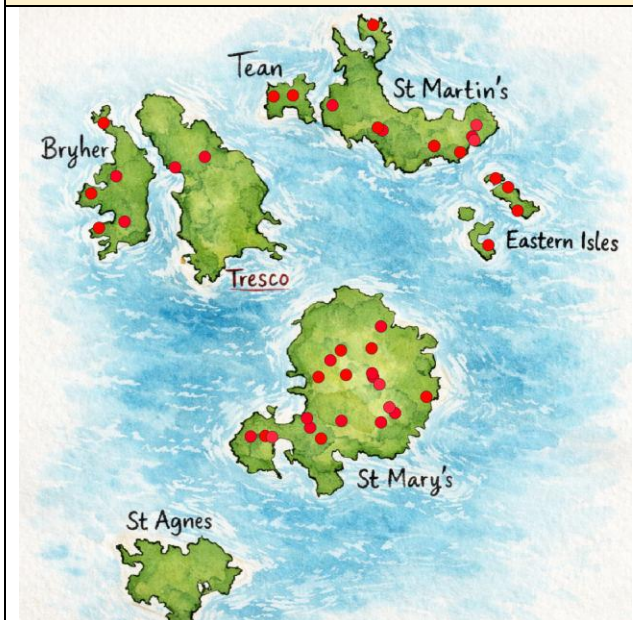


The lesser white-toothed shrew was recorded on all five islands as well as Teän and the Eastern Isles. The distribution appears to indicate widespread occupancy across each island – the only notable absence is within a central east-west band through St Mary's.

Figure B1 – Lesser white-toothed shrew distribution on the Isles of Scilly. Data from 2022 – 2024 is combined to create this map.

The lesser white-toothed shrew is the only shrew species known to exist on Scilly, and there is evidence of its presence since the Bronze Age, when the islands were a single landmass. It is unknown how the shrews arrived, although it is believed they may have stowed away on visiting ships during prehistoric times.

Brown Rat

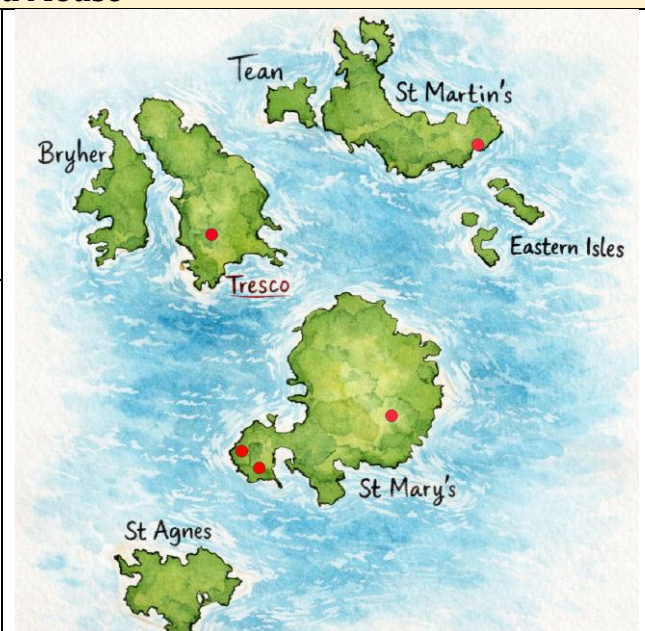


Brown rat was recorded on all inhabited islands with the exception of St Agnes and Gugh where this species was eradicated in 2013. Rats were also recorded on the Eastern Isles and Teän.

This species has been present on the Isles of Scilly since at least the 17th century, likely to have been introduced from ships.

Figure B2 - Brown rat distribution on the Isles of Scilly. Data from 2022 - 2024 is combined to create this map.

Wood Mouse



Wood mouse was identified from just a handful of locations on St Mary's, St Martin's and Tresco.

The calls of this species are much quieter than those of the other two rodents so the recorded distribution is likely to be an under-representation of the true distribution of this species across the islands.

Figure B3 - Wood mouse distribution on the Isles of Scilly. Data from 2022 - 2024 is combined to create this map.

Appendix C: References

- ¹ BTO Pipeline: <https://www.bto.org/data/tools-products/acoustic-pipeline>.
- ² Barratt, E. M. et al. (1997) DNA answers the call of pipistrelle bat species. *Nature* 387: 138–139.
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