

Acoustic Survey at Knepp Estate Repton Park 2019

Survey summary report by Sonia Reveley (BCT)

Background information

Passive acoustic monitoring was set up at Repton Park, part of the Knepp Estate located near the village of West Grinstead, West Sussex. Restoration of Repton Park began back in 2000 after years of intensive farming which was affecting the park oak trees that were suffering from the continuous ploughing and application of fertilisers. Since its restoration, the parkland is grazed by fallow deer and wildlife has returned.

The aim of the monitoring was to collect bat data for the Back from the Brink Ancients of the Future primary target species, the barbastelle and the noctule and for the project's secondary target species, the brown long-eared bat, lesser horseshoe bat, greater horseshoe bat and the soprano pipistrelle. The Bechstein's bat is also an Ancients of the Future primary target species but is difficult to identify from its echolocation calls alone because its calls are similar to other *Myotis* bat species.

Survey monitoring

At Knepp Estate, four nights of passive acoustic monitoring utilising the latest development in acoustic sensor design was carried out by volunteers during 2019. A similar survey methodology and recording schedule to the 2019 British Bat Survey and Forestry England Bat Survey was used.

Surveyors deployed AudioMoths, (the size of a credit card) at three fixed survey points (Table 5) each month in a range of wood pasture habitats within Knepp Estate.

The AudioMoths were deployed for one evening once a month sometime in August and October and two evenings in September during 2019, giving a snapshot of activity from one evening per deployment over three months.

The AudioMoths were configured to start 30 minutes before sunset and continued recording until 30 minutes after sunrise, on a quasi-continuous recording schedule of 58 seconds recording and 2 seconds sleep, at a sample rate of 384 kHz. Each sensor was fixed to a pole 2 m high which was then pushed into the ground securely. As the sensors were not waterproof, they were placed into a plastic bag to prevent moisture from entering the sensor microphone and circuitry.

Originally the plan was that the passive acoustic survey would allow us to do a direct comparison of bat species activity with static detectors that were deployed in 2018. However, grid references for the survey locations were not found which meant we were unable to deploy the AudioMoth at these previously surveyed location points. In addition, surveys were limited to one night and were not carried out on consecutive nights, as the size of the micro-SD card limited the amount of data that could be collected. The quasi-continuous recording schedule uses approximately 26 GB of the 32 GB storage provided by the micro-SD card. Together with limited capacity and resources to process and analyse the data, it was decided that one night per deployment would be sufficient for this project.

Equipment used, auto-ID software and manual verification.

An AudioMoth (<https://www.openacousticdevices.info/>), a full spectrum, low cost, still in development sensor was used to help monitor bat activity for this survey.

Due to the large volume of recordings collected, manual classification was not possible. Recordings were processed through Tadarida (<https://github.com/YvesBas>), an open-sourced software toolbox that automatically classified recordings to species and provided a classification probability. Recordings were split into five-second files segments using Kaleidoscope Pro software (Wildlife Acoustic) before they were processed through Tadarida. Five-second files containing three or more pulses identified to

species/genus were considered a pass. As a call sequence can be over five seconds, where a call sequence was split over two five-second files, they were merged.

Manual checks were then carried out on recordings classified as our target bat species, using the Wildlife Acoustic Kaleidoscope Pro Free sonogram viewer

(<https://www.wildlifeacoustics.com/products/kaleidoscope-pro>) and were reclassified if needed.

Recordings identified by the classifier as Alcathe bat, Natterer’s bat, Bechstein’s bat, Daubenton’s bat, whiskered bat and Brandt’s bat were manually checked then reclassified as the genus *Myotis* where the suggested species ID was uncertain. This is because we didn’t have the resources or capacity to confirm to species, as *Myotis* bat calls are very similar in shape and therefore difficult to differentiate through sound analysis alone. Extra time to analyse the recordings would be needed. As pipistrelle calls can account for 95% of recordings collected, a random sample of soprano pipistrelle recordings were manually checked to confirm that the Auto-ID classification was correct. Recordings classified as noctule were reclassified as Big Bat species if uncertain, as they can have similar calls to serotine and Leisler’s bat when recorded in a cluttered environment. Other species were not manually checked.

Summary of survey findings

Four evening surveys were successfully carried out by volunteers during the 22nd of August, 2nd of September, 16th of September and 2nd of October 2019.

Six species of bats (barbastelle, brown long-eared bat, serotine, noctule, common and soprano pipistrelle) and one species group *Myotis* were detected in Repton Park. The tables below (1 to 4) are a summary of bat passes.

Table 1. Repton Park 2019 (AM) 22/08/2019 <i>Passive Acoustic Monitoring</i>		Number of bat passes		
Species	Point 1	Point 3	Point 4	
Barbastelle	0	5	0	
Noctule	7	25	3	
Serotine	0	1	0	
<i>Myotis</i> spp.	0	6	5	
Common Pipistrelle	5	14	76	
Soprano Pipistrelle	12	142	47	
Total	24	193	131	

Table 2. Repton Park 2019 (AM) 02/09/2019 <i>Passive Acoustic Monitoring</i>		Number of bat passes		
Species	Point 1*	Point 3	Point 4	
Barbastelle		1	2	
Noctule		4	0	
Serotine		0	0	
Big bat spp.		0	0	
<i>Myotis</i> spp.		18	1	
Common Pipistrelle		9	175	
Soprano Pipistrelle		123	85	
Brown long-eared bat		1	0	
Total	0	156	263	

*equipment failure

Table 3. Repton Park 2019 (AM) 16/09/2019 <i>Passive Acoustic Monitoring</i>	Number of bat passes		
Species	Point 1	Point 3	Point 4
Barbastelle	0	10	3
Serotine	1	1	0
Noctule	4	6	2
<i>Myotis</i> spp.	7	9	4
Common Pipistrelle	72	27	164
Soprano Pipistrelle	31	374	188
Total	115	427	361

Table 4. Repton Park 2019 (AM) 02/10/2019 <i>Passive Acoustic Monitoring</i>	Number of bat passes		
Species	Point 1	Point 3	Point 4 *
Barbastelle	0	1	
Noctule	3	3	
<i>Myotis</i> spp.	4	5	
Common Pipistrelle	5	3	
Soprano Pipistrelle	9	55	
Brown long-eared bat	0	1	
Total	21	68	0

*equipment failure

The majority of calls detected were soprano pipistrelles. Most of the barbastelle passes were detected at Point 3, Brickyard Wood, where the survey point location was situated on the edge of woodland /parkland with young and mature oaks, with some passes recorded at Point 4, the rifle lag an area of wet scrape that's part of the river restoration work with wood/trees on either side. Noctules were detected at many of the survey locations selected across the park, with a higher level of activity recorded at Point 3, Brickyard Wood during August.

When compared to the species detected during the 2018 passive acoustic surveys, the AudioMoths recorded six out of the eight species including the species group *Myotis*. Leisler's bat and Nathusius' pipistrelle were not detected during the 2019 surveys, and this may be because consecutive nights of monitoring were not carried out, or the AudioMoths were not deployed in the right place to pick up both species. No new species of bat was detected.

Previous bat surveys at Knepp, which included radiotracking, identified barbastelle, noctule and Bechstein's bat roosts. With the veteran and mature trees located onsite, it is likely that Repton Park continues to support barbastelle and noctule roosting and foraging needs and is, therefore, an important site for these two bat species. Barbastelles are crevice dwelling bats that predominantly roost in trees and are associated with woodland that has a high proportion of standing deadwood or trees that are damaged or over-matured providing the cracks and crevices they prefer to use as roosts. They tend to forage over a wide area, with a typical nightly foraging radius of 7km. They are fast, agile flyers and specialist foragers in a range of habitats. They fly beyond the woodland to the wider countryside to forage in more open habitats like wood pasture, parklands, wetlands, over herb-rich meadows and alongside hedgerows and tree lines. They follow features in the landscape such as vegetated waterways or hedgerows to reach their foraging grounds. Noctules predominantly roost in trees and are associated with woodlands that have a high proportion of standing deadwood or trees that support tree holes that are used as roosts. They forage over open countryside and will benefit from

open parkland and wood pasture. They also forage over large waterbodies and broadleaved woodlands because of the abundance and diversity of insects supported by these habitats.

Maps showing where the bats were detected can be found in Appendix A and graphs showing activity through the night can be found in Appendix B. These can be used to identify hotspots of activity for future surveys, such as trapping to collect information about condition and breeding status of the bats.

Future survey recommendations

This survey provides a snapshot of activity from one night per deployment. If a better understanding of bat activity and the species using the site is required, further consecutive nights of passive acoustic monitoring are options to consider.

Some recordings are difficult to classify with certainty to species from echolocation calls alone. This includes *Myotis* species (Alcathoe bat, Daubenton's bat, Natterer's bat, whiskered bat, Bechstein's bat and Brandt's bat). In some cases, big bat species (serotine, noctule and Leisler's bat) can have similar calls when recorded in a cluttered environment. If the estate would like to determine what species of *Myotis* bats are using the reserve, further surveys under a licence with experienced bat workers to catch the bats and identify these species in the hand would need to be carried out.

BCT is developing new survey protocols using static detectors that are left on site for a few nights, which requires minimal surveyor effort and little or no previous experience of bat monitoring. Passive Acoustic Surveys under NightWatch and the British Bat Survey will be rolled out during the summer of 2022 as part of the National Bat Monitoring Programme. As data from this site has been collected using a passive acoustic monitoring survey protocol, taking part in a monitoring scheme like the [National Bat Monitoring Programme](#) is recommended. Taking part long term will feed into a national dataset that is used to produce robust population trends.

Managing for barbastelle and noctule

These surveys provided a snapshot of four nights of activity over three months and show us that barbastelles and noctules are using Knepp Estate (Appendix A & B).

Habitat management for barbastelle

The conservation of barbastelle requires consideration of both the woodland surrounding tree roosts and the wider landscape.

Woodland – woodland management should seek to encourage characteristics of ancient or semi-natural broadleaved woodland with high numbers of mature and over-mature trees, particularly if the woodland is within a known roost area. It should also retain standing deadwood, canopy cover, dense understorey and areas of minimum intervention especially in proximity to roost trees, streams or other water bodies. Oak trees are of particular value, providing thick plates of defoliating bark. However, such features are often short-lived, so a number of trees of varying ages, species and states of decay are required for the long-term provision of potential roosts within a woodland block.

Wood pasture – Ancient and veteran trees will support many potential roost features and are likely to be used by our target bat species as roosting habitat, so work on these trees should be avoided. Within a wood pasture environment, mature and veteran trees should be left alone to age and decline naturally so they continue to provide a range of potential roost features. Other trees should be allowed to mature and develop old growth naturally. Tree surgery on trees found in wood pastures should be a last resort i.e. to reduce the collapse of a tree or to reduce the weight of the crown. If possible consider other methods like erecting fencing around the tree to protect the public from any falling branches. If work cannot be avoided, appropriate bat surveys should be undertaken by a professional ecologist.

Beyond the woodland, general advice – management should focus on promoting moth-rich foraging habitats within a range of 7km but the nearer the roost woodland the better. This will support the bats in accessing those habitats quickly and easily.

Wildflower-rich meadows and other unimproved grasslands should be maintained or restored.

Arable margins – These can enhance the productivity of moths.

Hedgerows – Maintain a network of tall, bushy hedgerows. These are important for feeding and for providing cover as the bats head out from their roost woodland.

Other types of habitats - Increase the availability and quality of wetland habitats, including ponds, streams, marshes and reedbeds. Increase riparian habitat alongside rivers and streams with native shrubs and broadleaved trees. These will be commuting corridors and foraging grounds. Landscape connectivity is of importance to barbastelles; to commute to key foraging sites barbastelles will make use of sheltered flight lines like shaded tracks, woodland edges, bushy hedgerows, and tree-lined watercourses.

A lot of what is recommended for the barbastelle will also be beneficial to many other UK bat species, especially those that share similar ecological requirements.

Habitat management for noctule

Woodland management for the conservation of noctule requires retention of a high proportion of standing deadwood or trees that support tree holes as well as the provision of wood pasture and parkland in the wider landscape.

Woodland – woodland management should seek to encourage characteristics of ancient or semi-natural broadleaved woodland with high numbers of mature and over-mature trees, particularly if the woodland is within a known roost area. Trees favoured include oak and beech but any mature, deciduous tree can support a suitable roost hole. In managed woodlands sites that are actively logged, it is important to retain small patches of old-growth woodland connected by wildlife corridors. These old-growth patches will provide suitable roosting opportunities for the noctule. In addition, keep standing and fallen deadwood which will provide both roosting and foraging opportunities. Maintain open areas in woodlands for the noctule to forage in.

Woodland rides and glades – manage rides, glades, and woodland edges in a way that will improve insect diversity and activity. Consider using rotational cutting of these areas so that herb-rich layers are encouraged. Ensure pinch points and scalloped edges are incorporated into the management of rides and glades to encourage greater insect diversity and provide connection to adjacent woodland blocks.

Wood pasture – within a wood pasture environment, mature and veteran trees should be left alone to age and decline naturally so they continue to provide a range of potential roost features. Other trees should be allowed to mature and develop old-growth naturally and a diverse age structure across the pasture should be encouraged. Tree surgery on trees found in wood pastures should be a last resort i.e. to reduce the collapse of a tree or to reduce the weight of the crown. If possible consider other methods like erecting fencing around the tree to protect the public from any falling branches. If work cannot be avoided, appropriate bat surveys should be undertaken by a professional ecologist. Wood pastures are important foraging grounds for the noctule, particularly if grazed by livestock, so maintaining pastoral areas and retaining areas of permanent grassland with livestock would be beneficial.

Beyond the woodland, general advice – management should focus on protecting networks of mature hedgerows, tree lines, woodlands, wood pasture, parkland meadows and wetlands, particularly within a

2 km radius of any known roost site. This will support the bats in accessing those habitats quickly and easily.

Wildflower-rich meadows and other unimproved grasslands should be maintained or restored.

Arable margins – consider expanding unsprayed field margins and minimising the use of pesticides. These can enhance the productivity of moths and support cockchafer beetles.

Hedgerows – Maintain a network of tall, bushy hedgerows. Hedgerow trees can provide suitable roosts and a foraging resource as the bats head out from their roost woodland to feed.

Other types of habitats - Increase the availability and quality of wetland habitats, including waterbodies like ponds, streams, rivers and lakes. Increase riparian habitat alongside rivers and streams with native shrubs and broadleaved trees. These will be commuting corridors and foraging grounds.

Onsite management recommendations

Retain larger, older mature trees to become roost trees for the future and retain woodland areas of dense understorey and closed canopy if there are any onsite. The best management prescriptions to consider would be minimum intervention where possible, so trees with potential are retained for many years, allowed to age undisturbed by any management and the area is allowed to develop old-growth habitat naturally - great for bat roosts and will provide feeding opportunities.

Any haloing around mature trees (including young trees exhibiting roost potential) should be done sympathetically and be phased. This is because an abrupt change to the environmental conditions around the tree, could mean it becomes unsuitable for bats and if they are roosting in the trees, they may abandon the roost. Any abrupt change to the environmental conditions may also stress the trees, causing them to decline. Ensure appropriate bat surveys are undertaken before any work starts, to assess whether bats could be present and the potential risk to them from any tree/woodland work

Improve connectivity to the wider landscape. This will ensure good links with key foraging areas and other suitable foraging sites.

For additional information about wildlife management the [Woodland Wildlife Toolkit](#), an online toolkit has advice and guidance on managing woodlands for wildlife, (in particular rare and declining species that are dependent on woodland habitats). The toolkit was developed by the following partners: Bat Conservation Trust, Butterfly Conservation, Forestry Commission, Natural England, Plantlife, RSPB, Sylva Foundation, and the Woodland Trust.

Ancients of the Future have also created species information guides containing habitat management recommendations for its three primary target species, which can be downloaded from the Back from the Brink website. The barbastelle guide can be downloaded from [here](#), the noctule guide can be downloaded from [here](#) and the Bechstein's bat guide can be downloaded from [here](#).



Knepp Estate Repton Park Acoustic Survey (Static)

22nd August 2019 (1 night)

Bat species (and number of bat passes)

Survey start time: 19:43 Survey finish time: 06:28



- Point 1 - Noctule (7)
- Point 1 - Soprano pipistrelle (12)
- Point 1 - Common Pipistrelle (5)
- Point 3 - Common Pipistrelle (14)
- Point 3 - Noctule (25)
- Point 3 - Soprano pipistrelle (142)
- Point 3 - Serotine bat (1)
- Point 3 - Myotis species (6)
- Point 3 - Barbastelle (5)
- Point 4 - Soprano pipistrelle (47)
- Point 4 - Noctule (3)
- Point 4 - Common Pipistrelle (76)
- Point 4 - Myotis species (5)

Knepp Estate Repton Park Acoustic Survey (Static)
22nd August 2019 (1 night)
Barbastelle bat passes per hour



Knepp Estate Repton Park Acoustic Survey (Static)
22nd August 2019 (1 night)
Noctule bat passes per hour



Knepp Estate Repton Park Acoustic Survey (Static) 2nd September 2019 (1 night)

Bat species (and number of bat passes)

Survey start time: 19:16 Survey finish time: 05:46



- Point 3 - Noctule (4)
- Point 3 - Big bat species (4)
- Point 3 - Soprano pipistrelle (123)
- Point 3 - Myotis species (18)
- Point 3 - Common Pipistrelle (9)
- Point 3 - Barbastelle (1)
- Point 3 - Brown long-eared bat (1)
- Point 4 - Barbastelle (2)
- Point 4 - Soprano pipistrelle (85)
- Point 4 - Common Pipistrelle (175)
- Point 4 - Myotis species (1)

Knepp Estate Repton Park Acoustic Survey (Static)
2nd September 2019 (1 night)

Barbastelle bat passes activity per hour



Knepp Estate Repton Park Acoustic Survey (Static)
2nd September 2019 (1 night)
Noctule bat passes per hour



Knepp Estate Repton Park Acoustic Survey (Static)

16th September 2019 (1 night)

Bat species (and number of bat passes)

Survey start time: 18:44 Survey finish time: 07:36



- Point 1 - Soprano pipistrelle (31)
- Point 1 - Serotine (1)
- Point 1 - Common Pipistrelle (72)
- Point 1 - Myotis species (7)
- Point 1 - Noctule (4)
- Point 3 - Noctule (6)
- Point 3 - Serotine (1)
- Point 3 - Common Pipistrelle (27)
- Point 3 - Soprano pipistrelle (374)
- Point 3 - Myotis species (9)
- Point 3 - Barbastelle (10)
- Point 4 - Barbastelle (3)
- Point 4 - Noctule (2)
- Point 4 - Common Pipistrelle (164)
- Point 4 - Soprano pipistrelle (188)
- Point 4 - Myotis species (4)

Knepp Estate Repton Park Acoustic Survey (Static)
16th September 2019 (1 night)
Barbastelle bat passes per hour



Knepp Estate Repton Park Acoustic Survey (Static)
16th September 2019 (1 night)
Noctule bat passes per hour



Knepp Estate Repton Park Acoustic Survey (Static) 2nd October 2019 (1 night)

Bat species (and number of bat passes)

Survey start time: 18:08 Survey finish time: 07:33



- Point 1 - Noctule (3)
- Point 1 - Common Pipistrelle (4)
- Point 1 - Myotis species (4)
- Point 1 - Soprano pipistrelle (9)
- Point 3 - Brown long-eared bat (1)
- Point 3 - Noctule (3)
- Point 3 - Myotis species (5)
- Point 3 - Soprano pipistrelle (55)
- Point 3 - Common Pipistrelle (1)
- Point 3 - Barbastelle (1)

Knepp Estate Repton Park Acoustic Survey (Static)
2nd October 2019 (1 night)

Barbastelle bat passes per hour



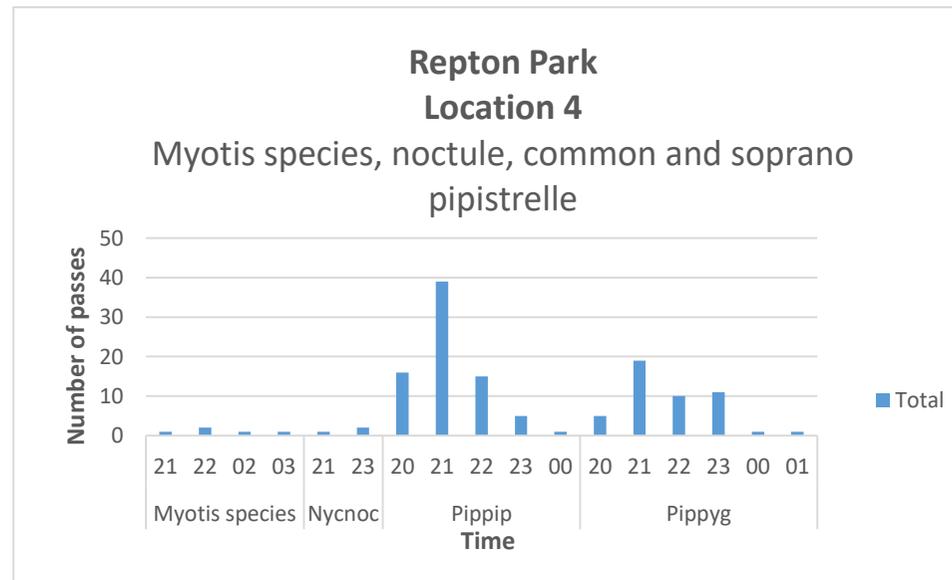
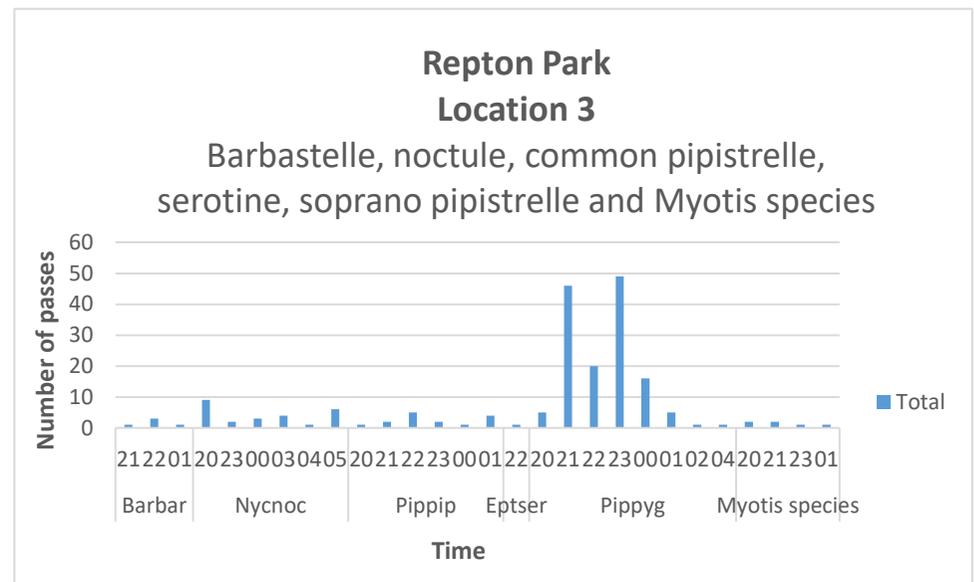
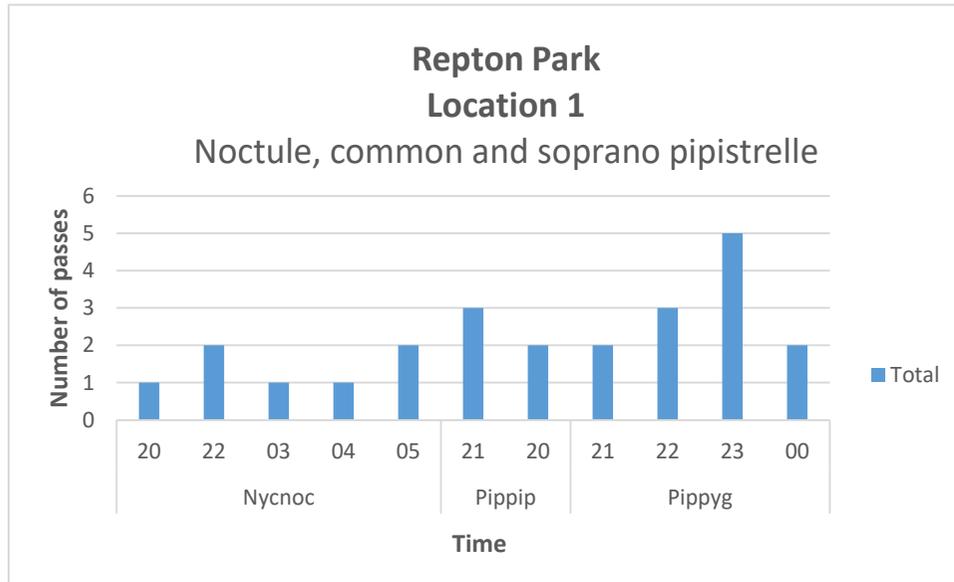
Appendix B – Graphs showing bat activity.

Table 5. Point Location Habitat Descriptions

Point location	Habitat Description – 18th August 2019	Grid Reference
1	Dead tree in park = more open habitat, open parkland with mature trees	TQ 1510822056
3	Brickyard Wood - edge of woodland /parkland with young and mature oaks	TQ 1533821948
4	Rifle lag - wet scrapes and river restoration. Wood/trees on either side	TQ 1512321845

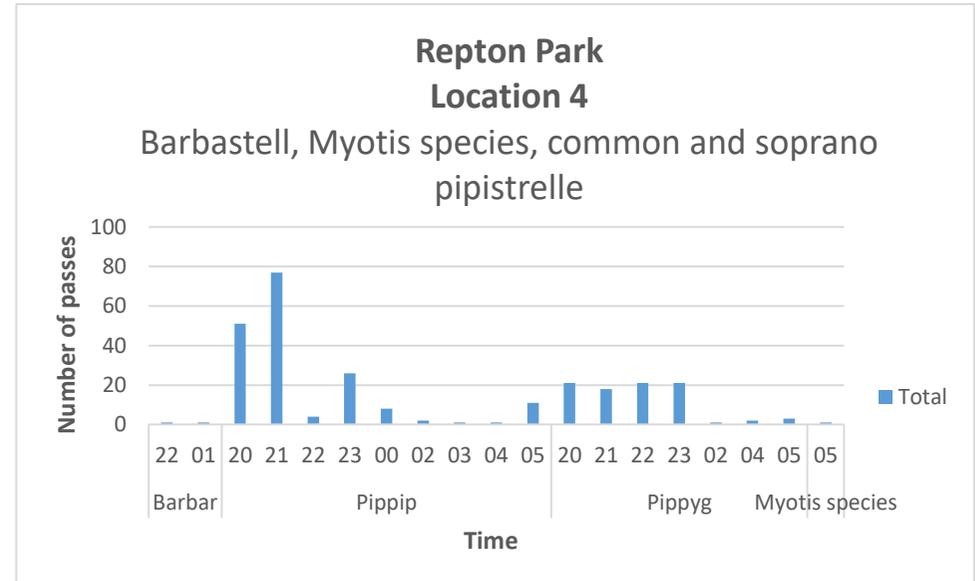
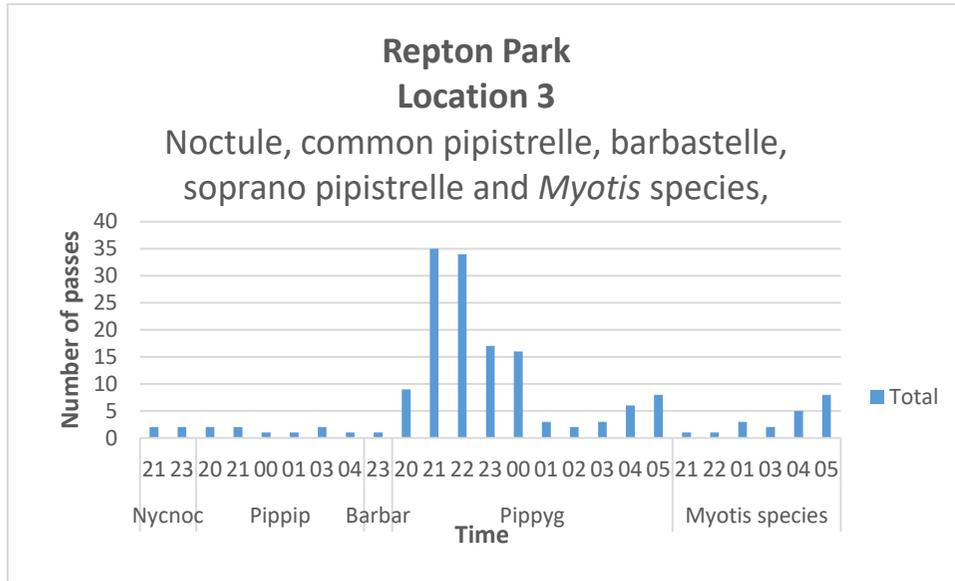
Appendix B – Graphs showing bat activity.

19th August 2019



Appendix B – Graphs showing bat activity.

2nd of September 2019



Appendix B – Graphs showing bat activity.

2nd October 2019

