Advanced Bat Survey Report

Goodwood Barbastelle Trapping and Radiotracking

Annika Binet & Daniel Whitby

21-090
October 2023

Contents

Author	Annika Binet
Authorised by	Daniel Whitby
Report and version number	21-090-ABS v2

Summary

- This bat survey and report has been carried out and prepared by Daniel Whitby and Annika Binet of AEWC Ltd, Natural England licensed bat workers, and was commissioned by Chichester District Council.

- This report details the interim results of surveys carried out in 2022 and 2023 to complete proportional radiotracking of the colony and help inform the population, behaviour and core areas used by the Barbastelle colony at Goodwood estate.

- Surveys carried out in 2015 identified a maternity colony of barbastelle bats within the Goodwood Estate which was identified to be connected to the Cocking and Singleton SAC for which Barbastelle is a qualifying feature.

- Barbastelle bats are one of the UK's rarest mammals which is listed on Annex II of the EC Habitats and Species Directive (JNCC, 2007) and is a Species of Principal Importance in England under Section 41 of the Natural Environment and Rural Communities Act 2006 in addition to being listed as vulnerable on the IUCN global red list (IUCN, 2016).

- The 2022 advanced surveys carried out 22 trap nights of survey effort over five nights. This caught a total of 105 bats of 10 species, which included three barbastelle bats.

- The 2023 advanced surveys carried out 21 trap nights of survey effort over six nights. This caught a total of 85 bats of 10 species, which included four barbastelle bats and one Bechstein's bat.

- Radio tracking of a five female Barbastelle bats identified eleven roosts for which colony counts were undertaken where possible, with a peak count of 33 adults present. Additionally, assessment of the core foraging areas for the tracked bats was made.

- The Goodwood colony is known to be linked to the Singleton and Cocking SAC for which barbastelle is a qualifying feature. There are few records to demonstrate the long-term viability of barbastelle populations in the UK. While the SAC makes a contribution to securing favourable conservation status for this Annex II species, wider measures are also necessary to support its conservation in the UK. Measures are provided in the UK Habitats Regulations to control, through the planning system, adverse impacts on a qualifying feature arising from outside the site of the SAC.

- The surveys during 2022, although limited, reconfirmed findings of the previous radio tracking study in 2015 with the colony still present in the Goodwood estate and 50% of the radio tracked bats using the East of Chichester Wildlife corridor for commuting and foraging during the tracking period and significant foraging time spent within the Goodwood estate. It additionally showed use of the habitat corridor to the west of Chichester which had not been previously identified as used.

- Five female barbastelle bats captured within the Goodwood Estate were radio tracked as part of this study with a minimum population count of 33, this represents around 15% of the colony. Best practice guidelines recommend 25% of a colony be tagged and radio tracked to get sufficient representation of the colony and understanding of the colony range, behaviour and habitat use. This study can be used with previous studies of the same colony to further support identifying areas of importance for this population.

- The survey results presented in the study represents a snapshot in time while the bat is tagged, there can be differences in behaviour both seasonally and under different weather conditions, this data is to provide a representation of the colony use but cannot be used to determine absence of bats using areas as only proportions of the colony area studied.

This report has been prepared by AEWC Limited, with all reasonable skill, care and diligence within the terms of the Contract with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above. This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

The information and data which has been prepared and provided is true and has been prepared and provided in accordance with the Professional Guidance and 'Code of Professional Conduct' issued by the Chartered Institute of Ecology and Environmental Management (CIEEM). We confirm that the opinions expressed are our true and professional bona fide opinions.

1 Introduction

1.1 This bat survey and report has been carried out and prepared by Daniel Whitby and Annika Binet of AEWC Ltd, Natural England licensed bat workers, and was commissioned by Chichester District Council.

1.2 The bat surveys and report writing were carried out in accordance with Bat Surveys: Good Practice Guidelines (Bat Conservation Trust, 2016).

1.3 Surveys carried out in 2015 identified the presence of a barbastelle bat maternity colony within the southern area of Goodwood Estate which was shown to be connected to the Cocking and Singleton SAC for which Barbastelle is a qualifying feature.

1.4 Barbastelle bats are one of the UK's rarest mammals which is listed on Annex II of the EC Habitats and Species Directive (JNCC, 2007) and is a Species of Principal Importance in England under Section 41 of the Natural Environment and Rural Communities Act 2006 in addition to being listed as vulnerable on the IUCN global red list (IUCN, 2016).

Aims and objectives
1.5 The objectives of the survey are to:
- Trap and radio tag Barbastelle bats to identify roost locations, enable colony counts and core foraging areas;

Site Location
1.6 The Goodwood Estate is located at central grid reference SU 88121 10049. The estate is located in a rural area to the north-east of Chichester and contains dwellings and businesses, a golf course, areas of open fields and pockets of woodland (some of which is ancient). The wider landscape comprises a mosaic of agricultural land, woodland and areas of residential and commercial development. See Figure 1.
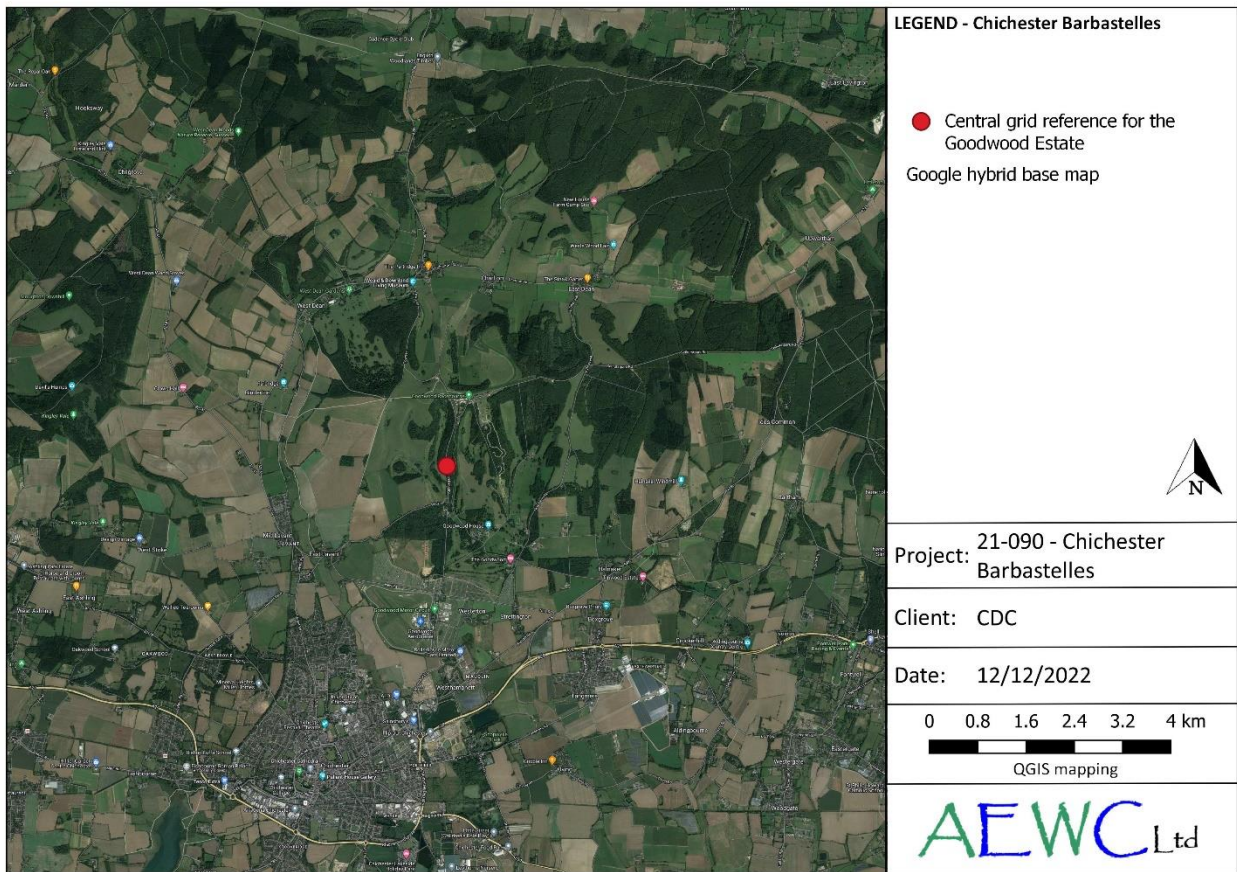
FIGURE 1: THE GOODWOOD ESTATE AND SURROUNDING AREA

Legislation

1.7 All species of bats are listed on *Schedule 5* of the *Wildlife and Countryside Act 1981 (as amended)* which affords them protection under *Section 9*, as amended. They are also protected under the *Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*. In combination, this makes it an offence to:
   - intentionally kill, injure or take (capture etc.);
   - possess;
   - intentionally or recklessly damage, destroy, obstruct access to any structure or place used by a scheduled animal for shelter or protection, or disturb any animal occupying such a structure or place; and
   - sell, offer for sale, possess or transport for the purpose of sale (live or dead animal, part or derivative) or advertise for buying or selling such things.

1.8 A roost is defined as 'any structure or place which a bat uses for shelter or protection'. As bats tend to reuse the same roosts, legal opinion is that a roost is protected whether or not bats are present.

1.9 Any disturbance of a bat occupying a roost can lead to prosecution. Disturbance can be caused by noise, vibration and artificial lighting. Penalties for breaking the law can include fines of £5,000 per bat, imprisonment and the seizure of equipment.

1.10 Furthermore, seven bat species (barbastelle, Bechstein's, noctule, soprano pipistrelle, brown long-eared, lesser horseshoe and greater horseshoe) are also Species of Principal Importance in England under *Section 41* of the *Natural Environment and Rural Communities Act 2006*.

2 Background

2.1 A maternity colony of Barbastelle bats is present within the Goodwood estate with a number of maternity roosts identified in the southern area of the estate. This colony has been confirmed to be linked to the Singleton and Cocking SAC for which barbastelle is a qualifying feature.

2.2 During 2014 and 2015 twenty-one adult females were caught and identified at Goodwood, all of which were ringed. Ten barbastelle roosts were identified at Goodwood during this period, of which four were classified as maternity roosts with the rest solitary or having an unknown count or status. The roosts were spread across a wide area with the furthest roosts approximately 3.3km apart, which is comparable with the furthest satellite roost spacing of the Barbastelle colony found at The Mens SAC, demonstrating that individuals are roosting over a wide area of the estate. See Figure 2.

2.3 It was estimated that the adult female population at Goodwood was at least 30 adult females, however if other satellite groups are present, which could be located in nearby woodlands/other landowner's sites it may be more than this.
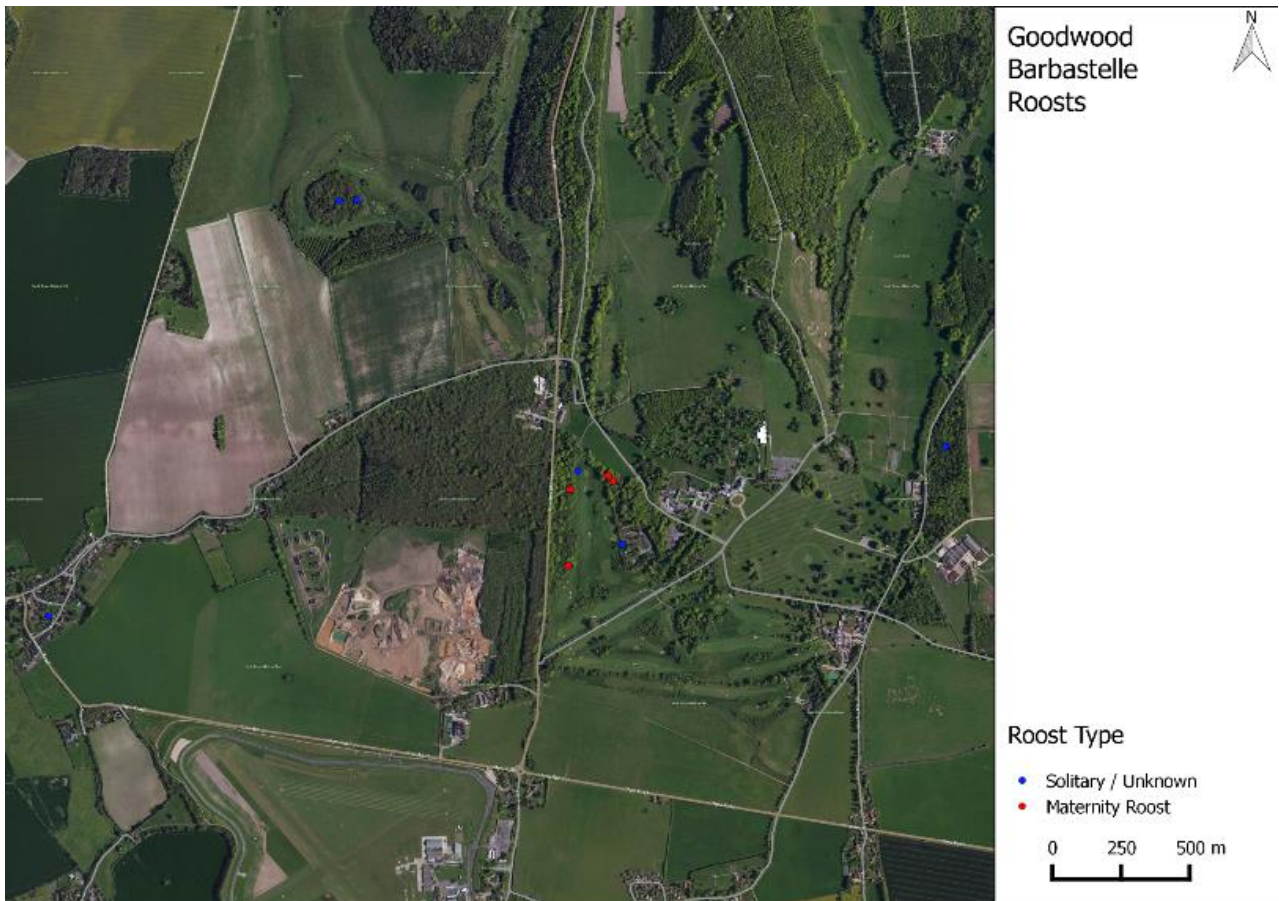
FIGURE 2: BARBASTELLE BAT ROOSTS IDENTIFIED AT GOODWOOD IN 2015

2.4 Seven individuals from the colony were radio tagged and tracked in 2014 (n=1) and 2015 (n=6) to both identify important areas for this colony and to search for satellite roosts associated with park of this colony. The 2014/15 radiotracking found that many

of the bats remained close to the roost foraging on Goodwood estate, notably the Valdo ancient woodland area, however notably all of the more distant foraging away from the roosting areas, which were used by 50% of the barbastelle bats tracked in 2015 travelled south through the East of Chichester Wildlife Corridor during the tracking period, utilising this area for commuting and foraging, the other 50% of tracked bats remained within the Goodwood Estate. See Figures 3 and 4.
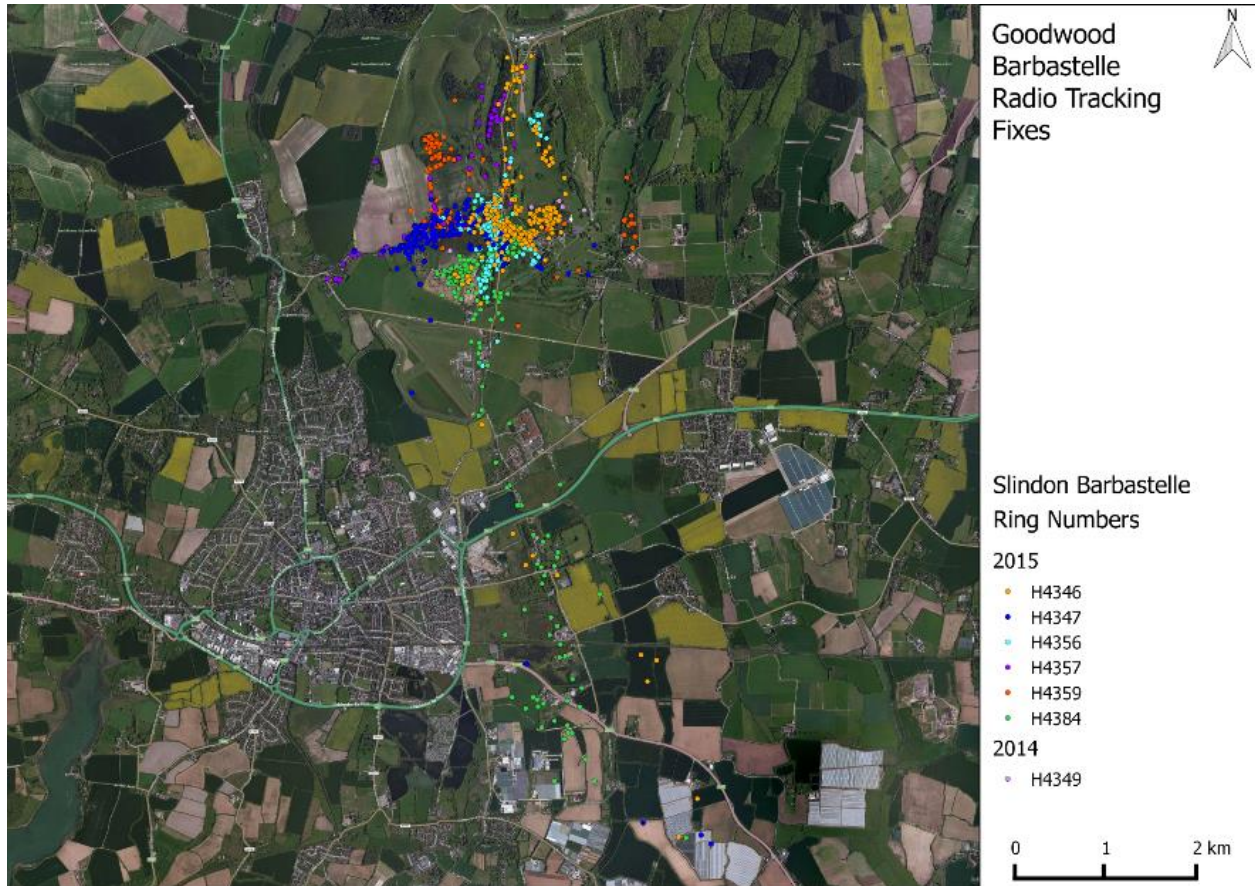
FIGURE 3: RADIO TRACKING MAP OF BARBASTELLE BATS FROM GOODWOOD ESTATE 2015

FIGURE 4: KEY FLIGHT LINES FOR TRACKED BARBASTELLE BATS FROM GOODWOOD ESTATE 2015

3   Methods

3.1   The methodology employed in this study consisted of a range of discrete and separate approaches of gathering data to ascertain the use of the site bats. These approaches, while separate, are interlinked to form a range of advanced survey methods.

Trapping Surveys

3.2   To accurately identify the presence, number and status of rare bat species and to enable bats to be marked by radio tagging trapping surveys were conducted on the site as the only survey method capable of obtaining this information.

3.3   Previous survey data and maps of trapping areas were provided, and a site assessment was carried out in August 2022 during daylight hours for the surveyors to familiarise with the site and identify habitats present and areas of potential trapping suitability.

3.4   Trapping was conducted over five sessions in 2022 with trapping surveys carried out between 15th August and 10th September 2022 and a further six sessions in 2023 carried out between 9th June and 21st August 2023.

3.5   Trapping surveys were conducted using several Harp traps (Austbat two bank and three bank) and Mist nets (Ecotone) to trap bats. Where suitable this was accompanied with a sonic lure (Sussex Autobat or Binary Acoustic Technology

AT100) to attract any bats foraging in the area using a range of bat species' social calls. This can increase the detection rate of quiet whispering species, such as Bechstein's bat, barbastelle, myotis (Myotis sp.) and long-eared bats (Plecotus sp.), which can be under-recorded on detector surveys.

3.6   All surveys conducted during followed an AEWC Trapping Protocol methodology following a precautionary approach. This incorporated advice from IUCN, Eurobats and BCT regarding minimising the potential for transmission of Covid-19 to UK bat species during the pandemic. This included disinfecting all equipment to be used, wearing of suitable PPE including face masks, regularly cleaning and hand sanitising and minimising handling and processing of all bats. All trapping surveys and the radio tagging of bats were carried out under licences issued for the site in 2022 and 2023 by Natural England.

3.7   All traps were checked regularly, to ensure no bats were trapped for extended periods. All bats caught were identified accurately to species level, sexed, aged and reproductive status ascertained. All bats were released at the capture site shortly after capture. Barbastelle and Nathusius pipistrelle bats were ringed where suitable with a Porzana bat ring.

Ringing

3.8   Barbastelle, Bechstein's and Nathusius pipistrelle bats were ringed to potentially provide additional information on movements, number of individuals throughout the study area, in addition to ensuring that the same bat was not tagged twice, either in the same year, or future years.

3.9   All bats were ringed with Porzana alloy bat rings using sizes 2.9mm as suitable for the species being ringed. Rings were closed manually until <1mm remained between the lipped ends of the ring. Before release each bat and ring were checked so that it did not stick on the wrist, it moved freely along the forearm and the 5th finger did not stick inside the ring.

Radiotracking Surveys

3.10 Individual bats were radio tagged to enable radio tracking surveys. Radio tags (Biotrack - UK and Holohil - Canada) were fixed to a bat using a latex-based adhesive (Torbot bonding cement) and carefully attached between the shoulder blades (the most suitable centre of gravity) of the bat.

3.11 Bats were radio tagged following a 5% rule where the combined radio tag and glue weight was not more than 5% of the bat's weight. A range of radio tag weights were used as suitable for the species being tagged.

3.12 After fitting the radio tag, the tag aerial was carefully cleaned, and the bat kept for 5-10 minutes to be thoroughly checked before being released. Bats were monitored intermittently upon release, however radio tracking data was not always collected on the night a bat was fitted with a tag, as behaviour could be affected/skewed by the tagging experience. Where bat activity was monitored on the night the bat was tagged this information was used to inform locations for subsequent nights' tracking.

3.13 Bats were radio tracked using Biotrack Sika receivers and different Yagi aerials using a range of radio tracking methods depending on activity, bat location and commuting distances.

Emergence surveys

3.14 Emergence surveys were carried out on accessible day roosts, which were identified using radio tracking data. Emergence surveys were conducted to enable accurate roost counts of visible roosts to indicate colony size and roost characterisation.

3.15 The evening emergence surveys were conducted in August during the radio tracking period when the tagged bats were known to be present within the roost.

3.16 The emergence surveys began a minimum of 15 minutes before sunset and finished one and a half hours after sunset on each survey. The species and number of bats exiting the roost were recorded.

3.17 Batlogger M bat detectors were used for taking time-expanded recordings of any bats emerging from the buildings or trees. These recordings were analysed on Elekon Bat Explorer analysis software that facilitates species identification.

3.18 Professional night vision infra-red or thermal imaging video cameras were used to film areas of the buildings or trees, with the assistance of an external infra-red lamp, to accurately identify and record bats emerging. All footage was analysed using VLC player to confirm the location of roost features and obtain a roost count.

Radio tracking analysis

3.19 The radio tracking fixes obtained for each bat were imported into R Studio, which was then used to produce visual representations of the estimated ranging areas using statistical algorithms included within the AdeHabitat HR package.

3.20 The home range of an individual animal is typically constructed from a set of fixes that had been collected over a period of time, identifying the position in space of an individual at many points in time. The 100% Minimum Convex Polygon (MCP) was used to estimate the foraging ranges of each of the radio tracked bats. The MCP simply connects the outermost points on the scatter of mapped locations such that the sum of linkage distances between edge points is minimised. However, MCPs are very sensitive to outliers and require large data sets for accurate estimations of home range size. Furthermore, they give no information about how the animal is using its home range.

3.21 Probabilistic approaches to home range estimators have also been developed whereby the density of fixes is estimated throughout the area used by the animal. Kernel Density Estimation (KDE) is a nonparametric technique that describes home ranges by means of hierarchical probabilities for the intensity of habitat utilisation, termed isopleths. Series of isopleths can be plotted around the smallest area where the cumulative probability reaches a particular value. For example, the 95% isopleth encompasses the area where the probability of finding an animal is 95%.

3.22 Studies on various species' home ranges show that, for a number of environment-related reasons, certain portions within the home range are visited more frequently than other. The centre(s) of activity can be defined as the area within the home range in which the most fixes occurred during the radio tracking period and can give an indication of which part(s) of the range the bat(s) used more intensively. Areas of more intensive use have been termed as the 'core area of the home range' of the animal and may be related to the greater availability of food resources and refuges.

3.23 Core areas can be a useful concept when describing patterns of behaviour or identifying particular resources. The 50% isopleth (median value) was adopted as an indicator of core area use.

4 Constraints/Limitations

4.1 Bats are some of the most difficult species to locate, identify and study. They cannot be easily identified in flight and nocturnal activity means that they cannot be easily visually observed to identify behaviours and movements, especially when moving over large areas.

4.2 Trapping surveys can improve data gathering by confirming species identification, sex and breeding status, however, trapping is more difficult and specialist, and trapping success can vary depending on trap suitability in different areas and access to suitable trapping positions. Bats are difficult to locate in foraging habitat and difficult to catch, especially in large, exposed open areas. Different species may also forage in different habitats throughout the year according to the availability of their preferred prey and particular weather conditions, e.g. more sheltered areas can be more highly used during periods of colder weather, wind or light rain than more open, exposed areas.

4.3 By their nature, rare species are difficult to catch, especially ones that have large, wide-ranging foraging areas. No surveys can be used as confirmation of absence, but rather an increased improbability of presence.

4.4 The survey results presented in the study represents a snapshot in time while the bat is tagged, there can be differences in behaviour both seasonally and under different weather conditions, this data is to provide a representation of the colony use but cannot be used to determine absence of bats using areas.

5 Results

Trapping

5.1 Trapping was conducted on five nights between August and September 2022 with an additional six nights between June and August 2023 with a total of 43 trap nights carried out with survey locations spread between The Valdoe and Shopwyke. See Figure 6.

FIGURE 5: SHOWING THE TRAP LOCATIONS

5.2 Trapping caught a total of 190 bats of 11 species, including Barbastelle, Bechstein's and Nathusius pipistrelle. See Table 1.

15 August 2022 – Goodwood Estate

5.3 Weather conditions were good for the survey, warm, partial cloud and only a light breeze. 17 bats of four species were captured.

16 August 2022 – The Valdoe

5.4 Weather conditions were suitable for the survey, warm and dry with a light breeze. Six bats of four species were captured including an adult female Barbastelle which was radio tagged (bat 1) following which trapping was concluded early.

20 August 2022 – Goodwood Hotel

5.5 Weather conditions were good for the survey, warm, partial cloud and a moderate breeze. 26 bats of eight species were captured including one adult male Barbastelle.

21 August 2022 – Goodwood Hotel Golf course

5.6 Weather conditions were good for the survey, warm, partial cloud and only a light breeze. 14 bats of nine species were captured including an adult female Barbastelle which was radio tagged (bat 2), and an adult male Nathusius pipistrelle bat.

10 September 2022 – Westbourne Lake

5.7 Weather conditions were good for the survey, warm, partial cloud and only a light breeze, cooling later in the evening. 42 bats of five species were captured including nine Nathusius pipistrelle bats.

9th June 2023 – The Valdoe

5.8 Weather conditions were good for the survey, warm, partial cloud and moderate breeze. Eight bats of four species were captured prior to nets being packed up following capture of an adult female Barbastelle which was radio tagged (bat 3).

11th June 2023 – Goodwood Hotel Golf course

5.9 Weather conditions were good for the survey, warm, muggy overcast and still. Activity levels were low with, nine bats of five species were captured.

23rd July 2022 – Goodwood Hotel Golf course

5.10 Weather conditions were good for the survey, warm, partial cloud with a moderate breeze. Bat activity was low, with only nine bats of four species captured.

27th July 2023 – The Valdoe

5.11 Weather conditions were good for the survey, warm and overcast with a slight breeze. The first two bats captured were both adult female Barbastelles, one of which was radio tagged (bat 4), nets were packed up following capture of the barbastelle bats and no further bats were captured.

3rd August 2023 – Goodwood Estate

5.12 Weather conditions were good for the survey, warm, overcast and still. 13 bats of six species were captured.

21st August 2023 – Goodwood Hotel Golf course

5.13 Weather conditions were good for the survey, warm, partial cloud and only a light breeze. 44 bats of ten species were captured including a juvenile female Barbastelle which was radio tagged (bat 5), and an adult male Bechstein's bat.

TABLE 1: SHOWING THE TRAPPING SURVEY RESULTS

Date	Site Name	Weather	No. of traps	Total Bats	P.pip	P.pyg	P.nat	P.aur	M.nat	M.dau	M.mys	M.bech	B.bar	N.noc	E.ser
15/08/22	Goodwood, South	Good, light Breeze, Warm partly overcast	3	17	0	6	0	1	0	9	1	0	0	0	0
16/08/22	Goodwood, The Valdoe	warm, dry, partial cloud	5	6	2	1	0	1	1	0	0	0	1	0	0
20/08/22	Goodwood Hotel	Moderate Breeze 19 partly cloudy	3	26	2	5	0	2	4	10	1	0	1	0	1
21/08/22	Goodwood southern golf course	Warm dry still, light breeze later	4	14	5	1	1	2	1	0	1	0	1	1	1
10/09/22	Westbourne lake	Warm, dry, light breeze, becoming cool	7	42	0	26	9	0	1	2	4	0	0	0	0
09/06/23	Goodwood, The Valdoe	warm, partial cloud and moderate breeze	4	8	5	1	0	0	1	0	0	0	1	0	0
11/06/23	Goodwood southern golf course	warm, muggy overcast and still	3	9	1	2	0	2	3	0	0	0	0	1	0
23/07/23	Goodwood southern golf course	warm, partial cloud with a moderate breeze	3	9	2	4	0	0	1	0	0	0	0	0	2

27/07/23	Goodwood, The Valdoe	warm and overcast with a slight breeze	3	2	0	0	0	0	0	0	0	0	2	0	0
03/08/23	Goodwood, South	warm, overcast and still	4	13	2	4	0	2	3	0	1	0	0	1	0
21/08/23	Goodwood southern golf course	warm, partial cloud and only a light breeze	4	44	9	11	0	3	5	5	2	1	1	7	0
				190	28	61	10	13	20	26	10	1	7	10	4

P.pip - Common Pipistrelle – *Pipistrellus pipistrellus*
P.pyg - Soprano Pipistrelle – *Pipistrellus pygmaeus*
P.nat – Nathusius Pipistrelle – *Pipistrellus nathusii*
P.aur – Brown long-eared bat – *Plecotus auritus*
M.nat - Natterer's bat – *Myotis nattereri*
M.daub – Daubenton's bat – *Myotis daubentoni*
M.myst – Whiskered bat – *Myotis mystacinus*
M.bech – Bechstein's bat – *Myotis bechsteinii*
B.barb - Barbastelle bat – *Barbastella barbastellus*
N.noc – Noctule – *Nyctalus noctula*
E.ser – Serotine – *Eptesicus serotinus*

Ringing

5.14 No previously ringed bats were caught during the 2022 or 2023 surveys. All barbastelle, Bechstein's and Nathusius pipistrelle bats caught in 2022 and 2023 were rung.

Radio Tracking

5.15 A total of five barbastelle bats captured within the Goodwood Estate were radio tagged in August 2022 and between June and August 2023 specifically targeted for identification of maternity roosts and colony range analysis.

Bat 1 – Barbastelle bat – Post lactating female
5.16 Tagged 16 August 2022 following capture in The Valdoe - SU 87825 09015– radiotracking identified two roosts. (See figure 5)

5.17 A daytime search on the 17 August identified bat 1 within a tree within the grounds of Goodwood House, in which she was identified to be solitary roosting. Bat 1 subsequently moved to a second tree within the same area on the 18 August and emergence counts identified a peak count of 26 bats.

5.18 Bat 1 predominantly foraged around the Goodwood estate and moving north into West Dean, with some foraging passes down the railway line which runs to the west of Chichester. Weather conditions were frequently foggy during the tracking period which may have caused the bat to prefer habitats in areas of higher ground, rather than low lying areas closer to Chichester.
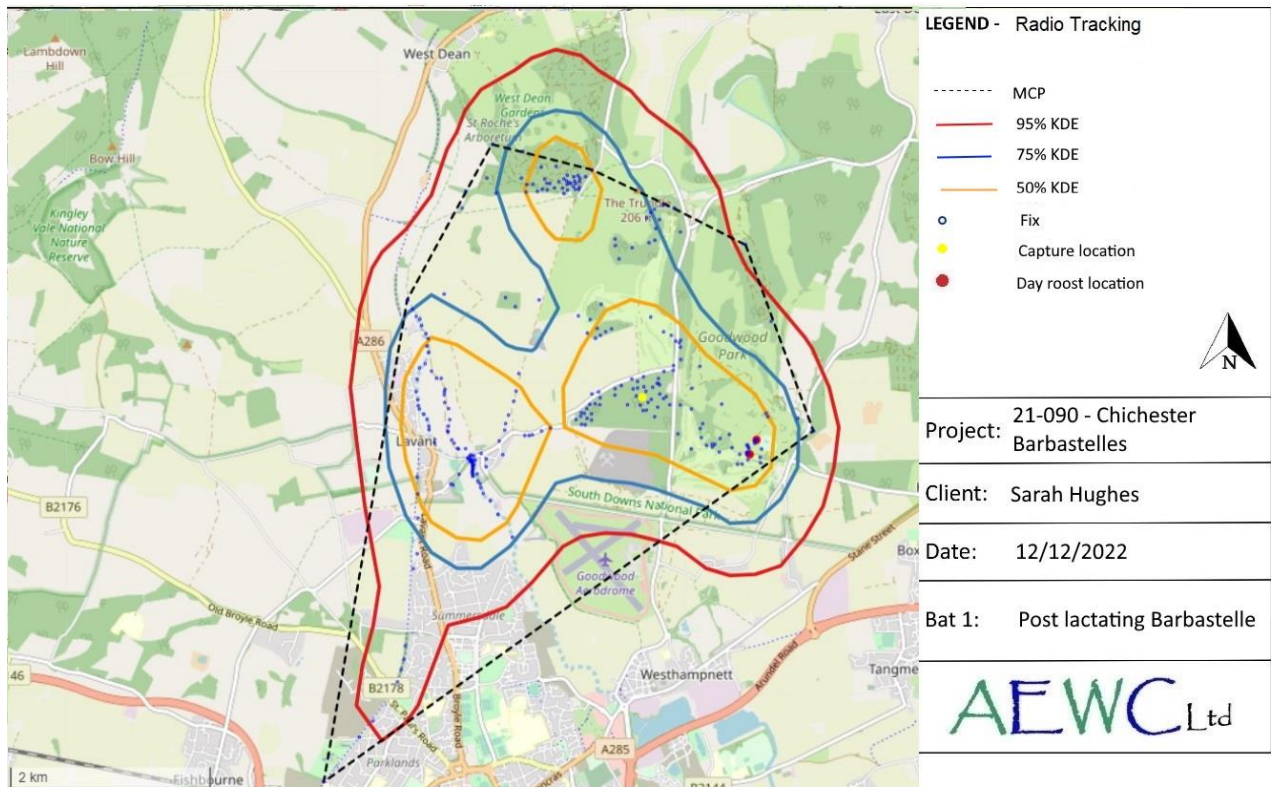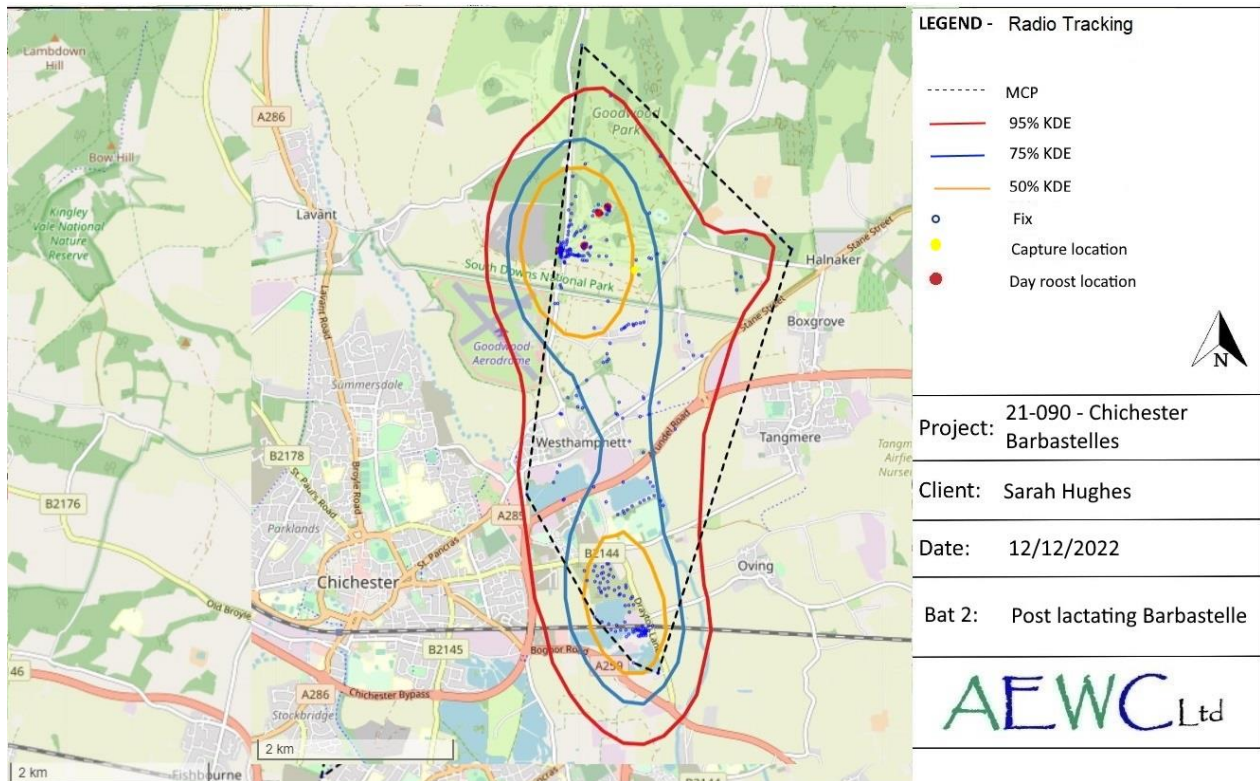
FIGURE 6: RADIO TRACKING FIXES, ROOSTS, MCP AND KDE FOR BAT 1

Bat 2 – Barbastelle bat – Post lactating female

5.19 Tagged 21 August 2022 following capture within the Goodwood Hotel Golf Course - SU 88832 08030– radiotracking identified four roosts. (See figure 6).

5.20 A daytime search on the 22 August identified bat 2 within a tree within the Goodwood Golf course in which she was confirmed to be solitary roosting. On the 23 August she was recorded to move into a tree outside to the west of Goodwood house. Emergence counts identified a peak count of seven bats within this roost. On the 25 August bat 2 moved into a tree close to Goodwood house, emergence counts identified a peak count of 13 bats emerging from this roost. On the 28 August bat 2 moved into a derelict building within the grounds of Goodwood house, with a peak count of eight bats obtained from emergence surveys.

5.21 Bat 2 foraged widely, spending time within the Goodwood golf course and estate during foggy periods and during dry weather preceding and following thunderstorms which occurred during the tracking period. During good weather bat 2 was recorded to commute south along tree lines prior to foraging around Drayton Lakes and neighbouring woodlands and water bodies.
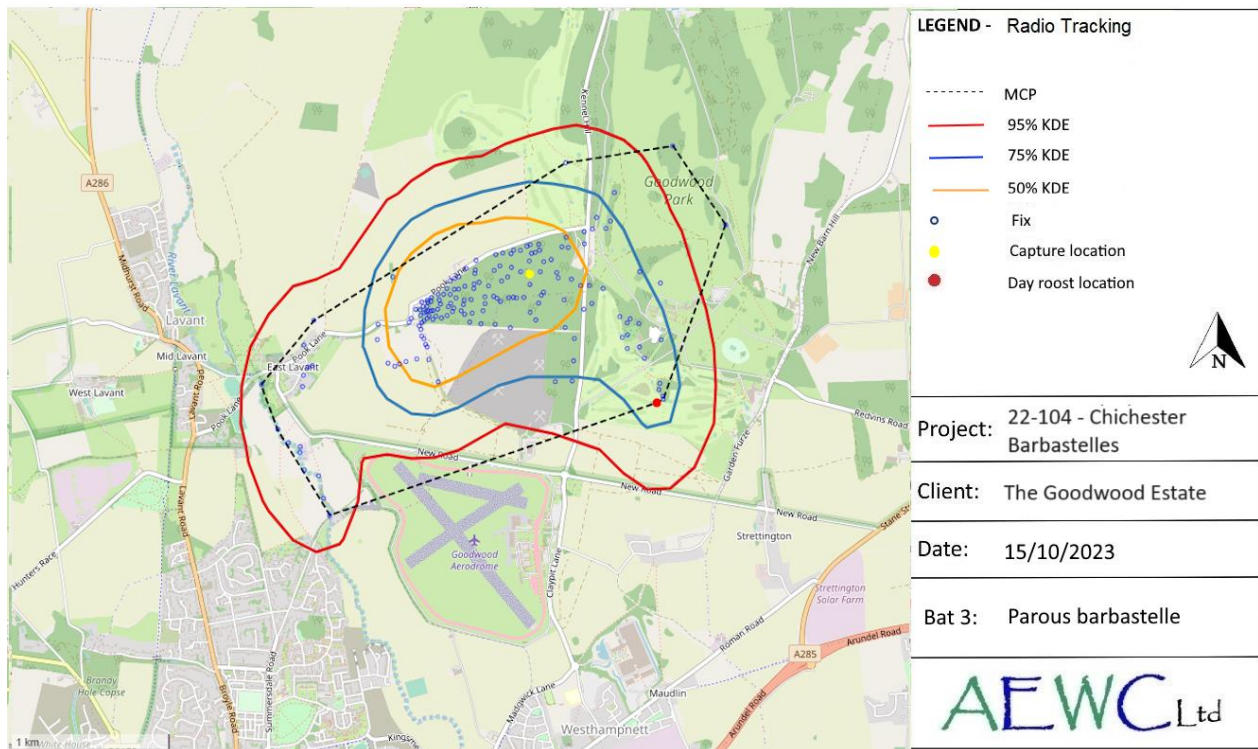
FIGURE 7: RADIO TRACKING FIXES, ROOSTS, MCP AND KDE FOR BAT 2

Bat 3 – Barbastelle bat – Parous female

5.22 Tagged 9th June 2023 following capture in The Valdoe - SU 87800 09021 – radiotracking identified one roost. (See figure 8)

5.23 A daytime search on the 10th June identified bat 3 within a tree within the grounds of Goodwood House, bat 3 stayed within this roost throughout the tracking period with emergence counts carried out nightly between 10th and 15th June which identified a peak count of 22 bats.

5.24 Bat 3 predominantly foraged around the Goodwood estate and moving south-east to East Lavant. Weather conditions were frequently foggy during the tracking period which may have caused the bat to prefer habitats in areas of higher ground, rather than low lying areas closer to Chichester.

FIGURE 8: RADIO TRACKING FIXES, ROOSTS, MCP AND KDE FOR BAT 3
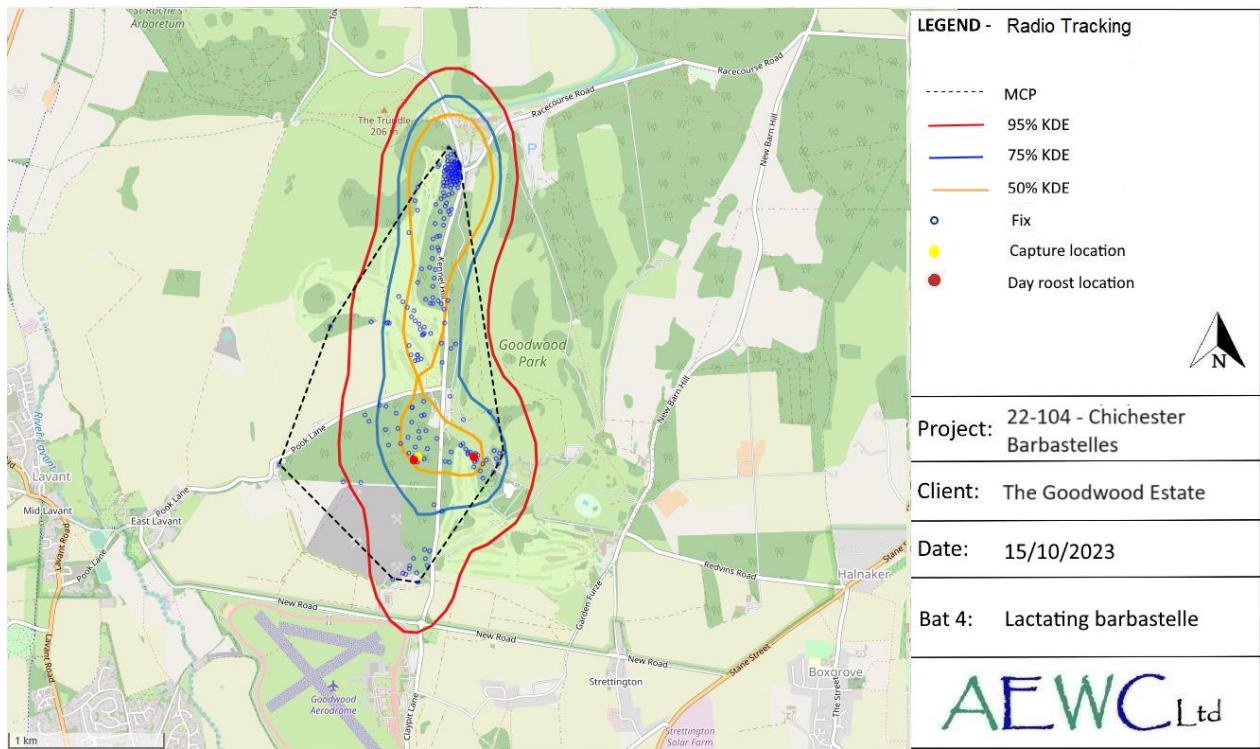
<u>Bat 4 – Barbastelle bat –Lactating female</u>

5.25 Tagged 27th July following capture in The Valdoe - SU 88000 08870 – radiotracking identified two roosts. (See figure 9)

5.26 Bat 4 was radio tracked for part of the night following release during which she predominantly foraged within the Valdoe. Daytime searches on the 28th August and 29th July did not pick up a signal for bat 4, the approximate roost location was triangulated based on last appearance at dawn on each day, capture location as she was caught shortly after sunset and first appearance at dusk each time. With the roost identified as in close proximity to her capture location within the Valdoe. High levels of barbastelle activity were recorded around a number of trees but no roost feature could be observed. Bat 4 subsequently moved to a second tree within the Goodwood Estate, which was confirmed to be a roost previously recorded during the 2014/15 project. Emergence surveys were carried out which confirmed the presence of a minimum of 31 adults, in addition to juveniles. Observations were carried out using a thermal scope which confirmed there to be a large hot spot remaining within the roost area following the emergence by 31 adults on the 30th July. A minimum of 2 adults were considered to have remained within the roost as they could be seen moving around under the bark of the tree. Additionally, a significant group of juveniles were also present.

5.27 A single juvenile barbastelle was noted to emerge from another section of lifted bark away from the main roost, this individual remained sat on a callous roll social calling for a number of hours.

5.28 Bat 4 predominantly foraged around the Goodwood estate with significant time spent within the northern gold course with frequent runs back towards the roost.
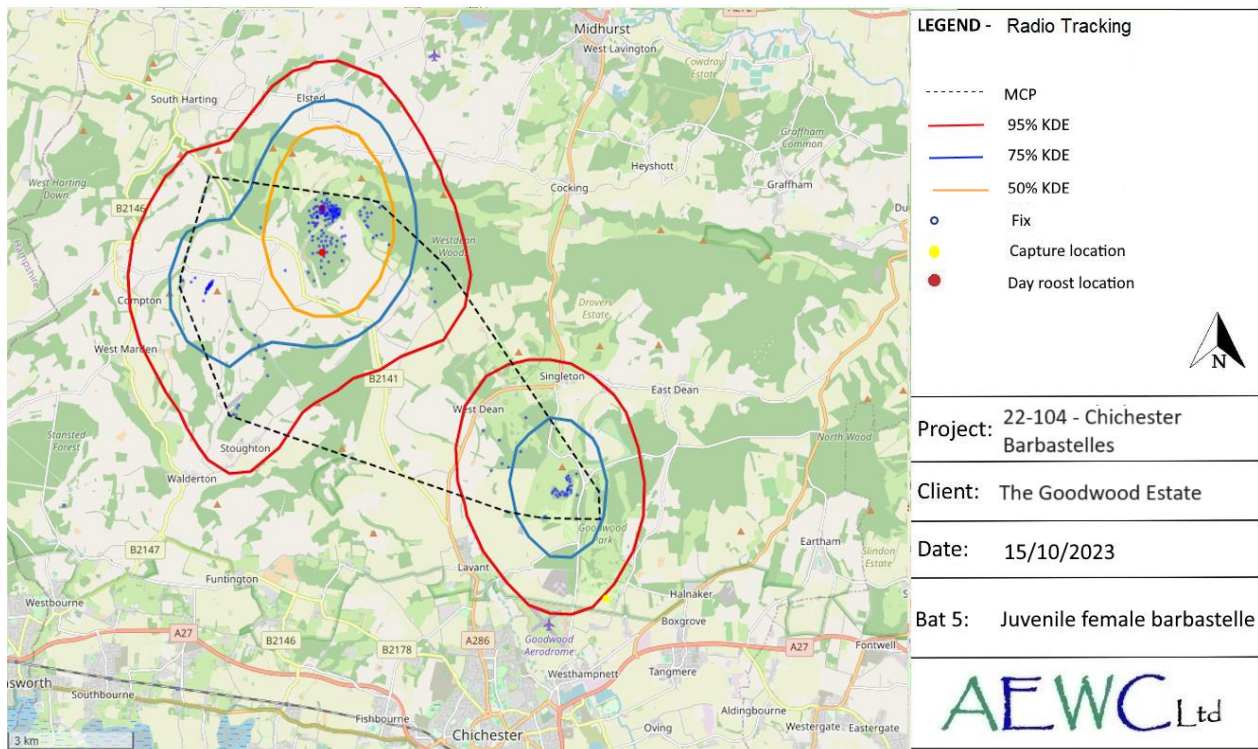
FIGURE 9: RADIO TRACKING FIXES, ROOSTS, MCP AND KDE FOR BAT 4

Bat 5 – Barbastelle bat – Juvenile female

5.29 Tagged 21st August 2023 following capture in The Goodwood Hotel Golf Course - SU 88832 08030 in the same location as bat 2, radiotracking identified two roosts which could not be pinpointed due to access issues. (See figure 10)

5.30 A daytime search for bat 5 on the 22nd August could not identify a signal. A roost location was identified on the 24th August to the north east in West Dean woods, however it could not be pinpointed due to lack of access into the woodland, the location was therefore identified through triangulation only. A second approximate roost site was identified on the 26th August. A high number of potential roost features were present within the trees in the area in which the signal was triangulated. A daytime search on the 27th August did not identify a signal for bat 5.

5.31 Bat 5 predominantly remained within the West Dean and the surrounding woodlands, the terrain in and around the woodlands in this area is very undulating with few roads and tracks leading to the signal becoming frequently lost or blocked throughout the tracking period, however a sufficient number of fixes were obtained to allow KDE calculations.

FIGURE 10: RADIO TRACKING FIXES, ROOSTS, MCP AND KDE FOR BAT 5

6   Discussion

6.1   Surveys on the site have been successful in trapping and tagging Barbastelle bats and locate and identify the colony present on the site. The 2022 and 2023 radio tracking identified a peak colony count of 33 adult bats with 11 roosts identified, including eight maternity/satellite roosts.

6.2   Surveys additionally identified a high number of Nathusius Pipistrelle bats during one night trapping at Westbourne Lake on 10th September 2022, an area where bat 2 was found to forage. A total of ten Nathusius were caught, include one breeding female. This species has a higher affinity to large waterbodies and while widespread is rare in the UK and currently has no confirmed maternity colonies in Sussex. Further research on this species locally separate to this study would be beneficial.

6.3   During 2014 and 2015 twenty-one adult females were caught and identified at Goodwood, all of which were ringed. Seven bats were radio tagged and ten barbastelle roosts were identified at Goodwood during this period, of which four were classified as maternity roosts with the rest solitary or having an unknown count or status. It was estimated that the adult female population at Goodwood was at least 30 adult females, however if other satellite groups are present, it may be more than this.

6.4   Barbastelle colonies commonly fragment into a number of smaller roosts demonstrating a fission fusion behaviour, with individuals separating and coming together to roost. Tagging only solitary individuals or very low numbers can be less successful in accurately identifying the colony size for this reason as not all roosts/groups can be simultaneously identified, compared to other species which

predominantly all roost together. As individuals from these fragmented roosts can commonly forage in different areas, it is often difficult to catch individuals close to roosts and therefore may not identify the total population size of the whole colony.

6.5   The fission-fusion behaviour of barbastelle bats moving between different roosts and fragmenting into multiple roosts is evident in the emergence surveys data. Getting full accurate population counts of a barbastelle colony can be difficult due to the behaviour of the species constantly both moving roost and the colony fragmenting into separate roosts. Where possible counts of multiple roosts were undertaken on the same night in order to obtain a peak colony count and where suitable night vision cameras were zoomed in on the emergence feature in order to try and identify whether the emerging bats had rings.

6.6   To date a minimum of 29 female Barbastelle bats from the Goodwood colony have been ringed over the last 10 years. A maximum of five rings were counted during emergence with a peak count of 26 bats, which may or may not have included juveniles. These surveys were all late in the season when juveniles were volant and maternity colonies were beginning to disband. The 2023 counts identified a minimum of 33 adults present within a maternity roost prior to juveniles becoming volant, with at least 9 ringed bats noted within the count.

6.7   The emergence and ring counts obtained indicate that further unidentified roosts used by the colony are present and taking into account the known fragmentation and behaviour of the species it is considered likely that there were other adults in other roosts at the same time and the total population is higher than the minimum count identified. (See table 2).

TABLE 2: ROOST LOCATIONS AND EMERGENCE SURVEY RESULTS

Roost ref	Tagged bat No.	Roost type	Dates used by tagged bat	Grid ref	Emergence date	Count
1	1	solitary	17/08/2022	SU 88907 08469	17-Aug 22	1
2	1	maternity	18-20/08/2022	SU 88972 08613	18-Aug 22	18
					19-Aug 22	26
					22-Aug 22	24*
					23-Aug 22	17*
					25-Aug 22	6*
					26-Aug 22	0*
3	2	solitary	22/08/2022	SU 88312 08271	22-Aug 22	1
4	2	satellite	23-25/08/2022, 26/08	SU 88066 08220	23-Aug 22	4
					24-Aug 22	7
					25-Aug 22	2
					26-Aug 22	6
5	2	satellite	25-Aug	SU 88545 08670	25-Aug 22	3
					26-Aug 22	13
6	2	satellite	28-Aug	SU 88457 08606	28-Aug 22	2
					29-Aug 22	2
7	3	maternity	10/06/2023 - 12/06/2023	SU 88605 08255	10-Jun 23	6
					11-Jun 23	21
					12-Jun 23	22
					13-Jun 23	15

					14-Jun 23	7
					15-Jun 23	8
8	4	Likely maternity	27/07/2023 - 29/07/2023	roost could not be pinpointed, approx. SU 87974 08849	N/A	N/A
9	4	maternity	30/07/2023 - 02/08/2023	SU 88356 08875	30-Jul 23	31
					31-Jul 23	30
10	5	unknown day	24/08/2023	approximately SU 81924 16993	N/A	N/A
11	5	unknown day	26/08/2023	approximately SU 81943 15975	N/A	N/A

*No signal for bat 1

6.8 Five female barbastelle bats captured within the Goodwood Estate were radio tracked as part of this study with a minimum population count of 33, this represents around 15% of the colony. Best practice guidelines recommend around 25% of a colony be tagged and radio tracked to get proportional representation of the colony and understanding of the colony range, behaviour and habitat use. However, this can depend on the total population, objectives of the study and findings to date from tagged bats. Radio tracking should ideally look to track the minimum number of bats needed to identify the necessary information for ethical and welfare reasons to minimise impacts on a population.

6.9 Female barbastelles are known to exhibit natal homing, or natal philopatry, which is the process by which some adult animals which have left their juvenile habitats return back to their birthplace to reproduce. Whilst males are more likely to disperse away from their birth site and join an unrelated colony to ensure genetic variation, females are more likely to remain within their birth colony range area but will commonly forage some distance from roost locations and can have large foraging areas.

6.10 The surveys during 2022 initially reconfirmed findings of the previous radio tracking study in 2015 with 50% of the radio tracked bats using the East of Chichester Wildlife corridor for commuting and foraging during the tracking period and significant foraging time spent within the Goodwood estate. It additionally showed use of the habitat corridor to the west of Chichester which had not been previously identified as used. In 2023 bats 3 and 4 largely remained within the Goodwood Estate, with only bat 5 tracked a significant distance from the estate.

6.11 Bats 1, 2 and 5 were all captured and tagged in August when maternity colonies had disbursed, whilst bats 3 and 4 were captured during the peak maternity period when female bats are known to remain in closer proximity to maternity roosts within the core sustenance zone and key foraging sites.

6.12 Barbastelle colonies can have roosts spread out over a large area, commonly extending over a couple of square kilometres. The roosts for bat 5 are approximately 10km from the closest roost identified at Goodwood in 2023. Whilst this is a very widespread for a single colony there is overlap in the tracking data for all five bats (see Figure 11) and when colonies disband following the summer breeding period many bats are known to disperse wider to areas further away from the main colony

summer roosts, juveniles in particular are known to cover extensive areas following dispersal from maternity roosts.
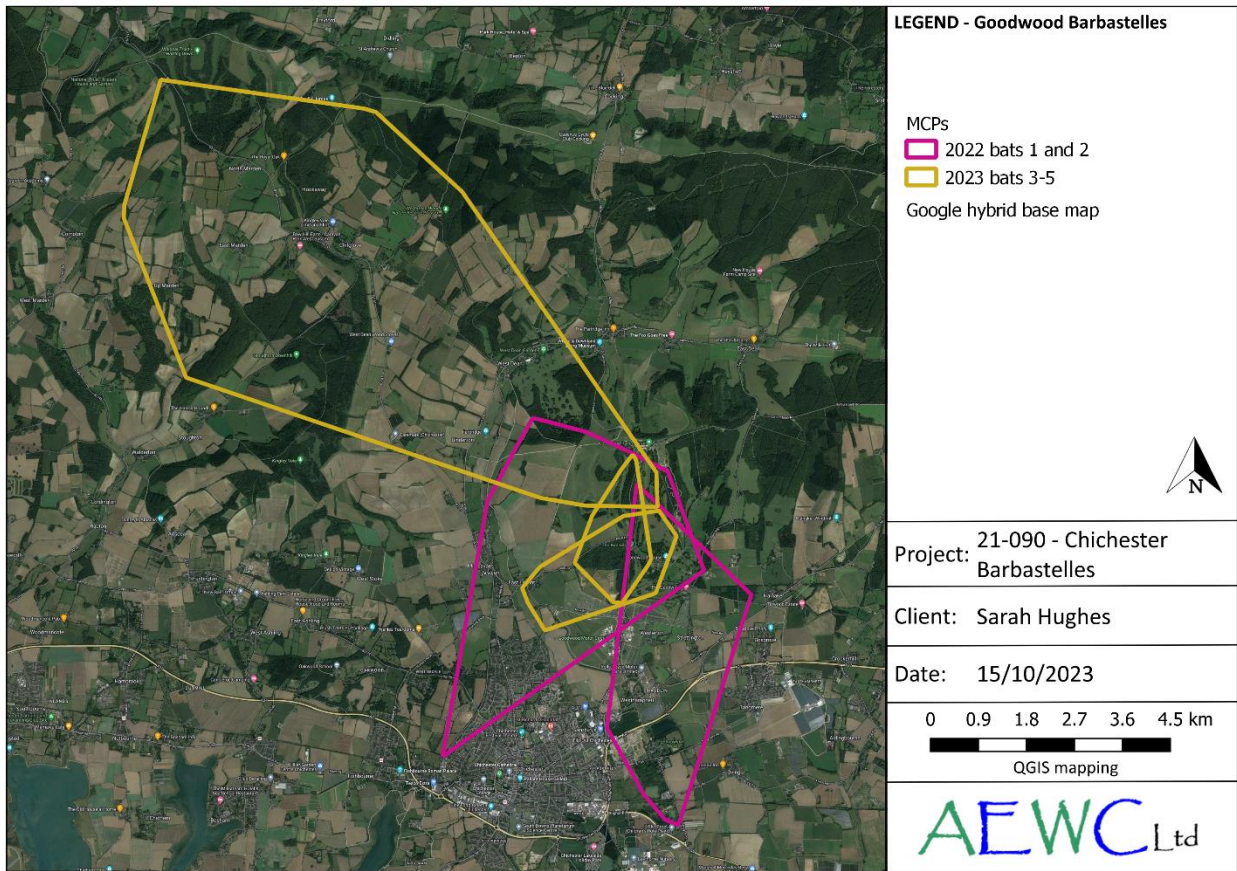
FIGURE 11: MCPS OF BARBASTELLE BATS CAPTURED WITHIN THE GOODWOOD ESTATE

6.13 Prey availability varies at different times of year and with changes in weather conditions. During foggy weather during the tracking period there was a shift in activity to higher ground which was warmer and will have had likely higher prey availability. During the later summer and early autumn large water bodies are often warmer than the surrounding area due to heat retention and this often leads to increased invertebrate activity at water bodies in comparison to within woodlands. Additionally, when extended dry periods are experienced invertebrate activity is often proportionally higher around water bodies than within higher and drier areas.

6.14 Woodland is very important for foraging all summer period, but additionally for autumn and winter foraging, which is frequently carried out by barbastelle. Activity is likely to shift from areas of water back into to the woodlands through autumn and into winter as the woodland will contain warmer areas through the insulating properties of dense vegetation present. The reduction in size of woodlands not only directly reduces the amount of woodland available for foraging but can make the whole wood colder and thereby reduce the suitability of the area even proportionally to that which was previously present.

6.15 The Goodwood colony is known to be linked to the Singleton and Cocking SAC for which barbastelle is a qualifying feature. There are few records to demonstrate the long-term viability of barbastelle populations in the UK. While the SAC makes a contribution to securing favourable conservation status for this Annex II species, wider

measures are also necessary to support its conservation in the UK. Measures are provided in the UK Habitats Regulations to control adverse impacts, through the planning system, on a qualifying feature arising outside the site of the SAC.

6.16 With the information gained over the last ten years it is considered that any significant negative impacts upon the habitats within the Goodwood Estate and surrounding area, including all communally used core foraging areas and connective habitat corridors shown to be used by Barbastelle bats could adversely impact Barbastelle bats and therefore adversely impact upon a qualifying feature of the Cocking and Singleton SAC.
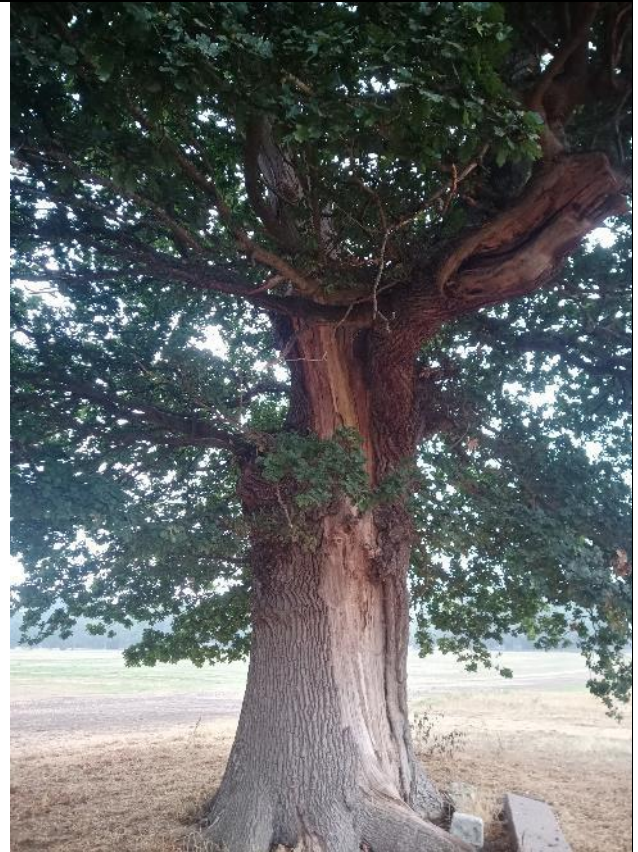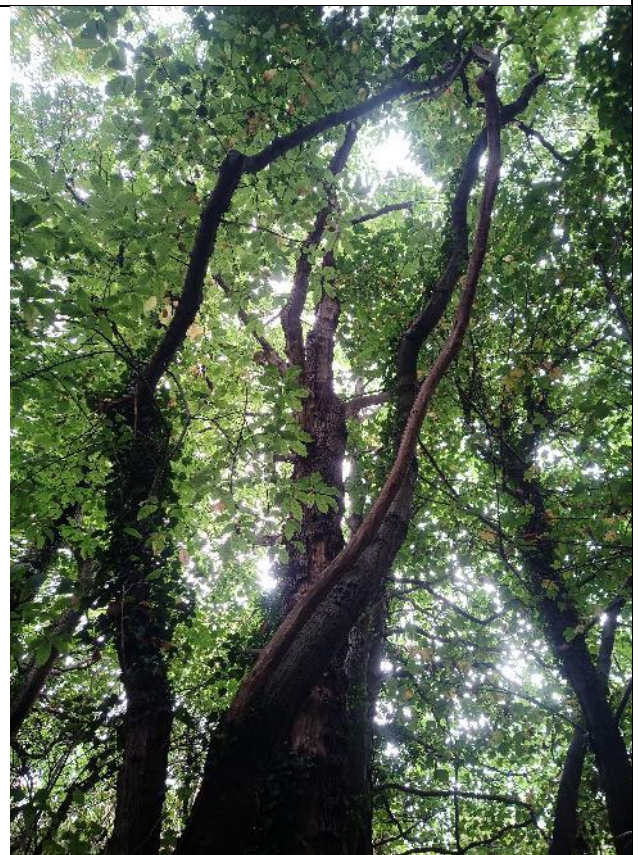
7   Annex

Roost photos

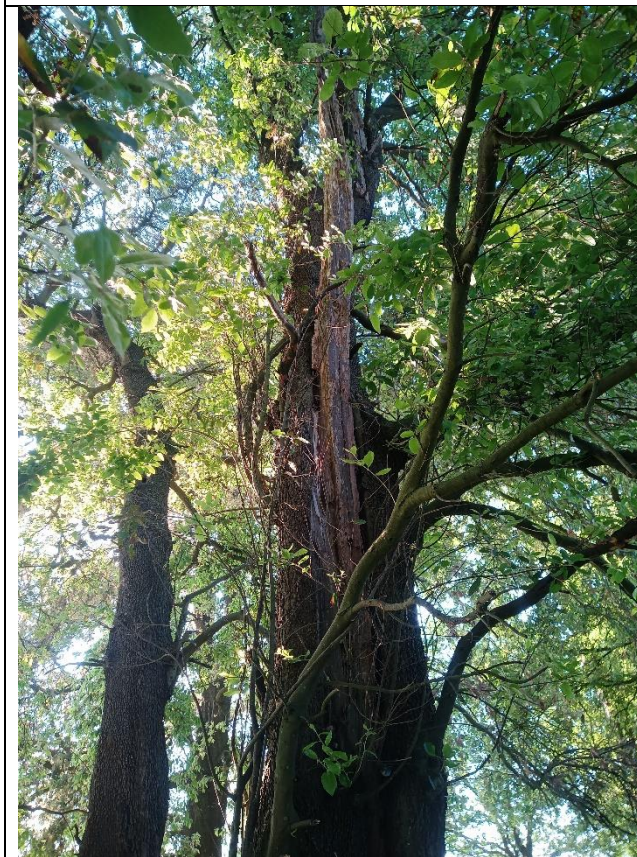|	
Roost 1	Roost 2
Roost 3	Roost 4

Roost 5

Roost 6

Roost 7

Roost 9

Tagged Barbastelle bat

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