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Bath Urban Surveys: Dusk Bat Surveys for horseshoe bats around south-western Bath. Assessments Summer 2008

Final Report prepared

by

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for

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REMIT

Bath & NE Somerset Council is required by Government through the Regional Spatial Strategy to identify (a) location(s) somewhere to the south-west of Bath to build an urban extension to the city providing some 1,500 to 2,000 dwellings. The development has the potential to adversely affect the SAC in this region. The SAC designation was initially made to safeguard Greater horseshoe bats, but Lesser horseshoe bats were added later.

In June 2008 Bat Pro Ltd. was commissioned by Bath and North East Somerset Council to carry out monthly dusk surveys for bats within six locations to the south and west of Bath. They were designed to re-assess the use made by horseshoe bats of certain foraging areas identified by the Billington radio-tracking study carried out in the summer of 2000. In addition the surveys were to identify the presence of other bat species (vesper bats) that were foraging at the various sampling stations. Surveys were to be monthly from June to September 2008.

These surveys were required to inform the planning authority of the current importance of various locations to the horseshoe bats that roost in the Combe Down Mines. Their roosts form part of the Bath and Bradford on Avon SAC. This designation was initially made because of the presence of significant populations of greater and lesser horseshoe bats. Both of these bat species are listed as endangered. Horseshoe bat foraging areas close to a SAC enjoy a high level of protection from activities that may harm their use.

Greater horseshoe bats are known to forage along tall hedgerows and woodland edge over long grass for moths from May to July/August, and cattle or sheep-grazed pastures for a significant part of the remaining summer months. Although detecting horseshoe bats and quantifying their use of different locations was a priority, it was also important to assess locations for foraging use by vespertilionid bat species, since they are also protected species.

An interim report was required in early August, and a final report of the 2008 surveys was required at the end of the surveys.

Karen Renshaw, Council Ecologist, provided current maps of the site and arranged site access permission.

1. INTRODUCTION

These surveys were undertaken by Bat Pro Ltd. Staff, supervised by Roger Ransome (English Nature bat survey licence No 20073256) assisted by additional surveyors sub-contracted from local consultancies.

1.1 **Description of the Locations sampled**.

Map 1 shows distribution of the 21 sampled sites (blue arrows); Horsecombe Mine entrance (red arrow) and other mine entrance areas with SSI status (red blobs or circles). The sampled sites were grouped into six locations, described below.

1.1.1 **Location 1: Horsecombe Vale.** A steep-sided valley between North Road & Midford Lane that is closest to the Byfield Mine (from which all bats were excluded under licence in September 2007), and also Horsecombe Mine. It is only sparsely grazed by two highland cattle. In 2008 grass and other vegetation grew very strongly within the valley, probably providing very good moth levels in May & June. A spring at the head of the valley produces a significant stream that is well screened by deciduous woodland in the valley bottom. Scrub development is generally quite advanced. Identified by Billington (2000) as a key foraging site for Greater horseshoe bats. See Maps 2 and 3.

1.1.2 **Location 2: Southstoke area of Cam Valley.** The region around the village of Southstoke with its range of old buildings showing good bat roost opportunities. Good range of habitat for foraging by many bat species with both grazed and ungrazed pasture within large fields delimited by tree lines and woodland blocks. A small area of maize was planted that included a pond created in May 2008 for game birds. Identified by Billington (2000) as a key foraging site for Greater horseshoe bats. See Maps 2 and 4.

1.1.3 **Location 3: Odd Down.** The flatter land to the east of the Park & Ride facility. Initially (June 2008) only the land to the west of Sulis Manor was sampled. In July a second area to the east of Sulis Manor that linked up with the Cam Valley was added. The most northerly parts of both areas on both sides of Sulis Manor were arable land used to grow broad beans in 2008. The southern edges were fringed with a narrow band (12 m wide) of young (about 12 years old?) ash plantations with thick grassland beneath. Further south, below the footpath, the land drops steeply into continuous deciduous woodland along the ridge before flattening somewhat with some open areas. Billington (2000) regarded it as a minor foraging site for Greater horseshoe bats. See Maps 2 and 4.

1.1.4 **Location 4: West of Odd Down.** Land to the west of the Park & Ride and the Radstock Road. Consists of a very large field adjacent to Vernham Wood to the south below the Bristol Cottages on Kilkenny Lane. Field permanently grazed by some 42 young cattle. Significant stream runs along the field/wood border. Billington (2000) regarded it as a minor foraging site for Greater horseshoe bats. See Maps 2 and 5.

1.1.5 **Location 5: North of Odd Down.** An area called the Tumps on flat land that is more or less enclosed by long-standing urban development. Deciduous woodland with some marshy ground covers the steeper slopes on the west and northern edges leading up to the flat land. Most of the flat land is amenity grassland, but a BMX track and some scrubland is adjacent to the woodland. Billington (2000) reported rare foraging use by Greater horseshoe bats. See Map 2.

1.1.6 **Location 6: Newbridge/Twerton.** A large open arable area containing Seven Acre Wood – deciduous wood on flatish land. In 2008 the fields were planted with cereals that were harvested in late July. Low hedgerows with gaps tenuously link the woodland to better foraging habitat for bats to the west at Newton St Lo, and south-east at the Caravan Park with its river and adjacent Nature Reserve. Billington (2000) reported no foraging use by Greater horseshoe bats of this area, but 2 night roosts at Claysend Farm not very far away. See Maps 2 and 6.

2. SAMPLING SITES

The first survey was carried out in June 2008 to trial the methodology. At this time two sampling sites per location were mainly used (total 13 sites). As the method proved to be successful in locating commuting and foraging horseshoe bats, the specification was increased to 21 sites from July onwards.
At Twerton during the July survey, a static system was stolen by 3 youths on bicycles. As a result of this, future surveys used two static systems at Twerton that could be simultaneously viewed from a single surveyor position. This prevented the surveyor from ranging more widely around this location. At other locations camouflaged material was used from August to make the static systems less visible to persons using the public footpaths during surveys.

At North Odd Down, the curiosity of the cattle and potential damage to equipment forced the surveyor to move the two static systems into the woodland behind barbed wire fencing. Subsequently two small areas were ringed with electric fencing to allow safe sampling in the grazed field areas.

The grid references and habitat descriptions for all static sites are provided in Table 2.1. Appendix 1 provides photos of static sites.

Table 2.1 below shows the description of each site by location & the name used for each one.

Location and detailed Map number	Name of site & position	Surrounding habitat conditions
Horsecombe Map 3	Horsecombe A 51° 21' 22.43" N 2° 21' 35.96" W	Near stream in valley bottom with pool beneath overhanging trees just below spring
Horsecombe Map 3	Horsecombe B 51° 21' 18.20" N 2° 21' 25.28" W	In tall grassland near tall tree line and hawthorn bushes near far gate to grazed field
Horsecombe Map 3	Horsecombe C 51° 21' 19.93" N 2° 21' 40.34" W	Off steep path in tall grassland near buddleia, hawthorn &other bushes near top of the bank
Horsecombe Map 3	**Horsecombe D** 51° 21' 24.78" N 2° 21' 31.75" W	Near sheep sheds within mixed short grass & orchard nearby half way up bank below mine
Southstoke (Cam Valley) Map 4	Southstoke A 51° 20' 56.24" N 2° 22' 04.80" W	At gap in tree line between hay fields linking woodland blocks west of Southstoke Village
Southstoke (Cam Valley) Map 4	Southstoke B 51° 20' 57.66" N 2° 22' 09.24" W	Corner of woodland block near newly created pond and maize field
Southstoke (Cam Valley) Map 4	**Southstoke C** 51° 21' 00.81" N 2° 22' 23.57" W	In tall grassland amongst trees and developing scrubland adjacent to woodland towards Odd Down
Southstoke (Cam Valley) Map 4	**Southstoke D** 51° 20' 51.29" N 2° 22' 05.46" W	Beneath tall tree adjacent to low hedgerow at corner of wood low down in valley
Odd Down Map 4	Odd Down A 51° 21' 07.00" N 2° 22' 58.43" W	Tall grassland in angle between high hedgerows near Park & Ride. Behind football clubhouse & near floodlit pitch..
Odd Down Map 4	Odd Down B 51° 20' 59.57" N 2° 22' 52.81" W	Inside young ash plantation in tall grassland just off public footpath near gate.
Odd Down Map 4	**Odd Down C** 51° 21' 02.74" N 2° 22' 46.74" W	Near bush in low hedge on footpath running between two open arable fields.
Odd Down Map 4	**Odd Down D** 51° 21' 04.38" N 2° 22' 26.67" W	Corner of arable field with broad beans near high hedgerow of Sulis Manor grounds & young ash plantation
Odd Down Map 4	**Odd Down E** 51° 21' 04.52" N 2° 22' 12.79" W	East side of broad bean arable field in tall grassland within young ash plantation near end of stone wall
W Odd Down Map 5	Vernham A 51° 21' 18.13" N 2° 23' 08.03" W	Grazed field corner of Vernham wood sheltered by bushes & tall trees
W Odd Down	Vernham B 51° 21' 20.97" N	Grazed field edge near fence and stream under overhanging woodland trees of Vernham wood

Map 5	2° 23’ 15.02” W	
W Odd Down	**Vernham C**	Within Vernham woodl across stream some 8m
	51° 21’ 16.74” N	away from field edge inside dense woodland
Map 5	2° 23’ 08.53” W	
N Odd Down	Tumps A	In a sheltered area near wood edge 10 m from
	51° 21’ 50.39” N	footpath within tall scrubby vegetation (mostly
Map 2	2° 22’ 28.24” W	Policeman’s helmet)
N Odd Down	Tumps B	Sheltered area with tall vegetation near wood
	51° 21’ 51.19” N	edge below corner of BMX circuit & just off
Map 2	2° 22’ 31.60” W	footpath
Twerton	Twerton A	Woodland (Seven Acre Wood); south-east
	51° 23’ 02.74” N	corner abutting on to cereal arable field
Map 6	2° 25’ 01.95” W	
Twerton	Twerton B	Woodland edge; north-east corner abutting on
	51° 23’ 04.19” N	to cereal arable field
Map 6	2° 24’ 59.21” W	

Bold sites were only added to the sampling areas from July 2008

3. METHODOLOGY USED FOR THE DUSK BAT SURVEYS

3.1 Introduction

Detailed habitat use by bats is often investigated by the use of radio-tracking. Bats are caught by hand net, mist net or harp trap, and a radio tag is glued between the shoulder blades after shaving off the fur. Usually two persons are needed to follow bats throughout the night to their foraging areas. Tags can adhere for up to 21 days and provide extensive data, but often fall off much sooner. An average of 7 days is typical.

Radio-tracking provides detailed data about the foraging use of habitats through the night made by certain bats at specific times of year. It is a labour-intensive procedure that can provide unique data on habitat use. If enough bats are tagged, and the study lasts over a significant period of the summer, it can provide a reliable picture of the location of key foraging areas required to sustain a given bat colony. Such a study was carried out by Geoff Billington, supervised by the then Dr (now Professor) Gareth Jones of Bristol University in 2000 (see Billington 2000 for the complete report, or Bat Pro Ltd 2001 for a summary).

The drawbacks to radio-tracking as a method of assessing overall use by bats of particular areas of land include:

- The numbers of bats that can be tracked simultaneously is usually fairly small, so the bats followed may not be representative of the colony being studied

- Once bats have been caught and tagged, the study has to follow immediately, whatever the weather conditions that occur.

- Bats cannot be tagged during the late pregnancy period (June/early July), as the additional stress to females is unacceptable.

- Bats cannot usefully be tagged in September as many disperse to more distant roosts.

Foraging habitat surveys used in this study

The methodology used was based upon the use of static recording systems, supplemented by surveyor observations, which have been widely used by Bat Pro staff over many years to assess habitat use by bats at night. The methods used overcome many of the drawbacks outlined above, and are suitable to assess specific habitat areas for foraging use by bats in a quantitative manner. However, this methodology has its own limitations, and does not provide an alternative to thorough radio-tracking studies. The two methods should be regarded as complementary ways of determining habitat use by bats.

Bat Mitigation Guidelines (2004) p 25 gives a methodology for dusk surveys to be carried out for planning applications involving significant areas (greater than 1ha) within 4 km of greater horseshoe bat roosts. Key recommendations are as follows.

- Surveys should pay particular attention to known greater horseshoe bat feeding habitat.
- Surveys should be carried out on two separate evenings per month from May to September.
- Study dates should be chosen to be during favourable weather conditions as far as was possible given the erratic 2008 summer weather and surveyor availability.
- Surveys should cover the period of peak activity for the bats – from sunset for the next 3 hours.
- Surveys should preferably use broad-band detectors to provide a record of calls obtained.

This methodology was largely adopted, apart from using one instead of two surveys per month. Also the study was not able to start until June.

In order to cover the extensive areas that needed to be sampled, involving 21 sites, each monthly survey had to be split into two for logistical reasons (staff and equipment availability). Twelve sites were sampled on one night, and nine on the other.

One survey per month was regarded as acceptable by English Nature for the Bathampton floodplain surveys in the summer of 2003. Broad-band detectors were used, so that all bat species were simultaneously recorded.

Bat activity over the study areas was sampled throughout the late pregnancy period (June/early July); lactation & weaning (late July & August), and the dispersal period (September). No stress to bats resulted from the methods adopted.

3.2 Static surveys

3.2.1 Surveyors were responsible for overseeing the setting up, correct operation and safety of up to 4 static broad-band detector systems (each with a Tranquility transect broad-band detector; a Sony ICD P520 dictation recorder & 6v battery pack) set at fixed sites within locations where bats, especially horseshoe bats, where likely to either commute or

forage. Their sites and general locations are shown on Maps 1 to 6. The habitats they were placed in are described in Table 2.1, and photographs in Appendix 1.

3.2.2 The equipment was placed on a low stool, about 0.6m above ground level as horseshoe bats commute at about 1m height above ground level. This height is also suitable for vesper bats that fly much higher, as long as they are within detection range, since their calls radiate out in all directions. The species most likely to cause detection problems is the Brown long-eared bat, whose calls are often very weak. The surveyors regularly checked the safety of the systems from a distance, once set up at dusk. Systems may be either stolen, or damaged by grazing animals. Each system automatically recorded bat calls onto the Sony digital recorder, which was set in voice-activated mode. It has a time facility that records the precise time of any bat calls detected at the site.

3.2.3 Weather data (temperature, windspeed, light level, rainfall) operating during the session, was recorded by one surveyor throughout each dusk survey.

3.2.4 Bat call recordings were later downloaded to computer and analysed using Batsound software (Pettersen Electronik). The precise times of all recorded horseshoe bat calls were noted by species and site location. Also the presence or absence of all identifiable vesper bat types at each location, as per the contract specification. Please note that *Nyctalus* species calls cannot always be separated into the two UK species (Noctule and Leisler's bats), and the *Myotis* species can only be separated into two groups – the 'Natterer's/Bechsteins' and 'other Myotis'. All other UK bats can usually be identified to species.

3.2.5 Note that the setting on the Tranquility transect was a 320 ms sample time. This was replayed 32 times slower in order to reduce the frequencies within the sensitivity range of the Sony ICD recorder. Hence it took about 10 seconds to replay each sample – from (320 x 32)/1000. During this period the detector is deaf to any further calls. In one minute, therefore, a maximum of 5 call blocks, or passes, can be recorded. Hence the system samples the level of bat call activity in a consistent, but not continuous, manner. Each call block sample can be treated as a bat pass. The 320 ms sample allows inter-pulse intervals to be calculated for vesper bats. This is an important characteristic in the identification of some bat species, such as *Nyctalus* bats.

3.2.6 Since bats were not aware of the static systems, their behavior was normal. Static systems are superior at recording the presence of horseshoe bats compared with surveyors carrying out transects using the same detectors. This is because horseshoe bats are predator-sensitive, and shun movements and/or light sources. They also fly low and/or close to vegetation where they are hard to see even when flying soon after sunset, and almost impossible to see later on in cloudy conditions.

4. DATA FROM THE DUSK SURVEYS

4.1 Summary data by static site

The presentation of data is complicated by the inconsistent number of sites sampled between the June and subsequent monthly dusk surveys. Table 4.1 summarises the horseshoe bat data for the 13 sites sampled from June to September.

Table 4.1.1 Summary of horseshoe bat passes in 13 sites by date using static systems

Site name (each sampled for 12 hours in total)	24th /25th June	21/22nd July	8th/12th Aug	8th/13th Sept	*Totals June to September (passes/hr)*
Horsecombe A	2 GH	2 GH	1 GH	1 GH	***6 GH (0.50)***
Horsecombe B (far field)	2 GH	2 GH	3 GH	None	***7 GH (0.58)***
Horsecombe C (buddleias)	3 GH	2 GH	2 GH	1 LH	***7 GH (0.58)***
		1 LH	4 LH		***6 LH (0.50)***
Southstoke A	1 GH	8 GH	7 GH	10 GH	***26 GH (2.17)***
	1 LH	6 LH		6 LH	***13 LH (1.08)***
Southstoke B	2 GH	1 LH	None	None	***2 GH (0.17)***
					1 LH (0.08)
Odd Down A	None	None	None	None	***None (0.0)***
Odd Down B	3 GH	1 LH	2 LH	1 GH	***4 GH (0.33)***
	2 LH				***5 LH (0.42)***
W Odd Down A	None	1 GH	None	None	***1 GH (0.08)***
W Odd Down B	None	1 LH	None	7 LH	***8 LH (0.67)***
N Odd Down A	None	None	1 LH	1 LH	***2 LH (0.17)***
N Odd Down B	None	1 GH	None	None	***1 GH (0.08)***

Twerton A	None	Kit stolen	None	None	***None?***
Twerton B	None	None	None	None	***None***
Total horseshoe bat passes	***13 GH***	***16 GH***	***13 GH***	***12 GH***	***54 GH (1.5)***
	3 LH	***10 LH***	***7 LH***	***15 LH***	***45 LH (1.25)***

NB. Greater horseshoe passes are in black. Lesser horseshoe passes are in red. Total 156 hours sampled. Mean 0.36 passes/hour GH; 0.29 passes/hour LH. Max = 2.17 passes/hour GH; 1.08 passes/hour LH.

From July, 8 further sites were included to improve the sample size in the crucial areas. Table 4.1.2 summarises the data obtained.

Table 4.1.2 Summary of horseshoe bat passes in 21 sites using static systems

Site name	**24th /25th June (estd)**	**21/22nd July**	**8th/12th Aug**	**8th/13th Sept**	***Totals June-Sept (passes/hr)***
Horsecombe A	2 GH	2 GH	1 GH	1 GH	***6 GH (0.5)***
(stream/pool ash)					
Horsecombe B	2 GH	2 GH	3 GH	None	***7 GH (0.58)***
(ungrazed field)					
Horsecombe C	3 GH	2 GH	2 GH	1 LH	***7 GH (0.58)***
(buddleias & scrub)		1 LH	4 LH		***6 LH (0.5)***
Horsecombe D	No sample	2 GH	2 GH	2 LH	***5 GH (0.42)***
(sheep sheds)	(1 GH 2 LH)	3 LH	2 LH		***9 LH (0.75)***
Southstoke A	1 GH	8 GH	7 GH	10 GH	***26 GH (2.17)***
(tree-line near gap)	1 LH	6 LH		6 LH	***13 LH (1.08)***
Southstoke B	2 GH	1 LH	None	None	***2 GH (0.17)***
(field corner)					***1 LH (0.08)***
Southstoke C	No sample	2 GH	None	None	***3 GH (0.25)***
(glade in scrub)	(1 GH)				
Southstoke D	No sample	None	None	None	***None***
(valley nr woods)	(None)				
Odd Down A	None	None	None	None	***None***
(near clubhouse)					
Odd Down B	3 GH	1 LH	2 LH	1 GH	***4 GH (0.33)***
(ash plantation)	2 LH				***5 LH (0.42)***
Odd Down C	No sample	None	None	None	***None***
(open arable field)	(None)				
Odd Down D	No sample	None	None	1 GH	***1 GH (0.08)***
(edge arable field)	(None)				

Odd Down E	No sample	1 GH	1 GH	3 LH	***3 GH (0.25)***
(ash plantation)	(1 GH 1 LH)	1 LH			***5 LH (0.42)***
W Odd Down A	None	1 GH	None	None	***2 GH (0.17)***
(field/wood edge)	(1 GH)				
W Odd Down B	None	1 LH	None	7 LH	***11 LH (0.92)***
(under trees/field)	(3 LH)				
W Odd Down C	No sample	Data stolen	None	None	***None***
(5m into wood)	(None)				
N Odd Down A	None	None	1 LH	1 LH	***3 LH (0.25)***
(wood/scrub edge)	(1 LH)				
N Odd Down B	None	1 GH	None	None	***1 GH (0.08)***
(wood/scrub edge)	(None)				
Twerton A	None	Kit stolen	None	None	***None***
(wood/arable edge)					
Twerton B	None	None	None	None	***None***
(wood/arable edge)					
Total horseshoe bat passes	***13 GH (4)***	***21 GH***	***16 GH***	***13 GH***	***67 GH (0.27)***
	3 LH (7)	***14 LH***	***9 LH***	***20 LH***	***53 LH (0.21)***

NB. Bold site names are additional ones from July. Greater horseshoe passes are in black. Lesser horseshoe passes are in red. Figures in brackets are additional estimated data. They are included in the final column totals.

To make the raw data more easily comprehensible, in table 4.1.3 below they are combined into totals per major location in order of distance from Horsecombe Mine, the main roost in summer 2008. Pass rates are again calculated in order to provide comparable data.

Table 4.1.3 Summary of horseshoe bat passes in the 6 locations using static systems

Location name (n sites sampled)	**24th /25th June (plus estimated)**	**21/22nd July**	**8th/12th Aug**	**8th/13th Sept**	**Totals June-Sept**	***Pass rate: passes/hr***
Horsecombe	8 GH	8 GH	8 GH	1 GH	**25 GH**	***0.52***
(4)	2 LH	4 LH	6 LH	3 LH	**15 LH**	***0.31***
Southstoke	4 GH	10 GH	7 GH	10 GH	**31 GH**	***0.65***
(4)	1 LH	7 LH		6 LH	**14 LH**	***0.29***
Odd Down	4 GH	1 GH	1 GH	2 GH	**8 GH**	***0.13***
(5)	3 LH	2 LH	2 LH	3 LH	**10 LH**	***0.17***
W Odd Down	1 GH	1 GH	None	7 LH	**2 GH**	***0.06***
(3)	3 LH	1 LH			**11 LH**	***0.33***

N Odd Down (2)	1 LH	1 GH	1 LH	1 LH	**1 GH** **3 LH**	***0.04*** ***0.13***
Twerton (2)	None	None	None	None	**None**	***0*** ***0***
Total horseshoe bat passes	***17 GH*** ***10 LH***	***21 GH*** ***14 LH***	***16 GH*** ***9 LH***	***13 GH*** ***20 LH***	***67 GH*** ***53 LH***	***0.27*** ***0.21***

NB. Greater horseshoe passes are in black. Lesser horseshoe passes are in red. Total 252 hours sampled, including estimated data.

Comments on data shown in tables 4.1.2 and 4.1.3

Greater horseshoe bat data

Table 4.1.2 shows that the greater horseshoe bat pass rates vary from 0 to 2.17 per hour over the four months, according to the site sampled. The mean was 0.27 passses/hour for all sites. Although these appear to show very low, or even insignificant levels of bat activity, it is necessary to appreciate the scale of the sampling compared with the likely area that the bats utilise for commuting and foraging. As the range of detectable calls by a single time-expansion detector seems to be about 8 metres, the maximum area of detection is about 137 m^2. This area assumes that calls radiate evenly from the bat in all directions. In fact these bats emit their calls horizontally via their nostrils in a highly directional manner, so this area is likely to be an overestimate.

If we assume the 137 m^2 estimate is correct, and that 20 hectares of land (200,000 m^2) is involved in the combined sampled areas (probably a minimum figure), then about 0.0685% of the areas were sampled by each static detector system. The 21 systems combined would have sampled about 1.4385% of the areas. Hence we should multiply the data by 69.5 to obtain estimates of the true figures for the whole area sampled. Mean data (0.27 passes/hour), when transformed becomes 18.8 passes per hour, or 0.31 passes/minute. The maximum figure of 2.17 becomes 151 passes/hour, or 2.5 passes/minute. The latter figure is well below the upper limit of 5 passes/minute set by the system (refer to section 3.2.5 above).

Lesser horseshoe bat data

Table 4.1.2 shows that the lesser horseshoe bat pass rates species vary from 0 to 1.08/hour over the four months, according to the site sampled. The mean was 0.21 passses/hour for all sites. These data are subject to the same kind of considerations as for the greater horseshoe bats. The range of detectable calls by a single time-expansion detectors seems to be about 5 metres, so the likely area of detection is about 53.6 m^2. This area also assumes that calls radiate evenly from the bat in all directions. In fact these bats also emit their calls horizontally via their nostrils in a highly directional manner, so this area is likely to be an overestimate.

Assuming the 53.6 m^2 estimate is correct, and that 20 hectares of land (200,000 m^2) is involved in the combined sampled areas (a minimum figure), then about 0.0268% of the areas were sampled by each static detector system. The 21 systems combined would have sampled about 0.5628% of the areas. Hence we should multiply the data by 178 to obtain estimates of the true figures for the whole area sampled. Mean data, which was 0.21 passes/hour, becomes 37.4 passes per hour, or 0.623 passes/minute. The maximum figure of 1.08 becomes 192 passes/hour, or 3.2 passes/minute. The latter figure is also beneath the upper limit of 5 passes/minute set by the system (refer to section 3.2.5 above).

Similarly data from table 4.1.3 can be transformed as shown in table 4.1.4 below.

Table 4.1.4 Summary and transformed data by main location

Location name (n sites sampled)	Totals June-Sept	Pass rate: passes/hour	*Transformed pass rate (passes/minute)*
Horsecombe	**25 GH**	**0.52**	***0.60***
(4)	**15 LH**	**0.31**	***0.92***
Southstoke	**31 GH**	**0.65**	***0.75***
(4)	**14 LH**	**0.29**	***0.86***
Odd Down	**8 GH**	**0.13**	***0.15***
(5)	**10 LH**	**0.17**	***0.50***
W Odd Down	**2 GH**	**0.06**	***0.07***
(3)	**11 LH**	**0.33**	***0.98***
N Odd Down	**1 GH**	**0.04**	***0.05***
(2)	**3 LH**	**0.13**	***0.39***
Twerton	**None**	**0**	***0***
(2)		**0**	***0***
Total horseshoe bat passes	***67 GH***	***0.27***	***0.31***
	53 LH	***0.21***	***0.62***

NB. Greater horseshoe passes are in black. Lesser horseshoe passes are in red. Total 252 hours sampled, including estimated data. For transformation explanation see text above.

Summary comments

The transformed data in table 4.1.4 and above should not be regarded as providing reliable ultimate data for horseshoe bat pass rates over the study area for two important reasons. Firstly the 20 hectare estimate is of doubtful accuracy. Secondly, horseshoe bats do not randomly use habitats for commuting and foraging. They are highly selective, commuting within 5m of linear features such as tree-lines and woodland edges. When foraging they also tend to remain within 5m of linear features. This behaviour was used to help select the static system sites, and also the routes taken by the roving surveyors to enhance the chances of detecting them. The data collected is therefore not randomly collected, but heavily biased.

What the calculations do show, however, is that the higher level of raw data obtained for greater horseshoe bats does not necessarily mean that more of them were commuting or foraging over the study area than lesser horseshoe bats. In fact the opposite is probably the case, due to range detection differences inherent in the methodology used as

discussed above. Similar considerations affect the detection of vesper bat calls. Pipistrelles and Noctules can be detected over much larger ranges than Brown long-eared bats.

During the summer of 2008, exit counts of horseshoe bats leaving the various Combe Down Mines and the Mount Pleasant derelict office at dusk showed peaks of about 90 adult Lesser horseshoes and 45 adult Greater horseshoes. These data reflect the call ratios of the transformed figures, and so provide support for the use of transformed data in making activity assessments.

What the data in tables 4.1.2 to 4.1.4 show, whichever data is used, is that the levels of each horseshoe bat species activity varies:

- with the month of the study
- with the location
- with the specific site sampled within a particular location

These variations will be explored in the following sections after considering the detailed data.

4.2 Activity level changes by month and time after sunset

Table 4.2.1 shows the times of all horseshoe bat data collected by the static systems by month and site.

Table 4.2.1 Horseshoe bat passes in 21 sites by survey date and time using static systems

Site name	24/25th June 2008	21/22nd July 2008	8th/12th August 2008	*8th/13th September 2008*
Sunset time	**21.30 hrs**	**21.12 hrs**	**20.39 hrs**	***19.40 hrs***
Horsecombe A (pond)	2 @ 23.00 & 00.24	2 @ 22.11 & 22.51	1 @ 21.52 (+1 @ 23.48 after survey end)	*1 @ 20.28*
Horsecombe B (far field)	2 @ 23.03 & 23.20 check	2 @ 21.49 21.50	3 @ 22.30; 23.20; 23.43 (+1 @ 23.55 after survey end)	*None*
Horsecombe C (buddleias)	3 @ 22.11: 22.12 & 23.01	2 @ 22.11 22.26 1 @ 22.30	2 @ 21.12 & 21.18 4 @ 21.12; 21.17 (2 passes) & 21.18	*1 @ 21.48*
Horsecombe D (Botley shed)	No sample	2 @ 21.41 & 21.50 3 @ 22.28; 22.38 & 22.50	2 @ 22.03 & 22.40 2 @ 22.37; 23.37 (+ 1 @ 00.07 after survey end)	*2 @ 20.29 &* *22.03*
Southstoke A	1 @ 22.24 1 @ 21.54	8 @ 21.44 (2 passes); 21.48; 21.45; 21.46; 21.51(2 passes); 21.53 6 @ these times 22.21; 22.27; 22.45; 23.54; 23.56; 23.57	7 @ these times: 21.00; 21.01 (2 passes); 21.02 (2 passes); 21.04; 21.07	*10 @ these times:* *20.00; 20.01; 20.03 (3 passes);* *20.04; 20.05; 20.08; 20.10; 20.35* *6 @ these times: 21.17; 21.38; 22.03; 22.10; 22.17; 22.19*
Southstoke B	2 @ 22.10 & 22.24	None 1 @ 23.15	None	*None*
Southstoke C	No sample	2 @ 21.57 & 22.22	None	*None*
Southstoke D	No sample	None	None	*None*
Odd Down A	None	None	None	*None*
Odd Down B	3 @ 22.10; 22.18 & 22.33 2 @ 23.29 & 23.49	1 @ 00.11	2 @ 21.34 & 21.37	*1 @ 20.22;*
Odd Down C	No sample	None	None	*None*
Odd Down D	No sample	None	None	*1 @ 20.52*

Odd Down E	No sample	1 @ 23.18 1 @ 23.19	1 @ 21.09	*3 @ these times: 20.16; 21.00; 21.57*
W Odd Down A	None	1 @ 22.52	None	*None*
W Odd Down B	None	1 @ 21.55	None	*7 @ these times: 20.39; 20.45; 20.54; 21.20; 22.02; 22.05; 22.42*
W Odd Down C	No sample	Data stolen next day	None	*None*
N Odd Down A	None	None	1 @ 22.17	*1 @ 20.11*
N Odd Down B	None	1 @ 21.54	None	*None*
Twerton A	None	Kit stolen by youths	None	*None*
Twerton B	None	None	None	*None*
Total horseshoe bat passes	10 GH 3 LH	21 GH 14 LH	16 GH 9 LH	*13 GH* *20 LH*
Temp. range	15.4 °C dsk; 13.0 °C @ 00.15	21st :16.7 °C dsk; 10.3 °C end 22nd: 18.1 °C dsk; 12.0 °C end	8th :15.9 °C dsk; 10.2 °C end 12th : 14.7 °C dsk; 12.7 °C end	*8th : 17.0 °C dsk;* *12.2 °C end* *13th : 15.2 °C dsk; 9.9 °C at end*
Windspeed	Force 3 SW dsk; 5 @ 23hrs; 1 @ 00.15	Force 2 SW dsk; 1 SW at end	Calm 8th. 12th 2-3 W dsk; then 2 falling to 1 at end	*Calm through both surveys*
Rainfall	*0*	*0*	*0 on 8th; Rain at 22.00 on 12th. Heavy from 22.30 – survey abandoned early*	*8th Drizzle started 22.00hrs; heavier from 22.20 – survey completed* *0 on 13th*

NB. Greater horseshoe bat passes are printed in black. Lesser horseshoe bat passes are printed in red.

This table is difficult to assimilate, and it is perhaps best to use it for detailed examination of specific points after the following summary figures and tables have been considered.

Figures 1 to 3 show passes recorded from Greater horseshoe bats at the three locations where reasonable levels of data were obtained. Figures 4 to 6 show the same data for Lesser horseshoes. The complete data for Figures 1 to 6 are provided in table 4.2.3, plus those from the other locations with insufficient data to produce viable figures.

Figure 1: Greater horseshoe passes by hour post sunset for Horsecombe sites combined.

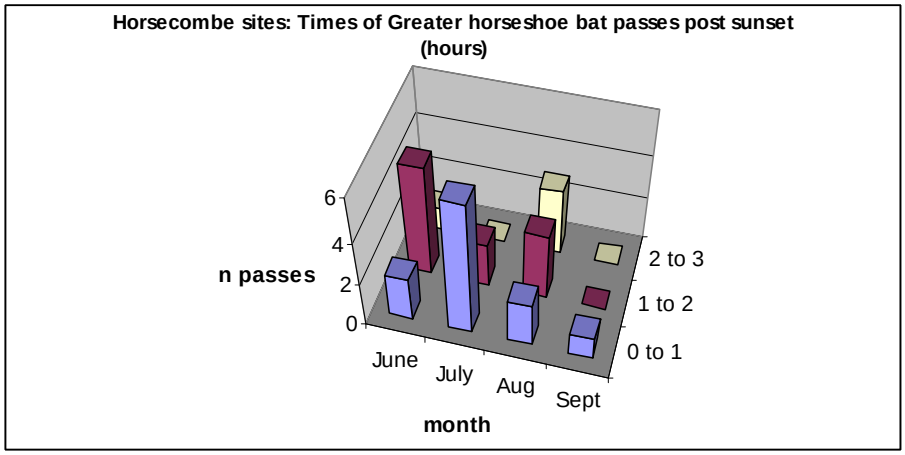


Figure 2: Greater horseshoe passes by hour post sunset for Southstoke sites combined.

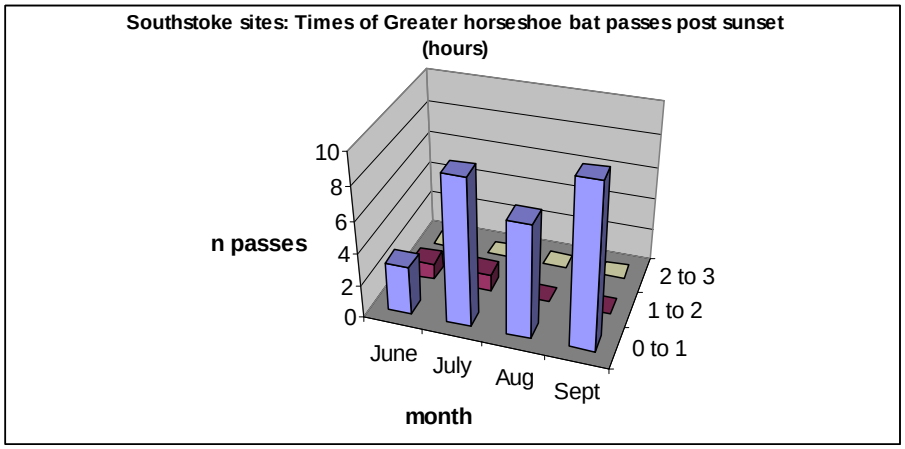
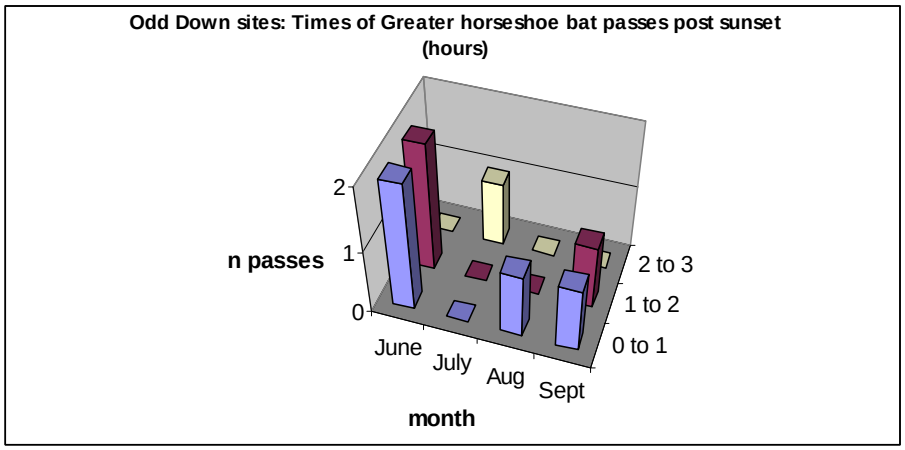


Figure 3: Greater horseshoe passes by hour post sunset for Odd Down sites combined.



Comments on the Greater horseshoe bat pass data

Figures 1 to 3 show different patterns of time use at the three sites. At Horsecombe and Odd Down, the passes were recorded for up to three hours in at least one month, and for up to two hours in at least 2 months. At Southstoke, the bats were recorded in larger numbers, but primarily in the first hour. Very few were recorded in the second hour, and none in the third hour.

Close examination of pass times in table 4.2.1 and visual observations by roving surveyors (table 4.2.2 below), confirm that these bats commuted rapidly through Southstoke site A, and carried on towards Odd Down usually without stopping to forage there near any of the other sampled sites. Presumably the bats commuted back later on in the night via other routes, or used night roosts until after the surveys had ceased.

At Horsecombe and Odd Down, similar evidence showed that these bats often foraged, especially from June to July, when moths are normally being eaten (Ransome 1996, and diet data from the Combe Down Mines Stabilisation Project 2004). In September, when dung beetles were probably the main prey item, they must have foraged elsewhere.

Figure 4: Lesser horseshoe passes by hour post sunset for Horsecombe sites combined.

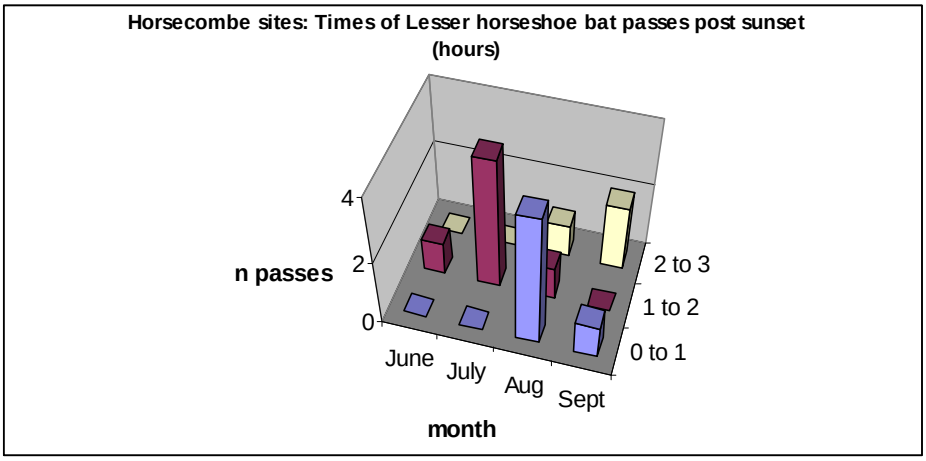


Figure 5: Lesser horseshoe passes by hour post sunset for Southstoke sites combined.

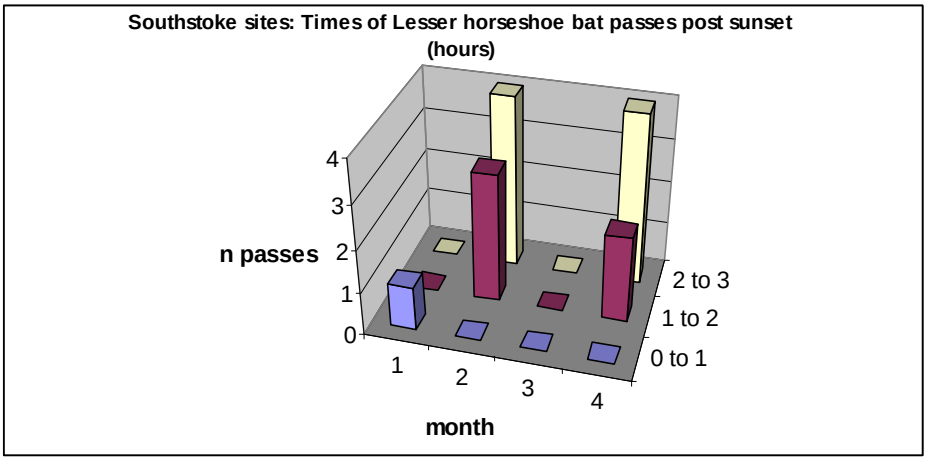
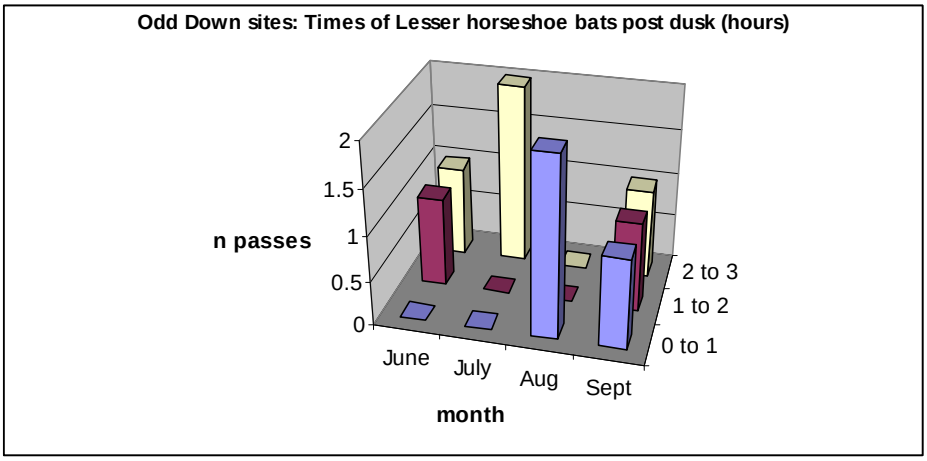


Figure 6: Lesser horseshoe passes by hour post sunset for Odd Down sites combined.



Comments on the Lesser horseshoe bat pass data

Figures 4 to 6 show the limited data obtained (usually <4 passes per location per date and time slot). Data show no consistent pattern of time use at the three sites over the 4 months. The month sampled seems to have had the greatest impact, especially at Southstoke. In August no passes were obtained there, and only one in June. In contrast the July and September months showed some of the highest levels of use in the second and third hours post sunset, when foraging took place. At Horsecombe and Odd Down, passes were recorded for up to three hours in at least one month, suggesting that the bats were mainly foraging. This was confirmed by frequent surveyor observations (see table 4.2.2 below).

Close examination of pass times in table 4.2.1 and visual observations by roving surveyors (table 4.2.2 below), provides no evidence for rapid commuting through Southstoke towards Odd Down soon after sunset, as was a feature of Greater horseshoe behaviour. Either the Lesser horseshoe bats detected came from local roosts, or they move slowly away from more distant roosts, foraging as they travel. Presumably the bats switch their foraging habitat locations as available prey change through the summer. At West Odd Down B, one or more Lesser horseshoe bats foraged for over 2 hours in September over cattle-grazed pasture. It was the only month when this happened (table 4.2.1).

Tables 4.2.1 and 4.2.2 also show data that is not presented in the figures. It is worth noting that small numbers of Greater and Lesser horseshoe bat passes were recorded in the North and West of Odd Down locations, but only by the static detectors. This reflects the results of Billington's Greater horseshoe radio-tracking study carried out in 2000. It suggests that the bats continue to forage in similar areas, at similar levels.

No dietary evidence is available for this area, but the species is known to feed on small moths, nematoceran dipterans and dung flies.

Table 4.2.2 Horseshoe bat passes recorded by location and survey date by roving surveyors

Site name	24th June 2008 (sunset 21.30 hrs)	21/22 July 2008 (sunset 21.12 hrs)	8th/12th August 2008 (sunset 20.39 hrs)	8th September 2008 (sunset 19.40 hrs)	Totals
Horsecombe	1 @ 23.05 1 @ 23.35 1 @ 00.02	2 @ 21.39; 21.41 commuting 1 @ 21.50 commuting 1 @ 22.35 foraging 2 @ 23.15 & 23.22 brief	1 @ 20.55 commuting along hedge 1 @ 21.33 foraging 1 @ 22.59 foraging 1 @ 22.15 foraging	1 @ 19.57 commute nr stream 1 @ 22.04 foraging 1 @ 22.25 foraging	15 GH 3 LH
Southstoke	0	4 from 21.40 to 21.52 commuting out 1 @ 23.35 commuting back	2 @ 21.02 commute W on track	1 @ 20.10 on road commute 1 @ 20.15 commute	9 GH 0 LH
Odd Down	1 @ 22.05 foraging 1 @ 22.20 foraging 1 @ 22.38 commuting 1 @ 23.07 foraging	Section 1 2 @ 22.55 & 23.12 commuting 1 @ 22.37 Section 2 3 @ 21.4g; 21.49; 21.50 commuting 1 @ 21.51 foraging 1 @ 23.18 foraging	Section 1 1 @ 21.03 not seen 1 @ 21.57 briefly Section 2 1 @ 21.05; not seen 1 @ 21.35 foraging near E	1 @ 20.08 commuting 1 @ 20.19 commuting 1 @ 19.58 foraging nr gate 1 @ 20.02 foraging 2 @ 20.06 foraging 2 @ 20.15 foraging	14 GH 10 LH
W Odd	0	0	0	0	

Down					
N Odd Down	0	0	0	0	
Twerton	0	0	0	0	
Total passes	**6 GH** **1 LH**	**17 GH** **2 LH**	**6 GH** **2 LH**	**5 GH** **8 LH**	**34 GH** **13 LH**

NB. Greater horseshoe bat passes are printed in black. Lesser horseshoe bat passes are printed in red.

Table 4.2.3 Horseshoe bat passes by time post sunset in 6 locations by static systems

Location name (hour post dusk)	24th /25th June (+estd)	21/22nd July	8th/12th Aug	8th/13th Sept	Totals June-Sept	Passes/hr Sampled
Horsecombe (1st)	2 GH	6 GH	2 GH	1 GH	11 GH	0.69
			4 LH	1 LH	5 LH	0.31
Horsecombe (2nd)	5 GH	2 GH	3 GH		10 GH	0.63
	1 LH	4 LH	1 LH		6 LH	0.38
Horsecombe (3nd)	1 GH		3 GH	2 LH	4 GH	0.25
			1 LH		1 LH	0.06
Southstoke (1st)	3 GH	9 GH	7 GH	10 GH	29 GH	1.81
	1 LH				1 LH	0.06
Southstoke (2nd)	1 GH	1 GH		2 LH	2 GH	0.13
		3 LH			5 LH	0.31
Southstoke (3rd)		4 LH		4 LH	8 LH	0.0
						0.5
Odd Down (1st)	2 GH		1 GH	1 GH	4 GH	0.20
			2 LH	1 LH	3 LH	0.15
Odd Down (2nd)	2 GH			1 GH	3 GH	0.15
	1 LH			1 LH	2 LH	0.10
Odd Down (3rd)	1 LH	1 GH		1 LH	1 GH	0.05
		2 LH			4 LH	0.20
W Odd Down (1st)		1 LH		1 LH	2 LH	0.18
W Odd Down (2nd)		1 GH		3 LH	1 GH	0.09
					3 LH	0.27
W Odd Down (3rd)				3 LH	3 LH	0.27
N Odd Down (1st)		1 GH		1 LH	1 GH	0.13
					1 LH	0.13
N Odd Down (2nd)			1 LH		1 LH	0.26
N Odd Down (3rd)						
Twerton (3 hours)					None	0
						0
Total horseshoe bat passes	17 GH	21 GH	16 GH	13 GH	67 GH	0.27
	10 LH	14 LH	9 LH	20 LH	53 LH	0.22

NB. Greater horseshoe passes are in black. Lesser horseshoe passes are in red. Total 244 hours sampled.

4.3 Activity at specific static sites within locations

Tables 4.1.2 summarises, and 4.2.1 shows detailed data for specific sites. Examination of both, show that data are strongly influenced by the precise position chosen to sample. The most extreme example of this is shown by the four Southstoke sites (table 4.1.2). Site A showed the highest pass levels of all sites for both horseshoe bat species. Site D, which was located on the opposite side of the field, showed no passes. Sites B and C had very low levels of horseshoe bat calls. Data from table 4.2.1 for Southstoke A show that Greater horseshoe bat passes were limited to very brief time slots, as bats commuted past soon after sunset.

In contrast, Horsecombe sites showed remarkably uniform pass rates for Greater horseshoe bats among the four sites sampled. This suggests that most of the Horsecombe Valley is used by them for most of the summer. It is the location that is closest to both Horsecombe and Byfield Mines. The former was used as an underground roost for breeding in summer 2008; the latter was the maternity roost site until exclusion at the end of summer 2007. Billington emphasised the importance of Horsecombe Valley to foraging Greater horseshoe bats in his 2000 study. The tables show that Lesser horseshoe bats made a more restricted use of the Horsecombe Valley sites. This may reflect their low level of use of Horsecombe Mine until September 2008.

At Odd Down, where five sites were sampled, both horseshoe bat species were detected by static systems, and observed by surveyors, foraging at certain sites. Bats avoided the open arable field areas, but regularly used various parts of the young ash plantations that bordered these fields. This behaviour was not noted by Billington (2000), who reported little use by Greater horseshoe bats of the Odd Down area. In 2000 the ash plantation bordering the arable fields would have been very young, and probably lacked sufficient cover for foraging by horseshoe bats at that time. Since then the trees and undergrowth have developed considerably, providing cover and becoming a richer source of moths. Suitable habitat features for generating moths present at site A did not attract horseshoes to forage near the football clubhouse and floodlit pitch.

At West Odd Down, three sites were sampled. At site C, within Vernham Wood, no horseshoe bat passes were detected in the two successful sampling attempts. However, at site A at the woodland/grazed pasture edge, a single Greater horseshoe pass was detected in three attempts. At site B, in a similar woodland edge location, but well sheltered by overhanging tree canopy, 8 Lesser horseshoe calls were detected in three samples, most of them in September. Billington (2000), also reported little use by Greater horseshoe bats of the West Odd Down area.

At North Odd Down, two sites were sampled. Both Greater and Lesser horseshoe bat passes were detected in the four successful sampling attempts. Both sites

were located at woodland/scrub edge, adjacent to the BMX cycle track some 250 metres apart. A single Greater horseshoe pass was detected in July at site B. Two Lesser horseshoe calls were detected at site A. Billington (2000), also reported little use by Greater horseshoe bats of the North Odd Down area.

At Twerton, two sites were sampled at the woodland/arable field edge. No horseshoe bat passes were detected in the three successful sampling attempts at site A and four at site B. Billington (2000), also reported no use by Greater horseshoe bats of the Twerton, Seven Acre Wood area.

Summary

The use of specific sites by horseshoe bats, and hence their importance to them, is influenced by:

- Distance from their summer roosts
- Availability of safe commuting links from the roost to the foraging areas
- Quality of foraging habitat, via its ability to generate the relevant insect prey required by the species at high levels for successful capture
- Topography, via its impact on the climatic conditions prevailing at sites. Bats avoided open, exposed areas to the prevailing wind, and valley bottoms that showed rapid cooling in calm, clear conditions.

In mid summer, Horseshoe bats used woodland or tree-lined edges to commute and forage along, or open areas of young plantations where undergrowth was tall and dominated by uncut grasses. Such habitats generate many moths.
In late summer, Horseshoe bats tend to switch to grazed pastures where they forage on dung-generated insects (Ransome, 1996).

The flat land at Odd Down is dominated by open arable fields. Most of it is of no value to horseshoe bats, either for commuting or foraging. However, the ash plantation strips at the southern edge of the arable fields are important foraging areas. Better quality habitat seems to exist lower down the valley slopes, but these areas may often be less suitable due to climatic influences on moth flight. Below 12 ^{o}C many summer moths do not fly. Table 4.2.1 shows that such temperatures occurred in mid summer 2008, even at higher levels of the slopes. Dung beetles (*Aphodius*), are tolerant of temperatures down to 9 ^{o}C, so summer impacts upon their flight are likely to be much more limited.

4.4 Vesper bats recorded at the various sites

Table 4.4.1 shows a summary of all data obtained through the four months. No attempt was made to assess the relative levels of presence at the sites.

Table 4.4.1 Vesper bats recorded by site and survey date by static systems

Site name	24/25th June 2008	21/22nd July 2008	8th/12th August 2008	8th/13th September 2008	Summary (minimum n species)
Horsecombe A (beneath ash tree canopy near pond and streams)	**P45; P55;** Myotis sp. including Natterer's?	**P45; P55**; Myotis sp. **Noctule**	**P45; P55;** Myotis sp.	**P45; P55;** Myotis sp**.; Serotine**	**P45; P55;** Myotis sp.; **Serotine; Noctule** (5)
Horsecombe B (far field, near gate to field with highland cattle)	**P45**	**P45; P55**; Myotis sp. Nyctalus sp.	**P45; P55**; **Serotine**; **Noctule**	**P45; P55;** Nyctalus sp; (Leislers?)	**P45; P55;** Myotis sp.; **Serotine; Noctule** (5)
Horsecombe C (high up grassy bank near buddleias)	**P45**	**P45; Noctule; Serotine**	**P45; P55**; Myotis sp.; **Serotine; Noctule**	**P45; P55; Serotine;** Nyctalus sp	**P45; P55;** Myotis sp.; **Serotine; Noctule** (5)
Horsecombe D (Botley's shed)	No sample	**P45; P55;** Myotis sp. **Noctule**	**P45**; Myotis sp.; **Serotine**	**P45; P55;** Myotis sp.; Nyctalus sp**.**	**P45; P55;** Myotis sp.; **Serotine; Noctule** (5)
Southstoke A (under canopy near gap in tree-line connecting wooded blocks)	**P45; P55;** Myotis sp. Nyctalus sp Leisler's? **BLE**	**P45**; Myotis sp. **Serotine**; **Noctule**	**P45**; Myotis sp.; **Serotine; Noctule**	**P45; Serotine;** Myotis sp.; Nyctalus sp.	**P45; P55;** Myotis sp.; **Serotine; Noctule B.L.E** (6)
Southstoke B (corner of hedge near new pond & maize field)	**P45; P55**; Serotine?	**P45; P55; Noctule**	**P45; P55**; Myotis sp.; **Serotine**	**P55; Serotine;** Nyctalus sp (Leislers?)	**P45; P55;** Myotis sp.; **Serotine; Noctule** (5)
Southstoke C (in grassy glade amongst tall bushes)	No sample	**P55**; Myotis sp. **Serotine**	**P45; Serotine**; Nyctalus sp.	**P45; P55;** Myotis sp.; Nyctalus sp	**P45; P55;** Myotis sp.; **Serotine;** Nyctalus sp. (5)
Southstoke D (edge of field used for hay; beneath large overhanging tree canopy)	No sample	**P45**; Myotis sp. **Noctule**	**P45; Serotine; Noctule**	**P45; P55;** Myotis sp.**; Noctule; Leislers**	**P45; P55;** Myotis sp.; **Serotine; Noctule, Leislers** (6)
Odd Down A (corner grassy field behind football club & near floodlit pitch)	**P45; Noctule Serotine**	**P55**; Myotis sp. **Noctule**; Serotine?	**P45; P55**; Myotis sp.; **Noctule**	**P55;** Myotis sp.	**P45; P55;** Myotis sp.; **Serotine; Noctule**

					(5)
Odd Down B (young ash plantation/arable. Edge with tall trees)	**P45; P55;** Nyctalus 2 sp? Myotis sp.; **Serotine**	**P45; P55**; Myotis sp. Nyctalus sp.	**P55**; Myotis sp.; **Noctule**	**P45; P55;** Myotis sp.; Nyctalus sp	**P45; P55;** Myotis sp.; **Serotine;** **Noctule** (5)
Odd Down C (arable field in sparse hedgerow with short trees)	No sample	**P45**; Nyctalus sp.	**P45**; Myotis sp.; **Noctule**	**P45; P55; Serotine;** Nyctalus sp	**P45; P55;** Myotis sp.; **Serotine;** **Noctule** (5)
Odd Down D (10m from young ash plantation in arable bean field. 10m from hedge with tall trees)	No sample	**P45; P55;** Myotis sp. **Serotine**	**P45; P55; Noctule**	**P45; P55;** Myotis sp.; **Leislers**	**P45; P55;** Myotis sp.; **Serotine;** **Noctule;** Leislers (6)
Odd Down E (at edge of young ash plantation and arable field with beans)	No sample	Myotis sp.	**P45**; Myotis sp.; **Noctule**	**P45; P55;** Myotis sp.; **Serotine; B.L.E.**	**P45; P55;** Myotis sp.; **Serotine;** **Noctule; B.L.E** (6)
W Odd Down A (wood/pasture edge in open corner)	**P45; Serotine**	**P45**; Myotis sp. **Noctule;** Leislers?	**P45; Serotine**	**P45; P55;** Myotis sp.; **Serotine; Noctule; B.L.E.**	**P45; P55;** Myotis sp.; **Serotine;** **Noctule; B.L.E** (6)
W Odd Down B (wood/pasture edge under overhang)	**P45**	**P45; P55**; Myotis sp.	**P45; P55**; Myotis sp.; **Serotine; Noctule**	**P45; P55;** Myotis sp.; Nyctalus sp. (Noctule?)	**P45; P55;** Myotis sp.; **Serotine;** **Noctule** (5)
W Odd Down C (inside wood)	No sample	Sony stolen at Twerton	Nyctalus sp.	**P45;** Myotis sp.; **Serotine;** Nyctalus sp. (Noctule?)	**P45; P55;** Myotis sp.; **Serotine;** **Nyctalus sp**. (5)
N Odd Down A	Nyctalus sp; **Serotine**	**P45**; Myotis sp. **Noctule;** Serotine?	**P45; P55**	**P45; P55;** Myotis sp.; Nyctalus sp. (Leislers?)	**P45; P55;** Myotis sp.; **Serotine;** **Noctule** (5)
N Odd Down B	Myotis sp.	**P45**; Myotis sp. **Serotine; BLE**	**P45; P55; Serotine**	**P45; P55;** Myotis sp.; Nyctalus sp.	**P45; P55;** Myotis sp.; **Serotine;** **Noctule; B.L.E** (6)
Twerton A	**P45;** Nyctalus sp.; Myotis sp.	Kit stolen	**P45; P55**; Myotis sp.; **Serotine**	**P55;** Myotis sp.	**P45; P55;** Myotis sp.; **Serotine;** **Nyctalus sp.** (5)
Twerton B	**P45;** Nyctalus sp.	**P45; P55;** **Noctule; Serotine**; BLE?	**P45; P55;** Myotis sp.; Nyctalus sp.	**P45; P55;** Nyctalus sp.; Serotine?	**P45; P55;** Myotis sp.; **Serotine;** **Noctule** (5)
Total Vesper bat types	**P45; P55;**	**P45; P55;**	**P45; P55**; Nyctalus –	**P45; P55**;	**P45; P55;** Myotis sp.;

Nyctalus sp. Myotis sp. **Serotine; BLE** (min. 6 sp.)	Nyctalus sp. Myotis sp. **Serotine; B.L.E** (min. 6 sp.)	**Noctule** & possibly Leislers Myotis sp. **Serotine** (min. 6 sp.)	**Noctule**; **Leislers** Myotis sp. **Serotine; BLE** (min. 7 sp.)	**Serotine;** **Noctule; Leislers; BLE** (min. 7 species, but most probably 10 with common Myotis bats)

Key: P45 = Common pipistrelle; P55 = Soprano pipistrelle; B.L.E. = Brown long-eared bat. Bold names are genera, not species. Bold names are species that have been definitely recognised from their calls. Doubtful identification has been ignored in column 6 totals.

Comments

A minimum of 6 vesper bat species occurred at all 21 sampled sites over the four months of sampling. This total was obtained by counting 'Myotis sp.'as a single species. This number is a minimum, since at least 4 Myotis bats are commonly found hibernating in the Combe Down Mines in winter. They are Daubenton's bat, Natterer's bat, Whiskered bat and Brandt's bat. Also the endangered Bechstein's bat is also found there. Hence there were likely to be at least 9 vesper bat species foraging in the whole study area, and possibly 10, if Bechstein's bat is included.

The number of vesper bat types recorded in each month varied considerably from month to month. Numbers were lowest in June, and highest in September overall.

The Tumps area of North Odd Down, surrounded by urban development, had at least 6 vesper bat species. This may be because it is a substantial area of mixed habitat, with deciduous woodland, amenity grassland and extensive scrub.

The Twerton area, where a substantial deciduous woodland was surrounded on all sides by arable cereal fields, also had a minimum of 5 vesper bat species. Either the lack of significant linear features linking the woodland edge to more favourable habitats, does not prevent these bats from crossing the fields to forage around the woodland, or they roost within the woodland.

5. STATUS OF BATS REVEALED BY DUSK SURVEYS

Table 6.2 summarises the current status of the bats identified by the surveys. Data summarised and discussed above.

Table 6.2 Distribution and conservation status of bats known, or believed to forage over Bath Urban study locations. From Hutson, 1993, Action Plan for the Conservation of bats in the United Kingdom, updated by subsequent review in 2007.

Common name	Species name	Distribution/Status	IUCN Status
Greater horseshoe bat	***Rhinolophus ferrumequinum***	**Restricted/Rare**	**Endangered**
Lesser horseshoe bat	***Rhinolophus hipposideros***	**Restricted/Rare**	**Endangered**
Natterer's bat	*Myotis nattereri*	Widespread/Frequent	Lower risk
Daubenton's bat	*Myotis daubentonii*	Widespread/Common	Lower risk
Whiskered bat	*Myotis mystacinus*	Widespread/Scarce	Lower risk
Brandt's bat	*Myotis brandti*	Widespread/Scarce	Lower risk
Soprano pipistrelle bat	*Pipistrellus pygmaeus*	Widespread/Common	Not listed
Common pipistrelle bat	*Pipistrellus pipistrellus*	Widespread/Common	Least concern
Brown long-eared bat	***Plecotus auritus***	**Widespread/Common**	**Lower risk**
Leisler's bat	*Nyctalus leisleri*	Widespread/Scarce	Near threatened
Noctule bat	*Nyctalus noctula*	Widespread/Common	Lower risk

Bold species are on the UK BAP list, but the Brown Long-eared bat has not yet had its action plan produced.

6. SUMMARY OF SURVEY FINDINGS

1) Nine bat species were shown by surveyors and static systems to forage over the whole study area. Since 4 common species were likely to be represented among, the Myotis calls, the true number is probably 12 species. They were Greater and Lesser horseshoe bats; Common and Soprano pipistrelles; probably at least four Myotis species – Daubenton's, Nattereer's, Whiskered and Brandt's bats; Noctule and Leislers; Brown long-eared bat and Serotine. Bechstein's bat is also known to hibernate in the Combe Down mines. Their calls cannot be distinguished from Natterer's in the field, so their presence cannot be verified by the methods used.

2) Static systems were more effective at detecting horseshoe bat calls, and other rare species, than roving surveyors. This is normally the case.

3) Use of the specified locations within the study area by Greater horseshoe bats is variable according to location and month of study. Horsecombe Vale is well used for foraging for the first 3 hours of the night when moths are mainly eaten from June to August. Southstoke seems to be primarily a key commuting route to Odd Down, soon after dusk. They probably foraged on moths generated by the overgrown grasslands, developing scrubland and young ash plantations. The Tumps and West of Odd Down were rarely used, and Twerton, not at all.

4) Both horseshoe bats avoided using the field corner behind the clubhouse at Odd Down, despite it being a good habitat for moth generation. This was probably due to the bright floodlights used for night matches.

5) At Odd Down, horseshoe bats primarily used the non-arable areas, especially the scrub near the top of the ridge, and the young ash plantation strips where moths seemed abundant in mid summer.

6) No horseshoe bats were detected foraging around the woodland at Twerton. This may be due to its long distance from Combe Down, and/or the dominance of the surrounding arable land.

7) Horseshoe bats preferential use of sheltered areas at the top of the ridges for foraging at Southstoke and Odd Down, rather than in the open valleys below, may be linked to their exposure to westerly winds on windy nights, and rapid temperature falls after dusk on calm nights. Temperatures fall too low for moths to fly on calm, clear nights, even in mid summer.

8) The habitats and sites used by Greater horseshoe bats, changed as their diet switched from moths to primarily dung beetles in September.

9) At least 7 and probably 10 species of vesper bats foraged over the whole study area. Even the poorest sites, such those at Twerton, had a minimum of 6 species using them.

7. RECOMMENDATIONS

The 2008 dusk surveys were carried out monthly from late June to mid September. During this period greater horseshoe bats forage mainly on moths (June to early August) and *Aphodius* dung beetles (August to September). This diet change has important implications for the dusk surveys, since these bats have to switch their foraging sites to obtain different prey. Moths are not abundant over grazed pastures, and dung beetles rarely fly over thick scrubland.

In April greater horseshoe bats forage on a wide range of prey that rarely includes moths. Temperatures at dusk are crucial in determining which ones are eaten. In May, cockchafer beetles are preferred. They need deciduous woodland adjacent to short grassland. In these months it is likely that these bats will make use of foraging sites that were not discovered by the 2008 surveys.

To be able to complete an appropriate assessment for the Combe Down population, it is recommended that two further surveys be carried out in spring 2009. One should be in April and the other in May, if weather conditions are favourable. Should the April weather be abnormally cold, the surveys should be carried out in early May and either late May or early June.

8. ACKNOWLEDGEMENTS

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We also thank Mr M Russell for permission to use the football club’s car park near Radstock Road Park and Ride during surveys.

Finally we acknowledge the assistance of Dr Karen Renshaw in providing initial advice and maps for planning the surveys and this report.

9. REFERENCES

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Bat Pro Ltd.

Horseshoe Bat Surveys

Map 1: All Monitoring Sites

Compiled by on 22 December 2008

Scale 1:32000

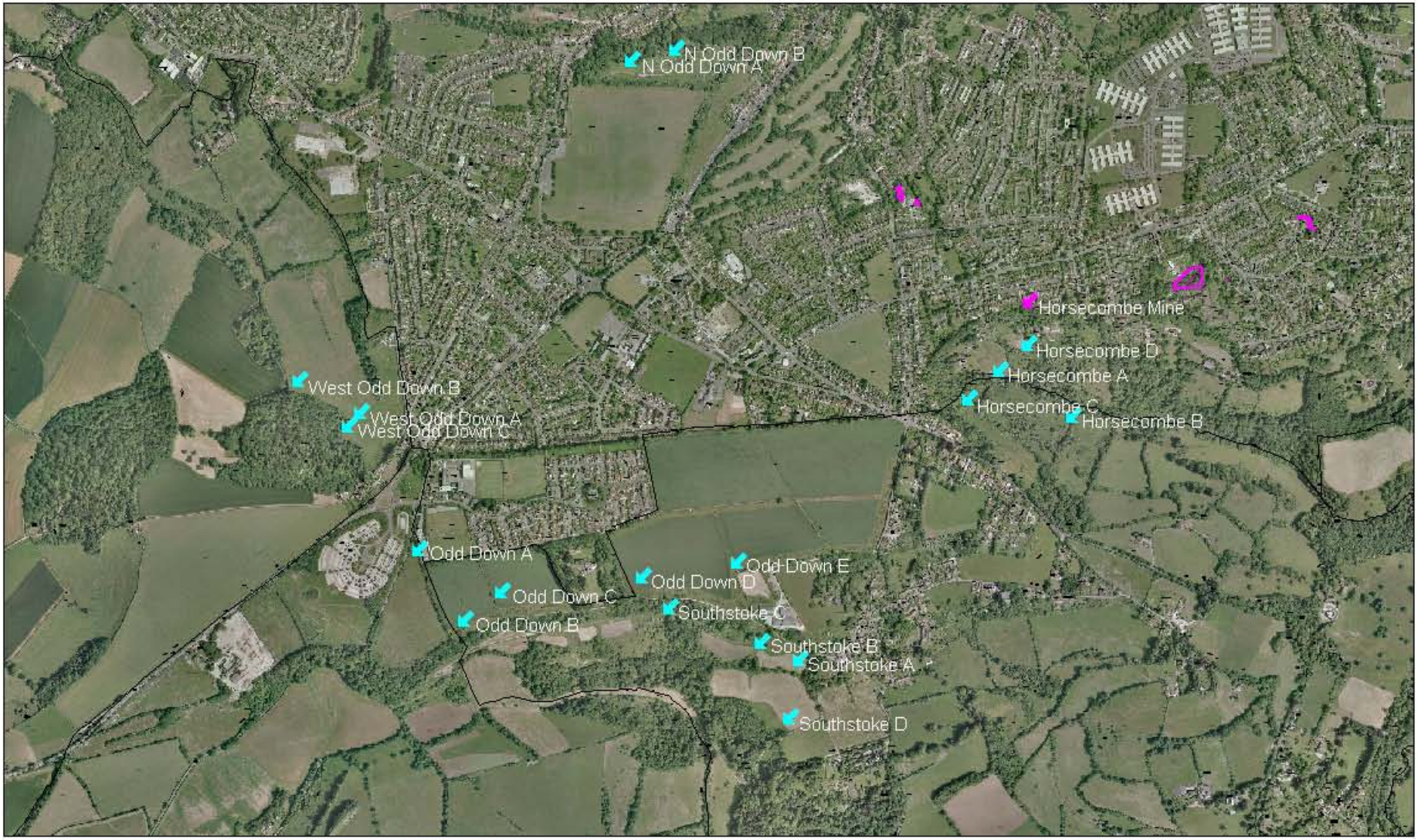
Bath & North East Somerset Council
Trimbridge House
Trim Street
Bath BA1 2DP
Tel 01225 477000

Horseshoe Bat Surveys

Map 2: Odd Down and Horsecombe Vale Monitoring Sites

Compiled by on 22 December 2008 **Scale 1:15000**

Bath & North East Somerset Council
Trimbridge House
Trim Street
Bath BA1 2DP
Tel 01225 477000



Horseshoe Bat Surveys

Map 3: Horsecombe Vale Monitoring Sites

Compiled by on 22 December 2008 **Scale 1:5000**

Bath & North East Somerset Council
Trimbridge House
Trim Street
Bath BA1 2DP
Tel 01225 477000

Horseshoe Bat Surveys

Map 4: Southstoke and Odd Down Monitoring Sites

Compiled by on 22 December 2008 **Scale 1:5000**

Bath & North East Somerset Council
Trimbridge House
Trim Street
Bath BA1 2DP
Tel 01225 477000

Horseshoe Bat Surveys

Map 5: West of Odd Down Monitoring Sites

Compiled by on 22 December 2008 **Scale 1:5000**

Bath & North East Somerset Council
Trimbridge House
Trim Street
Bath BA1 2DP
Tel 01225 477000

Horseshoe Bat Surveys

Map6: Twerton Monitoring Sites

Compiled by on 22 December 2008 **Scale 1:5000**

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Bath BA1 2DP
Tel 01225 477000