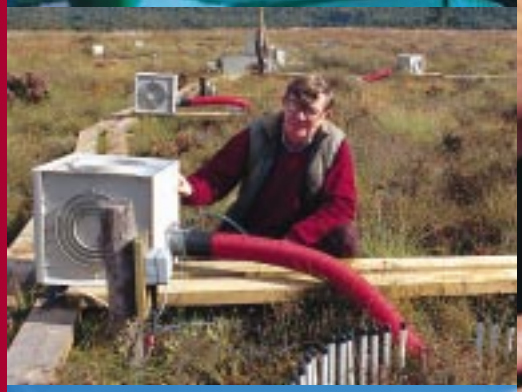
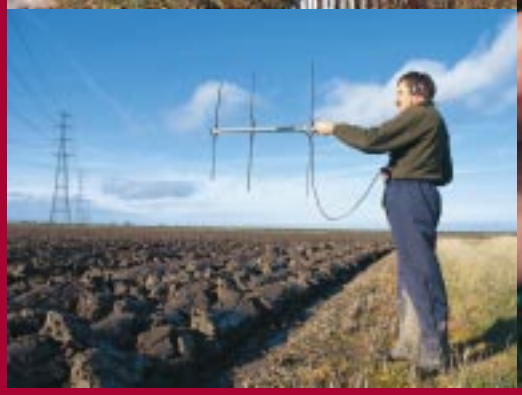
ENGLISH NATURE

Report Number
496

Radio tracking study of greater horseshoe bats at Chudleigh Caves and Woods Site of Special Scientific Interest

English Nature Research Reports





working today
for nature tomorrow

English Nature Research Reports

No 496

Radio tracking study of greater horseshoe bats

at Chudleigh Caves and Woods Site of Special Scientific Interest

2002

Mr Geoff Billington
Greena Ecological Consultancy

Project Manager: James Diamond, English Nature Devon Area Team

ISSN 0967-876X

Contents

Tables

Charts

Figures

Summary

The activity patterns of greater horseshoe bats *Rhinolophus ferrumequinum* roosting at Chudleigh Caves and Woods Site of Special Scientific Interest (SSSI) were investigated over periods of six and eight nights in June and August 2002 respectively. A total of 20 bats of both sexes were radio-tagged over the two sessions.

Bats regularly commuted to foraging areas up to five kilometres away and were recorded travelling over seven kilometres from the roost. The total area used by this population covers at least 120 square kilometres. Biopsy samples collected during the study provided the first evidence of a link between greater horseshoe bats in south Devon and the population found in the north of the county.

Bats foraged primarily over damp grassland, scrub, around tall overgrown hedgerows, and along tree lines, frequently next to watercourses.

A total of 14 foraging areas were identified during the study. The most significant foraging areas in June were between Chudleigh and Sandygate on the northern edge of Kingsteignton, and in August at Chudleigh and Ideford.

The main commuting routes used by the bats leaving Chudleigh were identified as northeast and southwest along Kate Brook, south through Gappah, east into Ugbrooke Park and northwest across Coburg. A greater horseshoe bat day roost was located near Ideford.

Recommendations are made for further survey and conservation work on commuting rotes, foraging areas and roosts.

1.0 Objectives

To identify the principal foraging areas and flight routes used by greater horseshoe bats roosting at Chudleigh Caves and Woods Site of Special Scientific Interest (SSSI). Secondary objectives were to identify any night and day roosts used by the bats.

2.0 Background

This study was commissioned and funded by English Nature and carried out by Greena Ecological Consultancy.

In this study the movements of relatively large groups of bats (up to ten) were examined to record the distribution and behaviour of greater horseshoe bats during June and August 2002.

3.0 Study area

Pixie's Hole (NGR SX856786) is a natural cave system that forms part of the Chudleigh Caves and Woods SSSI, a constituent of the South Hams candidate Special Area of Conservation (cSAC). Pixie Hole's supports a greater horseshoe bat maternity roost and hibernation site.

The SSSI lies in south Devon, to the southwest of Exeter and just outside of the Dartmoor National Park boundary. Livestock rearing and dairy production dominate the local agricultural landscape, which is largely a mixture of small and medium sized field systems. The landscape has an extensive network of hedgerows, with frequent copses and tree lines. Within the landscape are several large areas of coniferous and broadleaved woodland and an area of active and disused mineral workings.

4.0 Methods

Greater horseshoe bats were radio tracked over 14 nights from 7-12 June and 9–16 August 2002.

The bats were caught in a mist net as they left the main cave entrance at dusk. A team of people worked to process the bats. Captured bats were weighed, sexed, measured and examined to ascertain breeding condition.

The bats were fur-clipped and transmitters glued between the shoulder blades, using SkinBond adhesive. Bats were fitted with 0.57g 173MHz radio transmitters, manufactured by Biotrack, with a specified minimum nine-day battery life. The bats were given time to settle before release.

Professor Gareth Jones from Bristol University collected tail membrane biopsy samples (3 mm diameter punched holes) on the first of the two study periods (7 June), to use for ongoing genetic research.

Fieldworkers used *Australis* 26K and *Biotrack* receivers with *Yaggi* rigid aerials to track bats. Whip omni directional antennas were used to search for bats by vehicle. Dictaphone, mini cassette recorders and notebooks were used to record data. CB radio sets were used for two-way

communication. Accurate bearings of bat locations were taken from hand held compasses. Global Positioning Systems were used to increase the speed and accuracy of the surveyors. *Tranquility* and *Duet* bat detectors were used to confirm the presence of horseshoe bats by listening for their characteristic echolocation calls.

For all detectable bats the following data was recorded: observer location, bat ID number, triangulation bearings, signal strength, apparent location or route and behaviour. When bats were commuting, or at their first foraging sites, they were usually observed from elevated points (see Table 1) with each surveyor based at separate locations, in contact by radio set. Both receivers were able to automatically scan through different frequencies; this made it possible to search for a number of tagged bats. On several occasions surveyors were able to make close approaches to bats, to ascertain the exact foraging area and behaviour or commence pursuit if the bat was moving away.

Tracking ended either when the tags fell off the bats, the transmitters failed, the bats moved away or the fieldwork period ended.

At the start of each survey night, estimations of environmental conditions were noted: wind strength (Beaufort scale) and direction, rain (0-5), cloud cover (0-100%) and air temperature (Celsius). Any marked changes in weather throughout the survey period were also noted (see Appendix IV).

Table 1. Elevated observation points used during radio tracking

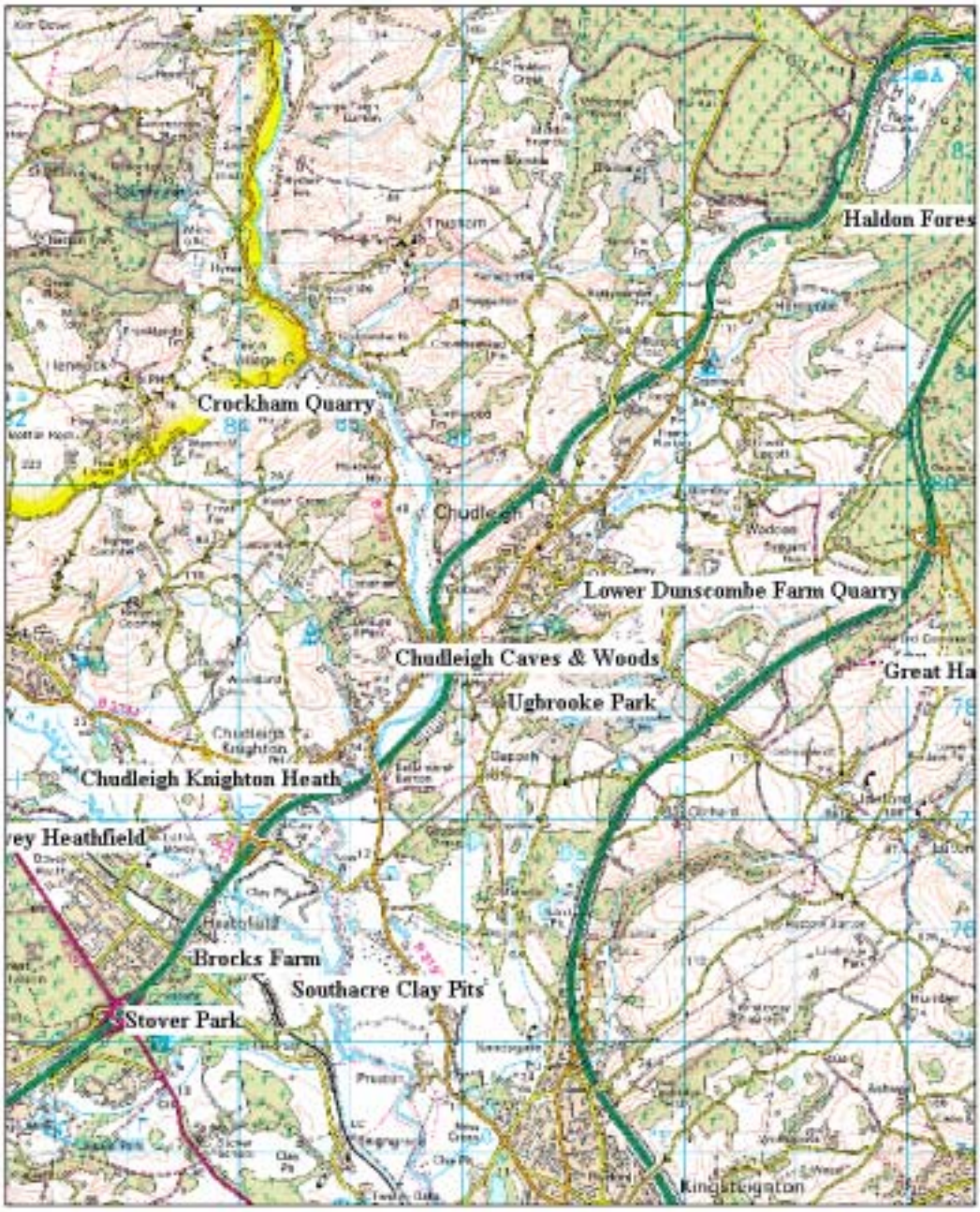
Observation point	Grid reference (All SX prefix)	Number of times used
Teign Bridge	867785	12
Chudleigh Rock	865786	9
Waddon	882797	5
Gappah	861774	11
Babcombe	868773	6
A38	878811 & 882816	9
Underhays	880772	9
Riding Parks	867784 & 863780	22
Bidecombe Cross	880790	15
Milestone Cross	875813	5
A380	871761 & 883780	8
Finlake	851784	5
Five Lanes	830801	5
Ashcombe Cross	902796	8
Ideford Park	892781	5
Little Haldon	919766 & 911764	9
Great Haldon	877857	4
Humber	898794	3
Lindridge	897761	3
Kerswell	890803	5
Oxencombe	881828	5

Daytime work included verifying roost occupation and recording and plotting out results.

ENGLISH NATURE

Figure 1. Location of Chudleigh Caves and Woods SSSI

Showing other SSSIs in vicinity



Scale 1:50000 Map

English Nature
Devon

working today
for nature tomorrow

5.0 Results

5.1 Tracking and bat data

A total of 54 separate greater horseshoe bats were caught during the study. The nineteen caught during the second session included six bats originally captured on 6 June and identifiable as such by their biopsy punch holes. Of this sample, a total of 20 bats were fitted with radio transmitters (Table 2).

On 6 June one bat was recaptured that was assumed to have been previously caught at Caen Valley Bats SSSI (approximately 73 km away) in North Devon on 17 May 2002. The bat had a biopsy punch hole and no other such samples were taken in the UK in 2002, except at Caen Valley Bats SSSI.

In total, 105 bat/days data were collected; 44 in June and 61 in August with an average of 5.3 days per bat (a range of 3-8 days), based on data from 20 bats (Chart 1 and Table 3 and 4).

Table 2. Greater horseshoe bat captures at Chudleigh Caves and Wood SSSI

Date	Total caught	Number radio tagged
6 June	41	10
8 August	19	10

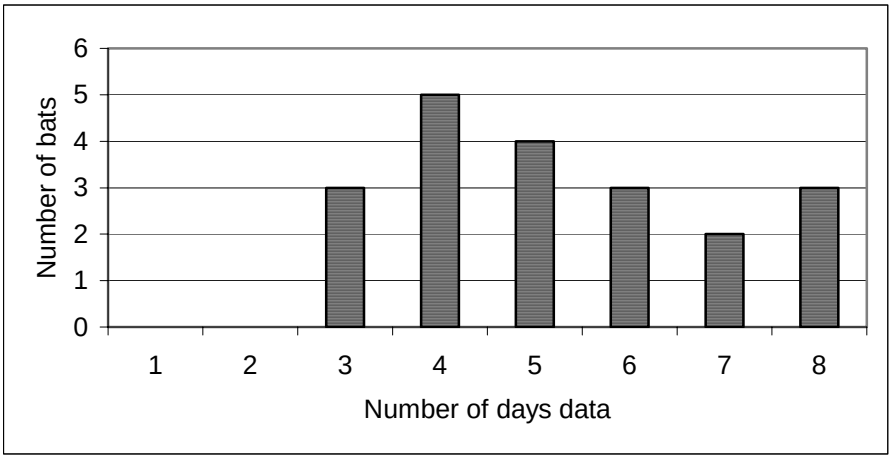


Chart 1. Radio-tracking periods at Chudleigh Caves and Woods SSSI

No evidence of any injuries or abnormal behaviour was detected from catching or radio tagging the bats, except for the first night when bats spent more time in the day roost than on subsequent nights.

Table 3. Greater horseshoe bat captures and measurements at Chudleigh Caves and Woods SSSI, 6 June 2002

F- female, M- male, j- juvenile, l-lactating, b- bred before, nb- not bred before, y- one year old, 2y- two years old, pr- pregnant, ft- false teats, 2s- second summer

Gender / Status	Forearm (mm)	Weight (g)	Tracking ID number
F nb	53.9	18.3	1
F 1 or 2s	55.7	19.0	8
M	55.0	17.9	5
F y	55.7	18.8	7
F ft	57.2	16.4	9
F 2y, ft	57.0	18.7	2
F ft	55.3	19.1	6
F ft	N/a	N/a	-
M y	N/a	N/a	-
M	55.3	18.4	-
F 2s, ft	53.3	19.0	3
F ft	53.8	17.6	-
F nb	53.3	18.5	4
M 2s	52.4	14.0	-
M	N/a	17.8	-
M 2s	53.0	18.3	-
F b, pr	56.9	23.0	10
M	53.7	17.7	-
M 2s	55.4	18.8	-
M	53.8	17.3	-
M 2s	55.3	17.0	-
F nb	56.2	18.2	-
M	N/a	19.0	-
M	56.0	18.5	-
F	52.1	17.3	-
M	53.4	18.3	-
M 2s	54.9	17.0	-
M 2s	52.8	16.9	-
M	55.0	18.5	-
M 2s	54.7	17.5	-
M 2s	55.7	17.8	-
M	54.3	14.3	-
F 2s	56.6	18.2	-
M 2s	53.1	18.5	-
F 2s	56.3	23.0	-
F pr b	57.2	20.0	-
M	55.6	19.2	-
M	55.3	18.5	-
F nb	55.9	18.3	-
F nb	55.9	18.3	-
M	54.9	N/a	-

Table 4. Greater horseshoe bat captures and measurements at Chudleigh Caves and Woods SSSI, 8 August 2002

F- female, M- male, j- juvenile, a- adult, l-lactating, b- bred before, nb- not bred before, y- one year old, 2y- two years old, pr- pregnant, ft- false teats, 2s- second summer

Gender / Status	Forearm (mm)	Weight (g)	Tracking ID number
F l	54.1	20.8	-
F l	55.7	20.5	20
F l	56.2	21.2	-
F l	55.2	21.1	19
F l	55.9	21.2	18
F l	55.0	21.8	17
F l	56.2	21.2	16
F l	54.0	21.4	15
F b	55.7	21.8	11
M a	53.1	19.0	-
F nb	50.2	18.1	-
F l	56.2	22.3	12
F nb	N/a	N/a	-
M a	52.5	19.7	-
F l	54.4	21.5	13
F l	54.6	20.9	14
M a	53.2	18.6	-
F a, nb	54.3	21.3	-
F a, nb	55.9	19.6	-

5.2 Foraging

5.2.1 Foraging areas

The location and descriptions of the 18 foraging areas identified during this study are given below and on Maps 1-14 in Appendix I. The numbering system used does not denote any particular significance in terms of the importance of an individual foraging area.

5.2.1.1 Chudleigh (1)

SX8578, SX8579, SX8678, SX8679, SX8779, SX8780, SX8879 & SX8880 (see maps 3, 4, 7, 8 & 11)
This area includes the Kate Brook from the A38 to the base of Kenton Hill near Harcombe. It is largely a mixture of small and medium sized field systems, in most cases enclosed by hedgerows, with frequent copses and tree lines. There is an extensive area of broadleaved woodland around Chudleigh Rock (where the main roost lies in Pixie's Hole). A total of 17 bats were recorded foraging here in June and August.

5.2.1.2. Ugbrooke (2)

SX8677, SX8678, SX8777, SX8778 & SX8878 (see maps 4, 8 & 9)
Parkland, lakes, extensive broadleaved woodland, small and medium sized field systems, in most cases enclosed by hedgerows, with frequent copses and tree lines. Sixteen bats were recorded foraging here in June and August.

5.2.1.3. Gappah (3)

SX8577, SX8578, SX8677, SX8678 & SX6778 (see maps 4 & 9)
The Ugbrooke stream valley, with small and medium sized field systems, in most cases enclosed by hedgerows, with frequent copses and tree lines. Seven bats were recorded foraging here in June.

5.2.1.4. Sandygate (4)

SX8574, SX8575, SX8576, SX8674, SX8675, SX8676
(see maps 4, 5, 9 & 10)
This is an extensive area of mineral workings; most are disused and flooded with water, others are still worked or in active use as landfill sites. The Ugbrooke stream winds its way through improved grassland bounded by hedgerows and blocks of woodland. Extensive areas of scrub, wetland and regenerating woodland lie in the old pits. This was a popular foraging area for the greater horseshoe bats in June, with seven bats recorded.

5.2.1.5. Combe (5)

SX8675, SX8676, SX8776 & SX8876 (see maps 5, 9 & 10)
A steep sided valley containing pastures bounded by hedgerows, with extensive coniferous woodland. There is a subsidiary greater horseshoe bat day roost at Underhays. The key area for the bats was in the valley base around hedgerows and in wet woodland. Four bats were recorded foraging here in June.

5.2.1.6. Ideford (6)

SX8877, SX8878, SX8976, SX8977, SX8978, SX9076, SX9077, SX90778, SX9175, SX9176, SX9177 & SX9178 (see maps 8, 9, & 12-14)
An area of extensive small field systems with high hedgerows and tree-lined watercourses. Large conifer plantations border the area on Kenton Hill and Humber Down. Popular feeding areas are around hedgerows, particularly associated with watercourses or wetland areas. Eight bats were recorded foraging here, mainly in August.

5.2.1.7. Haldon (7)

SX8978, SX8979 & SX9078 (see map 12)
An extensive area of coniferous plantation on high ground overlooking Ideford. Key feeding areas were close to the woodland edge at the sources of several streams. Six bats were recorded foraging here in June and August.

5.2.1.8. Ashcombe (8)

SX9079 & SX9179 (see maps 11 & 12)
A steep sided valley with pastures bounded by hedgerows, a tree-lined stream and extensive coniferous woodland. One bat was recorded foraging here.

5.2.1.9. Stover (9)

SX8375, SX8376 & SX8475 (see map 5)
Extensive coniferous plantation surrounding a large lake bordered by grazed fields. Three bats were recorded foraging here.

5.2.1.10. Chudleigh Knighton (10)

SX8276, SX8277, SX8376, SX8377, SX8378, SX8477, SX8478, SX8577 & SX8578
(see maps 1, 2, 4 & 5)
Area of enclosed grazed pasture, lowland heath and tree lined watercourses. Four bats were recorded foraging here.

5.2.1.11. River Teign Valley (11)

SX8578, SX8579, SX8580, SX8679, SX8680, SX8681, SX8780 & SX8781
(see maps 3, 4, 7 & 8)
The River Teign is the main river in the study. The valley has extensive small field systems with high hedgerows and tree-lined watercourses. Six bats were recorded foraging here, predominantly in August.

5.2.1.12. Bramble Brook (12)

SX8681, SX8682, SX8683, SX8781, SX8782 & SX8783 (see maps 6 & 7)
A tributary of the River Teign, the valley contains grasslands with high hedgerows, tree lined watercourses and extensive coniferous plantation. Four bats were recorded foraging here in August.

5.2.1.13 Harcombe (13)

SX8881 & SX8981 (see map 7)
An area of improved pasture bounded by hedgerows, with lakes, parkland and extensive woodland. One bat was recorded foraging here.

5.2.1.14. Oxencombe (14)

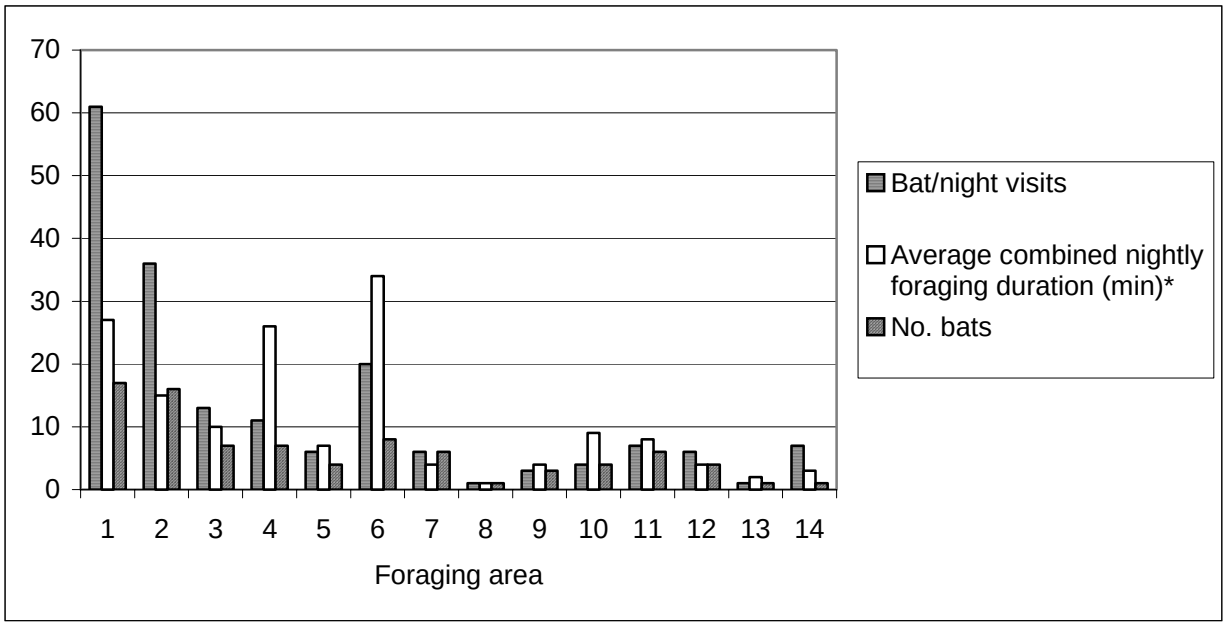
SX8882 (see maps 6 & 7)
A steep sided valley containing pastures bounded by hedgerows, a tree-lined stream and extensive coniferous woodland. One bat was recorded foraging here.

5.2.2. Foraging area usage

The four most significant foraging areas for both study periods were: Chudleigh (1), Ugbrooke (2), Sandygate (4) and Ideford (6). In June, Chudleigh (1), Ugbrooke (2) and Sandygate (4) were

the most important and Gappah (3) was also well used. During August, Chudleigh (1) and Ideford (6) were the key areas and Ugbrooke (2) was also important.

Chart 2 shows the combined foraging activity at all areas across both study periods. Foraging activity for the June and August study periods is shown in Charts 3 and 4 respectively.



* total number of minutes foraging during study period divided by total number of nights tracking

Chart 2. Combined foraging area usage by tagged bats over the two survey periods

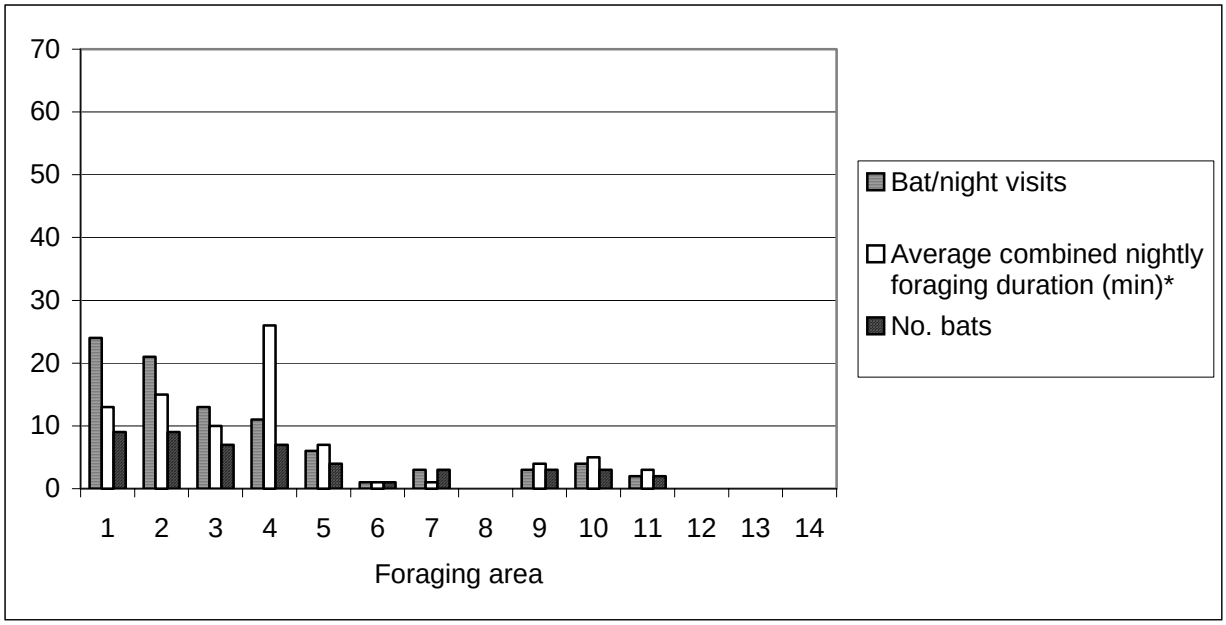
5.3 Flight corridors

Flight routes used by the bats are shown in the series of maps at Appendix I.

From Chudleigh the main commuting routes identified were:

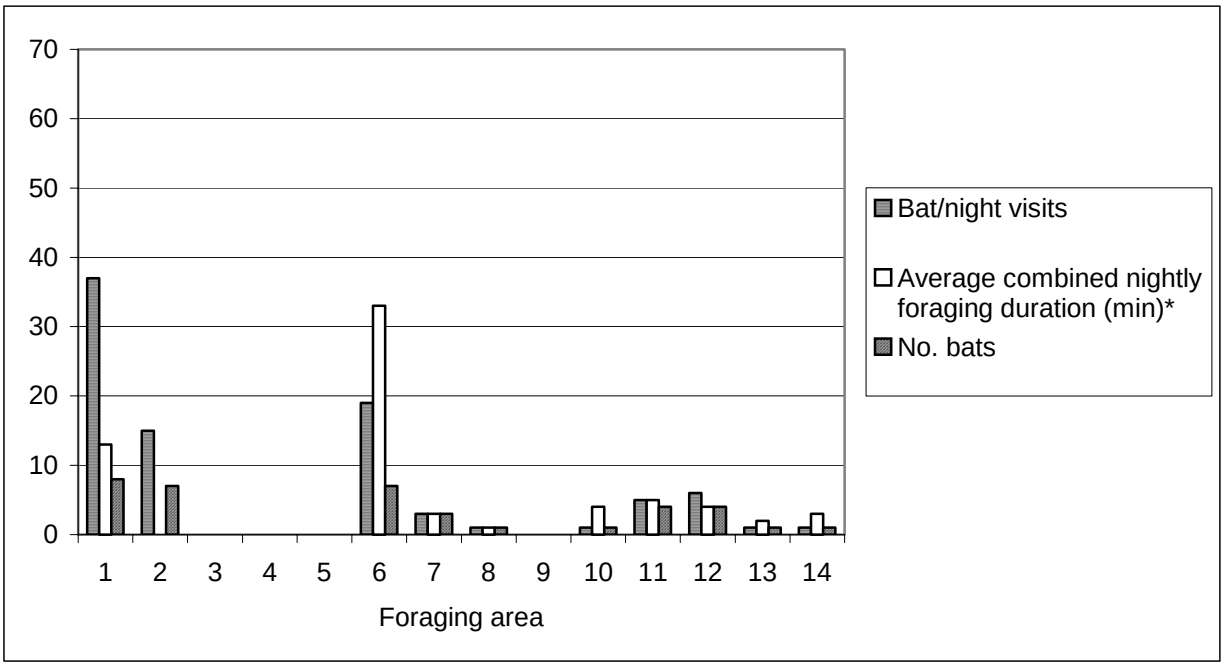
- southwest along Kate Brook to its confluence with the River Teign, then south to Chudleigh Knighton or north up the Teign Valley
- northeast along Kate Brook to Waddon and Harcombe
- south to Ugbrooke and Gappah and then on south to Sandylands or east to Ideford
- west to Coburg, under the A38 into the valley of the River Teign

The study identified a number of crossing points of major dual carriageway roads. These crossing are illustrated in the maps at Appendix I.



* total number of minutes foraging during study period divided by total number of nights tracking

Chart 3. Foraging area usage 7 – 12 June



* total number of minutes foraging during study period divided by total number of nights tracking

Chart 4. Foraging area usage 9 – 16 August

5.4 Daytime roost sites

5.4.1 Number of roosts and roost types

Day roosting was recorded at five sites; Pixie's Hole (Chudleigh Caves and Woods SSSI), Fairy Cave, at a limekiln in Palace Quarry, Underhays Farm and Ugbrooke House.

Charts 5 and 6 show the records of tagged bats made at each day roost. Bats unaccounted for on a particular day may have been in undetectable positions; either in known roosts or in other undiscovered locations.

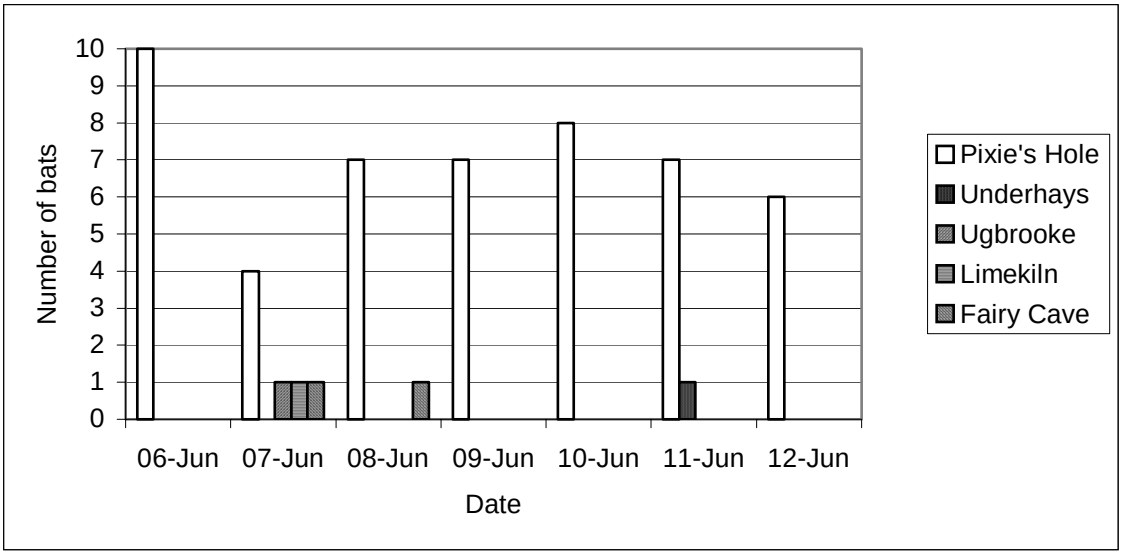


Chart 5. Daily usage of day roosts by tagged bats 6-12 June

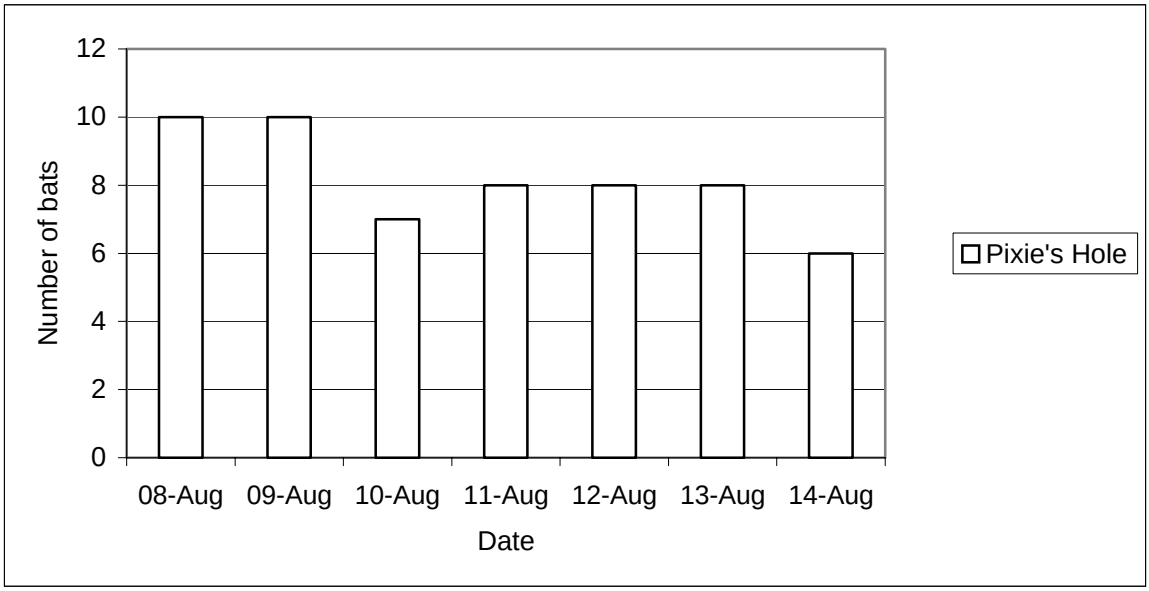


Chart 6. Daily usage of day roosts by tagged bats 8-14 August

5.4.2. Roost descriptions

5.4.2.1. Pixie's Hole (map 3 - site 1 SX866786)

A natural cave system with three entrances. The main entrance leads through a horizontal passage for around 70m to the base of a high 'rift' passage. The site has a long history as a greater horseshoe bat maternity and hibernation roost. Recent records indicate approximately 15 young appear here each summer and that approximately 120 bats use the site in the winter for hibernation (James Diamond, English Nature, personal communication)

5.4.2.2. Limekiln (map 3 – site 13 SX867787)

An old lime-burning kiln constructed of stone with blind tunnels running into each of the north, west and south sides. Each tunnel is around two metres in height; the north and south tunnels are around five metres long and the western about eight metres. Bat droppings were found mainly in the middle (western) tunnel: 150+ greater horseshoe bat, 20+ lesser horseshoe bat *Rhinolophus hipposideros* and a further ten droppings from unidentified bat species. Crevices into the roof, particularly in the northern tunnel, could be used as roosting sites for *Myotis* species. Visited on 13 June 2002 by Geoff Billington.

5.4.2.3. Fairy Cave (map 3 – site 2 SX865787)

A cave consisting of a single passageway leading off from the base of an old quarry on the north side of Chudleigh Rock, partially improved to allow the public access, with handrails and steps.

5.4.2.4. Ugbrooke House (map 8 – site 6 SX878783)

One of several buildings, site not visited.

5.4.2.5. Underhays (map 9 – site 3 SX879771)

Attic above two-storey house with stonewalls and a slate roof house; bats enter via adjacent barn. On upper barn floor 500+ fresh greater horseshoe bat droppings and three from lesser horseshoe bat were found. Owner reported greater horseshoe bats being present for many years. Eleven greater horseshoe bats emerged at dusk during visit on 11 June 2002 by Geoff Billington and Anita Glover.

5.5 Night roost sites

Night roosts are temporary roosts, used between and during bouts of foraging for resting, feeding and socialising.

5.5.1 Number of roosts and roost types

Bats were recorded night roosting at sixteen sites. Table 5 shows the night roost types identified or confirmed in this study. Appendix III contains tagged bat occupation records.

Table 5. Night roost types

Type	Number
Building	12
Cave	2
Lime Kiln	1
Unknown	1

5.5.2. Roost descriptions

5.5.2.1 Pixie's Hole (see map 3 - site 1 Sx866786)

See 5.4.2.1. for site description

5.5.2.2 Fairy Cave (see map 3 – site 2 SX865787)

See 5.4.2.3. for site description

5.5.2.3. Underhays (see map 9 – site 3 SX879771)

See 5.4.2.5. for site description

5.5.2.4. Northwood (see map 3 – site 4 SX856804)

A complex of farm building, not visited.

5.5.2.5. Hams Barton (see map 7 – site 5 SX879803)

Complex of buildings. Night roost in one of two twin storey barns, with stonewalls and slate roof.

5.5.2.6. Ugbrooke House (see map 8 – site 6 SX878783)

Complex of buildings, not visited.

5.5.2.7. Larcombe Bridge Barn (see map 13 – site 7 SX890767)

Two-storey barn with stonewalls and slate roof, not entered.

5.5.2.8. Higher Dunscombe Farm (see map 8 – site 8 SX892791)

Two storey barn with stonewalls and slate roof, not entered.

5.5.2.9. Stover (see map 5 – site 9 cSX835750)

Site not visited, but there are a small number of well-established greater horseshoe bat roosts in this area (James Diamond, English Nature, personal communication).

5.5.2.10. Gappah Lane Barn (see map 4 – site 10 SX871773)

One and a half storey barn with stonewalls and slate roof, not entered.

5.5.2.11. Sandygate shed (see map 10 – site 11 SX869756)

Single storey shed, not visited.

5.5.2.12. Fosterville building (see map 10 – site 12 SX861761)

Complex of industrial buildings – steel clad steel frame, not visited.

5.5.2.13. Limekiln (map 3 – site 13 SX867787)

See 5.4.2.2. for site description.

5.5.2.14. Lower Heightley (see map 8 – site 14 SX859784)

Exact building not determined.

5.5.2.15. Colleybrook Farm (see map 9 – site 15 SX894711)

Complex of two storey barns with stonewalls and slate roof, not visited.

5.5.2.16. Ashcombe Church (see map 11 – site 16 SX912795)

Porch on south side of church. Four lesser horseshoe bats and a single fresh greater horseshoe bat dropping were found during a night-time visit on 16 August 2002 by Geoff Billington.

6.0 Discussion

Study aims and objectives

The study was successful in achieving the primary objective of identifying the principal foraging areas and commuting routes used by greater horseshoe bats roosting at Chudleigh Caves and Woods SSSI during June and August 2002.

In addition, four other day roosts and sixteen night roosts were identified. Underhays Farm had eleven greater horseshoe bats roosting during the day in mid August and it is possible that this is a small nursery site.

Foraging distances

The majority of foraging areas identified lay within five kilometres of Pixie's Hole. This is slightly further than the findings of previous radio tracking studies in southwest England, which have generally found the main foraging areas to be within four kilometres of the roost (e.g. Billington 2001, Billington 2000, Ransome 1996, Duvergé 1996). Bats were recorded travelling up to 7.5 kilometres from the roost. Specific bat fixes were recorded in almost 60 one-kilometre squares and the total area used by this population appears to cover at least 120 square kilometres (Table 6).

Table 6. Maximum foraging distances and area of foraging from three radio-tracking studies of the greater horseshoe bat populations at Brockley Hall Stables SSSI, Caen Valley Bats SSSI and Chudleigh Caves and Woods SSSI

*Billington (2002); # Billington 2003

Age class	Maximum foraging radius from roost (kilometre)			Number of 1 km squares with bat fixes		
	Brockley Hall Stables*	Caen Valley Bats#	Chudleigh Caves and Woods	Brockley Hall Stables*	Caen Valley Bats#	Chudleigh Caves and woods
Juvenile	4.5	4.5	No data	75	62	59
Adult	6.8	7.25	7.5			

Primary foraging habitat

The longest foraging periods and most favoured foraging areas were associated with wet woodland, scrub, tall overgrown hedges, and woodland edges adjacent to meadows and grazed pastures. Limited foraging was recorded within woodland.

Jones *et al*.(1995) have previously reported the importance of grassland, hedgerow and woodland mosaics as foraging areas for greater horseshoe bats. Ransome (1996) has linked these landscape features to the availability and abundance of key prey species.

Flight corridors

Key flight corridors linking the roost with foraging areas were identified and were found to be associated with watercourses, tall bushy hedgerows, sheltered woodland edge, and tree-lines.

A potentially very vulnerable corridor passes through a narrow piece of undeveloped land at Sandygate; a connection that the bats use to reach Combe and Ideford foraging areas.

Roosts

Pixie's Hole is the primary greater horseshoe bat site in this area, with individuals spending single days away from the roost. Whether Underhays Farm is a subsidiary roost or another smaller nursery annex was not determined by this study. There is no evidence that another major nursery site lies close by.

7.0 Recommendations

Foraging areas

Hedgerows, often associated with watercourses or areas of wet ground, were found to be one of the main foraging features used by the bats. Where appropriate, further hedgerow planting and restoration should be promoted in and around the foraging areas.

The foraging areas and flight routes identified during this study should be given priority in the targeting of advice and management agreements to maintain and enhance the landscape for the bats using the Chudleigh Caves and Woods SSSI roost.

Potential developments that may affect the foraging areas and flight routes identified during this study should be fully assessed to ensure that there are no negative impacts on the bats or the landscape that supports them.

Disused mineral workings, where extensive areas of scrub and regenerating woodland occur, are important feeding sites. Management to retain these habitats should be discussed with the owners and managers of these sites.

Roosts

As appropriate, further investigations of the Underhays day roost should be made to establish its importance and status.

8.0 Acknowledgements

English Nature (in particular James Diamond) for planning, funding and licensing the activities carried out under this study, for the loan of aerial photographs and for providing copies of 1:10000 and Phase I habitat maps under their Ordnance Survey licence.

The contract field surveyors, John Kaczanow and Anita Glover and volunteer assistants John Randall, Siobhan Murphy and Miriam Glendell.

Lord Clifford for allowing extensive access to the site and the owner of Underhays for allowing their building to be surveyed.

9.0 References

Billington, G. E. (2000). *Radio tracking study of greater horseshoe bats at Mells, Frome, Somerset.* English Nature Research Report Number 403.

Billington, G. E. (2002). *Radio tracking study of greater horseshoe bats at Brockley Hall Stables Site of Special Scientific Interest, May-August 2001.* English Nature Research Report Number 442.

Billington, G. E. (2003). *Radio tracking study of greater horseshoe bats at Caen Valley Bats 2002.* English Nature Research Report Number 495.

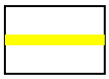
Duvergé, L. P. (1996). Foraging activity, habitat use, development of juveniles, and diet of the greater horseshoe bat (*Rhinolophus ferrumequinum)* – Schreber 1774 in south-west England. Unpublished PhD thesis, University of Bristol.

Jones, G, Duvergé, L. P. and Ransome, R.D. (1995). Conservation biology of an endangered species: field studies on greater horseshoe bats. *Symp. Zool. Soc. Lond*. 67: 309-324.

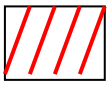
Ransome, R.D. (1996) *The management of feeding areas for greater horseshoe bats*. English Nature Research Report Number 174.

Appendix I - maps

Key to maps

Foraging areas/flight routes 

Flight connections (route unknown***)*** 

Approximate foraging area
(foraging site(s) within shaded area) 

Roosting sites are denoted by red circles

Map scale 1 : 10000

Maps

1/. 87NW Chudleigh Knighton

2/. 87NW Chudleigh Knighton

3/. 87NW & 87NE Chudleigh and Teign Valley

4/. 87NW & 87NE Chudleigh, Chudleigh Knighton, Gappah, Teign Valley and Ugbrooke

5/. 87NW, 87NE, 87SW & 87SE Chudleigh Knighton, Combe, Sandygate and Stover

6/. 88SE Bramble Brook & Oxencombe Brook

7/. 88SE Bramble Brook, Oxencombe Brook, Chudleigh, Teign Valley & Harcombe

8/. 87NE Chudleigh, Teign Valley, Ideford & Ugbrooke

9/. 87NE Combe, Gappah, Ideford, Sandygate & Ugbrooke

10/. 87SE & 87NE Combe & Sandygate

11/. 87NE, 88SE, 97NW & 97SW Ashcombe, Chudleigh & Haldon

12/. 87NE & 97NW Ashcombe, Haldon & Ideford

13/. 87NE & 97NW Ideford

14/. 97NW Ideford

Appendix II - Day roost usage data

Showing daily presence of tagged bats (by bat number) at known day roost sites

	Pixie's Hole	Lime Kiln	Ugbrooke House	Fairy Cave	Underhays
6 June	1-10				
7 June	1 & 3-5	6	7	8	
8 June	1-7			8	
9 June	1-6 & 8				
10 June	1-8				
11 June	1-8				9
12 June	2-4 & 7-9				
8 August	11-20				
9 August	11-20				
10 August	12-15 & 18-20				
11 August	1, 2, 4-7, 9 & 10				
12 August	1-6, 9 & 10				
13 August	1, 2, 4-7, 9 & 10				

Appendix III - Night roost usage data

Site	Date	Bat number	Times
1	7 June	2	0040
	10 June	1, 3 & 4	0151
		7	0107
		8	0250
	11 June	1	0020
	9 August	11	0005, 0215 & 0225
		15	0312
		16	0225
		18 & 19	0215 & 0225
		20	0312-0327
	11 August	14, 15 & 18	0115
	14 August	11	2349
		19 & 20	2349
		14	0031
		20	0050-0057
2	7 June	3	2353
		5	2350
	9 June	3	2359
	11 June	3 & 8	0155
	9 August	12	0005 & 0215
3	9 August	3	2309
4	16 August	20	2310
5	9 August	20	0048-0056 & 0223-0258
	10 August	20	0141
	11 August	20	0115-0146
	12 August	11	0023
		20	0003-0027
	14 August	11 & 20	0050-0057
	15 August	20	0018
6	10 June	1	0208
			2304-2306
7	10 August	13	0101-0107
8	15 August	15	2138 & 0034
	16 August	15	0034
		17	2329
9	10 June	6	0208
10	10 June	8	2215-2236
	11 June	7	
	12 June	3	2258-2322
11	12 June	3	2239-2240 & 2258-2322
		4	0217-0241
12	12 June	4	2250-0108 & 0248
13	12 June	1	2244-2342
		5	0110
	11 August	12	2305
14	7 June	5	0223
15	13 August	15	2235
16	16 August	17	

Appendix IV - Weather conditions during survey periods

Temperature (degrees centigrade), rainfall (0-5) this is an estimation of the rate of rainfall on a scale 0 = no rain to 5 = torrential rain, cloud cover (%) and wind strength (Beaufort), were recorded at dusk. During the surveys changes in temperature, increased wind strength and percentage rainfall were noted.

Date	Dusk weather				Min. temp (C)	Max. wind strength	% time rainfall
	Temp (C)	Rainfall	Cloud %	Wind			
7 June	13.5	1	100	1SW	13.5	1	95
8 June	15.5	0	60	0	11	1	0
9 June	12.5	0	85	1SW	12.5	2	15
10 June	11.5	0	30	0	8	0	0
11 June	13	1	100	0	12.5	0	90
12 June	13.5	1	100	1SW	13	1	20
9 August	15.5	2	100	2SW	12	3	30
10 August	17.5	0	100	1SW	15	1	0
11 August	17	0	75	1	16	1	0
12 August	16	0	20	0	16	0	0
13 August	18	0	70	0	15.5	0	0
14 August	17.5	0	100	0	17	0	0
15 August	16	0	25	1SW	7	1	0
16 August	15.5	0	15	0	10	0	0

Appendix V – Photographs

All photographs by Geoff Billington

1/. Chudleigh Rock

2/. A38 culvert to the River Teign

3/. Gappah

4/. Babcombe – commuting route

5/. Sandygate

6/. Sandygate

7/. Sandygate – commuting route

8/. Combe

9/. Combe - Well Covert

10/. River Teign

11/. A380 road crossing at Combe

1/. Chudleigh Rock – SX862781 N

2/. A38 culvert to the River Teign SX858785 S

3/. Gappah SX863776 W

4/. Babcombe – commuting route SX868773 S

5/. Sandygate SX867747 SW

6/. Sandygate SX863743 E

7/. Sandygate – commuting route SX869747 W

8/. Combe SX873762 SW

9/. Combe – Well Covert SX873762 NE

10/. River Teign SX856790 SSE

11/. A380 - Combe crossing SX871760

ENGLISH NATURE

English Nature is the Government agency that champions the conservation of wildlife and geology throughout England.

This is one of a range of publications published by:
External Relations Team
English Nature
Northminster House
Peterborough PE1 1UA

www.english-nature.org.uk

Cover printed on Character Express, post consumer waste paper, ECF.

ISSN 0967-876X

Cover designed and printed by Status Design & Advertising, 2M, 5M, 5M.

Front cover photographs:
Top left: Using a home-made moth trap.
Peter Wakely/English Nature 17,396
Middle left: Co_2 experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
Paul Glendell/English Nature 23,020
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
Paul Glendell/English Nature 24,888