BAT TREE HABITAT KEY

DATABASE REPORT 2016

ANDREWS ECOLOGY LTD
RESEARCH & DEVELOPMENT

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REVIEW & INITIAL ANALYSIS OF POTENTIAL ROOST FEATURE (PRF) AND OCCUPIED TREE-ROOST DATA HELD IN JULY 2016

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The Database framework was devised by Henry Andrews and Dr. Mark Gardener.

All basic presentation of data was performed by Henry Andrews.

All logistic regression analysis presented in this report was performed by Dr. Mark Gardener.

1. INTRODUCTION

Bat Tree Habitat Key (BTHK) is an AEcol Research & Development project that began in 2008.

The aim of the project was initially the collation of existing accounts of the ecology of tree-roosting bats in order to inform the design of professional surveys. This resulted in the production of three reviews comprising: -

1. Andrews H 2011. *A habitat key for the assessment of potential bat roost features in trees: Document I – Key Instructions & Document II – Key*. AEcol, Bridgwater

2. Andrews *et al*. 2013. *Bat Tree Habitat Key*. AEcol, Bridgwater

3. BTHK 2016. *Bat Tree Habitat Key – 3rd Edition*. AEcol, Bridgwater – **In preparation**

The Bat Tree Habitat Key Database (hereafter 'The Database') was begun in 2011 in order to begin filling-in gaps identified by the reviews. The Database comprises a framework of habitat, structural, environmental and faunal information recorded to a set criteria, set out on a recording form (see Section 2: THE DATA).

The objective of The Database is to search for patterns that might inform better methods for: scoping wooded habitats for tree-roosts; surveying those habitats to pinpoint where roosts are at a given moment in time; and analysing the data gathered during surveys. As a result, it is intended that all the information should have a practical application.

In 2016, some logistic regression analysis was attempted, but there is still great variability in the data. In order to bring more clarity to the situation more records are required; both for occupied and unoccupied (potential) roost features.

This report has therefore been simplified to present summaries of the results. Every attempt has been made to provide useful data in a format that can be put to practical use. Where statistical analysis has been performed, equal weight is given to significance and both ends of the range, in order that the results are not used to scope-out all but the typical situations.

It is expected that The Database will take many years to build to a sufficient level, but we hope by producing this report, professional ecological surveyors will see the value of recording thoroughly and submitting the records, and we will increase the power of the analysis.

We would like to thank everyone who has donated records so far.

Data access

The Bat Tree Habitat Key Database is entirely ‘open-access’. This means anyone that wants the data can have it. To get it, all they have to do is email info@aecol.co.uk and explain who they are and what they plan to do with it. They also have to agree to release their results upon completion, so that the fundamental result is a benefit to the bats themselves. Following this they must send in a data-chip and a stamped address envelope; the spreadsheet and photographs will then be loaded onto the chip and returned to them.

2. THE DATA

2.1 Recording criteria

Each of the *Bat Tree Habitat Key* records is recorded using set criteria, as shown at Table 1 on the following page.

For a record to be entered it must have at least seven pieces of information:-

1. Recorders name(s);
2. The Ordnance Survey (O.S.) grid reference;
3. The date the record was made;
4. The tree species;
5. The Potential Roost Feature (PRF) type; and
6. A photograph illustrating the PRF on the tree and either droppings or a bat in residence. Better yet; video footage.

The data are then submitted for inclusion via info@aecol.co.uk and then 'truthed' for accuracy prior to being entered onto the data-base and the photographs stored in a folder.

It should be noted that unoccupied PRF are every bit as important as roost records: We need them all!

Table 1. The Bat Tree Habitat Key PRF recording form.

GROUNDSMAN	**1st Recorder** (climber/inspector)						
	2nd Recorder (groundsman/scribe)						
	SITE NAME						
	DATE						
	HABITAT (Phase 1)						
	GRID REFERENCE (O.S. not lat/lon)						
	Tag number						
	TREE SPECIES						
	TREE ALIVE/DEAD						
	DBH (Diameter at Breast Height)						
	TREE HEIGHT						
	PRF on STEM/LIMB						
	PRF TYPE						
	DIRECTION PRF FACES						
CLIMBER	MEASUREMENTS	**PRF HEIGHT**					
		DPH (Diameter at PRF Height)					
		ENTRANCE	**Height**				
			Width				
		INTERNAL	**Height**				
			Width				
			Depth				
	ROOSTING EVIDENCE	**Droppings** (look in base)					
		Bats (look in cavity)	**Species**				
			Number of bats				
			Above, below or to side of entrance				
			Distance from entrance (cm)				
	INTERNAL CONDITIONS: Tick as many of the following as are applicable. Where a field is negative please put a cross.	**SMELL**	**None**	**Pleasant**	**Not unpleasant**	**Un-pleasant**	
		SUBSTRATE	**Smooth**	**Bobbly**	**Bumpy**	**Rough**	
			Clean	**Waxy**	**Blackened**	**Polished**	
			Dusty	**Debris**	**Dirty**	**Sludgy**	
		HUMIDITY	**Dry**	**Damp**	**Wet**		
		APEX SHAPE	**Dome**	**Spire**	**Peak/wedge**	**Flat**	
			Chambered	**tube**			
		COMPETITORS (invertebrates, birds, mammals?)					
	COMMENTS	**Don't forget the photographs!**					

2.2 Definitions

Seasons

In order to present the data and analysis in the context of bat activity the months of the year have been distributed into six key periods which reflects the status of colonies, as follows:-

1. **Winter –** January & February;
2. **Spring flux** – March & April;
3. **Pregnancy –** May & June;
4. **Nursery** – July & August;
5. **Mating –** September & October; and
6. **Autumn flux** – November & December.

These distinctions have been made in order to ensure that records fall within the key periods and can be used to define periods of occupancy that are buffered against anomalous years. As a result, there are two flux periods; spring and autumn which, within reasonable limits, take into account mild winters.

2.3 The records

On 11th July 2016, the records comprised 1,311 entries, each with up to 73 fields, which amounts to 95,703 individual pieces of information that have been verified prior to entry. To date, The Database encompasses 580 trees, of which 281 have held roosting bats, comprising:-

1. ***Barbastella barbastellus*** – 14 records relating to 11 trees and equating to 3.9% of trees in which roosting has been confirmed;
2. ***Myotis bechsteinii*** – 12 records relating to seven trees equating to 2.4% of trees in which roosting has been confirmed;
3. ***Myotis daubentonii*** – 48 records relating to 30 trees and equating to 10.6% of trees in which roosting has been confirmed;
4. ***Myotis nattereri*** – 80 records relating to 53 trees and equating to 18.8% of trees in which roosting has been confirmed;
5. ***Nyctalus noctula*** – 64 records relating to 30 trees and equating to 10.6% of trees in which roosting has been confirmed;
6. ***Pipistrellus nathusii*** – two records relating to one tree and equating 0.3% of trees in which roosting has been confirmed;
7. ***Pipistrellus pipistrellus*** – 32 records relating to 25 trees and equating to 8.8% of trees in which roosting has been confirmed;
8. ***Pipistrellus pygmaeus*** – 18 records relating to 12 trees and equating to 4.2% of trees in which roosting has been confirmed;
9. ***Plecotus auritus*** – 156 records relating to 123 trees and equating to 43.7% of trees in which roosting has been confirmed; and
10. ***Rhinolophus hipposideros*** – two records relating to one tree and equating to 0.3% of trees

in which roosting has been confirmed.

Note: Examination of the records will show that they amount to 293 roost trees and not 281, and that the percentage figures add up to 103.6%. This is because some roosts are occupied by more than one species of bat.

Photographic evidence exists to confirm the following four bat species roost in trees, but to date no detailed roost records exist on the BTHK Database from anywhere in the British Isles:-

1. *Myotis alcathoe*;
2. *Myotis brandtii*;
3. *Myotis mystacinus*; and
4. *Nyctalus leisleri*.

2.4 Geographic location

On 11th July 2016, The Database held records in the following countries[1]:-

- **England** – 1,295 records encompassing 267 roosts;
- **Scotland** – 12 records encompassing 10 roosts; and
- **Wales** – four records encompassing four roosts.

2.5 The recorders

Thus far, 58 people have contributed to The Database. Recorder data is filtered into two columns comprising:-

1. **First Recorder** – The person who is performing the inspection; and
2. **Second Recorder** – The scribe or assistant.

It is not uncommon for there not to be a Second Recorder. For example, if my family are present with me when I record a roost, but unless one of the kids is actually assisting me then they are not part of that record. The same is also true when I am leading a course. Where Louis Pearson and I work together, the roles alternate depending on who is holding the endoscope and who is holding the weather-writer.

Table 2 on the following page sets out who has submitted positive records as First Recorder, how many records they have submitted overall, how many of these were positive encounters, and which species they have encountered.

[1] Countries presented in the order of most roost and PRF records.

Table 2. Who has submitted positive records as First Recorder, how many records they have submitted to The Database overall, how many of these were positive encounters, and which species they had encountered to date; 11th July 2016.

RANK	NAME	No. of records	No. of times bats encountered	SPECIES ENCOUNTERED									
				B. bar	*M. bec*	*M. dau*	*M. nat*	*N. noc*	*P. nat*	*P. pip*	*P. pyg*	*P. aur*	*R. hip*
1	Henry Andrews	841	246	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2	Louis Pearson	185	17				✓		✓	✓		✓	
3	Jim Mullholland	61	27	✓	✓	✓	✓	✓		✓		✓	
4	Sam Davis	25	6			✓	✓					✓	
5	Carrie White	16	13			✓	✓			✓		✓	
	James Shipman	16	3							✓		✓	✓
6	Danielle Linton	10	9			✓					✓	✓	
7	Matt Dodds	9	3			✓	✓					✓	
8	Andrew Harrington	8	5			✓	✓				✓		
	Robert Bell	8	4					✓		✓		✓	
9	Tom Bennett	7	7					✓				✓	
10	Ben McLean	6	6				✓					✓	
	Helen Hamilton	6	1									✓	
11	Dave Dowse	5	5			✓				✓	✓		
	Daniel Whitby	5	5		✓	✓	✓	✓					
	Steve Allen	5	5				✓	✓				✓	
	Rich Flight	5	4				✓			✓	✓	✓	
	Jenny Wallace	5	3				✓			✓			
12	Paul Kennedy	4	4					✓		✓		✓	
	Daniel Simmons	4	3	✓				✓					
	Brady Roberts	4	2		✓								
13	James Faulconbridge	3	3				✓	✓				✓	
	James Whiteford	3	3									✓	
	Rebekah West	3	3									✓	
	Dave Smith	3	1							✓			
	Luci Spencer	3	1									✓	
14	Becci Smith	2	2							✓		✓	
	Chris Turner	2	2				✓					✓	
	Graeme Smart	2	2					✓					
	James Shipman	2	2			✓							✓
	Jonathan Durwood	2	2			✓							
	Michael Sharp	2	2				✓						
	Nick Underhill-Day	2	2							✓	✓		
	Peter Hadfield	2	2							✓		✓	
	Steve Parker	2	2			✓		✓					
15	Angus Andrew	1	1							✓			
	Bob Lester	1	1							✓			
	Chris Kerfoot	1	1					✓					

RANK	NAME	No. of records	No. of times bats encountered	SPECIES ENCOUNTERED									
				B. bar	*M. bec*	*M. dau*	*M. nat*	*N. noc*	*P. nat*	*P. pip*	*P. pyg*	*P. aur*	*R. hip*
	Conor Kelleher	1	1									✓	
	David Lee	1	1		✓								
	Emma Jennings	1	1							✓			
	Eric Palmer	1	1		✓								
	Gareth Harris	1	1							✓			
	Gemma Waters	1	1		✓								
	Grant Bramall	1	1									✓	
	Guy Miller	1	1									✓	
	James Harvey	1	1									✓	
	Jamie Woollam	1	1							✓			
	John Haddow	1	1				✓						
	Linda Tucker	1	1	✓									
	Louise Woolley	1	1									✓	
	Maria Parkinson	1	1									✓	
	Marianne Bergin	1	1					✓					
	Peter Davenport	1	1									✓	
	Peter Scrimshaw	1	1			✓							
	Reuben Singleton	1	1							✓	✓		
	Rob Fear	1	1									✓	
	Sam Arthur	1	1			✓							
	Sam Dyer	1	1		✓								

3. THE HABITAT

In order to present the data, the Phase 1 habitat classification as set out by JNCC (2010) has been adopted. The habitats the Phase 1 classification identifies and the number of roost and unoccupied PRF records held on The Database are set out at Table 3.

Table 3. Phase 1 (JNCC 2010) Wooded habitats in which records were held for tree-roosts and unoccupied PRF on The Database on 11th July 2016.

PHASE 1 (JNCC 2010) HABITAT		*Barbastella barbastellus*	*Myotis bechsteinii*	*Myotis daubentonii*	*Myotis nattereri*	*Nyctalus noctula*	*Pipistrellus nathusii*	*Pipistrellus pipistrellus*	*Pipistrellus pygmaeus*	*Plecotus auritus*	*Rhinolophus hipposideros*
HABITAT	***CODE***										
Broadleaved semi-natural woodland	A1.1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Broadleaved plantation	A1.1.2		✓	✓	✓						
Coniferous plantation	A1.2.2				✓						
Mixed semi-natural woodland	A1.3.1				✓					✓	
Parkland	A3			✓		✓		✓			✓
Improved grassland	A4	✓				✓					
Dry heath / acid grassland mosaic	D5				✓			✓	✓	✓	
Standing water	G1					✓					
Running water	G2			✓							
Hedge with trees	J2.3		✓	✓		✓		✓		✓	
Residential garden	J3					✓		✓			

4. THE TREES

4.1 Tree species

On 11th July 2016, The Database held records of bats roosting in 24 species of tree. The individual tree species, the bat species recorded roosting in them, and the number of roosts thus far recorded in the 20 deciduous trees is set out in Table 4 below. The number of roosts recorded in the four coniferous tree species is set out in Table 5.

Table 4. Deciduous tree species for which roost records were held on The Database on 11th July 2016, presented by number of roosts occupied by each bat species.

Tree species	*Barbastella barbastellus*	*Myotis bechsteinii*	*Myotis daubentonii*	*Myotis nattereri*	*Nyctalus noctula*	*Pipistrellus nathusii*	*Pipistrellus pipistrellus*	*Pipistrellus pygmaeus*	*Plecotus auritus*	*Rhinolophus hipposideros*	Total bat species	Total number of roosts
Quercus petraea	7	1	1	18	12	1	6	2	88		9	136
Quercus robur	3	3	5	9	9		5	5	8		7	47
Fraxinus excelsior		2	3	6	7			1	1		6	20
Acer pseudoplatanus			7	8			3	1	6		5	25
Betula pubescens		2		2			1	2	4		5	11
Fagus sylvatica			6		1		2		3		4	12
Acer campestre			4	3				1			3	8
Castanea sativa	1						3		1		3	5
Malus domestica		3	1	1							3	5
Aesculus hippocastanum				1			1		1		3	3
Alnus glutinosa			1						3		2	4
Betula pendula							1		1		2	2

Tree species	*Barbastella barbastellus*	*Myotis bechsteinii*	*Myotis daubentonii*	*Myotis nattereri*	*Nyctalus noctula*	*Pipistrellus nathusii*	*Pipistrellus pipistrellus*	*Pipistrellus pygmaeus*	*Plecotus auritus*	*Rhinolophus hipposideros*	Total bat species	Total number of roosts
Corylus avellana				1					1		2	2
Salix caprea		1							1		2	2
Salix fragilis			2								1	2
Prunus avium								1			1	1
Tilia x europaea					1						1	1
Quercus cerris										1	1	1
Liquidambar styraciflua									1		1	1

Note: The roost recorded on large-leaved lime was identified by the presence of droppings alone. However, DNA analysis by Warwick University proved inconclusive. The roost therefore does not appear within this table.

Table 5. Coniferous tree species for which bat-roost records were held on The Database on 11th July 2016, presented by number of roosts occupied by individual bat species.

Tree species	*Barbastella barbastellus*	*Myotis bechsteinii*	*Myotis daubentonii*	*Myotis nattereri*	*Nyctalus noctula*	*Pipistrellus nathusii*	*Pipistrellus pipistrellus*	*Pipistrellus pygmaeus*	*Plecotus auritus*	*Rhinolophus hipposideros*	Total bat species	Total number of roosts
Taxus baccata				1					4		2	5

Tree species	*Barbastella barbastellus*	*Myotis bechsteinii*	*Myotis daubentonii*	*Myotis nattereri*	*Nyctalus noctula*	*Pipistrellus nathusii*	*Pipistrellus pipistrellus*	*Pipistrellus pygmaeus*	*Plecotus auritus*	*Rhinolophus hipposideros*	Total bat species	Total number of roosts
Cupressus macrocarpa					**1**		**2**				**2**	**3**
Pinus sylvestris				**1**			**1**				**2**	**2**
Sequoiadendron giganteum							**1**				**1**	**1**

It should be noted that roosting bats have been encountered within other tree species in the British Isles and on the Continent. A review of these encounters is provided at Appendix A. However, this review is not exhaustive and we would be interested to hear of other evidence-supported encounters so they may be included.

4.2 Tree species summaries

In order to present the data in a format that is of immediate practical use, the following summary tables define:-

1. The roost opportunities presented by each tree species. This is set out as the PRF types that have thus far been recorded on the individual tree species, and which of those types have been proven to be exploited by bats. This is because although a tree species may form a particular PRF type it may not be exploited due to factors we do not yet understand. An example might be the knot-hole; all tree species can produce them, but the environmental conditions offered by the tree species differ widely in terms of dimensions, shelter and humidity.
2. The minimum dimensions of roost entrances thus far recoded are also provided as a guide.
3. In order to provide a guide of when individual tree species achieve sufficient size to begin to form PRF of a nature suitable to be exploited by roosting bats, the minimum Diameter at Breast Height (DBH) and Diameter at PRF[2] Height (DPH) is shown. <u>It is emphasised that this information is a guide and should not be used to scope out areas of wooded habitat and individual trees that have not been subject to visual inspection.</u>

[2] In response to comments DPH has now replaced DCH.

4. Height ranges are also provided for use as a guide. PRF that are outside the range shown should not be scoped-out simply because they do not fall within the heights recorded thus far.
5. The seasons in which bats have been recorded occupying PRF in the particular tree species is identified and a list of bat species known to exploit the individual tree species is provided.

The idea is that by producing summaries for individual tree species, a surveyor can see at a glance what to look out for in terms of bat roost potential. Tables 6 through 29 summarise each of the 24 tree species for which The Database holds records of bats roosting.

NOTE: Some empty-spaces are erroneous, such as the lack of knot-holes and cankers in association with *Quercus petraea*. This is due to the context of the classifications; clearly knot-holes do form on *Q. petraea*, but to date no one has submitted a record of one to The Database. Therefore, if you try to use these summaries in isolation to 'scope-out' PRF from surveys you will eventually come unstuck!

Table 6. The Database field maple *Acer campestre* summary.

***Acer campestre* (field maple)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Tear-outs	✓	Height: 85 mm Width: 16 mm
	Wounds	✓	Height: 80 mm Width: 15 mm
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		171 mm (17.1 cm)	
Minimum DPH at the roost entrance		158 mm (15.8 cm)	
Height ranges of roosts recorded		1.71 – 5 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	✓	
	Mating	✓	
	Autumn / winter flux	✓	
Bat species recorded	*Myotis daubentonii*, *M. nattereri* and *Pipistrellus pygmaeus*		

Table 7. The Database sycamore *Acer pseudoplatanus* summary.

***Acer pseudoplatanus* (sycamore)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Tear-outs	✓	Height: 30 mm Width: 30 mm
	Wounds	✓	Height: 115 mm Width: 13 mm
	Cankers	✓	Height: 80 mm Width: 20 mm
	Butt-rots	----	N/A
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		100 mm (10 cm)	
Minimum DPH at the roost entrance		80 mm (8 cm)	
Height ranges of roosts recorded		0.83 – 4.2 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	✓	
	Mating	✓	
	Autumn / winter flux	✓	
Bat species recorded	*Myotis daubentonii*, *M. nattereri*, *Pipistrellus pipistrellus*, *P. pygmaeus* and *Plecotus auritus*		

Table 8. The Database horse chestnut *Aesculus hippocastanum* summary.

***Aesculus hippocastanum* (horse chestnut)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Cankers	✓	Height: 100 mm Width: 60 mm
DAMAGE PRF	Hazard-beams	✓	Height: 2,500 mm Width: 150 mm
	Frost-cracks	✓	Height: 1,160 mm Width: 60 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		500 mm (50 cm)	
Minimum DPH at the roost entrance		300 mm (30 cm)	
Height ranges of roosts recorded		1.1 – 11 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	----	
	Pregnancy	----	
	Nursery	✓	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Myotis nattereri*, *Pipistrellus pipistrellus* and *Plecotus auritus*		

Table 9. The Database alder *Alnus glutinosa* summary.

***Alnus glutinosa* (alder)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Woodpecker-holes	----	N/A
	Tear-outs	✓	Height: 100 mm Width: 30 mm
	Wounds	✓	Height: 100 mm Width: 50 mm
DAMAGE PRF	Frost-cracks	----	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		150 mm (15 cm)	
Minimum DPH at the roost entrance		80 mm (8 cm)	
Height ranges of roosts recorded		2 – 3.3 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Myotis daubentonii* and *Plecotus auritus*		

Table 10. The Database silver birch *Betula pendula* summary.

***Betula pendula* (silver birch)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Tear-outs	✓	Height: 390 mm Width: 340 mm
	Cankers	✓	Height: 350 mm Width: 250 mm
DAMAGE PRF	Frost-cracks	----	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		350 mm (35 cm)	
Minimum DPH at the roost entrance		250 mm (25 cm)	
Height ranges of roosts recorded		2.5 – 5 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Pipistrellus pipistrellus* and *Plecotus auritus*		

Table 11. The Database downy birch *Betula pubescens* summary.

***Betula pubescens* (downy birch)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Knot-holes	----	N/A
	Tear-outs	✓	Height: 70 mm Width: 30 mm
DAMAGE PRF	Hazard-beams	----	N/A
	Frost-cracks	✓	Height: 93 mm Width: 15 mm
	Subsidence-cracks	✓	Height: 80 mm Width: 30 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		129 mm (12.9 cm)	
Minimum DPH at the roost entrance		152 mm (15.2 cm)	
Height ranges of roosts recorded		1.16 – 5.08 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	✓	
	Mating	✓	
	Autumn / winter flux	----	
Bat species recorded	*Myotis nattereri*, *Pipistrellus pipistrellus*, *P. pygmaeus* and *Plecotus auritus*		

Table 12. The Database sweet chestnut *Castanea sativa* summary.

***Castanea sativa* (sweet chestnut)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Wounds	✓	Height: 1,200 mm Width: 20 mm
DAMAGE PRF	Hazard-beams	✓	Height: 1,460 mm Width: 49 mm
	Desiccation-fissures	✓	Height: 740 mm Width: 12 mm
	Bark-plates	✓	Height: 370 mm Width: 21 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		374 mm (37.4 cm)	
Minimum DPH at the roost entrance		365 mm (36.5 cm)	
Height ranges of roosts recorded		1.2 – 5.86 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	✓	
	Pregnancy	----	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	✓	
Bat species recorded	*Barbastella barbastellus*, *Pipistrellus pipistrellus* and *Plecotus auritus*		

Table 13. The Database hazel *Corylus avellana* summary.

***Corylus avellana* (hazel)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Wounds	✓	Height: 45 mm Width: 25 mm
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		102 mm (10.2 cm)	
Minimum DPH at the roost entrance		123 mm (12.3 cm)	
Height ranges of roosts recorded		0.84 – 2.8 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Myotis nattereri* and *Plecotus auritus*		

Table 14. The Database beech *Fagus sylvatica* summary.

***Fagus sylvatica* (beech)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Knot-holes	✓	Height: 30 mm Width: 10 mm
	Compression-forks	✓	Height: 130 mm Width: 22 mm
	Wounds	✓	Height: 90 mm Width: 25 mm
	Cankers	✓	Height: 20 mm Width: 35 mm
	Butt-rots	✓	Height: 500 mm Width: 100 mm
DAMAGE PRF	Frost-cracks	✓	Height: 100 mm Width: 40 mm
	Subsidence-cracks	----	N/A
	Welds	✓	Height: 90 mmm Width: 10 mm
ASSOCIATION PRF	Fluting	✓	Height: 200 mm Width: 40 mm
Minimum DBH of roost trees		300 mm (30 cm)	
Minimum DPH at the roost entrance		147 mm (14.7 cm)	
Height ranges of roosts recorded		0.6 – 20 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	✓	
	Mating	✓	
	Autumn / winter flux	✓	
Bat species recorded	*M. daubentonii*, *Nyctalus noctula*, *Pipistrellus pipistrellus* and *Plecotus auritus*		

Table 15. The Database ash *Fraxinus excelsior* summary.

***Fraxinus excelsior* (ash)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Woodpecker-holes	✓	Height: 50 mm Width: 60 mm
	Knot-holes	✓	Height: 35 mm Width: 45 mm
	Pruning-cuts	✓	Height: 130 mm Width: 100 mm
	Compression-forks	----	N/A
	Wounds	✓	Height: 12 mm Width: 11 mm
	Cankers	✓	Height: 20 mm Width: 18 mm
	Butt-rots	----	N/A
DAMAGE PRF	Hazard-beams	✓	Height: 1,000 mm Width: 100 mm
	Subsidence-cracks	✓	Height: 75 mm Width: 75 mm
	Bark-plates	✓	Height: 70 mm Width: 65 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		120 mm (12 cm)	
Minimum DPH at the roost entrance		114 mm (11.4 cm)	
Height ranges of roosts recorded		0.6 – 13.5 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	✓	
	Mating	----	
	Autumn / winter flux	✓	
Bat species recorded	*Myotis bechsteinii*, *M. daubentonii*, *M. nattereri*, *Nyctalus noctula*, *P. pygmaeus* and *Plecotus auritus*		

Table 16. The Database American sweetgum *Liquidambar styraciflua* summary.

***Liquidambar styraciflua* (American sweetgum)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Tear-outs	✓	Height: 50 mm Width: 80 mm
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		690 mm (69 cm)	
Minimum DPH at the roost entrance		804 mm (80.4 cm)	
Height ranges of roosts recorded		4.8 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	----	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Plecotus auritus*		

Table 17. The Database domestic apple *Malus domestica* summary.

***Malus domestica* (domestic apple)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Woodpecker-holes	----	N/A
	Knot-holes	✓	Height: 90 mm Width: 35 mm
	Wounds	✓	Height: 30 mm Width: 20 mm
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		270 mm (27 cm)	
Minimum DPH at the roost entrance		105 mm (10.5 cm)	
Height ranges of roosts recorded		2.13 – 4.65 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	----	
	Pregnancy	✓	
	Nursery	✓	
	Mating	✓	
	Autumn / winter flux	----	
Bat species recorded	*Myotis bechsteinii*, *M. daubentonii* and *M. nattereri*		

Table 18. The Database wild cherry *Prunus avium* summary.

***Prunus avium* (wild cherry)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Cankers	✓	Height: 30 mm Width: 60 mm
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		395 mm (39.5 cm)	
Minimum DPH at the roost entrance		560 mm (56 cm)	
Height ranges of roosts recorded		1.63 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	----	
	Pregnancy	✓	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Pipistrellus pygmaeus*		

Table 19. The Database Turkey oak *Quercus cerris* summary.

***Quercus cerris* (Turkey oak)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Butt-rots	✓	Height: 350 mm Width: 2,010 mm
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		1,213 mm (121.3 cm)	
Minimum DPH at the roost entrance		1,450 mm (145 cm)	
Height ranges of roosts recorded		0.57 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	----	
	Pregnancy	✓	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Rhinolophus hipposideros*		

Table 20. The Database sessile oak *Quercus petraea* summary.

***Quercus petraea* (sessile oak)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Woodpecker-holes	✓	Height: 55 mm Width: 60 mm
	Tear-outs	✓	Height: 1,180 mm Width: 50 mm
	Wounds	✓	Height: 160 mm Width: 17 mm
	Butt-rots	----	N/A
DAMAGE PRF	Hazard-beams	✓	Height: 1,246 mm Width: 49 mm
	Frost-cracks	✓	Height: 15 mm Width: 8 mm
	Subsidence-cracks	✓	Height: 90 mm Width: 24 mm
	Lightning-strikes	✓	Height: 130 mm Width: 20 mm
	Transverse-snaps (snag-ends)	✓	Height: 60 mm Width: 180 mm
	Welds	✓	Height: 195 mm Width: 30 mm
	Bark-plates	✓	Height: 225 mm Width: 15 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		86 mm (8.6 cm)	
Minimum DPH at the roost entrance		95 mm (9.5 cm)	
Height ranges of roosts recorded		0.42 – 9.7 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	✓	
	Mating	✓	
	Autumn / winter flux	✓	
Bat species recorded	*Barbastella barbastellus*, *Myotis bechsteinii*, *M. daubentonii*, *M. nattereri*, *Nyctalus noctula*, *Pipistrellus nathusii*, *P. pipistrellus*, *P. pygmaeus* and *Plecotus auritus*		

Table 21. The Database pedunculate oak *Quercus robur* summary.

***Quercus robur* (pedunculate oak)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Woodpecker-holes	✓	Height: 30 mm Width: 18 mm
	Knot-holes	✓	Height: 50 mm Width: 56 mm
	Pruning-cuts	✓	Height: 45 mm Width: 55 mm
	Tear-outs	✓	Height: 50 mm Width: 9 mm
	Wounds	✓	Height: 100 mm Width: 40 mm
	Butt-rots	----	N/A
DAMAGE PRF	Hazard-beams	✓	Height: 40 mm Width: 30 mm
	Subsidence-cracks	✓	Height: 300 mm Width: 150 mm
	Lightning-strikes	✓	Height: 48 mm Width: 20 mm
	Desiccation-fissures	✓	Height: 880 mm Width: 12 mm
	Transverse-snaps (snag-ends)	✓	Height: 15 mm Width: 15 mm
	Welds	----	N/A
	Bark-plates	✓	Height: 28 mm Width: 20 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		200 mm (20 cm)	
Minimum DPH at the roost entrance		110 mm (11 cm)	
Height ranges of roosts recorded		0.92 – 14 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	✓	
	Mating	✓	
	Autumn / winter flux	✓	
Bat species recorded	*Barbastella barbastellus*, *Myotis bechsteinii*, *M. daubentonii*, *M. nattereri*, *Nyctalus noctula*, *Pipistrellus pipistrellus*, *P. pygmaeus* and *Plecotus auritus*		

Table 22. The Database goat willow *Salix caprea* summary.

***Salix caprea* (goat willow)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Tear-outs	✓	Height: 270 mm Width: 55 mm
	Wounds	✓	Height: 70 mm Width: 60 mm
DAMAGE PRF	Hazard-beams	----	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		190 mm (19 cm)	
Minimum DPH at the roost entrance		180 mm (18 cm)	
Height ranges of roosts recorded		3.5 – 3.94 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	----	
	Pregnancy	----	
	Nursery	✓	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Myotis bechsteinii* and *Plecotus auritus*		

Table 23. The Database crack willow *Salix fragilis* summary.

***Salix fragilis* (crack willow)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Woodpecker-holes	✓	Height: 30 mm Width: 30 mm
	Tear-outs	----	N/A
	Wounds	✓	Height: 680 mm Width: 40 mm
DAMAGE PRF	Hazard-beams	----	N/A
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		540 mm (54 cm)	
Minimum DPH at the roost entrance		260 mm (26 cm)	
Height ranges of roosts recorded		1.4 – 9.4 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	----	
	Pregnancy	✓	
	Nursery	✓	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Myotis daubentonii*		

Table 24. The Database large-leaved lime *Tilia platyphyllos* summary.

***Tilia platyphyllos* (large-leaved lime)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	----	N/A	N/A
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	Ivy	✓	Height: 200 mm Width: 20 mm
Minimum DBH of roost trees		1,486 mm (148.6 cm)	
Minimum DPH at the roost entrance		1,486 mm (148.6 cm)	
Height ranges of roosts recorded		1.12 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	----	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	Unknown		

Table 25. The Database common lime *Tilia x europaea* summary.

***Tilia x europaea* (common lime)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	----	N/A	N/A
DAMAGE PRF	Welds	✓	Height: 55 mm Width: 56 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		781 mm (78.1 cm)	
Minimum DPH at the roost entrance		637 mm (63.7 cm)	
Height ranges of roosts recorded		6.24 – 6.73 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	✓	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Nyctalus noctula*		

Table 26. The Database yew *Taxus baccata* summary.

***Taxus baccata* (yew)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	----	N/A	N/A
DAMAGE PRF	----	N/A	N/A
ASSOCIATION PRF	Fluting	✓	Height: 60 mm Width: 15 mm
Minimum DBH of roost trees		1,710 mm (171 cm)	
Minimum DPH at the roost entrance		1,710 mm (171 cm)	
Height ranges of roosts recorded		0.89 – 1.45 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	✓	
	Pregnancy	----	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Myotis nattereri* and *Plecotus auritus*		

Table 27. The Database Scots pine *Pinus sylvestris* summary.

***Pinus sylvestris* (Scots pine)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	Woodpecker-holes	----	N/A
	Wounds	✓	Height: 70 mm Width: 200 mm
DAMAGE PRF	Hazard-beams	✓	Height: Not recorded Width: Not recorded
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		500 mm (50 cm)	
Minimum DPH at the roost entrance		300 mm (30 cm)	
Height ranges of roosts recorded		10 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	----	
	Pregnancy	✓	
	Nursery	----	
	Mating	✓	
	Autumn / winter flux	----	
Bat species recorded	*Myotis nattereri* and *Pipistrellus pipistrellus*		

Table 28. The Database Monterey cypress *Cupressus macrocarpa* summary.

***Cupressus macrocarpa* (Monterey cypress)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	----	N/A	N/A
DAMAGE PRF	Hazard-beams	✓	Height: 35 mm Width: 10 mm
	Welds	✓	Height: 290 mm Width: 60 mm
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		730 mm (73 cm)	
Minimum DPH at the roost entrance		210 mm (21 cm)	
Height ranges of roosts recorded		2.31 – 5.3 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	✓	
	Spring flux	----	
	Pregnancy	✓	
	Nursery	✓	
	Mating	----	
	Autumn / winter flux	----	
Bat species recorded	*Nyctalus noctula* and *Pipistrellus pipistrellus*		

Table 29. The Database giant redwood *Sequoiadendron giganteum* summary.

***Sequoiadendron giganteum* (giant redwood)**			
PRF family	**PRF types the tree species forms**	**Whether bats exploit them**	**Minimum roost entrance dimensions**
DECAY PRF	----	N/A	N/A
DAMAGE PRF	Lifting-bark	✓	Height: 200 Width: 500
ASSOCIATION PRF	----	N/A	N/A
Minimum DBH of roost trees		1,890 mm (189 cm)	
Minimum DPH at the roost entrance		1800 mm (180 cm)	
Height ranges of roosts recorded		2 m	
Season in which bat occupancy has been recorded in PRF on this tree species	**Winter**	----	
	Spring flux	----	
	Pregnancy	----	
	Nursery	----	
	Mating	----	
	Autumn / winter flux	✓	
Bat species recorded	*Pipistrellus pipistrellus*		

4.3 Diameter at Breast Height (DBH)

The Diameter at Breast Height (DBH) data currently being used to guide conservation effort is biased to maternity roosts alone. Table 30 provides a more realistic picture of the true situation. However, it should be borne in mind that the season simply relates to the time of year and not the purpose for which the roost is occupied; for example, not all roosts recorded in the pregnancy period are occupied by pregnant females, many more are occupied by individual bats.

Note: The Database currently lacks data for *Myotis alcathoe, M. Brandtii, M. mystacinus* and *Nyctalus leisleri*.

Table 30. Seasonal roost DBH ranges exhibited by individual species in data held on The Database on 11th July 2016.

SPECIES	SEASON	DBH RANGE						
		< 10 cm	10.01 - 20 cm	20.01- 30 cm	30.01- 40 cm	40.01- 50 cm	50.01- 100 cm	> 100 cm
Barbastella barbastellus	*Winter*							✓
	Spring flux		✓	✓	✓			✓
	Pregnancy						✓	
	Nursery							✓
	Mating		✓					
	Autumn flux		✓	✓	✓	✓		
Myotis bechsteinii	*Pregnancy*					✓		
	Nursery			✓	✓	✓	✓	
	Mating				✓	✓		
Myotis daubentonii	*Spring flux*		✓	✓	✓			
	Pregnancy		✓	✓	✓		✓	✓
	Nursery		✓	✓	✓		✓	✓
	Mating		✓	✓				✓
	Autumn flux			✓				
Myotis nattereri	*Winter*		✓				✓	
	Spring flux		✓	✓	✓	✓	✓	✓
	Pregnancy	✓	✓	✓	✓	✓		
	Nursery	✓	✓	✓	✓	✓	✓	
	Mating		✓	✓	✓		✓	
	Autumn flux		✓	✓	✓	✓	✓	
Nyctalus noctula	*Winter*			✓	✓	✓	✓	✓
	Spring flux		✓	✓	✓		✓	✓
	Pregnancy			✓		✓	✓	✓
	Nursery					✓	✓	✓
	Mating		✓	✓			✓	
	Autumn flux			✓	✓	✓	✓	✓
Pipistrellus nathusii	*Autumn flux*				✓			

SPECIES	SEASON	DBH RANGE						
		< 10 cm	10.01 - 20 cm	20.01- 30 cm	30.01- 40 cm	40.01- 50 cm	50.01- 100 cm	> 100 cm
Pipistrellus pipistrellus	*Winter*		✓		✓		✓	✓
	Spring flux	✓		✓				
	Pregnancy			✓	✓		✓	✓
	Nursery		✓				✓	✓
	Mating						✓	✓
	Autumn flux	✓	✓		✓		✓	✓
Pipistrellus pygmaeus	*Winter*				✓			
	Spring flux		✓	✓	✓		✓	
	Pregnancy			✓	✓	✓	✓	
	Nursery						✓	
	Mating						✓	
	Autumn flux					✓		
Plecotus auritus	*Winter*	✓	✓	✓	✓	✓	✓	
	Spring flux		✓	✓	✓	✓	✓	✓
	Pregnancy		✓	✓	✓		✓	
	Nursery		✓	✓	✓		✓	
	Mating		✓	✓	✓		✓	
	Autumn flux		✓	✓	✓	✓	✓	✓
Rhinolophus hipposideros	*Pregnancy*							✓

4.4 Number of roosts on an individual tree

Of the 281 roost records held on The Database on 11th July 2016:-

- 262, equating to 93% of all roost trees, relate to a single occupied feature that was the only PRF on the tree;
- Seven, equating to 2.4% of all roost trees, comprise a single occupied feature that was one of two PRF on the same tree;
- Two, equating to 0.9% of all roost trees, comprise a single occupied feature that was one of three PRF on the same tree;
- Five, equating to 1.7% of all roost trees, comprise two occupied features that were the only two PRF on the tree;
- Two, equating to 0.9% of all roost trees, comprise two occupied features of an overall three present;
- One, equating to 0.3% of all roost trees, comprises two occupied features on a tree that held an overall six PRF; and
- One, equating to 0.3% of all roost trees, comprises three occupied features on a tree that held an overall three PRF.

No roost trees encompass more than three occupied features on the same tree.

5. THE BATS

5.1 Introduction

Each of the individual bat species accounts comprises:-

- **Seasonal occupancy** – In which months and seasons The Database has records of the species occupying trees;
- **Roost heights** – At what heights the species has been recorded roosting in trees;
- **DBH of roost trees** – The diameter at breast height ranges the roost trees recorded span;
- **PRF type** – The PRF types the bat species are proven to exploit;
- **Minimum entrance dimensions** – Looking at the entrance height and width, and the internal width, what the minimum dimension is on any one plane beyond which each species has been recorded; and
- **Roost-sharing** – Which bat species share the same PRF as either a time-share (i.e. two or more species exploit the same roost but not on the same day), or cohabitation (i.e. the species have been recorded in the same roost on the same day).

Caveats

It is important to bear in mind that these accounts relate purely to records held on The Database. As a result, it is more helpful to focus on the positive results than the negatives at this early stage. For example, the presence of *Myotis nattereri* in trees year-round is something I had not anticipated, but we can say with confidence that despite The Database not holding any records of *Barbastella barbastellus* occupying trees in February, June, July and September, the species certainly does occupy trees year-round.

As far as the species that are missing are concerned; *Myotis alcathoe*, *M. Brandtii*, *M. mystacinus* and *Nyctalus leisleri*, for the most part this is a case of roosts being discovered, but for whatever reason not being recorded, or being recorded but the records not being donated to The Database. This is unfortunate, but should not be perceived as anything untoward. The only negative I would like to identify at this stage is *Nyctalus leisleri*; I think this species is a good deal rarer in England than perhaps we understand.

Finally, where the numbers of bats are given, the lack of space and the need to simplify things across species has meant that numbers are stratified into only four divisions 1, 2, 3 and more than three (presented as > 3). In practice, this works very well due to the wide ranges of colony sizes between species and in different seasons, and the wide variations in the internal dimensions of PRF even of the same type. However, do be aware that Daubenton's bat, Leisler's bat and noctule may form all male aggregations in the pregnancy and nursery seasons, with well into double features of bats occupying the same tree (see Nyholm 1965, Encarnação *et al.* 2005, Dietz *et al.* 2011, August *et al.* 2014, Dietz & Kiefer 2016).

5.2 Barbastelle *Barbastella barbastellus*

Seasonal occupancy – Barbastelle

The seasons and individual months barbastelles have been recorded roosting in trees is set out at Table 31.

Table 31. The seasons and months for which The Database holds records of the barbastelle *Barbastella barbastellus* occupying trees to date; 11th July 2016.

Barbastelle *Barbastella barbastellus*												
Season	*Winter*		*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*	
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees	✓		✓	✓	✓			✓		✓	✓	✓

DBH ranges of roost trees – Barbastelle

The DBH ranges of trees holding barbastelle roosts of are set out at Table 32.

Table 32. The DBH ranges of barbastelle *Barbastella barbastellus* roost records held on The Database to date; 11th July 2016.

Barbastelle *Barbastella barbastellus*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats				1,596 mm (159.6 cm)		
3 bats						
2 bats						
1 bat	1,530 mm (153 cm)	190-1,530 mm (19-153 cm)	781 mm (78.1 cm)		195 mm (19.5 cm)	164-310 mm (16.4-31 cm)

Roost heights – Barbastelle

The heights at which barbastelle roosts have been recorded in the six seasons are set out at Table 33. Figures relate to the number of bats present.

Table 33. The heights of barbastelle *Barbastella barbastellus* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

		Barbastella barbastellus					
Canopy-Layer	9.01 – 10 m				>3		
	8.01 – 9 m						
	7.01 – 8 m						
	6.01 – 7 m						
	5.01 – 6 m						
Shrub-layer	4.01 – 5 m						
	3.01 – 4 m						
	2.01 – 3 m		1				1
Field-layer	1.01 – 2 m		1	1		1	1
	0.51 – 1 m	1	1				1
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		*Winter* **Jan / Feb**	*Spring flux* **Mar / Apr**	*Pregnancy* **May / Jun**	*Nursery* **Jul / Aug**	*Mating* **Sep / Oct**	*Autumn flux* **Nov / Dec**

PRF type – Barbastelle

The PRF types occupied by barbastelles in different seasons are set out at Table 34.

Table 34. Records of PRF types occupied by the barbastelle *Barbastella barbastellus* in different seasons held on The Database to date; 11th July 2016.

Barbastelle *Barbastella barbastellus*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes						
	Knot-holes						
	Pruning-cuts						
	Tear-outs						
	Compression-forks						
	Wounds						
	Cankers						
	Butt-rots						
Damage	Hazard-beams						
	Frost-cracks		✓			✓	✓
	Subsidence/shearing						
	Lightning-strikes				✓		
	Desiccation-fissures	✓	✓				
	Transverse-snaps						
	Welds						
	Lifting-bark		✓	✓			
Association	Fluting						
	Ivy						

Roost sharing – Barbastelle

The barbastelle has been recorded occupying a roost that is also occupied at different times by Natterer's bat, Nathusius' pipistrelle, common pipistrelle and soprano pipistrelle.

To date, The Database does not hold any records of the barbastelle cohabiting with any other species.

Minimum entrance dimension – Barbastelle

An average-sized adult barbastelle bat has the following dimensions:-

- Length (top of head to rump) – 67.5 mm;
- Width (wrist to wrist across shoulders) – 34 mm; and
- Depth (condylobasal; nose to back of skull) – 19.4 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 35. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 35. The minimum dimension a barbastelle *Barbastella barbastellus* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Barbastelle *Barbastella barbastellus*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	15 mm	----	15 mm	25 mm	20 mm	----	----	20 mm	----	40 mm	15 mm	15 mm

5.3 Bechstein's bat *Myotis bechsteinii*

Seasonal occupancy – Bechstein's bat

The seasons and individual months Bechstein's bat has been recorded roosting in trees is set out at Table 36.

Table 36. The seasons and months for which The Database holds records of Bechstein's bat *Myotis bechsteinii* occupying trees to date; 11th July 2016.

Bechstein's bat *Myotis bechsteinii*												
Season	*Winter*			*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees				✓	✓	✓	✓	✓	✓			

DBH ranges of roost trees – Bechstein's bat

The DBH ranges of trees holding Bechstein's bat roosts are set out at Table 37.

Table 37. The DBH ranges of Bechstein's bat *Myotis bechsteinii* roost records held on The Database to date; 11th July 2016.

Bechstein's bat *Myotis bechsteinii*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats				253-810 mm (25.3-81 cm)		
3 bats				279 mm (27.9 cm)	343 mm (34.3 cm)	
2 bats						
1 bat			435-450 mm (43.5-45 cm)	343 mm (34.3 cm)	450 mm (45 cm)	

Roost heights – Bechstein's bat

The heights at which Bechstein's bat roosts have been recorded in the six seasons are set out at Table 38. Figures relate to the number of bats present.

Table 38. The heights of Bechstein's bat *Myotis bechsteinii* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

Bechstein's bat *Myotis bechsteinii*							
Canopy-layer	7.01 – 8 m				>3		
	6.01 – 7 m				>3		
	5.01 – 6 m				>3		
Shrub-layer	4.01 – 5 m				>3		
	3.01 – 4 m				>3		
	2.01 – 3 m			1	1-3	1-3	
Field-layer	1.01 – 2 m			?	?		
	0.51 – 1 m						
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux	Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***	***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Bechstein's bat

The PRF types occupied by Bechstein's bat in different seasons are set out at Table 39.

Table 39. Records of PRF types occupied by Bechstein's bat *Myotis bechsteinii* in different seasons held on The Database to date; 11th July 2016.

Bechstein's bat *Myotis bechsteinii*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes				✓		
	Knot-holes			✓	✓	✓	
	Pruning-cuts						
	Tear-outs						
	Compression-forks						
	Wounds				✓		
	Cankers						
	Butt-rots						
Damage	Hazard-beams						
	Frost-cracks			✓			
	Subsidence/shearing						
	Lightning-strikes						
	Desiccation-fissures						
	Transverse-snaps						
	Welds						
	Lifting-bark						
Association	Fluting						
	Ivy						

Roost sharing – Bechstein's bat

Bechstein's bat has been recorded occupying a roost that is also occupied at different times by Natterer's bat.

To date, The Database does not hold any records of Bechstein's bat cohabiting with any other species.

Minimum entrance dimension – Bechstein's bat

An average-sized adult Bechstein's bat has the following dimensions:-

- Length (top of head to rump) – 69.5 mm;
- Width (wrist to wrist across shoulders) – 35.5 mm; and
- Depth (condylobasal; nose to back of skull) – 24.1 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 40. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 40. The minimum dimension a Bechstein's bat *Myotis bechsteinii* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Bechstein's bat *Myotis bechsteinii*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	----	----	----	----	13 mm	70 mm	65 mm	20 mm	65 mm	----	----	----

5.4 Daubenton's bat *Myotis daubentonii*

Seasonal occupancy – Daubenton's bat

The seasons and individual months Daubenton's bat has been recorded roosting in trees is set out at Table 41.

Table 41. The seasons and months for which The Database holds records of Daubenton's bat *Myotis daubentonii* occupying trees to date; 11th July 2016.

Daubenton's bat *Myotis daubentonii*													
Season		*Winter*		*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*	
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees			✓	✓	✓	✓	✓	✓	✓	✓	✓	

DBH ranges of roost trees – Daubenton's bat

The DBH ranges of trees holding Daubenton's bat roosts are set out at Table 42.

Table 42. The DBH ranges of Daubenton's bat *Myotis daubentonii* roost records held on The Database to date; 11th July 2016.

Daubenton's bat *Myotis daubentonii*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats			250-640 mm (25-64 cm)	322-1,203 mm (32.2-120.3 cm)		
3 bats				500 mm (50 cm)		
2 bats		262-300 mm (26.2-30 cm)	199-640 mm (19.9-64 cm)	199-897 mm (19.9-89.7 cm)	280 mm (28 cm)	
1 bat		199-387 mm (19.9-38.7 cm)		171-262 mm (17.1-26.2 cm)	199-300 mm (19.9-30 cm)	262 mm (26.2 cm)

Roost heights – Daubenton's bat

The heights at which Daubenton's bat roosts have been recorded in the six seasons are set out at Table 43. Figures relate to the number of bats present.

Table 43. The heights of Daubenton's bat *Myotis daubentonii* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

		Daubenton's bat *Myotis daubentonii*					
Canopy-layer	19.01 – 20 m			>3			
	18.01 – 19 m						
	17.01 – 18 m						
	16.01 – 17 m						
	15.01 – 16 m						
	14.01 – 15 m						
	13.01 – 14 m						
	12.01 – 13 m			3			
	11.01 – 12 m						
	10.01 – 11 m			2			
	9.01 – 10 m			>3			
	8.01 – 9 m	2 bats		>3			
	7.01 – 8 m			>3			
	6.01 – 7 m						
	5.01 – 6 m		>3	>3	?		
Shrub-layer	4.01 – 5 m		?				
	3.01 – 4 m	2	>3	>3	1	1	
	2.01 – 3 m	1	2	1-2	1-2		
Field-layer	1.01 – 2 m	1	>3	?	1		
	0.51 – 1 m	?	2				
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux	Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***	***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Daubenton's bat

The PRF types occupied by Daubenton's bat in different seasons are set out at Table 44.

Table 44. Records of PRF types occupied by Daubenton's bat *Myotis daubentonii* in different seasons held on The Database to date; 11th July 2016.

Daubenton's bat *Myotis daubentonii*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes				✓		
	Knot-holes			✓	✓	✓	
	Pruning-cuts						
	Tear-outs		✓	✓		✓	
	Compression-forks						
	Wounds		✓	✓	✓	✓	✓
	Cankers			✓		✓	
	Butt-rots			✓			
Damage	Hazard-beams				✓		
	Frost-cracks		✓				
	Subsidence/shearing						
	Lightning-strikes						
	Desiccation-fissures						
	Transverse-snaps						
	Welds						
	Lifting-bark						
Association	Fluting						
	Ivy						

Roost sharing – Daubenton's bat

Daubenton's bat has been recorded occupying roosts that are also occupied at different times by Natterer's bat and noctule.

To date, The Database holds records of Daubenton's bat cohabiting with Natterer's bat, with the noctule, and with the soprano pipistrelle.

Minimum entrance dimension – Daubenton's bat

An average-sized adult Daubenton's bat has the following dimensions:-

- Length (top of head to rump) – 72.5 mm;
- Width (wrist to wrist across shoulders) – 37 mm; and
- Depth (condylobasal; nose to back of skull) – 20.1 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 45. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 45. The minimum dimension Daubenton's bat *Myotis daubentonii* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Daubenton's bat *Myotis daubentonii*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	----	----	9 mm	15 mm	40 mm	15 mm	28 mm	12 mm	10 mm	35 mm	60 mm	----

5.5 Natterer's bat *Myotis nattereri*

Seasonal occupancy – Natterer's bat

The seasons and individual months Natterer's bat has been recorded roosting in trees is set out at Table 46.

Table 46. The seasons and months for which The Database holds records of Natterer's bat *Myotis nattereri* occupying trees to date; 11th July 2016.

Natterer's bat *Myotis nattereri*												
Season	*Winter*			*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

DBH ranges of roost trees – Natterer's bat

The DBH ranges of trees holding Natterer's bat roosts are set out at Table 47.

Table 47. The DBH ranges of Natterer's bat Natterer's bat *Myotis nattereri* roost records held on The Database to date; 11th July 2016.

Natterer's bat *Myotis nattereri*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats			450-500 mm (45-50 cm)	500-769 mm (50-76.9 cm)	673 mm (67.3 cm)	
3 bats						
2 bats			334 mm (33.4 cm)			262 mm (26.2 cm)
1 bat	154-758 mm (15.4-75.8 cm)	101-768 mm (10.1-76.8 cm)	86-340 mm (8.6-34 cm)	101-500 mm (10.1-50 cm)	101-358 mm (10.1-35.8 cm)	101-537 mm (10.1-53.7 cm)

Roost heights – Natterer's bat

The heights at which Natterer's bat roosts have been recorded in the six seasons are set out at Table 48. Figures relate to the number of bats present.

Table 48. The heights of Natterer's bat *Myotis nattereri* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

Natterer's bat *Myotis nattereri*							
Canopy-layer	12.01 – 13 m				>3		
	11.01 – 12 m						
	10.01 – 11 m				1		
	9.01 – 10 m			>3			
	8.01 – 9 m				>3		
	7.01 – 8 m						
	6.01 – 7 m						
	5.01 – 6 m		1	>3	1		
Shrub-layer	4.01 – 5 m		1	1			
	3.01 – 4 m		1	>3	1	1	1-2
	2.01 – 3 m	1	>3	1	1	>3	1
Field-layer	1.01 – 2 m	1	1	1	1	1	1
	0.51 – 1 m	1		1		1	
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux	Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***	***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Natterer's bat

The PRF types occupied by Natterer's bat in different seasons are set out at Table 49.

Table 49. Records of PRF types occupied by Natterer's bat *Myotis nattereri* in different seasons held on The Database to date; 11th July 2016.

Natterer's bat *Myotis nattereri*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes			✓	✓		
	Knot-holes					✓	
	Pruning-cuts						
	Tear-outs		✓		✓		✓
	Compression-forks						
	Wounds	✓	✓	✓	✓	✓	✓
	Cankers	✓			✓		
	Butt-rots						
Damage	Hazard-beams					✓	
	Frost-cracks	✓	✓	✓	✓	✓	✓
	Subsidence/shearing		✓		✓		
	Lightning-strikes		✓				
	Desiccation-fissures						
	Transverse-snaps						
	Welds						
	Lifting-bark						
Association	Fluting		✓				
	Ivy						

Roost sharing – Natterer's bat

Natterer's bat has been recorded occupying roosts that are also occupied at different times by Bechstein's bat, Daubenton's bat, common pipistrelle, soprano pipistrelle and brown long-eared bat.

To date, The Database holds an individual record of Natterer's bat cohabiting with Daubenton's bat.

Minimum entrance dimension – Natterer's bat

An average-sized adult Natterer's bat has the following dimensions:-

- Length (top of head to rump) – 65 mm;
- Width (wrist to wrist across shoulders) – 32.5 mm; and
- Depth (condylobasal; nose to back of skull) – 21.6 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 50. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 50. The minimum dimension Natterer's bat *Myotis nattereri* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Natterer's bat *Myotis nattereri*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	27 mm	20 mm	16 mm	12 mm	20 mm	11 mm	26 mm	18 mm	30 mm	15 mm	16 mm	20 mm

5.6 Noctule *Nyctalus noctula*

Seasonal occupancy – Noctule

The seasons and individual months the noctule has been recorded roosting in trees is set out at Table 51.

Table 51. The seasons and months for which The Database holds records of the noctule *Nyctalus noctula* occupying trees to date; 11th July 2016.

Noctule *Nyctalus noctula*												
Season	*Winter*		*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*	
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

DBH of roost trees – Noctule

The DBH of trees holding noctule roosts are set out at Table 52.

Table 52. The DBH of noctule *Nyctalus noctula* roost records held on The Database to date; 11th July 2016.

Noctule *Nyctalus noctula*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats	650-1,170 mm (65-117 cm)	750-1,180 mm (75-118 cm)	495-1,160 mm (49.5-116 cm)	440-750 mm (44-75 cm)		272-770 mm (27.2-77 cm)
3 bats						1,110 mm (111 cm)
2 bats	1,100 mm (110 cm)		1,180 mm (118 cm)		272 mm (27.2 cm)	272 mm (27.2 cm)
1 bat	222-796 mm (22.2-79.6 cm)	159-1,110 mm (15.9-111 cm)	438-1,110 mm (43.8-111 cm)	824-1,500 mm (82.4-150 cm)	159-618 mm (15.9-61.8 cm)	250-436 mm (25-43.6 cm)

Roost heights – Noctule

The heights at which noctule roosts have been recorded in the six seasons are set out at Table 53. Figures relate to the number of bats present.

Table 53. The heights of noctule *Nyctalus noctula* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

	Noctule *Nyctalus noctula*						
Canopy-layer	19.01 – 20 m	1					
	18.01 – 19 m						
	17.01 – 18 m						
	16.01 – 17 m						
	15.01 – 16 m						
	14.01 – 15 m						
	13.01 – 14 m			>3			
	12.01 – 13 m	2	>3	1			3
	11.01 – 12 m	1	1				
	10.01 – 11 m						
	9.01 – 10 m						
	8.01 – 9 m		>3	>3			
	7.01 – 8 m		>3	2	>3		
	6.01 – 7 m			>3	>3	1	
	5.01 – 6 m	>3			1		>3
Shrub-layer	4.01 – 5 m	>3		>3	?		
	3.01 – 4 m	1		1			
	2.01 – 3 m	1	1	?		1	1
Field-layer	1.01 – 2 m	1	1			1-2	>3
	0.51 – 1 m						
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux	Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***	***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Noctule

The PRF types occupied by the noctule in different seasons are set out at Table 54.

Table 54. Records of PRF types occupied by the noctule *Nyctalus noctula* in different seasons held on The Database to date; 11th July 2016.

Noctule *Nyctalus noctula*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes	✓	✓	✓	✓		✓
	Knot-holes		✓	✓			
	Pruning-cuts			✓	✓		
	Tear-outs	✓	✓	✓			✓
	Compression-forks						
	Wounds	✓	✓		✓		✓
	Cankers						
	Butt-rots						
Damage	Hazard-beams	✓	✓			✓	
	Frost-cracks	✓	✓			✓	✓
	Subsidence/shearing			✓			
	Lightning-strikes						
	Desiccation-fissures						
	Transverse-snaps						
	Welds		✓	✓	✓		
	Lifting-bark	✓					
Association	Fluting	✓					
	Ivy						

Roost sharing – Noctule

The noctule has been recorded occupying roosts that are also occupied at different times by Daubenton's bat and brown long-eared bat.

To date, The Database holds an individual record of a noctule cohabiting with a colony of Daubenton's bats.

Minimum entrance dimension – Noctule

An average-sized adult noctule has the following dimensions:-

- Length (top of head to rump) – 101 mm;
- Width (wrist to wrist across shoulders) – 47 mm; and
- Depth (condylobasal; nose to back of skull) – 11.2 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 55. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 55. The minimum dimension *Nyctalus noctula* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Noctule *Nyctalus noctula*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	18 mm	25 mm	18 mm	50 mm	50 mm	45 mm	55 mm	12 mm	55 mm	25 mm	16 mm	18 mm

5.7 Nathusius' pipistrelle *Pipistrellus nathusii*

Seasonal occupancy – Nathusius' pipistrelle

The seasons and individual months Nathusius' pipistrelle has been recorded roosting in trees is set out at Table 56.

Table 56. The seasons and months for which The Database holds records of Nathusius' pipistrelle *Pipistrellus nathusii* occupying trees to date; 11th July 2016.

Nathusius' pipistrelle *Pipistrellus nathusii*												
Season			*Winter*			*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*			*Autumn-flux*	
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees												✓

DBH of roost trees – Nathusius' pipistrelle

The DBH of trees holding Nathusius' pipistrelle roosts are set out at Table 57.

Table 57. The DBH of Nathusius' pipistrelle *Pipistrellus nathusii* roost records held on The Database to date; 11th July 2016.

Nathusius' pipistrelle *Pipistrellus nathusii*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats						
3 bats						
2 bats						
1 bat						310 mm (31 cm)

Roost heights – Nathusius' pipistrelle

The heights at which Nathusius' pipistrelle roosts have been recorded in the six seasons are set out at Table 58. Figures relate to the number of bats present.

Table 58. The heights of Nathusius' pipistrelle *Pipistrellus nathusii* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

Nathusius' pipistrelle *Pipistrellus nathusii*							
Field-layer	1.01 – 2 m						1
	0.51 – 1 m						
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux	Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***	***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Nathusius' pipistrelle

The PRF types occupied by Nathusius' pipistrelle in different seasons are set out at Table 59.

Table 59. Records of PRF types occupied by Nathusius' pipistrelle *Pipistrellus nathusii* in different seasons held on The Database to date; 11th July 2016.

Nathusius' pipistrelle *Pipistrellus nathusii*		Season					
PRF group	PRF type	*Winter*	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes						
	Knot-holes						
	Pruning-cuts						
	Tear-outs						
	Compression-forks						
	Wounds						
	Cankers						
	Butt-rots						
Damage	Hazard-beams						
	Frost-cracks						✓
	Subsidence/shearing						
	Lightning-strikes						
	Desiccation-fissures						
Damage	Transverse-snaps						
	Welds						
	Lifting-bark						
Association	Fluting						
	Ivy						

Roost sharing – Nathusius' pipistrelle

Nathusius' pipistrelle has been recorded occupying a roost that is also occupied at different times by the barbastelle, Natterer's bat, the common pipistrelle and the soprano pipistrelle.

To date, The Database does not hold any records of Nathusius' pipistrelle cohabiting with any other species.

Minimum entrance dimension – Nathusius' pipistrelle

An average-sized adult Nathusius' pipistrelle has the following dimensions:-

- Length (top of head to rump) – 73.5 mm;
- Width (wrist to wrist across shoulders) – 37 mm; and
- Depth (condylobasal; nose to back of skull) – 19.2 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 60. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 60. The minimum dimension Nathusius' pipistrelle *Pipistrellus nathusii* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Nathusius' pipistrelle *Pipistrellus nathusii*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	----	----	----	----	----	----	----	----	----	----	----	20 mm

5.8 Common pipistrelle *Pipistrellus pipistrellus*

Seasonal occupancy – Common pipistrelle

The seasons and individual months the common pipistrelle has been recorded roosting in trees is set out at Table 61.

Table 61. The seasons and months for which The Database holds records of the common pipistrelle *Pipistrellus pipistrellus* occupying trees to date; 11th July 2016.

Common pipistrelle *Pipistrellus pipistrellus*													
Season	*Winter*			*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*			*Autumn-flux*
MONTH	January	February	March	April	May	June	July	August	September	October	November	December	
Species present in trees	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	

DBH range of roost trees – Common pipistrelle

The DBH range of trees holding common pipistrelle is set out at Table 62.

Table 62. The DBH of common pipistrelle *Pipistrellus pipistrellus* roost records held on The Database to date; 11th July 2016.

Common pipistrelle *Pipistrellus pipistrellus*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats	553 mm (55.3 cm)					124 mm (12.4 cm)
3 bats	----					----
2 bats	114-1,180 mm (11.4-118 cm)					124-1,495 mm (12.4-149.5 cm)
1 bat	110-1,170 mm (11-117 cm)	96-238 mm (9.6-23.8 cm)	288-45,120 mm (28.8-451.2 cm)	114-45,120 mm (11.4-451.2 cm)	900-1,500 mm (90-150 cm)	95-1890 mm (9.5-189 cm)

Roost heights – Common pipistrelle

The heights at which common pipistrelle roosts have been recorded in the six seasons are set out at Table 63. Figures relate to the number of bats present.

Table 63. The heights of common pipistrelle *Pipistrellus pipistrellus* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

Common pipistrelle *Pipistrellus pipistrellus*							
Canopy-layer	10.01 – 11 m				1		1
	9.01 – 10 m						
	8.01 – 9 m						
	7.01 – 8 m	2		1			
	6.01 – 7 m					1	
	5.01 – 6 m						1-2
Shrub-layer	4.01 – 5 m			1			
	3.01 – 4 m	>3				?	
	2.01 – 3 m	1		1	1	?	
Field-layer	1.01 – 2 m	1-2	1		1	?	1
	0.51 – 1 m	1					>3
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux	Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***	***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Common pipistrelle

The PRF types occupied by the common pipistrelle in different seasons are set out at Table 64.

Table 64. Records of PRF types occupied by the common pipistrelle *Pipistrellus pipistrellus* in different seasons held on The Database to date; 11th July 2016.

Common pipistrelle *Pipistrellus pipistrellus*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes						
	Knot-holes						
	Pruning-cuts						
	Tear-outs						
	Compression-forks						
	Wounds	✓				✓	✓
	Cankers	✓		✓	✓		
	Butt-rots						✓
Damage	Hazard-beams	✓		✓	✓	✓	✓
	Frost-cracks	✓	✓				✓
	Subsidence/shearing						
	Lightning-strikes						
	Desiccation-fissures	✓					
	Transverse-snaps	✓					✓
	Welds						
	Lifting-bark			✓			✓
Association	Fluting	✓					
	Ivy						

Roost sharing – Common pipistrelle

The common pipistrelle has been recorded occupying roosts that are also occupied at different times by the barbastelle, Natterer's bat, Nathusius' pipistrelle and the soprano pipistrelle.

To date, The Database holds an individual record of the common pipistrelle cohabiting with the soprano pipistrelle.

Minimum entrance dimension – Common pipistrelle

An average-sized adult common pipistrelle has the following dimensions:-

- Length (top of head to rump) – 57 mm;
- Width (wrist to wrist across shoulders) – 30 mm; and
- Depth (condylobasal; nose to back of skull) – 16.4 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 65. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 65. The minimum dimension a common pipistrelle *Pipistrellus pipistrellus* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Common pipistrelle *Pipistrellus pipistrellus*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	10 mm	15 mm	----	20 mm	50 mm	42 mm	20 mm	----	30 mm	13 mm	20 mm	15 mm

5.9 Soprano pipistrelle *Pipistrellus pygmaeus*

Seasonal occupancy – Soprano pipistrelle

The seasons and individual months the soprano pipistrelle has been recorded roosting in trees is set out at Table 66.

Table 66. The seasons and months for which The Database holds records of the soprano pipistrelle *Pipistrellus pygmaeus* occupying trees to date; 11th July 2016.

Soprano pipistrelle *Pipistrellus pygmaeus*												
Season	*Winter*			*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees	✓	✓	✓	✓	✓	✓		✓		✓		✓

DBH range of roost trees – Soprano pipistrelle

The DBH range of trees holding soprano pipistrelle roosts are set out at Table 67.

Table 67. The DBH of soprano pipistrelle *Pipistrellus pygmaeus* roost records held on The Database to date; 11th July 2016.

Soprano pipistrelle *Pipistrellus pygmaeus*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats						
3 bats						
2 bats				800 mm (80 cm)		
1 bat	310 mm (31 cm)	180-310 mm (18-31 cm)	228-585 mm (22.8-58.5 cm)			422 mm (42.2 cm)

Roost heights – Soprano pipistrelle

The heights at which soprano pipistrelle roosts have been recorded in the six seasons are set out at Table 68. Figures relate to the number of bats present.

Table 68. The heights of soprano pipistrelle *Pipistrellus pygmaeus* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

Soprano pipistrelle *Pipistrellus pygmaeus*								
Canopy-layer	7.01 – 8 m				1	2		
	6.01 – 7 m							
	5.01 – 6 m							
Shrub-layer	4.01 – 5 m				?			
	3.01 – 4 m						?	
	2.01 – 3 m				1		?	
Field-layer	1.01 – 2 m	1	1		1		1	1
	0.51 – 1 m							
Ground-layer	0 – 0.5 m							
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux		Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***		***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Soprano pipistrelle

The PRF types occupied by the soprano pipistrelle in different seasons are set out at Table 69.

Table 69. Records of PRF types occupied by soprano pipistrelle *Pipistrellus pygmaeus* in different seasons held on The Database to date; 11th July 2016.

Soprano pipistrelle *Pipistrellus pygmaeus*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes		✓				
	Knot-holes			✓			
	Pruning-cuts						
	Tear-outs						
	Compression-forks						
	Wounds			✓		✓	
	Cankers			✓			
	Butt-rots						
Damage	Hazard-beams			✓	✓		
	Frost-cracks	✓	✓				
	Subsidence/shearing						
	Lightning-strikes						
	Desiccation-fissures						✓
	Transverse-snaps						
	Welds						
	Lifting-bark			✓			
Association	Fluting						
	Ivy						

Roost sharing – Soprano pipistrelle

The soprano pipistrelle has been recorded occupying roosts that are also occupied at different times by the barbastelle, Natterer's bat, Nathusius' pipistrelle and the common pipistrelle.

To date, The Database holds an individual record of the soprano pipistrelle cohabiting with the common pipistrelle.

Minimum entrance dimension – Soprano pipistrelle

An average-sized adult soprano pipistrelle has the following dimensions:-

- Length (top of head to rump) – 57 mm;
- Width (wrist to wrist across shoulders) – 28 mm; and
- Depth (condylobasal; nose to back of skull) – 16.4 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 70. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 70. The minimum dimension a soprano pipistrelle *Pipistrellus pygmaeus* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Soprano pipistrelle *Pipistrellus pygmaeus*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	20 mm	20 mm	20 mm	15 mm	17 mm	20 mm	----	50 mm	----	13 mm	----	12 mm

5.10 Brown long-eared bat *Plecotus auritus*

Seasonal occupancy – Brown long-eared bat

The seasons and individual months the brown long-eared bat has been recorded roosting in trees is set out at Table 71.

Table 71. The seasons and months for which The Database holds records of the brown long-eared bat *Plecotus auritus* occupying trees to date; 11th July 2016.

Brown long-eared bat *Plecotus auritus*												
Season	*Winter*		*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*	
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

DBH ranges of roost trees – Brown long-eared bat

The DBH ranges of trees holding brown long-eared bat roosts are set out at Table 72.

Table 72. The DBH ranges of brown long-eared bat *Plecotus auritus* roost records.

Brown long-eared bat *Plecotus auritus*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats		341 mm (34.1 cm)	495-1,160 mm (49.5-116 cm)	440-750 mm (44-75 cm)		277-770 mm (27.2-77 cm)
3 bats		174-217 mm (17.4-21.7 cm)	158-262 mm (15.8-26.2 cm)			1,110 mm (111 cm)
2 bats	577 mm (57.7 cm)	190-2,050 mm (19-205 cm)			272 mm (27.2 cm)	272 mm (27.2 mm)
1 bat	86-592 mm (8.6-59.2 cm)	86-4,130 mm (8.6-413 cm)	141-677 mm (14.1-67.7 cm)	824-1,500 mm (82.4-150 cm)	159-618 mm (15.9-61.8 cm)	250-436 mm (25-43.6 cm)

Roost heights – Brown long-eared bat

The heights at which brown long-eared bat roosts have been recorded in the six seasons are set out at Table 73. Figures relate to the number of bats present.

Table 73. The heights of brown long-eared bat *Plecotus auritus* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

Brown long-eared bat *Plecotus auritus*							
Canopy-layer	17.01 – 18 m			1			
	16.01 – 17 m						
	15.01 – 16 m						
	14.01 – 15 m						
	13.01 – 14 m						
	12.01 – 13 m						
	11.01 – 12 m						
	10.01 – 11 m						
	9.01 – 10 m						
	8.01 – 9 m						
	7.01 – 8 m						
	6.01 – 7 m					1	
	5.01 – 6 m		1		>3		1
Shrub-layer	4.01 – 5 m		1		>3	1-2	
	3.01 – 4 m	1	1	2		2	1
	2.01 – 3 m	1	1-3	>3	>3	>3	1-2
Field-layer	1.01 – 2 m	1-2	1-3	>3	>3	>3	1
	0.51 – 1 m	1	>3		1		1
Ground-layer	0 – 0.5 m		1				1
Number of bats recorded at different heights (m) in different seasons		Winter ***Jan / Feb***	Spring flux ***Mar / Apr***	Pregnancy ***May / Jun***	Nursery ***Jul / Aug***	Mating ***Sep / Oct***	Autumn flux ***Nov / Dec***

PRF type – Brown long-eared bat

The PRF types occupied by the brown long-eared bat *Plecotus auritus* in different seasons are set out at Table 74.

Table 74. Records of PRF types occupied by the brown long-eared bat *Plecotus auritus* in different seasons held on The Database to date; 11th July 2016.

Brown long-eared bat *Plecotus auritus*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes			✓	✓	✓	
	Knot-holes	✓			✓		
	Pruning-cuts						
	Tear-outs	✓	✓				
	Compression-forks						
	Wounds	✓	✓	✓		✓	✓
	Cankers	✓		✓			
	Butt-rots						
Damage	Hazard-beams				✓	✓	✓
	Frost-cracks	✓	✓	✓	✓	✓	✓
	Subsidence/shearing		✓	✓			
	Lightning-strikes		✓		✓		✓
	Desiccation-fissures						
	Transverse-snaps		✓				
	Welds			✓			
	Lifting-bark			✓			✓
Association	Fluting		✓				
	Ivy						

Roost sharing – Brown long-eared bat

The brown long-eared bat has been recorded occupying roosts that are also occupied at different times by Natterer's bat and the noctule.

To date, The Database holds no records of the brown long-eared bat cohabiting with any other bat species (although there is a record of an individual brown long-eared bat cohabiting with an individual grey squirrel *Sciurus carolinensis*).

Minimum entrance dimension – Brown long-eared bat

An average-sized adult brown long-eared bat has the following dimensions:-

- Length (top of head to rump) – 63 mm;
- Width (wrist to wrist across shoulders) – 32 mm; and
- Depth (condylobasal; nose to back of skull) – 22.1 mm (Dietz *et al.* 2011).

In order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 75. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 75. The minimum dimension a brown long-eared bat *Plecotus auritus* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Brown long-eared bat *Plecotus auritus*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	15 mm	17 mm	10 mm	15 mm	30 mm	30 mm	20 mm	41 mm	23 mm	20 mm	15 mm	8 mm

5.11 Lesser horseshoe bat *Rhinolophus hipposideros*

Seasonal occupancy – Lesser horseshoe bat

The seasons and individual months the lesser horseshoe bat has been recorded roosting in trees is set out at Table 76.

Table 76. The seasons and months for which The Database holds records of the lesser horseshoe bat *Rhinolophus hipposideros* occupying trees to date; 11th July 2016.

Lesser horseshoe bat *Rhinolophus hipposideros*												
Season	*Winter*		*Spring-flux*		*Pregnancy*		*Nursery*		*Mating*		*Autumn-flux*	
MONTH	January	February	March	April	May	June	July	August	September	October	November	December
Species present in trees						✓						

DBH ranges of roost trees – Lesser horseshoe bat

The DBH ranges of trees holding lesser horseshoe bat roosts are set out at Table 77.

Table 77. The DBH ranges of lesser horseshoe bat *Rhinolophus hipposideros* roost records held on The Database to date; 11th July 2016.

Lesser horseshoe bat *Rhinolophus hipposideros*						
DBH range of trees occupied in different seasons	**Jan / Feb**	**Mar / Apr**	**May / Jun**	**Jul / Aug**	**Sep / Oct**	**Nov / Dec**
	Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
>3 bats						
3 bats						
2 bats			1,213 mm (121.3 cm)			
1 bat						

Roost heights – Lesser horseshoe bat

The heights at which lesser horseshoe bat roosts have been recorded in the six seasons are set out at Table 78. Figures relate to the number of bats present.

Table 78. The heights of lesser horseshoe bat *Rhinolophus hipposideros* roost records held on The Database to date; 11th July 2016. Figures relate to the number of bats present.

Lesser horseshoe bat *Rhinolophus hipposideros*							
Field-layer	1.01 – 2 m						
	0.51 – 1 m	2					
Ground-layer	0 – 0.5 m						
Number of bats recorded at different heights (m) in different seasons		Winter	Spring flux	Pregnancy	Nursery	Mating	Autumn flux
		Jan / Feb	***Mar / Apr***	***May / Jun***	***Jul / Aug***	***Sep / Oct***	***Nov / Dec***

PRF type – Lesser horseshoe bat

The PRF types occupied by the lesser horseshoe bat *Rhinolophus hipposideros* in different seasons are set out at Table 79.

Table 79. Records of PRF types occupied by the lesser horseshoe bat *Rhinolophus hipposideros* in different seasons held on The Database to date; 11th July 2016.

Lesser horseshoe bat *Rhinolophus hipposideros*							
PRF group	PRF type	Season					
		Winter	*Spring-flux*	*Pregnancy*	*Nursery*	*Mating*	*Autumn-flux*
Disease & Decay	Woodpecker-holes						
	Knot-holes						
	Pruning-cuts						
	Tear-outs						
	Compression-forks						
	Wounds						
	Cankers						
	Butt-rots			✓			
Damage	Hazard-beams						
	Frost-cracks						
	Subsidence/shearing						
	Lightning-strikes						
	Desiccation-fissures						
	Transverse-snaps						
	Welds						
	Lifting-bark						
Association	Fluting						
	Ivy						

Roost sharing – Lesser horseshoe bat

The Database holds no records of lesser horseshoe bat sharing or cohabiting in a tree-roost with any other bat species.

Minimum entrance dimension – Lesser horseshoe bat

As lesser horseshoe bats do not alight to enter roosts, their dimensions are irrelevant in this context. Nevertheless, in order to establish how small a gap the species can pass through to exploit a larger PRF behind, or simply squash themselves into, the entrance height, width and internal width fields were investigated and the minimum gap the species can squeeze through or into has been identified in each month and presented in Table 80. It should be noted that this only represents one field, and that the other three may be significantly larger; i.e. the width of the entrance may be 150 mm but the height might be 1,500 mm and the internal width 300 mm.

Table 80. The minimum dimension a lesser horseshoe bat *Rhinolophus hipposideros* has passed through to gain access into a PRF on a tree to date; 11th July 2016.

Lesser horseshoe bat *Rhinolophus hipposideros*												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season	Winter		Spring-flux		Pregnancy		Nursery		Mating		Autumn-flux	
Minimum entrance dimension plane	----	----	----	----	----	350 mm	----	----	----	----	----	----

6. INITIAL ANALYSIS

A logistic regression model was chosen to explore the factors that influence PRF occupancy. Using logistic regression can answer questions like *"what is the likelihood that a north-facing PRF in an ash tree will be occupied?"*

A logistic regression model can indicate those 'features' that are most useful in helping to define what is a 'good' or 'bad' PRF. The results are in the form of probabilities or odds ratios (which are like betting). An odds ratio of >1 increases the likelihood of occupancy (odds on), whilst a value <1 reduces the likelihood (odds against). However, the greater the variability in the data the more likely it is that any 'prediction' will be wrong.

6.1 Physical characteristics

Analysis objective – Physical characteristics

The five objectives of the exploration of the physical characteristics of PRF are divided as follows:-

1. To test the hypothesis that bats of all species generally occupy higher PRF in the warmer seasons than they do in the winter and to investigate whether there are species distinctions;

   and

2. To identify whether particular tree species are more or less likely to develop specific PRF types;

   and

3. To identify whether PRF types typically occur at certain heights on individual tree species or when the tree reaches a certain DBH;

   and

4. To identify whether individual species of bats typically occupy PRF a certain combination of entrance dimensions, and whether this alters with the seasons;

   and

5. To identify whether individual species of bats typically occupy PRF with a certain combination of internal dimensions, and whether this alters with the seasons.

Data and analysis – Physical characteristics

Reference to the individual bat species accounts suggests that all species roost at different heights at different points in the year. In broad terms, it would appear that bats of all species roost in lower positions during the cooler seasons; autumn-flux, winter and spring-flux, and higher in the warmer seasons; pregnancy, nursery and mating. However, assessing statistical significance is problematic with small replicates and such large replication. There is a suggestion that *Plecotus auritu*s roosts lower than most other species, but there is great variability and this species also has some of the highest roosts recorded! Therefore, at the moment we still have insufficient data to identify any specific trends or give typical height ranges for individual bat species. Furthermore, although we have positive data and can demonstrate that some tree species do form certain PRF, and that some bat species have been recorded occupying those PRF, we have insufficient data to identify which individual tree species do not typically form different PRF types. Finally, even where we know a tree species forms a PRF, we do not have sufficient data to begin to understand at what height range those PRF will typically occur on that tree species, or at what DBH the PRF begin to form, but we are beginning to see trends in the heights of different PRF types generally across all tree species and these are shown at Table 81.

Table 81. Heights of Damage PRF records held on The Database to date; 11th July 2016.

PRF Group	PRF Type	Min	LQ	Median	UQ	Max
Disease & Decay	Woodpecker-holes	1.24	2.65	2.75	5.60	14.00
	Knot-holes	1.43	2.75	4.38	6.78	13.00
	Pruning-cuts	5.00	5.75	6.50	6.65	6.80
	Tear-outs	0.58	1.31	2.90	4.95	10.00
	Compression-forks	4.48	4.49	4.50	4.51	4.52
	Wounds	0.74	1.70	2.24	3.28	20.00
	Cankers	1.30	2.50	3.89	10.00	17.20
	Butt rots	0.22	0.59	1.12	3.03	5.10
Damage	Hazard-beams	1.17	3.15	5.23	6.36	11.00
	Frost-cracks	0.00	0.92	1.40	1.91	9.90
	Subsidence	0.88	1.72	2.23	4.74	9.00
	Shearing	7.38	7.38	7.38	7.38	7.38
	Lightning-strikes	2.24	5.96	9.80	10.80	10.80
	Desiccation-fissures	0.93	1.40	1.88	2.61	3.33
	Transverse-snaps	2.13	2.57	3.00	3.48	3.96
	Welds	0.73	1.27	1.50	5.54	8.35
	Lifting-bark	1.04	1.38	1.47	2.21	2.69
Association	Fluting	0.41	0.92	1.05	1.38	1.45
	Ivy	1.12	1.12	1.12	1.12	1.12

Looking at the median averages, the spatial picture is illustrated at Table 82[3].

Table 82. The median average height if PRF types in records held on The Database to date; 11th July 2016.

Median average height		PRF Group		
		Disease & Decay	Damage	Association
Canopy-layer	19.01 – 20 m			
	18.01 – 19 m			
	17.01 – 18 m			
	16.01 – 17 m			
	15.01 – 16 m			
	14.01 – 15 m			
	13.01 – 14 m			
	12.01 – 13 m			
	11.01 – 12 m			
	10.01 – 11 m			
	9.01 – 10 m		Lightning-strikes	
	8.01 – 9 m			
	7.01 – 8 m		Shearing	
	6.01 – 7 m	Pruning-cuts		
	5.01 – 6 m		Hazard-beams	
Shrub-layer	4.01 – 5 m	Knot-holes / Compression-forks		
	3.01 – 4 m	Cankers		
	2.01 – 3 m	Woodpecker-holes / Tear-outs / Wounds	Subsidence / Transverse-snaps	
Field-layer	1.01 – 2 m	Butt-rots	Frost-cracks / Desiccation-fissures / Welds / Lifting-bark	Fluting / Ivy
	0.51 – 1 m			
Ground-layer	0 – 0.5 m			

[3] There may be a better way of illustrating the PRF height data, with the ranges also shown, but time and limited resources have forced this compromise.

We attempted to identify a pattern in the PRF entrance dimensions, but none was obvious and at the moment there are not enough replicates in any one season to get any sensible statistical results. There may be something interesting happening with general entrance size and species but that is all we can infer thus far; essentially, it's worth pursuing, but we need much more data.

Similarly, there is no apparent relationship between overall internal PRF size and season, nor are there any obvious patterns relating to internal height inside the PRF and occupation by different species. In terms of internal width, analysis found that unoccupied PRF are no different than occupied. Although there is a hint that some differences may exist between species there is great variability. Looking at the internal depth, most bat species seem to prefer PRF with no downward development (since the majority of median depths are zero), but there are no significant differences between depths of occupied or unoccupied PRF (for any species).

6.2 Internal environment

Analysis objective – Internal environment

The objectives of the exploration of the internal environment are two-fold and comprise:-

1. Firstly, to test the hypothesis that certain substrate clues are linked to occupancy by bats generally, and some bat species individually. What we're not looking for is whether bats actually select a particular substrate at different times of year, because some substrate clues may actually be attributable to the bats themselves being present (and we would be getting into a chicken and egg argument);

   and

2. Secondly, to identify whether bats are more or less likely to be found in a particular environment at different times of year, in order that we can target our survey effort to the time the PRF is most likely to be occupied.

Data and analysis – Internal environment

The environmental conditions may be broadly divided into three categories, comprising:-

1. Texture;
2. Cleanliness; and
3. Humidity.

Texture

Texture is recorded as one of four characteristics, comprising:-

1. Smooth;
2. Bobbly;
3. Bumpy; and/or
4. Rough.

The 'smooth' category encompasses any situation where the internal substrate is smoothed flat so that it has no sharp or jagged edges or course projections.

The 'bobbly' category encompasses any situation where the substrate is finely stippled.

The 'bumpy' category encompasses any situation where the substrate is uneven, but the tips of larger projections are rounded-off. In a cave situation, the surface of a stalactite/stalagmite would be considered bumpy; the same is true inside PRF on trees.

The 'rough' category encompasses any situation where the substrate is course and jagged.

It is important to note that an individual PRF may encompass all four categories on different sides or at different internal heights.

The results of the logistic regression analysis are shown at Table 83.

Table 83. Odds ratios for PRF texture classes. Values >1 are "odds on" and <1 are "odds against".

TEXTURE	Present	Absent
Smooth	1.52	0.70
Bobbly	1.73	0.94
Bumpy	1.64	0.89
Rough	0.62	1.36

Investigation found that the environmental variables relating to PRF texture are all significant but have little explanatory power and low odds ratios. The take-home message appears to be that bats are generally less often recorded in PRF that have a rough internal substrate. However, as with so much, we do not have enough data to identify individual bat species trends, yet.

Cleanliness

Cleanliness is recorded as one of eight characteristics, comprising:-

1. Clean;
2. Waxy;
3. Blackened;
4. Polished;
5. Dusty;
6. Debris;
7. Dirty; and
8. Sludgy.

A ‘clean’ substrate is characterised by the lack of cobwebs, loose dust or debris or any accumulation of humus or fungal exudation.

A ‘waxy’ substrate is characterised by greasy tallow in a whitish sheen, coating the exposed heartwood, as though someone had rubbed a candle over the internal areas.

A ‘blackened’ substrate is characterised by a greasy blackening that often highlights the striations of the ray-wood.

A ‘polished’ substrate is characterised by an appearance similar to furniture with gloss varnish or lacquer.

The ‘dusty’ category is just that; accumulations of small particles and frass within the PRF. It is typically associated with Disease and Decay PRF that are the result of brown-rots, but also of Damage and Association PRF (ivy in particular) that are dry.

The ‘debris’ category encompasses any larger diameter particles and chunks of detritus.

The ‘dirty’ category encompasses any situation where the substrate itself appears to be coated in dirt, or the droppings of a competitor (e.g. night-roosting birds and invertebrates).

The ‘sludgy’ category encompasses any situation where the substrate comprises damp/wet decaying wood, and is more common to Disease and Decay PRF that are associated with a white rot.

As with texture, an individual PRF may encompass more than one cleanliness category on different sides or at different internal heights in an individual PRF.

The logistic regression analysis results are shown at Table 84 on the following page.

The environmental variables relating to PRF cleanliness are all statistically significant but have low explanatory power (Waxy has highest at 13%). The untidy variables (i.e. dusty, debris,

dirty and sludgy) point to bats being recorded in more PRF that are relatively "tidy". The other variables are harder to interpret.

Table 84. Odds ratios for PRF cleanliness classes. Values >1 are "odds on" and <1 are "odds against".

CLEANLINESS	Present	Absent
Clean	1.58	0.31
Waxy	3.20	0.50
Blackened	1.64	0.74
Polished	1.66	0.90
Dusty	0.28	1.23
Debris	0.44	1.21
Dirty	0.30	1.34
Sludgy	0.33	1.19

Humidity

Humidity is recorded as one of three characteristics, comprising:-

1. Dry;
2. Damp; and
3. Wet.

The distinctions between the three characteristics are that 'dry' is arid with no question of any moisture, 'wet' is any situation where water-droplets or surface-flow is present on the internal walls or pooled water is present in the base, and 'damp' is any situation between the two extremes.

As with texture and cleanliness, an individual PRF may encompass more than one humidity category on different sides or at different internal heights in an individual PRF.

The logistic regression analysis results are shown at Table 85.

Table 85. Odds ratios for PRF humidity variables. Values >1 are "odds on" and <1 are "odds against".

HUMIDITY	Present	Absent
Dry	1.17	0.16
Damp	ns	ns
Wet	0.26	1.14

The humidity variables 'dry', and 'wet' are statistically significant, but the 'damp' variable was not.

As with the other environmental variables, explanatory power is low and the odds ratios are fairly small. The initial analysis indicates bats are more often recorded in PRF that are not too wet (i.e. bats have been recorded in wet PRF, but not as many times as they have been recorded in damp and dry PRF). As with all the previous analysis, more records are required before the analysis will be meaningful for a practical application.

Overall, there are no obvious relationships between any particular bat species and any of the environmental variables in any particular season. Association analyses show that some combinations of species and environmental variable are 'interesting' but more data are required to make the tests more robust.

6.3 Competitors

Analysis objective – Competitors

The objective of the exploration of the competitor data was to see whether the presence of any of the other organisms that occupy PRF have a correlation with bat presence generally, and with individual bat species in individual seasons.

Data and analysis – Competitors

Thus far the following taxa have been recorded occupying PRF in trees:-

- Invertebrates comprising:-
  - Slugs (Mollusca / Gastropoda);
  - Snails (Mollusca / Gastropoda);
  - Flies (Diptera);
  - Wood wasps *Vespula sylvestris*;
  - Hornets *Vespa crabro*;
  - Tree bumblebees *Bombus pratorum*;
  - Hive bees *Apis mellifera*;
  - Spiders (Araneae);
  - Millipedes (Diplopoda);
  - Centipedes (Chilopoda); and
  - Woodlice (Isopoda).
- Amphibians comprising:-
  - Common toad *Bufo bufo*.
- Birds comprising:-
  - Blue tit *Cyanistes caeruleus*;
  - Great tit *Parus major*; and

    - Jackdaw *Corvus monedula*.
- Mammals comprising:-
    - Wood mice *Apodemus sylvaticus*;
    - Hazel dormice *Muscardinus avellanarius*; and
    - Grey squirrels *Sciurus carolinensis*.

Overall, the presence of mammalian competitors is a significant negative indication of PRF occupancy; a logistic regression model showed that mammal presence produces a 35 to 1 against likelihood of finding a PRF occupied.

Presence of invertebrate competitors is a significant factor, although the likelihood of an occupied PRF is not affected greatly (odds of 3 to 2 against when they are present, odds of 3 to 2 in favour when absent).

Other competitors appear to have no significance.

6.4 Field-signs

Analysis objective – Field-signs

The objective of the exploration of the field-signs data was to investigate the following:-

1. Whether the field-signs are reliable generally;
2. Whether there are any species specific distinctions; and
3. Whether there are any seasonal variations.

Data and analysis – Field-signs

The field-signs investigated comprise:-

1. Droppings; and
2. Odour.

Droppings

The logistic regression model identified that the absence of droppings still results in a 41% chance of an occupied PRF. This means there is still a 0.71:1 chance (2:3 against in betting terms) of an occupied PRF, even without droppings being present. Some inconsistencies in the data (as well as inconclusive DNA results) identified that the presence of droppings results in a 99% likelihood of an occupied PRF. However, the presence of droppings is still a 'racing certainty' with odds of 103:1 in favour of bats being (or having been) recorded day-roosting in the feature on another date.

Odour

Latterly, when PRF and occupied tree-roosts have been inspected the recorders have attempted to describe the odour by putting their nose to the entrance and inhaling shallowly in a series of short intakes 'sniffing' through the nose. The idea being that by discerning different smells we might then have another field-sign that would support hypotheses of occupation even where bats were not themselves visible. In particular, it is hoped a set of guidance can be produced for arborists.

However, several factors can be predicted to impact upon how effective odour is as a field-sign. Firstly, in the absence of fresh droppings, not all bat species appear to give off an odour at all. Secondly, where droppings are present, how strong the smell is may depend upon several other factors, such as the bat species, the season, the number of droppings and their age. Finally, there is a question of subjectivity when describing a smell, with different odours being evocative of similar smells that may be familiar to a limited group of people. For example, it has been said that the soprano pipistrelle smells very like burnt sesame-seed oil, and when I (Henry Andrews) got some sesame-seed oil and burnt it I found that this was remarkably accurate, but I wonder how many people would be familiar with this smell.

Thus far many odours have been described in The Database. In order to mitigate subjectivity within reasonable limits, the odours described have been divided into three categories comprising:-

- Pleasant, which encompasses such delights as:-
    - Citrus;
    - Cypress wood;
    - Hay;
    - Moss;
    - Mushrooms;
    - Sweet; and
    - Worcestershire sauce.
- Not unpleasant, which includes:-
    - Burnt rubber;
    - Damp cellar;
    - Dry attic;
    - Musk;
    - Earthy;
    - Tanalised timber;
    - Tar; and
    - Tree.
- Unpleasant / offensive, which includes:-
    - Burnt feathers;
    - Fish;
    - Funky;

- Grass snakes;
- Sour; and
- Urine.

It may be that guidance needs to focus simply on whether or not the odour is unpleasant. Regardless, observations of surveyors working in the field indicates the action of stopping to check the odour is valuable as it at once makes the surveyor pause before they use an endoscope, and by getting their nose to the tree they also bring their eyes into closer proximity and begin to pick up on other anomalies. Very often, the action heightens attention because the surveyor picks up on something they weren't expecting (i.e. the tree doesn't smell like the other trees they have recorded that morning; but why not?), and their inspection is all the more thorough as they try to identify what is responsible for the anomaly. This is all important, PRF inspections are not just about searching for bats, they are about searching for anomalies; anything that is different which might be changes from one inspection to the next, or something that makes that PRF special. A good surveyor doesn't just use their eyes, they use their nose, ears (yes I (Henry Andrews) do listen at the entrance of large PRF both before and after the inspection) and finger-tips.

The results of the logistic regression analysis show that some of the "smell classes" may be significant. A presence of an unpleasant smell increases the likelihood of an occupied roost, whilst the presence of a pleasant smell reduces the likelihood (see the odds ratios in Table 86).

Table 86. Odds ratios of smell classes on the likelihood of encountering an occupied roost. Values >1 are "odds on" and <1 are "odds against".

ODOUR CLASS	Odds ratio	Significance
No smell	0.807	n.s
Pleasant	0.573	< 0.05
Unpleasant	5.029	< 0.001
Not unpleasant	1.336	n.s

In order to explore the situation in greater depth, where the odour had been recorded, the number of roosts occupied by individual bat species was filtered into the four odour classes, the results of which are set out at Table 87 on the following page. The data was then analysed to see if there were any significant associations.

Table 87. Bat species associations with odour types: No smell; pleasant; not unpleasant; and, unpleasant.

BAT SPECIES	No Smell	Pleasant	Not unpleasant	Unpleasant
Barbastella barbastellus	10	2	1	----
Myotis bechsteinii	1	----	----	----
Myotis daubentonii	9	2	1	14
Myotis nattereri	33	5	12	1
Nyctalus noctula	6	2	12	29
Pipistrellus nathusii	2	-----	---	----
Pipistrellus pipistrellus	15	2	1	2
Pipistrellus pygmaeus	10	----	----	3
Pipistrellus pipistrellus & Pipistrellus pygmaeus	----	----	----	1
Pipistrellus sp.	2	----	----	----
Plecotus auritus	75	14	17	4

Association tests show that there are some significant results, comprising:-

- Daubenton's and an Unpleasant smell (Pearson residual +4.37)
- Noctules and an Unpleasant smell (Pearson residual +6.88)
- Brown long eared and an Unpleasant smell (Pearson residual -3.52)
- Natterer's and an Unpleasant smell (Pearson residual -2.68)

So, the Unpleasant smell category has some potential with two species showing a positive association and two a negative one. However, some of the expected values are small and this will impact the robustness of the result. More data will help to clarify the situation.

7. PUTTING IT ALL TOGETHER

The aim of The Database is to help inform future surveying so that surveyors may target their efforts more effectively.

If survey methods are effective they must be proven to work with evidence that is available to everyone, and discussed in a forum where criticism is actively encouraged.

You are urged to make every attempt to attack this project and the methods employed in order that failings are identified and corrected. Only by so doing can the result be satisfactory.

The current database (as of 11th July 2016) has now been rearranged and reorganised so that it can more easily produce output that could be used in regression modelling. This work will not

need repeating and thus more time and resources will be allowed for the analysis in future years.

At this early stage in the project there is great variability in the data. The 'best' model is one that has the largest explanatory power with the fewest model terms (variables). All the variables in the model should be statistically significant. In 2016 even the 'best' model gave poor explanatory power, with only around 39% of variability explained. Nevertheless, there are some interesting results that give the odd tantalising glimpses of the objectives, and we are optimistic that the objectives are realistic and achievable.

However, if we are to bring more clarity to the situation, more records are required, both for roosts and unoccupied PRF.

As more records are added the regression model can be updated and refined to produce the best possible guidance. As a result, The Database benefits not only the bats, but everyone who submits data.

Records can be submitted via the website: www.battreehabitatkey.co.uk

8. REFERENCES

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APPENDIX A. THE BIG TREE TABLES.

Tables A1 and A2 set out the tree species that are native to the British Isles and several that are naturalised. Additional species that are grown as crops are also listed where these are commonly encountered. Each species has its typical mature height and diameter at breast height (DBH) identified. Where individual bat species have been recorded day-roosting within a Potential Roost Feature (PRF) on the tree species these are identified and listed with the source of the record. Table A1 comprises the deciduous trees and Table A2 comprises the coniferous species. The review does not include accounts that were to taxa alone and did not identify the tree species. Nevertheless, this review is not exhaustive and I would welcome input from other sources.

Extraordinarily enough I found it hard to find the maximum DBH for a number of common trees. Those I did find were in school-room books from the early part of the last century. I'm sure this information must be set out somewhere but I'm afraid I simply ran out of time.

Table A1. The typical mature height and DBH of deciduous trees common to the British Isles, and the bat species that have been recorded day-roosting within PRF on that particular tree species.

SPECIES	HEIGHT (Mature)	DBH (Mature)	TREE ROOSTS RECORDED
Wych elm ***Ulmus glabra***	Av. 25-30 m (Thomas 1983), Max. 37 m (Stace 1991)	Typically up to 1.8 m (Boulton 1937)	No data.
English elm ***Ulmus procera***	Av. 28-30 (Thomas 1983) Max. 33 m (Stace 1991)	Typically less than 2 m (Wikipedia 2012)	No data.
Beech ***Fagus sylvatica***	Av. 25-30 m (Thomas 1983) Max. 42 m (Stace 1991)	1.2 - 1.8 m (Boulton 1937, Step 1924)	Barbastelle (Zeale 2011), Bechstein's bat (Dietz & Pir 2011), Daubenton's bat (Harris & Yalden 2008, BTHK Database), Natterer's bat (Smith & Racey 2005, BTHK 2016), Leisler's bat (Hopkirk & Russ 2004, Andrews *et al.* 2013), noctule (BTHK Database), common pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
Sessile oak ***Quercus petraea***	Av. 18-30 m (Thomas 1983), Max. 42 m (Stace 1991)	Typically harvested before 1.5 m (Lane & Tait 1990)	Barbastelle (Billington 2004, BTHK Database), Bechstein's bat (BTHK Database), Daubenton's bat (BTHK Database), Natterer's bat (Smith & Racey 2005, BTHK Database), noctule (BTHK Database), Nathusius' pipistrelle (BTHK Database), common pipistrelle (BTHK Database), soprano pipistrelle (BTHK Database), brown long-eared bat BTHK Database)

SPECIES	HEIGHT (Mature)	DBH (Mature)	TREE ROOSTS RECORDED
Pedunculate oak ***Quercus robur***	Av. 18-30 m (Thomas 1983), Max. 37 m (Stace 1991)	3.6 - 5.4 m (Boulton 1937) but typically harvested before 1.5 m (Lane & Tait 1990)	Barbastelle (Billington 2004, BTHK Database), Bechstein's bat (Flanders & Hill 2004, BTHK Database), Brandt's bat (BTHK 2016), Daubenton's bat (Harris & Yalden 2008, BTHK Database), whiskered bat (Andrews *et al.* 2016), Natterer's bat (BTHK Database), Leisler's bat (Hopkirk & Russ 2004, Andrews *et al.* 2013), noctule (BTHK Database), common pipistrelle (BTHK database), soprano pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
Turkey oak ***Quercus cerris***	Av. 30-38 m (Thomas 1983), Max. 39 m (Mitchell 1974)	Exceptionally 8 m (Mitchell 1974)	Lesser horseshoe-bat (BTHK Database)
Silver birch ***Betula pendula***	Av. 12-18 m (Thomas 1983), Max 30 m (Stace 1991)	Up to 0.3 – 0.4 m (Step 1924, Wikipedia 2012). Typically harvested before 0.35 m (Lane & Tait 1990)	Alcathoe's bat (Lučan *et al.* 2009), Natterer's bat (Smith & Racey 2005), Daubenton's bat (Andrews *et al.* 2013), common pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
Downy birch ***Betula pubescens***	Av. 12-18 m (Thomas 1983), Max. 24 m (Stace 1991)	Up to 0.7 m (Wikipedia 2012). Typically harvested before 0.35 m (Lane & Tait 1990)	Bechstein's bat (BTHK Database), Natterer's bat (Smith & Racey 2005, BTHK Database), Leisler's bat (Hopkirk & Russ 2004), common pipistrelle (BTHK Database), soprano pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
Alder ***Alnus glutinosa***	Av. 15-21 m (Thomas 1983), Max. 29 m (Stace 1991)	0.9 – 1.8 m (Step 1924). Typically harvested at 0.35 (Lane & Tait 1990)	Bechstein's bat (Červený & Bürger 1989), Alcathoe's bat (Lučan *et al.* 2009), Daubenton's bat (Červený & Bürger 1989, BTHK Database), Leisler's bat (Ruczyński & Bogdanowicz 2008) noctule (Ruczyński & Bogdanowicz 2008), brown long-eared bat (BTHK Database)
Hazel ***Corylus avellana***	Av. 3-6 m (Thomas 1983), Max. 12 m (Stace 1991)	0.3 m (Boulton 1937), but will grow to timber-size (Rackham 2003). Rarely harvested now.	Natterer's bat (BTHK Database), brown long-eared bat (BTHK Database)
Hornbeam ***Carpinus betulus***	Av. 15-21 m (Thomas 1983), Max. 32 m (Stace 1991).	Rarely grown as a timber tree (Rackham 2003) however can achieve up to 3 m (Step 1924, Boulton 1937). Generally far smaller 0.3 – 0.8 m (H. Andrews *pers exp*)	Bechstein's bat (Dietz & Pir 2011), Leisler's bat (Ruczyński & Bogdanowicz 2008), brown long-eared bat (Andrews *et al.* 2016)
Large-leaved lime ***Tilia platyphyllos***	Av. 28-38 m (Thomas 1983), Max. 34 m (Stace 1991)	No data	Lesser horseshoe-bat (Andrews *et al.* 2016)

SPECIES	HEIGHT (Mature)	DBH (Mature)	TREE ROOSTS RECORDED
Small-leaved lime ***Tilia cordata***	Av. 18-28 (Thomas 1983), Max. 38 m (Stace 1991).	1 – 2 m (Wikipedia 2012).	No data
Common lime ***Tilia x europaea***	Av. 28-38 m (Thomas 1983), Max. 40 m (Mitchell 1974)	Up to 3.7 m and exceptionally 7 m (Mitchell 1974)	Noctule (BTHK Database)
Black poplar ***Populus nigra*** **sbsp.** ***Betulifolia***	Av. 28-30 m (Thomas 1983), Max. 30 m (Mitchell 1974)	0.9 – 1.8 m (Step 1924, Boulton 1937), exceptionally 5 m (Mitchell 1974)	Daubenton's bat (BTHK Database)
Hybrid black poplar ***Populus* × *canadensis***	Av. 28-38 m (Thomas 1983), Max. 42 m (Mitchell 1974)	Exceptionally 6 m (Mitchell 1974)	Daubentons bat, Nathusius pipistrelle, soprano pipistrelle (Andrews *et al.* 2016)
Aspen ***Populus tremula***	Av. 9-12 m (Thomas 1983), Max. 24 m (Stace 1991).	0.9 – 1 m (Step 1924, Wikipedia 2012).	Roosts recorded (Červený & Bürger 1989), *but bat species not provided in text*, Alcathoe's bat (Lučan *et al.* 2009), Daubenton's bat (Andrews *et al.* 2016)
White willow ***Salix alba***	Av. 18-25 m (Thomas 1983), Max. 33 m (Stace 1991)	Up to 1 m as a standard (Wikipedia 2012), but larger as a pollard	Nathusius' pipistrelle (Floris Verhaeghe 2015, *pers. comm*., February, Marc Van De Sijpe 2015, *pers. comm*., April)
Crack willow ***Salix fragilis***	Av. 9-15 m (Thomas 1983), Max. 25 m (Stace 1991)	Up to 1 m as a standard (Wikipedia 2012), but larger as a pollard	Daubenton's bat (BTHK Database)
Goat willow ***Salix caprea***	Av. 3-9 m (Thomas 1983), Max. 19 m (Stace 1991).	Typically up to 0.4 m (*H.* Andrews *pers obs*).	Bechstein's bat (BTHK Database), Daubenton's bat (Andrews *et al.* 2016), Natterer's bat (Smith & Racey 2005), brown long-eared bat (BTHK Database)
Grey willow ***Salix cinerea***	Av. No data, Max. 15 m (Stace 1991).	Typically up to 0.4 m (*H.* Andrews *pers obs*).	Natterer's bat (Smith & Racey 2005)
Blackthorn ***Prunus spinosa***	Av. 2.5-3.8 m (Thomas 1983), Max. 4 m (Stace 1991)	Typically up to 0.3 m (*H.* Andrews *pers obs*).	No data
Wild cherry ***Prunus avium***	Av. 12-21 m (Thomas 1983), Max. 31 m (Stace 1991).	Typically up to 0.6 m (Step 1924), exceptionally up to 1.5 m (Wikipedia 2012). Harvested at 0.6 m (Lane & Tait 1990)	Soprano pipistrelle (BTHK Database)
Bird cherry ***Prunus padus***	Av. 9-15 m (Thomas 1983), Max. 19 m (Stace 1991)	No data	No data
Crab apple ***Malus sylvestris sens. Lat.***	Av. 3-9 m (Thomas 1983), Max. 10 m (Stace 1991)	No data	No data
Domestic apple ***Malus domestica***	No data	No data	Bechstein's bat (BTHK Database), Daubenton's bat (BTHK Database), Natterer's bat (BTHK Database)

SPECIES	HEIGHT (Mature)	DBH (Mature)	TREE ROOSTS RECORDED
Rowan ***Sorbus aucuparia***	Av. 9-15 m (Thomas 1983), Max. 18 m	Tends to be 'shrubby' but occasional individuals are found up to 0.4 m (*H.* Andrews *pers obs*)	No data
Hawthorn ***Crataegus monogyna***	Av. 6-9 m (Thomas 1983), Max. 15 m (Stace 1991).	Typically 0.2 m (H. Andrews *pers obs*)	No data
Midland hawthorn ***Crataegus laevigata***	Av. No data, Max. 10 m	Typically 0.2 m (H. Andrews *pers obs*)	No data
Holly ***Ilex aquifolium***	Av. 9-18 m (Thomas 1983), Max. 23 m (Stace 1991)	Typically 0.4 but occasionally up to 0.8 m	No data
Field maple ***Acer campestre***	Av. 9-15 m (Thomas 1983), Max. 25 m (Stace 1991).	Typically up to 1 m (Wikipedia 2012) but I have encountered one of 1.2 m (H. Andrews *pers obs*)	Daubenton's bat (BTHK Database), Natterer's bat (Smith & Racey 2005, BTHK Database), soprano pipistrelle (BTHK Database)
Sycamore ***Acer pseudoplatanus***	Av. 21-30 m (Thomas 1983), Max. 35 m (Stace 1991)	1.8 m (Boulton 1937). Typically harvested at 0.6 m (Lane & Tait 1990)	Alcathoe's bat (Lučan *et al.* 2009), Daubenton's bat (BTHK Database), Natterer's bat (BTHK Database), Leisler's bat (Hopkirk & Russ 2004), common pipistrelle (BTHK Database), soprano pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
Ash ***Fraxinus excelsior***	Av. 25-38 (Thomas 1983), Max. 37 m (Stace 1991)	1.8 – 2 m (Boulton 1937, Wikipedia 2012). Typically harvested at 0.6 m (Lane & Tait 1990)	Bechstein's bat (BTHK Database), Daubenton's bat (Harris & Yalden 2008, BTHK Database), Natterer's bat (Smith & Racey 2005, BTHK Database), Leisler's bat (Ruczyński & Bogdanowicz 2008, J. Haddow 2012 *pers. comm.*, March), noctule (Ruczyński & Bogdanowicz 2008, BTHK Database), Nathusius' pipistrelle (Marc Van De Sijpe 2015, *pers. comm*., April), soprano pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
Sweet chestnut ***Castanea sativa***	Av. 25-30 (Thomas 1983), Max. 35 m (Stace 1991)	Up to 2 m (Wikipedia 2012)	Barbastelle (BTHK Database), Natterer's bat (Smith & Racey 2005), Leisler's bat (Hopkirk & Russ 2004), common pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
Horse Chestnut ***Aesculus hippocastanum***	Av. 18-30 (Thomas 1983), Max. 39 m (Stace 1991)	0.9 m (Step 1924), exceptionally to 4.5 m (Boulton 1937)	Natterer's bat (BTHK Database), common pipistrelle (BTHK Database), brown long-eared bat (BTHK Database)
American sweetgum ***Liquidambar styraciflua***	Av. 18-25 (Thomas 1983), Max. 28 m (Mitchell 1974)	1.7 m, exceptionally up to 3 m (Mitchell 1974)	Brown long-eared bat (BTHK Database)

Table A2. The typical mature height and DBH of coniferous trees common to the British Isles, and the bat species that have been recorded day-roosting within PRF on that particular tree species.

SPECIES	HEIGHT (Mature)	DBH (Mature)	TREE ROOSTS RECORDED
Scots pine ***Pinus sylvestris***	Av. 21-28 m (Thomas 1983), Max. 36 m (Stace 1991)	1.2 - 1.5 m (Step 1924, Boulton 1937). Typically harvested at 0.8 m (Lane & Tait 1990)	Barbastelle (Pénicaud 2000), serotine (Pénicaud 2000), Natterer's bat (Mortimer 2005, BTHK Database), Leisler's bat (Ruczyński & Bogdanowicz 2008, J. Haddow 2012 *pers. comm.*, March), noctule (Pénicaud 2000, Harris & Yalden 2008), common pipistrelle (BTHK Database), long-eared sp. (Pénicaud 2000)
Yew ***Taxus baccata***	Av. 6-15 m (Thomas 1983), Max. 28 m (Stace 1991)	2 m (Wikipedia 2012), exceptionally 4.5 m (Boulton 1937)	Barbastelle (Andrews *et al.* 2016), Natterer's bat (BTHK Database), common pipistrelle (Andrews *et al.* 2016), soprano pipistrelle (Andrews *et al.* 2016), brown long-eared bat (BTHK Database).
Sitka spruce ***Picea sitchensis***	Av. No data, Max. 55 m (Stace 1991)	Up to 1.5 m (Wikipedia 2012). Typically harvested at 0.8 m (Lane & Tait 1990)	Brown long-eared bat (Andrews *et al.* 2016)
Norway spruce ***Picea abies***	Av. 28-30 m (Thomas 1983), Max. 46 m (Stace 1991)	0.9 - 1.2 m (Boulton 1937). Typically harvested at 0.8 m (Lane & Tait 1990).	No data
Western hemlock ***Tsuga heterophylla***	Av. 30 m (Thomas 1983), Max. 46 m (Stace 1991)	Up to 2.7 m dbh (Wikipedia 2012). Usually harvested much earlier	Brown long-eared bat (Andrews *et al.* 2016)
Douglas fir ***Pseudotsuga menziesii***	Av. No data, Max. 58 m (Stace 1991)	1.5 - 2 m (Wikipedia 2012). Usually harvested much earlier	Natterer's bat (Mortimer 2005), Long-eared sp., (Pénicaud 2000)
Corsican pine ***Pinus nigra***	Av. 21-28 m (Thomas 1983), Max. 42 m (Stace 1991)	1.2 - 1.5 m (Boulton 1937). Typically harvested at 0.8 m (Lane & Tait 1990)	Natterer's bat (Mortimer 2005)
European larch ***Larix decidua***	Av. 28-35 m, (Thomas 1983), Max. 46 m (Stace 1991)	1.2 m (Boulton 1937). Typically harvested at 0.7 m (Lane & Tait 1990)	Leisler's bat (Hopkirk & Russ 2004)
Japanese larch ***Larix kaempferi***	Av. No data, Max. 37 m (Stace 1991)	1.2 m (Boulton 1937). Typically harvested at 0.7 m (Lane & Tait 1990)	No data
Monterey cypress ***Cupressus macrocarpa***	Av. 18-28 (Thomas1983), Max. 37 m (Mitchell 1974)	7 m (Mitchell 1974)	Noctule (BTHK Database), common pipistrelle (BTHK Database)
Wellingtonia ***Sequoiadendron giganteum***	Av. No data, Max 50 m in England (Mitchell 1974)	6.5 m (Mitchell 1974)	Leisler's bat (Hopkirk & Russ 2004), common pipistrelle (BTHK Database)

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