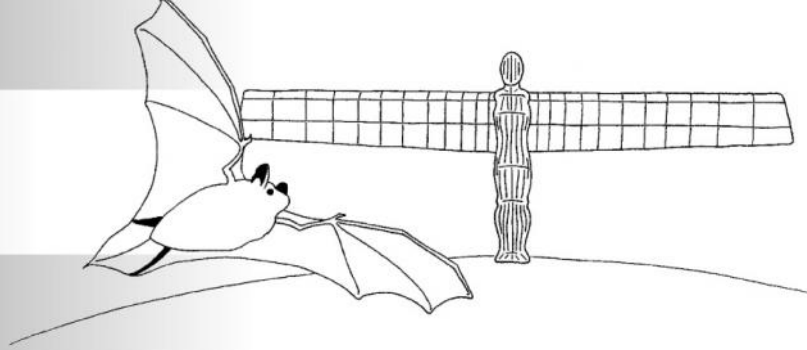


Northern Bats



Northern Bats

Volume 2 April 2017

- 1 South Yorkshire Magnesian Limestone Autumn Swarming Survey**
Robert Bell, Greg Slack, Peter Middleton and Sarah Proctor

- 24 Bat hibernation locations in adits with relation to temperature variation**
Tina Wiffen and Katherine Westerberg

- 29 The Bat Roost at St Andrew's Church, Grinton**
Brigitte Donoghue

- 39 Could this be the biggest noctule roost in the UK?**
Adam West

- 42 Boulby Bat Tunnel**
Ian Bond

- 46 The East Cleveland Batscape project**
Sarah Barry

- 51 The designation of Local Wildlife Sites for bats**
Ian Bond

- 56 Appendix - Local Wildlife Sites for bats**
Ian Bond



South Yorkshire Magnesian Limestone Autumn Swarming Survey

Robert Bell robert.andrew.bell@gmail.com

Greg Slack greg.slack@jacobs.com

Peter Middleton pmiddleton630@btinternet.com

Sarah Proctor jaboo004@aol.com

Introduction

Autumn bat swarming is characterised by intense bat flight activity in and around the entrances of underground sites, often by multi-species groups of bats. Bats captured at swarming sites often display a strong male bias and autumn swarming has been shown to function as a promiscuous mating behaviour (van Schaik *et al.*, 2015). The species present are usually limited to those that make use of the underground site for hibernation during the winter. Swarming is the major source of gene flow in many bat species (Rivers *et al.*, 2005; Furmankiewicz and Altringham, 2007) and is also likely to allow bats the chance to assess hibernation sites ahead of roosting (van Schaik *et al.*, 2015). Autumn swarming is potentially also a means of passing on knowledge of hibernacula locations from adults to young bats (Glover and Altringham, 2008).

The peak period for autumn swarming varies between sites and bat species (Glover and Altringham, 2008; van Schaik *et al.*, 2015; Rivers *et al.*, 2006), with this period extending from August to October, inclusive. Nightly peaks in bat swarming activity have been shown to vary with site, and period of the swarming season. Peak activity is most often recorded 4-6 hours after sunset (Parsons *et al.*, 2003b; Rivers *et al.*, 2006).

Previous trapping studies at autumn swarming sites have shown that caves in other parts of northern England are used by large numbers of bats throughout the course of the swarming period (Glover and Altringham, 2008; Rivers *et al.*, 2006). Some of these swarming sites are considered to be of national importance to the bat species utilising them (Rivers *et al.*, 2006). Individual bats have been shown to commute distances of up to 60km between summer roosts and major swarming sites (Rivers *et al.*, 2006), with bats most often returning to their day roosts after a night's swarming activity (Furmankiewicz, 2008). Studies have shown that bats may return to the swarming site of capture (Parsons & Jones, 2003) but mainly appear to visit only a single swarming site within one swarming season (Furmankiewicz, 2008).

Notable amongst known swarming sites in northern England are the 'windy pits', a series of mass-movement caves located close to Helmsley in North Yorkshire (Murphy and Cordingley, 2010), which were estimated to support a population of 2000–6000 Natterer's bats *Myotis nattereri* across the three best-studied caves (Rivers *et al.*, 2006). A study undertaken on mainland Europe also showed that bat species composition and abundance during swarming can correlate with composition and abundance during hibernation at the same site (van Schaik *et al.*, 2015).

Caves are rare in South Yorkshire and largely restricted to areas along the Magnesian Limestone belt that runs approximately north to south through sections of Doncaster and Rotherham, however, many of the bat species that engage in autumn swarming are known to be numerous in the county. Given there is a significant energetic cost involved in bats commuting from South Yorkshire summer roosts to swarming sites in other counties, it follows that there would be a strong driver for bats to swarm locally, where conditions allow. During 2014 and 2015, preliminary surveys of several potential bat swarming sites on the Magnesian Limestone were undertaken by South Yorkshire Bat Group members. These surveys showed that several caves were used by autumn swarming bats. Survey techniques adopted at that time included static monitoring, the use of infra-red enabled video cameras and lighting to record bat activity around cave portals and the recording of swarming bats using thermal imaging cameras. These survey techniques confirmed the presence of autumn swarming bats and recorded several bat species as using one or more sites. However, these techniques were limited in their ability to determine the species, sex, age and breeding status of bats using the site. Therefore it was considered that a systematic programme of trapping and static monitoring survey should be undertaken in two areas of South Yorkshire during autumn 2016.

Two locations were chosen in the Magnesian Limestone belt: Anston Stones Wood in Rotherham and Nearcliff Wood in Doncaster (Figure 1).

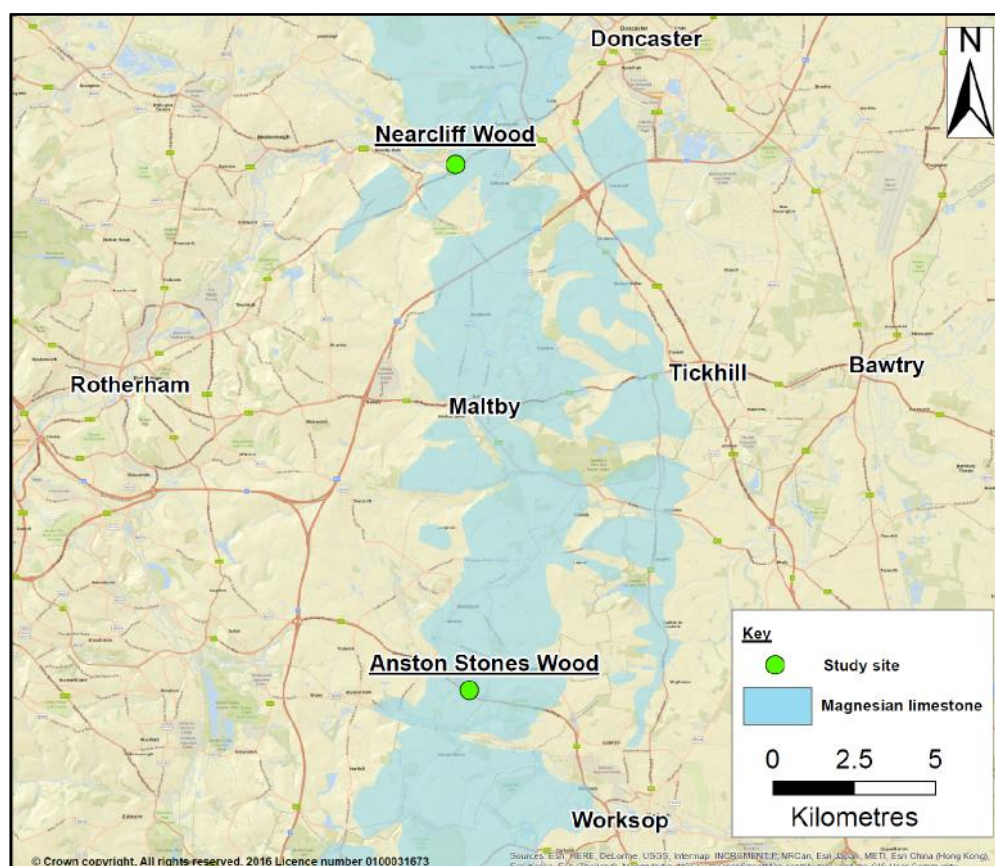


Figure 1: Map showing study site locations. Map prepared by Daniel Best with Ecus Ltd software.

Background information on the study sites and the cave/s surveyed is presented below.

Anston Stones Wood SSSI, South Anston, Rotherham

Anston Stones Wood is a 33ha area of mainly limestone woodland, comprising the second best example of this woodland type in South Yorkshire. The site is designated as a Site of Special Scientific Interest (SSSI) for its botanical communities. The Magnesian Limestone outcrops as natural crags on the Anston Brook valley slopes and also within a railway cutting. A study of the caves of this wood notes the presence of two caves and one large fissure together with a number of smaller fissures (Brown, 1968).

The principal cave at this site is known as Dead Man's Cave, named after the finding there of a human body in the winter of 1966/67. This small cave, which is a Scheduled Ancient Monument, consists of an entrance fissure 2.5m wide and 1.5m high. This leads, via a narrow passage, to a chamber 4.5m long by 3m wide. It appears to have been formed through historic water erosion which enlarged a natural fissure in the limestone. The sediment deposition in the cave has been shown to have covered Roman artefacts and also material dating from the Later Upper Palaeolithic period, including reindeer bone radiocarbon dated to c.9850 years ago (Historic England, 2017).

The 2016 trapping surveys also sampled a mass movement created limestone fissure known as Large Fissure. The entrance to this fissure is approximately 3m tall by 45cm wide and can be accessed for approximately 6m before continuing for an unknown distance.

A second cave known as Fissure Cave comprises an 8m tall by 3m high chamber accessed via a squeeze from above. Bat access is also possible via two additional entrance points. This cave was not covered during the 2016 survey work. Dead Man's Cave, Large Fissure and Fissure Cave are separated by a distance of only c.190m. Given the close proximity of these features the two caves and single fissure could be considered as one large swarming site, with the same bats likely to swarm at more than one of the three features during the same visit.

Nearcliff Wood, Conisbrough, Doncaster

Nearcliff Wood is a 21ha area of limestone woodland on the southern side of a gorge cut by the River Don. Part of the wood is included within the Sprotbrough Gorge SSSI, designated for its botanical and invertebrate communities. Sections of Nearcliff Wood have been subject to extensive former quarrying, resulting in changes to the ground levels. In addition, the wood is bisected by a gorge cut in the early 1900s for the former Dearne Valley Railway.

A group of mass movement caves are known from this section of the River Don valley (Murphy & Cordingley, 2010; Engering & Barron, 2007). Within Nearcliff Wood this grouping includes Nearcliff Wood Rift Cave and a number of smaller caves, associated with the former railway gorge.

Nearcliff Wood Rift Cave was the only cave at this site covered during the 2016 swarming survey. This cave is 88m long by 12m deep. It can be accessed by either of the two entrances. The upper and lower entrances both comprise of squeezes separated by a vertical distance of 10m on the steep slope of a quarry face.

It is likely that all caves within Nearcliff Wood could be considered as one large swarming site, with the same bats likely to swarm at more than one feature.

Aims

The study aims are given below:

- Confirm the range of bat species swarming at each of the two sites.
- Compare relative levels of bat swarming at the two sites.
- Compare the sex ratio, age distribution and reproductive status of bats captured at the two sites.
- Compare the results of trapping and static monitoring survey conducted in parallel.

Methodology

The two study sites were surveyed on four occasions each; with a single survey visit during each of the below survey periods:

- Mid-late August.
- Early-mid September.
- Mid-late September.
- Early-mid October.

Trapping protocol

Trapping surveys were carried out using a pair of 4.2m² Austbat triple-bank harp traps. Single traps were used to cover the openings of Dead Man's Cave and Large Fissure at Anston Stones Wood (Figure 2). Two individual traps were required to cover both the upper and lower entrances to Nearcliff Wood Rift Cave in Nearcliff Wood. Harp traps were erected directly across cave openings in order to intercept bats entering/exiting these features, with additional sections of camouflage netting used to cover the larger spaces between trap sides and the edges of the cave opening.



Figure 2: Surveyed caves with Nearcliff Wood Rift Cave (Nearcliff Wood) on left, Dead Man's Cave (Anston Stones Wood) in centre and Large Fissure (Anston Stones Wood) on right.

Trapping nights were selected based on recent weather forecasts for the survey night. Dry survey nights, with little or no wind and temperatures above 8°C at sunset were targeted. Weather data including temperature, wind speed and rainfall at the beginning and end of the survey were taken from local weather station records. The survey team was formed of an

even mix of surveyors drawn from South and West Yorkshire Bat Groups, including at least two surveyors experienced in bat trapping surveys.

Harp traps were installed from sunset until six hours after this time, with traps checked every 15 minutes during the survey period. The time of each bat retrieval was recorded with captured bats transferred to cotton drawstring bags for transfer to a bat processing area. In the bat processing area bat species, sex, forearm length, age and where possible, breeding status was recorded. Bats were processed in order of capture. Bats were aged as either adults or juveniles based on the degree of ossification of the joints within the finger bones (Mitchell-Jones & McLeish, 2004). A fur clipping (Natural England, 2013) was taken from all bats prior to release in order to allow re-captured bats to be identified. Bats were identified to species level with reference to their morphological characteristics, as presented in Bats of Britain and Europe (Dietz & Kiefer, 2016). In order to confirm species identification of suspected whiskered bat *M. mystacinus*/Brandt's bat *M. brandtii*/Alcathoe bat *M. alcathoe*, clipped fur was retained in a numbered vial for future DNA analysis. To date, seven fur samples have been subject to DNA analysis with a further ten probable whiskered bat samples awaiting identification. DNA analysis was undertaken by the Waterford Institute using a targeted qPCR analysis technique.

Static monitoring protocol

A single Pettersson d500x full spectrum static monitoring bat detector was installed adjacent to one of the two harp traps used on each survey occasion. The location of the static monitoring device was alternated between cave entrances with each survey occasion. Consequently, all surveyed cave entrances were covered by the static detector on two separate occasions. Sound files recorded by the static detector were downloaded and analysed to species level using BatClassify analysis software (Scott & Altringham, 2014). Any species identifications performed by the software which generated a probability of occurrence of 0.7 or more were accepted. Within the BatClassify software the calls of whiskered and Brandt's bat are grouped. The only sound files considered in this report, are those which relate to a bat species caught during the trapping surveys, which is also known to exhibit autumn swarming behaviour at cave sites. Species fitting these two criteria comprise Daubenton's bat *M. daubentonii*, whiskered/Brandt's bat, Natterer's bat and brown long-eared bat *Plecotus auritus*.

Hibernation survey

A single hibernation survey was undertaken on each surveyed cave in January 2017. Hibernation survey comprised a single daytime visual inspection undertaken with a high power torch. The survey of Nearcliff Wood Rift Cave was carried out on 21/01/2017 with the surveys of Dead Man's Cave and Large Fissure taking place on 29/01/2017.

It should be noted that it was not possible to survey all sections of any of three caves and consequently additional bats may have been present. Whilst most sections of Dead Man's Cave could be viewed, Large Fissure could only be accessed for the first 1-2m, whilst Nearcliff Wood Rift Cave supports extensive internal fissures which could not be fully inspected.

Evaluation of results

The findings of this study were compared with those of other documented swarming surveys, with an emphasis on those studies undertaken within the same region.

In particular, comparison of capture rates was made with studies of the North Yorkshire Windy Pits (Rivers *et al.*, 2016) and a number of caves and mines in Derbyshire (Roe, 2016). Relevant background information on the methodologies adopted by these studies is detailed below.

Between 2001 and 2003, Dr. Nicky Rivers trapped at three mass movement caves close to Helmsley in the North Yorkshire Moors. Dr. Rivers kindly supplied her survey data from which we calculated the median number of bats trapped at each of three caves (Slip Gill, Antofts and Bucklands) between mid-August and mid-October 2001-2003. Whilst the number of traps used and the start and end time of surveys varied, it appears that trapping typically continued from sunset until approximately six hours afterwards (Rivers *et al.*, 2006).

Over recent years Derbyshire Bat Conservation Group have carried out swarming surveys on a number of caves and mines within their county. The 2015 survey data presented in Figure 12 of the group's 'Summary Report 2015: Derbyshire Underground Sites Project Phase II' (Roe, 2016) was used to calculate the median number of bats trapped at each of three caves or mines (Owl Hole Cave, Jacobs Dream Mine and Jug Holes Cave and Mine). Again only survey data collected between mid-August and mid-October was used in the calculations. A maximum of three harp traps and two mist nets was used during surveys at each site; however the typical duration of survey works is not stated.

Given the number of sampling visits varied between studies, it was considered that use of a median value would offset the occasional very high or low capture rates, which are more likely to be encountered with an increased number of survey visits. Consequently the median was adopted as the measure of average used in comparisons.

Statistical analysis

Statistical analysis was completed by Dr Rebecca Slack to identify whether the results were statistically significant. The four null hypothesis tested, along with the type of statistical test used are shown in Table 1 below.

Table 1: Statistical tests performed.

Hypothesis	Statistical Test Used
There is no significant relationship between number of male and female bats captured and the species of bats present.	Chi Squared
There is no significant difference in the number of each species of bat captured at each site.	Chi Squared
There is no significant relationship between the age and species of the bat and the month of capture.	Chi Squared
There is no relationship between the age, sex, or location of the site of capture and the time of capture (relative to sunset).	Univariate ANOVA

Results

Trapping rate

A total of 129 bats were caught across all swarming sessions at both sites, totalling a catch rate of 2.69 bats caught per hour, per site. A higher catch rate was recorded at Anston Stones Wood, overall and during each catching session except October, when catching rates were even. Table 2 details total catches and catch per hour, broken down by site and catching period.

Table 2: Number of bats caught, broken down by recording session and site.

Sessions	Anston Stones Wood		Nearcliff Wood		Both Sites	
	Totals	Catch Per Hour	Totals	Catch Per Hour	Grand Total	Catch Per Hour
August	27	4.50	20	3.33	47	3.92
Early Sept	25	4.17	12	2.00	37	3.08
Late Sept	20	3.33	5	0.83	25	2.08
Oct	10	1.67	10	1.67	20	1.67

Sex ratio

The number of males caught far outnumbered females, resulting in a breakdown of 100 males, 28 females and 1 unknown¹ (77.52%, 21.71% and 0.78%, respectively). The breakdowns for Anston Stones Wood (76.83%, 21.95% and 1.22%) and Nearcliff Wood (78.72%, 21.28% and 0%) were similar to the overall male/female catch rate. Table 3, below, details the catch broken down by sex. There was no significant difference ($p > 0.05$) in the sex ratios recorded between the species captured ($\chi^2(8) = 2.189$, $p = 0.975$, Pearson's Chi-Square).

Table 3: Sex breakdown across both sites.

Sex	Count	Catch Per Hour	%
Female	28	0.29	21.71
Male	100	1.04	77.52
N/A	1	0.01	0.78

Species composition

Across all sites in combination, Natterer's bats were the most common species caught. Daubenton's bats were the second most abundant species, followed by whiskered bats. Brown long-eared bats were the least common swarming species caught² (Chart 1).

¹ A single bat escaped prior to being processed.

² A single common pipistrelle *Pipistrellus pipistrellus* was also caught but this was considered likely to have been a foraging bat, rather than a swarming individual.

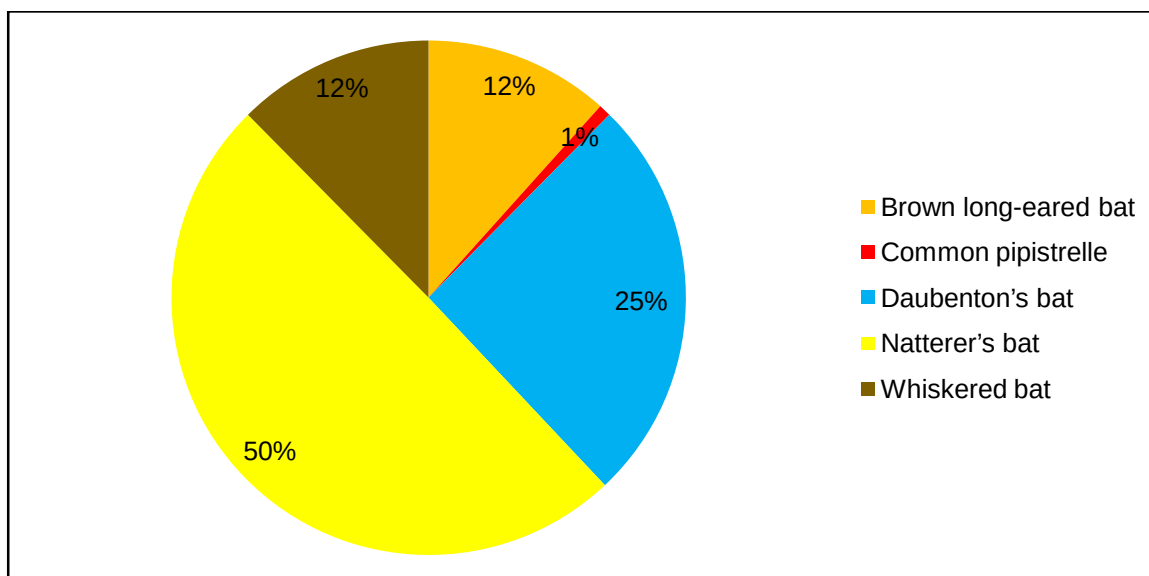


Chart 1: Species caught at both Anston Stones Wood and Nearcliff Wood.

The relative level of species abundance was not consistent across both sites. While only three species were caught at Anston Stones Wood, five species were caught at Nearcliff Wood Rift Cave; although one species caught at Nearcliff Wood, the common pipistrelle, was considered likely to have been foraging rather than swarming.

Whiskered bats were the most abundant species caught at Nearcliff Wood however this species was not caught at all at Anston Stones Wood. Natterer's bats were the next most frequently caught species at Nearcliff Wood and the most commonly caught species at Anston Stones Wood. At both sites this was followed by Daubenton's bat, and finally brown long-eared bat. The difference in the number of bats of each species caught at each site was highly statistically significant ($\chi^2(8)=37.061$, $p=0.000$, Pearson's Chi-Square); this is likely to be primarily due to the lack of whiskered bats caught at Anston Stones Wood. The relative proportion of each species caught at the two sites is shown in Charts 2 and 3.

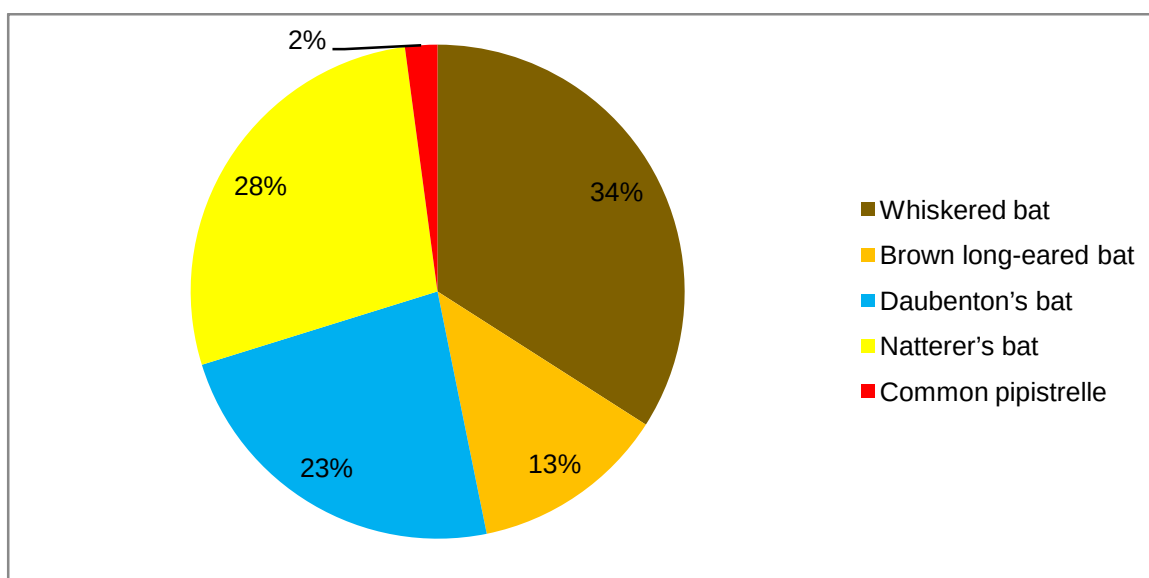


Chart 2: Species caught at the Nearcliff Wood site.

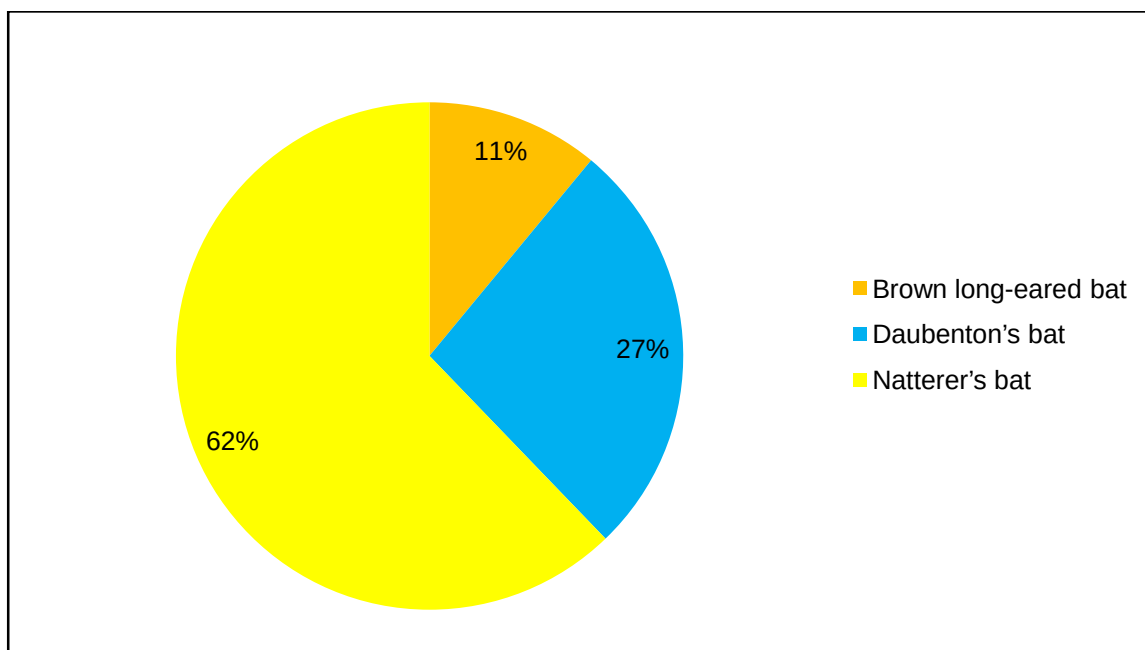


Chart 3: Species caught at the Anston Stones Wood site.

Adult / juvenile capture ratio

Adult bats made up 65% of all captures with juveniles comprising 35% with one bat (1%) unidentified. The proportion of juveniles was slightly higher at Anston Stones Wood (38% of all captures) than at Nearcliff Wood (28% of all captures).

The proportion of adult bats captured differed substantially between species, as shown in Table 4 below. The proportion of adult Natterer's bats and Daubenton's bats caught was broadly similar, slightly more adults than juveniles of both species were captured. However the proportion of juvenile whiskered bats and brown long-eared bats caught was much lower than the proportion of adults captured. Although the overall capture rate for whiskered bats and brown long-eared bats was lower than for the other two swarming species, very few juveniles of these species were captured (at just two and one bat respectively).

Table 4: Proportion of adults and juveniles captured for each species.

Species	Proportion of Captures Identified as Adults (%)	Proportion of Captures Identified as Juveniles (%)
Natterer's bat	59	41
Daubenton's bat	55	45
Whiskered bat	88	13
Brown long-eared bat	93	7

Seasonal differences in capture rate

The adult capture rate was highest early in the season; August recorded 47.6% of all adults captured with the rate decreasing each month until October, when only 9.5% of all adult bats captured during the study were recorded. Conversely, the juvenile capture rate increased initially (15.9% of all juveniles caught were captured in August, with this figure rising to 29.5% in late September) before dropping off slightly (to 27.3%) in October. Further

investigation showed that both adults ($\chi^2(8)=33.975$, $p=0.000$, Pearson's Chi-Square) and juveniles ($\chi^2(8)=19.948$, $p=0.003$, Pearson's Chi-Square) showed a highly significant relationship with season and species (Chart 4).

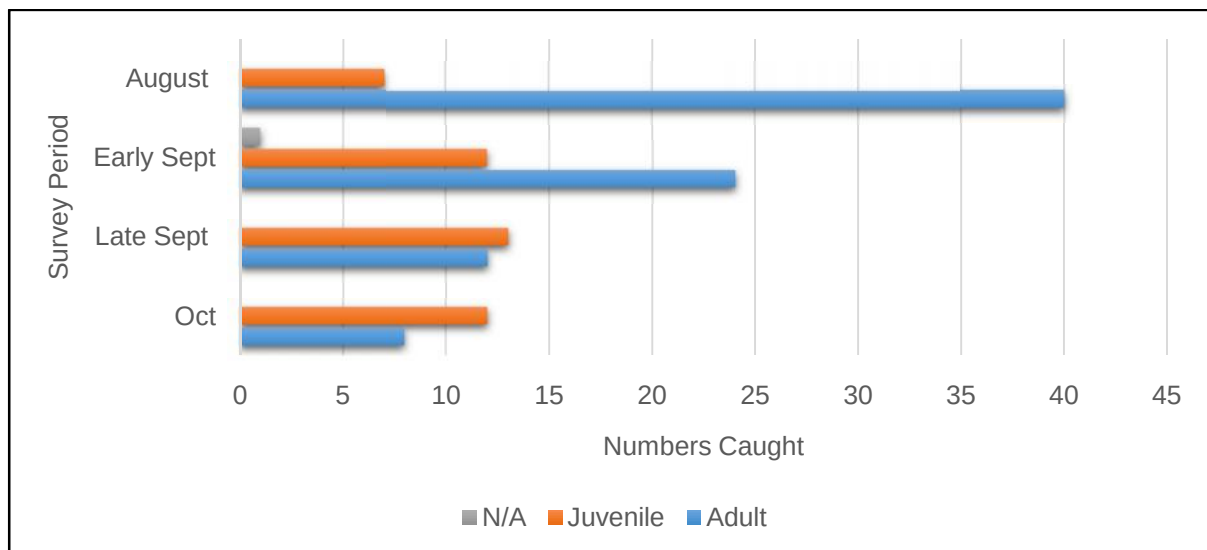


Chart 4: Number of adults and juveniles captured in each trapping session (combined across all species and for both sites).

The timing of the peak adult and juvenile capture rates was not constant for each species. The adult bat capture rate for Daubenton's bats, whiskered bats, and brown long-eared bats peaked early in the season (Charts 5-7). The adult Natterer's bat capture rate peaked later, in early September (Chart 8).

Adult Daubenton's bats only outnumbered juveniles in August, although as Chart 5 below shows, the difference in activity levels in that month was substantial. The lag in peak juvenile capture rate, relative to adult capture rate also appears to be present for Natterer's bats, with the number of juvenile bats caught continuing to build in late September and October, well after the peak in adult captures in early September. The numbers of juvenile brown long-eared bats and whiskered bats caught were too low to draw any meaningful conclusions from.

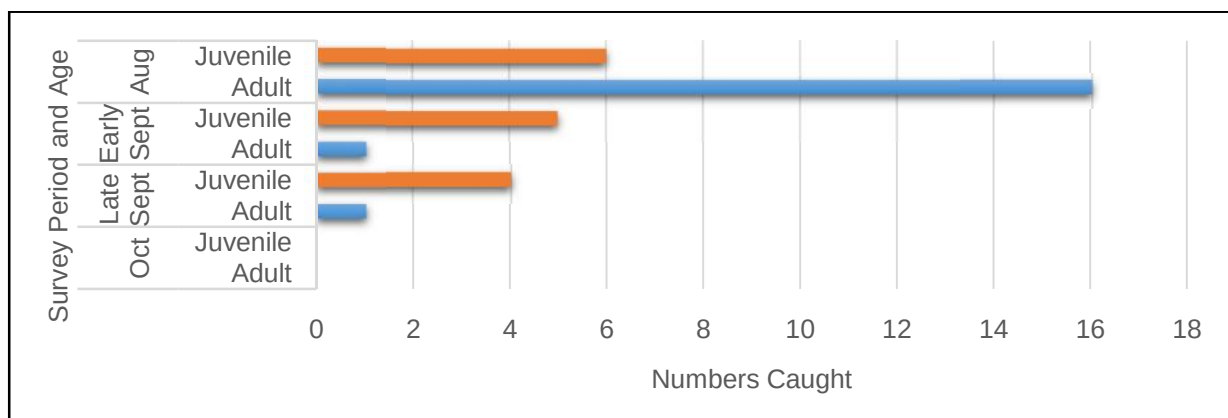


Chart 5: Number of adult and juvenile Daubenton's bats caught (combined for both sites) in each trapping session.

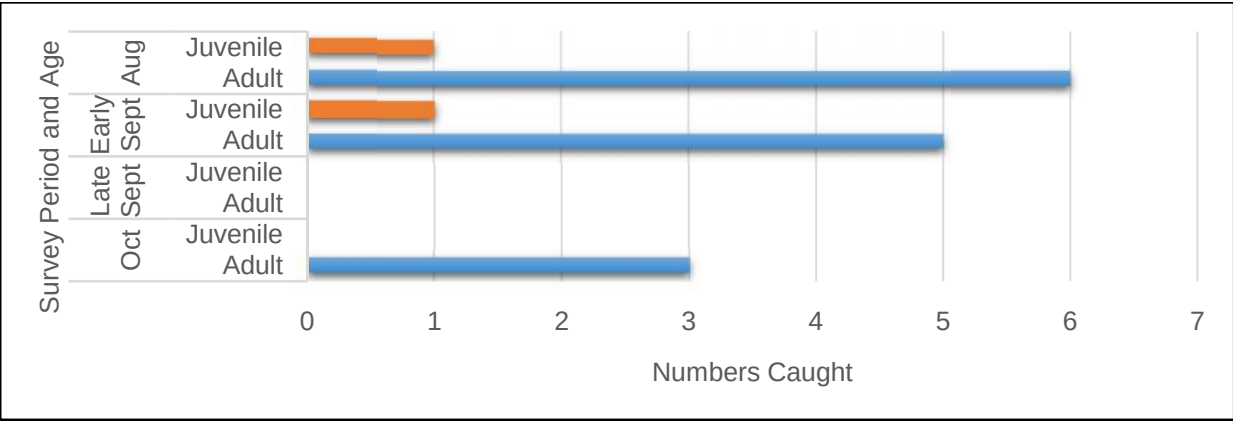


Chart 6: Number of adult and juvenile whiskered bats caught (combined for both sites) in each trapping session.

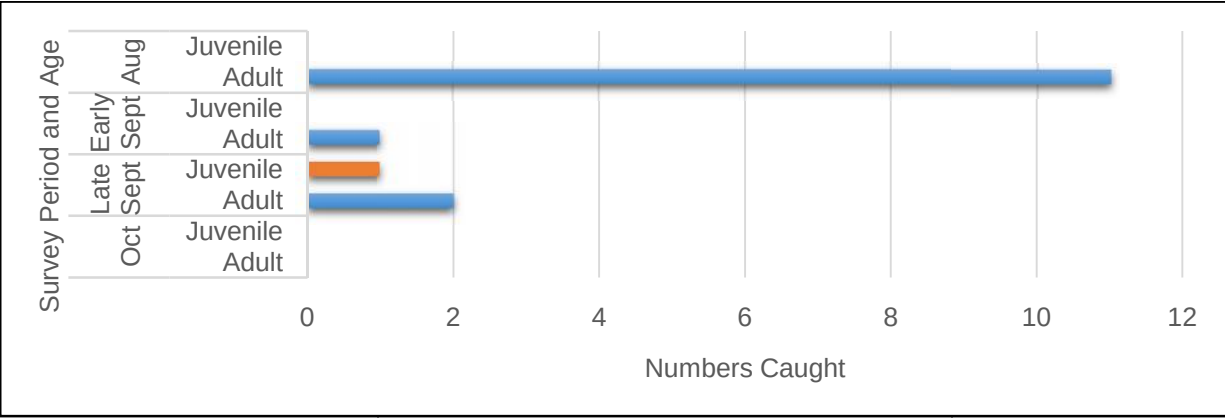


Chart 7: Number of adult and juvenile brown long-eared bats caught (combined for both sites) in each trapping session.

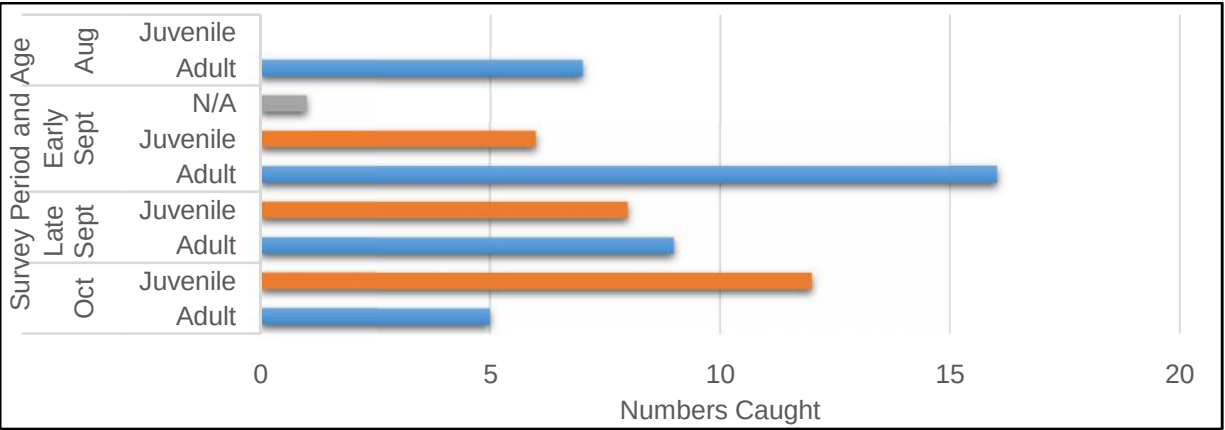


Chart 8: Number of adult and juvenile Natterer's bats caught (combined for both sites) in each trapping session.

Capture time

The peak capture rate, across all sessions, and all species, was recorded between 3 to 5 hours after sunset at Anston Stones Wood and 5 to 6 hours after sunset at Nearcliff Wood. The site of capture significantly influenced capture time at the $p < 0.05$ level ($F(1,103) = 5.35$, $p = 0.023$, univariate ANOVA). There were no significant effects caused by the other variables

considered (see table in appendix), apart from an interaction effect between age, species and location. However, it is considered possible that the single common pipistrelle caught may have skewed the result. Chart 9 summarises levels of activity per hour following sunset for each site.

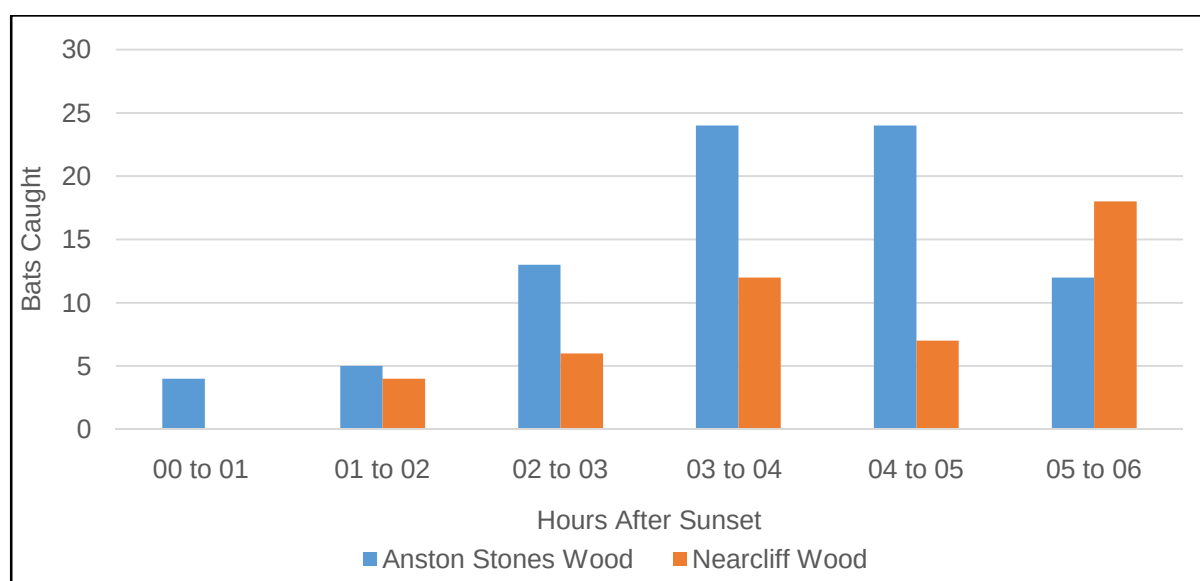


Chart 9: Bat captures broken down by hours after sunset.

Recaptures

The overall recapture rate was approximately 3.91%, across both sites and all species. This differed between sites, with Anston Stones Wood lowering the average recapture rate. The recapture rate at Anston Stones Wood was approximately 2.74% but 6.38% at Nearcliff Wood. Across both sites, all recaptures were male.

Static Monitoring

A total of 2,898 sound files were recorded from those bat species, which fitted the selection criteria outlined in the methods. A far higher number of sound files relating to autumn swarming bats species were recorded from Anston Stones Wood (2,717 sound files/94 % of sound files), in comparison with Nearcliff Wood (181 sound files/6 % of sound files) as shown in Table 5. This contrasted with the results of the trapping survey, which showed 64 % of all bats trapped were caught at Anston Stones Wood in comparison with 36 % of bats trapped in Nearcliff Wood.

Table 5: Sound files breakdown by site and trapping session.

Sessions	Anston Stones Wood		Nearcliff Wood		Both Sites	
	Total Sound Files	Sound Files/Hour	Total	Sound Files/Hour	Total	Sound Files/Hour
August	335	56	25	4	360	60
Early Sept	1186	198	92	15	1278	213

Sessions	Anston Stones Wood		Nearcliff Wood		Both Sites	
	Total Sound Files	Sound Files/Hour	Total	Sound Files/Hour	Total	Sound Files/Hour
Late Sept	893	149	17	3	910	152
Oct	303	51	47	8	350	58

The static monitoring species breakdown at the two sites is detailed in Table 6 below. This shows that the majority of sound files recorded at both sites were identified as Natterer's bat, although the percentage of Natterer's bat calls was higher at Anston Stones Wood. A higher percentage of whiskered/Brandt's bat sound files was recorded from Nearcliff Wood (24% of sound files recorded at site), in comparison with Anston Stones (3% of sound files). This fits with the expectations from trapping survey which did not record any Brandt's bat from either site, with whiskered bat only recorded from Anston Stones Wood. The percentage of Daubenton's bat and brown long-eared bat calls recorded at both sites was similar.

Table 6: Species breakdown across both sites.

Species	Anston Stones		Nearcliff Wood		Both Sites	
	Totals Sound Files	% Total Sound Files	Totals Sound Files	% Total Sound Files	Totals Sound Files	% Total Sound Files
Whiskered/Brant's bat	93	3	43	24	136	5
Daubenton's bat	206	8	10	6	216	7
Natterer's bat	2364	87	126	70	2490	86
Brown long-eared bat	54	2	2	1	56	2

In order to explore the correlation between the results of the trapping and static monitoring surveys, the number of bats captured has been plotted against the number of sound files recorded in Chart 9. Only trapping data obtained from cave or cave entrances surveyed using both the trapping and static monitoring survey method has been plotted. Each survey occasion generated four data points, comprising one for each autumn swarming bat species recorded during the trapping surveys (Daubenton's bat, whiskered/Brandt's bat, Natterer's bat and brown long-eared bat). Chart 10 shows that static monitoring data correlated quite weakly with the trapping results, with the data having a Pearson's correlation co-efficient of 0.55.

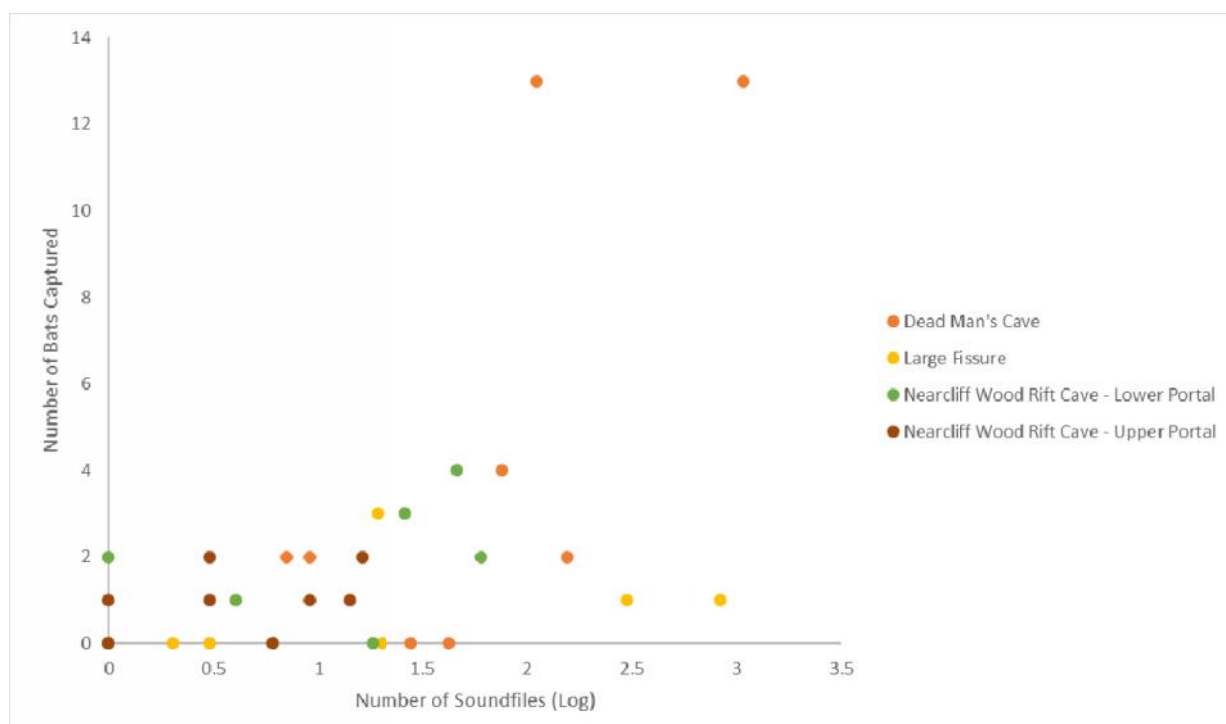


Chart 10: Comparison of trapping and static monitoring by cave or cave portal.

Hibernation survey findings

During hibernation survey undertaken at each cave in January 2017, a single hibernating brown long-eared bat was recorded from Nearcliff Wood Rift Cave, with no bats recorded during surveys of Dead Man's Cave and Large Fissure.

Discussion

Comparisons with other local studies

In comparison with other known swarming sites in northern England, these South Yorkshire sites display a number of similarities. This study captured a range of bat species commonly recorded at other swarming sites within the region including Daubenton's bat, whiskered bat Natterer's bat and brown long-eared bat.

Although the level of variation in species composition is notable, the overall species breakdown recorded during this South Yorkshire Bat Group (SYBG) study was broadly comparable to most other swarming capture projects (Glover & Altringham 2006, Rivers *et al.*, 2006, Roe 2015), even those located in southern England (Parsons *et al.*, 2003a). Although this is not true of the 2015 Derbyshire Bat Conservation Group work (DBCG) (Roe, 2016), it is interesting that the DBCG trapping study findings from 2014 do broadly match the breakdown in this study (Roe 2015) (Table 7).

Table 7: The percentage of captures recorded at Anston Stones (AS) and Nearcliff Wood (NW) as well as the percentage captured during the study overall (Tot). The table also shows the percentage of captures recorded for other nearby, or notable, projects.³

Species Recorded	Study							
	SYBG			Glover and Altringham (2006)	Rivers <i>et al.</i> (2006)	DBCG		Parsons <i>et al.</i> (2003a)
	AS	NW	Total			2014	2015	
Natterer's bat	62	28	50	54	79	40	11	37
Daubenton's bat	27	23	25	24	6	14	33	32
Brown long-eared bat	11	13	12	9	12	22	13	5
Whiskered bat	0	34	12	6	2	19	11	8
Brandt's bat	0	0	0	8	1	3	32	7
Other	0	1	1	0	0	0	0	12

Species composition is known to differ between swarming sites. A key difference between the results of this study and work conducted in North Yorkshire (Rivers *et al.*, 2006; Glover & Altringham, 2006) and Derbyshire (Roe, 2016) is the lack of any Brandt's bat captures. Additionally, the high proportion of whiskered bats recorded at Nearcliff Wood was substantially higher than average. It is noted that this is possibly due, in part, to the relatively low sample size of bats caught (just 47 bats in total) at Nearcliff Wood. Glover and Altringham (2008) identified that Natterer's bats dominated major swarming sites but that at minor swarming sites the species mix tended to be more evenly distributed. This fits with the findings of this study as both the capture rate, and proportion of Natterer's bats caught were substantially higher at the Anston Stones site than at Nearcliff Wood.

The sex ratio recorded at swarming sites varies across each research project and between species. Although the sex ratios recorded consistently have a highly male bias (Glover & Altringham, 2006; Rivers *et al.*, 2006; Roe, 2016), as with these other projects the sex ratio recorded at the South Yorkshire sites was also highly male biased.

The sex ratio for Anston Stones (78.72% males) and Nearcliff Wood (76.83% males), were both similar, with the percentage of males caught within the 70-80% range, resulting in an overall value of 77.52% (both sites combined). Rivers *et al.* (2006) recorded a similar sex composition. The sex ratio can be even more skewed, for example 84% of the 2015 Derbyshire Bat Group study captures were male (Roe, 2016), with Glover & Altringham (2008) suggesting differences in behaviour between the two sexes may be more pronounced in upland areas.

The peak period for autumn swarming varies between sites and bat species (Glover and Altringham, 2008; van Schaik *et al.*, 2015; Rivers, *et al.* 2006), with this period generally extending from August to October. The seasonality of use recorded in this study fitted with this pattern, but was dependent on species recorded.

³ The percentages in the table have been rounded up or down to the nearest whole number.

The earlier peak in whiskered bat and Daubenton's bat swarming activity when compared to Natterer's bat swarming is in line with other studies (Parsons *et al.*, 2003a; Glover & Altringham 2006; Roe 2016). Parsons *et al.* (2003a) propose that this could be primarily due to differences in hunting strategies as gleaning species such as Natterer's bat may be able to continue hunting in conditions that are unsuitable for aerial hawking species. However, if this were the only cause, it does not explain why brown long-eared bats also appeared to swarm earlier in the season in this study.

The lag in the start, and end, of swarming by juvenile Daubenton's bats and Natterer's bats could be the result of inexperienced juveniles taking time to learn where the swarming sites are and when to stop swarming. Although it is known that juveniles are more likely than expected to be caught with other juveniles than adults (given their respective overall capture rates) (Burns & Broders, 2015), such a lag in the timing of juvenile capture at swarming sites is not widely reported.

The nightly peak in swarming activity is most often recorded 4 to 6 hours after sunset (Parsons *et al.*, 2003b; Rivers *et al.*, 2006). A similar pattern was recorded at the South Yorkshire sites with the overall peak recorded between 3 to 6 hours following sunset. However, if study sites are assessed independently then the peak switches to 3 to 5 hours after sunset for Anston Stones Wood with a more complex pattern at Nearcliff Wood Rift Cave. At Nearcliff Wood Rift Cave a spike in the number of captures was recorded between 3 and 4 hours of sunset, followed by a lull from 4 to 5 hours, with the peak recorded between 5 and 6 hours of sunset. Although this could be the result of capturing foraging bats at Nearcliff Wood Rift Cave, it is noted that this could also be a facet of the low number of survey occasions (4 repeats) and effects of weather on one or more nights.

As documented by almost all previous swarming studies (Parson *et al.*, 2003b; Roe, 2016) weather on the survey night appeared to have a large influence on bat activity, however weather recorded during each of the 2016 catching sessions was considered to fall within the acceptable range for swarming surveys. As a some what anecdotal example of the likely impact of weather, intermittent light rain was experienced during the 21/09/2016 Nearcliff Wood trapping session and the number of bats caught was 58% lower than the early September trapping session at the site. This result suggests that inclement weather (at site or further afield) on the survey night is likely to have negatively affected trapping results.

Comparison of trapping and static monitoring methods

The survey results showed a positive but weak relationship between the number of bats trapped at a cave and the number of sound files recorded by a paired static monitoring device. Whilst both survey methods suggested that Anston Stones Wood experiences a higher level of bat swarming activity than Nearcliff Wood, static monitoring results showed the magnitude of difference between the two sites to be greater.

This study recorded a slightly weaker relationship between static monitoring and trapping data than a comparable study undertaken on a chalk mine in south-east England, which contrasted bat passes recorded by a custom bat activity logger with the number of bats caught in a single harp trap (Parsons *et al.*, 2003b). This might be in part due to our study encompassing two sites and four cave portals, in comparison with the single cave studied by Parsons *et al.* (2003b). Our study would appear to suggest that the number of bats

entering/exiting a cave and the level of echolocation activity close to the cave portal is likely to vary, depending upon site specific factors. It is likely that the distance between a cave portal and the main external bat flight areas utilised during swarming will vary with the site.

Within this study, trapping and static monitoring survey also recorded differences in the proportion of each bat species present at the study site. Both trapping and static monitoring survey recorded a greater level of whiskered bat activity at Nearcliff Wood and a higher proportion of Natterer's bats at Anston Stones. It was, however, noted that static monitoring recorded a higher proportion of Natterer's bats at both swarming sites when compared to trapping surveys. In comparison, static monitoring recorded a lower proportion of Daubenton's bats and brown long-eared bats.

Differences in the relative species abundance recorded during trapping and static monitoring are likely to result from an interplay of the following variables: ability of a species to evade the trap; variability in the volume and frequency of a species' echolocation call; and bias in species identification ability of any auto-analysis software used.

Overall our study demonstrates that in some instances static monitoring survey will give a different impression of the overall level of bat activity and bat species richness when compared with trapping survey data.

Importance of surveyed caves as hibernacula

A recent study in the Netherlands showed that bat species composition and abundance during swarming can correlate with composition and abundance during hibernation at the same site (van Schaik *et al.*, 2015). This relationship can, however, be difficult to demonstrate in practice as *Myotis* and *Plecotus* bat species often hibernate out of sight (Stebbing, 1988) and consequently visual surveys may be poor methods of assessing hibernacula (Glover and Altringham, 2008).

Whilst limited hibernation survey was undertaken as part of this study, the survey findings do appear to suggest that a far larger number of bats swarm at the surveyed cave than subsequently hibernate there. In particular, Dead Man's Cave is small, relatively easily surveyed and experiences high levels of human disturbance. Of the three caves studied, this cave appears to experience the highest level of use by autumn swarming bats, however no bats were recorded there during the hibernation survey. It appears unlikely that a high number of bats could use this cave during the hibernation period.

The findings of this study suggest that in some instances the autumn swarming importance of caves might far outweigh their importance as bat hibernacula. It is likely that in areas with few caves, small caves with limited chamber development and low suitability as hibernacula may nevertheless be of conservation importance as a location for autumn swarming.

Comparison of capture rates against other regional studies and contextualising results

Comparison of the level of autumn swarming behaviour recorded at different sites is biased by the trapping effort used during surveys. Additional sources of error and bias result from variation in annual and nightly survey timing, trapping efficiency, weather and identification protocols. Despite these considerations, in order to determine the level of importance of our sites, a contrast of our findings with those of two other studies undertaken within our region has been provided in Table 8.

Table 8: Comparison between studies.

Study	County	Cave	Median Number of Bats Caught/ Night
Rivers, Butlin and Altringham, 2006	North Yorkshire	Antofts	37
Rivers, Butlin and Altringham, 2006	North Yorkshire	Bucklands	35
Rivers, Butlin and Altringham, 2006	North Yorkshire	Slip Gill	32
Roe, 2016	Derbyshire	Owl Hole Cave	27
South Yorkshire Magnesian Limestone Study	South Yorkshire	Dead Man's Cave	19
Roe, 2016	Derbyshire	Jacobs Dream Mine	14
Roe, 2016	Derbyshire	Jug Holes Cave and Mine	12
South Yorkshire Magnesian Limestone Study	South Yorkshire	Nearcliff Wood Rift Cave	11
South Yorkshire Magnesian Limestone Study	South Yorkshire	Large Fissure	2.5

Table 8 shows that whilst trapping at the South Yorkshire caves typically records fewer bats than trapping at the North Yorkshire windy pits, median catch rates at Dead Man's Cave and Nearcliff Wood Rift Cave are comparable with the three sites studied in Derbyshire. The median nightly catch rate at Dead Man's cave is between 0.51-0.59 of the catch rate at the three windy pits. The windy pits are considered to be of up to national importance to nature conservation (Rivers *et al.*, 2006). On this basis, it appears reasonable to suggest the South Yorkshire study sites are likely to be of at least regional importance to nature conservation.

Importance of DNA testing

The importance of the DNA testing undertaken for this study cannot be underestimated due to the potential for misidentification of *Myotis* species, especially when confronted with an aberrant individual. It became apparent that one can prematurely misidentify an individual by not following a systematic procedure using an identification key. For an example of the potential pitfalls in identification; a DNA test result for a positive Daubenton's bat was

surprisingly mistakenly identified as a Brandt's/whiskered bat. The individual was small and dark in appearance and in hindsight, obviously a juvenile. Another example was when an aberrant *Myotis* species bat was identified as a Daubenton's bat using the key but the individual in question superficially appeared more like a Natterer's bat because of its red arms (a characteristic of Natterer's bat). The two thirds length of the calcar together with its large feet determined its identification as a Daubenton's bat. The bat had all the appearance of a hybrid but unfortunately a DNA test was not undertaken in this instance.

Importance of co-operation

The Magnesian Limestone Swarming Study was an inter-bat group working project between both South Yorkshire and West Yorkshire Bat Groups. Whilst it was a South Yorkshire Bat Group project, it would not have been achieved without the co-operation of the West Yorkshire Bat Group who loaned out a harp trap and contributed significantly to the field work. In our opinion this is a good example of inter-bat group working in the UK and it has resulted in numerous positive experiences and outcomes for members of both groups. The trapping sessions were attended by 22 South Yorkshire members and 12 West Yorkshire members in total, all of which were involved to some degree in the erection of harp traps and handling, processing and release of captured bats.



Figure 3: The trapping team in action and a Natterer's bat captured during the project.

Opportunities for further study

Repeat surveys at the 2016 study sites should in future years help to smooth any anomalies recorded and strengthen any assessment of the typical activity levels experienced at each site. In addition, alternative caves located within or close to the existing survey sites, such as Fissure Cave at Anston Stones Wood or Cadeby Pot located within the Don Gorge, could be surveyed either independently or in combination with the 2016 caves. Such an approach could provide further information on movements of bats between swarming sites located in close proximity to each other.

An alternative proposal being considered is to repeat the survey protocol across a number of new sites potentially reducing the number of survey occasions in order to increase the number of sites studied. New sites would be selected to maximise spread across the county and to take in alternative types of potential swarming sites, such as man-made tunnels. Given the relatively early stage of swarming survey works in South Yorkshire, inclusion of new sites would increase knowledge of swarming site abundance and diversity in the region

and contribute to existing information on bat species distributions in the county. This approach would also benefit the group when assessing the relative conservation value of county swarming sites.

Brandt's bat is a species regularly recorded at swarming sites. However, to date in-hand identification, and DNA analysis, has not recorded this species at either of the two South Yorkshire 2016 survey sites. This species has only been confirmed as resident at the western end of South Yorkshire (Jon Moore, pers. comm.) and its status within the wider county is poorly defined. This species is known to swarm early in the swarming season with activity recorded as peaking between the first and third week of August (Glover & Altringham, 2008; Roe, 2016). The first survey visits undertaken as part of this study were carried out in late August. It might be that early August trapping surveys undertaken at the 2016 study sites in future years would increase the likelihood of catching Brandt's bat.

The fur clipping method used in this study was considered to minimise risk/stress to the bats captured. However, this approach provided limited information regarding the recapture of individuals, as individual bats could not be identified and there was a risk of fur clip marks growing out during the survey period. Ringing of individual bats can provide extensive further information, including the location and date of first and repeat captures. This method would also allow identification of swarming bats in their summer and hibernation roosts. Joint effort to ring swarming bats across the region over the long term, could also provide information on cross county movements of individual bats. The ability to gather additional information does, however, need to be balanced against the risk to the bats welfare, with ringing only to be undertaken if future trapping effort can be committed to, and there is a clear use for the data collected.

Promoting site conservation

It is the aim of the project team to promote to Natural England a case for inclusion of autumn swarming bats as a feature of interest on the SSSI citation for Anston Stones Wood. It is considered that inclusion on the citation will help ensure that the importance to bats of the site's caves and fissures to bats is not forgotten or overlooked within future management plans or site assessments.

It is noted that Nearcliff Wood Rift Cave is located less than 100m from a SSSI boundary (Sprotbrough Gorge). A number of nearby caves and man-made underground features (Murphy & Cordingley, 2010; Engering & Barron, 2007), located both within and outside the SSSI have yet to be subject to autumn swarming survey. It might subsequently be possible to make a case for extension of Sprotbrough Gorge SSSI to cover a proportion of these underground features, due wholly, or in part, to their importance as sites for bat autumn swarming.

In addition to promotion of the study findings through this Northern Bats article, findings will be presented to audiences at South Yorkshire Natural History Day and the North of England Bat Conference. It is hoped that this study will inspire others to undertake bat conservation works in South Yorkshire and will promote study of the counties bats.

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Appendix

Results from a Univariate ANOVA considering the difference in time of capture when considering age, species, location and sex

Tests of Between-Subjects Effects

Dependent Variable: Hours after sunset

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	840021158.008 ^a	25	33600846.320	1.658	.041
Intercept	3636749606.926	1	3636749606.926	179.481	.000
Sex	12109356.859	1	12109356.859	.598	.441
Age	50673195.924	1	50673195.924	2.501	.117
Species	88624053.167	4	22156013.292	1.093	.364
Location	108434554.812	1	108434554.812	5.351	.023
Sex * Age	14184279.452	1	14184279.452	.700	.405
Sex * Species	70630963.622	3	23543654.541	1.162	.328
Sex * Location	3033685.165	1	3033685.165	.150	.700
Age * Species	99994317.791	3	33331439.264	1.645	.184
Age * Location	80965681.834	1	80965681.834	3.996	.048
Species * Location	29284571.778	2	14642285.889	.723	.488
Sex * Age * Species	81595300.068	2	40797650.034	2.013	.139
Sex * Age * Location	49481385.239	1	49481385.239	2.442	.121
Sex * Species * Location	13709598.472	2	6854799.236	.338	.714
Age * Species * Location	141535273.475	1	141535273.475	6.985	.010
Sex * Age * Species * Location	.000	0	.	.	.
Error	2087050767.57	103	20262628.811		
Total	27241117200.0	129			
Corrected Total	2927071925.58	128			

Bat hibernation locations in adits with relation to temperature variation

Tina Wiffen malinka1999@btinternet.com
Katherine Westerberg katewesterberg@aol.com

Introduction

The hibernation surveys within the lead mine adits in north Cumbria started in January 2014 and have been carried out in December, January and February of every winter since. The sites in this survey area are all within the Nenthead and Garrigill area in the North Pennines. Adits, or levels, were the main horse access routes into the lead mines, used to bring the ore to the surface for processing. The adits are level tunnels between 1-2m wide and from 1.5-2.5m high with small stone blocks used to construct the walls and arched roof. The mines themselves are not searched for hibernating bats as the mines maintain a steady temperature of 11°C and it is assumed (possibly in error) that the internal temperature is too high for bats to maintain themselves in torpor.

The study has grown over time; initially surveys were undertaken to establish if the adits were used by hibernating bats. As this study has progressed, more data has been recorded during each visit, with the aims now including considering how temperature within the adits affects the roost locations of hibernating bats and acoustic monitoring to try to establish when bats become active and leave these sites after hibernation. In winter 2016-7 dataloggers have been used to record temperature in the locations where bats have been found within adits and to test the assumption that the temperature rises and becomes more stable with distance underground. Additionally, from mid February 2017 static bat detectors have been placed in two adits to record bat activity. All sites that have been used by hibernating bats are registered with the Bat Conservation Trust's National Bat Monitoring Programme (NBMP). The surveys are undertaken by members of Northumberland and Cumberland bat groups.

This paper focuses on bats recorded in a single adit, Roaring Spring Water, during the four surveys in winter 2016-7. Due to the large amount of data generated by this project the results presented here represent a small sample of the wider study. More detailed analysis of the data is still ongoing. This report concentrates on temperature data both in relation to bats which were refound in subsequent months compared to bats which were not present a month later and in relation to the distance from the entrance of the adit.

Methodology

Roaring Spring Water is described as 'a trial level that does not go far' (www.aditnow.co.uk). This adit is the highest within the survey range, at 600m asl. Bat data was collected between December 2016 and March 2017. The level has stone arching for 28m from the entrance and then is shale cut, the tunnel narrows with distance underground. This adit was searched to 120m, beyond this the water level rises and the tunnel becomes small and harder to access. The adit was surveyed from the entrance inwards; all sections of arching were searched, as were the shale cut sections within the survey area. The adit was surveyed by a small team of surveyors led by experienced and licensed bat workers. The adits were searched with a torch taking care to check all the crevices from multiple angles.

When a bat was found, the species was identified and a datalogger placed in a spot below where the bat is roosting, in a different crevice to prevent disturbance to the bat and the possibility of the bat dislodging it when emerging. The dataloggers used were ibuttons; these are small loggers, 15mm in diameter and 5mm deep, discrete enough that they can be placed into the arching without revealing the location of the bat. The ibuttons were set to record temperature at four hourly intervals. The distance of the roost location from the adit entrance was recorded using a digital laser measure and a photographic record of the location of the bat and the ibutton was made to allow the crevice to be checked during the next survey for the ongoing presence of the bat. The recording of the bat and location were done quickly and efficiently to prevent any undue disturbance to the bat. In January, February and March the previous known roosts were checked for the ongoing presence of the bat within the same location between survey dates, bat behaviour was recorded, with a note made if the bat had moved or stayed.

Additionally, ibuttons have been deployed at 30m intervals from 0-120m within the adit to record ambient temperature inside the level. From mid February 2017 an Anabat Express bat detector set to night only has been placed near to the entrance of the adit to record bat activity within the level.

Temperature data was analysed by calculating the mean temperature and temperature range at each distance, the mean temperature range was calculated for both bat behaviours and a Wilcoxon rank-sum test in R (R Core Team, 2016) was used to test for significance.

Results

The maximum count of bats recorded within Roaring Spring Water on each survey visit was two Daubenton's bats and two brown long-eared bats in December 2016 and January 2017. During the survey period four bats were refound in consecutive months and seven bats were not present in the same location during the next survey (Table 1).

Table 1: Bat species, month present and distance from the entrance of bats recorded, bats present in the same location in the subsequent month are highlighted.

Bat species	Survey month			
	December	January	February	March
Daubenton's bat	26.5m	Not present	Not present	Not present
Brown long-eared bat	57.9m	57.9m	Not present	Not present
Daubenton's bat	80.0m	80.0m	Not present	Not present
Brown long-eared bat	98.4m	Not present	Not present	Not present
Brown long-eared bat	Not present	4.5m	Not present	Not present
Daubenton's bat	Not present	27.7m	Not present	Not present
Daubenton's bat	Not present	Not present	18.0m	Not present
Brown long-eared bat	Not present	Not present	52.8m	52.8m
Daubenton's bat	Not present	Not present	89.6m	89.6m

The ibuttons placed at the entrance of the adit to 120m underground at 30m intervals show that the temperature at the entrance of the adit undergoes greater variation than the temperature within the adit. The range of temperature variation decreases with distance underground, from a range of 11.5°C at 0m to 1.5°C at 120m (mean (°C): 0m = 11.5; 30m = 3.5; 60m = 3.0; 90m = 3.0; 120m = 1.5 (Figure 1)).

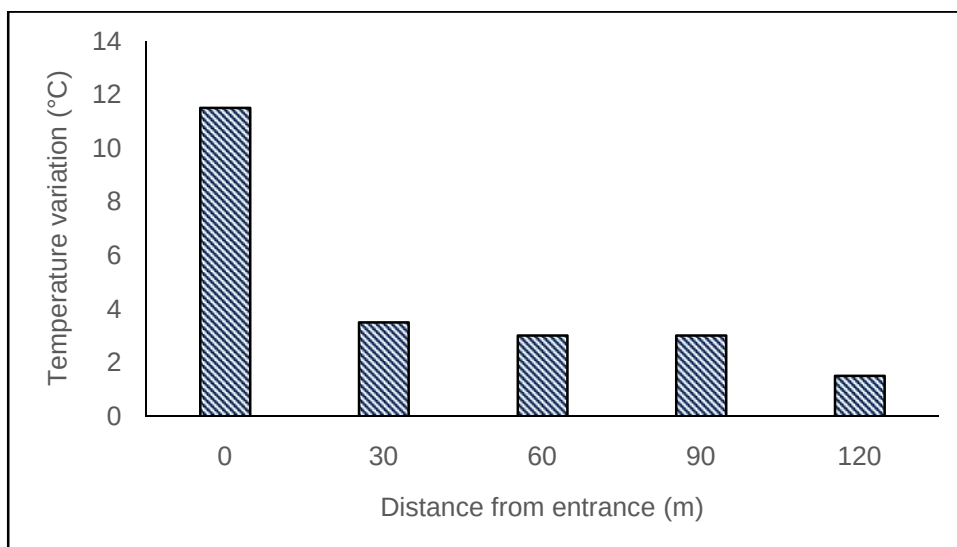


Figure 1: Temperature variation with distance from the adit entrance.

The mean temperature increases with distance into the adit, there is a small increase between 30-90m with a larger increase at 120m (mean $\pm$ standard error (°C): 0m = 2.706 ± 0.095 ; 30m = 5.186 ± 0.024 ; 60m = 5.417 ± 0.020 ; 90m = 5.947 ± 0.014 ; 120m = 6.605 ± 0.019 (Figure 2)).

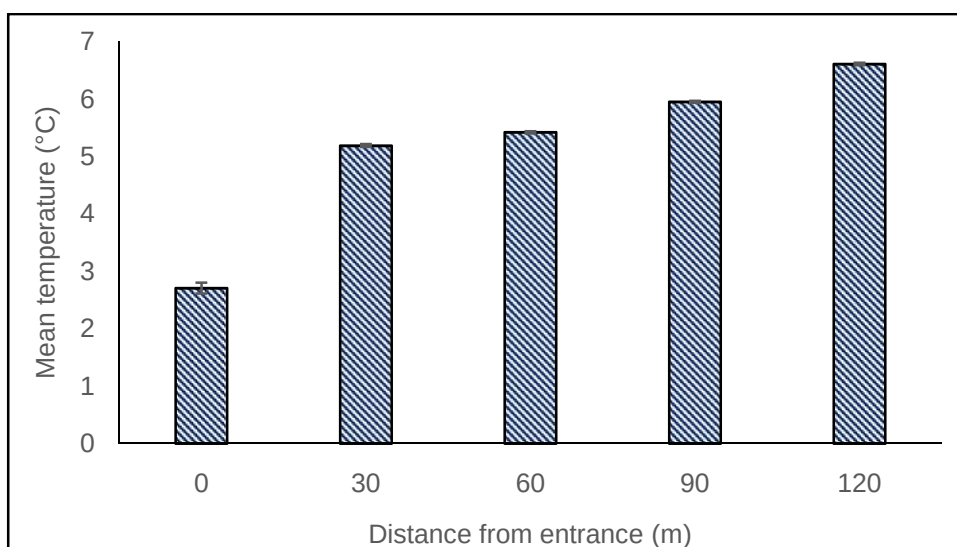


Figure 2: Mean temperature with distance from the adit entrance.

Four bats were recorded in subsequent months; seven bats were not refound (36.36% and 63.63% respectively). There was no significant difference between the mean temperature change for bats that stayed and bats that moved (mean $\pm$ standard error: bats that stayed = 1.63 ± 0.427 ; bats that moved = 2.57 ± 0.468 ; Wilcoxon rank-sum test, $W = 8$, $df = 10$, p -value = 0.2885 (Figure 3)).

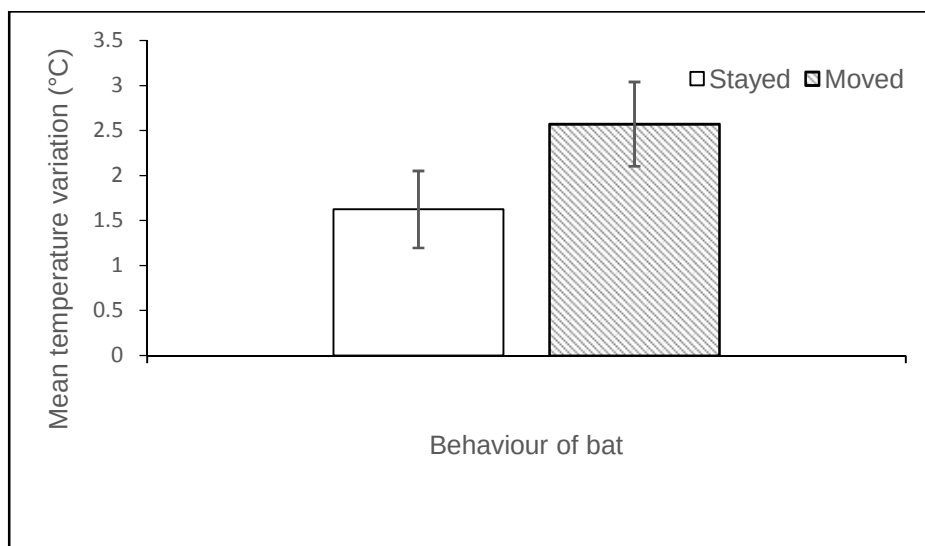


Figure 3: Mean temperature variation for bats that stayed and bats that moved.

The Anabat data collected in Roaring Spring Water from mid February to April is still to be analysed, although no bat files were recorded in February or early-mid March despite bats noted moving within the adit.

Discussion

There was no statistical significance between the mean temperature change for bats that stayed and bats that moved, however there is a potential for a pattern to be observed if more data is collected. The sample size was very small, with data for only 11 bats, collecting more data would enable a more representative sample, which would provide more reliable data to give greater precision and power to the results. Furthermore, when a bat was refound in the same location as the previous month it has been assumed that the bat has not changed its hibernation position between surveys. It is possible, based on data collected from a different adit, that the bat may have moved from this location and returned within the time between the two surveys. When a bat has moved it is not known when the bat moved during the survey interval, the bat may have been disturbed by the presence of the survey team and could have moved that night or it could have aroused naturally during the month between surveys and moved of its own accord. Data was recorded for a month at each point, so has been collected beyond the time when the bat was present. Areas of further research could include considering the data by species and also by the choice of hibernation location, either within a crevice or hanging openly against the wall.

The large degree of fluctuation at 0m is influenced by climatic conditions; this adit is at 600m asl in moorland with no protection from the weather, however the internal temperature becomes relatively stable at 120m from the entrance. The temperature at the entrance is influence by weather events, but by 30m the effect of these events is already less marked. The predicted internal temperature of 11°C was not reached; there are two possible explanations for this, either the dataloggers were not placed far enough underground or that this adit may be different as it is described as a trial adit and does not lead into an extensive mine system.

Future surveys will be undertaken following this methodology to allow more data to be collected. These surveys will be undertaken in this adit and also in the other adits that form part

of the wider study. Further analysis of results from different adits may provide further insights into these results; it may be possible to consider the effect of altitude or portal orientation.

Acknowledgements

This project would not have been able to take place without the help of members of both Northumberland and Cumberland bat groups. Thank you to everyone who has been part of the survey team, and especially to Cumberland and South Cumbria bat groups for the loan of their Anabat Express detectors. I hope you have enjoyed the surveys as much as I have, they are hard work but it's good fun and finding bats always makes it worthwhile.

Statistical analysis was completed by Katherine Westerberg to identify whether the results were statistically significant.

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The Bat Roost at St Andrew's Church, Grinton

Brigitte Donoghue ebdonog@hotmail.com

Introduction

St Andrew's Church in Grinton, Swaledale hosts a significant *Pipistrellus* bat maternity roost. The church is located approximately 185m above datum adjacent to the River Swale, close to Reeth (Figure 1). Two species of *Pipistrellus* bat, common pipistrelle *Pipistrellus pipistrellus* and soprano pipistrelle *P. pygmaeus* are known to occupy the roost, and it is also thought to house *Myotis* species bats and brown long-eared bats *Plecotus auritus*.



Figure 1: St Andrew's Church Grinton.

The vicar, Rev. Caroline Hewlett is very interested and enthusiastic about the bats despite the inconvenience they can sometimes cause. There is a Grinton Conservation Project which manages part of the graveyard as a wildlife habitat, benefiting the bats as well as other wildlife. With the help of the Yorkshire Dales National Park, sign boards have been erected in the churchyard providing information about the bats and other wildlife that can be found within it (Figure 2). There is also an additional information display about the bats within the church.

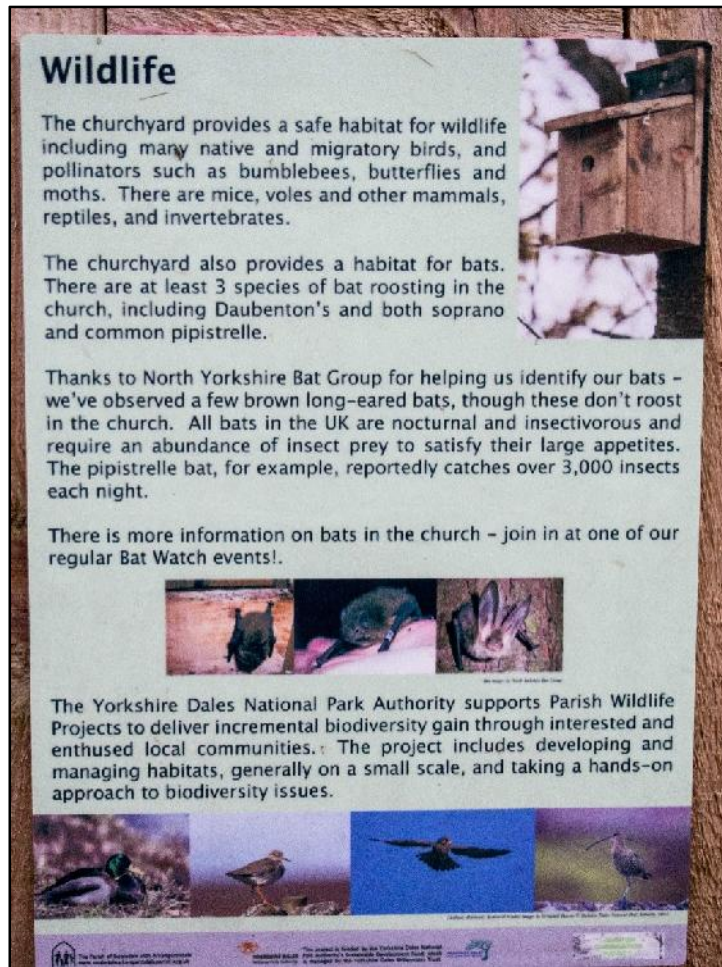


Figure 2: One of the sign boards produced by the Scenicview Gallery in Reeth and funded by the Yorkshire Dales National Park.

Given the location of the roost, it was agreed that more information about the roost population size and would be helpful. Consequently, a programme of monthly roost counts and bat observations started in 2015.

The project aims for 2015 were to:

- Establish how the roost population changes through the year.
- If possible, find out how many new pups were born in the roost.
- Try and find the other entrances and exits that the bats are using.

Equipment used:

- Bat detector - Batlogger M set to automatic trigger and recording.
- A clipboard and survey form.
- Hand held tally counter.

Methodology

Emergence surveys have been carried out monthly from April to October 2015. The surveys were carried out following the standard bat emergence protocols as listed in Bat Surveys: Good Practice Guidelines (2012).

The number of bats exiting the roost was counted and where possible the species identified. Any bat observed where the species was unclear was checked on the recordings later on. The calls of some *Pipistrellus* species bat were still not definitive so these have been recorded to genus level only.

Surveys in 2015 were carried out on:

- 01/04/2015
- 06/05/2015
- 03/06/2015
- 23/07/2015, survey delayed due to bad weather
- 05/08/2015
- 02/09/2015
- 01/10/2015

Temperature readings were recorded by the Batlogger M.

General weather observations were made although they are not presented in this article.

Results

The number of bats increased through the year. In April there were 21 *Pipistrellus* bats resident in the roost, rising to 88 in August (Figure 3). The numbers of common and soprano pipistrelle appear to fluctuate across the surveys. By the 01/10/2015 the number of bats in the roost had dropped to eleven.

The June survey coincided with a Swaledale Festival concert, consequently a degree of public engagement took place. For this reason, the count for the 03/06/2015 has a higher potential level of error than the other surveys. The Batlogger recordings were used as verification to reduce the level of error to that of the other surveys. The July survey was delayed due to bad weather at the start of the month.

Additionally, all species of bats noted within the churchyard during the survey period were recorded (Figure 4).

The temperature at the start and the end of each survey was noted (Figure 5).

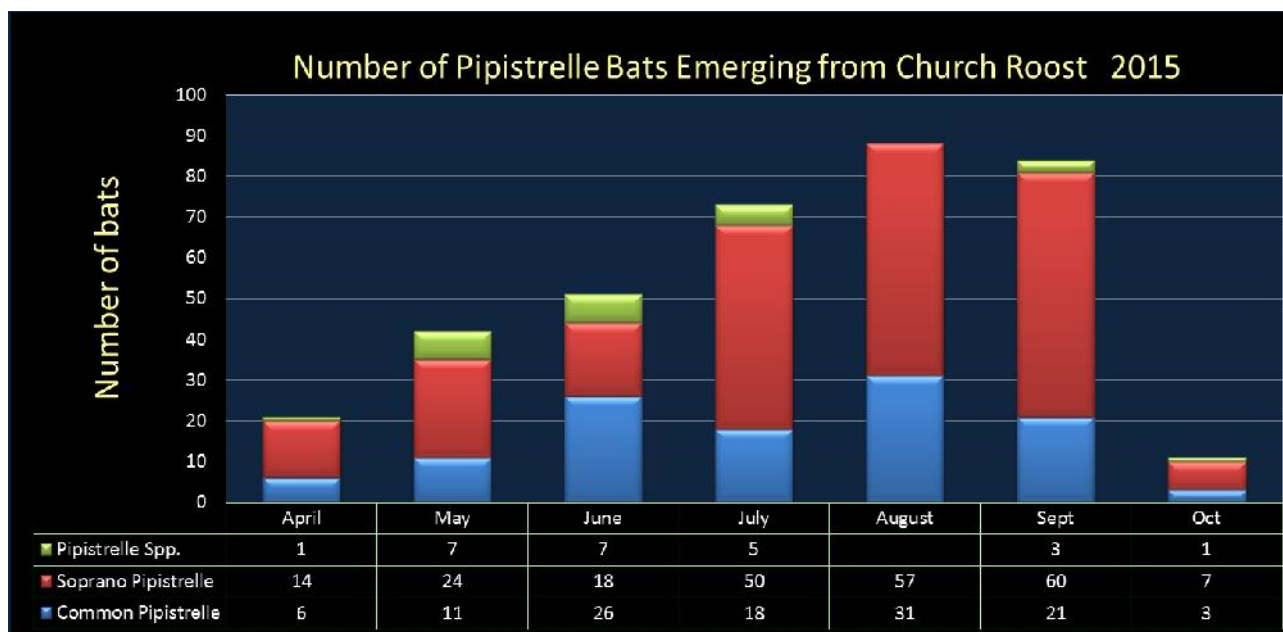


Figure 3: *Pipistrellus* species emerging from the roost by month, ± 2 bats.

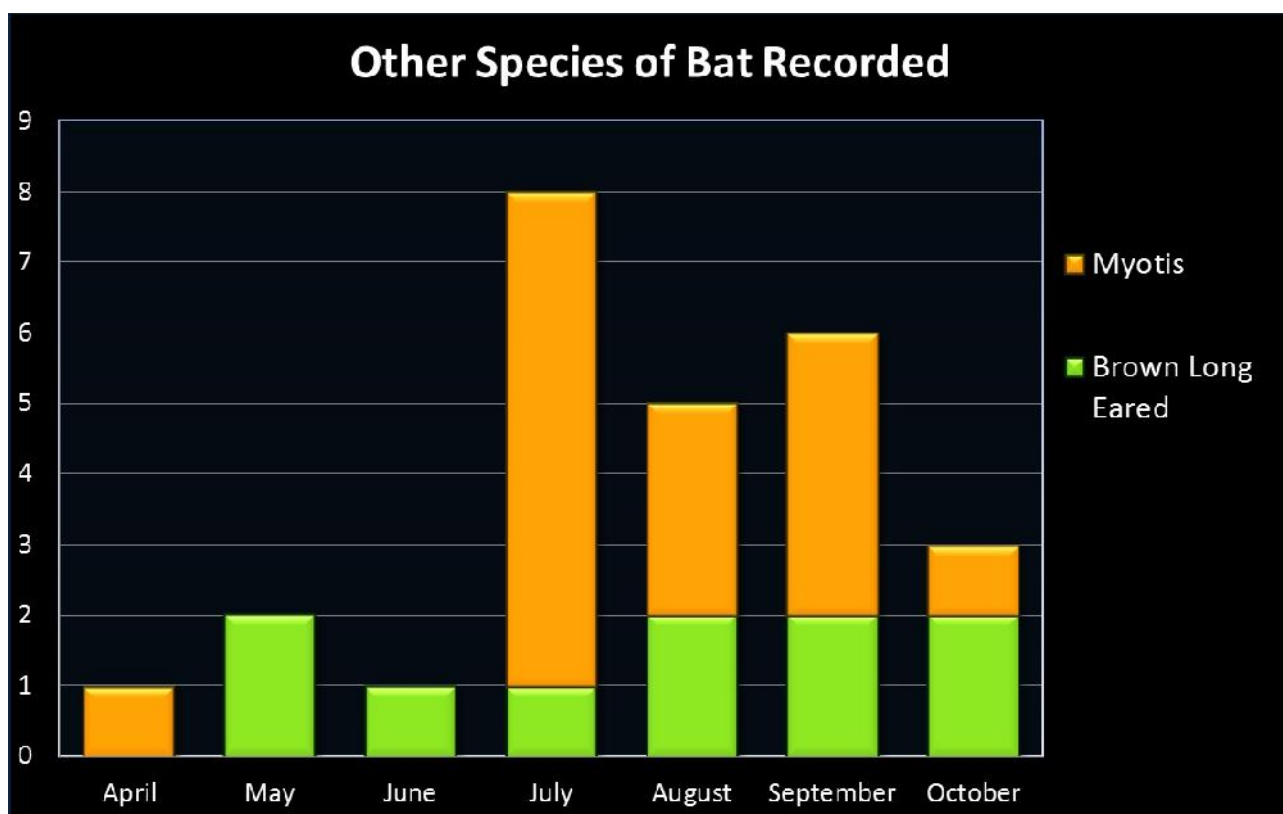


Figure 4: Other species of bats recorded in the churchyard.

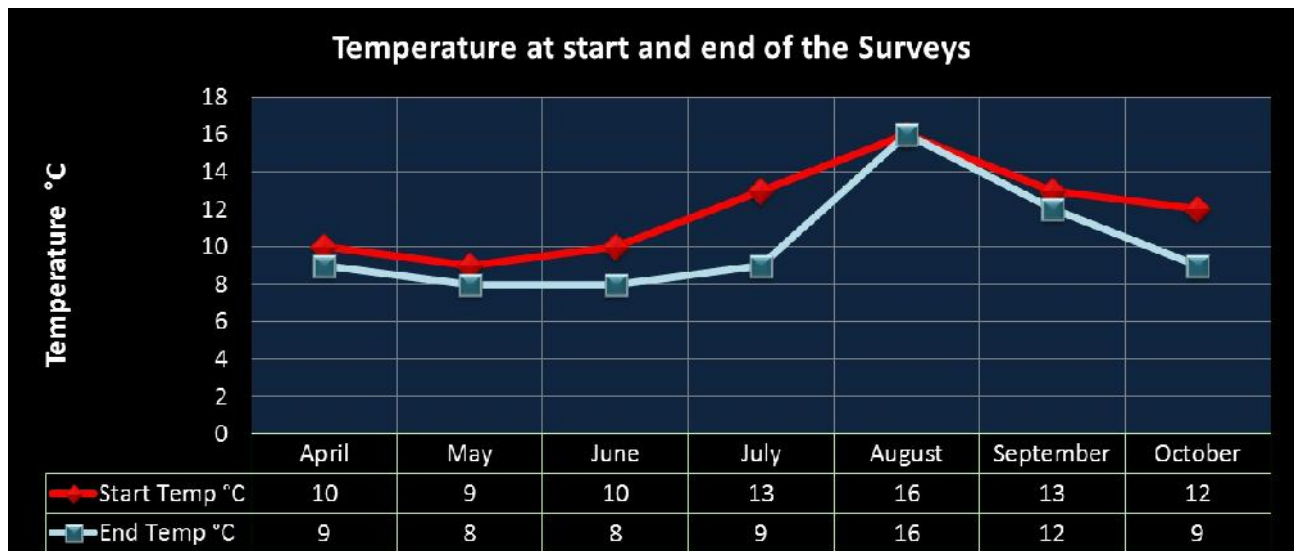


Figure 5: Temperature at the start and end of each survey.

Social Calls

There were a wide range of social calls emanating from the roost. There was an interesting correlation between the number and variation of social calls and the size of the roost population. The majority of calls corresponded to the pupping season, June, July and August.

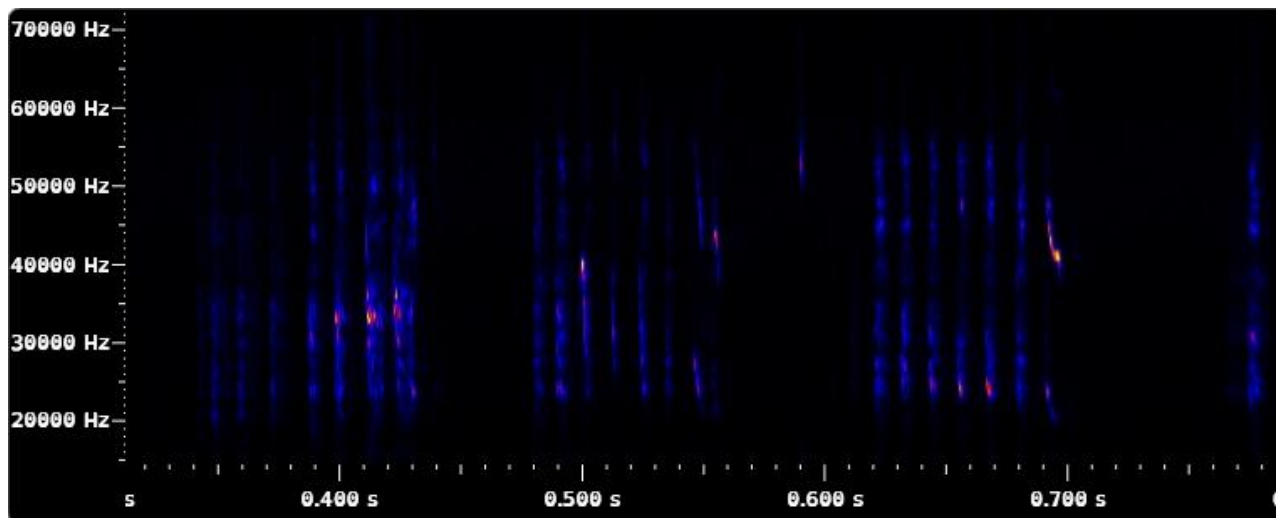


Figure 6: A sonogram from April showing the usual “chatter” often heard before bats emerge.

During June different types of call started to be heard which contained a more melodic element, (Figures 6-9). There were times when it sounded like long conversations were taking place within the roost. The three calls from June have one call around 50kHz and a second down around 28kHz. The lower frequency calls were clearly audible without a detector.

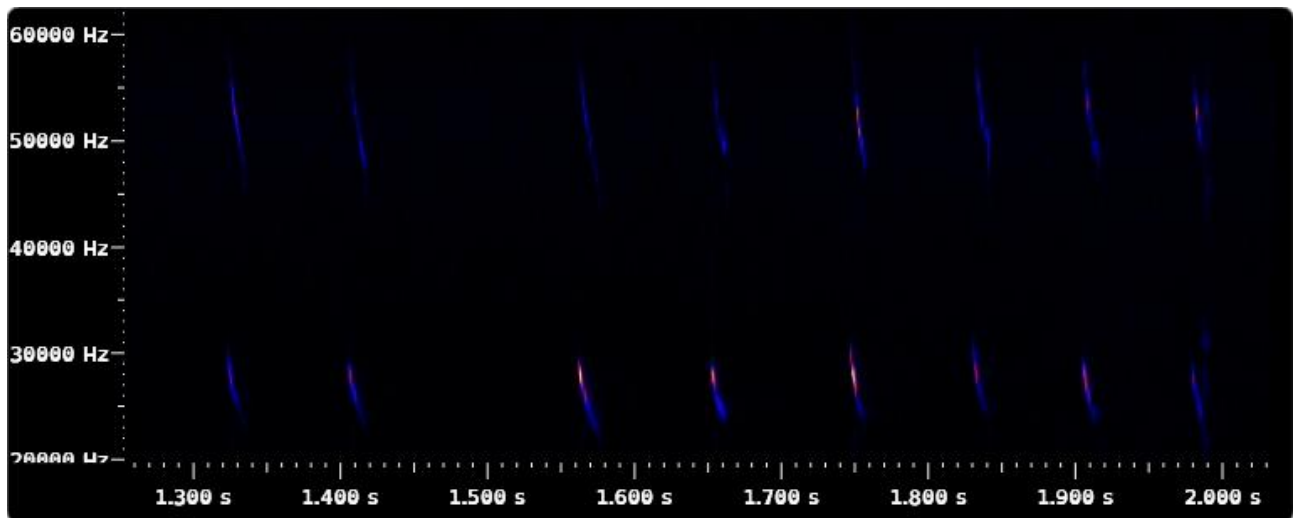


Figure 7: June social call 1.

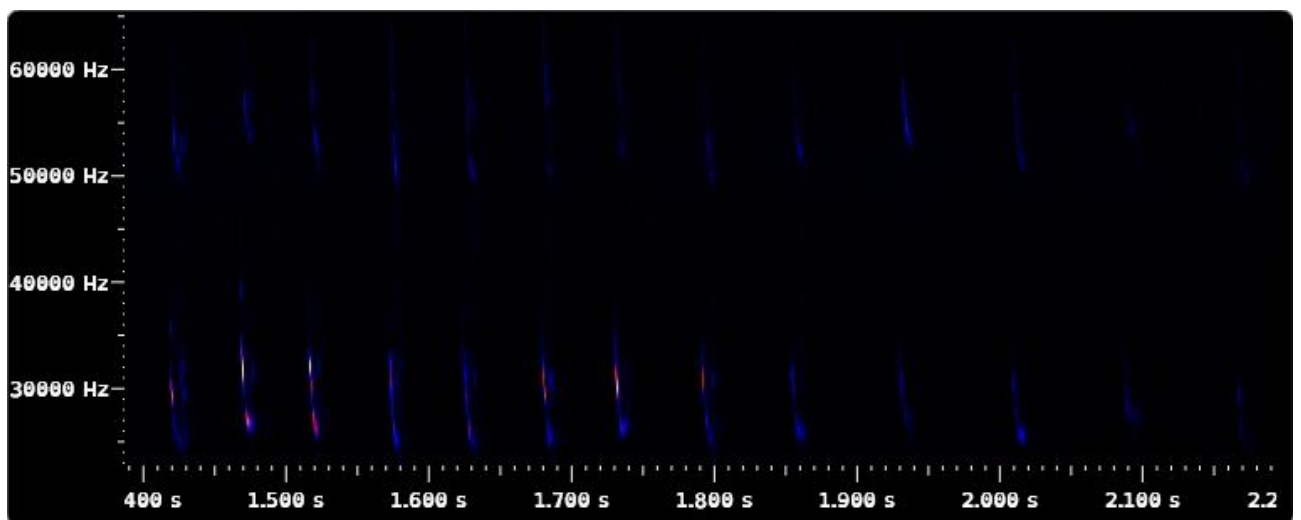


Figure 8: June social call 2.

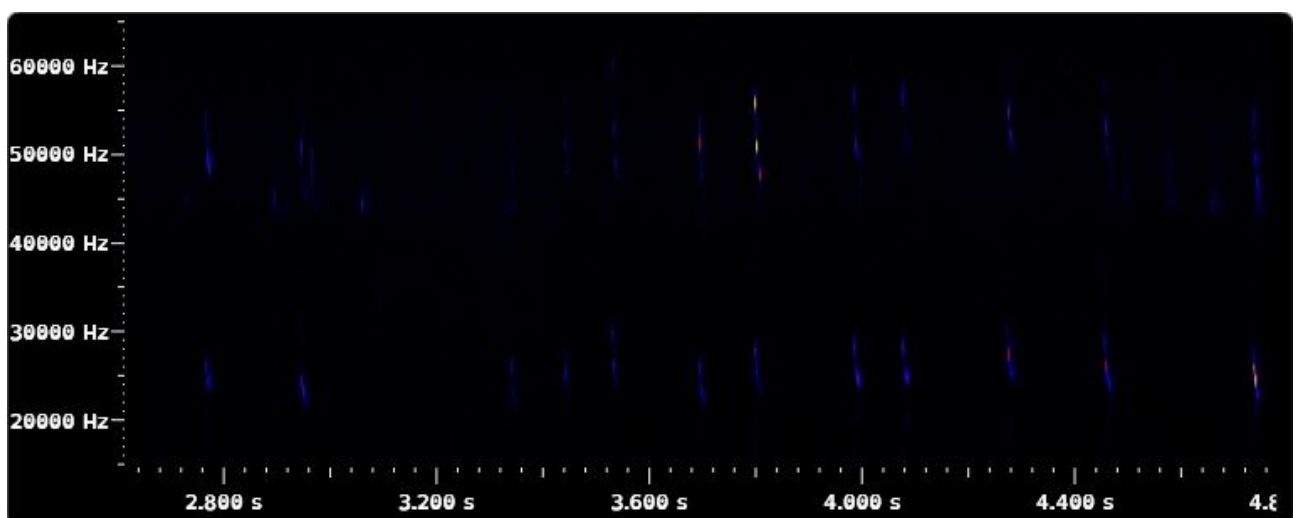


Figure 9: June social call 3.

The social calls recorded in July were very similar, although some had more emphasis on the lower frequency part of the calls (Figure 10), the second call from July shows the much more obvious pattern of pipistrelle social calls (Figure 11).

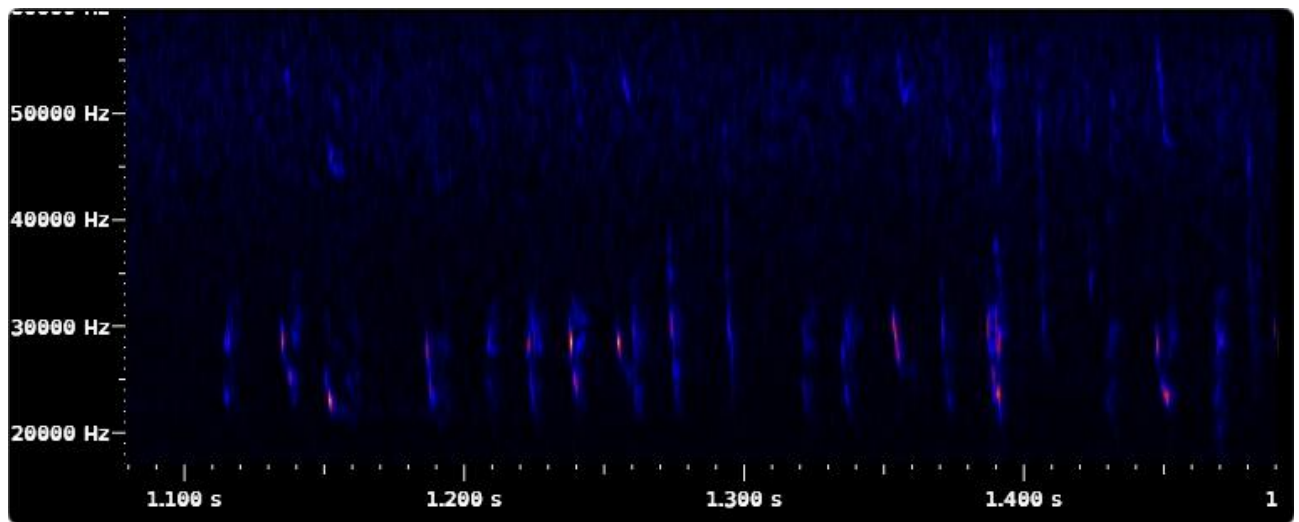


Figure 10: A sonogram of the social calls from the roost in July.

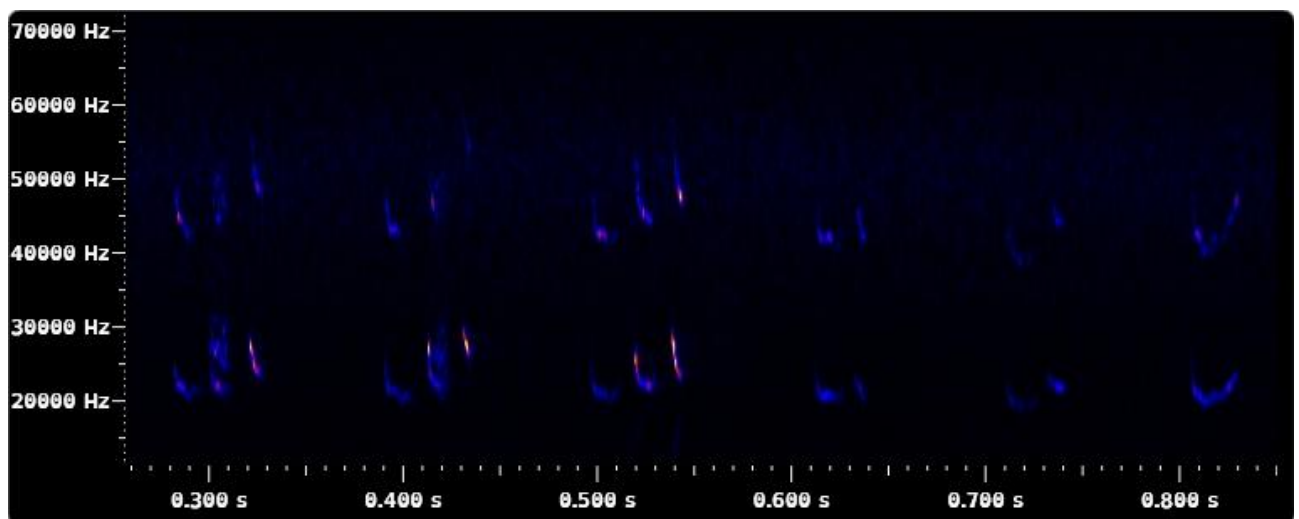


Figure 11: The second type of social call recorded in July.

During August another type of social call was recorded coming from the roost (Figure 12). In September (Figure 13) the bats seemed to return to the more standard pre-emergence calls.

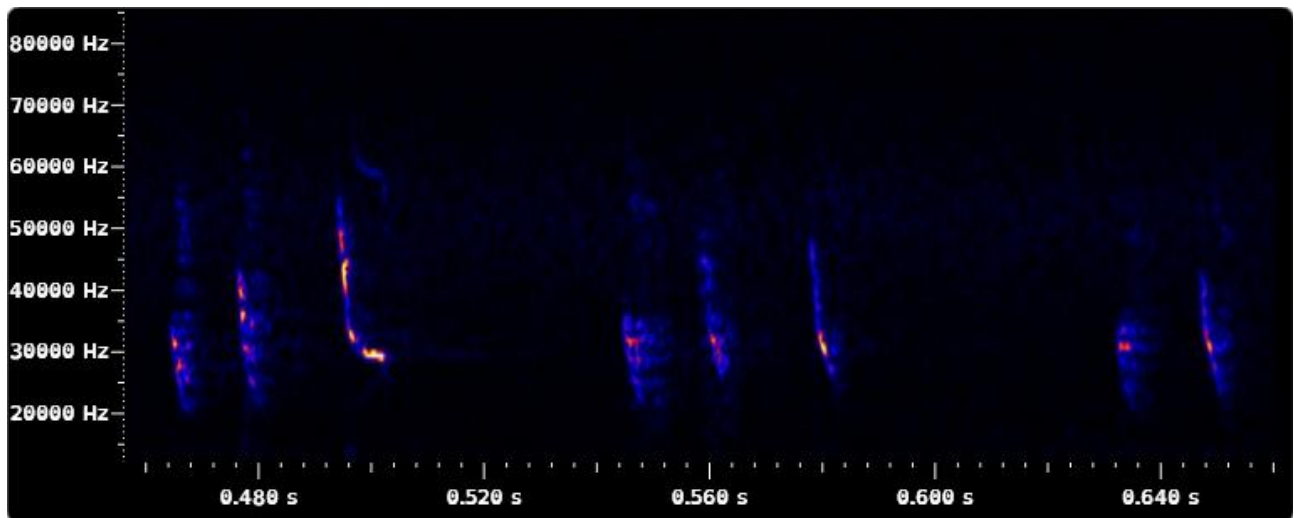


Figure 12: A roost social call during August.

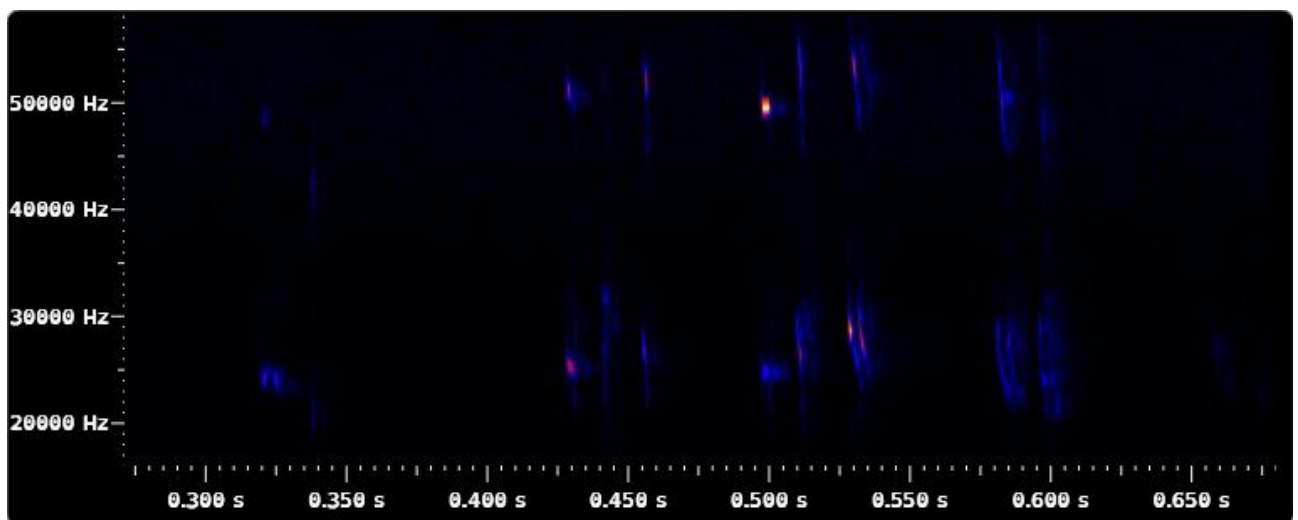


Figure 13: Another social call recorded in September.

Discussion

The findings from the short window the surveys provide show the life and use of the roost to be very complex. The first two project aims were met to some degree, but the low number of participants meant it was not possible to establish the locations of any other bat exits and entrances around the church. Bats are occupying the roost outside the standard maternity period, May to August. Currently it is not possible to say if they use the church as a hibernaculum and resident all year around, or if it is just a short term stop over. If they are male bats, then it is possible they could be resident all year around. An alternative explanation could be that they are pups who have not reached sexual maturity and so have not yet moved to the autumn swarming sites.

The results are in accord with the anticipated population curve for a maternity roost, with a peak number of bats found in August and early September. These results suggest that there were approximately 51 adult *Pipistrellus* bats in the roost and about 37 pups were born (Figure 3). The number of pups born in 2015 can only be given as an approximate figure.

The uncertainty of the June survey count and the late July survey make it hard to establish an accurate base line for the adult population.

The presence of brown long-eared bats was indicated by the quantity of droppings, inside and outside the church. However, only a couple were observed leaving the roost through the same exit as *Pipistrellus* bats (Figure 4). It seems likely that they use other exits from the church, especially as they are known to fly around inside prior to emergence. *Myotis* species bats were also recorded in and around the churchyard with Daubenton's bat *M. daubentonii* found along the river Swale. It is currently unclear whether the *Myotis* bats roost elsewhere and use the churchyard for foraging or if they too roost within the fabric of the church.

The count suggests that the young bats fledged somewhere between the middle of July and the beginning of August. The late July survey makes it hard to narrow down the timing further. Interestingly the survey showed an increase in the number of soprano pipistrelle from 18 individuals in June to 50 in July. Conversely, the number of common pipistrelle appears to have decreased from 26 to 18. The population fluctuations could be explained by the low temperatures in May and June (Figure 5) resulting in some of the bats remaining in the roost rather than leaving to forage. Another possible explanation is that individuals moved to, or arrived from, other roosts. It is beyond the scope of these surveys to be able to quantify these movements.

One unplanned but interesting finding was the varied social calls which were recorded emanating from within the bat roost (Figures 6-13). As might be anticipated the number and variation of calls followed the roosts temporal cycle. The most calls were recorded in June, July and August when the highest number of bats were present. The least were heard in April and October, when fewer bats were resident. The type of calls seemed to change and evolve along the lifetime of the roost. This may provide an area for further study in future years.

Conclusion

- The roosts occupation and use appears to be very complex with the number of common and soprano pipistrelle fluctuating throughout the year.
- The bats appear to have had a successful breeding year with the birth of about 37 pups, suggesting a healthy roost.
- The roost appears to have bats resident in it for longer than just the standard maternity period.
- Other bat species may be using different areas of the church utilising different access points.

Future work – 2016

- Try and establish the adult bat numbers during the counts in 2016.
- Investigate where else around the church bats are emerging.

- Record more of the social calls and interactions within the roost.

References

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Could this be the biggest noctule roost in the UK?

Adam West adamwest76@hotmail.co.uk



Figure 1: Nostell Priory.

In early 2016 West Yorkshire Bat Group (WYBG) were contacted by National Trust staff at Nostell Priory (Figure 1), near Wakefield, West Yorkshire. A structure known as the Gothic Arch (Figure 2), a late 18th century archway which once formed the entrance to the Menagerie Gardens, was deemed to require structural work to ensure the safety of the public walking through it. The archway was believed to be used by roosting bats and WYBG were asked to perform surveys prior to work being undertaken.



Figure 2: The Gothic Arch; the reason for WYBG coming to Nostell.

A request was circulated among WYBG members for volunteers to attend Nostell and carry out the survey. Around a dozen members responded and attended the Priory on the evening of 22/04/2016. With more than enough volunteers to survey the archway, two other features were selected for surveying to give all volunteers something to do. The former residence of the Menagerie's Keeper (Figure 3) was one feature chosen, as it had many points of access for bats and some bat droppings were found inside.



Figure 3: The Menagerie Keeper's House.



Figure 4: Beech tree.

The second additional feature surveyed was a mature beech tree (Figure 4), located on the shore of a large ornamental lake and containing numerous woodpecker holes. This tree had been noted some months previously when Maggie Brown was delivering some training at the Priory. She recognised the potential in this tree and having enough volunteers on the night, we decided to monitor it.

Three volunteers were stationed around the tree and in the run up to sunset they could hear social chatter from within the tree. Shortly after sunset, later than expected, 14 noctule *Nyctalus noctula* emerged and flew away over the lake. Satisfied with having witnessed an emergence of a good number of bats, the volunteers were milling around the tree and happened to hear more chatter coming from within. They repositioned themselves to watch for further emergence and waited. Approximately ten minutes later the second emergence began. Within the space of two to three minutes a further 135+ bats emerged.

The chance discovery of this major roost prompted a number of questions. What is the nature of this roost? Is it a hibernation roost which is about to disband or a maternity colony forming? Where are the bats from this roost spending the rest of the year? Is there a bigger noctule roost known in the UK? A follow up visit was organised to begin seeking answers to some of these questions. On the 22/05/2016 a second emergence survey found approximately 75 noctules emerging. However, conditions on that evening were suboptimal with a light but persistent rain falling throughout the survey. With the rain falling it is difficult

to say if this emergence represents a true picture of the numbers present at that time. A further survey was performed, under better conditions, on the 09/07/2016. On this occasion no bats emerged from the roost, suggesting that this is a hibernation roost which had disbanded for the summer.

In an attempt to determine the pattern of use at the roost, follow up inspections were carried out over the winter. On the 12/11/2016 an endoscope survey was performed. This was done from a ladder and only the lowest entrances were accessible. No evidence of occupation was found. On the 27/11/2016 a tree climbing survey, using an endoscope, was performed. All roost entrances were inspected but, once again, no evidence of occupation was found. A static detector was affixed to a nearby tree facing the roost. Data from the static detector was collected on the 01/01/2017 and another climbing survey using an endoscope was performed. There were still no signs of roosting within the tree. However, the data from the static detector revealed that on the 01/12/2016 there was a sudden increase in noctule activity in the vicinity of the roost, which tailed off over subsequent days. The static detector remains in place and further endoscope surveys will be performed in the coming months.

West Yorkshire Bat Group's work with this roost was featured in Bat Conservation Trust's quarterly magazine, *Bat News*. In this article, it was stated that we believe this to be the biggest known noctule roost in the UK and asked readers to let us know if they knew of one bigger. At the time of writing nobody has reported a larger roost.

References

West, A. (2016) 'Could this be the biggest noctule roost in the UK', *Bat News*, vol. 111, p. 5.

Boulby Bat Tunnel

Ian Bond bondian@hotmail.co.uk

Cleveland Potash Limited (CPL) which runs the mine at Boulby own quite substantial amounts of woodland in the surrounding area. Cutting through a high embankment in the woodland and starting just south of the Easington Beck, thereby being about 5m within the North Yorkshire boundary, there is a tunnel from a disused mineral line. The tunnel is several hundred metres long and 3m high, with around one third of the entrance bricked up at both ends. The lower courses are stone blocks and the upper courses brick. Water seeps through the ceiling to various degrees and at least half of the length of the tunnel has some standing water. Although access to the tunnel is discouraged it is evident that there is some human traffic throughout its length.

Since 2011, the Industry Nature Conservation Association (INCA) has been checking the tunnel annually for hibernating bats on behalf of CPL, with the information being fed into the National Bat Monitoring Programme. In the early years of the survey the tunnel was well pointed so roosting opportunities were limited to flaking bricks. In spite of this, meaning that the bats had to hibernate in very exposed locations, one to three individual bats have been found in most years across three species; Daubenton's bat *Myotis daubentonii*, Brandt's/whiskered bat *M. brandtii/mystacinus* and brown long-eared bat *Plecotus auritus*. One of the roosts is shown in Figure 1.



Figure 1: A typical flaking brick roost with protruding bat.

In addition to the hibernating bats, it was evident that bats were feeding in the tunnel from a number of moth wings on the floor. The moth wings were mainly in small alcoves in the tunnel wall, where it appeared that bats had been using a metal pin in the alcove as a feeding perch (Figure 2). The moth wings were principally from herald moths, *Scoliopteryx libatrix*. These moths hibernate on the tunnel roof in good numbers; in fact this is the second

highest recorded number of herald in Yorkshire, so it is likely that the bats had been feeding over the winter period.



Figure 2: Herald moth wings under a feeding perch.

Clearly the tunnel provided suitable conditions for hibernating bats so it was decided to research if its potential would be enhanced by the addition of bat boxes. CPL's joiner created a batch of bespoke bat boxes, which were based on the Kent bat box design of having narrow, open slots but varied in that they had four slots instead of two (Figure 3). They were also designed so that they would fit the curvature of the tunnel roof to enable them to be positioned at a reasonable height.

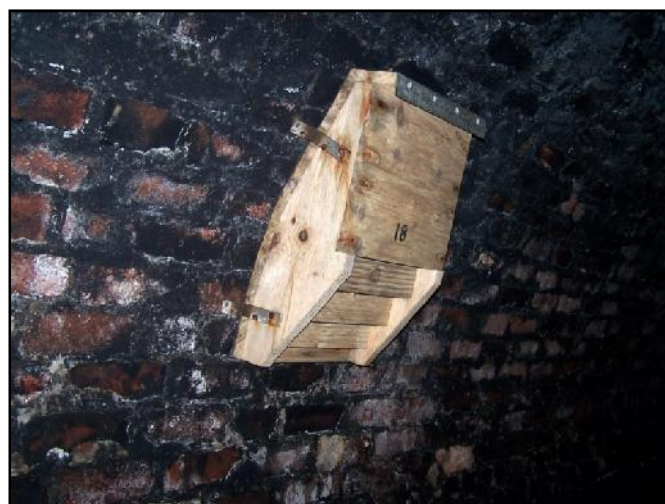


Figure 3: Bat box in Boulby tunnel.

The boxes were fixed in place in late summer 2013. Six boxes were attached to the west wall, starting very approximately 50m from the north entrance then around 20m apart, with the box entrances being around 2m above ground. All the boxes were placed on the same side of the tunnel at the same elevation. The tunnel and bat boxes were surveyed twice in 2014, in January and August. No bats were found on either occasion but there were bat droppings in and below a gap between sandstone blocks 45cm above the tunnel floor, which was a new roost location. In February 2015, two brown long-eared bats were found hibernating in the second box in from the entrance but no bats were found in the tunnel walls. In January 2016, a total of seven brown long-eared bats were spread across the four boxes furthest away from the entrance. Only in one case was there more than a single bat roosting in the same slot of a box and then at separate ends. This contrasts with long-term observations of brown long-eared bats roosting in an open-ended tunnel in Hartlepool, where they hibernate in a tight ball in spite of there apparently being plenty of opportunity to roost separately. In addition to the bats in the boxes, a single brown long-eared bat was hibernating in a shallow crack in the west wall, about 20m from the south entrance and about 1.1m above ground. This roost was above about 30cm of standing water, which would have given some protection from predators. No bats were behind flaking bricks.



Figure 4: Brown long-eared bat roosting in shallow crevice.

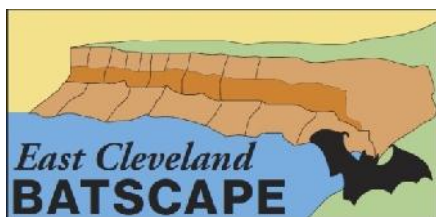
The two boxes nearest the north entrance did not have any bats in during the 2016 hibernation survey but both had large numbers of droppings that appeared to be from brown long-eared bats, suggesting that they are very well used during the bat activity season. Conversely the boxes with hibernating bats in them had no, or single numbers, of bat droppings underneath them suggesting that they were largely used for hibernation. It is unclear why some boxes should be used for hibernation and some when the bats are active as there were no readily apparent differences in temperature, humidity or light between the boxes, although the intention is to measure these parameters in future surveys.

It was noticeable in the 2016 survey that several gaps had appeared in the pointing that would potentially be suitable for hibernating bats. These were mainly in the stonework up to 1m above the ground but a small number were in the ceiling. Some were deep enough to require examination by endoscope however with the exception of the relatively shallow gap (Figure 4), none were used by hibernating bats.

As bat activity in the tunnel appears to have increased following the provision of these boxes, it may be worth considering using this design in other locations where there may be suitable climatic conditions for hibernating bats, but few suitable crevices. An additional benefit of this style of bat box for hibernating bats is that the bats can be monitored with relatively little disturbance.

The East Cleveland Batscape project

Sarah Barry sbarry@teeswildlife.org



Introduction

Over a year has passed since I last wrote about the East Cleveland Batscape project which unfortunately means the project is not long off completion. The project is due to finish in April 2017. Data is still being analysed, so we currently do not have any statistical results or have data entered into mapping software. However there is still much to bring to your attention.

As the Batscape is Heritage Lottery Funded, a large aspect of the project includes community engagement aiming to increase appreciation and understanding of the number of different bat species in East Cleveland and how they are using the landscape to roost, forage and commute.

Results so far

The project has been successful in engaging with the local community with public events and events targeted at specific groups. Through these events enthusiastic volunteers within the local community have become involved and have undertaken their own surveys and bat data analysis. Nineteen training events have taken place training 88 individual volunteers in how to use bat detectors and how to undertake their own survey, as well as how to use acoustic bat data software to analyse the data we are receiving from these surveys.

Thanks to these volunteers, the whole of the targeted East Cleveland Batscape area was surveyed. That is 120km² surveyed either with a line transect method using Anabat Express (frequency division) and Magenta (heterodyne) bat detectors or an SM2 (full spectrum) bat detector left in a single location within that one kilometre square for a minimum of three nights. Volunteers are also analysing this data using Analook W and Audacity software.

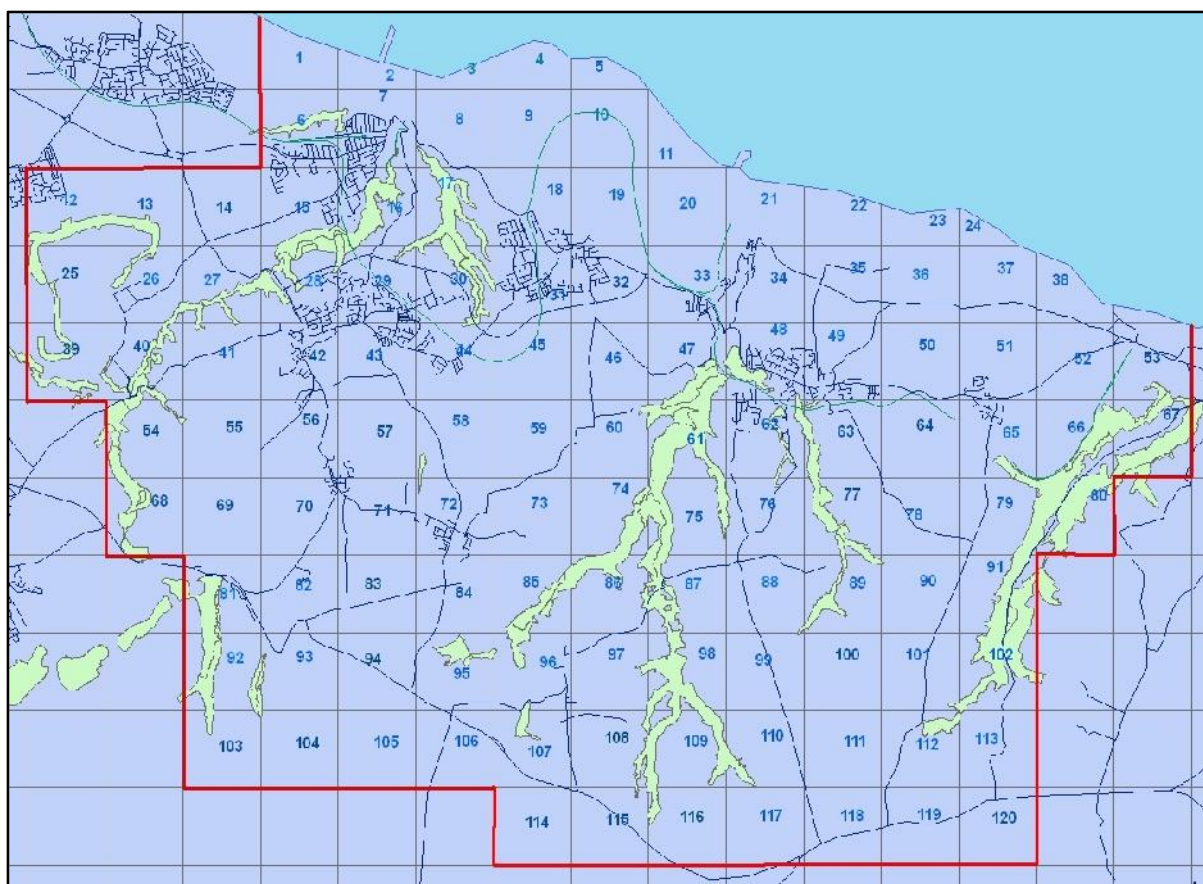


Figure 1: East Cleveland Batscape area, dividing the landscape into a mosaic of 1km² survey areas.

The data set acquired throughout the project is providing us with new information on bats in East Cleveland:

- We have found several major new hotspots that have not been surveyed previously.
- We have found bats at the top of cliffs along the Cleveland way at old alum quarries. These cliffs are the highest on the east coast of England.
- As far as we are aware, there were only two verifiable records of Nathusius' pipistrelle *Pipistrellus nathusii* in East Cleveland prior to the Batscape project commencing. We are still currently undertaking acoustic analysis of the data, but we now have a minimum of two more sites with acoustic data to prove Nathusius' pipistrelle are in the East Cleveland area (Figure 2).
- As far as we are aware, soprano pipistrelle *P. pygmaeus* had not been recorded in the East Cleveland area previously. We now have at least three acoustic records of soprano pipistrelle.
- Common pipistrelle *P. pipistrellus* in East Cleveland often produce foraging calls with a higher than average start frequency (Russ, 2012). Some start frequencies have been observed as high as 123kHz; the range, according to Russ (2012) is 50.8-95.2kHz.

- Many noctule *Nyctalus noctula* produced higher than usual calls. Leisler's bat *N. leisleri* and serotine *Eptesicus serotinus* have not previously been recorded in East Cleveland but several calls, recorded at different locations throughout East Cleveland, have been questionable and can only be described as "big bats" rather than identified to species level.
- Few bat roosts have been found, but there were many surveys with lots of social calls that require further investigation.

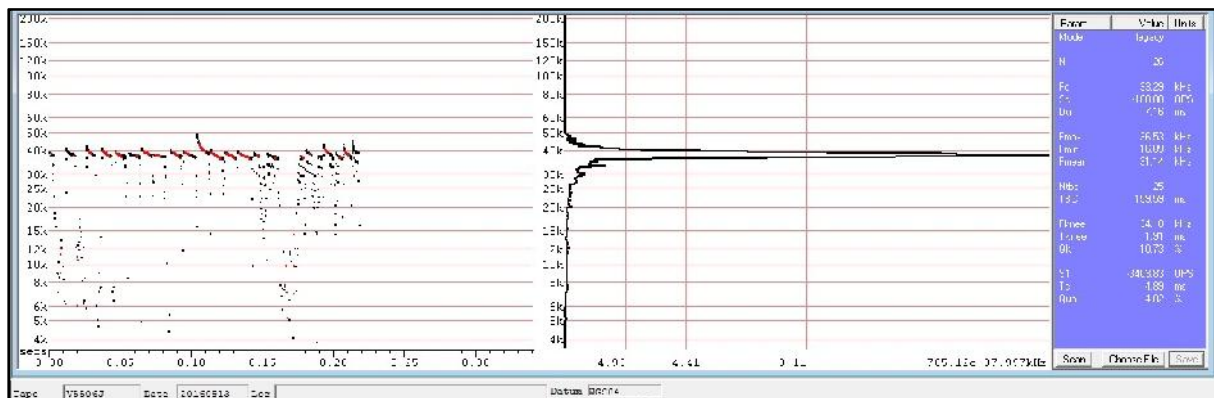


Figure 2: Nathusius' pipistrelle vocalisation recorded by Anabat Express at a new location within the East Cleveland area.

Public engagement

School visits have been a huge success with exciting responses from both teachers and children. Brownie, Rainbow, scout, cub, cadet and young farmer group sessions have been successful, all with follow up visits requested. Public events were surprisingly very well attended with 30 plus individuals attending talks and walks on a regular basis.



Figure 3: Eco-team pupils at St Josephs RC school proudly displaying their bat boxes.

One task required of the project was to produce an interpretive display that would tour local libraries and community halls. This was placed in ten different community buildings and had a good response with leaflets as part of the display disappearing quickly. Several engagement events were requested following on from the interpretive display.

Multiple interviews on BBC Radio Tees and Zetland Radio have provided the project with a good platform to advertise local events and helped dispel myths about bats and encourage an appreciation of them.

Achievements of the project so far:

- 106 active volunteers. Volunteers have undertaken surveys, web work, helped with events, bat data analysis, data management, design and photography.
- 19 workshops held with 88 volunteers trained in surveying and/or data analysis methods.
- 120km² surveyed. Many squares were surveyed more than once; a few were surveyed three times.
- Six schools visited, with 11 different sessions delivered and 275 children engaged with.
- 11 children's sessions provided with 255 children engaged with.
- Eight talks given, 319 individuals attended.
- 18 combined talks and guided walks given, 534 individuals attended.
- 12 guided walks given, 134 individuals attended.
- 72 events held in total with 1052 individuals engaged with.
- Evaluation undertaken at most events.

Please have a look at our website to learn more about the project www.clevelandbats.org

Future Plans

We are hoping that volunteers involved with the project will continue their learning of bats and undertake more local surveys, data analysis, public engagement and have an interest in becoming a bat carer. The nearest bat groups to East Cleveland are Durham and North Yorkshire. Although East Cleveland is technically in the North Yorkshire Bat Group area, there is a huge gap in bat surveyors and carers within the Cleveland area, with bat carers from outside of the area often having to travel long distances to pick up a bat that requires rescuing. One of the aims of the project was to co-ordinate a local bat group at the end of the project, but this is something still to be discussed and considered further.

We are looking at the possibility of a further study to continue surveying the East Cleveland area. Now that we know the area is good for bats, with specific hot spots, these places need investigating further.

A final report will be produced for the Heritage Lottery Fund to show the findings of the bat surveys including bat data plotted using GIS. This will include an analysis of the evaluation of public engagement events.

Acknowledgements

Many thanks to all the volunteers that have helped with surveys and data analysis and at public engagement events. Many thanks also to Stuart Newson of the British Trust for Ornithology for analysing the first season's full spectrum data with Sonochiro and for advice on the project. Thanks to Tina Wiffen for her continued advice on the project. Thanks to Ian Bond for feedback on bats in the area. Thank you to the Environmental Records Information Centre North East, the Bat Conservation Trust and local bat surveyors (Nick Whelan and Robert Woods in particular) for historic bat data for the region.

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The designation of Local Wildlife Sites for bats

Ian Bond bondian@hotmail.co.uk

Introduction

As is widely known, bats and their roosts are protected under UK statutory instruments, notably the Wildlife & Countryside Act 1981 (as amended) and the Habitats and Species Conservation Regulations (2010). Furthermore under the EU Habitats Directive, the UK government is required to designate as Special Areas of Conservation, core habitats for bat species that are on Annex II of the Directive (in the UK these species regularly occurring are both horseshoe bat *Rhinolophus* species, Bechstein's bat *Myotis bechsteinii* and barbastelle *Barbastella barbastellus*. Breeding or hibernation sites can also be selected as Sites of Scientific Interest under the Wildlife & Countryside Act, either for individual bat species or for an assemblage of breeding or hibernating species.

Beneath these tiers of statutory protected sites there is a third tier of locally important, non-statutory sites that are designated for nature conservation. These are currently known by the standardised name of Local Wildlife Sites (LWS) though they have previously gone under various names including Sites of Nature Conservation Interest and Sites of Biological Interest. Although there is often nothing to stop LWS being damaged or destroyed unless protected under some alternative legislation, LWS receive some protection from being adversely affected by permitted development through policies in the Local Plan of each Planning Authority. An example of the wording of such a policy is given below from the Hartlepool publication draft Local Plan.

Policy NE1

Locally designated sites: development of which would adversely affect a locally designated site, which is not also allocated for another use in the Local Plan, will not be permitted unless the reasons for the development clearly outweigh the harm to the conservation interest of the site. Where development on a locally designated site is approved, including sites that are also allocated for other uses, compensatory measures may be required in order to make development acceptable in planning terms and to mitigate against any loss of interest.

Furthermore, one of the performance indicators that Local Authorities have been required to report on to central government is the percentage of LWS in their area that are in positive management. This has provided some incentive to Local Authorities to take action to improve those LWS that they have some influence over, although it is to be imagined that in the current climate of funding cuts to Local Authorities, that this would fall down the list of priorities.

The approach to the identifying and selecting LWS was standardised across England by the publication of government guidance (Defra, 2006). The responsibility for this fell to Local Sites Partnerships (LSP). These are typically a sub-group of what were then Local Biodiversity Action Plan Groups and more recently of the Local Nature Partnerships (LNP) but in some cases individual Local Authorities have their own criteria for selection. The guidance required that: "All Local Sites systems should have a set of clear and locally defined site selection criteria with measurable thresholds ...". These criteria were to be drawn up so that they encompassed all areas of substantive nature conservation value including both the most important and the most distinctive species and habitats. *All sites*

meeting those criteria should then be designated. The criteria could take into consideration local circumstances, for example in an area where a particular species is very rare a criterion may be that any site supporting that species should be designated, whereas in areas where the same species is common and widespread it may not be appropriate to designate sites on account of it.

The way in which the use of selection criteria to identify LWS for bats might vary between various LSP was brought home by an article in the first edition of Northern Bats which referred to the criteria by which a site might be designated as an LWS on account of its bat populations by Barnsley Metropolitan District Council (Bell, 2016). This varied markedly from the two LSPs that I was familiar with, covering Tees Valley and Durham, neither of which have any criteria for selecting LWS for bats. This paper therefore attempts to draw a comparison between the criteria for the selection of LWS for bats across the region covered by Northern Bats.

Having chaired an LSP (Tees Valley) I'm aware that trying to encapsulate all that it is important to conserve in the natural environment within objective criteria, each with a set threshold, is fraught with difficulties, if not impossible. Therefore this article does not make any attempt to evaluate the suitability of any of the various criteria or make a judgement in terms of relative merits.

Data sources

As there does not appear to be a central repository of information on all LSP, information has been based on that which can be obtained from individual LNP or Local Authority websites. It is not guaranteed that this list is exhaustive or that the criteria might not have been amended since the information was referenced. The date of publication of each set of LWS selection criteria that have been used in this article and the area covered by each LNP (where this isn't obvious from the name) is given alongside the name of each LNP.

A summary of the criteria for selection of LWS for bats is given for each LNP. In many cases the selection criteria are quite lengthy and complicated, for example outlining the justification for selection or referring to appendices that give further information on bat populations in that LNP area. The detailed description may also list exclusions, for example in many cases it is stated that the criteria don't apply to domestic dwellings, or only apply in exceptional cases. In order to keep this article to a reasonable length, the full wording of the criteria for each LNP is given in an appendix, which can be downloaded separately from this edition of Northern Bats. The summaries below are therefore a simplification in most cases.

Results

A total of 16 LNP operate across the area covered by Northern Bats, of which at least 11 incorporate the role of Local Sites Partnerships. In addition, the four Unitary Authorities in South Yorkshire have their own set of criteria for designating LWS. Of the 14 for which it has been possible to get information all but three have at least one criterion by which a site can be designated as a LWS on account of the presence of bats.

Barnsley Metropolitan Borough Council (2011)

- Any breeding roost site that regularly supports a significant colony of bats (100 or more soprano pipistrelle bats *Pipistrellus pygmaeus*, 60 or more common pipistrelle bats *P. pipistrellus* or 30 or more of any other bat species).
- Any hibernation site which regularly supports at least ten bats or two or more species of bat.
- Any series of smaller hibernation sites which individually may not qualify as above but together are considered of significance.
- Any roost site which regularly supports at least three bat species.
- Any habitat area (e.g. woodlands, river corridors, lakes/lodges/ponds) which regularly support four or more foraging bat species.

Cheshire (2012)

- Likely breeding/hibernating populations of lesser horseshoe bat *R. hipposideros*, serotine *Eptesicus serotinus* and Nathusius' pipistrelle *P. nathusii*.
- Likely breeding/hibernating populations of at least two species of bat.
- Assemblages of mammals which score a total of 12 points (this includes a further nine species of bat which each score between two and four points).

Cumbria (2008)

- Any hibernation site that regularly supports two or more species of bat or ten or more individuals.
- Any site that regularly supports roosts of two or more species of bat, except where both common pipistrelle and soprano pipistrelle are present, in which case three or more species should be regularly present.
- Any breeding roost site that regularly supports a significant number of a bat species.
- Any autumn swarming site that regularly supports more than 50 bats.
- Any site regularly used by a significant proportion of the local populations of three or more species of bat.

Doncaster Metropolitan Borough Council (2010)

- Any single hibernation roost that regularly supports two or more species of bat and/or 15 or more individuals.

- Any series of smaller bat hibernation roosts that while individually would not qualify under the above criteria are together considered of significance.
- Any roost that regularly supports three or more species of bat.
- Any breeding roost that regularly supports a significant population of a bat species.

Hull and East Riding of Yorkshire (2010)

No criteria for bats.

Greater Manchester (2016)

This LNP covers Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan.

- Hibernation sites that are regularly used in one of the following ways: at least five individuals of one or more species or solely *Pipistrellus* species bats, hibernation sites of more than seven individuals.
- A breeding roost site that regularly supports more than 100 *Pipistrellus* species bat, ten Brandt's/whiskered bat *M. brandtii/mystacinus*, 20 of any other species currently known to occur in Greater Manchester or any size for other species not currently recorded with maternity roosts in Greater Manchester (e.g. Leisler's bat *Nyctalus leisleri* or serotine or colonisation by barbastelle).
- Any site which regularly supports roosting by three or more species of bat. Temporary night roosts and feeding roosts are not included within this categorisation.
- Any site which is of known importance for feeding bats either due to species numbers or numbers of individuals, will be considered for selection, even where it is not necessarily associated with a known roost.

Lancashire (2008 but may have been revised)

This LNP covers Blackburn with Darwen, Blackpool, Burnley, Chorley, Fylde, Hyndburn, Lancaster, Pendle, Preston, Ribble Valley, Rossendale, South Ribble and Wyre.

- Any site which regularly supports a roost of any species of bat.

North Merseyside (2008)

This LNP covers Knowsley, Liverpool, Saint Helens and Sefton.

- Any site which supports a roost of any species of bat.
- Any site other than a roost which regularly supports an exceptional assemblage of bats.

Northumberland (2011)

The LNP area includes the whole of Northumberland, excluding the North Pennines.

- Any site that regularly supports a hibernation or nursery roost of any species of bat.

North Yorkshire & York (2008)

- Any hibernation site that regularly supports two or more species of bat and 30 or more individuals.
- Any site that regularly supports roosts of three or more species of bat.
- Any breeding roost site that regularly supports a significant population of a bat species.

Rotherham Metropolitan Borough Council (2011)

- Any site that supports roosts of two or more species of bat.
- Any site that is regularly used for foraging by at least four species of bat.

Tees Valley (currently in the process of being updated).

The LNP area covers the former county of Cleveland plus the borough of Darlington.

There are no criteria for designating LWS for the purpose of conserving bats, in fact this is specifically excluded with regards to bat roosts however one of the criteria for designating waterbodies is the presence of at least four species of bat. The purpose of this is to use bats as a proxy for the biodiversity and bioabundance of the water body, which would otherwise be harder to measure.

Three Rivers (2013)

This covers the Durham Wildlife Trust operational area.

No criteria for bats.

West Yorkshire (2016)

- Any hibernation site that regularly supports ten or more individuals of any species of bat.
- Any site that regularly supports roosts of three or more species of bat, with at least five individuals of each species.
- Any breeding roost site that regularly supports a significant population of a bat species.

References

Bell, R. (2016) Romptickle Viaduct and Thurgoland Tunnel: survey and designation of a site for bats. Northern Bats, vol. 1.

Defra. (2006) Local Sites Guidance on their Identification, Selection and Management.

Appendix - Local Wildlife Sites for bats

Ian Bond bondian@hotmail.co.uk

This appendix shows the full text of the designation criteria for bats, for each of the Local Sites Partnerships listed in the main article that has such criteria.

Barnsley Metropolitan Borough Council (2011)

Sites qualifying for consideration will include one or more of the following:

(a) Any breeding roost site that regularly supports a significant colony of bats (100 or more soprano pipistrelle bats, 60 or more common pipistrelle bats or 30 or more of any other bat species).

(b) Any hibernation site which regularly supports at least ten bats or two or more species of bat.

(c) Any series of smaller hibernation sites which individually may not qualify as at (b) but together are considered of significance.

(d) Any roost site which regularly supports at least three bat species.

(e) Any habitat area (e.g. woodlands, river corridors, lakes/lodges/ponds) which regularly support four or more foraging bat species.

Where breeding sites are considered for selection, the selection may include vital flight and commuting routes to and from the roost and vital foraging areas around the roost.

Cheshire (2012)

S3 Mammals Sites should be selected that regularly support:

- Likely breeding/hibernating populations of hazel dormouse *Muscardinus avellanarius*, otter *Lutra lutra*, lesser horseshoe bat, serotine and Nathusius' pipistrelle.
- Likely breeding/hibernating populations of at least two species of bat.
- Assemblages of mammals which score a total of 12 points.

Mammal score based on local status (Cheshire mammal group):

lesser horseshoe bat 12

Daubenton's bat (*M. daubentonii*) 2

Brandt's bat 3

whiskered bat 3

Natterer's bat (*M. nattereri*) 3

Noctule (*Nyctalus noctula*) 3

Leisler's bat 4

serotine 12

common pipistrelle 2

soprano pipistrelle 2

Nathusius' pipistrelle 12

Brown long-eared bat (*Plecotus auritus*) 3

Cumbria (2008)

- Ma2a Any hibernation site that regularly supports two or more species of bat or ten or more individuals.
- Ma2b Any site that regularly supports roosts of two or more species of bat, except where both common pipistrelle and soprano pipistrelle are present, in which case three or more species should be regularly present.
- Ma2c Any breeding roost site that regularly supports a significant number of a bat species.
- Ma2d Any autumn swarming site that regularly supports more than 50 bats.
- Ma2e Any site regularly used by a significant proportion of the local populations of three or more species of bat.

Application

These guidelines will not be applied to domestic dwellings. Other artificial structures for example, mine shafts, tunnels, bridges, commercial and industrial buildings, and historic monuments (except those that are also domestic dwellings), however, may be considered for designation. Individual trees or groups of trees may be selected. Ma2a – Ma2c: a site may be any place used by bats for roosting. For summer and breeding roosts the site boundary may also include key feeding areas associated with the roost and flyways between them and the roost, where a discreet boundary can be identified. Key feeding areas are those locations bats from the roost regularly use for feeding and ones where they spend significant time feeding each night. Identifying key feeding areas for all species may not be possible or desirable, as some species feed over a wide area and in a variety of habitats. For other species, however, such as the Daubenton's bat, which feeds over lakes, rivers and canals, it may be appropriate to identify the appropriate water body. The selection of feeding areas for inclusion within the site should be based on survey information which clearly demonstrates the connection between the roost and the key feeding areas. Ma2e: a site may cover just feeding areas or flyways and flight lines, or may be applied to roosts in a similar manner to that described above. The guidelines are intended to identify and protect the most important regularly used or 'traditional' sites. It is not intended to cover sites that support low numbers of bats and/or roost sites which are intermittently used.

Numbers of bats that indicate a significant breeding roost in Cumbria:

Daubenton's bat 20 or more animals; Brandt's bat 10 or more; whiskered bat 10 or more; Natterer's bat 30 or more; noctule 20 or more; common pipistrelle 100 or more; soprano pipistrelle 400 or more; brown long-eared bat 30 or more.

Justification

All species of British bat are protected under Section 9 of the Wildlife and Countryside Act 1981 (as amended) and Section 39 of The Conservation (Natural Habitats, &c.) Regulations. This protection is provided because all species of bat have declined significantly throughout the UK in the last 50 years. This decline has been brought about by a variety of factors,

including reduction in habitat and subsequent habitat fragmentation, destruction of roost sites, either directly or through chemical treatment of roof timbers, and a reduction in insect food supplies arising from reduced habitat and extensive use of pesticides. Bats have a low reproductive rate, and consequently breeding success is vital to the survival of populations. When there is a loss through the destruction of a breeding colony, the recovery rate is slow. Breeding success is affected by a variety of factors including the quality of roost site, weather conditions, food availability and disturbance of the roost site. Bats are very selective in their choice of breeding roosts and good quality roosts are utilised regularly over a long period of time. Such roost sites often provide a variety of environmental conditions, which the bats are able to utilise depending on the prevailing weather conditions. These roosts also are often close to, or well connected by, flyways to good feeding habitat. Feeding areas close to roosts are particularly important as it means the female adult bats can readily return to the roost on a regular basis during the night to suckle their dependent young. Hibernation roosts are also important for the survival of a bat population and sites that provide suitable habitat for a variety of species of bat or large numbers of bats are particularly valuable. Hibernating bats require constant, undisturbed, cool but moist environments for hibernation, which will minimise the need for activity during the winter and hence the use of fat reserves. Like breeding roosts, some hibernation sites have been used regularly over many years.

Doncaster Metropolitan Borough Council (2010)

13. Site Selection Criteria - Mammals

M1

(a) Any single hibernation roost that regularly supports two or more species of bat and/or 15 or more individuals.

(b) Any series of smaller bat hibernation roosts that while individually would not qualify under criteria M1(a) are together considered of significance.

(c) Any roost that regularly supports three or more species of bat.

(d) Any breeding roost that regularly supports a significant population of a bat species.

Application

13.1 These criteria will be used to select sites that support significant populations of bats within Doncaster. The criteria will not be applied to industrial buildings, agricultural buildings or domestic dwellings. Other man made structures such as bridges, tunnels and mine shafts will be eligible for designation, as well as natural features such as trees and caves. Foraging areas, which have been identified by surveys as supporting the roost site, will also be eligible for inclusion within the designated area. Sites considered for inclusion under criterion M1(b) will be assessed through appropriate consultation.

Rationale

13.2 All species of bat found within the UK are protected by legislation (Wildlife and Countryside Act 1981 and The Conservation (Natural Habitats, &c.) Regulations). This protection has stemmed from the serious declines that these species have undergone in the last 50 years. Bats have a slow reproductive rate, females having only one offspring in a year, and hence are vulnerable to population crashes if breeding colonies are destroyed or damaged. An ideal breeding roost may be used repeated over many years and hence is appropriate for designation as a conservation site. Hibernation roosts can also be used repeatedly over many years. A good roost has to provide a variety of environmental

conditions and be suitable in a range of prevailing weather conditions. Roosts that support large numbers of bats or a variety of species are therefore particularly important. In addition, sites with a series of smaller roosts, that may provide differing environmental conditions, are equally important.

Numbers of bats that indicate a significant breeding roost in Cumbria:

Daubenton's bat 30 or more animals; Brandt's bat 30 or more; whiskered bat 30 or more; Natterer's bat 30 or more; noctule 30 or more; Leisler's bat 30 or more; common pipistrelle 100 or more; soprano pipistrelle 100 or more; brown long-eared bat 30 or more.

Greater Manchester (2016)

This LNP covers Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan.

All species of bats are UK and European Protected Species and UK Biodiversity Priority Species (except common pipistrelle, which has been removed in the 2007 UK BAP Review). The distribution and population sizes of bats in Greater Manchester are not well understood. In addition, the number of species present in the County is not truly known. To date validated records for ten species are known and all are considered of conservation importance. These species are: Daubenton's bat, Brandt's bat, whiskered bat, Natterer's bat, noctule, Leisler's bat, serotine, common pipistrelle, soprano pipistrelle and brown long-eared bat. The Bat SBI Guidelines will not generally be applied to occupied domestic dwellings or active industrial buildings. However, consideration will be given to the selection of sites in these types of premises, where the site is either critical to that species' survival in the Greater Manchester context, or supports high species numbers or exceptional populations. The boundaries of any site selected may include key feedings areas and/or commuting routes to feeding areas where they can be identified.

Mm1 BATS Sites qualifying for consideration for selection will include one or more of the following:

- Hibernation sites that are regularly used in one of the following ways; at least five individuals of one or more species, solely *Pipistrellus* species bats, hibernation sites of more than seven individuals.
- A breeding roost site that regularly supports more than 100 *Pipistrellus* species bats, 10 Brandt's/whiskered bats, 20 of any other species currently known to occur in Greater Manchester and of any size for other species not currently recorded with maternity roosts in Greater Manchester (eg Leisler's bat or serotine or colonisation by Barbastelle).
- Any site which regularly supports roosting by three or more species of bat. Temporary night roosts and feeding roosts are not included within this categorisation.
- Any site which is of known importance for feeding bats either due to species numbers or numbers of individuals, will be considered for selection, even where it is not necessarily associated with a known roost. Further consultation on the interpretation of the final bullet point of this Guideline should be sought from the bat specialists within the Greater Manchester Partnership (Appendix 1) on the determination of how

significant a site may be for a particular species in the sub-regional or District context.

Lancashire (2008 but may have been revised)

This LNP covers Blackburn with Darwen, Blackpool, Burnley, Chorley, Fylde, Hyndburn, Lancaster, Pendle, Preston, Ribble Valley, Rossendale, South Ribble and Wyre.

Ma1(b) Any site which regularly supports a roost of any species of bat, as included in Schedule 5 of the Wildlife and Countryside Act 1981 (as amended).

Application

It is not intended that this guideline will be applied to domestic or industrial (including agricultural) buildings, whether or not they are in use by man. However, consideration may be given to certain types of artificial structures, such as tunnels, bridges, retaining walls and mine shafts. Any type of roost (nursery, hibernation, etc.) may be selected. The following bat species are presently known to occur in Lancashire: Daubenton's bat, Brandt's bat, whiskered bat, Natterer's bat, noctule, serotine, *Pipistrellus* species bat and brown long-eared bat.

Justification

All British bats are protected under section 9 of the Wildlife and Countryside Act 1981 in view of the threats faced by bats generally. Whilst the *Pipistrellus* species bat, by far the commonest species in Britain and in Lancashire, is largely associated with buildings, natural habitats and other structures are also important, especially for the scarcer species. N.B. Whilst bats and their roost sites are protected under the Wildlife and Countryside Act 1981 (as amended), their foraging areas are not. Successful conservation of bats is dependent not only on the protection of roost sites but on the identification and protection of their key feeding areas. The National Bat Habitat Survey investigated the use of numerical measures of bat flight activity. Such surveys of the habitats required by foraging bats in the County are not sufficiently advanced; consequently the quantitative information required to develop and apply a guideline relating to foraging habitat is not currently available. A standardised methodology for bat surveys should be available in the future with the publication of the Bat Survey Manual.

North Merseyside (2008)

This LNP covers Knowsley, Liverpool, Saint Helens and Sefton.

Bat1 Any site which supports a roost of any species of bat.

Application

12.1 It is not intended that this guideline should be applied to domestic or industrial (including agricultural) buildings, whether or not they are in use. Protection of bats must rely upon the provisions of the Wildlife and Countryside Act in such situations. However, consideration may be given to certain types of artificial structures such as tunnels, bridges and retaining walls. Any type of roost site may be selected.

12.2 Bats are highly mobile species and require a range of roosting, breeding and feeding sites at different times of year. Much existing conservation effort has focused on their need to congregate in summer breeding colonies and winter hibernation sites. Bats are especially

vulnerable at such sites but it is recognised that their protection may be insufficient for the successful conservation of bats.

Justification

12.3 All British bats are protected under section 9 of the Wildlife and Countryside Act 1981 (as amended) in view of threats faced by bats generally. Bats are also protected through the Habitats Directive Article 12 which prohibits a) all forms of deliberate capture or killing of specimens of these species in the wild, b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration and c) deterioration or destruction of breeding sites or resting places. This protection also applies to other European protected species that are present in North Merseyside. Whilst the *Pipistrellus* species bat, by far the commonest species of bat in Britain and in North Merseyside, is largely associated with buildings, natural habitats and other structures such as tunnels, caves, arches are also important for its survival. The same is true for species which are more scarce.

Bat2 Any site other than a roost which regularly supports an exceptional assemblage of bats.

Application

12.4 In order for such a site to qualify it would need to be demonstrated that it has been of special significance in relation to surrounding areas over the last five year period for which data are available.

Justification.

12.5 Bats are dependent on a range of feeding sites at different times of year. Bat populations are under threat because of small and/or fragmented populations, rapid decline in numbers, habitat destruction or loss.

Northumberland (2011)

BATS 5.53 Any site that regularly (note viii) supports a hibernation or nursery roost of any species of bat, as included in Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). It is not generally intended that this guideline will be applied to domestic, agricultural or industrial buildings, whether or not they are in use. However, consideration may be given to certain types of artificial structures, such as tunnels, bridges, retaining walls and mine shafts.

North Yorkshire & York (2008)

(i) Bats Guideline

M1(a) Any hibernation site that regularly supports two or more species of bat and 30 or more individuals.

M1(b) Any site that regularly supports roosts of three or more species of bat.

M1(c) Any breeding roost site that regularly supports a significant population of a bat species.

Application (all bat selection guidelines)

These guidelines will not be applied to domestic or industrial (including agricultural) buildings. Other artificial structures for example, mine shafts, tunnels, bridges, historic

monuments (except those that are also domestic dwellings), however, may be considered for designation. For the purposes of the guidelines, a site may be any place used by bats for roosting. For summer and breeding roosts the site boundary may also include key feeding areas associated with the roost and flyways between them and the roost, where a discreet boundary can be identified. Key feeding areas are those locations bats from the roost regularly use for feeding and ones where they spend significant time feeding each night. Identifying key feeding areas for all species may not be possible or desirable, as some species feed over a wide area and in a variety of habitats. For other species, however, such as the Daubenton's bat, which feeds over lakes, rivers and canals it may be appropriate to identify the appropriate water body. The selection of feeding areas for inclusion within the site should be based on survey information, which clearly demonstrates the connection between the roost and the key feeding areas. The guidelines are intended to identify and protect the most important regularly used or 'traditional' sites. It is not intended to cover sites that support low numbers of bats and/or roost sites, which are intermittently used.

Rationale (all bat selection guidelines)

All species of British bat are protected under section 9 of the Wildlife and Countryside Act 1981 (as amended) and section 39 of The Conservation (Natural Habitats, &c.) Regulations. This protection is provided because all species of bat have declined significantly throughout the UK in the last 50 years. This decline has been brought about by a variety of factors, including reduction in habitat and subsequent habitat fragmentation, destruction of roost sites, either directly or through chemical treatment of roof timbers and a reduction in insect food supplies arising from reduced habitat and extensive use of pesticides. Bats have a low reproductive rate and consequently, breeding success is vital to the survival of populations. When there is a loss through the destruction of a breeding colony, the recovery rate is slow. Breeding success is affected by a variety of factors including the quality of roost site, weather conditions, food availability and disturbance of the roost site. Bats are very selective in their choice of breeding roosts and good quality roosts are utilised regularly over a long period of time. Such roost sites often provide a variety of environmental conditions, which the bats are able to utilise depending on the prevailing weather conditions. These roosts also are often close to, or well connected by flyways to good feeding habitat. Feeding areas close to roosts are particularly important as it means the female adult bats can readily return to the roost on a regular basis during the night to suckle their dependent young. Hibernation roosts are also important for the survival of a bat population and sites that provide suitable habitat for a variety of species of bat or large numbers of bats are particularly valuable. Hibernating bats require constant, undisturbed, cold but moist environments for hibernation, which will minimise the need for activity during the winter and result in the use of fat reserves. Like breeding roosts, some hibernation sites have been used regularly over many years.

Numbers of bats that indicate a significant breeding roost in Cumbria:

Daubenton's bat 30 or more animals; Brandt's bat 30 or more; whiskered bat 30 or more; Natterer's bat 30 or more; noctule 30 or more; Leisler's bat 30 or more; common pipistrelle 100 or more; soprano pipistrelle 100 or more; brown long-eared bat 30 or more.

Numbers of bats that indicate a significant breeding roost in North Yorkshire:

Daubenton's bat 50 or more animals; Brandt's bat 50 or more; whiskered bat 50 or more; Natterer's bat 50 or more; noctule 50 or more; common pipistrelle 100 or more; soprano pipistrelle 100 or more; brown long-eared bat 50 or more.

Rotherham Metropolitan Borough Council (2011)

Mammal Selection Guidelines – Bats Sites that meet one or more of the following guidelines will be eligible for designation as a Local Wildlife Site.

M1 Any site that supports roosts of two or more species of bat.

Application

The guidelines are intended to identify and protect the most important regularly used or 'traditional' sites and their supporting habitats. It is not intended to cover sites that support low numbers of bats and/or roost sites that are intermittently used. These guidelines will not be applied to domestic or industrial (including agricultural) buildings. Other artificial structures, for example, mine shafts, tunnels, bridges, historic monuments (except those that are also domestic dwellings) may, however, be considered for designation. For the purposes of the guidelines, a site may be any place used by bats for roosting. For summer and breeding roosts the site boundary may also include key feeding areas associated with the roost and flyways between them and the roost, where a discreet boundary can be identified. The selection of feeding areas for inclusion within the Wildlife Site should be based on survey information that clearly demonstrates the connection between the roost and the key feeding areas.

Rationale

All species of British bat are protected under Section 9 of the Wildlife and Countryside Act 1981 (as amended) and Regulation 39 of The Conservation (Natural Habitats, &c.) Regulations. This protection is provided because all species of bat have declined significantly throughout the UK in the last 50 years. This decline has been brought about by a variety of factors including a reduction in habitat and subsequent habitat fragmentation, destruction of roost sites, either directly or through chemical treatment of roof timbers and a reduction in insect food supplies as a result of reduced habitat availability and the extensive use of pesticides. Bats have a low reproductive rate and consequently breeding success is vital to the survival of populations. When there is a loss through the destruction of a breeding colony the recovery rate is slow. Breeding success is affected by a variety of factors including the quality of roost site, weather conditions, food availability and disturbance of the roost site. Bats are very selective in their choice of breeding roosts and good quality roosts are utilised regularly over a long period of time. Such roost sites often provide a variety of environmental conditions, which the bats are able to utilise depending on the prevailing weather conditions. These roosts are also often close to or well connected by flyways to good feeding habitat. Feeding areas close to roosts are particularly important as are habitat links to feeding grounds further afield. Hibernation roosts are also important for the survival of a bat population and sites that provide suitable habitat for a variety of species of bat or large numbers of bats are particularly valuable. Hibernating bats require constant, undisturbed, cold but moist environments for hibernation, which will minimise the need for activity during the winter and result in the use of fat reserves. Like breeding roosts, some hibernation sites have been used regularly over many years.

M2 Any site that is regularly used for foraging by at least four species of bat.

Application

Key feeding areas are those locations that bats regularly use for feeding and ones where they spend significant time feeding each night. Identifying key feeding areas for all species may not be possible or desirable, as some species feed over a wide area and in a variety of habitats. For other species, however, such as the Daubenton's bat, which feeds over lakes,

rivers and canals it may be appropriate to identify the appropriate water body. The selection of feeding areas for inclusion within the site should be based on regular survey information and not on a single visit.

Rationale

Bats are protected under UK and European legislation because they are restricted in distribution or have suffered dramatic declines in recent years in the UK and/or Europe. However, their feeding grounds and commuting routes have no formal protection yet are essential to the maintenance of these species. The need to conserve these habitats is clear.

West Yorkshire (2016)

3.3.1 Bats

Guideline M1(a) Any hibernation site that regularly supports ten or more individuals of any species of bat.

Guideline M1(b) Any site that regularly supports roosts of three or more species of bat, with at least five individuals of each species.

Guideline M1(c) Any breeding roost site that regularly supports a significant population of a bat species.

Application (all bat selection guidelines)

These guidelines will not be applied to domestic dwellings or employment premises. Other artificial structures for example, mine shafts, tunnels, bridges, quarries, historic monuments (except those that are also domestic dwellings) and churches as well as natural structures may be considered for designation. Tree roosts with a long history of occupation should not generally be taken in isolation and sites should consider including other stands of trees within the locality where they might provide additional or replacement roosting opportunities to maintain the population in the longer term. A site should usually include a maternity roost, hibernaculum or swarming site for mating, as these are places where bats aggregate and are likely to be more important to bat populations if they are lost. The site should include features in the immediate surroundings which contribute to the quality of the habitat for bats, but not extensive areas of feeding habitat, unless the species is listed under Annex II of the Habitats Directive (horseshoe bat species *Rhinolophus* species, Bechstein's bat and barbastelle), none of which have been recorded recently in West Yorkshire. The guidelines are intended to identify and protect the most important regularly used sites. It is not intended to cover sites that support low numbers of bats and/or roost sites which are intermittently used. "Regularly supports" will require evidence from three maternity roost visits in the last ten years. This will be reduced to one visit in the last ten years for hibernacula due to the higher risk associated with disturbance to bats.

Rationale (all bat selection guidelines)

All species of British bat are protected under Section 9 of the Wildlife and Countryside Act 1981 (as amended) and Regulation 39 of The Conservation (Natural Habitats, &c.) Regulations. This protection is provided because all species of bat have declined significantly throughout the UK in the last 50 years. This decline has been brought about by a variety of factors, including reduction in habitat and subsequent habitat fragmentation, destruction of roost sites, either directly or through chemical treatment of roof timbers, and a reduction in insect food supplies arising from reduced habitat and extensive use of pesticides. The legislation is generally considered to offer the most effective way to protect

bats in domestic houses and employment premises. Designating other bat habitat used by significant numbers or a diverse range of bat species helps to raise the profile of these important sites. Bats have a low reproductive rate and consequently, breeding success is vital to the survival of populations. When there is a loss through the destruction of a breeding colony, the recovery rate is slow. Breeding success is affected by a variety of factors including the quality of roost site, weather conditions, food availability and disturbance of the roost site. Bats are very selective in their choice of breeding roosts and good quality roosts are utilised regularly over a long period of time. Such roost sites often provide a variety of environmental conditions, which the bats are able to utilise depending on the prevailing weather conditions. These roosts also are often close to or well connected by flyways to, good feeding habitat. Feeding areas close to roosts are particularly important as it means the female adult bats can readily return to the roost on a regular basis during the night to suckle their dependent young. Hibernation roosts are also important for the survival of a bat population and sites that provide suitable habitat for a variety of species of bat or large numbers of bats are particularly valuable. Hibernating bats require constant, undisturbed, cold but moist environments for hibernation, which will reduce the need for activity during the winter and minimise the use of stored fat reserves. Like breeding roosts, some hibernation sites have been used regularly over many years.

Numbers of bats that indicate a significant breeding roost in North Yorkshire:

Daubenton's bat 20 or more animals; Brandt's bat 20 or more; whiskered bat 20 or more; Natterer's bat 20 or more; noctule 20 or more; Leisler's bat 20 or more; common pipistrelle 100 or more; soprano pipistrelle 100 or more; Nathusius' pipistrelle one or more, brown long-eared bat 20 or more; other bat species one or more.

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