Derbyshire Bat Conservation Group

Summary Report 2015

Derbyshire Underground Sites Project

Phase II

CONTENTS

On the cover: Volunteers from Derbyshire Bat Conservation Group check two harp traps at Owl Hole Cave in the Peak District National Park in autumn 2015. Green algae lining the pothole walls can be seen in the background.
Photograph ©Copyright Steven Roe. Credits continue on page 21.

1. PREFACE

The surveys undertaken in 2015 continued phase II of the project into its second year of trapping and data collection. A consolidated survey effort in the autumn of 2015 together with lessons learnt from the 2014 surveys saw a great deal more data successfully collected. This report summarises the findings from this year and goes on to combine the whole dataset from the last two years. The background to the Derbyshire Underground Sites Project has already been discussed in the 2014 Summary Report and so will not be replicated here but is available in Appendix 1.

As I write this, the licence returns form has already been submitted to Natural England and a licence renewal been granted. The data laid out in these pages give us a whole new insight into the lives of Derbyshire's bats and with a few more years of trapping will give us a valuable dataset to work with to aid in their conservation.

This report provides a summary of the information generated during these surveys and has been prepared solely to inform members of Derbyshire Bat Conservation Group of the scope of work undertaken and the key findings of the study. Derbyshire Bat Conservation Group were not commissioned to undertake this study and the opinions expressed in this report are those of the report's author and do not necessarily represent the opinions of Derbyshire Bat Conservation Group. Derbyshire Bat Conservation Group accepts no responsibility for the consequences of this document being used for any purpose other than the purposes for which it was prepared. Any person using or relying on the document for any such other purpose agrees and will by such use or reliance be taken to confirm his or her agreement to indemnify Derbyshire Bat Conservation Group for all loss or damage resulting there from. Derbyshire Bat Conservation Group accepts no responsibility or liability for this document to any other party.

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2. ACKNOWLEDGEMENTS

The surveys in the past two years were made possible by the participation and assistance of a large number of volunteers from Derbyshire Bat Conservation Group (DBCG) and the occasional visitor from neighbouring bat groups! Thanks go to Adrian Aspinall, Andrew Burrows, Alan Roe, Alan Wragg, Alison Sharkey, Angelena Efstathiou, Ben Gilbert, Bill Cove, Bob Simpson, Charlotte Parry-Smith, Chris Vine, Dean Trenam, Donald Scott, Dwayne Martin, Ellena Dickinson, Garry Gray, Georgia Marchington, Hayley Marshall, Helen Ball, Jack Roper, Jess Eades, Jeremy Tompkinson, Jill Leheup, Jim Dolan, Joel Hacking, John Blackburn, Julie Parr, Kate Haymes, Kerri Watson, Lauren Cater, Lee Glasby, Lewis Andrew, Lisa Bedford, Louise Cox, Maria Desborough, Marian Mackinnon, Mark Howard, Mark Weston, Matt Cook, Natasja Groenink, Oli Grice-Jackson, Rachel Gordon, Rebecca Dicks, Rose Brown, Rupert Simms, Sam Arthur, Sam Newbold, Shirley Cross, Stephanie Bennet, Suzie Hill, Tim Elton, Tim Moughtin, Tom Bennet, Victoria Worrall, Zoe Worthington.

Thanks must also go to all the landowners for allowing us access and permission to undertake the surveys.

3. INTRODUCTION

This report summarises the autumn swarming surveys which took place at three underground locations in Derbyshire in autumn 2015 and goes on to summarise the combined data set from the last two years. The background to the project is discussed in Appendix 1. The surveys undertaken in 2015 build on those from the previous years. We consolidated our survey efforts into three areas; two in the Matlock area and one near Longnor. These sites were chosen following the results of previous surveys. The methodology (see Appendix 2) remained very similar to that of 2014 with two main changes, the first being the addition of mark-recapture techniques. The project licence allowed us to mark captured bats using fur-clipping and non-toxic marker techniques. The former also doubled as a DNA sample method. Most surveys used harp traps but mist nets were utilised on occasion. The second main change was swapping one of the double-bank harp traps for a triple-bank harp trap. The size of the catching area is the same but the triple–bank harp trap has an additional bank of strings to increase the number of successful captures.

Surveying swarming bats using trapping methods can cause high levels of disturbance including disruption to the mating rituals and has a significant chance of affecting behaviour. This is one reason the use of trapping is a licensable activity requiring

experienced batworkers to assess the trapping situation on a continual basis throughout a trapping session and ensure as little disturbance occurs as possible. The trapping which took place as part of this study was very limited in its use but was employed for three reasons. Firstly its ability to collect a large and very useful dataset in a short time period. Secondly, the use of trapping during the swarming season causes far less disturbance than a hibernation survey in the winter, which risks arousing bats from hibernation causing bats to use up valuable fat reserves and ultimately may result in death. Thirdly, it is far easier to identify active bats in the hand than bats in hibernation when many of the characteristics used in the identification process are often not visible, due to many bats being tucked deep into crevices. This is particularly true of the 'small *Myotis*' bat species which consist of whiskered/Alcathoe's/Brandt's bats (WABs) where the differences in biometrics is slight.

4. 2015 SITES AND HABITAT DESCRIPTONS

Five sites were surveyed (see figure 1) in 2015 and consisted of both natural caves and disused man-made lead-ore mines. Sites were selected based on various factors which included:

- High bat capture rates in 2014
- Ease of access
- Landowner permission
- Sites with historic evidence of bats

Three of these sites had been surveyed the previous year and two had not been surveyed in 2014, but records of hibernating bats from winter surveys from both these sites exist in the DBCG records database.

The following underground sites were surveyed using similar methodology as the surveys in 2014 (see Appendix 2):

- Good Luck Mine
- Jacob's Dream Mine
- Jug Holes Cave and Mine
- Owl Hole Cave
- Silver Eye Mine

Good Luck mine, Jug Holes cave and Owl Hole cave were part of the 2014 surveys. Silver Eye mine had never been surveyed for autumn swarming behaviour before but hibernating bat records exist in the DBCG records database. Jacob's Dream mine was surveyed as part of the pilot 2013 survey and swarming bats were visually observed

using night vision equipment (see 2013 report). This site is also monitored as part of the National Bat Monitoring Programme for hibernating bats. It was decided to survey this site in 2015 following the 2014/2015 winter hibernation survey when a record number of bats were observed hibernating in the system. Good Luck mine, Jacob's Dream mine and Silver Eye mine are all within the Via Gellia and in close proximity to each other.

The Via Gellia is a ravine-like, steep, wooded limestone valley and lies within the Derwent valley. A small water course runs alongside the road at the bottom of the valley. The village of Cromford lies to the east, famous for Cromford mill built by Richard Arkwright in the industrial revolution. The valley was heavily mined for lead ore and there are many disused mines and shafts within the coppiced ash woodland. The site is a SSSI including a designation for its hibernating bats. The road running east to west along the bottom forms the boundary of the Peak District National Park.

Jug Holes cave and mine lies a little further north than the Via Gellia and sits above the town of Matlock in the Derwent valley within the Peak District National Park. Hosting one of Derbyshire's largest pothole entrances, the limestone caverns lie within Jug Holes wood, a SSSI. The site is popular with the caving community and the upper series of caverns are known for their unique 'beehive' formations.

Owl Hole cave is another of Derbyshire's largest potholes. Located near the Derbyshire/Staffordshire border in Earl Sterndale halfway between Buxton and Longnor, the limestone pothole is in a very exposed location on the higher ground of the Peak District with no nearby woodland. The site lies at the top of a dry valley and the top of the hole is surrounded by a ring of sycamore trees which provide a canopy. At the bottom of the pothole are five cave entrances, leading into different lengths of cave systems.

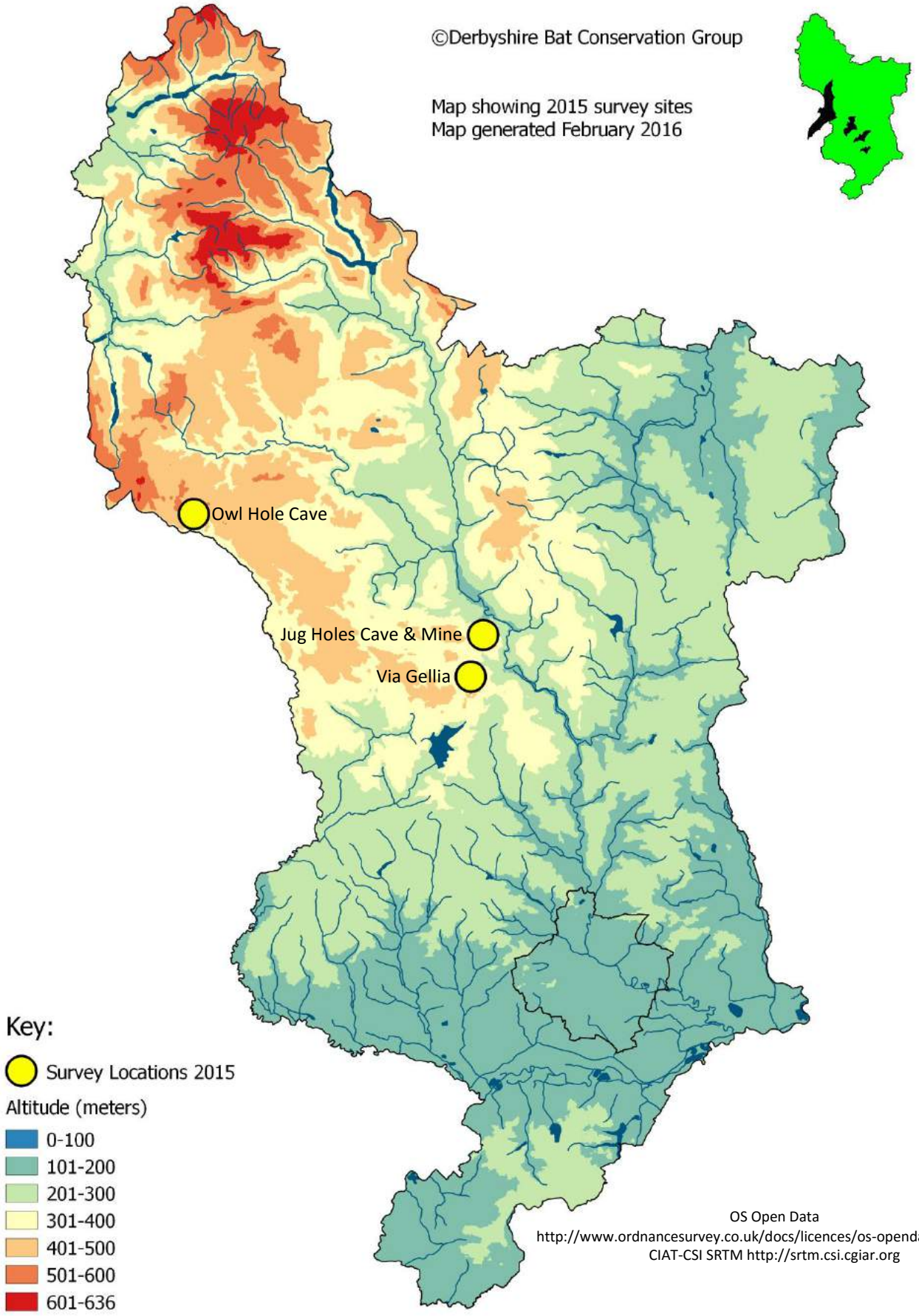

Figure 1. 2015 survey locations

5. SURVEY DATES

The table below shows the dates each site was surveyed in 2015.

Table 1. Survey locations and dates

Date	Site
25th July 2015	Owl Hole cave
31st July 2015	Silver Eye & Good Luck mines
1st August 2015	Jug Holes cave and mine
6th August 2015	Jacob's Dream mine
7th August 2015	Jug Holes cave
8th August 2015	Silver Eye & Good Luck mines
13th August 2015	Jacob's Dream mine
15th August 2015	Owl Hole cave
20th August 2015	Jacob's Dream mine
22nd August 2015	Jug Holes cave and mine
28th August 2015	Jacob's Dream mine
4th September 2015	Owl Hole cave
5th September 2015	Jug Holes cave and mine
2nd October 2015	Owl Hole cave
3rd October 2015	Silver Eye & Good Luck mines

We started surveys much earlier in the 2015 season following other such studies which had found that Brandt's bats swarm earlier in the year (Daniel Whitby *pers. comm.* 2014).

6. RESULTS FROM 2015 SURVEYS

The following results are from the 2015 surveys only. The full dataset from the past two years is analysed in section 7.

Fifteen surveys were undertaken under licence at five sites (see figure 1 and table 1). Each site was surveyed four times with the exception of Silver Eye mine and Good Luck mines which were surveyed three times. A total of 193 bats were captured. Figure 2 gives a species breakdown. Daubenton's bat was the most frequently-caught species with a third of all bats caught consisting of this species (63 individuals). In 2014 just four Brandt's bats were caught so it was very surprising to us to catch 62 Brandt's bats this year (32%). Many of these bats were caught in the August survey period. Before this year's survey

effort had begun, just 274 records of individual Brandt's bat were present in the DBCG records database. The addition of these 62 records is valuable and suggests that Brandt's bat is very much under-recorded in the county. The remaining three species were caught in smaller numbers. 25 brown long-eared bats, 22 Natterer's and 21 whiskered (all less than half the number of Brandt's bats caught).

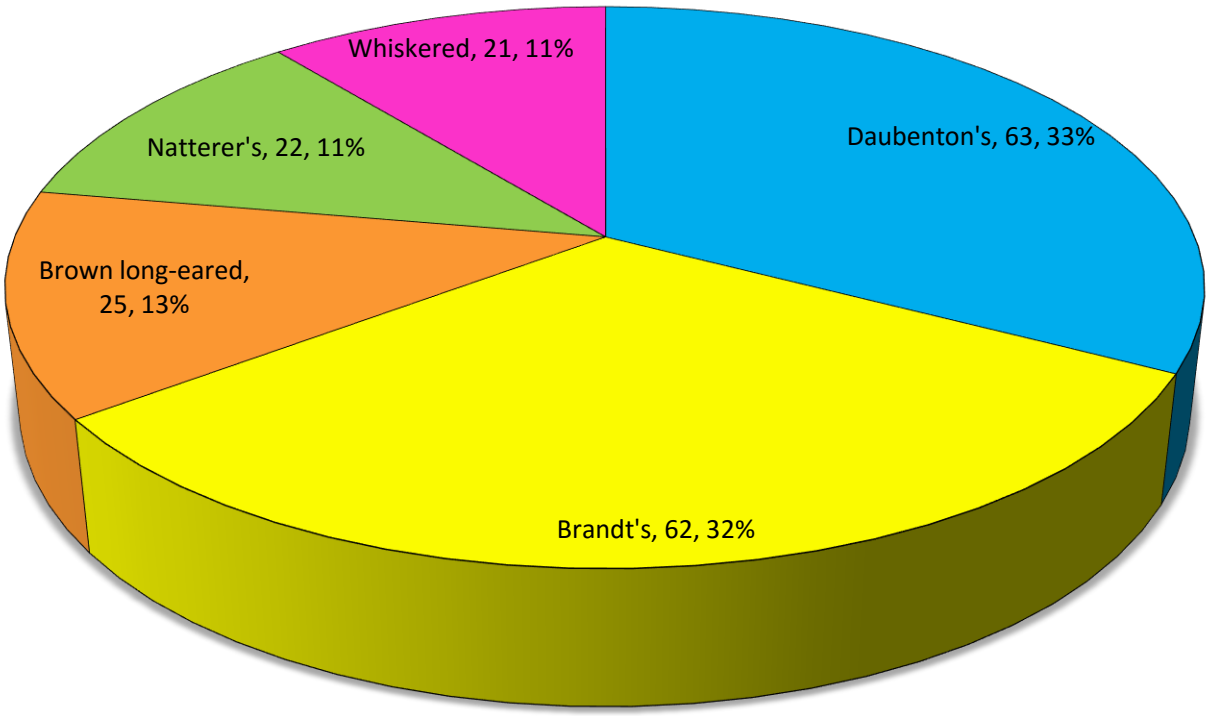

Figure 2. Species breakdown of 2015 data

Figure 3 below shows the numbers of bats caught at each site in 2015. The largest number of bats was caught at Jacob's Dream mine followed by Jug Holes cave and Owl Hole cave. It is also possible to see from this that the largest number of Brandt's bats was caught at Jacob's Dream mine and the largest number of Daubenton's bats was caught at Jug Holes cave. Most Natterer's bats were caught at Owl Hole cave with most whiskered bats caught at Jacob's Dream mine and Jug Holes cave and mine.

Plate 1: Brandt's bat (confirmed by DNA) at Jug Holes cave and mine

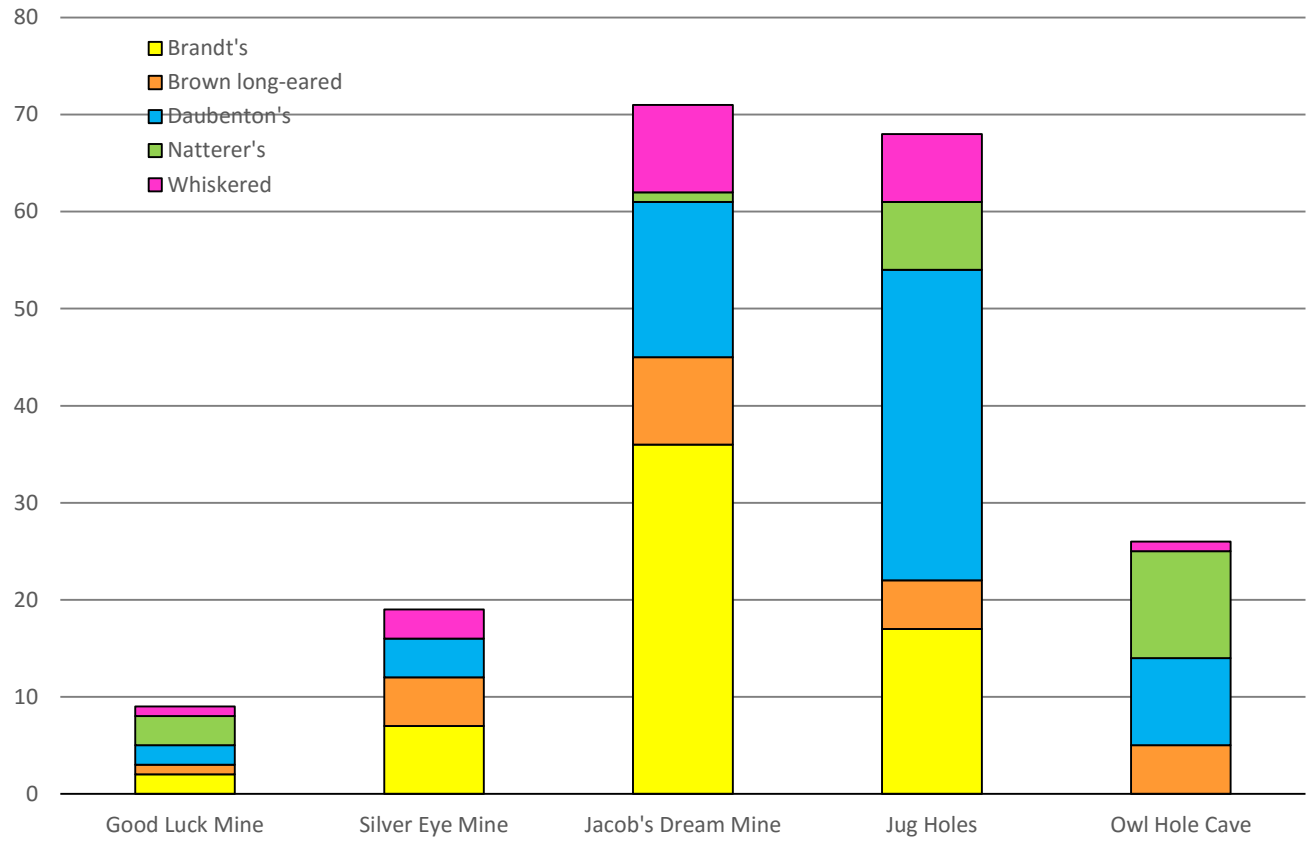

Figure 3. Numbers of bats per site (2015 data)

We know that bats will travel large distances to reach swarming sites but movement between swarming sites in an evening is not commonly known[1]. Given the very close proximity between sites in the Via Gellia and the observed pattern of swarming behaviour, it could be considered that the valley is one large swarming site with bats swarming at most (if not all) of the mine sites within it and so if we stack the three sites in the Via Gellia together (see figure 4) we can see that there is a clear picture in the number of bats caught.

Plate 2: Trapping at Owl Hole cave

[1] Rivers, N.M., Butlin, R.K., Altringham, J.D., (2005) Genetic population structure of Natterer's bats explained by mating at swarming sites and philopatry *Molecular Ecology* **14:** 4299-4312

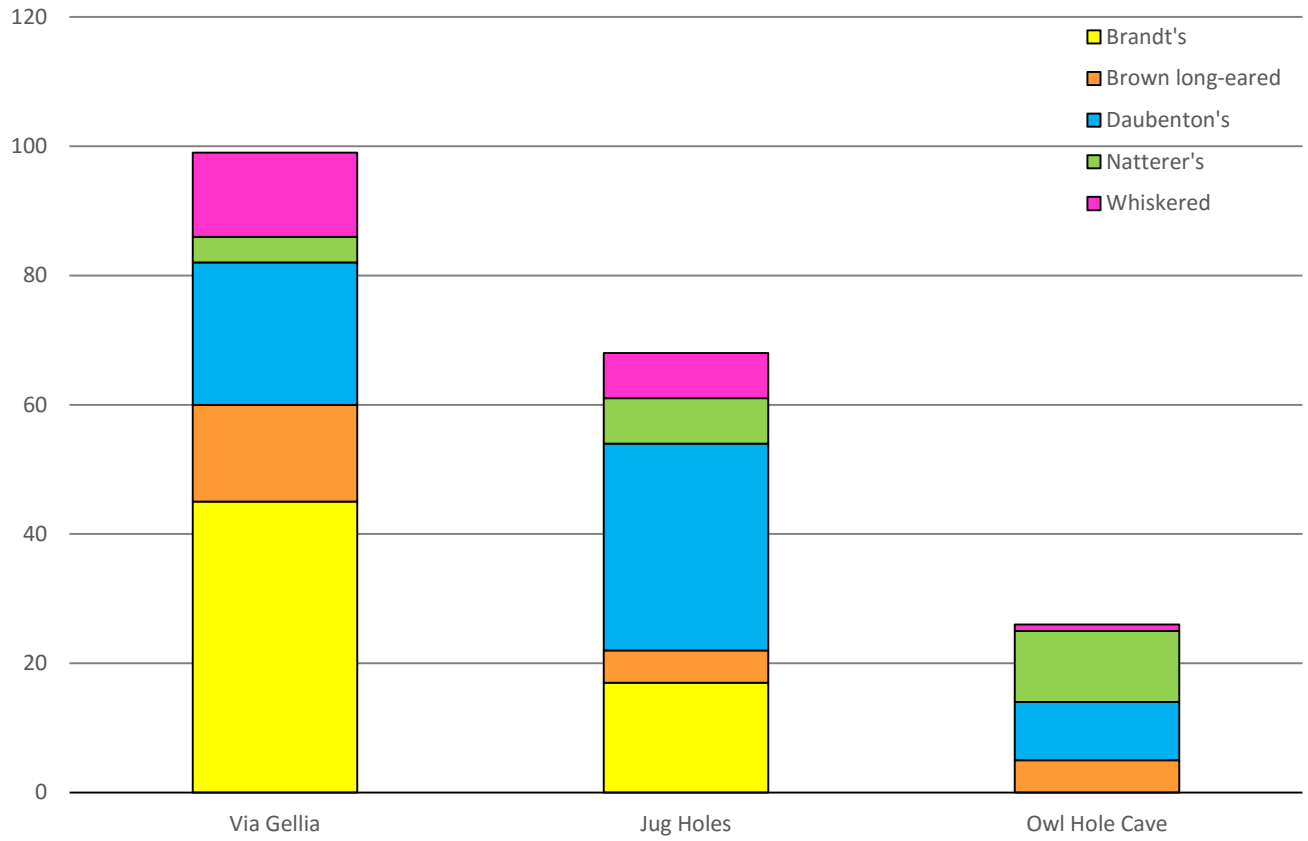

Figure 4. Numbers of bats per site (2015 data)

When bats were caught they were placed in cotton catch bags, each trap having its own colour bag to facilitate recording which trap each bat had been caught in. Figure 5 shows that over the survey as a whole, the triple bank harp trap caught slightly more bats than the double bank.

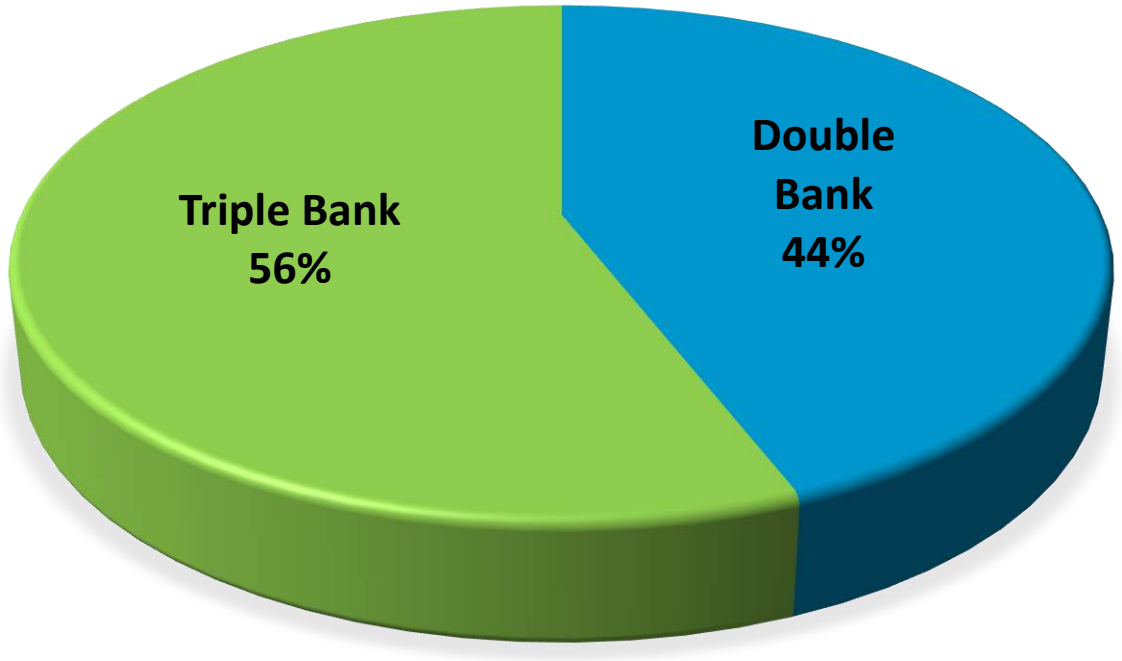

Figure 5. Numbers of bats per site (2015 data)

Thirteen bats had samples collected for laboratory DNA analysis (ten fur samples and three faecal samples) where the identification of the bat was not possible (or certain) in the field (see Appendix 3). These were all small *Myotis* species (whiskered/Alcathoe's/Brandt's). Of these twelve samples, one analysis failed to produce a result, seven were correctly identified out in the field, two whiskered bats were incorrectly identified in the field as Brandt's bats, two Brandt's were misidentified in the field as probable whiskered and a sample from a single whiskered bat was submitted for DNA analysis as a possible Alcathoe's.

7. OVERALL DATASET

Over the past two years, Derbyshire Bat Conservation Group has undertaken 24 surveys at 10 sites and have caught 306 bats of 6 species. The species breakdown of those 306 bats is shown in figure 6 below. Over a quarter of all bats caught were Daubenton's bats, just one bat separated the number of Natterer's and Brandt's bats caught with smaller numbers of brown long-eared and whiskered bats caught. Two common pipistrelle bats were caught in 2014 as incidental fly-by's (pipistrelle bats don't undertake autumn swarming). As stated in section six, the number of Brandt's bats caught in this project was unprecedented. Over the past two years, the catches have increased the number of individual Brandt's bat records in the DBCG database by 24% and this is considered further later in the report.

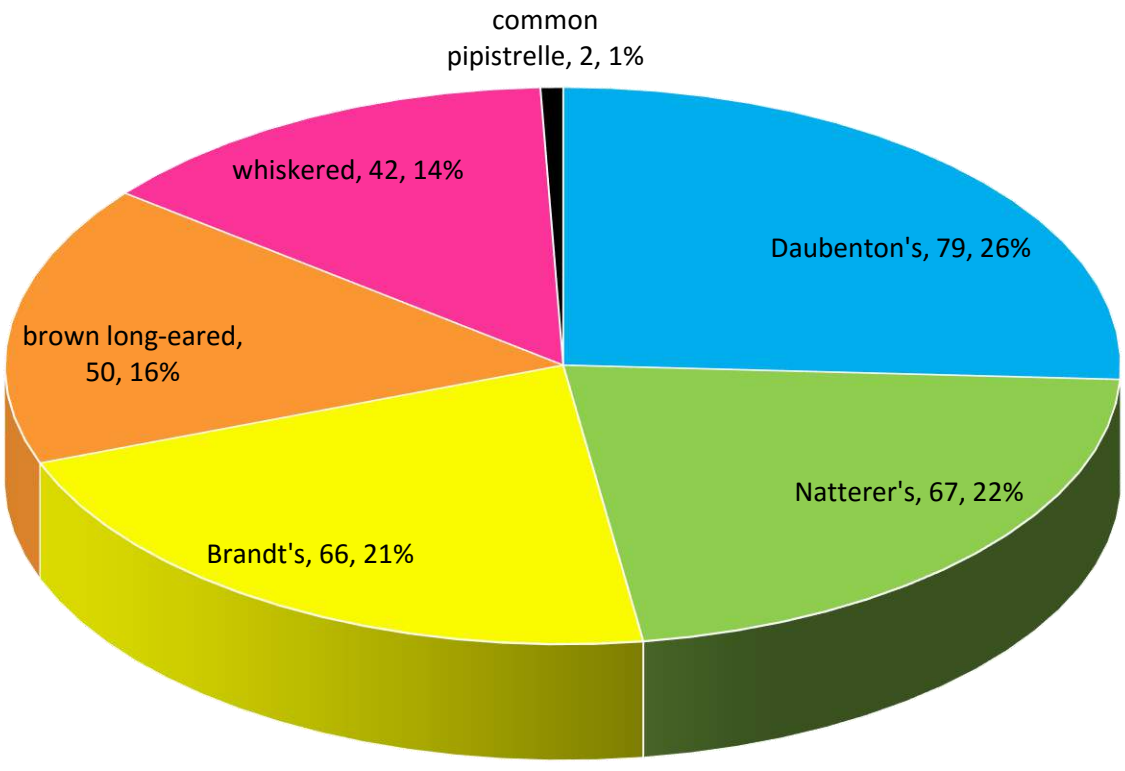

Figure 6. Species breakdown (all data)

The sex ratio (figure 7) was similar to those of other studies with 84% of all bats caught being males, 14% females and 2% unknown (a small number of bats were identified to species level and escaped capture before any other biometric information could be taken).

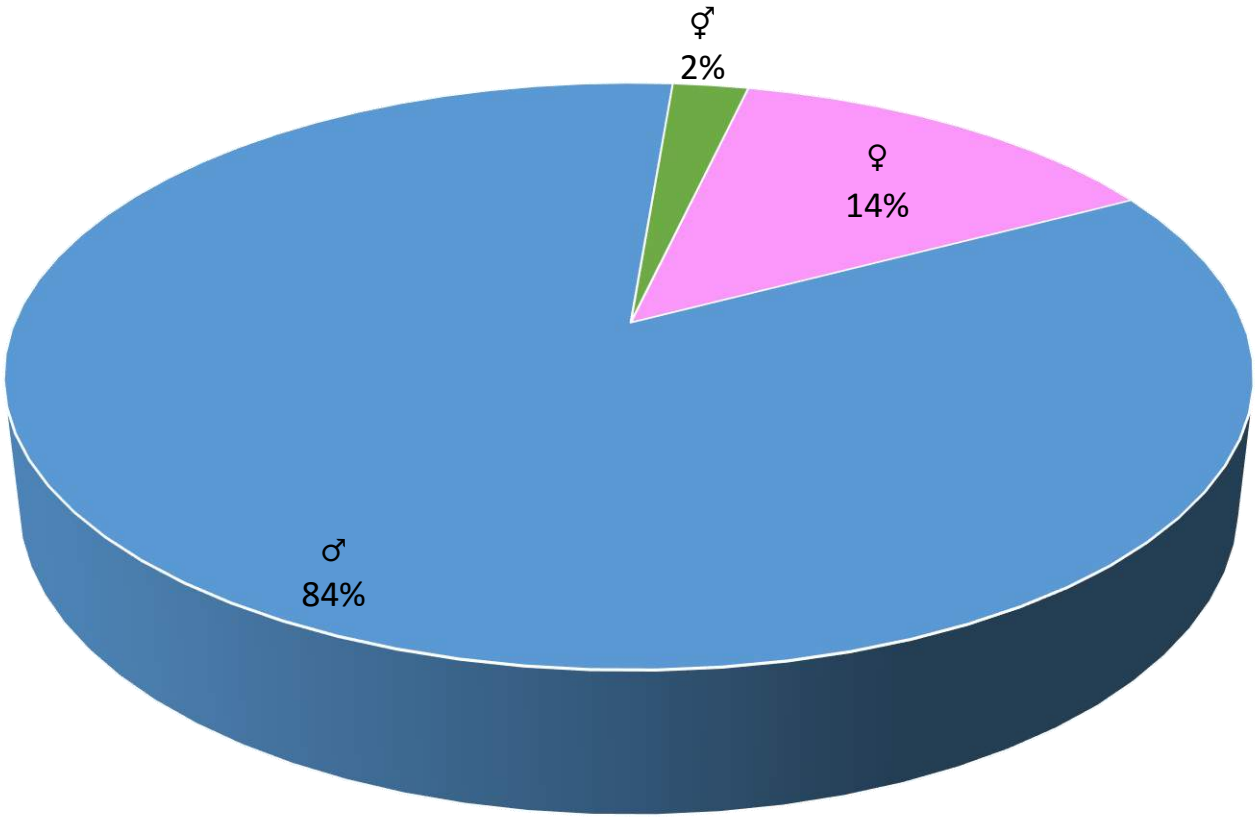

Figure 7. Sex ratio of all bats caught (all data)

Figure 8 below shows the numbers of bats caught at all ten sites surveyed. As a single site, the largest number of bats caught was Jug Holes cave followed by Jacob's Dream mine and Owl Hole cave. Figure 9 shows all Via Gellia sites stacked together (as stated in section 6 above, we could treat this whole valley as single swarming site). With this approach we see a clearer picture emerging.

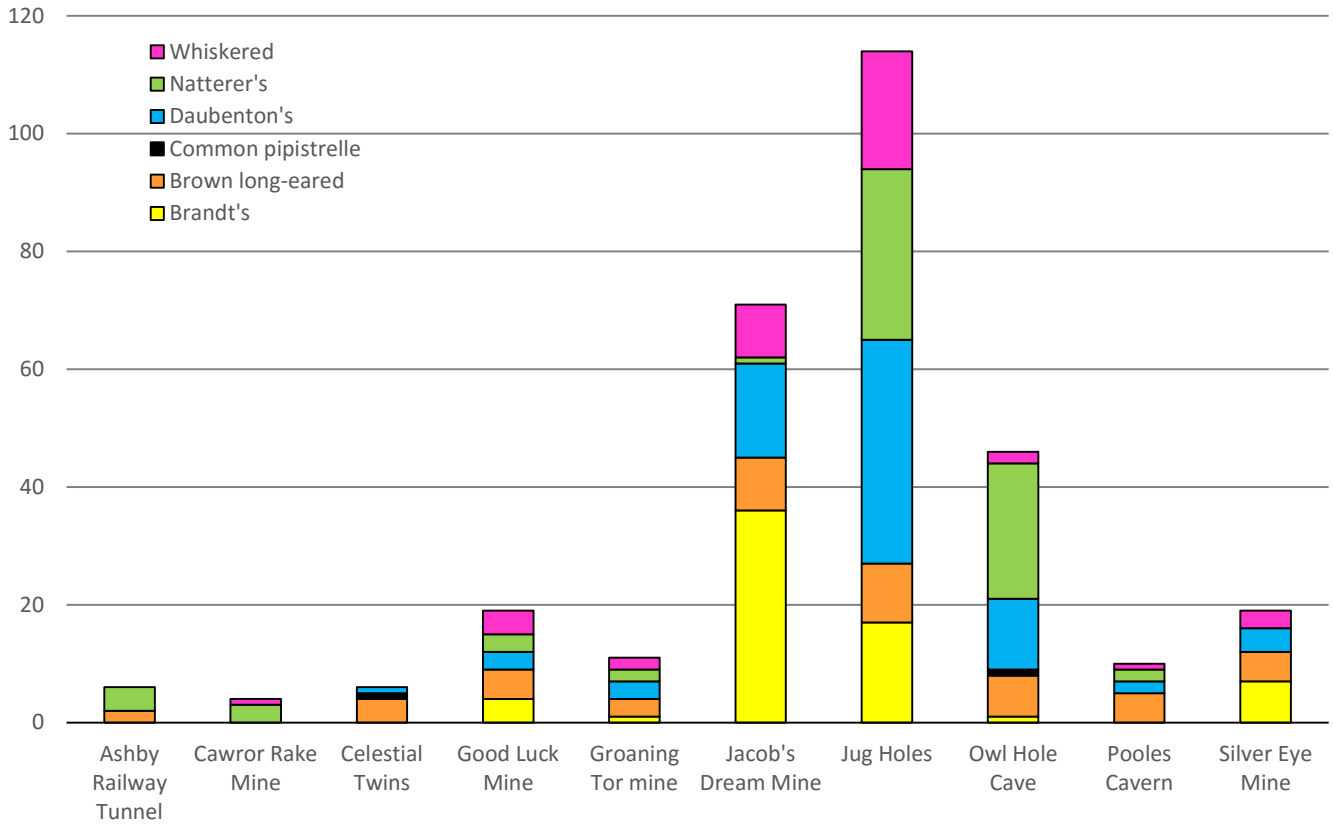

Figure 8. Number of bats caught (all data)

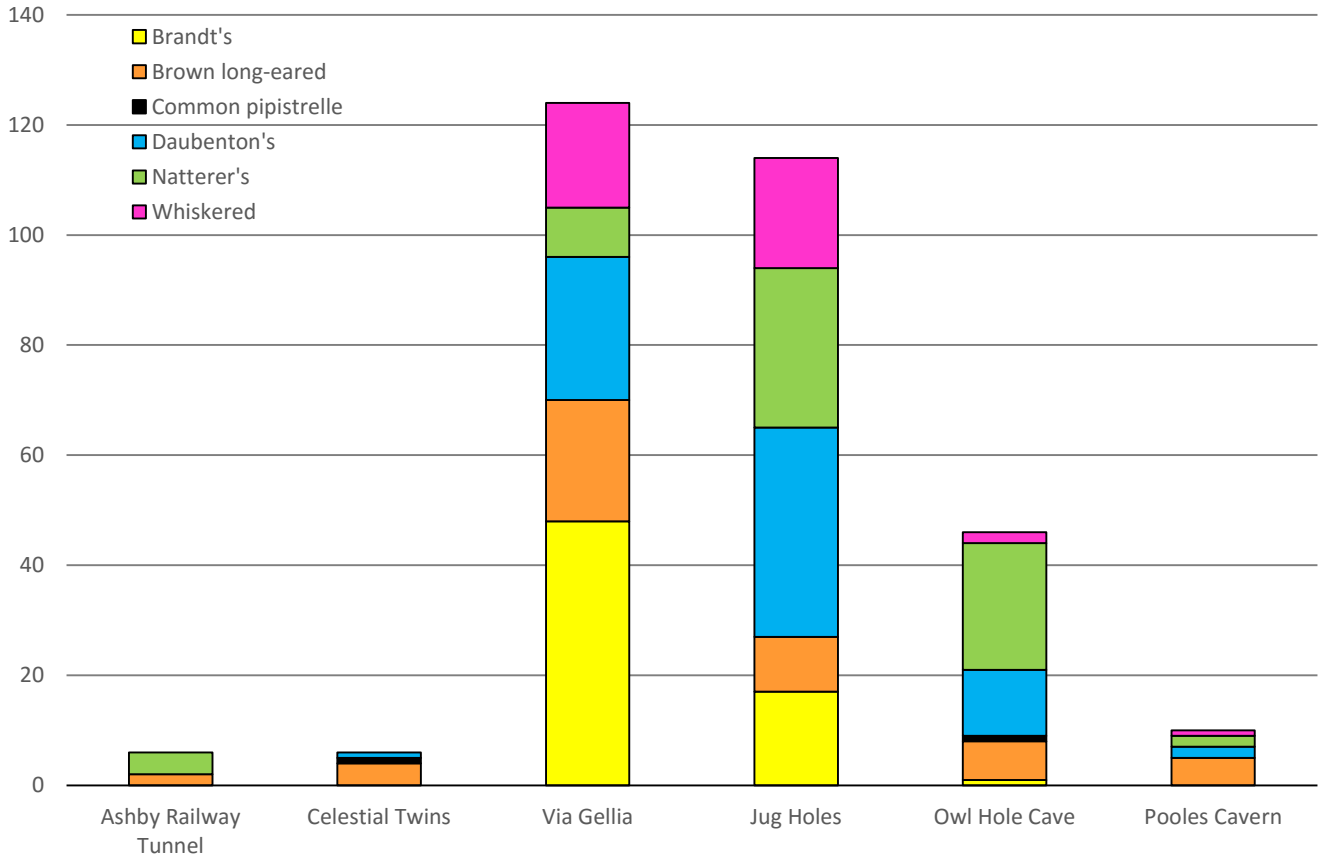

Figure 9. Number of bats caught (all data, Via Gellia sites consolidated)

However the data reported in figures 8 and 9 don't take account of survey effort. The Via Gellia has been surveyed ten times, Jug Holes cave and mine six times and Owl Hole cave five times. Therefore it's unsurprising that we see the patterns in figures 8 and 9. If we normalise the data to eliminate the effect of survey effort a far more useful figure is produced. Figure 10 below suggests that more bats swarm at Jug Holes cave and Owl Hole cave than the entire Via Gellia and therefore are possibly more important. However it should be remembered that just five sites within the Via Gellia have been surveyed in the past two years (see figure 11) and there are many more mine adits within the valley. Therefore the number of bats swarming within the Via Gellia will undoubtedly be higher than that shown below. It is clear that the Via Gellia is the most important site for swarming Brandt's bats, Jug Holes cave is the most important for swarming Daubenton's bats and that Ashby Railway Tunnel, Jug Holes cave and Owl Hole cave are all as equally important as each other for swarming Natterer's bats.

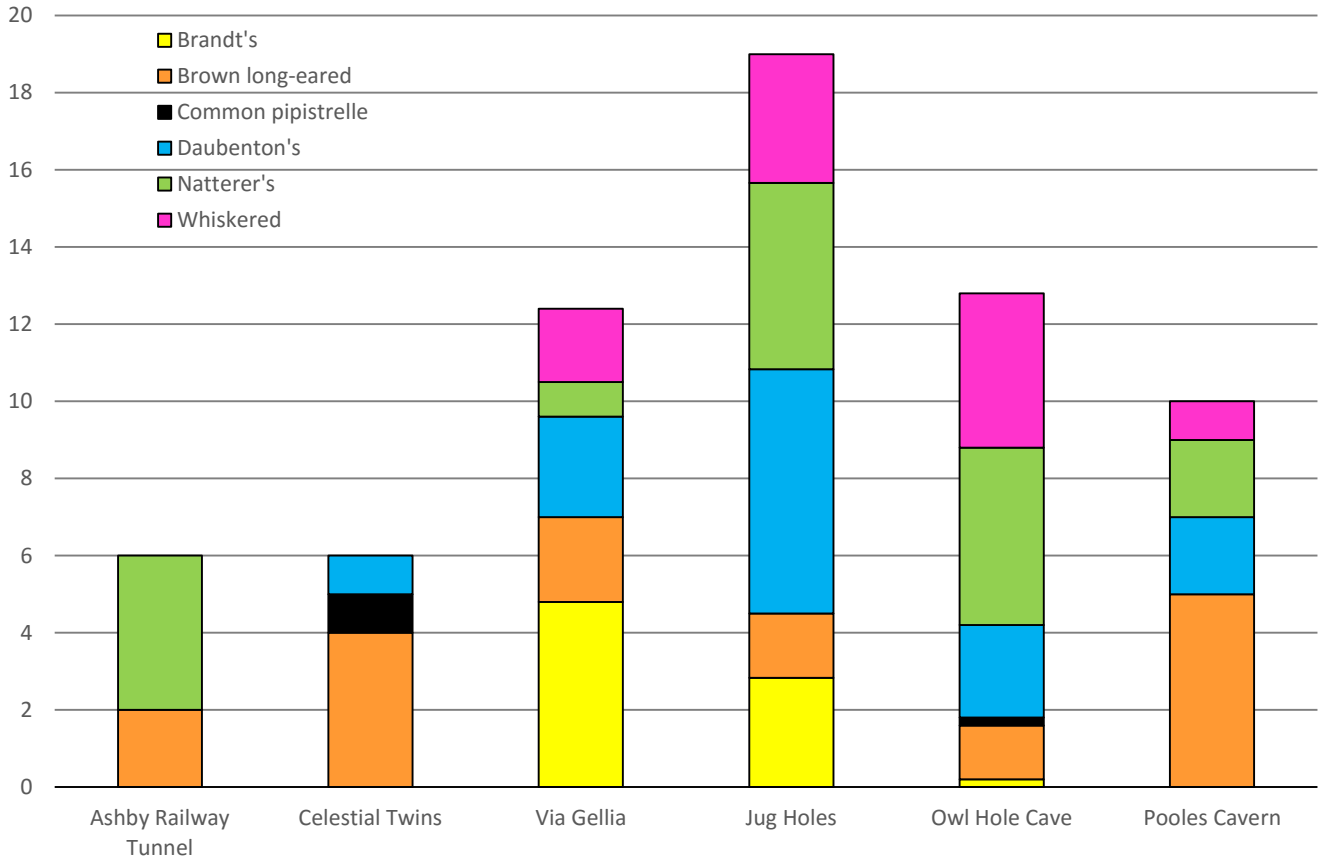

Figure 10. Numbers of bats caught per survey (all data with survey effort eliminated)

Figure 11 has been normalised to show numbers of bats caught at individual Via Gellia sites without survey effort bias. The two sites surveyed as part of the National Bat Monitoring Programme (Groaning Tor and Jacob's Dream mines) have the highest number of swarming bats. Cawror Rake mine is a much smaller adit than the other systems extending just a couple of dozen metres, as opposed to Jacob's Dream, a larger

system which extends for 150m. By comparison Good Luck mine is 1079m in length. However there are several factors which make a site suitable for swarming in combination including the complexity of the system[2].

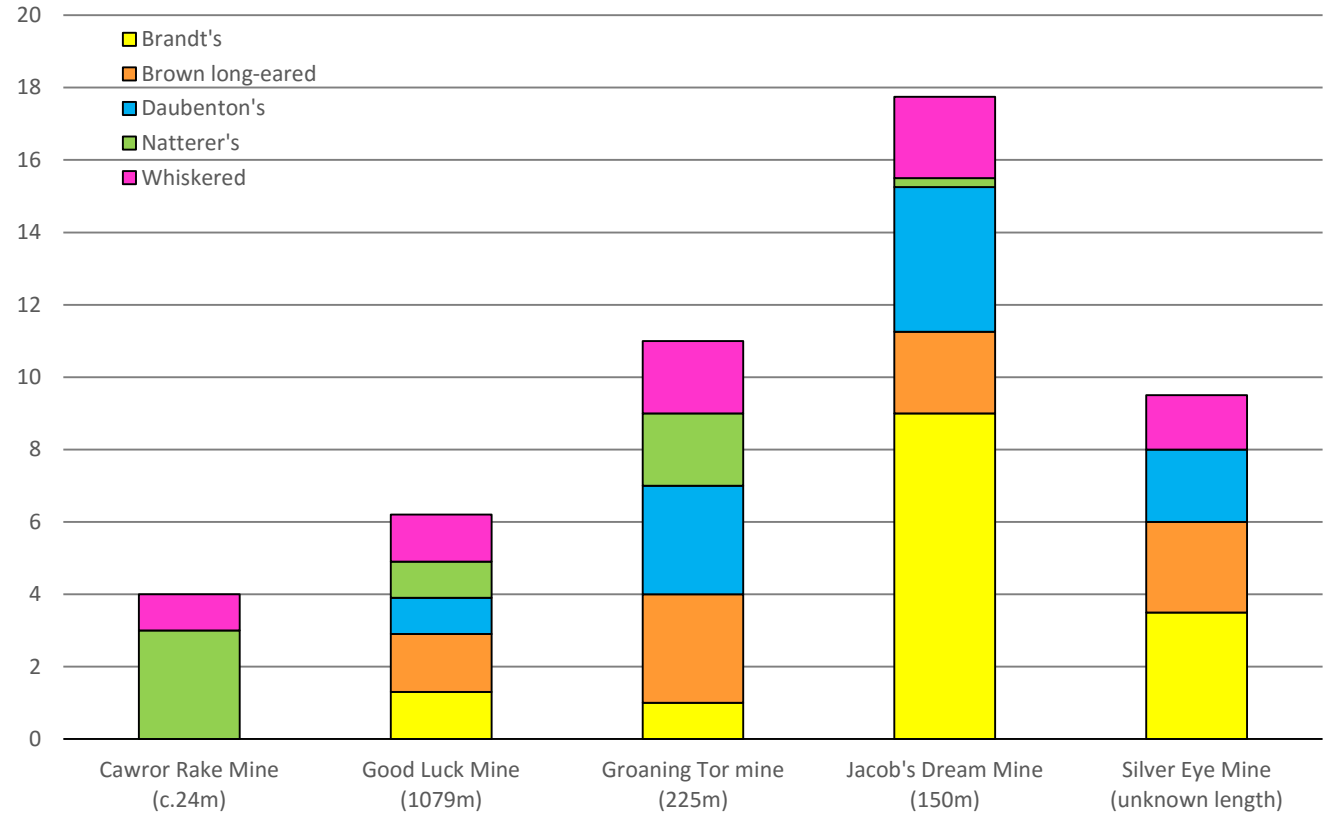

Figure 11. Numbers of bats caught at Via Gellia sites per survey (all data with survey effort eliminated)

Activity between nights at an individual site level varied considerably. It should be noted that true swarming activity doesn't take place at each site every night. Exactly what factors are required for swarming to take place on an evening are certainly not fully understood. Figure 12 below shows the activity between nights at Jug Holes cave and mine, Jacob's Dream mine and Owl Hole cave. It should be noted the data is across both trapping years and that sites have been subjected to different amounts of trapping. The bat activity at Jug Holes cave and mine and Owl Hole cave tended to increase throughout the trapping season with activity dropping off in October. There is a drop in activity on 5th September 2015 at Jug Holes cave and mine. The temperature on this night was 7°C compared with other nights in August and September where the temperature was above 10°C. Jacob's Dream mine illustrates how swarming activity can be affected by the weather. On 13th August heavy rain started to fall an hour into the survey and continued through the night. Bat activity picked up in between the rain showers. Just how much effect temperature has on swarming activity is debatable; temperatures in the autumn are regularly low and such activity has existed for many thousands of years so bats must

have evolved to swarm with low autumn temperatures. However all our surveys in October have taken place in very low temperatures and catch rates have also been low.

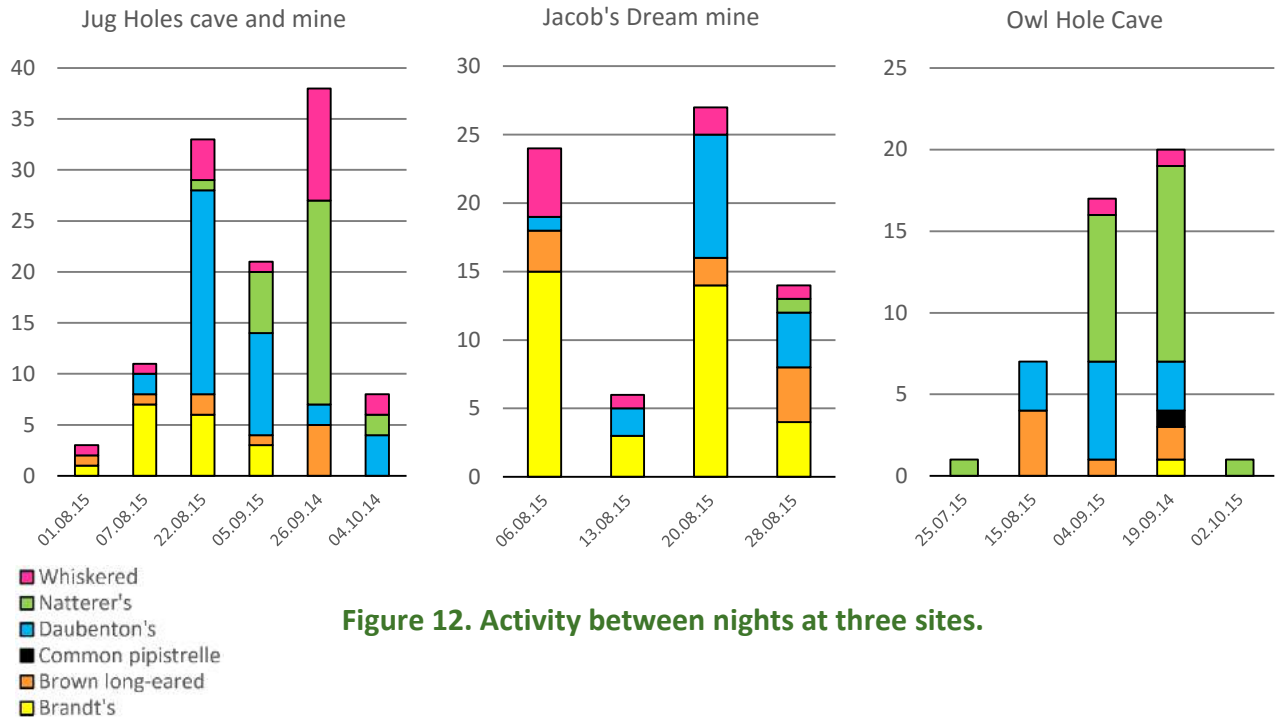

Figure 12. Activity between nights at three sites.

Over the past two years we have found that different bat species swarm at different times in the autumn which has also been noted in other studies[2]. Figure 13 breaks the numbers of bats down into a weekly number to show how different species peak throughout the season (normalised to remove survey effort bias). July has been omitted from this chart as only three bats were caught in this month. Therefore week one is the first week of August following through to week nine which is the first week of October. This shows the change in species through the season very clearly. Brandt's bats reach peak

Plate 3: Daubenton's bat swarming activity peaks in late August and early September

[2] Glover, A.M., Altringham, J.D., (2008) Cave selection and use by swarming bat species *Biological Conservation* **141:** 1493-1504 and Rivers, N.M., Butlin, R.K., Altringham, J.D., (2005) Genetic population structure of Natterer's bats explained by mating at swarming sites and philopatry *Molecular Ecology* **14:** 4299-4312

swarming activity in the third week of August. There is no clear peak in brown long-eared and whiskered bats and the species are both present throughout the swarming season. Daubenton's reach peak swarming activity in the last week of August and first week of September. Natterer's bats don't appear until September and peak towards the end of September.

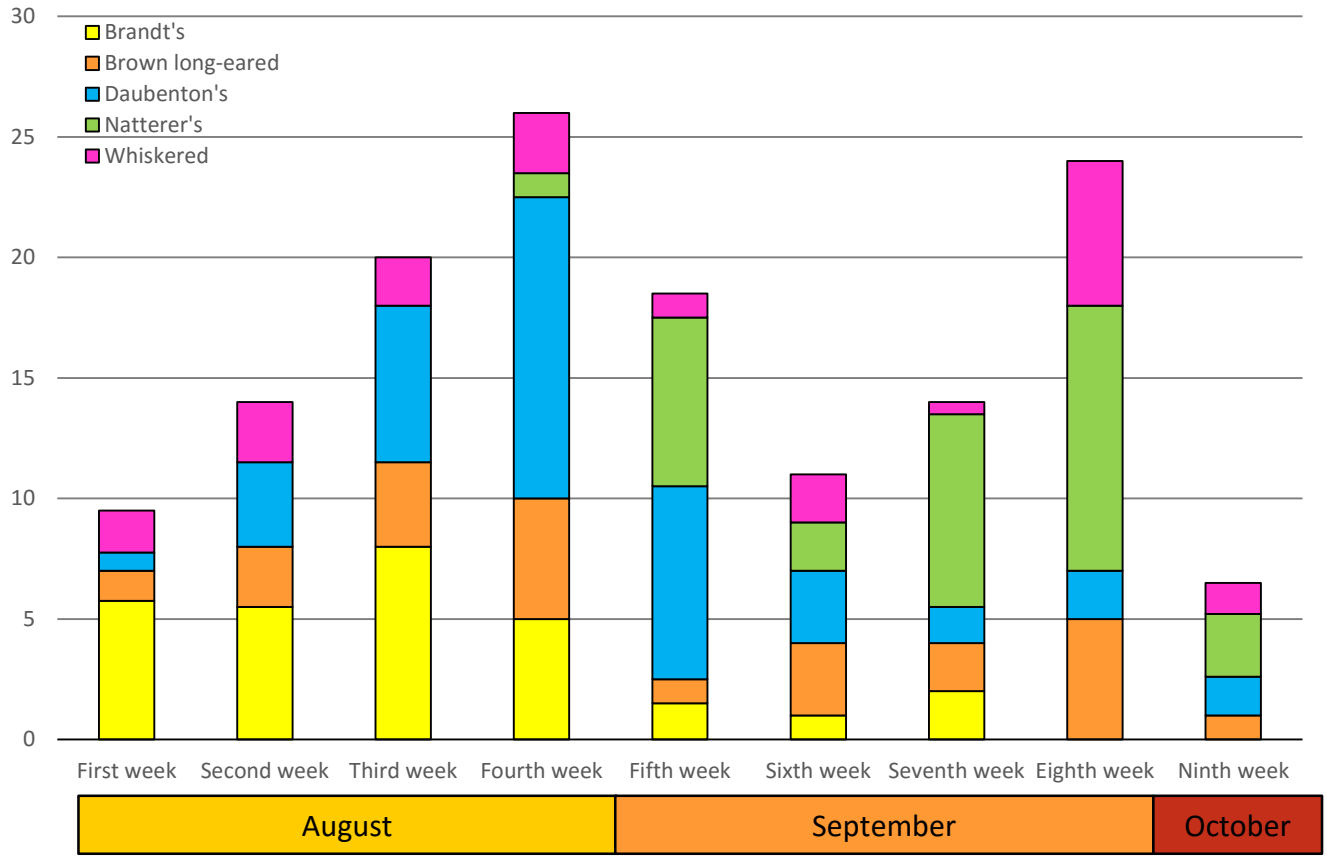

Figure 13. Species catch breakdown by week. First week is the first week of August, ninth week is first week of October (all data is normalised to eliminate survey effort).

The times of each catch were noted and these were placed into thirty-minute intervals to plot the hours in the night when species reached peak swarming times (figure 14). It is clear that Natterer's bats appear early on in the evening with Brandt's, brown long-eared and Daubenton's bats reaching similar peaks around midnight and half-past one in the

Plate 4: Brandt's bats peak in the third week of August

morning. It appears that whiskered bats are present throughout the evening in low numbers.

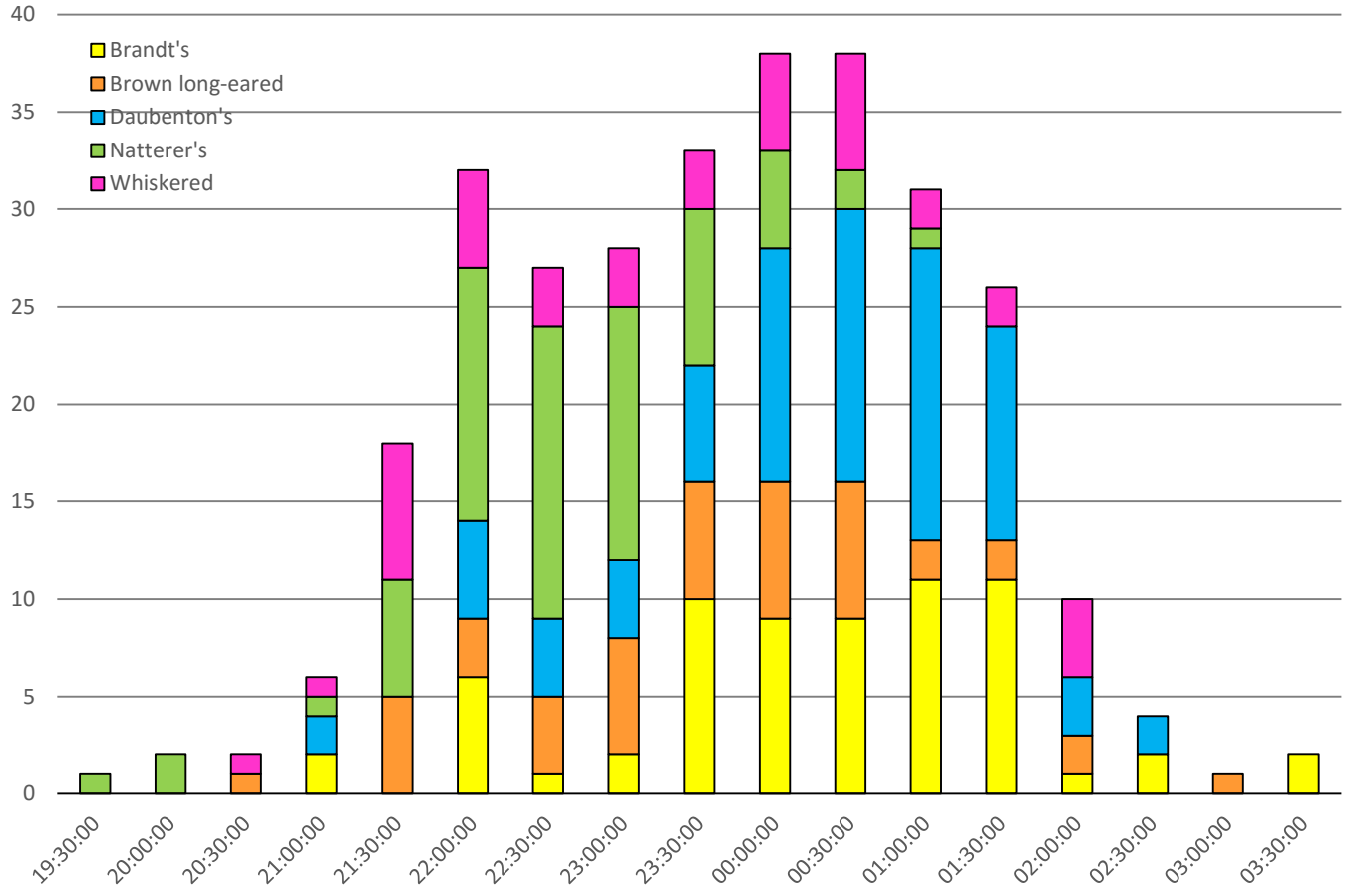

Figure 14. Times at which species swarm in a night.

8. DISCUSSION

During the survey periods in 2014 and 2015, a total of 306 bats of six species were caught (figure 6). All bat species caught were anticipated during the study. The six species caught are listed in nomenclature order below:

- Daubenton's bat *Myotis daubentonii*
- whiskered bat *Myotis mystacinus*
- Brandt's bat *Myotis brantii*
- Natterer's bat *Myotis nattereri*
- common pipistrelle bat *Pipistrellus pipistrellus*
- brown long-eared bat *Plecotus auritus*

Brown long-eared bats and the four *Myotis* bat species are regularly found in underground sites during winter hibernation surveys. Two common pipistrelle bats were caught during the study as a result of chance fly-bys (pipistrelle bats do not swarm at underground sites).

The most frequently caught species during the study was Daubenton's bat (figure 6), totalling over a quarter of all bats trapped. The second most-frequently caught species were Natterer's and Brandt's bat (22% and 21% respectively). Brown long-eared and whiskered bats were caught in lower numbers and two individual common pipistrelle bats were caught in 2014.

The 2014 summary report said that "the low number of Brandt's bat was to be expected". The increase in the number of Brandt's bat caught in 2015 was unprecedented (an increase of 1450%) and the study has now increased the number of individual Brandt's bat records in the DBCG records database by 24%. Figure 13 shows that one reason for this increase in Brandt's catches is due to starting the trapping earlier in the swarming season – in 2015, a huge 95% of all Brandt's bats were caught in July and August. Just 5% were caught in September. In 2014 just two surveys were undertaken in August which partly explains the low number of Brandt's bats that year (nine surveys took place in August 2015). The second reason for an increased number of Brandt's catches is the addition of Jacob's Dream mine – 58% of Brandt's bats in 2015 were caught at Jacob's Dream mine (figure 8).

84% of bats caught were male and 14% were female. This ratio is in accordance with other studies. 2% of bats caught were not sexed. This occurred when bats were identified to species level but then escaped from the trap or handler. The difference in capture ratios demonstrates that male bats will visit each swarming site numerous times and for longer periods of time (given there is an approximate 1:1 ratio of each sex in bat populations[3]). This allows males a greater chance of mating with a greater number of females. In contrast, the number of female bats at a site is much lower, as once they have mated there is no need to mate again that season.

As the swarming period progressed, the change in the demographic of species fitted with other studies and the lack of any peak in whiskered and brown long-eared bats also fitted with such studies.[4]

[3] Rivers, N.M., Butlin, R.K., Altringham, J.D., (2006) Autumn swarming behaviour of Natterer's bats in the UK: Population size, catchment area and dispersal. *Biological Conservation* **127**: 215-226.

[4] Glover, A.M., Altringham J.D., (2008) Cave selection and use by swarming bat species *Biological Conservation* **141:** 1493-1504.

9. SUMMARY

The study has confirmed autumn swarming activity within Derbyshire and the Peak District National Park at ten underground sites within the past three years and it seems likely that autumn swarming activity takes place at most underground sites within the county. Three important sites for autumn swarming activity have been confirmed (Jug Holes cave and mine, Owl Hole cave and Jacob's Dream mine) as a direct result of the study. The study has significantly changed our knowledge of Brandt's bat within the county.

10. THE FUTURE

The project is set to continue to further our understanding of autumn swarming within Derbyshire and the Peak District National Park. The number of potential swarming sites within the Via Gellia warrants further study as a relatively small number of sites have been surveyed so far. The study will now concentrate on the Via Gellia with Jug Holes cave as a satellite study site. The licence has been renewed for the 2016 swarming period with the addition of the part of the Peak District National Park in Staffordshire. The additional area was requested because there are several sites in Staffordshire which warrant study and these will be surveyed where possible.

The project leaders are looking into the possibility of starting a long-term ringing study which would add far more useful data to the project as full mark-recapture techniques could then be employed.

APPENDIX 1 – BACKGROUND TO THE PROJECT

Hibernation surveys for bats in underground sites in Derbyshire have been undertaken on a regular annual basis by members of the bat group since the early millennium and the results from some of these are submitted to the National Bat Monitoring Programme. The presence of limestone caves in the white peak and the numerous old lead ore mines make Derbyshire one of the top counties for underground sites and the bat group was keen to establish the use of these structures by bats and the importance of such sites to the bat populations of Derbyshire. There are around 560 caves listed in "Caves of the Peak District"[5] that are certainly accessible to bats (there are many more sumps listed but these have not been included). This number includes a small number of mine sites but there are many hundreds more unlisted and many sites outside of the Peak District National Park. Since the turn of the century, a considerable number of sites have been surveyed in the winter months with varying numbers of bats and species recorded. Given the variety of sites surveyed it is now our opinion that bats probably make some use of most, if not all, caves and mines in the Peak District at some point during the year.

Prior to 2013, we knew that underground sites were being used for winter hibernation, summer bachelor roosts, maternity colony roosts and night time feeding roosts but no one had observed bats using such sites for autumn swarming behaviour. In the mid-2000's Leeds University was recording large numbers of bats swarming around underground sites in the Yorkshire Dales. There was anecdotal evidence of swarming activity taking place at a site in the Peak District (Staffordshire) from the late 1990's/early 2000s, but it had never been followed up. The next logical step forward for DBCG was to undertake surveys to establish if swarming behaviour was taking place in the county. A feasibility survey was undertaken in 2013 (see DBCG Swarming Survey 2013 Report). That survey confirmed swarming activity within Derbyshire and so a long-term project plan was created to help us understand the importance of underground sites by bats. Altringham (*pers. comm.*) has shown that for every bat observed during hibernation surveys in caves, it is estimated that 9 other bats won't be found and suggests that to establish the importance of underground sites for bats, swarming surveys are the best indicator.

As part of the long-term project plan, a project-specific licence was applied for and subsequently granted from Natural England (NE) to undertake further studies using licensable survey methods including the use of harp traps and mist nets.

[5] Barker, I., Beck, J.S., (2010) *Caves of the Peak District* **Derbyshire Caving Association** Hucklow Publishing

The project had three main aims. These were:

- To establish the presence of Alcathoe's bat within the county of Derbyshire and the Peak District.
- To establish the species of bats swarming at underground sites within the county of Derbyshire and the Peak District (at both known hibernations sites and previously un-surveyed systems).
- To establish the numbers of bats swarming at underground sites within the above areas. If Alcathoe's bat is found to be present, the study will establish which underground sites this species uses for swarming and hibernation.

The initial licence allowed trapping to occur between 1st August and 31st October 2014 inclusive. The licence permitted surveys to take place at all underground sites within the study area where other necessary permission was granted. Following the approval from NE, permission was requested from the various landowners, the Peak District National Park Authority (PDNPA) and the members of staff at NE responsible for any underground structures located within any SSSI sites or where the structures were designated as a SSSI in their own right. This process in some cases took a long time, as landowner details are not always easy to obtain. Eleven sites were identified during the project planning process as potential swarming sites and nine of these sites were surveyed at least once during the licensed period.

Plate 5: Surveyors process bats at Jug Holes cave

All surveys were undertaken under a Natural England licence. The trapping which took place as part of this study was very limited in its use but was employed for three reasons. Firstly its ability to collect a large and very useful dataset in a short time period, therefore reducing the potential disturbance. Secondly, the use of trapping for a short time period during the swarming season is thought to cause far less disturbance than a hibernation survey in the winter which risks arousing bats from hibernation causing bats to use up valuable fat reserves and ultimately may result in death. Thirdly, it is far easier to identify active bats in the hand than bats in hibernation when many of the characteristics used in the identification process are often not visible due to many bats being tucked deep into crevices. This is particularly true of the 'small *Myotis*' bat species which consist of whiskered/Alcathoe's Brandt's bats (WABs) where the differences in biometrics is slight.

Plate 6: Measuring the forearm of a small *Myotis* bat species

Two methods of trapping were used in this study; harp traps and mist nets. A maximum of three harp traps or two mist nets were used at each site.

Harp Traps

The model of trap used in the study were Faunatech Austbat double-bank and triple-bank harp traps. These pieces of research equipment are made in Australia and have been developed over a 22 year period, refining catch success and bat safety. They are constructed of aluminium tubing and consist of a square frame, around $4m^2$ sat on four splayed legs, with a canvas catch bag underneath. The square frame holds 143 vertical nylon strings split across two banks or 215 strings across three banks. When the trap is erected the strings are put under tension. The opposite banks of strings are off-set to prevent bats flying through the trap. When a bat flies into the trap, the soft strings flex to cushion the 'landing'. The bat then falls into the canvas catch bag, which has clear plastic lining the upper parts of the bag to prevent bats escaping and provide an area for bats to rest until they are removed by hand from the bag.

Harp traps were placed at the entrances to underground sites at dusk. They were situated to try and cover as much of the entrances as possible to reduce the amount of available trap-free space for bats to use. No other blocking of entrances was used in order to avoid excessive disturbance (there is anecdotal evidence to suggest that complete blocking of entrances discourages bats to swarm). No effort was made to hide the traps. Trapping at swarming sites is very different to trapping bats elsewhere. Bats are immersed in efforts to mate during swarming and whether the trap is visible or not makes little difference to catch rates. Traps were periodically checked at approximately 15 minute intervals.

Mist Nets

Avinet mist nets were used in this study. Similar to nets used for bird ringing studies, bat nets have smaller pockets to minimise the risk of entanglement. A range of net sizes were used, ranging from 4m up to 9m in length. Where mist nets were used they were placed away from the harp traps but within the area of swarming activity. They were constantly monitored when in use.

Plate 7: Mist Net at Good Luck mine

Any bats caught were extracted from traps, placed into cotton holding bags and taken to a nearby base camp for processing. The following trapping and biometric data were recorded:

- Time of capture
- Ambient air temperature
- Trap
- Handler
- Species
- Sex
- Age (where determinable)
- Reproductive status
- Forearm
- Weight
- Mark-recapture method
- Wind
- Rain
- Moon phase

For the full dataset, please see Appendix 4.

With the exception of the thirteen bats subjected to DNA analysis techniques, all bats were identified using various biometric and morphological features as described in various publications including:

- Dietz, C. and von Helversen, O., (2004) "Illustrated identification key to the bats of Europe" *Electronic publication version 1.*
- Dietz, C., Nill, D., von Helversen, O., (2009) "Handbook of the Bats of Europe and Northwest Africa" A&C Black Publishers Ltd.
- Lucan, R., *et al.* (2012) "Reliability of field determination in three cryptic whiskered bats (*Myotis alcathoe, M. mystacinus, M. brandtii*) and basic biometric characters: evidence from the Czech Republic." Vespertillio 15: 55-62.

For the cryptic species (WABs), multiple identification features were taken and observations matching descriptions in the above publications were used to identify the species. We found that the most useful and reliable features included penis shape, dentition and colouration at the base of the ears. Other features with less value included nostril shape and forearm length. The thirteen bats subjected to DNA analysis were selected because of their conflicting features which were a combination of each small *Myotis* species and not enough features outweighed the non-matching ones. Five of the bats were female, eight were male.

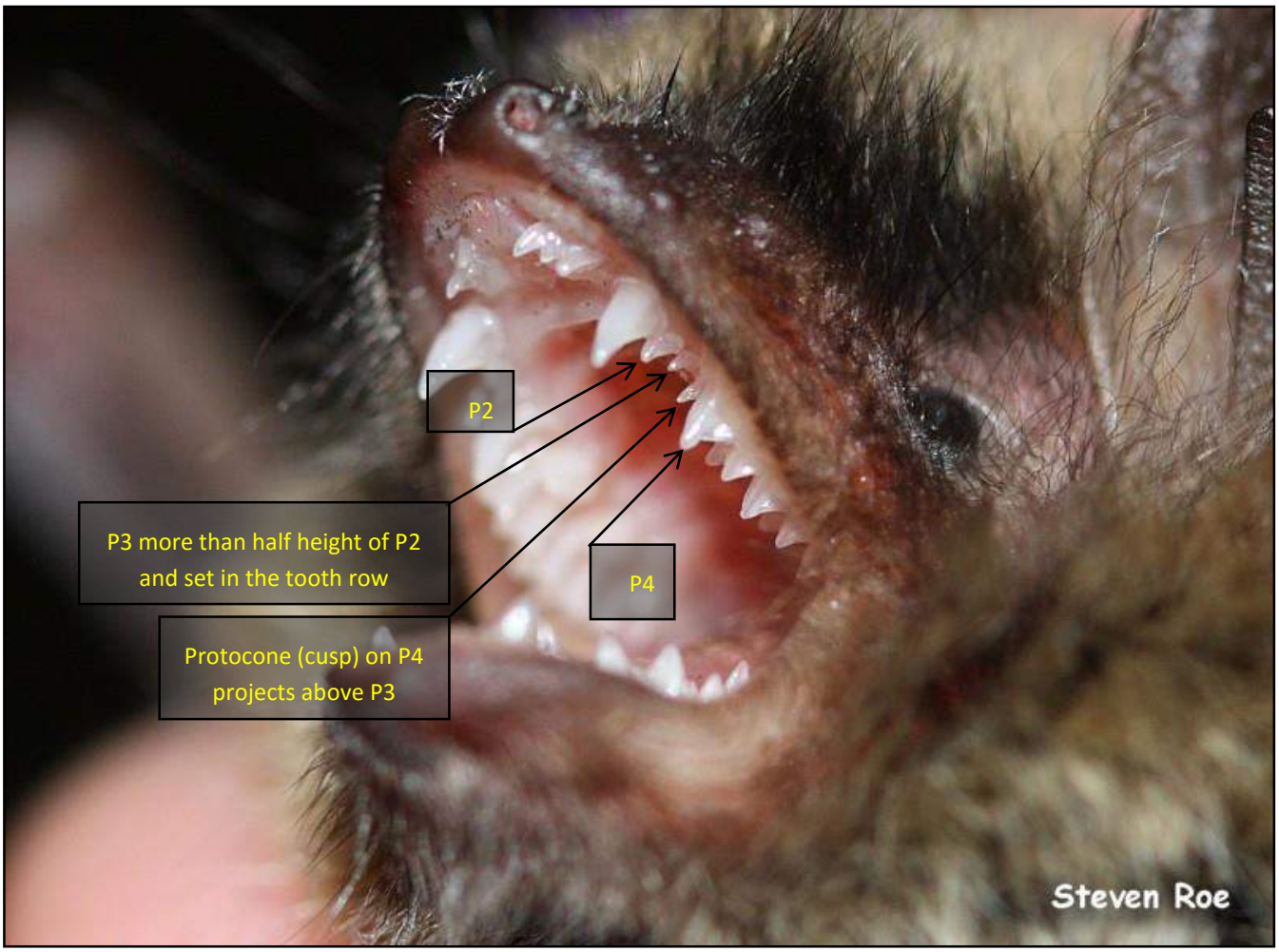

Plate 8: The large cusp on P4 can be clearly seen from this angle on this Brandt's bat from the Via Gellia in Derbyshire

Year	Sample	Tentatively identified as	DNA confirmed as
2014	1	whiskered or Brandt's bat species	*Myotis brandtii*
2014	2	whiskered or Brandt's bat species	*Myotis brandtii*
2015	3	whiskered or Brandt's bat species	*Myotis brandtii*
2015	4	whiskered bat species	*Myotis brandtii*
2015	5	Brandt's bat species	Fail
2015	6	Brandt's bat species	*Myotis brandtii*
2015	7	whiskered bat species	*Myotis mystacinus*
2015	8	Brandt's bat species	*Myotis brandtii*
2015	9	Alcathoe's bat species	*Myotis mystacinus*
2015	10	whiskered bat species	*Myotis mystacinus*
2015	11	whiskered bat species	*Myotis mystacinus*
2015	12	Brandt's bat species	*Myotis mystacinus*
2015	13	juvenile whiskered bat species	*Myotis mystacinus*
2015	14	Brandt's bat species	*Myotis mystacinus*
2015	15	Brandt's bat species	*Myotis brandtii*

APPENDIX 4 – Dataset

Please note not all data recorded is replicated here.

Location	Date	Month	Year	Time	Species	Sex	Age	Reproductive Status	Teste Size	Epid Size	Epid Colour	Forearm (mm)	Weight (g)	Temp °C
Good Luck Mine	20.08.14	August	2014	00:00	Brandt's	Male	Adult		Unknown			34.6	5	-
Good Luck Mine	20.08.14	August	2014	00:40	Daubenton's	Male	Juvenile		Unknown			37.3	8	-
Good Luck Mine	20.08.14	August	2014	00:40	Whiskered	Male	Unknown		Unknown			35	5	-
Good Luck Mine	20.08.14	August	2014	00:40	Brown long-eared	Male	Unknown		Unknown			49	7	-
Good Luck Mine	20.08.14	August	2014	00:40	Brandt's	Male	Unknown		Unknown			36.3	5.5	-
Good Luck Mine	20.08.14	August	2014	00:40	Whiskered	Male	Unknown		Unknown			35.1	5	-
Celestial Twins	29.08.14	August	2014	-	Daubenton's	Male	Adult		Large Testes			36.2	9.04	14
Celestial Twins	29.08.14	August	2014	-	Brown long-eared	Female	Adult	Parus				37.7	5.65	14
Celestial Twins	29.08.14	August	2014	-	Brown long-eared	Female	Adult	Parus				37.8	8.69	14
Celestial Twins	29.08.14	August	2014	-	Brown long-eared	Male	Adult		Large Testes			40	8.65	14
Celestial Twins	29.08.14	August	2014	-	Brown long-eared	Female	Adult	Parus				37.6	7.52	14
Celestial Twins	29.08.14	August	2014	-	Common pipistrelle	Male	Juvenile		N/a			30.5	-	14
Groaning Tor mine	09.09.14	September	2014	22:24	Natterer's	Male	Adult		Large Testes			39.4	7.01	
Groaning Tor mine	09.09.14	September	2014	22:33	Daubenton's	Male	Unknown		Small Testes			36.7	8.1	
Groaning Tor mine	09.09.14	September	2014	22:40	Whiskered	Male	Unknown		Small Testes			33.4	5.08	
Groaning Tor mine	09.09.14	September	2014	23:12	Daubenton's	Male	Unknown		Small Testes			38.9	8.16	
Groaning Tor mine	09.09.14	September	2014	23:12	Brown long-eared	Male	Unknown		Small Testes			39.3	7.08	
Groaning Tor mine	09.09.14	September	2014	23:30	Brown long-eared	Male	Adult		Large Testes			38.4	7.25	
Groaning Tor mine	09.09.14	September	2014	00:00	Whiskered	Male	Uknown		Small Testes			34.4	4.63	
Groaning Tor mine	09.09.14	September	2014	00:30	Natterer's	Male	Adult		Large Testes			38	7.28	
Groaning Tor mine	09.09.14	September	2014	00:50	Brandt's	Male	Adult		Large Testes			35.1	5.67	
Groaning Tor mine	09.09.14	September	2014	00:50	Daubenton's	Male	Adult		Large Testes			36.5	7.62	
Groaning Tor mine	09.09.14	September	2014	01:50	Brown long-eared	Male	Adult		Medium Testes			36.4	6.17	
Owl Hole Cave	19.09.14	September	2014	21:10	Natterer's	Male	Adult		Large Testes			40.3	6.5	
Owl Hole Cave	19.09.14	September	2014	21:46	Natterer's	Female	Unknown	Null-Parous				40	7.5	
Owl Hole Cave	19.09.14	September	2014	21:46	Common pipistrelle	Female	Unknown	Unknown				31.7	6.5	
Owl Hole Cave	19.09.14	September	2014	21:46	Whiskered	Male	Adult		Large Testes			35	6	
Owl Hole Cave	19.09.14	September	2014	21:46	Natterer's	Female	Unknown	Null-Parous				39.8	9	
Owl Hole Cave	19.09.14	September	2014	21:46	Natterer's	Male	Adult		Large Testes			38.8	8	
Owl Hole Cave	19.09.14	September	2014	21:46	Natterer's	Male	Adult		Large Testes			41.2	8	
Owl Hole Cave	19.09.14	September	2014	22:50	Natterer's	Male	Adult		Large Testes			39.9	8	
Owl Hole Cave	19.09.14	September	2014	22:50	Natterer's	Male	Adult		Large Testes			40	7	
Owl Hole Cave	19.09.14	September	2014	22:50	Natterer's	Male	Unknown		Medium Testes			39.92	7.5	
Owl Hole Cave	19.09.14	September	2014	22:50	Brown long-eared	Male	Unknown		Small Testes			37.2	7	
Owl Hole Cave	19.09.14	September	2014	22:50	Natterer's	Male	Adult		Large Testes			39.75	7	
Owl Hole Cave	19.09.14	September	2014	22:50	Natterer's	Male	Adult		Large Testes			39.5	9	
Owl Hole Cave	19.09.14	September	2014	22:50	Daubenton's	Male	Adult		Large Testes			35.6	8	
Owl Hole Cave	19.09.14	September	2014	23:25	Brown long-eared	Male	Unknown		Small Testes			37.2	6.5	
Owl Hole Cave	19.09.14	September	2014	23:25	Daubenton's	Male	Adult		Large Testes			37.8	7	
Owl Hole Cave	19.09.14	September	2014	23:25	Natterer's	Female	Unknown	Unknown				39.91	7.5	
Owl Hole Cave	19.09.14	September	2014	23:25	Natterer's	Male	Adult		Large Testes			38.4	7.5	
Owl Hole Cave	19.09.14	September	2014	00:15	Brandt's	Male	Adult		Large Testes			34.2	7	
Owl Hole Cave	19.09.14	September	2014	00:15	Daubenton's	Female	Unknown	Unknown				38.8	8	
Ashby Railway Tunnel	20.09.14	September	2014	21:50	Brown long-eared	Female	Unknown	Unknown				39.3	7	

Ashby Railway Tunnel	20.09.14	September	2014	22:10	Natterer's	Male	Adult		Large Testes			39	7.5	
Ashby Railway Tunnel	20.09.14	September	2014	22:26	Natterer's	Male	Adult		Large Testes			38.2	7.5	
Ashby Railway Tunnel	20.09.14	September	2014	23:06	Natterer's	Male	Adult		Large Testes			40.01	8	
Ashby Railway Tunnel	20.09.14	September	2014	23:22	Brown long-eared	Female	Unknown	Unknown				39	8	
Ashby Railway Tunnel	20.09.14	September	2014	00:24	Natterer's	Male	Adult		Large Testes			39.5	8.5	
Jug Holes	26.09.14	September	2014	20:20	Natterer's	Female	Unknown	Unknown				39.5	7	10.5
Jug Holes	26.09.14	September	2014	20:50	Whiskered	Male	Adult		Large Testes			34.2	5.1	10.5
Jug Holes	26.09.14	September	2014	21:54	Whiskered	Male	Adult		Large Testes			33.7	4.7	10.5
Jug Holes	26.09.14	September	2014	21:54	Whiskered	Male	Adult		Large Testes			33.3	5	10.5
Jug Holes	26.09.14	September	2014	21:54	Natterer's	Male	Adult		Large Testes			36.8	7.3	10.5
Jug Holes	26.09.14	September	2014	21:54	Whiskered	Male	Unknown		Unknown			35.2	5.3	10.5
Jug Holes	26.09.14	September	2014	21:54	Natterer's	Male	Adult		Large Testes			38.2	6.5	10.5
Jug Holes	26.09.14	September	2014	21:54	Whiskered	Male	Adult		Medium Testes			33.5	4.8	10.5
Jug Holes	26.09.14	September	2014	22:15	Natterer's	Female	Unknown	Unknown				40	7	10.5
Jug Holes	26.09.14	September	2014	22:15	Natterer's	Male	Adult		Large Testes			39.5	7.4	10.5
Jug Holes	26.09.14	September	2014	22:15	Whiskered	Male	Adult		Medium Testes			33.3	5.9	10.5
Jug Holes	26.09.14	September	2014	22:15	Natterer's	Male	Adult		Large Testes			40.06	7.9	10.5
Jug Holes	26.09.14	September	2014	22:15	Natterer's	Male	Adult		Large Testes			38.1	7.1	10.5
Jug Holes	26.09.14	September	2014	22:15	Daubenton's	Male	Adult		Large Testes			36.3	7.3	10.5
Jug Holes	26.09.14	September	2014	22:15	Brown long-eared	Male	Adult		Medium Testes			39	7.3	10.5
Jug Holes	26.09.14	September	2014	22:15	Whiskered	Male	Unknown		Unknown			33.5	4.8	10.5
Jug Holes	26.09.14	September	2014	22:15	Natterer's	Male	Adult		Medium Testes			39.7	7	10.5
Jug Holes	26.09.14	September	2014	22:15	Whiskered	Male	Unknown		Small Testes			34.1	5.1	10.5
Jug Holes	26.09.14	September	2014	22:15	Natterer's	Female	Unknown	Unknown				40.02	7.7	10.5
Jug Holes	26.09.14	September	2014	22:50	Natterer's	Male	Adult		Large Testes			38.9	7.1	8.3
Jug Holes	26.09.14	September	2014	22:50	Natterer's	Male	Adult		Large Testes			37.5	7.1	8.3
Jug Holes	26.09.14	September	2014	22:50	Whiskered	Male	Adult		Medium Testes			35.5	5.9	8.3
Jug Holes	26.09.14	September	2014	22:50	Natterer's	Male	Adult		Large Testes			37.5	7	8.3
Jug Holes	26.09.14	September	2014	22:50	Whiskered	Male	Adult		Medium Testes			33.4	5.5	8.3
Jug Holes	26.09.14	September	2014	23:15	Whiskered	Male	Adult		Medium Testes			33.2	4.9	8.3
Jug Holes	26.09.14	September	2014	23:15	Brown long-eared	Male	Adult		Medium Testes			38	7.6	8.3
Jug Holes	26.09.14	September	2014	23:15	Natterer's	Male	Adult		Large Testes			36.4	7.2	8.3
Jug Holes	26.09.14	September	2014	23:15	Natterer's	Female	Unknown	Unknown				39.4	7.1	8.3
Jug Holes	26.09.14	September	2014	23:15	Natterer's	Male	Adult		Medium Testes			39.8	7.2	8.3
Jug Holes	26.09.14	September	2014	23:15	Natterer's	Male	Adult		Large Testes			38.3	7.8	8.3
Jug Holes	26.09.14	September	2014	23:15	Natterer's	Male	Adult		Large Testes			37.8	7	8.3
Jug Holes	26.09.14	September	2014	23:15	Natterer's	Male	Adult		Large Testes			36.8	6.6	8.3
Jug Holes	26.09.14	September	2014	23:15	Natterer's	Male	Adult		Large Testes			38.5	7.4	8.3
Jug Holes	26.09.14	September	2014	23:50	Brown long-eared	Female	Not processed		Not processed			Not processed	Not processed	8.3
Jug Holes	26.09.14	September	2014	23:50	Brown long-eared	Female	Not processed		Not processed			Not processed	Not processed	8.3
Jug Holes	26.09.14	September	2014	23:50	Brown long-eared	Unknown	Not processed		Not processed			Not processed	Not processed	8.3
Jug Holes	26.09.14	September	2014	23:50	Natterer's	Unknown	Not processed		Not processed			Not processed	Not processed	8.3
Jug Holes	26.09.14	September	2014	23:50	Daubenton's	Unknown	Not processed		Not processed			Not processed	Not processed	8.3
Pooles Cavern	27.09.14	September	2014	20:35	Brown long-eared	Male	Adult		Large Testes			37.7	8.5	
Pooles Cavern	27.09.14	September	2014	21:10	Whiskered	Male	Adult		Large Testes			33.6	6	
Pooles Cavern	27.09.14	September	2014	21:40	Brown long-eared	Male	Adult		Large Testes			38.8	6.5	
Pooles Cavern	27.09.14	September	2014	21:40	Brown long-eared	Male	Adult		Large Testes			37.6	8	
Pooles Cavern	27.09.14	September	2014	22:10	Natterer's	Male	Adult		Large Testes			38.2	7	
Pooles Cavern	27.09.14	September	2014	22:20	Daubenton's	Male	Adult		Large Testes			37	9	
Pooles Cavern	27.09.14	September	2014	22:20	Brown long-eared	Male	Adult		Large Testes			39.1	8	

Pooles Cavern	27.09.14	September	2014	22:40	Daubenton's	Male	Adult		Large Testes			36	8.5	
Pooles Cavern	27.09.14	September	2014	22:40	Brown long-eared	Male	Adult		Large Testes			38.5	7	
Pooles Cavern	27.09.14	September	2014	22:40	Natterer's	Unknown	Not processed		Not processed			Not processed	Not processed	
Good Luck Mine	03.10.14	October	2014	21:50	Brown long-eared	Male	Adult		Large Testes			40	7.44	
Good Luck Mine	03.10.14	October	2014	21:50	Whiskered	Male	Juvenile		Small Testes			32.8	5	
Good Luck Mine	03.10.14	October	2014	23:55	Brown long-eared	Male	Unknown		Unknown			39.3	8.2	
Good Luck Mine	03.10.14	October	2014	00:55	Brown long-eared	Male	Adult		Large Testes			38.5	6.8	
Cawror Rake Mine	03.10.14	October	2014	22:25	Natterer's	Female	Unknown	Unknown				37.9	7.3	
Cawror Rake Mine	03.10.14	October	2014	23:50	Whiskered	Male	Unknown		Unknown			34.2	4.8	
Cawror Rake Mine	03.10.14	October	2014	23:50	Natterer's	Male	Adult		Large Testes			38.2	7.2	
Cawror Rake Mine	03.10.14	October	2014	23:50	Natterer's	Female	Unknown	Unknown				40.2	7.3	
Jug Holes	04.10.14	October	2014	21:00	Daubenton's	Male	Unknown		Small Testes			37.2	12	
Jug Holes	04.10.14	October	2014	21:00	Daubenton's	Male	Adult		Medium Testes			35.9	7.5	
Jug Holes	04.10.14	October	2014	22:00	Whiskered	Male	Unknown		Small Testes			33.6	5	
Jug Holes	04.10.14	October	2014	23:00	Whiskered	Male	Unknown		Small Testes			34.2	5	
Jug Holes	04.10.14	October	2014	23:40	Daubenton's	Male	Unknown		Small Testes			34.9	7.5	
Jug Holes	04.10.14	October	2014	23:40	Natterer's	Male	Unknown		Small Testes			38.2	7.25	
Jug Holes	04.10.14	October	2014	23:40	Natterer's	Male	Unknown		Medium Testes			36.4	7	
Jug Holes	04.10.14	October	2014	00:15	Daubenton's	Male	Unknown		Small Testes			35	9.5	
Owl Hole Cave	25.07.15	July	2015	23:10	Natterer's	Male	Adult		Medium	Small	Black	39.5	8	-
Silver Eye Mine	31.07.15	July	2015	22:34	Brown long-eared	Male	Adult		Large	Small	Black	39.1	6.9	11.2
Silver Eye Mine	31.07.15	July	2015	01:46	Brandt's	Male	Adult		Small	Small	Black	35.9	5.9	10.7
Jug Holes	01.08.15	August	2015	00:30	Brandt's	Male	Adult		Medium	Small	Black	36.7	6.2	10.2
Jug Holes	01.08.15	August	2015	00:30	Whiskered	Female	Adult	Unknown				34.9	5.4	10.2
Jug Holes	01.08.15	August	2015	01:30	Brown long-eared	Male	Adult		Medium	Small	Black	38.7	7.9	10.4
Jacob's Dream Mine	06.08.15	August	2015	22:00	Brown long-eared	Male	Adult		Medium	1	Black	39.9	8.3	13.2
Jacob's Dream Mine	06.08.15	August	2015	22:00	Brandt's	Male	Adult		Large	2	Black	36	-	13.5
Jacob's Dream Mine	06.08.15	August	2015	11:04	Brandt's	Male	Adult		Medium	1	Black	34.3	6.4	12.6
Jacob's Dream Mine	06.08.15	August	2015	11:30	Brandt's	Male	Adult		Medium	2	Black	34.7	6.1	11.5
Jacob's Dream Mine	06.08.15	August	2015	11:45	Brandt's	Male	Adult		Large	1	Black	34.3	5.5	12.1
Jacob's Dream Mine	06.08.15	August	2015	11:45	Brandt's	Male	Adult		Large	1	Black	34.8	6.1	
Jacob's Dream Mine	06.08.15	August	2015	12:10	Brown long-eared	Male	Adult		Large	1	Black	38.6	8.8	
Jacob's Dream Mine	06.08.15	August	2015	12:31	Brandt's	Male	Adult		Large			35.1	6	11
Jacob's Dream Mine	06.08.15	August	2015	01:05	Brandt's	Male	Adult		Medium	1	Black	33.4	4.9	11.3
Jacob's Dream Mine	06.08.15	August	2015	01:05	Brandt's	Female	Adult	Unknown				34.5	5.9	11.3
Jacob's Dream Mine	06.08.15	August	2015	01:06	Brandt's	Male	Adult		Medium	1	Black	35	6	11.1
Jacob's Dream Mine	06.08.15	August	2015	01:07	Brandt's	Male	Adult		Medium	1	Black	35.6	6	11.1
Jacob's Dream Mine	06.08.15	August	2015	01:08	Brandt's	Male	Adult		Medium	Unknown	Unknown	36.2	7.9	11.1
Jacob's Dream Mine	06.08.15	August	2015	01:09	Whiskered	Male	Adult		Small	1	Black	35.2	5.2	11.1
Jacob's Dream Mine	06.08.15	August	2015	01:09	Brandt's	Male	Adult		Large	1	Black	36.4	6.7	11.1
Jacob's Dream Mine	06.08.15	August	2015	02:00	Brown long-eared	Male	Unknown		Small	1	Black	38.7	13.4	11.2
Jacob's Dream Mine	06.08.15	August	2015	02:00	Whiskered	Male	Adult		Small	1	Black	34.5	5.1	11.2
Jacob's Dream Mine	06.08.15	August	2015	02:00	Whiskered	Female	Adult	Unknown				33.5	5.6	11.3
Jacob's Dream Mine	06.08.15	August	2015	02:00	Whiskered	Male	Adult		Small	2	Black	35.1	5.6	11.3
Jacob's Dream Mine	06.08.15	August	2015	02:10	Whiskered	Male	Adult		Small	1	Black	33.6	4.8	11.4
Jacob's Dream Mine	06.08.15	August	2015	02:10	Daubenton's	Male	Adult		Small	1	Black	35.8	7.8	11.4
Jacob's Dream Mine	06.08.15	August	2015	02:10	Brandt's	Male	Adult		Medium	1	Pale	36.5	7.8	11.4
Jacob's Dream Mine	06.08.15	August	2015	02:30	Brandt's	Male	Adult		Medium	1	Black	34.7	5	11.4
Jacob's Dream Mine	06.08.15	August	2015	02:30	Brandt's	Male	Adult		Medium	2	Black	36.2	5.9	11.4
Jug Holes	07.08.15	August	2015	11:57	Brown long-eared	Male	Adult		Large	1	Black	37.5	7.7	12.5

Jug Holes	07.08.15	August	2015	11:57	Brandt's	Male	Adult		Large	1	Black	35.8	5.8	12.5
Jug Holes	07.08.15	August	2015	11:57	Brandt's	Male	Adult		Large	1	Black	35.2	5.4	12.5
Jug Holes	07.08.15	August	2015	11:57	Brandt's	Male	Adult		Large	1	Black	34.7	5.3	12.5
Jug Holes	07.08.15	August	2015	12:45	Daubenton's	Male	Adult		Large	1	Black	35.5	7.9	11.8
Jug Holes	07.08.15	August	2015	12:45	Daubenton's	Male	Adult		Medium	1	Black	36.7	8.2	11.8
Jug Holes	07.08.15	August	2015	01:45	Brandt's	Male	Adult		Medium	1	Black	33.7	5.6	11.7
Jug Holes	07.08.15	August	2015	01:45	Whiskered	Male	Adult		Large	1	Black	35.2	5.2	11.7
Jug Holes	07.08.15	August	2015	01:45	Brandt's	Female	Adult	Unknown				33.7	5.4	11.7
Jug Holes	07.08.15	August	2015	01:45	Brandt's	Male	Adult		Large	1	Black	35	5.9	11.7
Jug Holes	07.08.15	August	2015	01:45	Brandt's	Male	Adult		Medium	1	Black	34.4	5.9	11.7
Silver Eye Mine	08.08.15	August	2015	00:00	Daubenton's	Male	Adult		Medium	1	Black	37.3	9	10.8
Silver Eye Mine	08.08.15	August	2015	00:00	Brandt's	Male	Adult		Medium	1	Black	34.1	4.3	12.2
Silver Eye Mine	08.08.15	August	2015	00:00	Daubenton's	Male	Adult		Large	1	Black	37.8	8.4	
Silver Eye Mine	08.08.15	August	2015	00:00	Brandt's	Male	Adult		Large	1	Black	35	6.2	
Silver Eye Mine	08.08.15	August	2015	00:00	Whiskered	Male	Adult		Medium	1	Black	35.3	5.7	12.1
Silver Eye Mine	08.08.15	August	2015	00:55	Brown long-eared	Male	Adult		Large	1	Black	38.5	7.5	
Silver Eye Mine	08.08.15	August	2015	00:55	Daubenton's	Male	Adult		Medium	1	Black	38.2	8.3	
Silver Eye Mine	08.08.15	August	2015	00:55	Whiskered	Male	Adult		Small	1	Black	32.6	5.2	
Silver Eye Mine	08.08.15	August	2015	00:55	Brown long-eared	Male	Adult		Large	1	Black	37.8	7.9	
Silver Eye Mine	08.08.15	August	2015	00:55	Brown long-eared	Male	Adult		Large	1	Black	37.5	7.3	
Silver Eye Mine	08.08.15	August	2015	00:55	Brown long-eared	Male	Adult		Large	1	Black	36.6	7.1	
Silver Eye Mine	08.08.15	August	2015	01:40	Brandt's	Male	Adult		Large	1	Black	35.3	5.2	
Silver Eye Mine	08.08.15	August	2015	01:40	Daubenton's	Male	Adult		Medium	1	Black	37.2	8.4	
Silver Eye Mine	08.08.15	August	2015	01:40	Brandt's	Male	Adult		Medium	1	Black	34.8	5.4	11
Silver Eye Mine	08.08.15	August	2015	01:40	Whiskered	Male	Adult		Small	1	Black	35.3	4.8	11.2
Silver Eye Mine	08.08.15	August	2015	03:30	Brandt's	Male	Juvenile		Small	1	Black	33.6	5.7	10.7
Silver Eye Mine	08.08.15	August	2015	03:30	Brandt's	Male	Adult		Medium	1	Black	34.7	6	11.5
Good Luck Mine	08.08.15	August	2015	23:45	Whiskered	Male	Adult		Small	1	Black	36.1	5.4	
Good Luck Mine	08.08.15	August	2015	00:10	Brown long-eared	Male	Adult		Medium	1	Black	37.7	8.1	
Good Luck Mine	08.08.15	August	2015	01:10	Daubenton's	Male	Adult		Large			37.4	8.7	
Good Luck Mine	08.08.15	August	2015	01:20	Brandt's	Male	Adult		Large	1	Black	36.2	6.2	10.9
Good Luck Mine	08.08.15	August	2015	01:20	Brandt's	Male	Adult		Large	1	Black	35.5	5.2	15.5
Jacob's Dream Mine	13.08.15	August	2015	21:20	Brandt's	Male	Adult		Medium	2	Black	34.7	5	15.5
Jacob's Dream Mine	13.08.15	August	2015	21:30	Whiskered	Female	Adult	Unknown				34.3	4.6	15.5
Jacob's Dream Mine	13.08.15	August	2015	22:00	Daubenton's	Female	Adult	Unknown				38.6	8.3	15
Jacob's Dream Mine	13.08.15	August	2015	22:00	Brandt's	Male	Adult		Medium	1	Black	34.3	6	15
Jacob's Dream Mine	13.08.15	August	2015	22:00	Daubenton's	Male	Adult		Medium	3	Pale	36.6	7.2	15
Jacob's Dream Mine	13.08.15	August	2015	00:00	Brandt's	Male	Adult		Small	1	Black	35.1	6.5	14.6
Owl Hole Cave	15.08.15	August	2015	22:00	Daubenton's	Male	Adult		Medium	1	Black	39.1	7.3	5.2
Owl Hole Cave	15.08.15	August	2015	00:05	Brown long-eared	Male	Adult		Medium	2	Black	37.9	7.1	2.5
Owl Hole Cave	15.08.15	August	2015	00:05	Brown long-eared	Male	Adult		Large	1	Black	37.5	7.8	2.5
Owl Hole Cave	15.08.15	August	2015	00:05	Brown long-eared	Unknown	Unknown							
Owl Hole Cave	15.08.15	August	2015	00:05	Brown long-eared	Unknown	Unknown							
Owl Hole Cave	15.08.15	August	2015	00:40	Daubenton's	Male	Adult		Medium	1	Black	39.2	9.4	4
Owl Hole Cave	15.08.15	August	2015	01:30	Daubenton's	Unknown	Unknown							
Jacob's Dream Mine	20.08.15	August	2015	21:15	Brandt's	Male	Adult		Large	4	Black	36.6	5.7	
Jacob's Dream Mine	20.08.15	August	2015	22:00	Brandt's	Male	Adult		Medium	1	Black	36	6.6	15.1
Jacob's Dream Mine	20.08.15	August	2015	22:15	Brandt's	Male	Adult		Medium	4	Cream	34.2	7	13.5
Jacob's Dream Mine	20.08.15	August	2015	23:30	Brandt's	Male	Adult		Small	1	Black	36	5.8	13.5
Jacob's Dream Mine	20.08.15	August	2015	23:30	Brandt's	Male	Adult		Small	1	Pale	35.5	5.8	13.5

Jacob's Dream Mine	20.08.15	August	2015	00:00	Brandt's	Male	Adult		Medium	1	Pale	34.4	5	14.9
Jacob's Dream Mine	20.08.15	August	2015	00:00	Daubenton's	Male	Adult		Medium	3	Pale	37.6	8.4	14.9
Jacob's Dream Mine	20.08.15	August	2015	00:00	Whiskered	Male	Adult		Medium	1	Black	33	4.6	14.9
Jacob's Dream Mine	20.08.15	August	2015	00:00	Brandt's	Male	Adult		Small	1	Pale	35.7	5.1	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Brown long-eared	Male	Adult		Large	2	Pale	37.1	7.3	14.4
Jacob's Dream Mine	20.08.15	August	2015	00:45	Brandt's	Male	Adult		Small	1	Black	34.1	5.7	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Daubenton's	Male	Adult		Large	1	Black	35.7	7.6	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Daubenton's	Male	Adult		Medium	1	Black	38.1	8.8	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Brandt's	Male	Adult		Small	4	Pale with black edges	33.9	6.1	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Brandt's	Male	Adult		Medium	1	Black	34.2	5.6	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Brandt's	Male	Adult		Large	1	Grey	34.9	6.4	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Whiskered	Male	Adult		Small	1	Pale	34.6	5	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Daubenton's	Male	Adult		Small	1	Black	36.2	8.4	
Jacob's Dream Mine	20.08.15	August	2015	00:45	Daubenton's	Male	Adult		Medium	1	Black	37.4	8.4	
Jacob's Dream Mine	20.08.15	August	2015	01:40	Brandt's	Male	Adult		Small	2	Black	36.4	6.2	
Jacob's Dream Mine	20.08.15	August	2015	01:40	Brandt's	Male	Adult		Medium	1	Pale	34.9	5	14.2
Jacob's Dream Mine	20.08.15	August	2015	01:40	Brandt's	Male	Adult		Small	2	Black	35.1	5.6	
Jacob's Dream Mine	20.08.15	August	2015	01:40	Daubenton's	Male	Adult		Medium	1	Black	36.9	8.4	
Jacob's Dream Mine	20.08.15	August	2015	01:40	Daubenton's	Male	Adult		Medium	3	Pale	36.6	7.8	
Jacob's Dream Mine	20.08.15	August	2015	01:40	Daubenton's	Male	Adult		Large	1	Black	37	8.2	
Jacob's Dream Mine	20.08.15	August	2015	02:15	Brown long-eared	Male	Adult		Large	3	Black	38.8	8.1	14
Jacob's Dream Mine	20.08.15	August	2015	02:15	Daubenton's	Male	Adult		Large	1	Pale	38	8.1	
Jug Holes	22.08.15	August	2015	22:15	Whiskered	Female	Adult	Null-Parous				35	5.1	
Jug Holes	22.08.15	August	2015	23:45	Daubenton's	Male	Adult		Large	2	Black	38.3	9.5	13.7
Jug Holes	22.08.15	August	2015	23:45	Brandt's	Male	Adult		Small	5	Pale with black edges	35.2	6.8	
Jug Holes	22.08.15	August	2015	23:45	Daubenton's	Male	Adult		Medium	1	Pale	35.5	7.6	
Jug Holes	22.08.15	August	2015	23:45	Daubenton's	Male	Adult		Large	1	Black	37.8	8.8	
Jug Holes	22.08.15	August	2015	00:20	Daubenton's	Male	Adult		Medium	3	Pale with black edges	35.3	7.1	14.3
Jug Holes	22.08.15	August	2015	00:20	Whiskered	Male	Adult		Large	2	Black	33.9	5	
Jug Holes	22.08.15	August	2015	00:20	Brandt's	Male	Adult		Large	3	Pale with black edges	35.3	5.8	
Jug Holes	22.08.15	August	2015	00:20	Daubenton's	Male	Adult		Small	1	Black	37.5	8	
Jug Holes	22.08.15	August	2015	00:20	Brandt's	Male	Adult		Medium	4	Pale	34.8	5.2	
Jug Holes	22.08.15	August	2015	00:20	Daubenton's	Male	Adult		Large	1	Pale	36.1	7.9	
Jug Holes	22.08.15	August	2015	00:20	Whiskered	Female	Juvenile					35	4.6	13.9
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Female	Juvenile					36.8	8.5	
Jug Holes	22.08.15	August	2015	01:25	Brandt's	Male	Adult		Small	2	Black	35.1	5.8	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Small	3	Pale with black edges	37.8	9.4	
Jug Holes	22.08.15	August	2015	01:25	Whiskered	Male	Juvenile		Small	2	Black	33.6	4.8	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Small	1	Black	37.3	8.9	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Small	1	Black	38	8.8	
Jug Holes	22.08.15	August	2015	01:25	Brown long-eared	Male	Adult		Small	3	Black	38.5	8.1	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Medium	1	Black	38.5	9.1	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Medium	1	Black	37	8.3	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Female	Juvenile					39.9	9.1	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Small	1	Black	36.4	8.5	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Small	2	Pale with black edges	37.3	8.2	
Jug Holes	22.08.15	August	2015	01:25	Brandt's	Male	Adult		Small	1	Black	34	5.3	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Large	1	Pale	38.2	8.1	
Jug Holes	22.08.15	August	2015	01:25	Brandt's	Male	Adult		Medium	3	Pale with black edges	34.1	6.1	
Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Large	1	Black	35.7	7.2	

Jug Holes	22.08.15	August	2015	01:25	Daubenton's	Male	Adult		Medium	1	Black	36.8	8.4	
Jug Holes	22.08.15	August	2015	01:25	Natterer's	Female	Adult	Parus				41.9	9.5	
Jug Holes	22.08.15	August	2015	02:30	Daubenton's	Male	Adult		Small	1	Pale	36.8	8.3	13.5
Jug Holes	22.08.15	August	2015	02:30	Daubenton's	Male	Adult		Medium	1	Black	38.5	8.7	
Jug Holes	22.08.15	August	2015	03:00	Brown long-eared	Male	Adult		Medium	3	Black	39	7.3	13.9
Jacob's Dream Mine	28.08.15	August	2015	21:30	Brown long-eared	Male	Adult		medium	2	Black	37.7	7.5	12.1
Jacob's Dream Mine	28.08.15	August	2015	22:20	Brandt's	Male	Adult		Medium	3	Pale with black edges	35.9	6.5	11.7
Jacob's Dream Mine	28.08.15	August	2015	22:20	Brandt's	Male	Adult		small	3	Pale with black edges	34.5	6.7	11.7
Jacob's Dream Mine	28.08.15	August	2015	23:00	Brown long-eared	Male	Adult		medium	2	Black	38.6	7.3	11.8
Jacob's Dream Mine	28.08.15	August	2015	23:00	Brown long-eared	Female	Adult	Null-Parous				40.1	6.9	11.8
Jacob's Dream Mine	28.08.15	August	2015	23:00	Brandt's	Female	Adult	Parus				33.6	5.6	11.8
Jacob's Dream Mine	28.08.15	August	2015	23:00	Natterer's	Male	Adult		large	2	Pale with black edges	41.1	8.6	11.8
Jacob's Dream Mine	28.08.15	August	2015	00:10	Daubenton's	Male	Adult		medium	1	Black	36	8.6	11.3
Jacob's Dream Mine	28.08.15	August	2015	00:30	Whiskered	Female	Adult	Null-Parous				34.7	5.1	11.2
Jacob's Dream Mine	28.08.15	August	2015	00:55	Daubenton's	Male	Adult		Medium	2	Pale	36.3	8.4	11.3
Jacob's Dream Mine	28.08.15	August	2015	01:15	Brown long-eared	Male	Adult		large	2	Black	41	8.5	11.2
Jacob's Dream Mine	28.08.15	August	2015	01:15	Daubenton's	Male	Adult		medium	3	Pale	38.7	9	11.2
Jacob's Dream Mine	28.08.15	August	2015	01:34	Brandt's	Male	Adult		small	4	Pale with black edges	33.8	6.1	11.3
Jacob's Dream Mine	28.08.15	August	2015	01:44	Daubenton's	Male	Juvenile		small	1	Black	39.2	8.4	11.1
Owl Hole Cave	04.09.15	September	2015	22:00	Natterer's	Female	Adult	Null-Parous				41	9.1	11.1
Owl Hole Cave	04.09.15	September	2015	22:00	Natterer's	Male	Adult		small	1	Pale	39.5	7.5	11.1
Owl Hole Cave	04.09.15	September	2015	22:45	Natterer's	Male	Adult		medium	1	Black	37.8	7.2	10.6
Owl Hole Cave	04.09.15	September	2015	22:45	Natterer's	Female	Adult	Null-Parous				40	7.6	10.6
Owl Hole Cave	04.09.15	September	2015	22:45	Brown long-eared	Male	Adult		small	1	Black	40	7.2	10.6
Owl Hole Cave	04.09.15	September	2015	22:45	Natterer's	Male	Adult		large	2	Black	40.3	7.7	10.6
Owl Hole Cave	04.09.15	September	2015	23:40	Natterer's	Female	Adult	Null-Parous				39.1	7.3	10.9
Owl Hole Cave	04.09.15	September	2015	23:40	Whiskered	Female	Adult	Null-Parous				34.1	4.7	10.9
Owl Hole Cave	04.09.15	September	2015	23:40	Daubenton's	Male	Adult		small	1	Pale	37.3	8.4	10.9
Owl Hole Cave	04.09.15	September	2015	23:40	Natterer's	Male	Adult		medium	2	Black	38.8	7.8	10.9
Owl Hole Cave	04.09.15	September	2015	23:40	Natterer's	Male	Adult		medium	1	Pale	40.5	8	10.9
Owl Hole Cave	04.09.15	September	2015	00:35	Natterer's	Female	Adult	Null-Parous				40.5	9.2	10.9
Owl Hole Cave	04.09.15	September	2015	00:35	Daubenton's	Male	Adult		Medium	1	Black	37.5	7.3	10.9
Owl Hole Cave	04.09.15	September	2015	01:45	Daubenton's	Female	Adult	Null-Parous				39	8.8	10.6
Owl Hole Cave	04.09.15	September	2015	01:45	Daubenton's	Male	Adult		Small	1	Black	37.3	8.1	10.6
Owl Hole Cave	04.09.15	September	2015	01:45	Daubenton's	Male	Adult		medium	2	Pale	37.5	8.3	10.6
Owl Hole Cave	04.09.15	September	2015	01:45	Daubenton's	Male	Adult		small	1	Black	37.6	7.7	10.6
Jug Holes	05.09.15	September	2015	22:30	Daubenton's	Male	Adult		Large	4	Pale	38.4	8.5	6.9
Jug Holes	05.09.15	September	2015	22:43	Brandt's	Male	Adult		Large	5	Pale	34.8	5.6	6.5
Jug Holes	05.09.15	September	2015	22:43	Natterer's	Male	Adult		small	2	Black	39.1	8	6.5
Jug Holes	05.09.15	September	2015	23:00	Daubenton's	Male	Adult		Large	3	Pale	37.8	9.1	7.1
Jug Holes	05.09.15	September	2015	23:20	Natterer's	Male	Adult		Large	2	Pale with black edges	38.8	7.5	7.2
Jug Holes	05.09.15	September	2015	23:20	Whiskered	Female	Juvenile	Null-Parous				35	5.2	7.2
Jug Holes	05.09.15	September	2015	23:40	Brandt's	Male	Adult		Small	5	Pale with black edges	35	5.9	7.3
Jug Holes	05.09.15	September	2015	00:00	Natterer's	Male	Adult		Large	2	Black	40.8	8.1	7.3
Jug Holes	05.09.15	September	2015	00:00	Daubenton's	Male	Adult		Small	1	Black	35.6	7.9	7.3
Jug Holes	05.09.15	September	2015	00:00	Daubenton's	Male	Adult		Medium	2	Pale	35.6	8.1	7.3
Jug Holes	05.09.15	September	2015	00:00	Natterer's	Male	Adult		Small	2	Pale with black edges	38.9	7.4	7.3
Jug Holes	05.09.15	September	2015	00:20	Daubenton's	Male	Adult		small	1	Black	39.6	8.5	7.7
Jug Holes	05.09.15	September	2015	00:20	Natterer's	Female	Adult	Parus				38	7.6	7.7
Jug Holes	05.09.15	September	2015	00:20	Natterer's	Male	Adult		Medium	1	Pale with black edges	39.5	6.8	7.7

Jug Holes	05.09.15	September	2015	00:20	Brown long-eared	Male	Adult		Medium	2	See comments	38	7.1	7.7
Jug Holes	05.09.15	September	2015	00:40	Daubenton's	Male	Adult		Medium	2	Pale with black edges	36	7.8	8.2
Jug Holes	05.09.15	September	2015	00:40	Brandt's	Female	Adult	Parus				35.5	8.5	8.2
Jug Holes	05.09.15	September	2015	00:40	Daubenton's	Male	Adult		Medium	2	Pale with black edges	38.1	9.1	8.2
Jug Holes	05.09.15	September	2015	01:00	Daubenton's	Male	Adult		small	1	Pale with black edges	36.4	8.9	8.2
Jug Holes	05.09.15	September	2015	01:40	Daubenton's	Male	Adult		large	3	Pale	36.3	7.4	7.5
Jug Holes	05.09.15	September	2015	02:00	Daubenton's	Male	Adult		Medium	3	Pale	36.5	8.6	7.5
Owl Hole Cave	02.10.15	October	2015	22:45	Natterer's	Male	Adult		small	5	Pale with black edges	39	7.5	0.2
Good Luck Mine	03.10.15	October	2015	19:30	Natterer's	Male	Juvenile		small	1	Black	37	6.7	9
Good Luck Mine	03.10.15	October	2015	20:00	Natterer's	Male	Adult		small	1	Black	38.8	6.8	7.5
Good Luck Mine	03.10.15	October	2015	22:45	Natterer's	Male	Adult		small	5	Pale	40.6	8.1	5.1
Good Luck Mine	03.10.15	October	2015	23:16	Daubenton's	Male	Adult		small	3	Pale	36.6	7.8	4.8