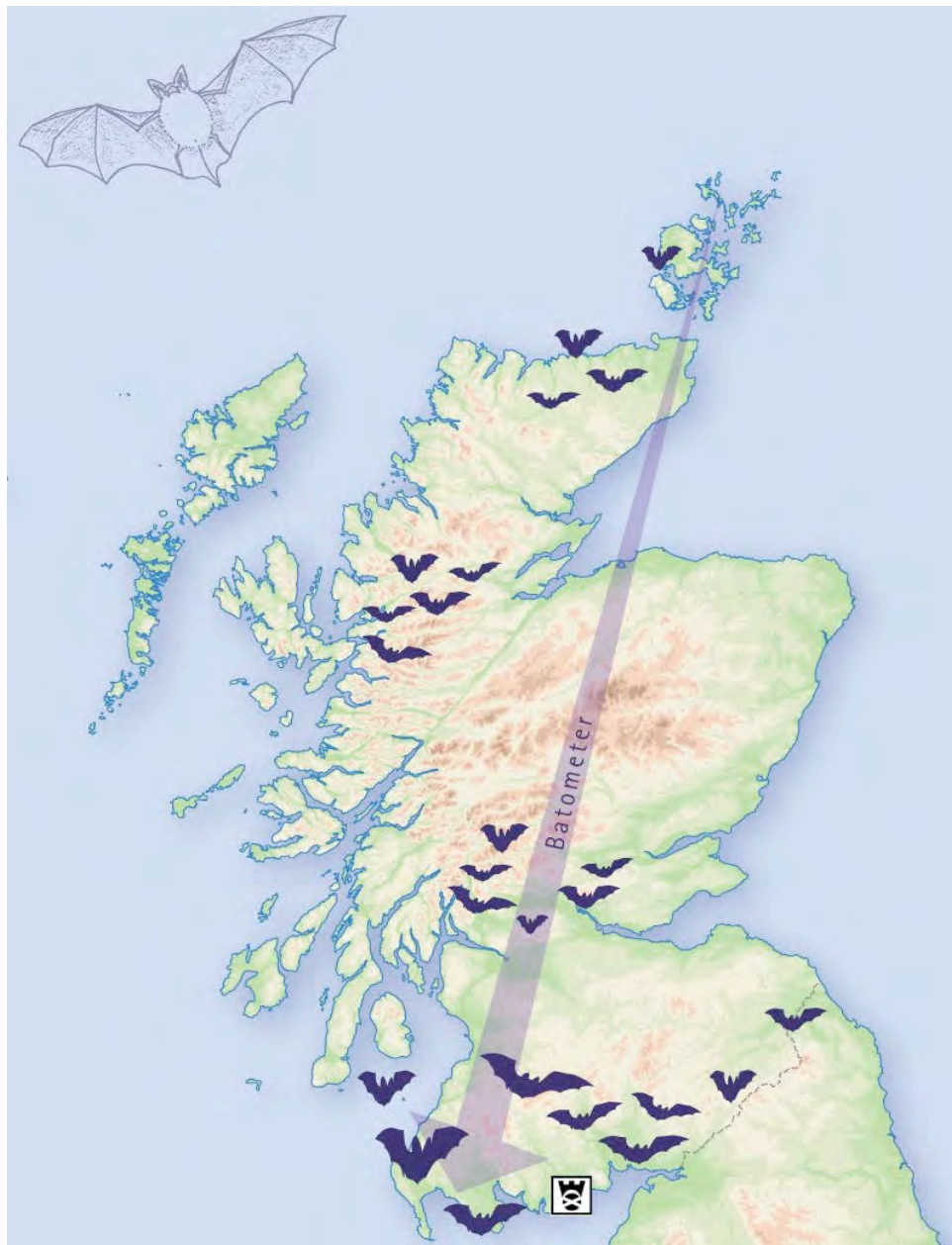


Scottish BATS

Volume 6 – October 2014

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Batometer in Scotland © BCT.

Aims of *Scottish BATS*

- To provide a publication outlet where bat workers, researchers and enthusiasts are encouraged to share their experience and knowledge of bats in Scotland.
- To help bring Scottish Bat Groups closer; assisting all groups to learn from each other through education, research and enjoyment.
- To share our ideas and findings with a new audience outwith Scotland and the UK.

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'Whatever projects you pursue, if you have interesting and reliable findings you should let other people know about them. Natural history and science are of little or no value if they are not communicated to others. Sharing your findings also enhances the pleasures you derive from your efforts'. 'Your findings may interest others and prompt new work from them. Finally, the knowledge may benefit the bats themselves through increased public understanding and better conservation. So keep good records and share your data and ideas'

Altringham, J. (2003), *British Bats*, The New Naturalist, Harper Collins.

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***Scottish BATS* is now seeking articles for Volume 7 (2015/16).** If you are interested, please get in touch: Info@scottishbats.org.uk.

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A long term ringing study of a Daubenton's bat *Myotis daubentonii* roost on the Union Canal in West Lothian, Scotland

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Abstract

During the period 2003 to 2013 a ringing study of Daubenton's bats (*Myotis daubentonii*) was carried out at a site on the Union Canal in West Lothian. In total, 192 bats were ringed and monitored. 62.5% of all ringed bats were recaptured and an overall population estimate for the site was ascertained. The data gathered also provided an insight into the use of the site, including sex, age mix, typical forearm length and weight measurements.

Key words: *Myotis daubentonii*, ringing, bats, Daubenton's

Introduction

Daubenton's bat (*Myotis daubentonii*) is a widely distributed species within Scotland (Haddow and Herman, 2000). It shows a strong association with fresh water habitats, in particular calm water, above which it feeds by hawking or gaffing insects from just above or on the water surface (Rydell *et al.*, 1999; Siemers *et al.*, 2001). As well as a strong association with calmer water features (e.g. rivers, ponds, lakes, canals), it can also be found foraging away from water, in woodland areas for example. This species is typically found roosting in bridges, old structures and tree cavities in the UK.

Within the central belt of Scotland during the period 2001 to 2008 the BATS & The Millennium Link (BaTML) project was established to study bats utilising the canal corridors in the area (i.e. the Union Canal and the Forth & Clyde Canal corridors). This project focussed primarily on the activity of Daubenton's bat, soprano pipistrelle and common pipistrelle, looking at commuting, foraging and roosting behaviour. BaTML carried out and reported upon numerous projects throughout its lifespan, full details of which can be found within the BaTML Publications archive (www.batml.org.uk).

As part of BaTML and then latterly as an ongoing research project (sponsored by Echoes Ecology), a ringing project of a Daubenton's bat roost was carried out from September 2003 to September 2013. This was set up to establish the general use of the roost, as well as to monitor individual usage.

The study site was situated at Lins Mill Aqueduct, where the Union Canal crosses over the River Almond in West Lothian (NT104706). Bats accessed the roost within the aqueduct structure via a maintenance access hole.

Materials & Methods

All methods adopted were carried out under licence by suitably experienced bat workers. Best practice methods as described within the Bat Workers' Manual (Mitchell-Jones and McLeish, 2004) were followed.

In order to capture bats, a two banked harp trap (Faunatech Austbat, Australia) was placed over the maintenance access hole (Figure 1). This trapped bats as they were leaving their roost at dusk (Figure 2) on each of the survey nights in question.

Once captured, bats were contained within the holding bag of the harp trap, prior to being transferred to small cotton holding bags. For each bat captured a number of features were noted (i.e. sex, forearm length, adult or immature and weight).

A magnesium-aluminium flanged ring (2.9mm internal diameter when secured), suitable for small to medium sized bats within the UK, was then fitted around the bats forearm (Figure 3). The ring number was recorded against all data collected for that individual. The bat was then released at place of capture. All data were stored on a database (MS Excel spreadsheet software) throughout the study period.

Figure 1: Harp trap in place over maintenance access hole.



Figure 2: Looking down onto harp trap from above. Bats can be seen within holding bag.



After the first ringing session, the potential existed to recapture individuals that had been ringed on a previous occasion. When a previously ringed bat was caught, its ring number was noted and other details checked against the existing database entry. Where appropriate, biometric details were updated (e.g. weight).

Recapture data was also used in order to provide an estimate of the overall population size for the site. In order to do this, a method multiple-recapture data analyse programme for open populations was used (Sutherland, 2006). The Jolly-Seber method was applied to the data using MARK software with time intervals being adjusted according to 'months between visits'. The individual recapture history of each bat during the period in question was utilised in order to provide an overall population estimate.

Figure 3: Daubenton's bat fitted with numbered ring on forearm.

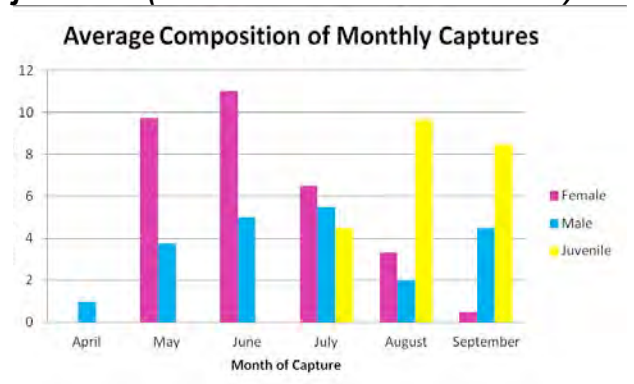


Results

In total, 192 bats were ringed during the period September 2003 to June 2010, with monitoring continuing until September 2013. The results are described as follows.

Figure 4 shows the average monthly capture rates of bats throughout the entire study, split by sex of adult bats and age (i.e. adult or juvenile). The juveniles have not been separated according to sex in this instance. Figure 5 provides a percentage split between age and sex for all bats captured and ringed at the site, as well as providing the total numbers in each category.

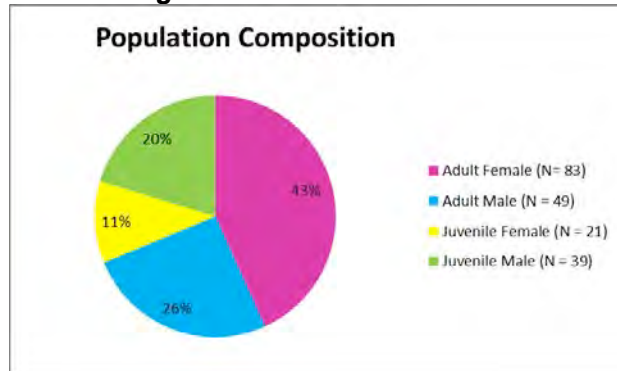
Figure 4: Average monthly capture rates split by adult male, adult female and juveniles (males and females combined)



No females were captured at the site during trapping sessions in April. During the period May to August adult female bats outnumbered adult males. In comparison, during

September, adult males outnumbered adult females. Juveniles (i.e. born earlier in the same year) were only caught from late July onwards.

Figure 5: Percentage split (age and sex) for all bats ringed



Forearm length (mm) and weight (g) for the study group are described in Figures 6 and 7 respectively. For each measurement the data are shown as box plots and split between males and females.

Regarding forearm length, as expected, female measurements are typically, on average, longer than male. The range encountered within the study group was 34.8mm to 39.1mm for males, and 35.4mm to 39.9mm for females.

A similar comparison exists when considering weight, albeit the presence of pregnant females within the data will influence the comparison to some extent in this respect. The range recorded for weight was 6.1g to 9.8g for males, and 6.5g to 11.4g for females.

Of the 192 individuals ringed a total of 120 bats were recaptured on at least one occasion (62.5%). Multiple recaptures (i.e. bats recaptured on two or more occasions) were not uncommon. 58 individuals (30.2%) were recaptured on at least two occasions after having been ringed. 36 individuals (18.8%) were recaptured on at least three occasions. Of these, 19 (9.9%) were caught a fourth time, and five of those (2.6%) caught on a fifth occasion.

We also looked at the longevity of life and the estimation of the overall population size for the site.

The oldest bats encountered at the site are known to be at least 10 years in age. Three individuals demonstrate this. Two males that were ringed as adults in September 2003 and last caught in May 2012 and May 2013 respectively, and a first year male originally caught in September 2003 which was recaptured for the first time during August 2013.

Figure 6: Forearm length (mm) split between males and females

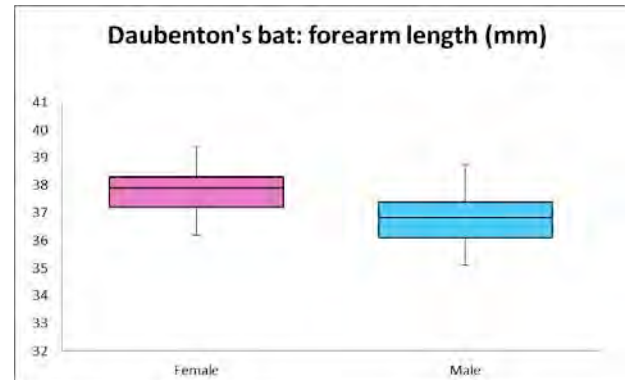
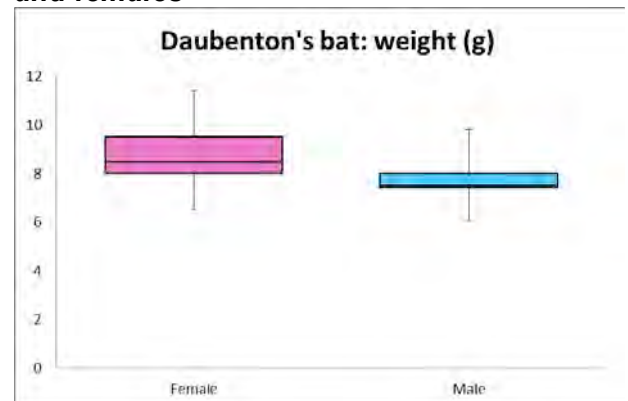
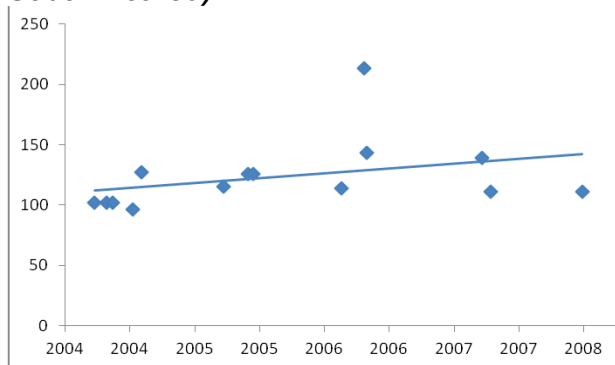


Figure 7: Weight (g) split between males and females



An estimation of the overall site population size, using the Jolly-Seber method, was carried out for the period 2004 to 2008. The results of this (see Figure 8) concluded that the overall population size was in the region of 100 to 125 bats, with numbers fairly consistent during the sample period.

Figure 8: Population size estimate (Jolly-Seber method)



Discussion

The site should be regarded as being of high importance for roosting bats locally. It lies at a point where two valuable habitat corridors cross (i.e. the Union Canal and the River Almond), and it is therefore not surprising to find Daubenton's bats roosting within the aqueduct structure. Occasionally, other species emerge from the same access point (e.g. Natterer's bat and brown long-eared bat). The numbers of other species are considerably smaller by comparison, with less than 20 individuals over ten years.

The seasonal use by females would support the conclusion that the site is being used during the summer for maternity purposes. Pregnant adult female bats were regularly encountered at the site, as were, later in the summer, juveniles. The adult female population appears to drop off into the autumn, with mainly males being encountered during September, albeit the overall number of bats present at that time is generally much lower than encountered during the early summer months.

Forearm measurements, as expected, were longer for females on average than those recorded for males (Harris and Yalden, 2008). Weight measurements followed a similar pattern, however it must be factored in that some of the female weights related to pregnant females (i.e. body weight was higher than in a non-pregnant female). As such, the weight data, should not be regarded as being directly comparable between males and females.

We have compared our forearm and weight data with another Daubenton's roost site on the same canal corridor (Avon Aqueduct, approximately 15km to the west of Lins Mill). Figures 9 and 10 provide this comparison, with the same degree of caution being attributable to the weight measurements of female bats.

The longevity information shows that these mammals can live for a long time relative to their small size. Longevity in this species is not well documented, with average life-spans of 4 to 5 years being quoted from numerous sources. However the life-spans quoted in this study are by no means close to what can be achieved, with the oldest life-span record found for this species being c.20 years old. This record relates to a bat being monitored in the East Midlands, UK (Harris and Yalden, 2008). It is, nonetheless, still interesting to see how this study can monitor bats at an individual level. One of our bats was originally ringed in 2003 and not encountered again until 2013 (i.e. recaptured once during the period). This shows that bats that have not been encountered for a lengthy period should not necessarily be assumed to have died.

The estimation of population size has to be treated with a degree of caution, especially bearing in mind that this is a small sample size. Also owing to the irregularity and inconsistent timings of each individual capture event, the time intervals had to be adjusted for accordingly within the MARK software. The data produced from this does provide fairly consistent figures (c.100 to 125) with the exception of a single 'outlier' estimate of in excess of 200 for one of the 2006 measurements. On one occasion, at least 77 bats were known to have emerged (note that not all of these bats were captured during that emergence). So an overall population estimate in the order of 100 to 125 seems reasonable for the site.

Due to the importance of this long-term study, with ringed bats still being trapped, this monitoring is earmarked to continue for the foreseeable future.

Figure 9: Comparison in forearm length (mm) between males and females at two sites (Lins Mill and Avon) within Central Belt of Scotland

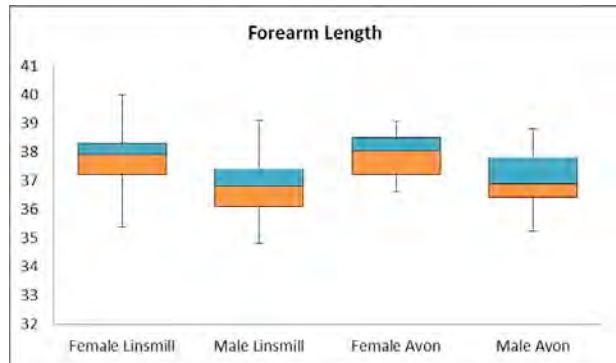
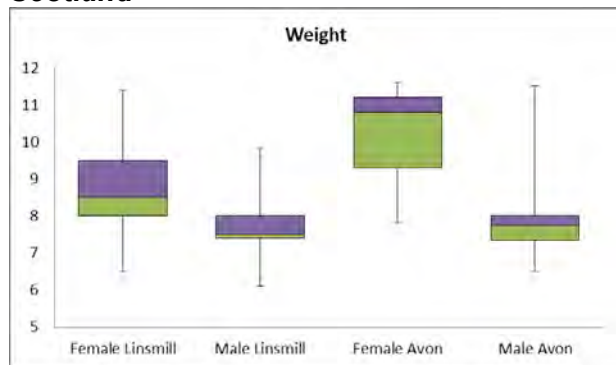


Figure 10: Comparison in weight (g) between males and females at two sites (Lins Mill and Avon) within Central Belt of Scotland



Acknowledgements

We would like to acknowledge and thank all of the following who helped contribute towards this work: Kirsty Morrison; Chris Gould; Laura Davis; Natalie Todman; John Haddow (Central Scotland Bat Group); Stuart Smith (Lothian's Bat Group); Sue Swift; Iain Mackie; James Aegerter; BaTML Project Team and volunteers (2003 to 2008); Echoes Ecology Ltd project team (2007 to 2013).

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February 2014.

A parti-coloured bat *Vespertilio murinus* found on the Isle of Arran

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Figure 1 - The Arran parti-coloured bat *Vespertilio murinus* showing its characteristic ear shape with a curved, blunt, forward pointing tragus. The orange-yellow objects in the ear are ectoparasitic mites (photo J. Haddow).



On 13 March 2011 a medium sized bat was found grounded in a garden at Kildonan in the south of the Isle of Arran, 0.4km inland from the coast (OS grid reference NS 036 213, coordinates 55°26'N, 5°06'W). The finder was nine-year-old Victoria Mowatt who was a member of the National Trust for Scotland Young Naturalists Club. She contacted Corinna Goeckeritz, a Ranger with the NTS at Brodick Country Park. On examination it appeared that the wings were damaged, probably by a domestic cat.

Corinna sent photographs of the bat to John Haddow, who travelled to Arran on 2 April 2011 with Anne Youngman (Scottish Bat Officer for the Bat Conservation Trust). Damage to both wings was

evident, but particularly its left wing, including loss of some phalanges (finger bones). There was injury to the left wrist joint, so that articulation of the carpal and metacarpal bones was also damaged. These injuries would prevent the bat from flying again. Since the bat could not be released, it was taken to an experienced bat carer in Dundee (Tracey Joliffe), and kept for some months before it died.

The bat was a female, forearm length 44.2mm. It was identified as a parti-coloured bat on its morphology, particularly the form of its ears, its skin and fur coloration. Samples of its faeces were sent for identification using DNA (Waterford Institute of Technology, Waterford, Ireland) and the species was confirmed by a 100% sequence match.

Figure 2 - The Arran bat showing the distinctive dorsal fur, dark at the base with silver-whitish frosted tips, hence the name "parti-coloured". Compared with other medium to large Vespertilionid bats in Europe, the forearm length of 44.2mm is within the range for Leisler's bat but smaller than a noctule or serotine (photo J. Haddow).



Possible origin of the Arran parti-coloured bat

The parti-coloured bat does not breed the UK or Ireland, but a small number of vagrant bats of this species are recorded annually in the UK, mainly near the east

coast. There are also records from North Sea oil rigs and from the Shetland Isles.

Figure 3 - The Arran bat *uropatagium* (tail membrane) showing the post calcarial lobe and the section of tail free from the membrane (photo J. Haddow).



The Shetland Biological Records Centre website lists one found on Whalsay, 31st March 1927; Lerwick 19th November 1981; Mid Yell 16th November 1984; Spiggie, south mainland, 15th June 2011. A live bat of this species was recorded in a sheltered porch area on a house at Gluss, Ollaberry, mainland, on the 11th and 12th December 2013. Photographs taken of this bat enabled confident identification, but it was noted that it had “flown off”. However the bat was seen in the same roost location in February 2014, so must have survived in the area from December to February at least.

The distribution of *Vespertilio murinus* in Europe (Dietz et al. 2009) includes Netherlands, Belgium, Germany, Denmark and southern Norway as the nearest populations to the UK. Migratory movements in the spring and autumn may result in some individuals from nearby Netherlands or Belgium (distance approximately 180km) being found in the east of England. The Shetland Isles are 360km from the coast of Norway. Based on this proximity it is possible that Shetland vagrants originate from the Norway population of the parti-coloured bat.

The record of a parti-coloured bat on Arran is the most westerly of any found in the UK, and the most distant from any of the known European populations. Did this bat fly from Norway, via Shetland and Orkney, or did it arrive on the east coast of England or Scotland, and from there fly north-westwards to Arran?

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April 2014.

Assynt Cave Bat Project Report 2009-2011

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Summary

Results from this three year survey indicate that it is likely bats use some of the caves within the Assynt Cave System, West Sutherland (North Highland) and thus gives specific caves; Bone Caves (close set of 4 entrances), Cnoc Nan Uamh (upper) and Uamh An Tartair a Grade 2 status of importance as underground sites for bats.

Daubenton's bat and common pipistrelle were recorded at cave entrances. In addition, three soprano pipistrelle (with many common pipistrelle) passes were recorded foraging along the River Tralligill. No data indicative of significant bat swarming activity was noted during the survey period.

Presence in two new 10km squares was established for Daubenton's bat and one for soprano pipistrelle, contributing to the Atlas of Highland Land Mammals.

The Assynt Caves may facilitate an autumn mating bat roost site and may also act as a hibernation site for small numbers of Daubenton's bats. Use of underground sites by pipistrelle bats is discussed in context to Assynt Caves (see 5. 3).

More often than not, harsh weather (heavy rain and strong winds) reduced the effectiveness of the bat loggers in providing positive results on bat usage. Emergence survey visits to cave sites and the use of an Anabat detector greatly assisted the collection of data.

More intensive bat survey work at Bone Caves (4), Cnoc Nan Uamh (upper), Uamh An Tartair and Rana Hole would help to give a more accurate picture of bat frequency and determine further the most important site for bats within the Assynt Cave System.

As a precaution, bats should be fully considered (at least at caves where bat activity was recorded) should anthropogenic activities be proposed which might affect bats or their roost sites (see Bat Conservation Code in Annex A).

1. Background

An unexpected discovery of a Natterer's bat (*Myotis nattereri*) (the 1st record of this species for North Highland area) was recorded near Inverlael near Ullapool on the late date of 20 September 2007 (NBN Gateway). The species and timing of this record suggests that this individual may have been in the area seeking an appropriate autumn mating and winter roost site. Natterer's bats are known to frequent cave sites within the UK for autumn mating and winter hibernation. They will travel considerable distances to find these optimum sites, perhaps as far as 60km (BCT, 2007).

Myotis bats (i.e. in this case both Natterer's and Daubenton's bats) are true cave dwellers, especially in the autumn (August-October) when they are known to swarm at cave entrances prior to using these caves as autumn mating and winter hibernation sites. Winter surveys by bat surveyors to locate hibernating bats within caves are normally unsuccessful, since many bats (e.g. *Myotis* species) habitually hibernate deep in crevices, making them hard to find, particularly in complex, natural cave systems (Glover & Altringham, 2008). Survey work in parts of the UK's karst landscapes (i.e. Yorkshire Dales) by Leeds University continues to focus on cave systems and their importance for populations of bats (Altringham, 2011).

Figure 1 - Typical remote upland habitat seen through Badger Cave (bat logger being placed at cave entrance.) (Photo – A. Summers).



Daubenton's bats (*M. daubentonii*) are known to forage over the Traligill Burn in late August, which is relatively close to one of the Assynt Cave Systems (A. Summers *pers. comm.*).

As little is known about how bats may interact with the Assynt Caves, this project set out to implement survey work to assess the presence of bats using the Assynt Cave systems. The Assynt Caves include some of the largest caves in Scotland, thus they may be suitable as autumn/winter bat roost sites. The main valleys crossing the limestone outcrop (the Traligill and Allt nan Uamh valleys) each contain cave systems, whose length and complexity single them out as worthy of conservation (Young, *et al.*, 2005; SNH 2011a). The caves are identified as a feature of interest within Ben More Assynt Site of Special Scientific Interest (SSSI) (SNH, 2011b).

All of the above issues and initial findings helped trigger the Assynt Cave Bat Project, taken forward by members of North Highland Bat Network (NHBN).

2. Objective

The objective of this project was as follows:

- **To ascertain if the Assynt Caves are used by bats and**

to help determine their importance for bats.

3. Methods

3.1 Automated bat loggers

This project used specialised survey data loggers, which were positioned either within or just at cave entrances to detect and record bat activity. These special little loggers are able to log any bat activity at 45 KHz but they do not distinguish between different bat species. It was recognised that the first and most important part of this project was to assess if caves were being used by bats (irrespective of species). The equipment used for this project was replicated from other bat surveys where bat loggers have been successful in showing bat presence and cave use by autumn bats (Glover & Altringham, 2008).

Figure 2 – Bat loggers within protective cases used at each of the cave entrances.



Each bat logging device was left at the entrance of a cave for around 5 days, mainly during September, as this month appears to be the peak period known for bat activity at cave systems. The loggers were well hidden, either within vegetation or under a peat sod, close to the entrance of suitable caves. They were retrieved after a week, when data was downloaded onto computer and batteries re-charged for the next sampling session.

3.2 Remote Anabat detector

An Anabat detector was used to assist bat sampling at the Assynt Caves, when it could be placed at a remote location away from regular public

access. On occasion, it was put out late in the evening and retrieved early the next day to reduce risk of theft. The longest the Anabat was in situ was at Uamh An Tartair (Knockan Basin), when it was out for a period of 2 weeks in September to maximise recording of any bat presence at the entrance to the cave.

The Anabat detector records actual bat calls and bats can be identified to species level with experience. The detector also records the time and date of the bat call. Anabat calls were downloaded and analysed using the Anabook software programme. Species identification was aided using Russ (1999), and some specific calls were assessed by other bat survey colleagues, providing a second opinion on the more tricky *Myotis* family of bats and their very similar calls.

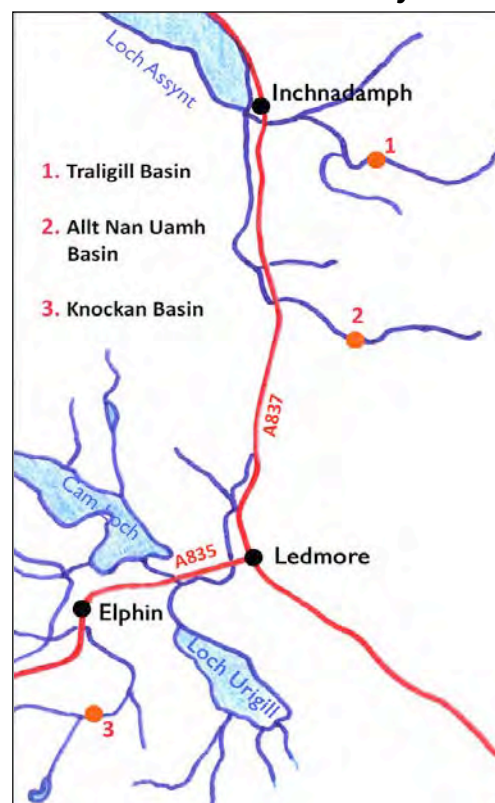
3.3 Caves

The Assynt Caves comprise three main systems; Traligill Basin, Allt Nan Uamh Basin (Bone Caves) and Knockan Basin. Specific caves chosen for sampling were taken from Lawson, *et al.* (1988); concentrating on caves that were long and complex, offering bats better roosting options. Each cave was visited in advance (usually in the summer) to assess its suitability for hiding the bat logger from possible theft. This aspect also influenced which caves could be sampled, taking into consideration all available factors.

Glover & Altringham (2008) found that caves in Yorkshire with vertical shaft entrances and little water movement were favoured by bats. However, most of the Assynt Caves involve water movement, either at the entrance or deeper within the cave system. Thus, it was not possible to sample caves without encountering some flowing water, sometimes this being torrential. The caves less affected by flowing water are unfortunately the ones promoted for public access, the Allt Nan Uamh Basin (i.e. the Bone Caves). This factor alone made these

caves more problematic to sample with expensive bat survey equipment. In addition, vegetation surrounding these caves is cropped short by browsing deer, further limiting options to hide bat survey equipment.

Figure 3 – Map showing location of the three cave basins at Assynt.



4. Results

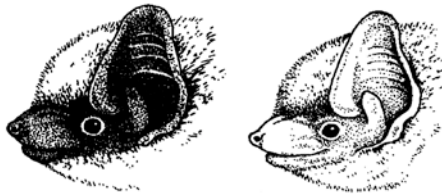
Information and results of this survey were collated in three main ways: visual observations of bats flying close to caves (with the aid of a heterodyne bat detector), bat loggers, and the Anabat detector. The results presented below are split into relevant sampling methods.

Sampling sessions indicating likely bat presence are identified in bold above. Using the bat logging method, three caves resulted in bat logger graphs showing slightly unusual peaks of activity during the night (albeit at low levels). This same activity was not repeated on graphs from other caves. Although the loggers are triggered by bat calls, not all of the registrations can be attributed to bats; some may

be strong winds and torrential water, making the results more difficult to interpret.

As can be seen from Table 2 (Annex B), use of a normal hand-held heterodyne bat detector, along with a remote Anabat detector, have helped to confirm bat usage of the Assynt Cave upland habitats. Three species have been confirmed; common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*P. pygmaeus*) and Daubenton's bat (*Myotis daubentoni*). For soprano pipistrelle and Daubenton's bat these records resulted in new 10km squares for both species, contributing to new bat distribution maps for Highland Region (Patterson & Wells, 2011).

Figure 4 – Common pipistrelle (left) and Soprano pipistrelle bats (© BCT)



The number of bat passes recorded with the Anabat detector has been very low, with the exception of just one night's recording opposite Tree Hole (Traligill Cave system) totalling 169 bat passes, comprising all three of the above bat species along a tree lined river-bed (see Fig. 5).

Figure 5 – Riparian upland habitat close to Tree Hole Cave.



5. Discussion

5.1 Survey limitations / effectiveness of bat survey equipment.

Time and weather

As this was a voluntary project, it was not possible to deploy bat loggers just to suit favourable weather conditions. As a result, the number of bat sampling nights, which coincided with suitable bat activity weather, was less than all available night time hours. The results from some of the bat loggers show that a fair proportion of the sampling periods coincided with both high winds and driving rain. If it had been possible to only sample for bats on evenings with suitable bat activity weather (i.e. warm and calm), then potentially more bat data may have been forthcoming.

Bat loggers

As almost all of the caves within the Assynt Cave Systems are normally affected by water-flow close to their entrance, the use of the bat loggers has resulted in recording a high level of background noise, which was not possible to eliminate using sensitivity control functions. The noise of gushing water and heavy rain, coupled with high winds, were all too dominant. Usually all the bat logger graphs showed high levels of this noise. Unfortunately, the graphs showing vibrant weather systems patterns could be 'masking' any low-level bat activity associated with the caves.

Emergence surveys and Anabat detector

As it is known that autumn bat activity normally associated with caves peaks in the middle of the night, emergence surveys (conducted at dusk for about one hour) were acknowledged as unlikely to give a true representation of bat usage for this purpose. However, of the three emergence surveys conducted, the first one, confirming presence of a bat in such a remote and inhospitable upland habitat, showed that extra survey effort of

people on the ground can aid ecological technology.

The use of an Anabat detector was a very helpful addition to the bat survey methods employed at this site, especially as this detector does not usually register water movement and weather conditions. Although the public location of many caves prevented leaving this detector in such places, where it was possible for it to be used, it did provide valuable results and helped indicate the level of bat activity taking place during the night. There is potential scope to use an Anabat again at Assynt Caves, but only on non-public sites where heathland vegetation is vigorous, providing good hiding potential.

5.2 Use of caves by bats: species recorded

Allt Nan Uamh Basin – Bone Caves

It is likely that at least one of the four caves (entrances) that lie within close proximity to each other; Badger, Reindeer, Bone and Fox (the main Bone Caves) attract some bat usage. The proximity of the Anabat detector close to the mouth of these caves for one night, registering both Daubenton's bat and common pipistrelle, is perhaps the most significant result. This set of caves is not affected by flowing water, at least in the upper sections close to cave entrances (although may be affected by water-flow deeper down). Therefore, they may be attractive to bats.

The bat logger graph on 24 (before midnight) and 26 August 2009 does indicate data patterns consistent with low levels of bat activity (see Fig. 6). However, it is difficult to be confident about this due to the influence of weather patterns on the data collected. Dr Anita Glover kindly commented on this graph and suggested the patterns are likely to be low levels of bat activity.

Figure 6 – Data graph from Fox and Bone Cave (23-26 August only)

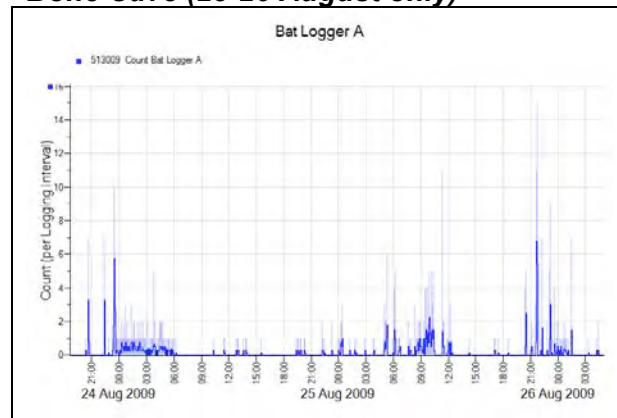


Figure 7 – Set of four close cave entrances at Allt Nan Uamh



Rana Hole is a vertical shaft, again with no direct association with flowing water (but may be affected by water-flow deeper down). This is perhaps the most attractive cave for bat usage within the whole of the Assynt Cave Systems. The bat logger placed at this cave was well sheltered in a hollow. The sensitivity of this data logger was possibly set too low as only two data points were recorded (in addition to noise detected during logger collection). However, the fact that these data points were detected during night time (22.06) might indicate bat passes over the top of the cave site (i.e. possibly a prospecting bat).

Unfortunately, bat access into and out of Rana Hole was restricted due to safety mesh, which had been in place over the vertical cave entrance for some time. This was to ensure public safety during protracted cave digging work within Rana (see Fig. 8). The digging work was carried out by members of the Grampian Speleological Group (GSG) and was linked to the very interesting discovery of more bone artefacts (i.e. a

magnificent, undamaged bear skull)
(GSG, 2009).

Figure 8 – Infrastructure to aid digging work within Rana Hole 2009.



There was mention of Rana Hole entrance being 'gated' in the future, to ensure general public safety at the Bone Caves (GSG, 2009). In an interim cave report, North Highland Bat Network (NHBN) highlighted the following information to SNH, Inchnadamph Estate and GSG:

'It is possible to successfully 'gate-off' a cave for safety reasons but still allow bats access. This has been achieved at other bat roost sites. If a gate has to be fitted to the entrance of Rana Hole, it is suggested that:

Consideration should be given to the possibility of bats using the cave;

The gate should be designed to accommodate either existing or future bat use (SNH's bat specialist should be able help in this regard). A range of grilles suitable for bat use can be seen within Mitchell-Jones et al., (2007), http://www.eurobats.org/publications/publication%20series/pubseries_no2_english_2nd_ed.pdf and;

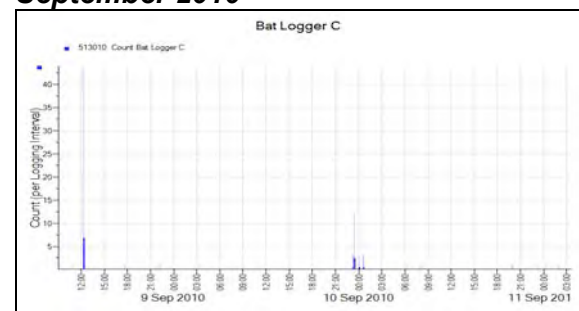
As a bat friendly grill (gate) is unlikely to reduce through-draft, it may be necessary to explore other possible options of reducing airflow back to original [pre-digging] conditions'.

We do, however, fully acknowledge that it is unknown if bats are using Rana Hole at this present time. This being said, bats **have** been recorded in the very near vicinity of Rana Hole, a cave that provides the dynamics that bats have been found to favour (i.e. a vertical cave shaft with little water influence). A precautionary approach would be sensible at this time until further survey information is forthcoming.

Traligill Basin

Although bats were not recorded using Tree Hole cave during the autumn, the sheltered tree lined riparian habitat is attractive to foraging bats. The Anabat detector (one evening sample) recorded one pass of a Daubenton's bat (4 September 2010 - 21.38).

Figure 9 – Bat logger data probably linked to bat activity at Cnoc Nan Uamh (upper cave entrance) on 10 September 2010



It could be argued that a single bat pass might indicate that this animal was passing through, as it did not return, at least along this route. Interestingly, the results recorded opposite Tree Hole are somewhat similar to those recorded in southern central Scotland by Park (2000). In this study eight transect foraging surveys were undertaken within 1km of known hibernation sites and recorded just one

Myotis bat, but much higher numbers of pipistrelles.

Cnoc Nan Uamh (upper cave entrance) is hydrologically connected to Tree Hole and lies only about 500m from this cave entrance. It is possible that the Daubenton's bat was either flying to or from Cnoc Nan Uamh (upper cave entrance). The bat logger graph showed some interesting data (around midnight on 10 Sept), which is consistent with bat activity (see Fig. 9). The peak after midday on 9th was considered to be attributable to a small rock-fall close to the logger.

Figure 10 – Cnoc Nan Uamh (upper cave entrance)



Knockan Basin

Uamh An Tartair is an impressive cave entrance which 'swallows' the Abhainn a' Chnocain into the heart of the cave (see Fig. 11). This cave also supports an impressive vertical shaft, with torrents of water passing directly through it. An Anabat was left at the entrance to this cave for a two-week period, logging two Daubenton's and eight common pipistrelle bat passes.

The Daubenton's passes occurred on subsequent evenings, perhaps indicating that the bat pass may have been in just one direction (possibly with no return flight). As only one pass occurred, it is possible that the bat did associate with, or roost within, the cave. However, the number of bats recorded at this cave over a full two-

week period was somewhat disappointing.

Figure 11 – Entrance to Uamh An Tartair Cave overlooked by Anabat detector



If this cave was used significantly by bats for autumn mating, swarming and/or hibernation it is likely that more bat activity would have been logged on the Anabat during the two-week period, especially by Daubenton's bats. Bat data collected at other caves (i.e. Bone Caves [four entrances] & at Cnoc Nan Uamh [upper entrance]) was more encouraging and related to much shorter sampling periods. The small amount of bat activity at Uamh An Tartair suggests some bat usage, but perhaps not enough to imply great importance for bats during the autumn period, despite it being an impressive cave structure.

More intensive bat sampling at each of the above caves where positive bat presence has been determined (or considered likely to be present) would help indicate which caves are likely to be the most important for bats within the Assynt Cave Systems.

5.3 Bats

To add to the complexity of ascertaining bat presence at cave sites, it is not certain when cave usage by bats might peak during the autumn period at Assynt. The sampling period

used to assess bat presence during this survey (i.e. generally the first two weeks of September) was influenced by similar survey work in the Yorkshire Dales. In that study, the peak activity was generally from the last week of August through to the second week of September, although bat activity (albeit at lower levels) progressed through into October (Glover & Altringham, 2008).

In Kent, peak bat swarming activity was found to be late September, which included a high proportion of Natterer's bats (Pucket & Scrimshaw, 2009). Altringham (2003) mentions that swarming can occur between August and November, with a typical peak of activity in September. Dietz *et al*, (2009) note that Daubenton's bats generally appear at a cave in Germany during August, compared to Natterer's arriving later in September/October. Thus, it is still not known when peak autumn activity might occur in North Highland compared to other sites much further south within the UK. Perhaps further work at another **known** autumn bat site might provide a better handle on this issue, to help inform similar surveys at other autumn bat sites (see 5.4 below).

Daubenton's bat (Myotis daubentoni)

This species is known as a true underground dwelling species and will seek out suitable mating and hibernation sites in caves, mines, limestone quarries and icehouses. It has been recorded at underground sites in central and southern Scotland (i.e. mines, castle vaults and limekilns), where it has been found using sites in the autumn during the mating season and also seen hibernating (Smith, 2000; Park, 2000). All reports of bats swarming in Scotland have been at sites also used as hibernacula (Racey, *et al*, 2004). Thus, this species is known to use underground sites in Scotland, but there is little information available to indicate if natural cave sites are used or preferred, especially in northern

Scotland. The use of Assynt Caves by Daubenton's bats, based on the few records of this species at cave entrances obtained during the project, and supplemented with graphs showing likely bat activity during the night, is considered noteworthy. More intensive surveys at specific caves (already mentioned) may shed more light on their use by Daubenton's bats during the autumn period.

Common and soprano pipistrelle (Pipistrellus pipistrellus and P. pygmaeus)

These species are not known as cave dwelling bats, and are not regularly recorded or trapped at underground sites when *Myotis* bats are being surveyed. They are thus considered rare as an underground hibernating species (Herman & Smith 1992; 1995) and winter behaviour is still poorly understood (Racey, *et al.*, 2004). However, one pipistrelle was discovered at an underground site by Smith (2000). Further, Mortimer (1995) and Patterson & Wells (2011) know of observations of pipistrelles using coastal sea caves. It is therefore possible that small numbers of pipistrelle bats may be using specific cave structures, although this requires further clarification.

Figure 12 – Common pipistrelle (close-up in-hand image)



General bat discussion

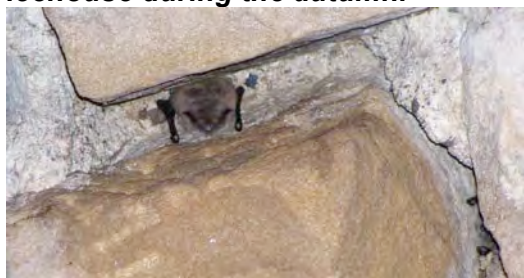
The information on small numbers of bats (especially Daubenton's bats) using the remote upland habitats in proximity of the Assynt Caves suggests that some caves may be used by bats, but probably in small

numbers. The number of bats recorded during this initial survey suggests that specific caves (as mentioned above) within the Assynt Cave systems could be recognised as having a **Grade 2 status** (i.e. small numbers of bats – no restrictions on visiting caves but follow the Bat Conservation Underground Code [see Annex A]) (Mitchell-Jones, *et al.* 2007).

5.4 Other autumn bat mating sites in North Highland

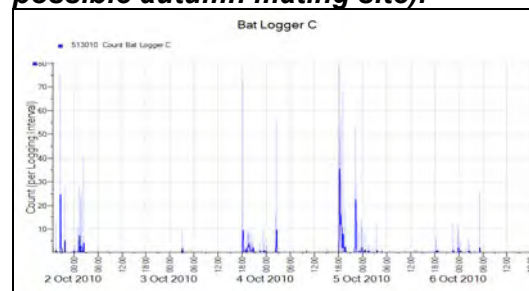
The only other **known** possible autumn mating site for *Myotis* bats in North Highland is within an icehouse in East Sutherland. This site is also a hibernacula.

Figure 13 – Daubenton’s bats within icehouse during the autumn.



To gauge how bats use this icehouse during the night, an Assynt Cave bat logger was deployed within the icehouse during October 2010 for several days. The resulting logger graph showed peaks of activity, which are consistent with social bat activity, with comings and goings during the night (see Fig. 14). The graph does not appear to be consistent with swarming however, perhaps showing that not all underground sites are used for swarming. Some sites may be important for bats for other reasons.

Figure 14 - Bat logger data taken from East Sutherland Icehouse, a known Daubenton’s bat roost site (a possible autumn mating site).



6. Conclusion

The results of this survey indicate that it is likely that Assynt Caves are used by low numbers of bats, giving particular caves (i.e. Bone Caves (4), Cnoc Nan Uamh (upper) and Uamh An Tartair) a Grade 2 status of importance as underground sites for bats. Further bat survey work could be undertaken at Rana Hole when full access is possible for bats.

Information on use of Scottish caves by bats appears to be scarce. Human made underground structures seem to be more popular for carrying out bat survey work. The one known underground site in East Sutherland is a Daubenton’s roost (within an icehouse – see 5. 4), suspected to be a mating roost and confirmed as a bat hibernacula. Similarly, the Assynt Caves may also provide an autumn bat mating roost site and also act as a hibernation site for small numbers of Daubenton’s and possibly some pipistrelle bats.

As a precaution, bats should be fully considered (at least at caves where bat activity has been recorded) should anthropogenic activities be proposed which might affect bats or their roost sites (see Bat Conservation Code in Annex A).

The Assynt Cave Bat Survey Team at their last cave (Sept 2011); Uamh An Tartair. [L to R – Karen Reid (with Mij), Lyn Wells, Tom Talbot & David Patterson (with Tjorn)].



7. Acknowledgements

We would like to thank Dr. Anita Glover (Postdoctoral researcher – Bat Ecology at Leeds University), Ivan Young (Grampian Speleological Group), John Haddow, Neil Middleton and Anne Youngman (Bat Conservation Trust – Scottish Bat Officer). Sue Agnew, Meryll Carr, John Charity, Tamara Lawton and Alex Scott (all SNH) provided assistance and support when requested. Andy Summers and Laura Talbot assisted with fieldwork, our thanks to them. Thanks also to Alex Scott who assisted as emergency ‘battery technician’ when our energy levels were low!

Thanks to Inchnadamph Estate for giving permission for the survey to go ahead. This project would not have been possible without funding from Scottish Natural Heritage (SNH), supporting small and local biodiversity projects.

Highland Biological Recording Group (HBRG) assisted with fuel and overnight accommodation costs. All mammal biological data was submitted to HBRG, so that it is publicly available and can be used for conservation purposes.

February 2012.

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ANNEX A – The Bat Conservation Underground Code (adapted from Mitchell-Jones & McLeish, 2004)

Caves and mines, their formations, artefacts and fauna, are all part of our national heritage. All visitors to underground sites should strive to maintain these sites for current and future generations. Always follow the safety and conservation codes published by caving and mining organisations and liaise with local groups over access and safety requirements.

Remember also that bats need your help to survive the winter. Most hibernating bats are very difficult to see – many squeeze into cracks and crevices. Just because you cannot see bats does not mean they are not there. Seek advice about any activity that might affect bats.

Those visiting known bat sites for purposes such as recreation are asked to observe the voluntary conservation code and respect any species restrictions that have been placed on particularly important bat sites. Because disturbance can be so damaging, only a limited number of people are licensed to disturb or handle hibernating bats in underground sites and licences are issued only after training has been given. Such licences are issued for controlled, carefully considered basic survey and monitoring and occasionally for scientific research.

Contact with bats - *be careful not to:*

Handle bats. Also beware of dislodging bats from their roosting position particularly when you are moving through low passages.

Photograph roosting bats. Flashguns can be very disturbing.

Warm up hibernating bats as this can arouse them. Try not to linger in

confined spaces, as even your body heat is sufficient to cause arousal out of hibernation.

Shine bright lights on bats. Both the light and the heat can trigger arousal.

Use carbide lamps in bat roosts. Carbide lamps are particularly undesirable because of the heat and fumes.

Smoke or make excessive noise underground. Any strong stimulus can arouse bats from hibernation.

Take large parties into bat roosts in winter. Rescue practices should also be avoided when bats are present.

Further advice:

Seek advice before blasting or digging. Explosives can cause problems both from the blast itself and from the subsequent fumes. In known bat sites, blasting should be limited to the summer or to areas not known to be used by bats.

Digging operations may alter the microclimate of bat roosts.

ANNEX B**Table 1 – Assynt caves sampled for bats using bat loggers.**

Dates	Cave	Grid Ref. of cave entrances sampled	Cave system	Bats recorded on logger graphs	Weather/water flow affected results
23-29 Aug 2009	Bone Caves: Fox and Bone	NC267 165	Allt Nan Uamh Basin	Yes - probably	Yes.
23-29 Aug 2009	Bone Caves: Reindeer and Badger	NC267 165	Allt Nan Uamh Basin	No – unlikely	Yes.
6-13 Sept 2009	Rana Hole	NC268 167	Allt Nan Uamh Basin	Yes – probably	No.
6-13 Sept 2009	Otter Hole	NC26808 17059	Allt Nan Uamh Basin	No – unlikely	Yes.
6-13 Sept 2009	Stream Cave	NC274 171	Allt Nan Uamh Basin	No – unlikely	Yes.
6-13 Sept 2009	Uamh Ard	NC28181 17947	Allt Nan Uamh Basin	No – unlikely	Yes.
5-11 Sept 2010	Cnoc Nan Uamh (upper)	NC27617 20389	Traligill Basin	Yes – probably	Not significantly.
5-11 Sept 2010	Cnoc Nan Uamh (lower)	NC27620 20577	Traligill Basin	No	Yes.
4-11 Sept 2010	Tree Hole	NC26921 21019	Traligill Basin	No	Yes.
20-25 Sept 2010	Glenbain Cave	NC26526 21669	Traligill Basin	No	Yes.
20-25 Sept 2010	Stream Cave (re-survey)	NC274 171	Allt Nan Uamh Basin	No	Yes.
20-25 Sept 2010	Otter Hole (re-survey)	NC26808 17059	Allt Nan Uamh Basin	No – unlikely	Yes.
5-15 Sept 2011	Ewan's Hollow	NC21163 09270	Knockan Basin	No – unlikely	Yes.
5-15 Sept 2011	Elphin Hole	NC20874 09327	Knockan Basin	Unsure	No.
5-15 Sept 2011	Knockan Pot	NC19692 09428	Knockan Basin	No – unlikely	Yes

Table 2 – Caves sampled for bat use either by ad hoc visual observations at emergence time or by placement of an Anabat detector.

Dates	Cave	Grid Ref.	Cave system	Bats confirmed	Method
31 Aug 2009	Bone Caves: Reindeer & Badger Cave	NC267 165	Allt Nan Uamh Basin	Yes – species unsure.	Emergence count (45 mins) – T. Talbot.
31 Aug 2009	Bone Caves: at waterfall	NC254 178	Allt Nan Uamh Basin	Yes, three <i>Myotis</i> sp. bat passes over river. Suspected Daubenton's bats.	Normal (heterodyne) bat detector and visual obs. T. Talbot.
4 Sept 2010	Tree Hole – opposite cave entrance by river-bed.	NC26916 21030	Traligill Basin	Yes – Daubenton's bat (1 pass), Common and Soprano pipistrelle (165 & 3 passes respectively). Considered to be foraging along river-bed.	Anabat detector (one night).
4 Sept 2010	Bone Caves: Reindeer & Badger Cave	NC267 165	Allt Nan Uamh Basin	Yes – 1 common pipistrelle	Emergence count (45 mins) – L. Wells & D. Patterson.
18 Sept 2010	Bone Caves: located at entrance to Badger Cave.	NC26701 16593	Allt Nan Uamh Basin	Yes – Daubenton's bat (1 pass) and common pipistrelle (3 passes).	Anabat detector (one night).
21 Sept 2010	Bone Caves: Reindeer & Badger Cave	NC267 165	Allt Nan Uamh Basin	No bats noted.	Emergence count (45 mins) – T & L Talbot.
4-17 Sept 2011	Uamh An Tartair	NC21669 09110	Knockan Basin	Yes – Daubenton's bat (2 passes) and common pipistrelle (8 passes).	Anabat detector (14 nights).

Bat conservation across the National Trust for Scotland

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The National Trust for Scotland (NTS) is a conservation charity that was first established in 1931 to protect and promote Scotland's natural and cultural heritage for all to enjoy. The Trust owns 76,000 hectares of land made up of 130 properties, 46 Munros and 16 major islands. Across such a large area there is a wide diversity of wildlife offering unparalleled opportunities for enjoyment.

Bats in the UK

Within the UK, 19 species of bats have been found, all of which are nocturnal insectivores. In Scotland, 11 of these species have been recorded:

Table 1: The Status of Scotland's Bat Species (Bat Conservation Trust)

Species	Status
Soprano Pipistrelle	Common
Common/Bandit Pipistrelle	Common
Nathusius' Pipistrelle	Rare
Brown Long-eared Bat	Common
Daubenton's Bat	Common
Natterer's Bat	Common
Whiskered Bat	Rare
Noctule	Rare
Leisler's Bat	Rare
Brandt's Bat	Rare
Parti-coloured bat	Rare/Vagrant

In recent decades bats have suffered large declines due to the loss of roosts and reductions in prey abundance; however some species are now showing signs of recovery. As a consequence of declining populations of bats, bats and their roosts are afforded a high level of legal protection in the UK (for more details see <http://www.snh.gov.uk/protecting-scotlands-nature/protected-species/which-and-how/mammals/bat-protection/>). The need to conserve Scotland's bats, coupled with ensuring we work within existing legislation, have been the main drivers behind NTS carrying out detailed bat survey work.

Many NTS properties are home to bats at various times of the year, therefore, the Trust feels it has a duty to manage our properties accordingly for bats all year round.

The Past: Bat Conservation in the Trust in 2001

As one of Scotland's leading bat conservation bodies, we strive to conserve bats on our properties. To briefly backtrack, in 2001 a basic questionnaire was produced

and sent out to many of the Trust's property managers to determine the extent of bat presence and conservation within its properties across the whole of Scotland. Responses were received from 54 properties looking at a number of different things.

Table 2: Summary of the questionnaire findings

Question	Number of Properties (N=54)
How many properties have bats present?	40
How many properties have known bat roosts?	23
How many properties have had surveys in the last 3 years?	18

Overall, 40 properties were known to have bats present and 23 of these had known bat roosts, but within a 3 year period, only 18 properties had had bat surveys carried out within them. Many factors influence the presence of bat roosts within a property and the results suggested that more surveys would bring the identification of more bat roosts. In terms of species, the survey found that 7 of the 11 Scottish bat species had been recorded on NTS properties.

The survey highlighted some key issues:

- There was a lack of bat survey information on many Trust properties;
- There were insufficient numbers of qualified members of staff to deal with surveys and advice;
- There was generally poor data management and communication across 3 of the 4 Trust regions at the time.

To address these deficiencies, the Trust produced its first NTS Bat Conservation Action Plan in 2003, which was subsequently updated in 2009, and which is about to be further updated in 2014.

Twelve Years on...

Since the 2001 questionnaire, gaps in NTS survey knowledge have been filled over many properties. After a few years of development and adaptation, the Trust completed its very own NTS National Bat Database in 2012 in order to manage all of its bat data effectively and efficiently. The Bat Database is a huge collection of the bat monitoring data collected by volunteers, rangers, ecologists, ecological consultants and local bat groups across the Trust properties. Within the database the data is organised into individual records for each of the 130 properties. Each property record contains contact information, the bat species present, surveys, roost sites, licences and much more.

The Bat Database in an ever-expanding resource that continues to grow as we survey more buildings and trees in our properties. With the data now all in one place, it was collated and managed in order to answer many of the same questions as the 2001 questionnaire, and

provide further information to direct bat conservation within the Trust.

Table 3: Summarised comparison of the data in 2001 and 2013

Question	2001	2013
How many properties have bats present?	40	57
How many have known roosts?	23	46
How many have had surveys in preceding 3 yrs?	18	33
How many species have been recorded?	7	10 (inc parti-coloured on Arran)
How many licensed staff are within the Trust?	5	14

With the increase in the number of licensed bat workers since 2001 and much financial support from Scottish Natural Heritage, donations and joint-working with other bat ecologists, concentrated efforts have seen increases in our knowledge (**Table 3**). The data provides a snapshot of bat presence, properties with known roosts and conservation across Scotland, but by using the Bat Database a lot more data has been extracted, including the total number of species' roosts, the size of each roost and the number of different surveys that have been carried out over the years.

Historic data on bats across Trust properties is rare. The bat database, however, holds information from as far back as 1984. From this, it was possible to find out just how many bat surveys had been carried out (**Fig. 1**).

Table 4: The total number of bat surveys carried out each year between 1984 and 2013

Year	Total No. of Surveys Carried Out
1984	1
1985	2
1986	1
1987	12
1989	2
1990	3
1991	2
1992	2
1993	8
1994	3
1995	2
1997	9
1998	10
1999	9
2000	25
2001	29
2002	35
2003	49
2004	61
2005	63
2006	70
2007	103
2008	145
2009	31
2010	122
2011	139
2012	151
2013	63

Until the year 2000, the number of annual bat surveys being carried out rarely moved into double figures (**Table 4**). From 2001, the numbers of surveys increased rapidly, and by 2007 they were into triple figures with over 100 surveys being carried out each year. However, this dipped in 2009 when no large bat projects were initiated in the Trust. In 2013, only 63 surveys were carried, mainly because many of the gaps in our knowledge about bats in our buildings had been addressed over the previous 10 years.

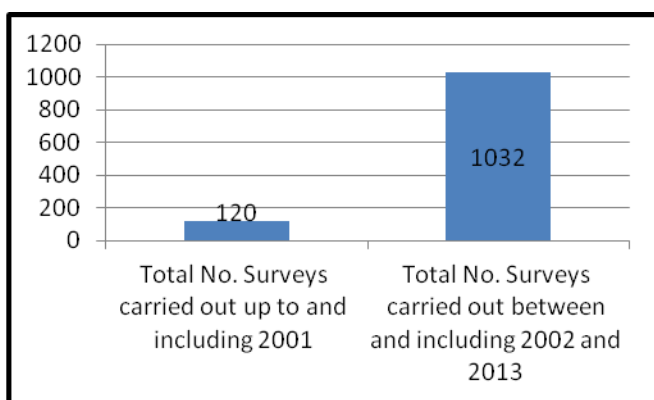


Figure 1: The total number of bat surveys carried out across the Trust during the time periods 1984-2001 and 2002-2013

From 1984 to 2001, surveys were largely carried out in NE Scotland and Culzean, with only 120 surveys being carried out over a 17 year period. Since the questionnaire survey in 2001, bat conservation across the Trust has come a long way and within a much shorter time period the number of surveys carried out over Scotland has seen almost a 10-fold increase.

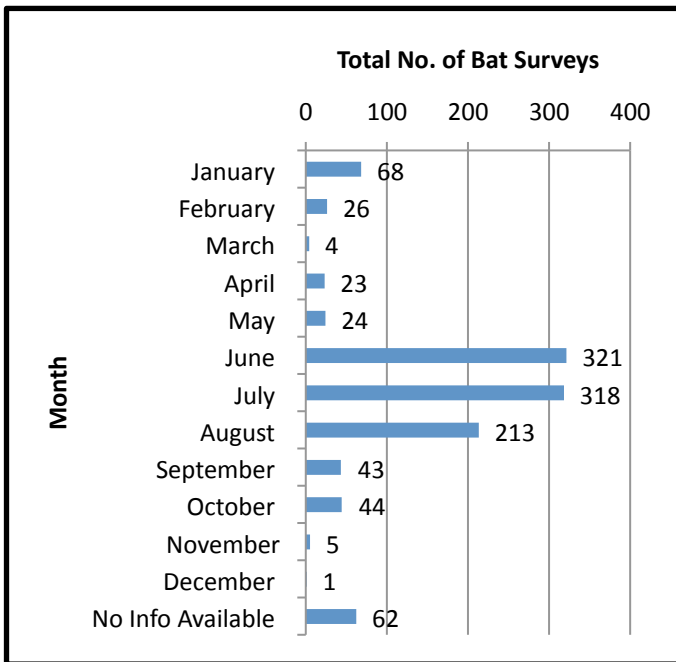


Figure 2: The total number of bat surveys (1984 to 2013) carried out in each month of the year

Bats behave differently depending on species and the time of the year. Three-quarters of bat surveys have taken place in the months of June, July and August, primarily aimed at locating maternity roosts (Fig. 2). Fewer surveys have been carried out in each of the other months of the year. Those surveys where the months were not recorded were the more historic reports (all before 2001) where only the year was recorded. From this, it can be seen that future survey efforts should aim to gain better understanding of bats at other key periods in their life cycles.

As bats roost and forage in a variety of locations, it is not only important to carry out numerous surveys each year but also to apply a number of different survey techniques to get a full picture of species activity.

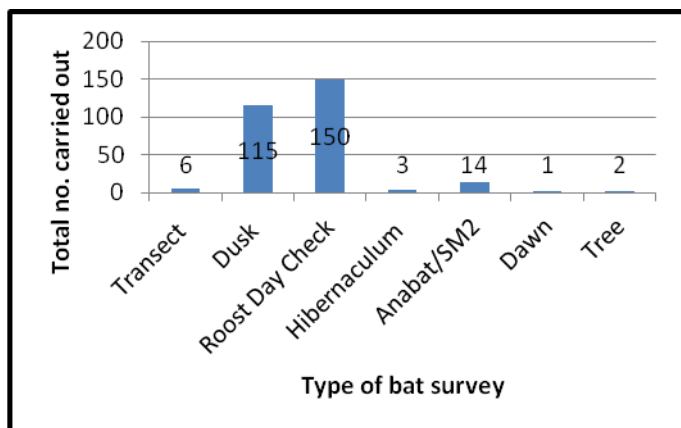


Figure 3: The different types of bat surveys carried out over the last 3 years and the total number of times each of these were carried out

The difference in survey efforts over the last 3 years can clearly be seen (Fig. 3). Very few transect, hibernacula,

anabat/SM2, and dawn surveys have been carried out (it is suspected that tree surveys are significantly under-recorded as negative results were historically rarely recorded by staff during routine tree checks). However, large numbers of dusk surveys and day checks have been carried out, reflecting the urgent need to support essential building maintenance work. Recent advances in bat survey guidance and technology will doubtless see more dawn surveys and surveys carried out using Songmeters and other similar equipment, adding greatly to our knowledge.

Surveys for bats may be undertaken for a variety of reasons. In the Trust, most surveys are carried out in order to support building and tree management on properties and to conserve bats during the course of such work. As a leading charity in bat conservation, this work is extremely important and allows us to also record species occurrence, distribution and information on bat roosts.

In the UK, bats and their roosts are protected under various types of legislation. Roosts are particularly important, although the roosting requirements of some bat species are still not completely understood.

Bats can and do use many roost locations in any one Trust property, depending on many factors. The challenge for the Trust is to ensure that all key roosts are identified and protected during the course of our conservation work, and more work is planned to address this issue.

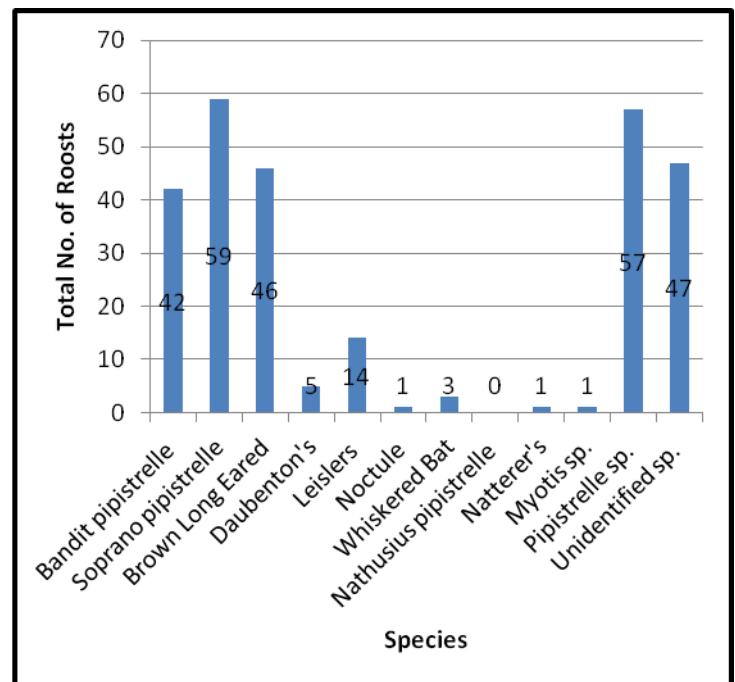


Figure 4: The total number of roosts occupied by each species of bats across Scotland's Trust properties

With 279 currently known bat roosts across Trust properties, it is vital to know the total number of roosts

occupied by each species of bat (**Fig. 4**). Both pipistrelle species had the highest number of roosts recorded, an expected result as they represent Scotland's most common bats. However, the characteristics of many of our historic buildings have also made them frequently attractive to brown long-eared bats too.

With more than half of the Scottish bat species being rarely recorded, the Trust is blessed with the presence of all but one of these species (Brandt's bat) on and around properties. Nathusius' pipistrelles have not yet been found to be roosting; however they have been recorded foraging on two properties to date. The increased number of Leisler's roosts has been down to sterling research work at Culzean and Brodick, led by John Haddow. However, we still only know of one noctule roost, despite the species being recorded over several properties.

Whiskered bats are only known to be roosting at the NTS Threave Bat Reserve. Little is known about the ecology of whiskered bats in Scotland. The ongoing radio-tracking project led by Neil Middleton of Echoes Ecology Ltd, in collaboration with the National Trust for Scotland, is venturing into the unknown in order to shed some light on the world of whiskered bats on the reserve.

Almost half the total number of roosts known have been identified (by species), but in many cases, the species using the roosts have not always been pinned down, largely due to a previous lack of suitable equipment to do so. However, the increased use of more sophisticated survey equipment and DNA analysis of droppings should address these gaps in our knowledge.

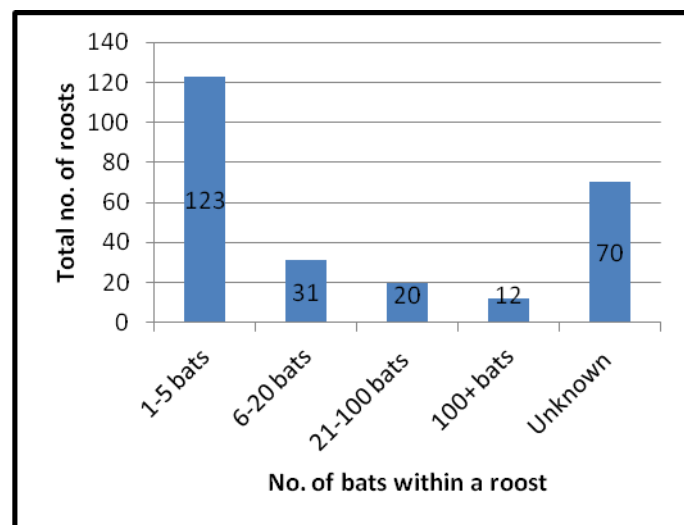


Figure 5: The average number of bats occupying any one roost across Scotland's properties

NTS has collected much data on the number of bats leaving roosts as part of dusk survey work. Dusk surveys consist of counting the number of bats leaving a roost. As these roost counts tend to be repeated on more than one occasion and the roosting habits of bats change, an average roost count was taken for each

individual roost (**Fig. 5**). The roosts classed as 'unknown' are those that have been identified during daytime assessments but no follow-up dusk survey has taken place. The majority of roosts across the Trust are very small with only 1 to 5 bats occupying any one roost, however, 12 roosts are known to have more than 100 bats.

Top 5 Properties to see Bats

From previous assessments of past bat project results, the National Trust for Scotland estimates that over 25% of its buildings have roosts within them. This means that a visit to a NTS property will likely allow you a great chance to see bats. However, some properties are better than others to see bats, with the top spots as follows:

- **Crathes Castle** is home to at least 5 species of bat, including Brown long-eared bats and Daubenton's bats.
- **Culzean Country Park** is home to at least 8 bat species, including 2 new species discovered in 2011.
- At **Haddo House**, it is possible to see over **800** Soprano pipistrelles emerge from a roost.
- The Laundry House at **Hill of Tarvit** is a fantastic spot to watch over **300** Soprano pipistrelles leave their roost at head height.
- NTS established Scotland's first ever bat reserve at **Threave** in 2010, where at least 8 bat species are found. The NTS Threave Bat Reserve now offers many educational opportunities for families and schools to learn about bats.

Conclusion

The detailed analysis of the NTS National Bat Database has provided NTS with much food for thought and has informed the production of the forthcoming NTS Bat Conservation Action Plan 2014-2018, which will aim to continue to ensure that NTS remain one of the leaders in bat conservation work in Scotland.

Acknowledgements

This work would not have been possible without the hard work of many people (sadly, too many to name here!), who include NTS staff, rangers, NTS Bat Group volunteers, local Bat Group members, consultants and specialists. We would especially like to acknowledge the support we have obtained from the Bat Conservation Trust, and our donors, especially Scottish Natural Heritage, in our work.

January 2014.

Bats in Bridges Survey 2004 – East Sutherland

Lyn Wells* & David Patterson (both *North Highland Bat Network*)

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Summary

This survey was carried out in 2004 to establish the level of use by roosting bats in bridges within East Sutherland, Highland Region.

- Sixty-eight bridges were assessed for potential bat crevices. Twenty-five (37%) were found to have crevices suitable for roosting bats. However, only two bridges (3%) were found to actually support bats.
- This study shows that bridges do not appear to support a significant number of bat roosts within East Sutherland area. However, it is acknowledged that this survey has used a lower sample size than other studies returning higher rates of bat occupancy within bridges.
- There remains the possibility of bat roosts being newly established or used on an infrequent basis in suitable bridge crevices. Bat surveys are therefore recommended for inclusion within bridge work programmes prior to maintenance. These surveys could also identify where positive bat management might be undertaken.
- During evening visits to bridges supporting suitable bat roost cavities, the foraging bat assemblage was identified and recorded. Four distinct bat species were identified. Pipistrelles accounted for 86% of total bat passes, with pipistrelle 'breakdown' comprising 91% common *Pipistrellus pipistrellus* and 9% soprano *P. pygmaeus*.

1. Introduction

During 2004 a study area within East Sutherland was chosen as a representative sample of the region to assess how frequently bats use bridge structures as roost locations.

1.1 *The Conservation of Bats in Bridges*

Some bat survey work has been undertaken on bridges in the past within Highland region, but with limited effort and no positive bat roosts being identified within North Highland (Whittaker, 1995).

1.1.1 *Bats in North Highland (Caithness, Sutherland & NW Ross)*

To date, there have been very few detailed studies of bats within North Highland. Some bat monitoring has been undertaken by volunteers for the Bat Conservation Trust (BCT), adding to national data-sets helping to establish trends in UK bat populations.

1.2 *Bats and bridges*

1.2.1 *Roosts*

Many bridges have suitable roost crevices for bats and offer safety, stable temperature conditions, high humidity, nearby drinking water and feeding areas, and access to linear habitat features used for commuting. A large number of bats in Britain and Ireland have been found to roost within bridge structures (Billington & Norman, 1997).

1.2.2 *Threats to bridge roosts*

Bridge roosts can be threatened by unsympathetic bridge repair, maintenance, strengthening, and demolition. Most roads and associated bridges are owned and maintained by the appropriate county council, but maintenance contracts are often let for particular major trunk roads. Rail bridges within the North Highland area are managed and maintained by Network Rail.

2. Survey methods

2.1 *Survey area*

The study area was chosen as it supports a circular road route with railway, and public and private road bridges. Within this circular route there are many minor unclassified roads bridging small water courses and railway lines, and railway bridges crossing water courses and roads. Most of the bridges have suitable bat foraging habitat in close proximity (e.g. woodlands, riparian trees, solitary trees, scrub and many freshwater bodies). However, a proportion of the habitat within the study area is a transition to upland habitats, with expansive areas of wet/dry heathland and upland grazed pastures.

Fig. 1 – Boundary of east Sutherland study area



2.2 *Survey method*

During January and February of 2004 an initial daytime survey of all 68 bridges within the survey area was carried out. Each bridge was numbered and photographed, and various details such as biometrics and habitat were recorded using field recording sheets. Bridges that hosted 'suitable' bat crevices and were in close proximity to suitable bat

foraging habitat were identified as 'potential bat roosts', worthy of night time (emergence) bat surveys. Suitable bat crevices were taken to be any crevice >100m deep (Billington & Norman, 1997). Spring and autumn night visits were carried out on all the bridges with potential bat roosts. The spring and autumn periods were targeted as previous bridge studies have indicated that these are the most likely periods for bat use, as pre-breeding or post-breeding roosts.

Night surveys were carried out by two observers positioned at either side of the bridge, using visual and audible methods of bat detection. Duration of each night visit was 1.5 hrs, starting 10 minutes before dusk. Bat detectors (Batbox III) were used to pick up echolocation calls of any bats that exited the bridge, combined with any visual observations.

To allow completion of the study within one season it was necessary to omit three railway bridges in less than ideal bat foraging habitat from the study. One bridge was also omitted due to safety concerns for surveyors.

Fig. 2 – Bridge being inspected



3. Survey results and discussion

3.1 Bat roosts in bridges

Roosts provide bats with shelter from adverse weather conditions and predators. They also provide a suitable microclimate for the bats' physiological needs. 'If there is some choice in the location of the roost, it can reduce commuting distance, and minimise energetic and predation costs of foraging'. Roost choice may often require a compromise, since a single roost site may not support all the necessary environmental requirements for the species of bat (Altringham, 2003).

Many bridges are known to provide suitable roost crevices for bats offering safety, stable temperature conditions, high humidity and normally close access to foraging areas. A high proportion of stone bridges are suitable for bats, with the majority of bat roosts occurring in crevices spanning watercourses (Joint Nature Conservation Committee, 2004).

A total of 68 bridges were surveyed for suitable bat crevices. 25 (37%) supported crevices that appeared suitable for roosting bats. Of those 25 bridges, night visits (both spring and autumn) were undertaken on 21.

Only two (3%) bridges were found to support roosting bats. The precise location of where these bats roosted within each bridge structure is unknown.

3.2 Bat roost selection - discussion

One other bat study (which included 37 bridges within North Highland), found the level of bat occupancy within Highland region as a whole at 6.5% ($n=108$), (Whittaker, 1995).

On average, bat roosts have been identified in 6% of bridges surveyed within the UK ($n=2,170$ bridges). This encompasses ten surveys; four in

England/Wales, two in Ireland and four in Scotland (Billington & Norman, 1997).

Therefore, it was somewhat surprising to find only two bridges within the North Highland study area hosting roosting bats, this being below the national average (c. 6%). There could be several possibilities for this, as follows;

- Lower sample size of bridges surveyed (than other studies)
- Fewer bat species
- Low bat density
- Lower temperatures
- Reduced foraging time (short nights)

3.3 Bats in vicinity of bridges (foraging bats)

During each night visit, the number and species of any bats detected foraging within the vicinity of each bridge was recorded (See Annex A, Table 1).

The only *Myotis* species currently recorded within North Highland area is Daubenton's bat *Myotis daubentonii*, but it is possible that Natterer's bat *Myotis nattereri* could also be present here in suitable habitat but remaining, as yet, undetected.

3.4 Foraging bats – discussion

Both species of pipistrelle bat are described as being common and widespread within a Scottish context (Racey *et al* 2004). However, this survey shows that of the pipistrelle passes recorded the proportion of the soprano pipistrelle *Pipistrellus pygmaeus* (9%) noted is markedly lower than that of the common pipistrelle *P. pipistrellus* (91%). A study of the two species in Perth & Kinross (Swift *et al* 2001) found that common pipistrelle was more likely to roost in remote, upland habitats, while soprano pipistrelle roosted and foraged mainly in lowland riparian valleys (Racey *et al* 2004).

The survey area has many bridges located on the edge of transitional upland vegetation, which may be one reason why there is such a low contact rate with soprano pipistrelle. However, habitat types present throughout East Sutherland, are very typical of that sampled within the study area. It is therefore possible that the proportion of both pipistrelle species encountered during this survey could be representative of the East Sutherland area as a whole.

As yet, there is no *known* soprano pipistrelle roosts recorded from North Highland area, though many roosts have been noted for common pipistrelle. The distribution of soprano pipistrelle (foraging records) within North Highland is either poorly understood or the species is rather uncommon within the area (Richardson 2000). Recent Highland bat data tends to reflect the above comments. However, concerted bat survey effort within East Sutherland over the last few years (including this study) has shown that soprano pipistrelles are indeed present (Highland Biological Recording Group [HBRG] web-site, 2006), but at a lower population density than that of common pipistrelle.

4. Acknowledgements

We would like to thank Central Scotland Bat Group, in particular Anne Youngman and John Haddow for advice and support in connection with this survey. Stan Whittaker also provided helpful information in connection with his Highland bat survey.

We would also like to acknowledge Highland Council and Network Rail for welcoming our short report.

February 2005.

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Annex A

Table 1 – Bat species and number of passes recorded whilst undertaking 21 night visits per season (spring and autumn).

Bat species	Spring	Autumn	Total (%)
Common pipistrelle <i>Pipistrellus pipistrellus</i>	239	88	327 (78)
Soprano pipistrelle <i>P. pygmaeus</i>	31	2	33 (8)
Brown long-eared bat <i>Plectotus auritus</i>	2	11	13 (3)
<i>Myotis</i> sp. (likely to be <i>M. Daubentonii</i>)	16	31	47 (11)
Seasonal total	288	132	420

DRIP: Daubenton's Roost Investigation Project

An investigation into the seasonal variation of Daubenton's bat roosts.

Emilie Wadsworth* & Natalie Todman
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Project Summary

Following previous studies on Daubenton's bats along the Union Canal in West Lothian and Falkirk, it was decided to investigate changes in tree roosts during summer 2009.

All the roosts selected for study were found during previous radio tracking studies in 2006-2008, and are located between Winchburgh and Linlithgow (see map). The roosts were selected on a number of grounds, including: access (with reference to surveyor safety and landowner cooperation), ease of monitoring, and for their collective spread of use throughout the season.

The roosts were counted simultaneously on a weekly basis to eliminate double counting. Preliminary results suggest that all four roosts were used in different ways over the summer, some earlier in the season and then again later, whilst some were just used during the peak maternity season of June to August. Emergence times suggest a link to seasonality, with earlier emergences during July.

The volunteer aspect of the project was also highly successful, with many of the 41 volunteers expressing interest in joining BCT and/or their local bat group, and in doing more bat work next year.

Aims:

- Undertake weekly counts of four known Daubenton's bat roosts to establish the number of individuals using the roosts throughout the summer season,

- Identify any seasonal variations in the number of individuals using each roost,
- Identify any variation in emergence times relative to climatic variations.
- To create an opportunity for volunteers in the Central Belt that would not require extensive knowledge and experience, and could provide a level of involvement suitable to each individual.
- To create networking opportunities and develop the highly social nature of bat work.
- To provide training opportunities when possible and relevant.

Map showing roost locations for the inaugural DRIP project



Volunteer recruitment

Our team of volunteers came from varied sources and backgrounds. Before the start of the project, an information email was sent out to three bat groups local to the study area (Lothians, Central and Fife & Kinross) and also to volunteers involved in previous projects. We asked people to forward the email onto anyone they thought may also be interested. This resulted in the information being distributed to staff at Edinburgh Zoo, Napier University students, members of the Edinburgh Natural History Society and a number of volunteers' friends. Once the volunteers had been recruited, a system of car sharing was implemented for each survey, minimising car use.

Methods

During the active bat season emergence counts of four known roosts were undertaken simultaneously on a weekly basis.

Counts started 30 minutes before sunset and continued for 90-120 minutes. On the occasions that bats were still emerging after 120 minutes, the survey continued until 15 minutes after the last bat emerged.

A minimum of two surveyors counted each roost (for health & safety reasons), providing an average count for each roost. Cumulative totals for each surveyor were recorded at 10 minute intervals to allow emergence distributions to be plotted. Data on weather conditions (cloud cover, precipitation, wind force, etc.) were recorded for each of the survey evenings.

Teams

Volunteers were split into four teams, with a range of experience and ability. There was always at least one volunteer in each group that had a high level of experience, either of bat work and roost counts in general, or of the specific roosts we were counting through previous studies. None of the activities involved required a bat survey licence, which meant greater involvement for new volunteers.

Each team were provided with an equipment bag, comprising of a heterodyne bat detector, one tally counter per volunteer, a thermometer, a large heavy duty torch and a survey recording sheet.

Initially, volunteers were rotated around the different sites, so they could gain experience of counting different types of roosts and also increase the chance of seeing bats at different times in the season.

Towards the end of the project, fewer 'new' volunteers meant that regulars often ended up taking charge of a particular site, counting it each week.

It is thought that this will have led to a certain amount of consistency in the data, not anticipated at the beginning of the project. It was also found that some volunteers gained a certain level of affinity, or ownership with a particular site and often requested to count that site each week.

Daubenton's bat (Natalie Todman)



Additional aspects

A monthly newsletter was distributed to volunteers keeping them up-to-date on the project, disseminating initial results and providing information on the next set of surveys and additional events.

DRIP volunteers surveying a tree (N. Todman).

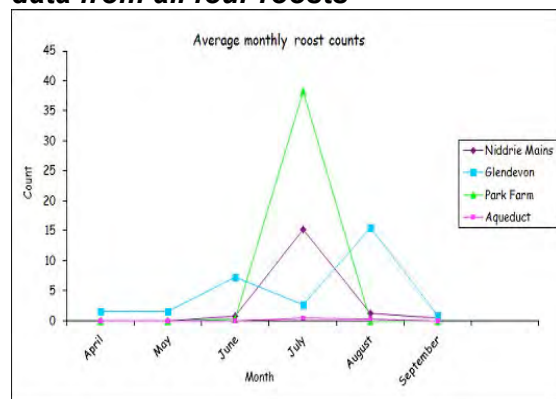


Two social/training events took place at Linlithgow Palace – to look closely at roosts, see bats close up, to gain training on the use of bat detectors, identify roosts in buildings etc., and a chance to ask all those little questions you never dared to ask before. During the first outing, we took delivery of a bat that had unfortunately died after being handed into the local Ranger Service. This provided an opportunity for non-vaccinated volunteers to also gain some handling experience.

Results

Average monthly count data can be seen in Graph 1. Over the summer, bats were counted emerging from all four of the roosts, however the aqueduct roost was used significantly less than any of the others, with only two bats emerging during one survey in July. Of the other roosts, Glendevon was the most active, with bats emerging from mid-April to mid-September. This roost had two peaks, which interestingly occurred simultaneously with the peak counts at both Park Farm (green on graph) and Niddrie Mains. These latter two roosts are clearly maternity colonies, with count data doubling towards the end of July when juveniles were on the wing.

Graph 1 - Average monthly count data from all four roosts



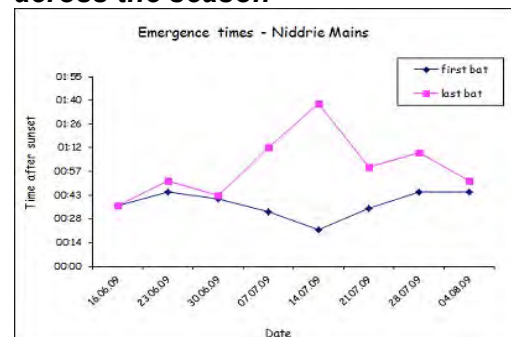
Graph 2 (below) shows the emergence times of the bats at Niddrie Mains, (00:00 represents sunset). It clearly shows the spread of bats at the peak count, with bats emerging over a longer period of time (both earlier and

later) at the beginning of July when the peak counts were also made.

Aim 3 (above) was to 'create an opportunity for volunteers in the Central Belt that wouldn't require extensive knowledge and experience and could provide a level of involvement suitable to each individual'. Aims 4 and 5 were also centred on the volunteers that would be involved in the project.

Over the 24 week survey period, 41 volunteers were involved, contributing towards a total of 648 hours. Interestingly, this equates to 16 working weeks, which at current minimum wage level (£5.80/hour) equals £3,758 of survey work. Of the 41 volunteers, 63% did more than one survey, with six (15%) attending more than 10, and two (5%) fantastic and dedicated volunteers managing more than 15 out of the 24 surveys.

Graph 2 - Emergence times of bats across the season



Questionnaire Responses

At the conclusion of the project, a survey questionnaire was sent round all of the volunteers involved in DRIP. This provided interesting results, particularly around the aim 'to create an opportunity for volunteers in the Central Belt that wouldn't require extensive knowledge and experience'.

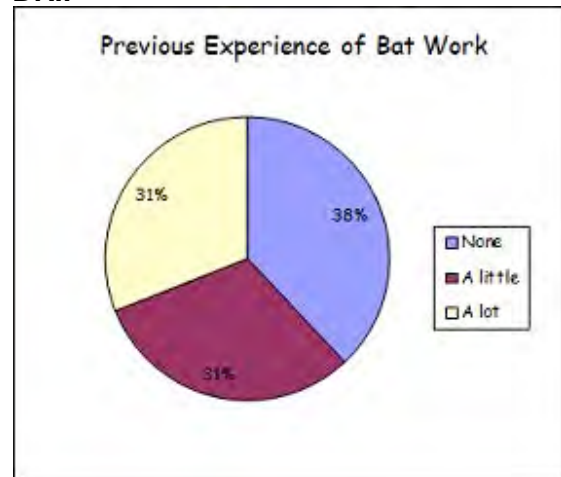
The volunteer return rate was 78%, which in itself suggests that the people involved in DRIP were keen and enthusiastic about the project. Graph 3 shows the percentage of respondents who had been involved in bat work

prior to DRIP, whereas Graph 4 shows the percentage of respondents who would be interested in doing a similar project again. The responses show that DRIP has had a positive influence on the volunteers involved. Several expressed intentions to join their local bat group as well as interest in being involved in more bat work. They were also able to engage with new volunteers in an accessible and inclusive way.

Open questions also enabled the volunteers to be more specific about the project, what they wanted to get out of it and what they did get out of it. The answers could be grouped into five categories, which are shown in Graph 5. A third of the volunteers who responded also said that they were interested because the project was something different, a chance to see bats and a way to help out and be involved in a conservation project.

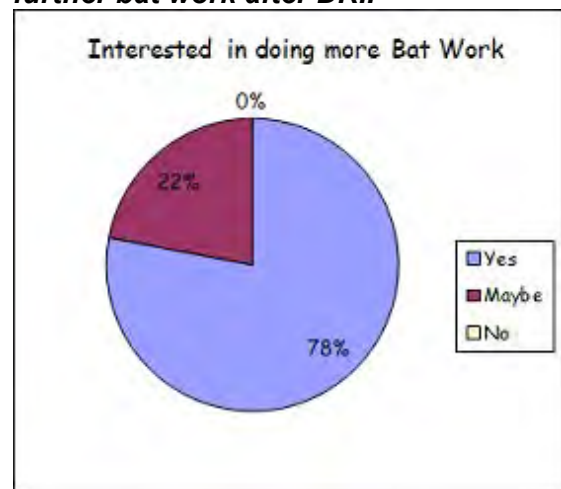
The results show that most people gained what they had hoped from their involvement, but also gained in other ways. For example, four people who didn't list 'meeting people' as a reason for taking part still cited it as something they felt they had gained. Interestingly, one volunteer who listed 'gaining experience' as the primary reason for being involved, listed meeting new people as one of the most important things they had gained.

Graph 3 - Previous experience of DRIP

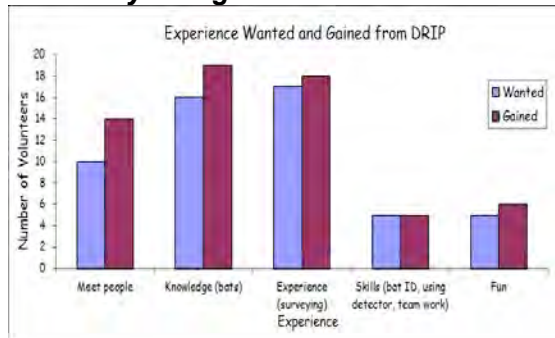


Finally, there was a space for additional comments. The fact that many of the respondents felt willing and able to add extra comments, is testament to the fact that in addition to the original aims of the project, DRIP was a highly successful volunteer engagement project.

Graph 4 - Volunteers interested in further bat work after DRIP



Graph 5 - Types of experiences volunteers wanted from DRIP and what they had gained.



Acknowledgements

We would like to acknowledge the support of all the landowners who allowed us to use their land for bat surveys. We thank all volunteers who gave their time to make this project possible.

May 2014.

Conclusions

The seasonal use of the roosts show some interesting variations. Three of the roosts had peak numbers in July, but were not really used outwith this time. Glendevon was the exception with a low count in July, but with consistently higher numbers throughout the rest of the season. It's not possible to say why this was, though it could support the idea of links between the roosts and the populations using them, suggested initially during the radio tracking study.

The DRIP project far out-reached its original expectations. Volunteer numbers were consistently high, allowing us to always count all four bat roosts each week.

The questionnaire has shown that volunteers came from a range of backgrounds, some with no bat experience and some with a lot. However, they all remained involved throughout the whole project. For the new volunteers, it has opened the door to bat work and shown it to be highly accessible to anyone; many have shown an interest in doing more bat work in the future.

Review of the brown long-eared bat in North Highland & Northern Isles

David Patterson* & Lyn Wells (both North Highland Bat Network).

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1. Introduction

The brown long-eared bat (*Plecotus auritus*) is a breeding resident within the UK and is found throughout Europe. It is also known to occur at high latitudes (up to 64°N), where the climate is cool and more changeable (Stebbing, 1970, cited in Swift 1998, pp.6-7). The brown long-eared bat is considered common in Denmark (Eurobats, Danish Report 2010), and in central and southern Sweden where it occurs as far north as 63° - 64°N (Ahlén & Gerell, 1989; Mitchell-Jones *et al.* 1999; Eurobats, Swedish Report 2006). It is considered to be present at similar latitudes in Norway, southern Finland and Estonia (Swift, 1998, pp.6-7; Eurobats, Norwegian Report 2010). Dietz *et al.* 2009 describes the species to be present throughout the whole of Europe, north to 63° - 64°N.

The brown long-eared bat is widely considered to be non-migratory and sedentary (Altringham, 2003, p.131; Harris & Yalden, 2008, p.368; Swift 1998, p.119). Kunz & Fenton (2003, Table 4.3, p.170) and Popa-Lisseanu & Voigt (2009) do not recognise the brown long-eared bat as a migrant, or partial migrant. Dietz *et al.* (2009, p. 350) consider it to be a very sedentary species, noting that migration of over 30km was rare and usually related to dispersing immature males. Hutterer *et al.* (2005, p.102-103) identifies the brown long-eared bat as a sedentary species with seasonal movements of a few kilometres, with the longest known movement in Europe of 90km. However, the latter authors do recognise one reference (Corbet, 1970) where brown long-eared bats

were noted on lightships in the North Sea (as does Harris & Yalden, 2008, p.368), which may indicate occasional migrations. Moussy *et al.* (2012), acknowledge that in temperate climates, the brown long-eared bat may relocate within the same area, with seasonal movements of >100km being rare.

Figure 1 – Brown long-eared bat within its known breeding range in North Highland (September).



2. Brown long-eared bats in North Highland and the Northern Isles

The brown long-eared bat is a regular resident within parts of Highland Region, scarce in northern North Highland (Scott, 2011; Harris & Yalden, 2008). In the Northern Isles it is considered rare/vagrant or an unusual visitor outwith its normal range (Harvey, 2014; Berry 2000; Harris & Yalden, 2008). Haddow & Herman (2005) and Harvey (2014) suggest that there are no known resident brown long-eared bats in Shetland and bats recorded there have been vagrants.

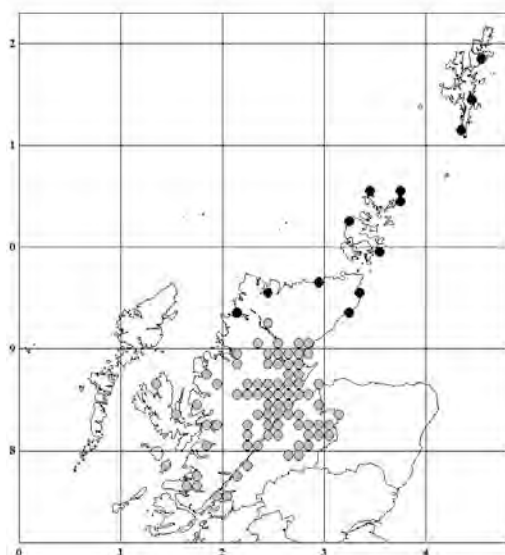
The most northerly *known* breeding/communal roosts are currently in the Brora and Lairg areas of Sutherland. However, one roost (considered to be brown long-eared) of unknown status was recorded north of Lairg (Scott, 2011). Table 1 (Annex A) and Figure 2 below show all records of brown long-eared bats outwith their known breeding range.

Ten out of the 15 brown long-eared bat records are from the autumn; August, September and October periods. Two have unknown months of observation and the other records occur from the winter, perhaps a fall-over from the autumn period. However, there are no confirmed records from the main breeding season period (May, June or July) when arguably this species is most likely to come into contact with humans through roosting in domestic premises.

The three August records occurred before 18 August, which can be considered to fall just within the very end of the breeding season in northern Scotland (*own obs.*).

There is uncertainty whether the record from Kylestrome area (a tree roost) involved several brown long-eared bats or may have just related to a single individual.

Fig. 2 – Distribution of brown long-eared bats recorded from Highland and the Northern Isles.



Grey – Within known breeding range
Black – Outwith known breeding range.

3. Discussion

Racey, *et al.* (2004) suggests that the absence of the brown long-eared bat from Orkney and Shetland may be

connected with lack of woodland on which it is normally strongly dependant. However, a few locations in Orkney support mature broadleaved woodland foraging habitat (i.e. Shapinsay, Rousay, Hoy and Orkney Mainland), often associated with large traditional houses (potential roost sites). In addition, northern North Highland also supports similar areas of mature broadleaved woodland with potential roost structures nearby (e.g. Berriedale, Dunbeath, Latheronwheel, Reay, Castletown, Loch Hope and Tongue, etc.). Therefore, it could be argued that suitable habitat *does* exist to support small colonies of brown long-eared bats in these very northern locations. It is however acknowledged that these woodland areas are fragmented, often over large areas. Shetland also supports some small areas (c. 1ha) of coniferous, broad-leaved and mixed woodland plantations, as well as a few relict ancient trees (P. Harvey, *pers. comm.*).

If northern colonies of resident brown long-eared bats do exist, it is possible that they may be small colonies (due to restricted woodland habitat) and could be under-recorded, especially due to their quite calls which can be difficult to detect (Scott, 2011).

However, at this present time, available literature, data and expert opinion, strongly suggests that brown long-eared bats are not resident (breeding) in northern North Highland, Orkney or Shetland. If this is indeed the case, this calls into question where these bats are coming from in order to reach these remote and isolated places. In addition to the possibility of small colonies going undetected, there could be two other reasons for the bats occurrence; dispersal from other UK sites from the south (i.e. southern North Highland within their breeding range) or vagrants from the continent (e.g. Scandinavia or northern Europe). These options and other related issues are discussed in more detail below.

3.1 Dispersal

The furthest known distance travelled by a brown long-eared bat in Europe is 90km (Hutterer, *et al.* 2005). Dietz, *et al.* 2009, states that based on 30,000 ringed bats in Europe, movements of over 30km were rarely recorded, and usually related to dispersing young males. Philopatry of both sexes has been observed in the northern parts of Scotland, but male dispersal has been shown to occur in Germany (Entwistle *et al.* 2000).

The distance from the most northern known roost colony in North Highland is approximately 113km from Kirkwall, Orkney and 300km from Lerwick, Shetland. Thus, the distance for North Highland bats to populate the Northern Isles would far exceed the maximum recorded movement of dispersing brown long-eared bats.

3.2 Vagrancy from the continent

Fleming & Eby (2003, p.158) identify that bats which spend their summers at northern latitudes (>40°N) may well have more tendency for migration and/or hibernation. Fleming & Eby (2003, p. 169) state that partial migration is common in bats, with some species migrating substantial distances that are also sedentary within in the same parts of their range. Fraser, *et al.* (2012) suggests that in Tri-coloured bats, it is preferable for *some individuals* at the northern extent of their range to migrate south rather than hibernate through long winters.

However, during studies of migrating bats in southern Sweden, Ahlén, *et al.* (2009), recorded only one brown long-eared bat at a coastal migration site (where many other bat species were being recorded). Even though one brown long-eared bat has been noted on a coastal island (Michaelsen, *et al.*, 2003) there is currently no evidence to suggest that there are long distance movements of brown long-eared bats from Western Norway. However, there is also recognition of the lack of knowledge on migrating bats from this

area (T. Chr Michaelsen *pers. comm.*). In addition, between 1988 and 2007, no brown long-eared bats were noted from offshore platforms in Dutch sector of North Sea (Boshamer & Bekker, 2008).

Accidental introduction (e.g. animals transported within freight ship cargo, transport luggage, etc.) of brown long-eared bats to the Northern Isles (and the offshore record in Table 1, involving one individual) cannot be ruled out. However, Corbett (1970) details a group of bats in flight observed offshore in the North Sea, considered to be brown long-eared bats, which are unlikely to be assisted by accidental introduction.

Altringham (2003), p72, highlights that the brown long-eared bat rarely forages far from their roost and does not fly long distances. In addition, there is likely to be drag from their long ears reducing flight efficiency. Entwistle *et al.* (2000) also identifies that limited distance movements of brown long-eared bats are consistent with expectations based upon wing morphology (i.e. distinctive short broad wings). These comments suggest that this species is not suited to long distance migration due to its physiology, with low flight efficiency.

It is also possible that any vagrant brown long-eared bats occurring in other parts of the UK will mix with resident populations which will make it impossible to determine vagrants from resident individuals through normal methods of detection. Specifically studying bat presence at northern locations where certain resident species are known to be absent or at coastal bird migration hot-spots (e.g. North Ronaldsay and Isle of May, etc.) (Archer, *et al.*, 2010) could help us to understand more about migrant bat movements in Scotland.

3.3 Conservation significance

It is important to have good knowledge of protected species distribution within

the UK so that sound decisions can be made to maintain favourable conservation status within their natural range (JNCC, 2007). Therefore, knowing the northern natural breeding range of the brown long-eared bat in Scotland could have some conservation significance for this protected species.

Should records of brown long-eared bat in northern North Highland and the Northern Isles consist largely of UK dispersals or vagrants (recorded outwith the main breeding season), then this has the potential to influence decisions over the normal range of the species so that the true northern breeding range can be identified. For example, just because an autumn brown long-eared bat is noted in north Caithness may not necessarily mean they are resident and reflect natural breeding range (even though the species is considered largely sedentary!).

3.4 Future survey work

Table 1 presents records of brown long-eared bats known to date, but how many go unnoticed in the hours of darkness during autumn? How many bats pass by quickly or perish without us even knowing? If we consider that it is very unlikely that all brown long-eared bats reaching northern North Highland, Orkney & Shetland are moribund and subsequently found, then it is likely that the true frequency of brown long-eared bat records could be higher than that presented in this review.

This review highlights the potential for a collaborative bat project involving northern Bat Groups and other bat researchers to find out more about brown long-eared bats discovered in the very north of the Scotland. Investigations using modern techniques, which have aided and advanced our understanding of bat movements, could be a future possibility in this part of Scotland (Popa-Lisseanu & Voigt, 2009;

Moussy, *et al.* 2012). For example, accessing brown long-eared bats (under licence) to assess genetic markers or/and stable isotopes could be aided either through provision of strategically sited bat box schemes or/and occasional trapping sessions during the autumn period (using sonic lure). However, the frequency with which brown long-eared bats occur in these extreme northern parts of Scotland is a mystery and therefore such a project is likely to require a high level of effort with an unknown level of return.

4. Conclusion

There appears to be little published sources explaining why brown long-eared bats occur outwith their known breeding range and where they originate from. Therefore, this short review helps to present the possible reasons for their occurrence in northern North Highland and the Northern Isles.



Brown long-eared bat (© BCT).

Occasional records of brown long-eared bats occurring outwith their known regular range could relate to; an unknown resident population, dispersing animals from other parts of the UK (post-breeding), accidental introduction or vagrants migrating from the continent. From the information presented within this review, it is not yet possible to pinpoint which of the possible explanations result in the presence of the brown long-eared bat outwith their known breeding range. What is clear; is that targeted survey work could help to try to clarify the

situation (even though this may be challenging!).

5. Acknowledgements

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May 2014.

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Annex A

Table 1 - All records of brown long-eared bats in North Highland, Orkney & Shetland north of known breeding range

Year	Month	Location	Region	Grid Ref.
1931	February	Start Point, Sanday	Orkney	HY74
1947	December	Lerwick, Shetland	Shetland	HU44
1948	October	Holm, Mainland	Orkney	ND59
1972	Unknown	Reafirth, Shetland	Shetland	HU58
1980	Unknown	Reay, Caithness	N. Highland	NC69
1980's	Aug/Sept	Kylestrome, Sutherland	N. Highland	NC13#
1987	March	Sumburgh, Shetland	Shetland	HU31
1987	August	Sandwick, Mainland	Orkney	HY22
1992	September	Papa Westray	Orkney	HY45
1995	August	North Sea platform	N/A	Unknown.
2006	September	North Ronaldsay BO.	Orkney	HY75
2010	October	Lybster, Caithness	N. Highland	ND23
2010	September	Wick, Caithness	N. Highland	ND35
2012	October	Loch Hope, Sutherland	N. Highland	NC45
2013	August	Lerwick	Shetland	HU44

Taken from Scott *et al.* (2011); Shetland Biological Records Centre and Orkney Field Club data. # = Record not within Scott *et al.* (2011).

The occurrence of bats in Shetland

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The Shetland archipelago lies over 100 kilometres north of the Scottish mainland at latitude 60 degrees north. The influence of the North Atlantic Current means that winter temperatures are not significantly lower than elsewhere in Scotland but the summer months are much cooler.

It is one of the windiest locations in the UK with a mean wind speed throughout the year of 7.1 metres per second and gales occur on average on 58 days a year (Johnston, 1999). Given the climate, the isolation and a lack of native tree cover, it is perhaps not surprising that there has been no evidence of bats breeding in the islands. Six species have occurred in the islands as migrants or vagrants. This article discusses these records.

1. Records pre-1980

A sift through back copies of the islands' weekly newspaper *The Shetland Times* confirms that the occurrence of bats in the islands has always been a noteworthy event. Between 1904 and 1959, the paper details ten dated records. Two of these were collected and sent to the National Museum of Scotland (NMS) where their identity was confirmed.

A bat on Whalsay on 31 March 1927 proved to be Britain's first record of a parti-coloured bat (Ritchie, 1927). Another, also found on Whalsay on 22 October 1940 (although the date has erroneously been given as 2 November in subsequent publications), was initially identified as a common pipistrelle but has since been shown to be Britain's first Nathusius' Pipistrelle (Herman, 1992). In addition,

there is a published record of a brown long-eared bat in Lerwick in December 1947 (Venables & Venables, 1955).

The later reports of bats prior to 1980 only involved records where the identity of the species was confirmed. A Leisler's bat at Ollaberry on 2 August 1968 (sent to NMS), a noctule at Burravoe, Yell, on 25 July 1977 (sent to NMS) and a brown long-eared bat photographed by the late Bobby Tulloch at Reafirth, Yell, in 1972 (no date given).

2. Recent records and status

Since the mid-1970s, when the oil industry came to Shetland, the quality of wildlife recording in the islands has improved dramatically. This was initially through the efforts of an ever-increasing band of professional and amateur naturalists. Then in the 1990s the Nature in Shetland website went online and in 1998 the Shetland Biological Records Centre (SBRC) was established. Both of these have encouraged the general public to get involved in recording all taxa in the islands. It is evident though, that even now some bats reaching Shetland are not being reported.

Since 1980, a total of 92 bat records, totalling at least 97 individuals, have been reported in the islands (two individuals brought to Shetland from North Sea oil rigs are excluded from this total). Of these, 50 have been identified, involving six species. The majority of those identified refer to individuals that have allowed close examination having been trapped inside buildings, or found moribund or freshly dead. In the 1980s and 1990s specimens were often forwarded to Aberdeen University for confirmation but in recent years bats have been identified using the standard reference works by staff from SBRC, the Lerwick Office of Scottish Natural Heritage (SNH), or members of

the Shetland Bird Club. In a few recent cases, photographs of individuals taken in the field have enabled subsequent identification.

Two bats identified as common pipistrelle are best considered unconfirmed at present. These concern individuals at Sumburgh, south Mainland, on 3 October 1982 and on Unst on 26 October 1984. Both were identified at Aberdeen University but given that every confirmed record of a *Pipistrellus* species in Shetland since these two has referred to Nathusius' pipistrelle there must be an element of doubt about their identification. It is possible that Nathusius' pipistrelle was not even considered as it was practically unknown in Britain at that time.

The remaining 40 records mainly involve field sightings. They include three sightings of two bats seen together and an astonishing report of three or four bats together at Burrafirth on Unst on 30 October 2011. All other multiple sightings were in September or October.

The status of the six species confirmed in the islands is detailed below:

Parti-coloured bat: *Vespertilio murinus*

Seven records: In Lerwick on 19 November 1981; at Mid Yell, Yell, on 16 November 1984; on Whalsay on 24 November 2001; at Haroldswick, Unst, on 24 August 2003; in Lerwick on 23 June 2009; at Spiggie, south Mainland, on 15 June 2011, and at Bardister, north Mainland, on 11 December 2013. The first two were sent to Aberdeen University for confirmation. The individual at Bardister remained until 23 December 2013. It roosted under the eaves of a house and was seen leaving each afternoon, returning to roost at dusk.

Parti-coloured bat, Bardister, Shetland, December 2013 © Rory Tallack.



Serotine: *Eptesicus serotinus*

One was found on Whalsay on 18 October 1991. It was sent to Aberdeen University and its identity confirmed.

Leisler's bat: *Nyctalus leisleri*

Four records: at East Burrafirth, central Mainland, on 16 October 1996 (confirmed by Aberdeen University); at Sumburgh, south Mainland, on 9 March 2002; on Whalsay on 10 June 2011, and at Burrafirth, Unst, on 16 December 2012.

Noctule: *Nyctalus noctula*

Two records: at Asta, central Mainland, on 20 August 1986 (confirmed at Aberdeen University) and at Voe, central Mainland, on 23 November 1987. The latter was apparently sent to Surrey where its identity was confirmed although no other details are available.

Nathusius' pipistrelle: *Pipistrellus nathusii*

A total of 34 confirmed records, 29 of which were first found alive, or freshly dead, and four of which were found desiccated inside buildings or in leaf litter. This is undoubtedly the most common bat in Shetland and of the 47 unidentified bats reported since 1980, 19 were either confirmed as, or considered by their observers to be, pipistrelle species.

Brown long-eared bat: *Plecotus auritus*

Two records: at Sumburgh, south Mainland on 12 March 1987 and at Lerwick on 17 August 2013.

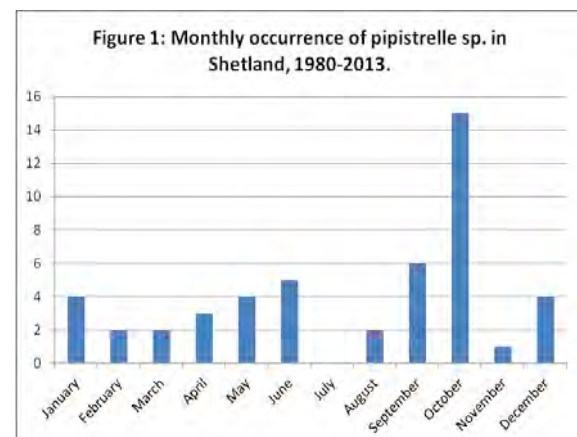
3. Why do bats occur in Shetland?

Bats could arrive in Shetland naturally or be brought here accidentally by humans. Four of the six species that have occurred in the islands are known to have migratory populations. Parti-coloured bat, noctule and Nathusius' pipistrelle, all breed in southern Scandinavia and at relatively high latitudes in eastern Europe and Asia. Leisler's bat does not breed as far north as these species but it too has some migratory populations (Dietz *et al.* 2007).

The appearance of serotine and brown long-eared bats in Shetland is perhaps more unexpected. Serotines have been known to disperse up to 330 km, however, (Dietz *et al.* 2007) so it seems plausible that a dispersing individual from the near continent may have got caught out by a rapidly changing weather system and been blown to Shetland. Brown long-eared bats are noted as being very sedentary but the species does breed at 60 degree latitudes in Scandinavia. Individuals have also been recorded at oil rigs in the North Sea so it seems likely that this species too has reached Shetland naturally.

Figure 1 shows a clear peak in September-October which coincides with

the autumn migration of Nathusius' pipistrelle, which occurs from August to October (Dietz *et al.* 2007). Many bird species that breed in Scandinavia occur in Shetland most commonly on autumn migration when their population size is swelled by large numbers of juveniles. The occurrence of these migrant birds in Shetland is dictated very much by the weather with larger numbers occurring when south-easterly winds blow them across the North Sea during their southward migration (Pennington *et al.* 2004). It seems highly likely that migrating bats could be caught out by the same weather conditions and thus reach Shetland, albeit unintentionally. Indeed many of the records of bats have been associated with periods of strong south-easterly winds when continental migrant birds are also common.



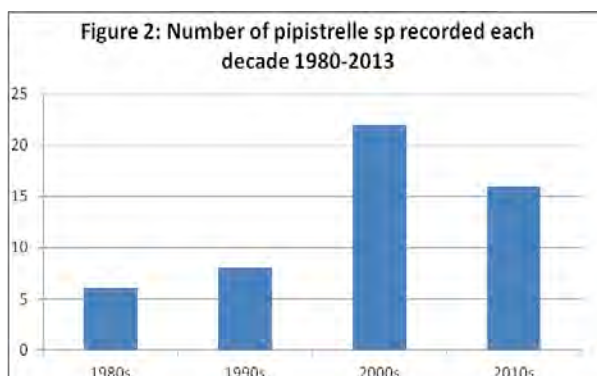
It is plausible that some of the winter records of bats in Shetland could refer to animals that arrived in the islands in the previous autumn and remained undetected for several weeks. It is interesting to note that a parti-coloured bat returned to the same roosting site from 11 to 23 December 2013, showing that bats can survive in Shetland for at least short periods in the late autumn/winter. There may of course be other explanations for winter arrivals – the

sudden onset of cold weather, or disturbance of winter roosts among them.

Shetland is also renowned for the occurrence of vagrant birds from much farther east i.e. central Asia and Siberia. There is an attractive theory, although the evidence to support it is largely circumstantial, that such birds are migrating in the wrong direction during their first migration because of a genetic error. Such genetic malfunctions could presumably also occur in migratory juvenile bats.

It is also relevant to note that there are only two records of bats in Shetland in July, both unidentified to species. Yet July is one of the warmest months in the islands, when insect life is at a peak, daylight hours are long and many people are out in the countryside.

The number of pipistrelles recorded in Shetland each decade is presented in Figure 2. These data suggest that *Nathusius' pipistrelle* may be coming more common in the islands although observer awareness and improved reporting may be at least in part responsible for this trend. The species appears to be expanding its range in Europe (Dietz *et al.* 2007) so it will be interesting to see if the number reaching Shetland continues to increase.



Nathusius' pipistrelle, Unst, February 2011 © Rory Tallack



4. Summary

Six species of bat have been confirmed in Shetland. *Nathusius' pipistrelle* is considered to be a scarce migrant to the islands. Parti-coloured, serotine, Leisler's, noctule and brown long-eared bats are best treated as vagrants to Shetland, the probability of them occurring naturally far exceeding that of them having arrived with human intervention.

5. Acknowledgements

This article would not have been possible without the efforts of those observers who took the time to report their sightings of bats to SBRC or the Nature in Shetland website. Mike Pennington has been especially helpful in drawing records together.

I would like to thank Rory Tallack for permission to use his photographs and for commenting on an early draft and to David Patterson for encouraging me to submit this paper.

February 2014.

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To what extent will bats use maritime habitats?

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Summary

- There appears to be a low awareness that maritime habitats (i.e. beach, cliff/slope) may be regularly used by bats. This short paper helps raise the profile of these habitats for bats.
- Bats have been found to utilise a section of beach, maritime cliff and slope in Berwickshire. This resulted in an average of 212 bat passes per hour in both June & August, including common and soprano pipistrelle, as well as *Myotis* bats.

1. Introduction

There appears to be little published information on bats using maritime habitats, such as beach, cliff /slope. Harris & Walsh (1996) is one of few studies where coastal habitats have been included in bat foraging surveys. They were surprised to find that bats did not avoid cliffs, and beach habitat (including rocky beach) was positively selected.

It is acknowledged that coastal cliffs can be an important habitat for invertebrates (e.g. flies, beetles and moths) (Kirby, 2001, pp. 136-140; JNCC, 2008). Linear habitats are valued as commuting routes and for providing shelter to foraging bats and their prey (Entwistle, *et al.* 2001). However this latter publication does not value maritime habitat for foraging bats. Hundt (2012, p. 9), notes that natural cliff face has a possible value to bats. However, this could be interpreted as just having relevance to sheltered inland sites, as there is no specific reference to maritime habitat.

A bat surveyor was surprised to find bats foraging along exposed maritime cliff/slope habitat at St Abbs Head (Waters, 2010). Common and soprano pipistrelle, as well as *Myotis* bats were all recorded. The surveyor suggested that perhaps bats may be attracted to foraging on a higher insect abundance on the seabird cliffs. His observations are noteworthy.

2. Methods

To assess whether bats utilise maritime cliff and slope habitat that are not used by nesting seabirds, a stretch of coastal habitat with no history of seabird use was surveyed.

The survey site is at Eyemouth (NT9564), Berwickshire (see fig. 1) approximately 8km south of St Abbs Head. The cliff face supports a species-rich unimproved maritime cliff grassland (MC8, Red fescue *Festuca rubra* – thrift *Armeria maritima* maritime grassland) (Rodwell, *et al.* 2000), which is a typical habitat along this stretch of coastline (*own obs.*).

This maritime cliff and slope habitat is a protected habitat within Burnmouth Coast Site of Special Scientific Interest (SSSI), which also falls within Berwickshire & North Northumberland Coast Special Area of Conservation (SAC) identified for its coastal sea-caves and other coastal features.

An Anabat detector was deployed for one overnight session, both in June and August 2014. The detector was positioned half way down the cliff, with the microphone directed along the length of the cliff to maximise bat detection. Bat calls were identified using Russ (2012).

Fig. 1 – Survey site supporting typical vegetated maritime habitats.



Table 1 – Bat foraging activity measured along a section of maritime habitat at Eyemouth, Borders Region.

Overnight dates of bat survey	No. of bat passes#	Bats per hour	Species (%)	Weather
22/23 June 2014	1,024	212	Common pipistrelle – 57 Soprano pipistrelle – 40 Pipistrelle sp. – 2.5 Myotis sp. - 0.5	E wind 0-1, cloud cover 8, very warm and calm, 15-16°C at dusk.
09/10* August 2014	1,110	212	Common pipistrelle – 63 Soprano pipistrelle – 35 Pipistrelle sp. - 2	SW wind 2 (decreasing at dusk), cloud cover 3, 13-14°C at dusk.

*Duration of survey cut short due to interference of bat detector at 2am.

#Based on Hundt (2012).

3. Results

A surprising number of bat passes were recorded (table 1). It was also unexpected that soprano pipistrelle would be so well represented (35-40%), in addition to the presence of *Myotis* bats.

Bats were present throughout the period of the surveys. In addition, many feeding buzzes were recorded.

4. Discussion

The east-facing cliffs offer good sheltered foraging conditions for bats during westerly winds. Winds were relatively calm during both surveys, yet bats still utilised this site throughout the survey period.

As the bat detector was directed along the length of the cliff, this is likely to have increased the number of bat passes recorded, rather than if the

detector was set at a right-angle to the linear cliff habitat. In addition, bats attracted to feed over the rocky beach at the foot of the cliff cannot be specifically separated from those foraging on the cliff/slope grassland. Walsh & Harris (1996) show 'beach' to have more attraction to bats than cliff. However, it may prove difficult to separate these maritime habitats for the purpose of bat surveys (see fig. 1) at some sites. It is therefore likely to be easier to just combine beach, with the maritime cliff and slope habitat.

Common and soprano pipistrelle, including *Myotis* bats are not acknowledged as associating with maritime cliff/slope habitat (Dietz *et al.* 2009). Harris & Walsh (1996) do not identify the bat species using coastal habitats. Soprano pipistrelle is known to be more closely associated with riparian foraging habitat (Altringham, 2003, p. 127). However, Middleton *et al.* (2014, p.108), notes that soprano pipistrelle can be a generalist and not necessarily associated with just riparian habitats.

In addition, survey work in North Sutherland found that several 'radio-tracked' common pipistrelles favoured maritime cliff/slope habitat (c. 7km from the roost) in preference to a slow moving river and riparian woodland which was much closer to their roost (*own obs.*).

Fig. 2 – Foraging common pipistrelle (L. Wells).



These results show that bats will regularly utilise maritime habitats (beach, cliff and slope), even when there is no association with seabird guano. Do these individual bats have a preference to mainly feed along the coast? Do the pipistrelles that use maritime habitats also roost in coastal cliffs and/or sea-caves? We now know that pipistrelles will roost in Scottish sea-caves (Mortimer, 1995; Scott, 2011, p.67), but to what extent remains unknown.

5. Conclusion

This brief study shows that several bat species will use and forage along maritime habitats (beach, cliff and slope). Further survey work would prove interesting, as there is obviously much more to learn about how bats utilise exposed maritime habitats.

Awareness of bats using coastal habitats (i.e. maritime cliff/slope) could be increased through reviewed Habitat Action Plans (e.g. Scottish Borders Council, 2006).



Common pipistrelle (© BCT)

6. Acknowledgments

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