A long term ringing study relating to *Myotis daubentonii* present at a regularly used roost site on the Union Canal in the Central Belt of Scotland

Authors: Neil E Middleton* and Sophia R Punteney

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*Correspondence details: email: neil.middleton@echoesecology.co.uk

Abstract

During the period 2003 to 2013 a ringing study was carried out at a site on the Union Canal in the Central Belt of Scotland. In total, 192 Daubenton's bats (*Myotis daubentonii*) were ringed and monitored thereafter. 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 by this species, including sex and age mix at the roost location, and typical forearm 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 surfaces, 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). In terms of its foraging behaviour, 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).

Initially within the umbrella of BaTML, and then latterly within the context of research being carried out and sponsored by Echoes Ecology Ltd (www.echoesecology.co.uk), a ringing project relating to a Daubenton's bat roosting location was carried out during the period September 2003 to September 2013. This study was set up to establish the general use of the roosting location throughout the study period, as well as to monitor individual bats using the site.

The study site was situate at Lins Mill Aqueduct, where the Union Canal crosses over the River Almond in West Lothian (NT104706). At the site bats accessed their roosting locations within the aqueduct structure via a maintenance access hole.

Materials & Methods

All methods adopted during this study, including the procedure of capturing and the subsequent processing and ringing of bats, were carried out under licence by suitably experienced bat workers. Also, during the study best practice methods as described within the Bat Workers' Manual (Mitchell-Jones and McLeish, 2004) were followed.

In order to capture bats using the roosting location, a two banked harp trap (Faunatech Austbat, Australia) was placed over the maintenance access hole (Figure 1) which caught 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 then being transferred to small cotton holding bags within which they were kept for a short period of time. The bats were then processed at place of capture (i.e. no bats were taken from the site locality). For each bat captured a number of features were noted (i.e. sex; forearm length; adult or immature; weight).

Figure 1: Harp trap in place over maintenance access hole at Lins Mill Aqueduct

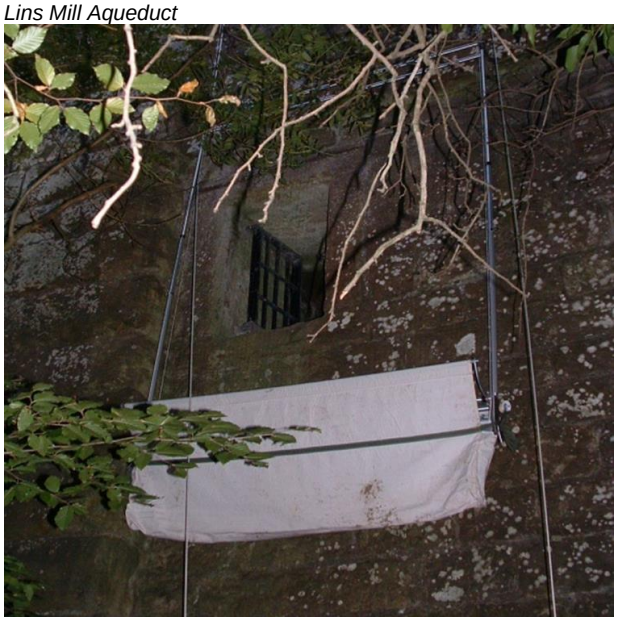


Figure 2: Looking down on harp trap with bats contained within the traps holding bag

An magnesium-aluminium flanged ring (2.9mm internal diameter when secured) suitable for small to medium sized bats within the UK (manufacturer - Porzana Ltd; supplier - The Mammal Society) was then placed around the bats forearm (Figure 3), with the ring number being recorded against the other data that had been already noted for the 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.

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

Recapture data were also used in order to provide an estimate of the overall population size for the site. In order to do this a method (Jolly-Seber) appropriate for analysing multiple-recapture data from open populations was used (Sutherland, 2006). In this instance, this method tracked the individual recapture history of each bat during the period in question, in order to provide an overall population estimate for the study group.

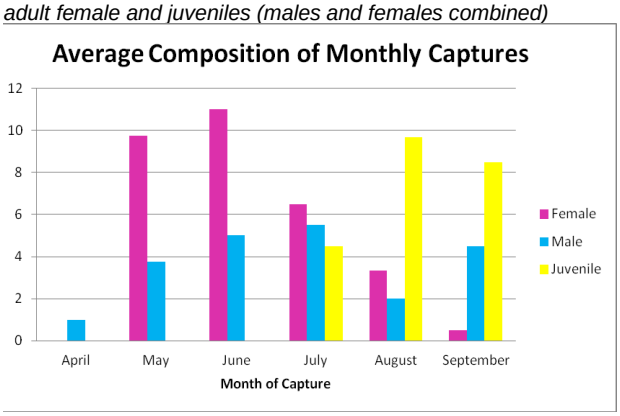
Figure 3: Daubenton's bat with magnesium-aluminium ring (2.9mm) placed over forearm

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.

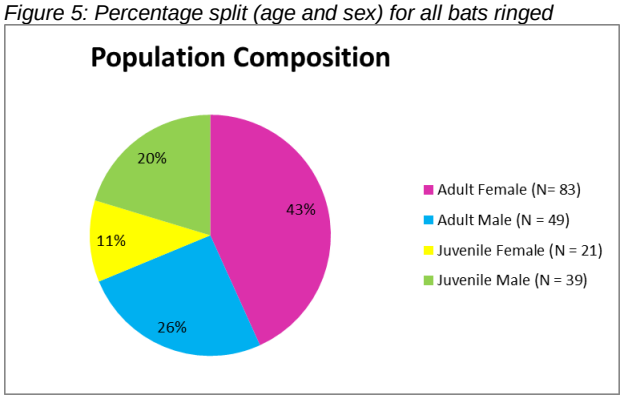
Figure 4: Average monthly capture rates split by adult male, adult female and juveniles (males and females combined)



In regards to the number of bats typically encountered, no females were captured at the site during the sessions carried out 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.

The gathering of recapture data allowed for two further aspects to be looked at, namely the longevity of life and the estimation of the overall population size for the site.

As a result of the ringing study 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

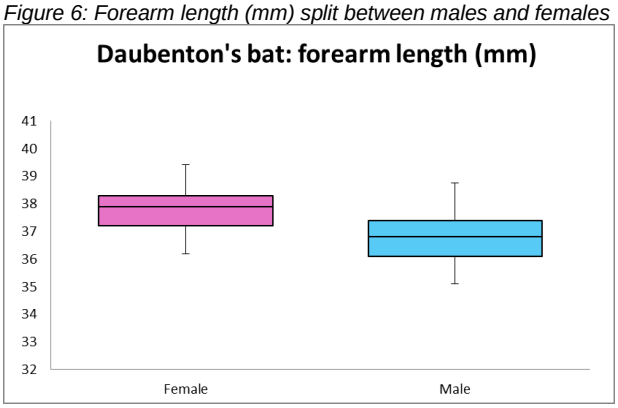
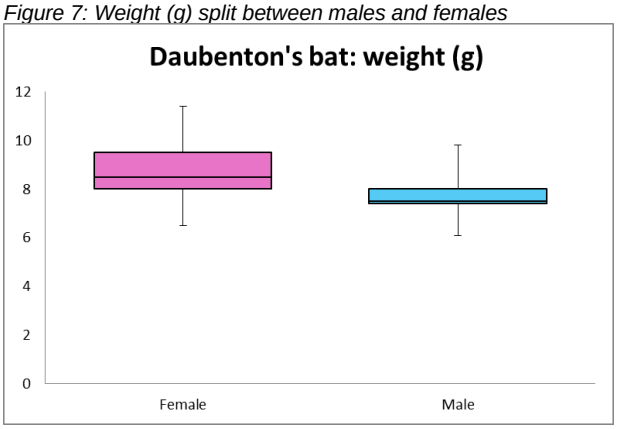
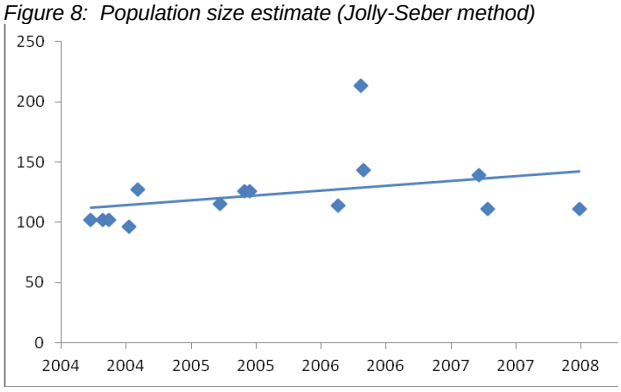


Figure 7: Weight (g) split between males and females



An estimation of the overall site population size, using the Jolly-Seber method, was carried out for the period 2004 to 2008. During this period the data gathered was strong enough against which to run the method. The results of this exercise, shown in Figure 8, concluded that the overall population size for the site for the period in question may have been in the region of 100 to 125 bats, and that the numbers were fairly consistent during that 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 over (i.e. the Union Canal and the River Almond), and it is not surprising therefore to find Daubenton's bats roosting within the aqueduct feature itself. In addition to these bats found roosting here, occasionally other species have been captured emerging from the same access point (Natterer's bat and brown long-eared bat). The numbers relating to these other species are considerable smaller by comparison, with less than 20 records in total over the ten years of visiting the site.

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 contributing towards that data related to pregnant females (i.e. their body weight was higher than that what would occur in a non-pregnant adult female). As such the weight data, as presented, should not be regarded as being directly comparable between males and females.

It is of interest to compare the data gathered in both respects (i.e. forearm and weight) with a smaller dataset from a population of Daubenton's bats present at another 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 of life information established 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 lifespans of 4 to 5 years being quoted from numerous sources. However the lifespans quoted in this study are by no means close to what can be achieved, with the oldest lifespan 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, none the less, still interesting to see how a study such as this one can monitor individuals in this respect. With regards to the one of the bats discussed in the results, it was originally ringed in 2003 and not encountered again until 2013 (i.e. recaptured once during the period). As such bats that have not been encountered for lengthy spells should not necessarily be assumed to have died. It will be interesting to not going forward if any other such instances occur.

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 and the capture sessions were not wholly developed with the Jolly-Seber method in mind. Having said that, the data produced from the method for the period in question does provide a fairly consistent result (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 during the study period when a formal count of bats emerging from the roost was carried out, at least 77 bats were known to emerge that evening (note that not all of these bats were captured during that emergence). So an overall population estimate in the order of 100 to 125 would in no way seem unreasonable for the site.

Due to the importance of the data being gathered at this site and the fact that ringed bats are still being encountered as at September 2013, the monitoring work 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

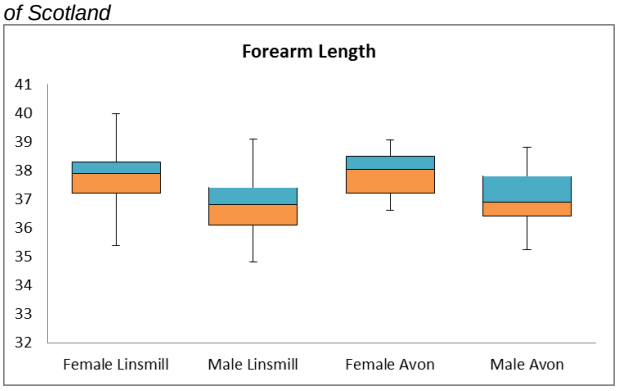
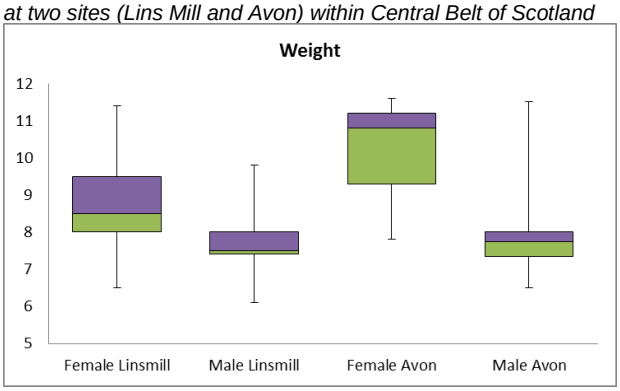


Figure 10: Comparison in weight (g) between males and females at two sites (Lins Mill and Avon) within Central Belt of Scotland



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