Activity relating to Daubenton's bat (*Myotis daubentonii*) on the Union Canal in central Scotland during the transition period between winter and spring

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Abstract

There is not a set time for the termination of hibernation as this will vary from year to year depending upon weather conditions. This study aimed to better determine the winter and spring activity of *Myotis daubentonii* (Daubenton's bat) on canal sites in the Central Belt of Scotland. We were interested in establishing at which point in the season these bats became active and which, if any, changes in weather patterns affected their activity at this time of year. In addition to these main objectives, supplementary work relating to insect activity was also carried out and is described herewith.

Key words: hibernation, bats, weather, insect

Introduction

Bats are members of the order Chiroptera and are the only mammals which have evolved to be able to carry out true flight (Altringham, 2003). All species of bat present in Britain belong to the sub-order microchiroptera of which 16 species are considered to be resident (Vaughan *et al*, 1997a; Jones and Barratt, 1999). In Scotland it is generally accepted that nine species are present, of which six regularly occur including *M. daubentonii*, the subject of this study (Haddow and Herman, 2000).

All bats resident in the UK are heterotherms (Ransome, 1990) and as such they conserve energy at times of low ambient temperatures and low availability of food. During these conditions bats enter into periods of inactivity (torpor) when they lower their heart rate, metabolism and body temperature (Park, 2001). Generally speaking, torpor may last for very short periods of only a few hours (i.e. during the summer months) through to prolonged periods (many weeks) during the cold winter months. This winter inactivity in bats, commonly referred to as hibernation, is better described as prolonged periods of seasonal torpor (Feldhamer *et al*., 1999) varying in length of time depending upon environmental conditions.

A limited number of studies have been carried out relating to the activity of bats during times of the year when they are in the transition between winter hibernation and spring/summer activity. There is not a set time for the termination of hibernation as this will vary from year to year depending upon weather conditions.

M. daubentonii was an ideal study subject for this project as they were deemed to be fairly abundant in the Edinburgh and West Lothian area (BaTML, 2002) and could also be studied using non-invasive methods.

These bats forage typically, albeit not exclusively, over water (Altringham, 2003; Vaughan *et al*., 1997b) and their technique of flying very close to the water surface, hovercraft style, is regarded by bat researchers in the UK to be diagnostic. This behaviour can be verified visually, with as little disturbance as possible, using a red filtered light (Monhemius, 2002) as a bat 'skims' by in front of the observer. In particular they tend to forage over smooth water (Warren *et al*., 2000) emitting their echolocation parallel to the water surface (Rydell *et al*., 1999; Siemers *et al*., 2001).

From an audio perspective, this species of bat produces echolocation calls consisting of broadband frequency modulated sweeps without any constant frequency tail (Russ, 1999). The range of frequencies covered by any one call varies, however calls sweeping from as high as 88.20 kHz through to 36.46 kHz would not be deemed unusual (Parsons & Jones, 2000). *M. daubentonii* can be best listened to on a heterodyne bat detector at frequencies between 35 kHz and 50 kHz. Whilst commuting, these pulses are generated typically at a rate of 12 to 15 per second (Stebbings, 1993) producing a rapid and regular series of 'ticks' when heard on a heterodyne bat detector.

Methodology

Survey site selection

Four existing BATS & The Millennium Link (BaTML) study sites were chosen, each with varying characteristics. Two of these sites (Slateford and Fawnspark) were the subject of pilot surveys from November 2001 to February 2002. These pilot surveys allowed the surveyors to become familiar with the equipment before the project start date of 12th February 2002. Of the four sites selected Slateford (Edinburgh) was the most easterly and Fawnspark (West Lothian) the most westerly, the distance between the two being 21 km.

Slateford (OS Grid Ref: NT224708)

This site lies within the City of Edinburgh and is, in the main, bordered by residential gardens. Immediately to the west of this study location is a large canal aqueduct carrying the Union Canal over the Water Of Leith. Slateford is situated approximately 6 km from the next nearest survey site (Gogar Moor Bridge), and was the only site selected within the city boundaries.

Gogar Moor Bridge (OS Grid Ref: NT156706)

Situated just behind Ratho Park Golf Club and approximately 2 km east of the village of Ratho, this site is lined with trees along both banks of the canal offering a relatively sheltered environment. This site is approximately 6 km west of Slateford and 12 km east of Winchburgh North.

Winchburgh North (OS Grid Ref: NT087753)

Located on the northern outskirts of the small town of Winchburgh (West Lothian), this survey area is situated opposite a private house, with the surrounding countryside being farmland and scrubland. The site lies approximately 12 km west of the Gogar Moor Bridge site and 4 km east of the site at Fawnspark.

Behind the survey area to the east is a large pond, which we felt could also be used as foraging habitat by *M. daubentonii*. Connecting the pond and the canal is a linear strip of tall vegetation, thus providing ideal conditions for bats wishing to commute between the two water features. Although beyond the scope of this paper, it should be noted that we did conduct a special survey on 7th May 2002 monitoring the pond, the commuting corridor and the canal. The results of this work established that our assumptions were indeed correct.

Fawnspark (OS Grid Ref: NT062767)

This site is situated approximately 4 km west of Winchburgh North. There is a semi-natural woodland located just behind the site, and fields with the occasional tree and high vegetation present on the opposite side of the canal (Morrison and Middleton, 2004).

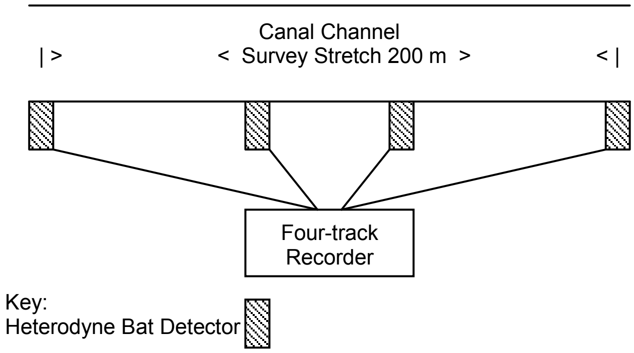
Bat surveys

In total 16 surveys were carried out at the four sites in question (four surveys per site). Each site contained its own consistent 200 m survey stretch upon which our activity was focused.

Bat activity was monitored using four heterodyne bat detectors (Stag Electronics, Bat Box III) simultaneously linked by cabling to a four-track tape recorder (Fostex Corporation, model X24). All activity was recorded onto tapes for later analysis. This methodology mirrored that previously developed and being used by BaTML (Middleton *et al*., in prep) as part of their wider monitoring studies.

The bat detectors, which were placed on tripods and directed over the canal water surface, were all tuned to 40 kHz. At this frequency *M. daubentonii* could, in conjunction with visual observations, be safely separated from other species that may be present. On each survey night surveying commenced at 30 mins after sunset and continued for 90 mins thereafter. A basic plan of how the equipment was set up is shown in Figure 1 below.

Figure 1: Plan of equipment set up relative to canal bank



In addition to recording the data relative to bats, at the beginning, mid-point and end of each survey we also noted the various environmental conditions against which we planned to monitor the bat activity (i.e. precipitation, wind, humidity, lux, cloud cover, air temperature and water temperature).

After each survey night the recorded tapes were analysed with all relevant data being noted, including the number of bat passes, which would be used to determine overall activity.

Insect analysis

Supplementary to the main objective it was also felt that it would be of interest to carry out insect surveys at each of the sites in question. This was to help ascertain which insect families (the prey of bats) (Vaughan, 1997) were represented at each of the sites in question at this time of year.

It was decided that sweep netting of the vegetation on the banks of the canal at each site would be the most appropriate method for this aspect of the project. This would give a snapshot as to what adult insects were present and in what densities. One three minute sweep was carried out on the vegetation at each of the four sites. To ensure consistency, all of these samples were obtained on the same day in April 2002, therefore reducing variables resulting from the weather. The sweep net was dragged along the bankside vegetation on the 200 m bat survey stretch. The contents of the net were then emptied into a jar and taken back to the laboratory where the samples were individually sorted and identified to family level.

Results

Bat activity

A full summary of the results obtained during the survey period are given in Appendix I at the end of this paper. In summary, with regards to when activity commenced in the area, *M. daubentonii* were first recorded during our survey at Fawnspark on 18th March 2002 and thereafter, at various levels, on each and every survey evening.

Prior to conducting our own analysis relating to how activity was influenced by environmental conditions we considered the following null hypothesis (H_0): Ambient temperature and other local weather conditions does not affect the activity of *M. daubentonii* during the transitional period between winter and spring.

Our results suggested that neither precipitation or wind strength had any impact upon bat activity. However it should be noted that during our surveys, once bats were known to be present, we did not experience extremities of either of these two variables.

With regard to the other environmental variables being measured, statistical tests (Pearson correlation) were carried to see if any significant relationships were present. All statistical analysis was carried out using Minitab 12. Table 1 summarises the results.

Bearing in mind the results of the Pearson correlation with regards to air and water temperature H_0 could therefore be rejected in favour of H_1: Ambient temperature does affect the activity of *M. daubentonii* during the transitional period between winter and spring.

When the same statistical test was carried out for the other environmental variables being considered H_0 could not be rejected, therefore suggesting that activity did not appear to be affected by the other variables being considered.

Table 1: The results of the statistical tests (Pearson correlation) comparing environmental conditions against the number of bat passes recorded.

Pearson Correlation	r value	P-value	Significant or Insignificant Result
Air Temperature 30 mins after sunset	0.750	0.000	Significant
Water Temperature 30 mins after sunset	0.800	0.000	Significant
Lux (light intensity) 30 mins after sunset	0.291	0.126	Insignificant
Humidity 30 mins after sunset	0.353	0.061	Insignificant
Cloud cover 30 mins after sunset	-0.026	0.895	Insignificant

Insect Activity

A summary of the insect families recorded as a result of the sweep netting surveys is contained within Appendix II.

Discussion

The period in question, during 2002, was fairly mild compared to previous years and as such it is possible that the level of activity we encountered was greater and earlier than the norm for this species. As the general trend for air and water temperature increased, unsurprisingly bats began to appear at the sites in question.

A correlation of bat activity against lux and cloud cover did not occur. Likewise the presence of precipitation and wind did not have any significant affect on bat activity. We would have expected activity to be influenced by wind and rain as these would cause disturbance to the water surface making it harder for these bats to locate prey (Von Frenckell and Barclay, 1986). Having said this, the weather conditions during our survey evenings did not produce heavy rain or strong wind and as such the conclusions drawn from our study in this respect cannot be relied upon.

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Appendix I

A summary of results obtained during Daubenton's bat surveys on the Union Canal, West Lothian, Scotland during the period February to May 2002.

Site	Date	Number of Bat Passes	Precipitation	Wind Strength	Air Temperature (^{0}C)	Water Temperature (^{0}C)	Lux	Humidity %	Cloud Cover %
Slateford	12.02.02	NIL	Dry	Moderate	6.1	6.2	7.5	80	85
Winchburgh North	18.02.02	NIL	Dry	Moderate	5.5	4.9	2.1	80	40
Gogar Moor Bridge	27.02.02	NIL	Dry	Calm	3.0	not recorded	1.5	62	10
Fawnspark	04.03.02	NIL	Dry	Moderate	6.7	6.0	8.8	76	20
Slateford	05.03.02	NIL	Light	Strong	7.0	6.0	3.9	75	80
Winchburgh North	11.03.02	NIL	Dry	Strong	6.1	5.2	10.6	48	15
Gogar Moor Bridge	12.03.02	NIL	Dry	Calm	5.0	4.6	4.8	80	10
Fawnspark	18.03.02	28	Dry	Calm	5.2	7.6	7.3	72	25
Slateford	26.03.02	10	Dry	Light	7.2	8.4	7.1	47	50
Winchburgh North	28.03.02	3	Dry	Calm	7.5	8.5	11.3	64	5
Gogar Moor Bridge	02.04.02	15	Dry	Light	9.8	9.2	2.4	72	100
Fawnspark	03.04.02	31	Dry	Calm	9.3	10.6	1.5	73	100
Slateford	09.04.02	26	Light	Light	9.5	11.8	5.9	51	100
Winchburgh North	10.04.02	28	Dry	Calm	6.5	10.9	13.9	51	55
Gogar Moor Bridge	15.04.02	4	Dry	Calm	6.6	10.2	4.2	70	20
Fawnspark	17.04.02	22	Dry	Calm	8.5	10.4	1.2	66	100
Slateford	22.04.02	62	Dry	Light	12.1	13.5	7.8	80	15
Winchburgh North	25.04.02	30	Light	Moderate	8.7	12.2	3.4	68	100
Fawnspark	29.04.02	6	Dry	Moderate	6.6	9.6	9.8	74	0
Gogar Moor Bridge	02.05.02	8	Light	Calm	10.8	10.8	4.3	65	70

Appendix II

A summary of the families of insects encountered as a result of sweep net surveys on the Union Canal, West Lothian, Scotland during April 2002.

Insect Family	**Slateford** (number of specimens)	**Gogar Moor Bridge** (number of specimens)	**Winchburgh North** (number of specimens)	**Fawnspark** (number of specimens)
Ancylidae	1	NIL	NIL	8
Asellidae	7	6	49	36
Chironomidae	NIL	2	1	5
Coenagriidae	NIL	1	NIL	2
Dytiscidae	1	1	6	6
Erpobdellidae	1	1	NIL	6
Gammaridae	6	NIL	7	9
Gerridae	1	NIL	3	6
Hydrobiidae	5	1	12	52
Leptoceridae	NIL	NIL	2	NIL
Limnephilidae	1	3	4	15
Lymnaeidae	NIL	NIL	NIL	2
Physidae	11	2	7	17
Planaridae	3	4	3	2
Planorbidae	103	1	2	7
Sphaeridae	4	NIL	3	16