The speed of travel of *Myotis daubentonii* along canal corridors in central Scotland

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Abstract

During the period 2001 to 2006 BaTML surveyors monitored the abundance and distribution of *Myotis daubentonii* along the canal network that connects the east coast of Scotland with the west coast. During these activities the methods adopted allowed us to simultaneously look at other behaviour, including speed of travel, as bats travelled along this valuable wildlife corridor.

Key words: BaTML, bats

Introduction

Bats use their ability to fly in order to travel from their roosts to suitable foraging areas and other roosts. Flight allows these mammals to typically exploit far wider territories than similar sized, terrestrial mammals. Due to the difficulties in observing individual bats during their active periods (i.e. the hours of darkness) it is not easy to track an individual bat with a view to establishing its speed of progress (i.e. travel) within a habitat.

Speed of travel may be useful to know in order to consider the potential range of bats operating within an area of habitat. This is especially important when we are dealing with a species such as *Myotis daubentonii* which has a strong association with water features (Altringham, 2003; Vaughan *et al*., 1997) and the water feature in question is a long and narrow canal. This habitat imposes constraints, upon the typical behaviour of *M. daubentonii*, as to how many individual bats can share the limited airspace above the water surface for effective foraging purposes.

In 2000 the Forth & Clyde and Union Canals, in the Central Belt of Scotland, were reopened to water traffic along their entire length. The canal system is approximately 110 km in length and stretches from Edinburgh city centre in the east through to Bowling, a small town on the Firth of Clyde, to the west of Glasgow (British Waterways, Scotland).

M. daubentonii shows a strong association with 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). This species is found roosting in bridges, old structures and trees within the study area. These bats typically feed between 10 and 50 cm above the water surface (Jones & Raynor, 1988; Kalko & Schnitzler, 1989). This means that the ideal air space they typically exploit is restricted vertically and hence pressure to feed free from other bats, competing for the same airspace, should be a preference in a narrow canal habitat.

Due to the narrow width of the canal water surface along its length (Forth & Clyde Canal typically 15-18 m; Union Canal typically 8-12 m), there is a limit to the number of bats that can simultaneously patrol the same foraging areas. As such these bats appear to travel purposefully along the canal either in search of a suitable clear feeding area on the canal itself or as a commuting corridor (exploiting feeding opportunities as they arise) taking them to other habitats (e.g. local rivers and lochs) where better feeding opportunities can be found.

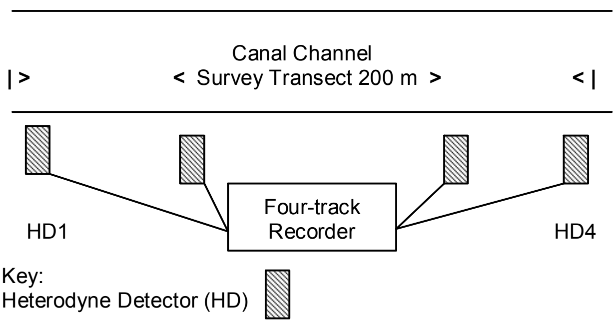
As part of our wider studies we felt it would be useful to establish the potential distance that a bat could feasibly travel during a typical nights foraging. In doing so, this would help us establish broad detail as to the likely time bats could take to travel to other local, and perhaps more efficient, feeding areas. In addition it may also give us clues as to the potential distances roosts may be from particular foraging spots encountered through our studies within the area.

Materials & Methods

A bespoke monitoring survey system (Middleton *et al*., 2005; Middleton *et al*., 2006) was developed in order to monitor the distribution and abundance of *M. daubentonii* within the study area. This system, called a Recordable Remote Heterodyne Detector System (RRHDS), was created primarily to monitor the distribution and abundance of *M. daubentonii* within the study area. However, additionally, it also allowed a number of other aspects to be recorded, including speed of travel (Middleton *et al*., 2005).

The RRHDS uses four remotely positioned heterodyne bat detectors (Bat Box III, Bat Box Ltd, UK). Each detector is linked, simultaneously, by cabling to its own channel on a four-track recording station (Fostex Corporation, model X24). These heterodyne detectors are used to record all activity relating to *M. daubentonii*. All data is recorded onto tape and analysed at a later date. Figure 1 describes the layout of the RRHDS survey model.

Figure 1: Plan of the RRHDS survey model



The system allows us to track individual bats as they travel through the 200 m survey transect. As the distance between the bat detectors is known and we are able to measure the time it takes for a bat to travel through the transect, we can therefore measure speed of travel. It is important to make a distinction between speed of travel and speed of flight. The former allows for the fact that bats travelling along a route will not necessarily do so in a straight line and at a constant speed. For example, flying bats may slow down as a result of reacting to their immediate surroundings or may divert from a straight line of flight, or double back on themselves, in order to pursue insect prey.

To establish speed of travel we measured the time taken (in seconds) for a bat to travel the 200 m from HD1 to HD4 (see Figure 1). Allowing for the fact that the bat detectors begin to pick up the bat echolocation prior to the bat being directly in front of the detector (which is positioned at right angles facing across the water surface) we measured the time from point of first sound heard on HD1 until point of first sound heard on HD4 (or vice versa for bats travelling in the opposite direction).

Eight survey tapes, taken from our wider monitoring studies, were selected at random in order to measure the speed of travel in km per hour (kmph). From each tape the first three complete bat passes were analysed. The calculation used in order to establish the data was as follows:

$$\text{Distance (200 m)} / \text{Time (seconds)} = \text{Speed (metres per second)}$$

The metres per second speed results were then converted into kmph. So that some bias could be avoided, albeit not eliminated, for analysis purposes we used bat passes occurring earlier in the evening when typically less bats would be present and recorded bats were more likely to be commuting.

Results

The results of this study are shown below within Tables 1 and 2. Three bat passes were measured from each of the eight randomly chosen sites giving a total sample of 24. The time (in seconds) for each bat pass was recorded and then converted into kmph values as shown within Table 1 below.

The results overall were then looked at in order to produce a number of key measures, including: mean speed of travel (19.51 kmph): standard deviation (4.88 kmph); min/max range (10.44 kmph to 30.00 kmph). Table 2 provides this data.

Table 1: Results per survey transect chosen

Site Code (Location)	Pass No	Time (sec)	kmph
FC4 (Kirkintilloch W)	1	45	16.00
	2	42	17.14
	3	45	15.99
FC5 (Tintock)	4	69	10.44
	5	53	13.59
	6	46	15.65
UN12 (A801)	7	38	18.95
	8	36	20.00
	9	43	16.74
UN16 (Fawnspark)	10	36	20.00
	11	38	18.95
	12	30	24.00
UN17 (Winchburgh N)	13	27	26.67
	14	28	25.71
	15	30	24.00
UN18 (Learielaw)	16	37	19.46
	17	46	15.65
	18	64	11.25
UN19 (Wilkies Basin)	19	30	24.00
	20	28	25.71
	21	24	30.00
UN21 (Slateford)	22	44	16.36
	23	32	22.50
	24	37	19.46

Table 2: Overall summary of results relating to the speed of travel of *Myotis daubentonii*

	kmph
Range (min/max)	10.44/30.00
Mean	19.51
Median	19.21
Skew (Pearsons coefficient)	0.187
Standard Deviation	4.88

Discussion

Speed of travel, as opposed to speed of flight, has been described here as in all likelihood the bats measured would not have been travelling in a straight line through the survey stretch. Some bats may have slowed down or veered to the side of the transect in order to search for insects. Further it is possible that, occasionally, a bat may have even doubled back on itself, for a short period, in order to pursue prey. The slower speeds recorded during this study may therefore relate to such circumstances, whilst the faster speeds may be more relative to straight line (i.e. speed) of flight.

If it is accepted that that speed of travel can only be equal to or slower than speed of flight, then it can be said that the data shown from this study represents, by and large, speeds slower than those of direct flight.

Within our min/max range we have bats travelling as fast as 30 kmph (18.65 mph), however we are not suggesting that this speed would be sustained over a longer period of time. Conversely at the lowest speeds recorded the bats are, it would appear, behaving casually in comparison, as they *meander* along the route, perhaps seeking foraging opportunities.

In theory, it would not take much effort for these bats within this type of habitat to travel fairly long distances in a typical night, provided of course that the return on foraging whilst commuting was economically viable. At the mean speed recorded (19.51 kmph) a bat travelling away from its roost for circa 90 minutes could start off in an area such as Linlithgow (West Lothian) and end up as far a way as Edinburgh (to the east) or Falkirk (to the west). As such the opportunity for these bats to potentially 'mingle' with bats from other populations of the same species would appear to be quite high.

However, the fore-mentioned theory has to be tempered with other potential contributing factors such as; length of time foraging, locality of known roosts and locality of good quality foraging areas close to occupied roosts whereby longer journeys for potentially less efficient feeding would not be economic to complete.

This aspect of our overall studies was very much a one-off with a small sample size. Perhaps an interesting further study would be to compare more transects of a slightly longer distance and co-relate speed of travel against evidence of foraging (i.e. feeding buzzes emitted) so that direct flight could be compared against bats that are known to be feeding.

Acknowledgements

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