A five year study into the distribution and abundance of *Myotis daubentonii* along the canal network of central Scotland

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Abstract

During the period April 2001 through to September 2005 the BATS & The Millennium Link (BaTML) project carried out a survey programme to monitor the distribution and abundance of *Myotis daubentonii* along the canal corridors of central Scotland. This survey activity corresponded with a period of change (i.e. the first five years of the re-opening of these waterways to canal traffic) within the locality. Our survey methods used heterodyne bat detectors in conjunction with a four-track recorder to survey bats as they travelled through pre-selected sections of canal.

Key words: heterodyne, canal, bat, bats, BaTML

Introduction

The opportunity to study the affect upon bats as a result of changes to a specific habitat arose in 2000 when it became apparent that the changes to the canal corridors within the Central Belt of Scotland (i.e. Forth & Clyde and Union Canals) could potentially have an impact upon *Myotis daubentonii* (Daubenton's bat), a species that shows a strong affiliation with calm water habitat (Dietz *et al*., 2006).

M. daubentonii is one of three European species of bat (the others being *M. capaccinii* and *M. Dasycneme*) that can be described as 'trawlers', and the only one of which that occurs within the UK. As a 'trawler' it shows a strong affinity with riparian habitat, especially calm water, above which it forages for insects from on or just above the water surface (Kalko & Schnitzler, 1989; Warren *et al*., 2000; Siemers *et al*., 2001)

Methodology

In order to carry out a consistent survey methodology within this narrow habitat corridor we designed and built a bespoke survey system to study these bats (Middleton *et al*., 2005; Middleton *et al*., 2006). The system developed, called a Recordable Remote Heterodyne Detector System (RRHDS), has proven itself to be ideal for recording *M. daubentonii* as they commute and forage along these narrow canal corridors.

In conjunction with our survey methods, specific forms for recording data were also developed (Middleton *et al*., 2004).

During the survey period (2001 to 2005) BaTML carried out numerous surveys (N=123) using the methods described within Middleton *et al*., 2005. These surveys established a number of outputs including; speed of travel, direction of roost and commuting/foraging behaviour. A large number of the surveys carried out (N=74) were done so with the aim of showing distribution within the canal network and a comparison of activity during the five year period.

The 74 survey evenings (111 hours) were conducted over the five seasons (2001 to 2005) and, as far as possible, repeated site surveys in future years were carried out within a corresponding three week period of the original. The 22 survey sites were selected randomly with the ultimate aim of having at least 3 surveys carried out at each site during the five year period, each of which could contribute towards our study.

Appendix I shows a summary of the data relating to the study. It should be noted that four locations* (FC6, UN12, UN15, UN22) failed to achieve either the consistency in survey dates or the required minimum amount of survey effort to contribute towards a number of the areas reported here, however two locations** (UN16, UN20) achieved the minimum criteria twice and have therefore contributed accordingly.

Results

In order to assist with the interpretation of our results, Table 1 (below) shows a summary of the site names, BaTML site codes and approximate OS Grid References for each of the 22 randomly

selected study transects. In addition we have also shown the canal that each site belongs to.

Table 1: Summary of the study sites

Survey Site Name	BaTML Site Code	Canal	OS Grid Reference
Netherton	FC1	Forth & Clyde	NS5469
Possil Loch	FC2	Forth & Clyde	NS5870
Jellyhill	FC3	Forth & Clyde	NS6172
Kirkintilloch West	FC4	Forth & Clyde	NS6473
Tintock	FC5	Forth & Clyde	NS6874
Auchinstarry	FC6	Forth & Clyde	NS7276
Kelvinhead	FC7	Forth & Clyde	NS7578
Underwood East	FC8	Forth & Clyde	NS8079
Carmuirs	FC9	Forth & Clyde	NS8580
Falkirk Tunnel East	UN10	Union	NS8878
Purliehill	UN11	Union	NS9078
A801	UN12	Union	NS9477
Causewayend	UN13	Union	NS9675
Avontoun	UN14	Union	NS9776
Wilcoxholm	UN15	Union	NT0177
Fawnspark	UN16	Union	NT0676
Winchburgh North	UN17	Union	NT0875
Learielaw	UN18	Union	NT0871
Wilkies Basin	UN19	Union	NT1171
Gogar Moor Bridge	UN20	Union	NT1570
Slateford	UN21	Union	NT2270
Harrison Park	UN22	Union	NT2371

The relative abundance of *M. daubentonii* across the canal network is shown within Figures 1 to 5. Each figure describes a local authority area, from Figure 1 (East Dunbartonshire) in the west, through to Figure 5 (Edinburgh) in the east.

For these results we have taken the average number of bat passes per survey for each of the sites (2001 to 2005) and all 74 surveys have contributed to our findings.

The results bring out some interesting observations. Site FC1 (within the city of Glasgow), perhaps unsurprisingly, shows very low activity. However the low figure relating to UN14, which is in very close proximity to a number of known roosts, is surprising in that this specific stretch of canal does not appear to be as popular as the other sites immediately to the east (UN15) and the west (UN13). In all other respects it appears suitable, for example it is fairly well sheltered and has mature trees on both banks.

Of all the sites measured, one site showed a considerably higher level of activity (FC6 - Auchinstarry Basin). In the early years of the study, prior to development within the basin, this area appeared to show a substantial level of attraction to foraging bats, with our bat detectors being constantly activated to the point that it sometimes became difficult to establish when one bat pass finished and another started. Since the basin has been developed (artificial lighting, new berths and more canal traffic) there still appears to be relatively good levels of foraging taking place, albeit no-where close to what we experienced initially (personal observations by author during 2005 and 2006).

Figure 1: East Dunbartonshire

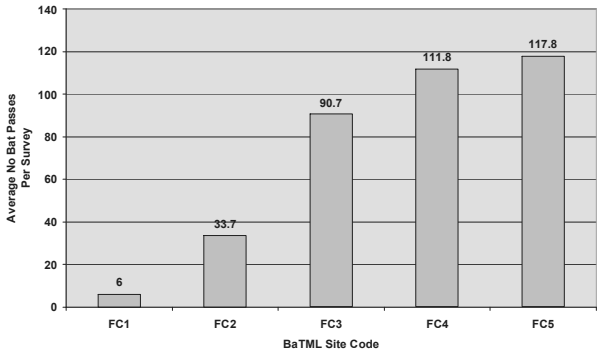


Figure 2: North Lanarkshire

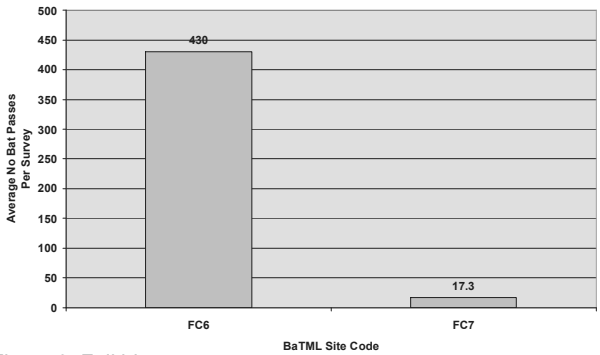


Figure 3: Falkirk

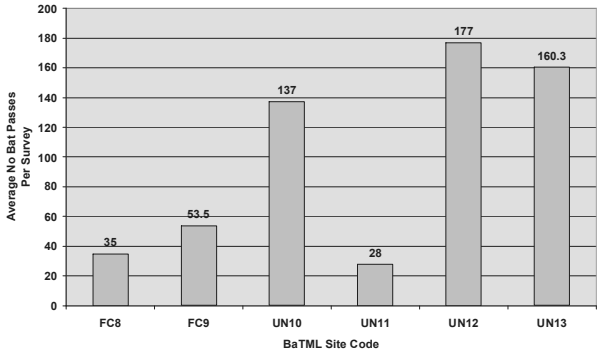


Figure 4: West Lothian

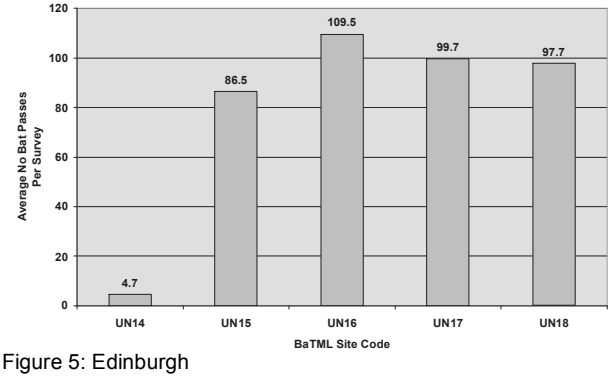
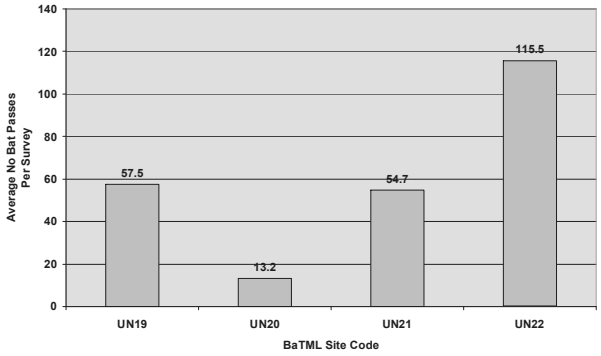


Figure 5: Edinburgh

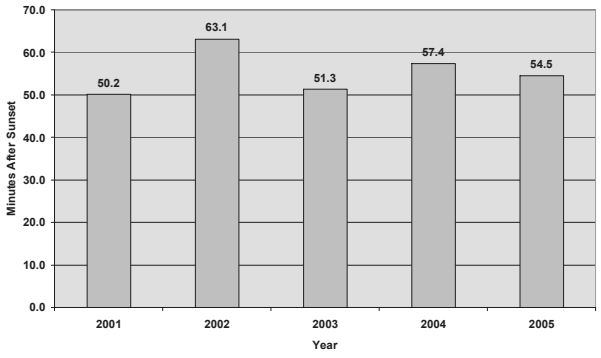


Our survey methods allowed us to establish the time of first appearance on the canal of *M. daubentonii* during each of our site visits.

It should be remembered, however, that time of first appearance, in this context, does not equate to time of roost emergence. This latter aspect will always be earlier than what we report here due to bats leaving roosts from some distance away. Therefore our first encounters on the canal could, in some cases, be considerably later than the initial roost emergence time for any single bat.

Figure 6 (below) shows the annual average time (minutes after sunset) that we encountered our first bat during the survey activities for all sites monitored and for each year in question.

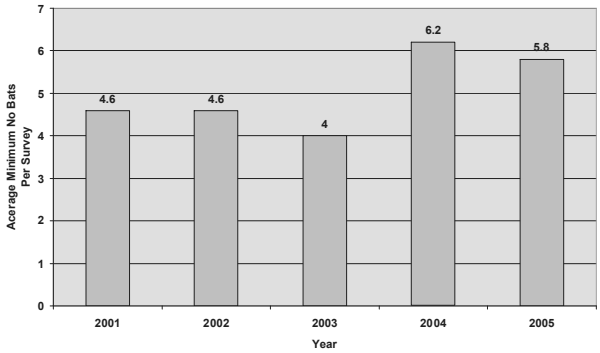
Figure 6: Average time of appearance of first bat per annum (minutes after sunset)



In addition to this measure, our methods also allowed us to estimate the direction of roosts from each of our study locations. This aspect of our study is not fully reported upon here, however, we can say that we estimate there to be at least 15 roosting locations for this species across the canal network.

The methods adopted allowed us to establish a minimum number of bats encountered during each survey evening and we have shown these results as an annual comparison (see Figure 7 below). Our results show that on a typical survey evening we can expect to encounter a minimum of between 4 and 6.2 bats. The trend, when we compare 2001 to 2005, appears to be upwards during the period in question.

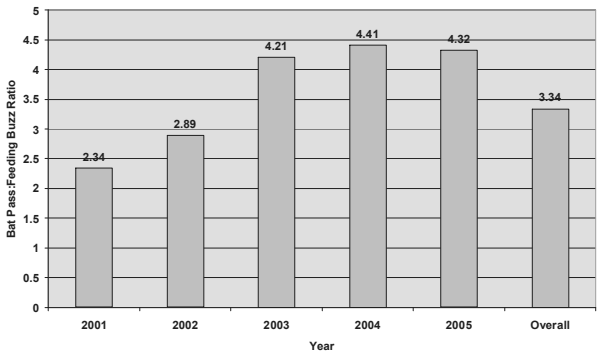
Figure 7: Average annual minimum number of bats encountered



Our survey methods also allowed us to measure feeding buzzes emitted by foraging bats within each of the survey transects. Figure 8 (below) shows an annual comparison of the ratio of bat passes to feeding buzzes throughout the study period. In addition to this annual comparison we have also shown an overall average for the five year period (i.e. an average of 3.34 bat passes for every feeding buzz emitted).

Throughout the study period the trend appears to be upwards and we can certainly say that *M. daubentonii* are using this habitat for foraging purposes.

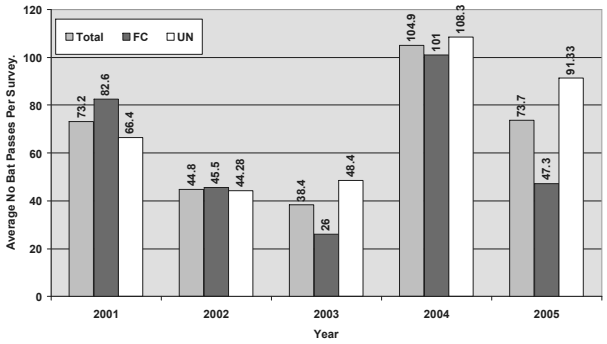
Figure 8: Bat pass to feeding buzz ratio (annual comparison)



Finally, our methodology allowed us to measure bat passes for each of the sites in question. Figure 9 (below) provides a comparison of the annual average number of bat passes per survey evening.

The data has been isolated for each of the two canals (Forth & Clyde Canal and Union Canal), as well as being provided as a total across the five year study period. For the period in question there appears to be an initial dip in activity, followed by a recovery and then a return to near initial levels. However, when comparing the 2001 to 2005 results for each canal it would appear that the Union Canal populations are performing far better than those within the Forth & Clyde Canal corridor.

Figure 9: Annual average number of bat passes per survey (2001 to 2005)



Discussion

The RRHDS has consistently delivered the results we would have hoped for and in addition has proven to be physically robust.

On the whole, we are pleased to see that every randomly selected site produced bat activity during our study period. As such, we have shown that the canal corridor does support this species throughout its length. The overall assessment of bat activity during our study appears to suggest that a fall in activity occurred during 2002 and 2003 with a marked recovery in 2004, followed by a result in 2005 not dissimilar to 2001. However, upon isolating each of the canals, it would appear that an increase in bat activity on the Union Canal is compensating for a reduction on the Forth & Clyde Canal. Further, with regards to the Forth & Clyde Canal, at least one site (FC6 - Auchinstarry Basin) appears to have suffered as a result of development (personal observations by author during 2005 and 2006), albeit not to the extent that bats are no longer using the area completely.

The ratio of bat passes to feeding buzzes shows that good numbers of encounters involving foraging were found during our surveys and that *M. daubentonii* does appear to be using the canal habitat for foraging purposes.

Our methods have also allowed us to estimate to existence of at least 15 roosting locations for this species within or associated to the canal network. In view of the low roost fidelity shown by this species (Altringham, 2003) we would suggest that our estimate is likely to be well below what is actually happening. As a result of supplementary work carried out by ourselves (Middleton & Dodds, 2005) over the period and a subsequent radio tracking programme commencing in 2006, six of these roosting locations have now been found. Further work, sponsored by BaTML, in this area of study is now planned for 2007 and 2008 and as such we hope to establish far more detail regarding the habitat use and roosting behaviour of *M. daubentonii* within the Central Belt of Scotland.

In overall assessment of our results to date we would conclude that the short term impact upon *M. daubentonii* within this habitat during a period of change has not been dramatic and based on a comparison between 2001 and 2005, activity levels arguably appear to be holding their own. Against a backdrop of this, however, is the impact that development (especially loss of roosting opportunities, installation of artificial lighting and loss of bank side vegetation/mature trees) could potentially have upon this species. We would strongly suggest that when developments are being planned within these canal corridors that full scoping surveys assessing the impact of proposals specifically upon bats are carried out.

It is also worth pointing out and reminding those involved with any such developments (or removal of habitat, e.g. mature trees) that bat roosts are fully protected by law at all times irrespective of whether bats happen to be in residence or not. As such any sites that could potentially hold a bat roost should be checked by qualified persons prior to any work being allowed to proceed.

We recognise that for the raw data presented here we have not been able, so far, to carry out a more robust statistical analysis. The author would be more than happy to consider sharing our data with others with a view to a fuller statistical analysis being carried out and reported upon.

Acknowledgements

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Appendix I: An overview of the data collected during study period (2001 to 2005)

Site	Surveys	Survey Month	2001	2002	2003	2004	2005	Average
FC1	3	May			3	11	4	6
FC2	3	Aug	81	8			12	33.7
FC3	3	Jun	31	41		200		90.7
FC4	4	Jun	161	134	10	142		111.8
FC5	4	Jul	116	17		174	164	117.8
FC6*	2	Aug	665	195				430
FC7	3	Aug	24			19	9	17.3
FC8	3	Sep		19	39		47	35
FC9	4	Aug		54	52	60	48	53.5
UN10	3	Aug	32		114	265		137
UN11	3	Jun	4	50			30	28
UN12*	4	Various	25	201	235		247	177
UN13	3	Jun	119	111		251		160.3
UN14	3	May	1	2		11		4.7
UN15*	4	Various	54	58		137	97	86.5
UN16**	3	Apr		22		12	20	18
UN16**	3	Jul	159			108	336	201
UN17	3	Jul	127			86	86	99.7
UN18	3	Aug		113	20		160	97.7
UN19	2	Sep			34		81	57.5
UN20**	3	Apr		4	0		37	13.7
UN20**	3	May		8		25	5	12.7
UN21	3	Aug	23		74		67	54.7
UN22*	2	Various	20		211			115.5
Total	**74**	**Total Bat Passes per annum**	**1642**	**1037**	**792**	**1501**	**1450**	**86.8**
		Surveys / Year	**16**	**16**	**11**	**14**	**17**	**14.8**
		Bat Passes / Survey	**102.6**	**64.8**	**72**	**107.2**	**85.29**	**86.4**
		Feeding Buzz / Survey	**43.8**	**22.4**	**17.1**	**24.3**	**19.76**	**25.5**
		Bat Pass:Feeding Buzz Ratio	**2.34**	**2.89**	**4.21**	**4.41**	**4.32**	**3.34**
		Min No Bats / Survey	**4.6**	**4.6**	**4**	**6.2**	**5.8**	**5.1**
		Average Time Arrival of 1st Bat	**50.2**	**63.1**	**51.3**	**57.4**	**54.5**	**55.5**

* Survey sites that did not achieve either consistency or minimum number of surveys to contribute towards comparative results within this report.

** Survey sites which managed to contribute twice towards the comparative results within this report.