Habitat preferences of Daubenton's bats (*Myotis daubentonii* Kuhl 1819: Vespertilionidae) and their prey

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A bat in the a hand is worth ten in the trees and 12±144 rainy, cold, wet nights of fieldwork! *Myotis daubentonii.* Photo: Victoria Turner

Introduction

The small, (6-12g) Daubenton's bat has a wide distribution ranging throughout the Palaearctic over the whole of Europe, Russia, Central Asia and outer India. Individuals feed almost exclusively over water, usually in the 0.3 – 1.0 m airspace above the water by either aerial hawking insects from the air or gaffing prey from the surface using their large feet or tail membranes (Fig. 1.).

Past research

Along the river Wharfe (North Yorkshire, UK), radio tracking (Fig. 2.) and mist netting has shown that there appears to be marked sexual segregation in the bat population. Females forage exclusively in the lower river reaches and males almost exclusively higher up.

➔ *Why do females not use the upper reaches when insects are expected to be present in similar abundance ?*

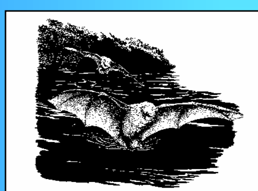


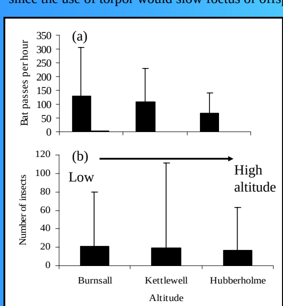
Figure 1. Daubenton's bat gaffing prey from the water surface

Figure 2. Radio-tagged Daubenton's bat. Photo: John Altringham

Hypotheses

➔Prey abundance at higher altitudes is similar as at lower altitudes, but that due to more marked temperature variations, prey are temporally clustered

➔Males, which can use torpor during periods of low prey availability, can exploit this resource, while gravid or lactating females are effectively excluded since the use of torpor would slow foetus or offspring development



2000

➔ Significantly more bats present at low than at high altitude (Dunn's pair-wise multiple comparisons test $P < 0.001$) (Fig.7a)

➔ No significant difference in insect abundance with altitude ($P > 0.05$) (Fig. 7b)

➘ Figure 7. (a) Mean ± SD of the number of bat passes /hr and (b) insect numbers at different altitudes (pooled all nights, all altitudes, 2000)

Conclusions

➔ Reproductive females probably get more quality foraging time at low altitudes as temperature warmer and more stable. Insects are therefore more temporally predictable, and they can avoid torpor allowing faster development of young

➔Bats prefer trees possibly as anti-predator avoidance mechanism. Trees also allow earlier emergence and the exploitation of earlier insect activity

➔Bats avoid rapids as high frequency noise may interfere with bats' echolocation system also possibly masking prey signals

➔Bats avoid cluttered water sections as it is more energetically costly to navigate around obstacles. Smooth, obstacle-free sections therefore preferred

➔Radio-tracking studies (in preparation) show that females feed for less time over shorter distances than upstream males, despite their higher energetic demands, supporting the conclusion that insects are easier to find

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Materials & Methods

Habitat mapping

1999

➔ A river section was chosen between 270 m to 150 m (AMSL)

➔ Four altitudes sele-ced along the river section

➔ Tiny Talk tempera-ture logger placed at each altitude

➔ Each altitude sect-ion (n = 4) mapped for nine habitat types and control where Daubenton's bats do not forage (over grass) (Table 1.)

Major category	Sub-category	Habitat #
Smooth water surface	Trees present on both banks	1
	Trees present on one bank	2
	No trees on either bank	3
Rapid water surface	Trees present on both banks	4
	Trees present on one bank	5
	No trees on either bank	6
Cluttered water surface	Trees present on both banks	7
	Trees present on one bank	8
	No trees on either bank	9
Control	Grass	10

Table 1. Habitat categories of the river Wharfe

2000

➔ Three altitudes chosen (low, mid and high) to compare altitudinal differences in bat and insect numbers

Habitat sampling

1999

➔Latin square design (Table 2.). Each night, habitats rotated by two therefore sampled at the full range of times throughout the night

➔ Sampling repeated as replicates for the next five nights

➔ n = 10 nights/altitude. n = 40 nights for all four altitudes

2000

➔Habitat category one only chosen (smooth water, trees both sides)

➔Altitudinal bat and insect activity investigated at this habitat type at three altitudes only

➔All completed within the same month: altitudes compared

Results

1999

➔Lower altitude significantly warmer than higher altitudes (Two-way ANOVA (d.f. = 4, $F_{4,3}$ = 170.01, $P < 0.0001$) (Fig. 4.)

➔Lower altitude more stable in temperature than higher altitude (same found in 2000, data not shown). Mean 1°C diff. between two extreme alts

➔ Bats preferred river sections with smooth water with trees on both banks (Dunn's pair-wise multiple comparisons test $P < 0.001$) (Fig. 5a.)

➔ Bats avoided rapid and cluttered water (Fig. 5a.)

➔Bat habitat selection same at all four altitudes

➔ No significant difference in insect numbers or families with habitat type ($P > 0.05$) (Fig.5b.)

➔Positive correlation between bats and temperature (Spearman's rank order correlation: rS = 0.207, n = 393, $P < 0.0001$) (Fig. 6a) and insects and temperature (Pearson's correlation r = 0.303, n = 400, $P < 0.0001$) (Fig. 6b)

NB: The correlation between bat and insect activity is currently being investigated. Data will be truncated as the insect activity peak occurs before the bat emergence. There is therefore a lag period between the activity of bats and peak insect activity

➔ Weak correlation between bats and insects (rS = 0.12, n = 400, $P < 0.05$) (not shown)

➔ 98% insects Nematoceran Diptera (Chironomids & Ceratopogonids). Ephemeroptera, Trichoptera, Hemiptera, Plecoptera and Hymenoptera = rare

Nights	1	2	3	4	5
Habitat type rotation	1	9	7	5	3
	2	10	8	6	4
	3	1	9	7	5
	4	2	10	8	6
	5	3	1	9	7
	6	4	2	10	8
	7	5	3	1	9
	8	6	4	2	10
	9	7	5	3	1
	10	8	6	4	2

Table 2. Latin square design for habitat sampling, e.g. for one altitude. Shaded cells show habitat rotations by two

Bat recordings

➔ Bats recorded in different habitat types with a time-expanding bat detector (Tranquillity II) commencing 1 hr before sunset (in 1999 and in 2000) till 1 hr after dawn

➔ Recordings made on Sony Professional Walkman (WM-D6C)

➔ Time expanded (x10) spectral analysis of calls made on PC (Fig. 3.)

Insect sampling

➔ Insects collected with fine mesh (*ca.* 1 mm^2) sweep net

➔ At each habitat type, 40 180º sweeps made *ca.* 1 m above the surface

➔ Insects preserved in 70% alcohol

➔Dipterans identified down to family level using keys

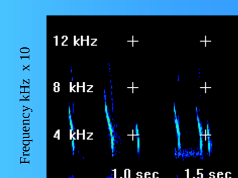

Figure 3. Time expanded FM call of *Myotis daubentonii*

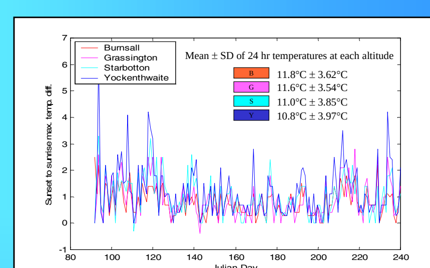

Figure 4. Change in temperature from sunset till the minimum temperature before dawn. Δt = temp at sunset - min temp before dawn. Burnsall = low altitude, Grassington and Starbotton mid and higher altitudes and Yockenthwaite = highest altitude (1999 data)

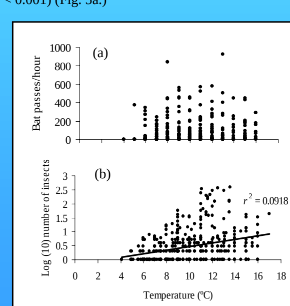

Figure 6. Correlation of the number of bats (a) and insects (b) (pooled for altitude and all habitat types) with temperature (1999)

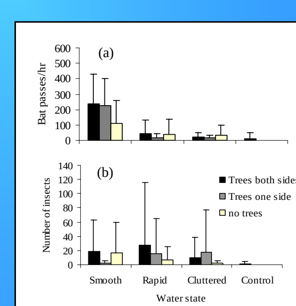

Figure 5. (a) Mean ± SD of the number of bat passes/hr and (b) insect numbers at different habitats (pooled for all nights, all altitudes, 1999)