

Supplementary Information

Table S1. Parameters of bat echolocation calls used for species identification. Call structure: FM: frequency modulation; CF: constant frequency; QCF: quasi-constant frequency. The size of the letter corresponds to the length of the FM and CF parts.

Species	Call structure	Frequency of maximum energy (kHz)	Minimum frequency (kHz)	Maximum frequency (kHz)	Call duration (ms)	Interpulse interval (ms)
<i>Eptesicus nilssonii</i>	fm-QCF	28-32	22	55	10-14	ca. 200
<i>Eptesicus serotinus</i>	fm-QCF	24-28	22	65	10-14	100-150
<i>Vespertilio murinus</i>	fm-QCF	24-27	20	50	6-20	180-200
<i>Nyctalus noctula</i>	alternately fm-QCF	17-22	17	65	5-20	125-400
<i>Nyctalus leisleri</i>	FM-qcf alternately fm-QCF	24-27 24-25	20	55	3-14	90-350
<i>Pipistrellus pipistrellus</i>	FM-qcf	28-30	35	70	3-10	60-100
<i>Pipistrellus pygmaeus</i>	FM-qcf	42-49	48	87	3-6	62-95
<i>Pipistrellus nathusii</i>	FM-qcf	51-60	35	70	5-13	110-200
<i>Myotis</i> spp.	FM	-*	min 20	up to 120		
<i>Barbastella barbastellus</i>	alternately FM	30-35	23	33	2.5-4.5	45-120
	qcf-FM	39-43	33	43		
<i>Plecotus</i> spp.	FM	two peaks: 26-40 50-60	25	80	1.5-5.0	50-64

**Myotis* spp. contain many species with different frequencies of maximum energy. Therefore, the call structure was the main parameter used to identify this genus.

Table S2. Number of bat passes with navigation sequences on the ridge of the Karkonosze in autumn. Species/groups of species included in multivariate analyses are marked with an asterisk.

Species	No. sequences	% (95% CI)
<i>Eptesicus nilssonii</i> *	781	19.2 (18.0, 20.5)
<i>Eptesicus serotinus</i> *	554	13.6 (12.6, 14.7)
<i>Vespertilio murinus</i>	244	6.0 (5.3, 6.8)
<i>Nyctalus noctula</i> *	774	19.0 (17.8, 20.3)
<i>Nyctalus leisleri</i>	20	0.5 (0.3, 0.8)
<i>Pipistrellus pipistrellus</i>	677	16.6 (15.5, 17.8)
<i>Pipistrellus pygmaeus</i>	86	2.1 (1.7, 2.6)
<i>Pipistrellus nathusii</i> *	503	12.4 (11.4, 13.4)
<i>Myotis</i> sp.*	380	9.4 (8.5, 10.3)
<i>Barbastella barbastellus</i>	45	1.1 (0.8, 1.5)
<i>Plecotus</i> sp.	5	0.1 (0.05, 0.3)
Total:	4069	100

Table S3. Univariate regression models describing seasonal changes in the number of bat passes on the ridge of the Karkonosze in autumn. Table shows regression coefficients (\pm SE) and Δ AIC values of the linear model:

$$\text{Number of passes} = \alpha + \beta \cdot \text{date}$$

versus the 2nd degree polynomial model:

$$\text{Number of passes} = \alpha + \beta_1 \cdot \text{date} + \beta_2 \cdot \text{date}^2$$

Date expressed as natural numbers (June 20 = 1, June 21 = 2 etc.) was divided by 100 to avoid extreme small values of regression coefficients.

Species	Linear			The 2 nd degree polynomial			
	α	β	Δ AIC	α	β_1	β_2	Δ AIC
<i>E. nilssonii</i>	3.78 \pm 0.098	-2.55 \pm 0.152	46.6	1.80 \pm 0.3191	3.93 \pm 1.002	-4.70 \pm 0.732	0
<i>E. serotinus</i>	2.83 \pm 0.117	-1.58 \pm 0.165	100.1	-0.78 \pm 0.416	9.64 \pm 1.241	-7.81 \pm 0.877	0
<i>N. noctula</i>	3.36 \pm 0.098	-1.89 \pm 0.143	112.3	0.18 \pm 0.344	8.21 \pm 1.047	-7.12 \pm 0.751	0
<i>P. pipistrellus</i>	3.86 \pm 0.106	-2.92 \pm 0.170	73.0	0.99 \pm 0.384	6.71 \pm 1.253	-7.21 \pm 0.959	0
<i>P. nathusii</i>	1.16 \pm 0.138	0.55 \pm 0.159	172.3	-4.89 \pm 0.579	16.77 \pm 1.436	-9.94 \pm 0.866	0
<i>Myotis</i> sp.	1.74 \pm 0.141	-2.66 \pm 0.220	16.7	0.00 \pm 0.449	3.06 \pm 1.418	-4.16 \pm 1.036	0

Table S4. Effect sizes of GLMMs explaining variation in the number (Poisson model with log links) and direction (binomial model with logit links) of bat passes on the ridge of the Karkonosze. Year, location of recording sites, bat species, and ID of individual observation were entered as random factors. The table shows intercepts and beta coefficients (\pm SE). Betas not covering a value of zero are shown in bold.

Term	Response variable	
	No. of all bat passes	Proportion N→S to S→N passes
Intercept	1.171 \pm 0.343	0.869 \pm 0.380
Standardised date	-0.868 \pm 0.088	0.728 \pm 0.197
(Standardised date) ²	-0.512 \pm 0.063	
Migratory habits (dummy; 1 = long-range)	0.172 \pm 0.228	0.968 \pm 0.505
Weather (PC1 value; higher values = milder)	0.294 \pm 0.068	0.063 \pm 0.138
Standardised date * Migratory habits	0.637 \pm 0.130	0.926 \pm 0.335
Weather * Migratory habits	0.079 \pm 0.112	0.385 \pm 0.262