

Nathusius' pipistrelle bats (*Pipistrellus nathusii*, Keyserling & Blasius 1839) breeding in Ireland

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Abstract

We describe the most westerly known maternity colony of Nathusius' pipistrelle bats (*Pipistrellus nathusii*). The bats were identified by using morphometric measurements and analysis of time-expanded echolocation and social calls. The roost, containing approximately 150 individuals, was located in a mid 19th century farm stable block and store house situated in parkland in County Antrim, Northern Ireland. The roost was visited on 30 April, 1 May and 22 June 1997. Over this period, 11 bats were caught: one adult male, five pregnant females, four lactating females and a juvenile male. Direct observation of behaviour patterns suggests that mating groups of *P. nathusii* may occur in Ireland as late as May. The migratory nature of this species is discussed.

Key words: *Pipistrellus nathusii*, biodiversity, reproduction, echolocation, migration

INTRODUCTION

Nathusius' pipistrelle, *Pipistrellus nathusii* (Keyserling & Blasius 1839) is found from western Europe to Asia Minor (Corbet & Harris, 1991). In autumn and winter it migrates in a south-westerly direction (Strelkov, 1969) and returns during the late spring (Aellen, 1983). Males establish mating territories along the migration routes and some remain in the areas along the route where they mate throughout the year (Kapteyn & Lina, 1994). *P. nathusii* has been found occasionally in Great Britain. It is classed as a migrant winter visitor in Great Britain, although it has been suggested that it may reproduce while in this part of its range (Speakman *et al.*, 1991; Hutson, 1993; Harris *et al.*, 1995). It is also known from the Shetland Islands, and there are a number of records from North Sea oil platforms (P. A. Racey, pers. comm.). Until 1996, there were no records of *P. nathusii* in either the Republic of Ireland or Northern Ireland. However, in August 1996, one of the authors (JMR) recorded the echolocation calls of a bat flying along a deciduous treeline near Moneymore, Co. Londonderry (H855831), 45 min after sunset which, after sonographic analysis, were attributed to *P. nathusii*. In September 1996, a live specimen of Nathusius' pipistrelle was captured by L. Rendle & A. Ross (pers. comm.) in Windsor Park, Belfast. The identity of this bat was confirmed by Mr A. M. Hutson (Bat Conservation Trust, London). This was the first confirmed 'in the hand' record of the presence of *P. nathusii* in Ireland.

However, the status of this species in Ireland remained uncertain.

Barlow & Jones (1996) suggest that the species may form mating groups in Britain in late autumn. In continental Europe, male and female *P. nathusii* are found together in mating groups during autumn, with males performing an advertisement display to attract a potential mate. Indeed, Barlow & Jones (1996) found such a mating group near Bristol in late autumn. This display consists of male bats emitting a characteristic advertisement call at regular intervals while flying in the vicinity of the roost or while stationary at the roost (Gerell-Lundberg & Gerell, 1994). The advertisement call consists of two parts; the first main part has several components that sweep up and down in frequency between 14 and 28 kHz. After a pause of approximately 100 ms, the second part, or 'trill', consists of several components at around 35 kHz (Ahlén, 1990; Gerell-Lundberg & Gerell, 1994; Barlow & Jones, 1996). Male common pipistrelles (*Pipistrellus pipistrellus*) also emit songflight calls in the vicinity of mating roosts. However, these calls lack a 'trill' and, hence, differ markedly from those of *P. nathusii* (Ahlén, 1990; Gerell-Lundberg & Gerell, 1994; Barlow & Jones, 1996). Recordings of social calls in both autumn and winter and observations of male and female bats found together at the sites of advertisement displays, led Barlow & Jones (1996) to suggest that *P. nathusii* may form mating groups in the U.K. in autumn and hence, may overwinter here. This supports the earlier

Table 1. Morphometric measurements taken from Nathusius' pipistrelle bats (*Pipistrellus nathusii*) captured upon emergence from roosts at Antrim, Northern Ireland. *Missing data, †from Schober & Grimmberger (1987), ‡from Greenaway & Hutson (1990), §from Stebbings (1970)

No.	Date	Sex	Reproductive status	Forearm length (mm)	Third digit length (mm)	Fifth digit length (mm)	Ratio	Ear length (mm)	Body mass (g)
1	30/4/97	m	adult	34	66	44	1.29	15	*
2	1/5/97	f	pregnant	33	63	44	1.33	12	8.00
3	1/5/97	f	pregnant	36	65	46	1.28	12	7.75
4	1/5/97	f	pregnant	35.5	64	46	1.30	13	9.00
5	1/5/97	f	pregnant	36	65	45	1.25	12	9.50
6	1/5/97	f	pregnant	34	68	47	1.38	12	8.00
7	22/6/97	f	lactating	35	65	48	1.37	11	9.00
8	22/6/97	f	lactating	34	65	46	1.35	*	9.50
9	22/6/97	f	lactating	35	64	46	1.31	*	8.50
10	22/6/97	f	lactating	34	64	46	1.35	*	8.50
11	22/6/97	m	juvenile	32	56	41	1.28	*	7.00
Published data				32–37†	>60‡	43–48†	>1.25§	10–14†	6.0–15.5†

suggestion of Speakman *et al.* (1991) that this species is likely to remain in Great Britain after mating in order to overwinter. However, it remained to be established whether *P. nathusii* is present throughout the summer or is merely a migrant, visiting in autumn and winter.

We report the most westerly known record of a maternity colony of Nathusius' pipistrelles, including sonographic analysis of echolocation calls.

METHODS

Bats were captured in hand-nets upon emergence under licence from The Environment & Heritage Service of the Department of the Environment (N.I.). Callipers were used for all measurements. The following morphometric measurements were recorded for all bats captured to confirm identification; forearm length, length of the fifth digit (not including the wrist), length of the third digit (including the wrist), and ear length (Stebbing, 1986). The body mass of all female bats captured was measured to the nearest 0.25 g using a Pesola scale balance (Pesola Balances, Switzerland) calibrated previously in the laboratory. The ratio of the length of the fifth digit to the length of the forearm was used as indicative of *P. nathusii* if the ratio was more than 1.25 (Stebbing, 1970). Reproductive status was assessed according to Racey (1974, 1982) and Anthony (1988). The relative size and position of the third upper premolar (p^3) was used as diagnostic of *P. nathusii* (Yalden, 1985), provided all other measurements were consistent with those in Stebbings (1970, 1986), Schober & Grimmberger (1987), and Greenaway & Hutson (1990).

Echolocation and social calls were recorded onto cassette tape via a Pettersson D-980 bat detector (Pettersson Elektronik AB, Uppsala, Sweden) in 10 × time-expansion mode, and were analysed subsequently using the software Batsound v1.0 (Pettersson Elektronik AB, Uppsala, Sweden)(sample rate 22050Hz, FFT-size

1024, Hanning window). A single echolocation call sequence was recorded from 1 male and 5 female bats as they were released from the hand and a further 12 call sequences were recorded from bats foraging within the area; 3 calls (total = 54) were selected for analysis from each call sequence. Social calls were recorded from 3 individual bats flying outside both roosts and a riparian treeline.

The minimum frequency (f_{min}), maximum frequency (f_{max}), the frequency that contained maximum energy (f_{maxE}), the duration (dur), and the inter-pulse interval (IPI) were recorded for each echolocation call. All frequency measurements were in kilohertz (kHz) and all time measurements in milliseconds (ms).

RESULTS

Individuals of *P. nathusii* were located roosting in a mid 19th century farm stable block and storehouse, both of which have been extensively renovated. The roosts were situated approximately 50 m from a river in a country park on the outskirts of Antrim town, Co. Antrim (J1487). One adult male was caught emerging from a gap in a stone wall next to a drainpipe on 30 April 1997. On 1 May 1997, five pregnant females were caught at the same site emerging from a gap in the brickwork under the soffit of an adjacent building. Subsequently, one juvenile male and four lactating females were caught emerging from the same roost at a different exit point on 22 June 1997. On 30 April 1997 at the first roost, a total of three individuals were observed emerging. At the second roost on 1 May, 1997 an estimated 15 bats were counted emerging and on the 22 June, 1997 the estimated number was 150 individuals. It is not known whether all these bats were *P. nathusii*. However, none of the two phonic types of *P. pipistrellus* (Jones & van Parijs, 1993) was caught emerging at any time and was not heard in the vicinity of the roost.

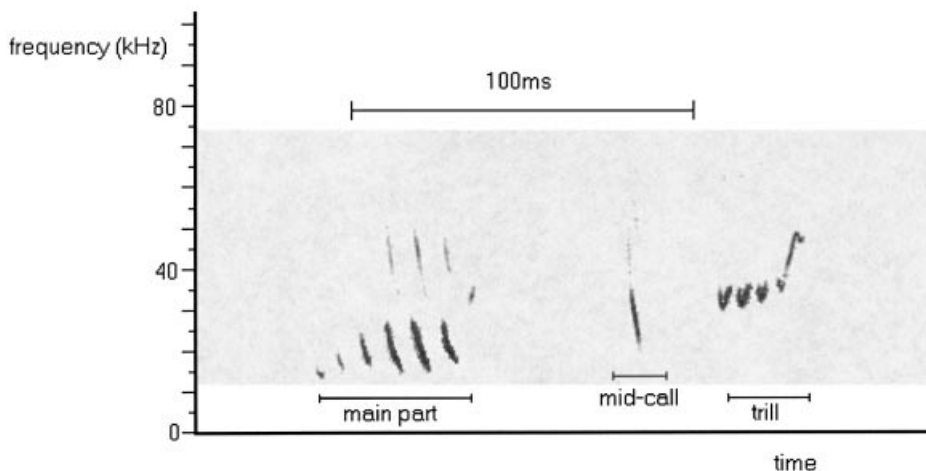


Fig. 1. Sonagram of a social call of *P. nathusii* recorded on 30 April 1997.

Morphometric measurements

All morphometric measurements are presented in Table 1. The values are in agreement with Yalden (1985), Stebbings (1970, 1986), Schober & Grimmberger (1987) and Greenaway & Hutson (1990).

Behavioural observations

On both 30 April and 1 May 1997, approximately 20 min after the first bat emerged from a roost, individual bats were observed circling the immediate vicinity of each roost and by a riverside treeline. The bats emitted social calls continually while circling and those outside roosts were observed occasionally alighting outside of the roost area as a 'false landing'. None of these bats appeared to be foraging since no terminal buzzes (i.e. the marked increase in echolocation pulse rate associated with attacks on insect prey) were recorded on the bat detector. Occasionally, another bat entered the area near the roost where it was rapidly 'chased' by the circling bat. This was accompanied by an increase in the incidence of social calls and bats would often repeat the 'trill' of the call up to six times after the main part. In addition, all female bats captured were released in the vicinity of a circling bat which chased them for short periods before vacating the area. This behaviour was not performed on the subsequent visit on 22 June 1997.

Echolocation and social calls

The mean values and standard deviation for echolocation call parameters were: $f_{min} = 38.6 \pm 1.8$ kHz, $f_{max} = 49.4 \pm 6.9$ kHz, $dur = 7.5 \pm 1.7$ ms, $f_{maxE} = 40.1 \pm 1.7$ kHz, $IPI = 103.5$ ms (69–253) (the median and range are given for *IPI*). A sonagram of a social call of *P. nathusii* showing the main part of the call followed by the trill is shown in Fig. 1. Values for parameters of

social calls are in accordance with Gerell-Lundberg & Gerell (1994) and Barlow & Jones (1996). In addition to the main part and the trill there was a 'mid-call' comprising of a frequency modulated sweep that started at about 41 kHz and dropped to around 25 kHz in approximately 20 ms.

DISCUSSION

This study reports the first confirmed nursery roost of *Pipistrellus nathusii* in the British Isles. Previously, the most westerly record in Europe for a nursery colony of *P. nathusii* was from The Netherlands (Kapteyn & Lina, 1994). Both morphometric data and recorded echolocation and social calls in the present study provide evidence that Nathusius' pipistrelle occurs in Ireland in the late spring and mid-summer while reproductive assessment and the capture of a volant juvenile indicate that bats have successfully produced young. The morphometric data fall within the range recorded by Yalden (1985), Stebbings (1986, 1970), Greenaway & Hutson (1990) and Schober & Grimmberger (1987). Echolocation and social calls are consistent with those recorded by Ahlén, (1990), Gerell-Lundberg & Gerell (1994) and Barlow & Jones (1996).

Recordings of echolocation calls from one individual (J. Russ, pers. obs.) and a single specimen 'in the hand' (L. Rendle & A. Ross, pers. comm.) indicate that individuals of *P. nathusii* are present in Ireland during early autumn. The presence of *P. nathusii* at roosts in spring and mid-summer in Ireland gives strong support to the suggestion of Speakman *et al.* (1991), Hutson (1993) and Barlow & Jones (1996) that the species overwinters in the British Isles. The predominantly north-easterly migrations assumed to be undertaken by *P. nathusii* in spring to their summer roosts also support this view (Aellen, 1983), as there are no land masses or islands to the immediate south and west of Ireland with the exception of the Iberian peninsula where the species

is rare and was absent from records for 72 years before being relocated (Rodríguez-Munoz *et al.*, 1993).

The calls recorded and the behaviour patterns noted during spring in the present study are similar to those of mating groups of *P. nathusii* in autumn. Nathusius' pipistrelles establish mating territories to acquire harems immediately prior to the mating period (Gerell-Lundberg & Gerell, 1994) whereas, in contrast, male common pipistrelle bats (*P. pipistrellus*) set up territories up to 2 months before the commencement of mating (Gerell-Lundberg & Gerell, 1994). The earlier (end of July and August) and shorter mating period of the Nathusius' pipistrelle is therefore presumed to be an adaptation to south-westerly migrations which start in September (Gerell-Lundberg & Gerell, 1994). While springtime mating is rare in bats, it is feasible that the migratory behaviour of *P. nathusii* may compromise time available for mating. If Irish populations of *P. nathusii* are migratory it is possible that the short mating period of Nathusius' pipistrelle (Gerell-Lundberg & Gerell, 1994), combined with the migratory nature of the species and the energetic requirements of individuals to attain sufficient body fat reserves for hibernation may leave a proportion of females unmated in autumn. The social behaviour observed in Ireland in springtime possibly reflects the attempt of male bats to attract and copulate with any female bats unmated the previous autumn or with females which mated then and subsequently stored spermatozoa in the uterus (Racey, 1979). The increasing evidence of sperm competition in bats (Mayer, 1995) makes it feasible that mating may carry on into springtime, providing new viable spermatozoa to increase intra-uterine sperm competition.

It is known that Nathusius' pipistrelle is capable of undertaking long distance migrations between summer and winter roosting sites (Strelkov, 1969). Records of bats being located on North Sea oil platforms (P.A. Racey, pers. comm.) and the recovery of banded individuals (Lina, 1990) provide evidence of the migratory capability of the species. The south westerly direction of these autumn migrations (Strelkov, 1969; Heise, 1982) has long been noted and it is likely that Ireland, given its position on the west of Europe, may be the end point of many of these migrations.

The occurrence of maternity colonies of this species in Ireland has not previously been noted. However there is increasing evidence of a westerly spread of *P. nathusii*. Since the discovery of *P. nathusii* in Britain in 1940 (Herman, 1992) there have been 27 documented records of *P. nathusii* identified in the hand (Stebbins, 1970; Speakman *et al.*, 1991, 1993), and a few unsubstantiated bat detector records, including one in summer in Scotland (Rydell & Swift, 1995). The maternity colony discovered in Ireland is the most westerly located to date, and evidence of a possible expansion into the U.K. is supported by the recent observations of *P. nathusii* in Northern Scotland, in an area where extensive research on *P. pipistrellus* has been carried out for many years, and the species is unlikely to have been overlooked. In

the Netherlands maternity colonies have only come to light in 1994 (Kapetyn & Lina, 1994). The rediscovery of the species on the Iberian Peninsula after a 72 year absence (Rodríguez-Munoz *et al.*, 1993) also supports this theory. This evidence supports a recent spread in the distribution of *P. nathusii*. However, this theory is not yet substantiated and the apparent population increase and assumed westerly spread may simply reflect the increasing amount of research carried out on bats and the related improvements in the technology developed to study them.

The present study indicates that at least some males of *P. nathusii* remain in Ireland all year round. In continental Europe Nathusius' pipistrelle is typically migratory, enabling the species to avoid extreme winter conditions at summer breeding sites. Britain, and especially Ireland, have mild winters and it is possible that the bats may give up their migratory behaviour, and settle for a more sedentary lifestyle. The migratory tendencies of the species may decrease as they occur further west, and the requirement to migrate to warmer overwintering sites in order to survive winter conditions becomes less critical. If this is indeed the case the predisposition of the species to migrate in winter and summer may differ markedly on the eastern and western extremes of the species' range, varying according to the severity of winter conditions encountered at summer breeding sites in each area.

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