Mammal Notes
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A pilot study of a method to monitor hedgehogs (*Erinaceus europaeus*)

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Introduction

There is evidence from a number of sources that hedgehogs have been generally declining in the UK (Battersby, 2005). Analysis of national counts of road kills suggests an overall decline in hedgehog numbers of about 15% from 2001-2008 (PTES, 2009). However, trends vary greatly between regions, urban and rural environments and the specific factors driving decline remain unclear (Dowding, 2007). Hedgehogs are now a UK Biodiversity Action Plan priority species and The Mammal Society has been proposed as Lead Organisation in a recent action document (JNCC, 2008).

There is currently no simple, standardised field survey method either for long-term monitoring of hedgehog populations or for assessment of populations in individual sites. The method described here has been designed to allow volunteers with limited expertise and equipment to assess hedgehog presence within a site and to obtain a semi-quantitative index of abundance. In early 2009 a pilot study was established using a relatively small number of volunteers with three main aims:

- To test the field methods, protocol and relevant documents (guidelines, risk assessment, *etc*.) for clarity and ease of use.
- To establish basic recording rates for hedgehogs, especially the likelihood of zero detection.
- To set up and test the procedures for data transfer to The Mammal Society as well as data storage and analytical methods.

Methods

The field method was piloted over a five month period; May to September 2009. Each volunteer was asked to visit their site five times, once each month, with at least two weeks separating visits. Volunteers were allowed to choose their own sites, within which they located a survey route approximately 1km in length. The sites were chosen to be practical, safe and convenient to reduce volunteer drop-out. The routes were located in green open spaces (such as parks, farmland or golf courses) with good visibility and were as linear as possible to prevent double counting. Routes encompassed suitable habitat (such as woodland edges or hedgerows) and avoided features such as water courses.

The survey route was divided into ten sections, approximately 100 metres in length, with a stopping point at the end of each section, where possible at a suitable, prominent feature. During each visit volunteers were asked to walk the whole route shortly after sunset, wait five minutes and then return along the route to search for hedgehogs. In this way, they could ensure that no obstacles had appeared along the route and they would finish the walk in darkness nearest to their home or car. Each 100m section was walked slowly, listening and

looking for hedgehogs, using a small hand-held torch for guidance. A one million candle-power spotlight was used to illuminate any suspected hedgehogs.

Only confirmed sightings constituted a positive record, which were recorded as small (juvenile) or large (sub-adult/adult). Sightings of badgers (*Meles meles*), foxes (*Vulpes vulpes*) and deer were also recorded. At each stopping point the volunteers paused for four minutes and recorded hedgehogs and other species in the same way.

Volunteers were asked to record the start and end times of their walks, the temperature, and wind and rain conditions on three-point scales. On a separate visit, volunteers also recorded the grid references of the stopping points and the major habitat types on either side of each section, based on UK Phase I Habitat Survey categories.

Results

Site-visits

A total of 30 sites were surveyed comprising 97 monthly visits. The number of visits per month across all sites was consistent (Table 1a), although there was a slight decline during the five month period. In contrast, the number of visits per site (Table 1b) varied from only one visit, all four of which were in May, up to five visits in seven of the sites. Sites were well distributed around England, but there were only two sites in Scotland and one each in Wales and Ireland (Fig. 1). Although there did not appear to be any pattern in the distribution of sites, it should be noted that ten of the sites were within 10km of the coast, which may reflect an unknown variable affecting volunteer recruitment.

Table 1. a) The number of visits per month across sites and b) the frequency of visits per site.

a)	Months	*May*	*Jun*	*Jul*	*Aug*	*Sep*
	Frequency	22	22	17	17	19
b)	Visits per site	*1*	*2*	*3*	*4*	*5*
	Frequency	4	6	6	7	7

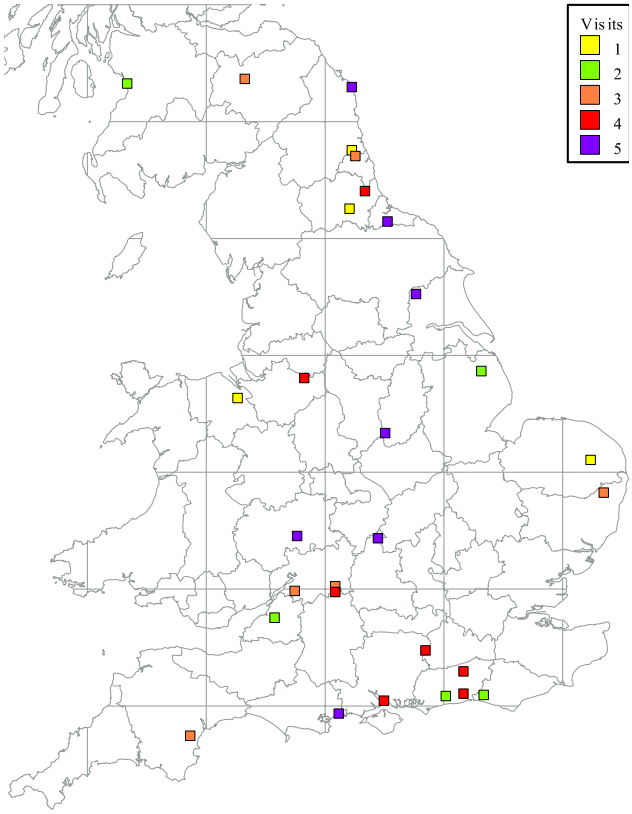

Fig. 1. The distribution of sites (excluding the one site in Ireland) colour coded for the number of visits.

Hedgehog sightings

A total of 16 hedgehogs were recorded during the 97 site-visits. These sightings were made on 14 visits to seven sites, meaning that no hedgehogs were recorded in 77% of sites. Consequently, the sightings were reduced to binary presence/absence data for a site-visit. However, the severely non-orthogonal nature of the data precluded successful model building using generalised linear models, so each of the two methodological factors were tested separately using contingency tables. Month was found not to have an effect on the incidence of positive visits (maximum-likelihood $\chi^2_{(4)} = 6.68$, $p = 0.154$) but the site effect was significant ($\chi^2_{(29)} = 47.4$, $p = 0.017$). However, as site was completely confounded with volunteer, this may have been an observer rather than geographical or spatial effect.

Start time varied between 18:00 and 22:39 and time spent searching ranged from 17 minutes to 2hrs 6 minutes. These data were standardised against monthly means to test for the effects of unusually early or late starts, or deviations from mean time spent searching. Neither of these two methodological variables had a significant effect on the likelihood of recording hedgehogs (using a GLM with a binomial error term and logit link function, start time; $p = 0.302$, time searching; $p = 0.218$). Of the three weather variables, rain was only recorded for a few sections during three site-visits, so could not be analysed as a predictor. Neither of the other two weather factors were significant predictors of hedgehog presence (temperature; $p = 0.394$, wind; $p = 0.459$).

Habitat categories were recorded for 918 section-visits, of which 437 had two different habitats on either side of the section. The habitat codes for the remaining 481 were duplicated to represent the same habitat on either side of the survey route, yielding a total of 1836 data belonging to 25 categories (Table 2). The most frequently recorded habitats were hedgerows and amenity grassland, followed by arable, built-up areas, broadleaved woodland and improved grassland. Three habitats (scattered scrub, parkland and semi-improved grassland) formed a block of moderately well-used habitats, with the remaining 16 habitat types each comprising fewer than 3% of sections. Contingency table analysis showed that there was a highly significant difference in the presence of hedgehogs between habitats ($\chi^2_{(24)} = 124$, $p \approx 0$). Sub-dividing the chi-squared analysis showed that this was entirely due to the higher than expected occurrence of hedgehogs in built-up areas (without this category the contingency $\chi^2_{(23)} = 21.9$, $p = 0.530$).

Other species

Three other species were recorded, one of which, foxes were seen more frequently than hedgehogs (Table 3). Most importantly, combined sightings of all species were made on 19 sites representing 63% of sites.

Table 2. Breakdown of presence / absence of hedgehogs by habitat-section.

Habitat	*Absent*	*Present*	*Total*
Acid grassland	50		50
Amenity grassland	210	1	211
Arable	190		190
Bare ground	10		10
Bracken	26		26
Broadleaved woodland	173		173
Built-up area	169	21	190
Calcareous grassland	26	1	27
Coniferous woodland	10		10
Dense/continuous scrub	12		12
Dry ditch	4		4
Fence	10		10
Heathland	16		16
Hedge	229	2	231
Improved grassland	170		170
Marsh	6		6
Mixed Woodland	43		43
Neutral grassland	33		33
Other	5		5
Other tall herb and fern	41		41
Parkland/scattered trees	122		122
Quarry, spoil, etc	24		24
Scattered scrub	129	3	132
Semi-improved grassland	96	2	98
Wall	2		2
Total	**1806**	**30**	**1836**

Discussion

This pilot was successful in that 30 volunteers were successfully recruited with a good geographical spread, covering a wide range of habitats. Although a few dropped out after the first month, the majority completed at least three visits and the temporal spread of visits throughout the five month study was fairly uniform. Consequently, and despite the biases introduced by the subjective selection of sites and habitats, we consider the overall findings of this pilot to have general relevance to a method for assessing hedgehog presence.

Table 3. Records of other species (including hedgehogs for comparison).

	Counts				*All*
	hedgehog	*badger*	*fox*	*roe deer*	*species*
Individuals	16	9	25	10	60
Sites	7	3	12	6	19

The hedgehog encounter rate was lower than expected, with animals only being recorded on seven sites on 14 occasions. The method clearly does not provide a quantitative index of abundance or activity. It may be that by increasing the route length to, say, 2km, and increasing the number or duration of visits, would raise the encounter rate.

However, it is not likely that this would be sufficient to reach a useful quantitative measure and a longer walk may also deter long-term volunteer participation. The concentration of records in a few sites and the important finding that hedgehogs were significantly more likely to be found in built up areas, suggests that hedgehogs really are absent from many parts of the countryside, especially open farmland. It just may not be possible to use extensive monitoring methods for these populations. However, it is encouraging that this method does not seem to be susceptible to weather conditions, nor influenced by methodological factors such as month, start time or duration.

The very low rate of hedgehog encounters probably reflects a real low level or absence of local populations. Consequently, it is proposed that with some modifications and the inclusion of additional species to encourage volunteer participation, this technique could provide a more general "crepuscular" survey method. In this case the hedgehog would be just one of several nocturnal species being recorded, which would be a more cost-effective monitoring tool in terms of the amount of useful survey data yielded.

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