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**Winter Mammal Monitoring**  
**– a pilot study**

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# 1. Executive Summary

## **Introduction & Methods**

Winter Mammal Monitoring (WMM) is a pilot survey run by the British Trust for Ornithology (BTO) and The Mammal Society for three winter field seasons (2001/02 to 2003/04). The project is funded by Defra, and aims to test the feasibility of using a volunteer-based UK-wide multi-species survey of winter mammals to monitor population trends in a suite of target species.

WMM has two components: a sightings survey to record the numbers of readily-detected and identified mammal species, and a field signs survey to record evidence of the presence of a target suite of mammals whose field signs can be identified by volunteers.

The primary sampling unit is the 1km OS grid square. Both components were carried out along line transects of between 2 and 3km in length. During the first year, sighting surveys were carried out between October and December, and field sign surveys between January and March. In the following years, both surveys were carried out between October and March (with few exceptions).

Volunteers were provided with recording forms, instructions and maps of their allocated square. They were also provided with information on how to identify the target mammal species (e.g. roe deer, fallow deer) by sight, and the field signs of the target species (e.g. badger latrines, molehills). Volunteers were asked to return forms to the BTO or The Mammal Society, by post, for inputting and analysis. During the three years of the project, four different newsletters were sent to current and potential volunteers, thanking them for their participation and providing some preliminary results.

At the start of the project, three species (brown rat, field vole and harvest mouse) were included in the list of field sign species and recording protocols were developed for these species. Between the first and subsequent seasons, the recording of field signs of two species groups (squirrel dreys and deer slots) were dropped, mainly because they were non-specific but also because of difficulties in detection and identification. Recording field signs of dormice (chewed hazelnuts) was also dropped, mainly due to the small amount of data collected in the first year

## **Results**

### **Volunteers**

Over the three field seasons, 907 volunteers carried out at least one survey (just under half of potential recruits that requested forms and were assigned a square). Of these, 553 carried out at least one sightings survey and at least one field signs survey. A small number of particularly dedicated individuals (18) carried out at least six different surveys over the three years of this project. Overall, 176 volunteers undertook either sign or sighting surveys on more than one site.

Based on the questionnaire, 60% of volunteers were male and 40% female. Only 7% of respondents had previously taken part in surveys for The Mammal Society, but more than 50% had previously taken part in surveys organised by the BTO or other organisations. Fourteen percent had taken The Mammal Society's *Look Out for Mammals* training course.

## Sites

In total, 1121 sites were surveyed on at least one occasion using either method. Sightings were recorded in 1043 and field signs on 690 sites. Both methods were used on 612 sites. The majority of sites were in England (885), with lower numbers in Scotland (132), Wales (98), the Isle of Man (2) and Northern Ireland (4).

Although square allocation included a random element to minimise bias towards preferred sites, the geographical distribution of volunteers and the likelihood of their take-up of allocated squares inevitably resulted in unequal coverage across regions and landscape types. This means that landscapes such as lowland arable land were over-represented, whereas upland, montane and coastal landscapes were under-represented.

## Site Turnover

The turnover rate for both sightings and field signs surveys was high. For sighting surveys, the proportion of sites revisited was 36% between the first and second winters and 49% between the second and third winters. Only 15% were surveyed for sightings in all three years. For the field signs survey, the proportion of sites revisited was 44% between the first and second winters and 47% between the second and third winters. Only 17% were surveyed for field signs in all three years.

The main factors positively influencing rate of revisit are: i) previous commitment, ii) the proportion of sightings or field signs detected, iii) number in the party, iv) the diversity of habitat along the route, v) the proportion of woodland or grassland habitat, vi) the proportion of transects along waterways, vii) participation in The Mammal Society's other surveys, and viii) age of volunteer. The only other significant effects were a higher tendency for sightings surveys to be abandoned after the first season, and a lower revisit rates from volunteers listing their occupation as academic.

Sites that had been visited previously were more likely (57%) to be revisited than those for which there was no previous visit (39%). Overall, there was no effect of the year that the survey was done, but after the first season, a larger proportion of sites where sightings were recorded in the first season were not revisited, compared to those surveyed for field signs. Sites where a high proportion of sections had sightings or signs were far more likely to be revisited than those with a low proportion.

## Species coverage

Excluding records of species that were non-specific, domestic animals, feral cats and free-roaming dogs, 29 species were recorded during the Winter Mammal Monitoring sightings survey. Only 11 species (excluding cats and dogs) were seen at least 10 sites. Species such as red squirrel, badger, stoat, weasel and smaller mammals were sighted at very low rates. For the field signs component, the original target species were badger, fox, mole, rabbit, squirrels, and hedgehog. Hedgehogs are not generally active in the winter and hence were dropped from the list of target species. Three species (brown rat, field vole and harvest mouse) were added to the list of field sign species and recording protocols were developed. Results showed that brown rat and field vole could be monitored by these methods but that harvest mouse signs were detected at too low frequencies. In the first year, we also trialled the recording of squirrel dreys, deer slots and hazelnuts chewed by dormice. After the first season,

these were all dropped, the first two because they were non-specific, and the dormice hazelnuts because of very low rates of detection.

## Statistical Methodological Assessment

### *Power analyses – assessing the survey’s capacity to detect population change*

The crucial question is whether WMM will be able to provide information on changes in abundance of the target mammal species that can be used in conservation assessments (e.g. red listings, species of conservation concern) and with sufficient confidence in the measured changes. This assessment should take into account the magnitude of change that is thought to be an appropriate threshold (e.g. a 25% decline), the statistical power to detect a particular change, and the sample size. These will differ between species, between sightings and field signs, and the measures of abundance used (presence in the square, proportion of transect sections occupied, counts). Our assessment of our capacity to monitor each species is based on power analyses.

We carried out simulations using the empirical WMM data (the proportionate change between years) to determine the minimum detectable change (MDC) that could be detected for a given significance level and power from a range of sample sizes. This was carried out on both a matched dataset (where there were repeated visits to the same site) and an unmatched dataset (treating years as independent samples), yielding a series of graphs from which the MDC for a range of sample sizes could be extracted.

For sightings, the analyses based on repeat visits, using the proportion of transect sections in which the species was recorded, proved to be most powerful and hence those results are presented. The sightings data showed that for seven species (rabbit, brown hare, fox, grey squirrel, roe deer, fallow deer – and possibly muntjac), a decline of 50% and an increase of 100% could be detected with a WMM sample of 500 sites, with 95% confidence. Moreover, for two species (rabbit and grey squirrel), it would be possible to detect a decline or an increase of only 25% with 500 sites, with 95% confidence. If the sample of WMM squares was increased to 750-1000 sites, we would also be able to detect a 25% change in the abundance of fallow deer. However, it should be noted that ‘abundance’ in this context, and for field signs, strictly refers to changes in the proportion of transect sections with positive records of sightings (or signs) and not necessarily to the magnitude of change in numbers of animals.

The power analysis of field signs data showed that a change of  $\pm 25\%$  could be detected for all signs except harvest mouse nests, with a sample size of 600 or less. Furthermore, for five species (brown rat, fox, field vole, mole and rabbit) sample sizes of 250 would be sufficient to achieve MDCs of this size.

With respect to monitoring mammal populations in different regions, it seems that sample sizes in some of the Scottish environmental zones are adequate (30-60 sites per zone) to detect large changes (declines of 50% or increases of 100%) for species such as field vole, mole and rabbit (using field signs) or grey squirrel and rabbit (using sightings). It should be possible to monitor a number of species in Scotland overall, as well as in the three England and Wales environmental zones.

The power analyses also highlighted three important methodological factors. Firstly, the sample sizes required to show a given change using signs were always much smaller than the sample required for sightings. Although this was only based directly on two species (foxes and rabbits), the pattern was evident throughout the power analysis. Secondly, a sampling strategy based on repeated visits to the same site, compared to randomly drawing samples of new sites each year, was much more powerful. In 94% of comparisons, the sample sizes for independent samples were larger than those required for repeated-measures, in many cases four or five times larger.

## Comparison with the Breeding Bird Survey

### *Numbers and occurrence*

The BTO/JNCC/RSPB Breeding Bird Survey (BBS) is a volunteer-based UK-wide survey organised by the BTO with RSPB and JNCC, running since 1994. In 1995 the BTO expanded its scope to collect information on mammals as well. BBS observers were asked to record counts of all mammals seen during their visits, and any evidence (such as field signs) of their presence. Approximately 85% of ca. 2000 participants provide this information annually. There is, therefore, considerable overlap in the species covered by both surveys, particularly for widespread species such as rabbit, brown hare, roe deer, muntjac, fallow deer, grey squirrel and red fox. However, WMM surveyors recorded almost no hedgehogs, which hibernate much of the winter period.

Of the species counted, absolute numbers of rabbits and brown hares were significantly higher during the summer BBS than during the winter WMM surveys, whereas numbers of grey squirrel and roe deer were higher during the winter compared to at least one of the BBS visits (early or late). None of the other species showed any significant differences. However, of species compared using evidence from field signs, rabbit, brown rat, fox and mole (the latter only in year 2) were detected more frequently during the winter than the summer. This is most likely due to the dedicated effort to search for field signs on WMM surveys. There is no standardisation of effort in BBS, but it has been possible since 2002 to distinguish between evidence based upon field signs, dead animals, visits other than the counting visit and local knowledge. With the exception of fox signs, which were recorded in fewer squares in the second winter, there were no differences in frequency of occurrence between the two years of the survey (BBS or WMM). There were also no marked differences in frequency of occurrence between matched and unmatched datasets.

### *Comparing annual changes between WMM and BBS*

We found no significant differences in the inter-annual rates of change between WMM and the BBS (either early or late) for the seven species that could be compared by sightings (rabbit, brown hare, fox, fallow deer, muntjac, roe deer and grey squirrel). Only grey squirrel showed a consistent pattern – an increase – across surveys. However, because of small sample sizes and high variance, our capacity to detect differences was low for most species. Although the direction of the trends sometimes differed between winter and summer surveys, the only evidence of a significant difference was for brown hare, based on the matched dataset, and this was

a very marginal level of significance. Based on field signs, foxes appeared to be less common during the second winter (but not the second summer) but there were no differences in the results based on field signs for any other species. Differences, whether significant or not, might be expected due to real changes in the numbers (e.g. adults during the winter versus adults and offspring during the summer) as well as differences in the direction of change of key environmental factors (e.g. food supply) between the two seasons.

### Factors influencing measures of abundance for each species

Single species models using data from sites over all three field seasons provided information on parameters, both environmental and methodological, that influenced measures of abundance. These differed among species, but there were some broad patterns. It is important to note that for species with few data (e.g. muntjac), it is difficult to detect the influence of as many different factors. The results of the single species models can be compared to the analyses of factors using the general mammal response variable. However, although the latter is likely to be particularly useful in assessing the influence of the results on volunteer behaviour, it is less relevant to the assessment of variables such as habitat, because the relationships with many environmental factors are likely to differ across species.

Of four target species monitored solely using field signs, duration of survey had a positive effect on the proportion of transect sections with field signs for badger and rat but not for mole or field vole. Start time was important only for field vole, and number of observers was important only for mole. Latitude had an effect on badger, mole and rat (all were more abundant further south). Longitude had an effect on all four species, with badger and field voles more abundant in the west and rats and moles more abundant in the east. No weather variables had any effect. Habitat diversity had a positive effect on all four species, and all were influenced by habitat type. Three species were influenced by the presence of one of the linear features, but all differently. There was no effect of year or month.

Of five target species monitored in sufficient numbers to detect biologically important changes in abundance, duration influenced the number of sightings of squirrels and hares but had no effect on sightings of any of the deer species. Year and month influenced sightings of grey squirrel, and number of observers influenced positively sightings of muntjac. Latitude influenced four species, with roe deer, fallow deer and squirrels more common in the south, and brown hares more common in the north. Longitude also had an effect on four species. Habitat diversity positively influenced numbers of squirrel, hare and muntjac, and habitat type influenced numbers of all species. Four species were influenced by weather variables.

Two species (fox and rabbit) were monitored by both sightings and field signs, and additional models were run to test for the effect of survey type and its effect on year and other variables. Rabbit sightings were recorded in a significantly lower proportion of sections than signs (burrows). Both measures were positively related to duration and habitat diversity but not to year, month, start time or observer number. Farmland-related landscape types and the presence of hedges had a significant positive effect. Survey type interacted with start time, with more sightings but not field signs recorded on routes started later in the day.

Fox sightings were also recorded in a significantly lower proportion of sections than their signs. There was no effect of year overall but this differed between surveys.

Sightings were significantly lower in the third year but there was no difference in the frequency of signs. A significant seasonal effect was evident, with the proportion of transect sections containing foxes or their signs increasing throughout the winter. No significant effect of either number of observers or start time was identified, but duration had a significant positive effect. Fox sightings and signs were greatest in lowland England and Wales and at lower latitudes. There was no effect of habitat diversity or linear features but sightings and signs were greater at sites with higher proportions of rough grassland or woodland.

Overall, of the methodological parameters, duration had a positive effect on detection of the two more cryptic field signs (badger latrines/setts and rat burrows) and sightings of the smaller species (squirrel and brown hare). Number of observers had little overall effect, and, surprisingly neither did the month in which the survey was carried out (except for grey squirrel). Weather variables had no effect on the detection of any field signs and little effect on sightings. Where they were significant, no more than one weather variable was retained in the model, and these showed that brown hare, grey squirrel and muntjac were more often seen on colder or less rainy days.

Of the spatial and habitat parameters, latitude and longitude were clearly important for most species – reflecting both east-west and north-south gradients in abundance. In general, these confirm the spatial patterns of abundance revealed by previous bespoke surveys of these species, such as for brown hare and badger, or the known distribution of the species, e.g. muntjac. Habitat diversity had a positive effect on all measures except for deer sightings, and most species showed some preference for particular habitats (e.g. woodland or arable land). At least one of the linear features was important for field signs of three species, as well as for sightings of grey squirrel and brown hare. Environmental zone was difficult to assess in the full models because it was confounded with latitude and longitude. When these variables were removed from the models, environmental zone was important for most species, reflecting the known distributions of the species.