Mammal Notes
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Surveying hazel dormice (*Muscardinus avellanarius*) with tubes and boxes: a comparison

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Introduction

Nest boxes designed for hazel dormice (*Muscardinus avellanarius*), with the entrance hole facing the trunk, were first used in the UK in the late 1980s (Morris *et al.*, 1990) when they were shown to be a successful method of studying the species. They also appeared to enhance the habitat, since higher numbers of dormice were caught in traps (described in Morris &Whitbread, 1986) in areas where nest boxes were present than in areas where they were not. Since then nest boxes have become a standard method for long term studies of dormice, and have been used for the National Dormouse Monitoring Programme from 1991 to the present (Sanderson, 2004), as well as being recommended as a means of habitat enhancement by increasing potential nesting sites (Bright *et al.*, 2006).

Nest tubes were first described several years later (Morris & Temple, 1998). They were originally used as a means of catching and thereby controlling the edible dormouse (*Glis glis*). A modified version of the tube was later designed for hazel dormice, being somewhat smaller (ca 50mm x 50mm in cross section). These can now be purchased from a number of outlets in the UK (e.g The Mammal Society) and are accepted as a standard method for dormouse surveys (Bright et al., 2006). They are not normally used by breeding dormice, although litters are occasionally found (Andrew McCarthy, two instances, personal communication; Paul Chanin, one instance, personal observation).

In general, being much heavier and more expensive, boxes are better suited to long term studies and monitoring programmes such as the National Dormouse Monitoring Programme (Sanderson 2004). Tubes are quicker and easier to deploy but are less robust, so are mainly used for short term surveys to detect the presence of dormice, often in connection with development, as described in the Dormouse Conservation Handbook (Bright et al., 2006). Chanin & Woods (2003) showed that use of nest tubes by dormice varied through the year with peaks in May and September. This enabled them to publish a method for assessing survey effort using correction factors depending on the probability of encountering dormice or their nests in a particular month. Relative probabilities were based on the results from their study. Months with a high probability of finding dormice, or newly built nests, have a high score (e.g. 4 for May, 7 for September) months with a low probability attract a low score (e.g.1 for April, 2 for July). Totalling the scores for the months when tubes are deployed (corrected for the number of tubes) provides a value for survey effort.

There is also seasonal variation in nest box use, with use during July and August being lower than in either May-June or September-October (Sanderson, 2004). This variation is believed to indicate a preference for using natural nesting sites during periods when the use of boxes is low (Morris *et al.*,

1990), but might also reflect differences in dormouse activity.

For example, Bright and Morris (1991) found that dormice forage more in the canopy in June and August and in the shrub layer during May and July. Both tubes and boxes are normally placed low down within easy reach of surveyors (<2m above the ground) but more distant from where dormice are active at those times. Chanin et al. (2003) recorded dormice in fewer deciduous woods than expected when surveying with nest tubes and considered that dormice in this habitat might be less likely to use tubes than those in scrub, hedges or other habitats where natural cavities are scarce. Despite this, at present, nest tubes are recommended as a method of detecting the presence of dormice where development is planned (Bright et al., 2006).

Both box and tube use therefore is influenced by season, type of dormouse activity and by the presence or absence of suitable, natural, alternative sites as well as by dormouse abundance. However, to date, no direct comparison of the use of tubes and boxes in the same habitat has been published. We describe here the results of a four year study of dormice in a fragmented habitat in south west England where we used both. The aim of the study was to investigate the way dormice used this fragmented habitat and whether or not we could detect them crossing the road. However our sampling involved both boxes and tubes so we were also able to compare use of these two types of artificial nesting site in the same habitats. In this paper we compare the patterns of use of tubes and boxes by dormice to see whether it differs and, if so, what consequences this has for using the two methods to study the ecology and the distribution of the species.

Methods

Our study site in southwest England, UK stretched along two kilometres of the A30 in Cornwall, five kilometres to the northwest of Bodmin (between grid references SX 094696 and SX 109708). The road is dual carriageway with narrow strips of woodland and scrub, less than 20m wide on the central reservation. The study area was limited to land designated as highway, mostly within 20m of the road edge.

The habitats consisted of semi-natural woodland, plantation (including broadleaved as well as coniferous species) and scrub beside the road and on the central reservation (see Table 1).

Table 1. Area and habitat type of each section

Section	Approx Area (ha)	Habitat Description
S1	0.5	Small young woodland plot. Mostly birch, pine and sycamore surrounded by gorse and bramble.
S2	0.4	Scattered scrub comprising gorse, bramble and pockets of hawthorn.
S3	0.2	Dense scrub comprising tall gorse, hazel and hawthorn.
S4*	10	Mostly young blackthorn thicket close to the road. Much of this is outside the highway boundary.
C1	0.3	Tree plot with ash and hazel predominantly, surrounded by gorse and bramble.
C2	0.9	Linear tree plot in central reservation with ash and sycamore being the main species and occasional oak, hazel and hawthorn. Gorse and bramble is found at localised areas throughout this plot.
C3	0.7	Long plot of linear willow, hazel and hawthorn with occasional gorse and pockets of bramble.
N1	0.3	A fairly open area at the eastern end of the plot with localised areas of gorse and scattered oak, willow, hawthorn and bracken changing to dense gorse and blackthorn/hawthorn thicket to the west.
N2	0.7	Mature hazel, willow and stunted oak from a remnant hedgerow dominate this section together with occasional gorse, blackthorn,

		bramble and honeysuckle.

*connects with suitable habitat outside survey area.

Some of this is continuous with vegetation outside the highway boundary, which is suitable for dormice but there were several isolated fragments of potential dormouse habitat which could not be reached by dormice without crossing the ground. This includes three separate sections on the central reservation of the A30. All isolated habitat fragments except one were less than 1ha in size (Table 1).

Nine fragments of dormouse habitat, referred to as 'sections, were numbered sequentially from east to west with a prefix letter referring to their location on the north side of the road, south side, or central reservation (N, S, C respectively) see figure 1.

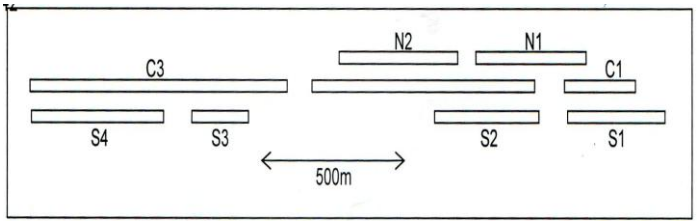

Figure 1. Schematic layout of sections with width not to scale.

We used 100 dormouse nest boxes as our principle means of sampling the population, since we wished to monitor all aspects of dormouse behaviour, including breeding. These were spaced at intervals of 30m along the length of the road. In the hope that it would increase the probability of finding dormice we also installed 200 tubes, interspersed with the boxes at a spacing of 10 metres. Thus at every 10m there was either a box or a tube in a linear pattern of box-tube-tube-box-tube-tube-box.

The site of each box or tube was determined by pacing out the appropriate distance and selecting the nearest suitable fastening point. As boxes are easier to fix to vertical stems and tubes to horizontal branches, these points were not identical. However the range of tree and shrub species selected for each was determined by what was available at each point and these were broadly similar.

Boxes and tubes were installed in March 2007 and checked monthly from April to October in 2007 and 2008. In 2009 and 2010 checking ended in September as no dormice had been recorded in October in the previous years. Dormice were marked on first capture with radio-frequency identification tags, also known as PIT tags (FDXB - 8mm tags manufactured by pet-iD UK Ltd) under the terms of appropriate licences from English Nature and Natural England. Captured dormice were scanned with an 'iDentifier' (manufactured by pet-iD UK Ltd) weighed, sexed and their reproductive condition assessed.

Nests with no animals present were also recorded and a note was made of the species likely to have constructed them. Identification of dormouse nests was made on the basis of the description in Chanin et al. (2003). Most boxes were only checked once per month but on a few occasions checks were spread over two days when a large number of animals had to be handled. When this occurred, small numbers of boxes and tubes which had been occupied on the first day were rechecked on the second to determine whether occupancy had changed overnight.

Results

Excluding dependent young, a total of 110 dormouse 'captures' were recorded and 62 animals marked. Thirteen dormice were found in tubes and three of these were also caught in one or more boxes. The other 10 were detected only in tubes. No animal was caught more than once in a tube, although 19 dormice were caught more than once in a nest box (mean of 1.67 captures per animal in boxes). A high proportion (69%) of the dormice in tubes were found in just two months, four in April 2009 and five in May 2010.

We found that nests in boxes were frequently used over a number of months (maximum five) sometimes by a number of different dormice. Tubes were only found to be occupied in the month a nest was first recorded, but on two occasions when some tubes were checked on consecutive days, a different animal was present on the second day

A further 17 dormouse nests were recorded in tubes with no dormice present. Combining dates when tubes were occupied with dates when tubes with

dormouse nests only were first detected, provides a sample of 30 records for comparison with records of dormice found in boxes. Figure 2 shows that the seasonal pattern of use differs between boxes and tubes. Tubes were mainly used in April and May with a second peak in September. They were not used in June and July. Boxes were occupied throughout the part of the year when dormice are active but with a distinct peak in May. These differences are statistically significant (Chi^2 = 27.125; 6 d.f.; p = 0.0001).

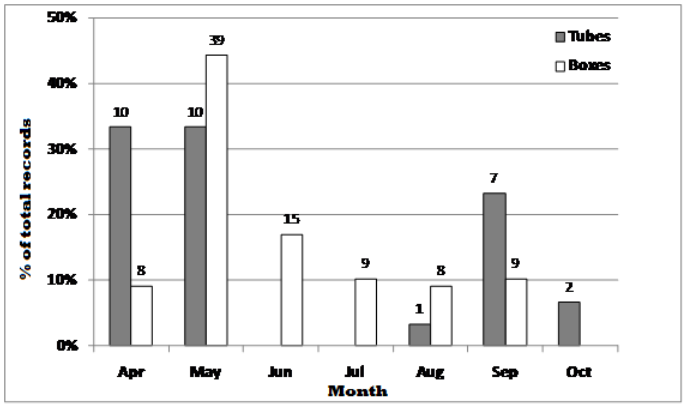

Figure 2. Seasonal changes in tube and nest box use. Boxes expressed as number of animals recorded each month as percent of the number recorded throughout the year (N=88). For tubes, values include number of dormice plus the number of newly constructed nests each month as percent of those occupied and constructed through the year (N=30).

No juvenile dormice were found in tubes and no breeding dormice. Six male and six female dormice were found in tubes but in boxes there were more than three times as many adult females as males. However the sample is small and the difference not significant (Chi^2 = 3.436; 1 d.f.;. p > 0.05). We also observed differences between areas (figure 3) with a higher proportion of tubes being used in section C3 and lower in C1 and N2, by comparison with box use. These differences are significant (Chi^2 = 26.901; 6.d.f.; p = 0.0002). Overall, taking into account the higher number of tubes, we were nearly 20 times more likely to find a dormouse in a box than in a tube. Nevertheless 10 dormice (16%) were only found in tubes and might not have been recorded if tubes were not used.

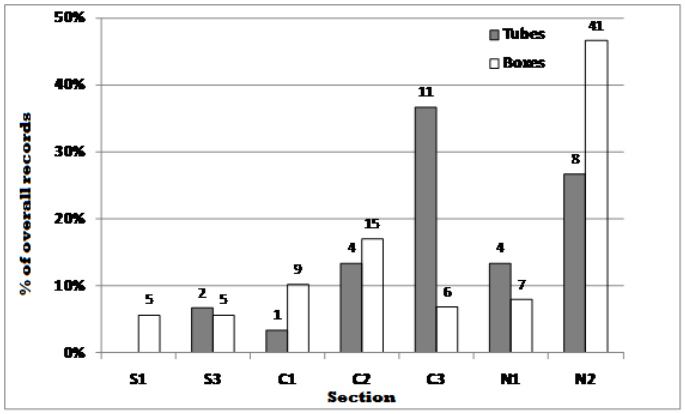

Figure 3. Variation in box and tube use for each section. Boxes expressed as number of animals recorded in each section as percent of the number recorded over the whole site (N=88). For tubes, values include number of dormice plus the number of newly constructed nests in each section as percent of the number recorded over the whole site (N=30).

Discussion

Although we did not provide a direct choice experiment by placing tubes and boxes side by side, we conclude that where both tubes and boxes are available dormice are more likely to use the boxes for most of the year. They show a stronger disposition to use tubes in April, May and September but only in the first and last of these months was the proportion of tubes used higher than the proportion of boxes. These correspond to the post-hibernation /pre-breeding period and the post-breeding period.

The seasonal and spatial differences in box and tube use show that the two techniques do not reveal the same patterns of behaviour. For example it would be inappropriate to use tubes for studies where information on breeding is needed. Conversely if there were a need to obtain information on dormice immediately post hibernation - tubes would be more suitable. Although no dormouse was captured twice in tubes, three dormice were caught in both boxes and tubes so it is not necessarily the case that different individuals show a preference for one or the other.

The seasonal pattern of tube use is broadly similar to that described by Chanin et al. (2003) but in the present study the spring peak is higher than that in late summer, whereas in the previous survey the reverse was true. Box use showed a strong peak in

spring but not a late summer/autumn one, as found in previous studies (Sanderson, 2004).

The peak in tube use in the spring may reflect the fact that dormice have just emerged from hibernation. At this time they do not require a nest site suitable for breeding, and may prefer to use a smaller cavity which can more quickly be filled with nesting material. Spatial differences in use are more difficult to explain unless it reflects differences in the likelihood of dormice breeding in different places. In C3 breeding was only observed during the first year of the study whereas breeding activity was detected in three out of four years in N2. It is possible that most of the dormice recorded in C3 were dispersing rather than resident and were therefore less willing to invest time in constructing the larger nest normally found in a box. One of the dormice in C3 was known to have crossed the road from section S3.

Implications

Sampling methods which involve animals responding to traps or artificial nest sites, run the risk of biasing results due to different behaviour or responses. For example, trap-shyness can affect animals as small as house mice (Crowcroft and Jeffers, 1961) and as large as tigers (Wegge et al., 2004). Similarly, the greater mobility of males amongst small mustelids leads to their being over-represented in trapping studies (Gerell 1970, King 1975).

Our results indicate that dormouse nest boxes and tubes do not sample populations in the same way, suggesting that the biases may differ between the two methods. Since 10 of the 62 dormice we marked were never recorded in boxes at all, it would be wise to assume that boxes do not detect all the animals present in an area. Although dormice use boxes throughout the season when they are active, they use tubes more frequently just after emerging from hibernation and in the post breeding period. Boxes therefore are most suitable for long term studies where information on breeding is important but additional information could be obtained if they were supplemented by tubes. Given the much higher proportion of boxes that were used, the question arises as to whether it is sensible to use tubes as a standard method of detecting the presence dormice as recommended by Bright et al. (2006) and Chanin et al. (2003).

Tubes are much lighter and cheaper than boxes and quicker to install and check. These are significant advantages for short term studies where intensive sampling over large areas may be necessary. In addition there is an established and accepted protocol for tubes which is calibrated for survey effort and permits the setting of a criterion for ‘adequate survey’ (Bright et al., 2006), but not for boxes.

In our study, dormice could choose between boxes, tubes and natural nest sites. Where the choice is between tubes and natural nest sites, tube use might differ, particularly in habitats other than woodland where natural cavities are scarce.

Conclusion

Our results show that dormice use nest boxes more frequently than tubes when given the choice between the two. Boxes were used by more dormice, for longer periods and breeding dormice were only found in boxes. Despite this, tubes have a valuable role in carrying out short term surveys where the aim is simply to determine whether dormice are present or not. However, adding a small number of nest boxes to a standard tube survey could increase the chances of detecting dormouse at a site or reduce the time taken to do so.

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