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Results and experiences from the South West Dormouse Project

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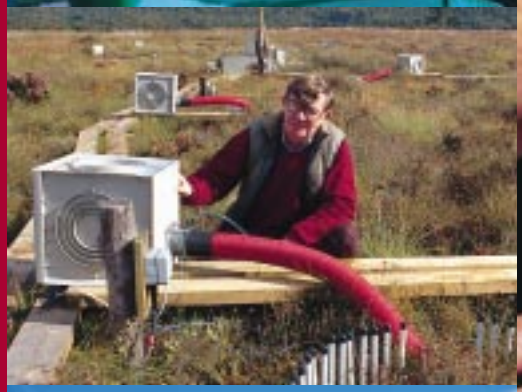

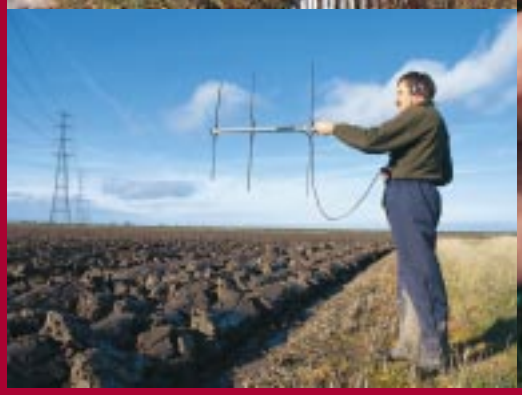

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Surveying dormice using nest tubes.
Results and experiences from the South West Dormouse Project

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Summary

In South West England dormice have been found in several habitats which are not normally considered to be suitable for them such as coastal scrub, Culm grassland and heath. Conventional surveying methods do not work well in these habitats, or in more 'typical' habitats when hazel trees are scarce. The recent development of plastic nesting tubes for dormice provides a means of carrying out surveys in these circumstances.

The aim of the South West Dormouse Project was to investigate the use of tubes for dormouse surveying. We wished to determine whether or not the use of such 'unconventional' habitats might be considered normal in South West England and to make recommendations for the use of nest tubes in systematic surveying.

Volunteers installed tubes in groups of 16 at 117 sites in Cornwall, Devon, Dorset, Somerset and Avon in March 2002. They checked them regularly for evidence of dormice from April to November inclusive. Habitats included various types of woodland, hedges, scrub and heath/grassland.

We recorded dormice at 32 sites covering all four main habitat types. New nests (and dormice) were found in every month from April to November. There was a small peak in nest building in May and a larger one in August and September. Dormice were known to be present at some sites where they were not recorded in tubes.

We found dormice at several sites with untypical habitats including coniferous woodland, Culm grassland, heavily managed hedges, gorse, birch scrub and low-growing coastal scrub.

On the basis of these results we have made a series of recommendations for planning, carrying out and interpreting nest tube surveys. We recommend that a minimum of 50 tubes should be used in systematic surveys but the length of time they are left out is less important than the time of year. We have devised a simple scoring system to take this into account and provide an index of 'effort'.

Practical advice on using setting and checking tubes in the field is also given.

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Introduction

The common or hazel dormouse (*Muscardinus avellanarius*) has traditionally been linked to hazel coppice and it is well known as a mammal that lives in semi-natural ancient woodland. It is also known to live in hedgerows, especially those that are rarely cut and which have a diversity of flowering and fruiting shrubs (Bright *et al.*, 1996; Bright and McPherson, 2002). The most frequently used method for detecting the presence of dormice is to search for the discarded shells of hazel nuts (*Corylus avellana*) which have been chewed in a fashion characteristic of this mammal (Hurrell and McIntosh, 1984; Bright *et al.*, 1996). This methodology has been used in three national surveys, The Mammal Society Dormouse Survey and two Great Nut Hunts, to good effect.

But dormice are increasingly being found in unexpected places such as hedgerows and scrub where hazel is absent (Eden and Eden, 1999), in gorse (*Ulex europaeus*) (this study) and in reed beds (*Phragmites australis*) (Crowden (via S. Eden); Boris Krystofek, (pers. comm.); Gorner, 1990). Detecting this internationally protected species in such diverse habitats requires the use of other survey methods and a number have been tried.

Nest searches. This is a time consuming method and can be physically difficult because it requires the surveyor to search through dense bramble and gorse thickets. Once found, a newly constructed dormouse nest can rarely be mistaken for anything else but it is easy to miss nests or to misidentify weathered ones. (Hurrell and McIntosh, 1984).

Hair tubes. This involves deploying short lengths of plastic waste pipe baited with suitably enticing food so that small mammals will squeeze into them. The ends are fitted with sticky tape to collect fur samples from the animals visiting the tubes. These samples are subsequently inspected under a microscope in order to identify which small mammals have visited the tubes. The main disadvantages are that a microscope is required to identify the hairs and this identification can be tricky while fewer than 30% of tubes are actually visited by any species of small mammal so that the uptake is low (Bright and Morris, 1989).

Live traps. The most successful traps appear to be home-made wire mesh cage traps which are set up in trees or scrub and baited with apple (Jermyn, Messenger and Birks, 2001). A licence is needed to trap for dormice (Bright and Morris, 1989). While they can be successful and identification is positive, setting and checking the traps is time consuming and they have to be set for a number of nights in order for a reasonable effort to have been made.

Dormouse nesting boxes. Nest boxes, which are put up specially for dormice, with the entrance holes facing the tree trunks to which they are tied, can be very successful and identification of a nest or mammal found inside can generally be positive. Boxes have a number of disadvantages such as cost, weight and difficulty with handling when putting them up, attractiveness to vandals and thieves and the possibility of them affecting the size of the dormouse population as they are readily used for breeding and can double a population in certain conditions (Bright *et al.*, 1996).

Dormouse nest tubes. An innovative idea designed by Dr Pat Morris, (Morris and Temple, 1998) they consist of a length of tubing made from light weight corrugated plastic and square in section together with a wooden tray which also forms the end of the tube. They are very useful in hedgerows, scrub and other habitats where tree holes and other alternative nesting sites are generally absent. They are cheap, so can be used for extensive surveys, they do not look valuable and are rarely stolen and they are very light to carry into the field. Their size is such that they are rarely used for breeding.

The nest tubes for common dormice are 250mm long and 65mm square. The wooden tray extends beyond the end of the tube by 55mm. They are fastened under suitable horizontal branches using garden wire. They have proved very successful as a survey method (Bright and McPherson, 2002) in habitats where dormice are not expected to turn up but there is, however, no accepted protocol for their use.

The Project

The South West Dormouse Project was established to try and achieve two objectives. The first was to survey systematically those places in the south west such as Culm grassland, coastal scrub and other sites with a low diversity of trees and shrubs were dormice were not expected to be found but where naturalists have reported finding them in the past.

The second objective was to find out more about tube use. In particular we wanted to know how long they need to be in place before dormice will use them, at what times of the year they are most likely to be used and after how much effort would it be reasonable to assume that dormice were absent? We believe that this information will be particularly useful to guide local planning authorities, environmental consultants and English Nature teams who, at times, need to know whether dormice are present in hedgerows, scrub or similar habitats

The participants were the mammal groups of Cornwall, Devon, Dorset and Somerset. The project was funded by English Nature with smaller grants being provided by Hanson Aggregates and Exmoor National Park. Avon Wildlife Trust used the same methods and their results are included here. Their work was funded by South Gloucestershire Council.

The Report

In the next three sections of this document we describe the results of the South West Dormouse Project, the methods used and our main conclusions. The fourth section includes our recommendations for using tubes as a standard survey technique based on the results of the survey and practical advice for surveyors based on field experience gained during the South West Project and other surveys. The Appendices include example recording forms from the South West Project, a form recommended for use in standard surveys, case studies and sources of additional information.

Methods

Site selection

It was not practical to pre-select sites and volunteers were asked to choose their own which, in most cases, were near their homes. In order to achieve a reasonable spread across habitats an attempt was made to ensure that volunteers selected from the following main categories: woodland, heathland, scrub, hedges. To some extent, organisers were able to select sites to complement those chosen. Volunteers who were professionally involved in land management, were encouraged to select appropriate and, sometimes, less popular habitats. For example most of the coniferous woodlands were surveyed by professional foresters.

The result of this was that reasonably large numbers of sites were surveyed for woodland (29), hedge (46), and scrub (32) but heathland sites (9) were few in number.

Installing tubes

Volunteers were instructed to install tubes during March when it was expected that dormice would still be hibernating. Sixteen tubes were set at each site spaced at 20m intervals. In 'two dimensional' habitats such as woodland, scrub and heath a grid system was used although it was necessary to allow flexibility where sites were not large enough or the wrong shape to permit a regular 4 x 4 (60m x 60m) grid. This proved to be particularly problematic in dense scrub where volunteers had to place tubes as best they could but not less than 20m apart.

For safety reasons most tubes were set within reach of the ground but at some conifer sites which were surveyed by staff of the Forestry Commission tubes were set higher to ensure that they were within the green canopy. Ladders were used to reach these.

Volunteers were provided with instructions for setting out the tubes as well as copies of the Mammal Society leaflet on the use of nest tubes[1].

Checking tubes

Tubes were checked twice in April and May and then once per month through the rest of the year. In order to provide sufficient flexibility to account for holidays and poor weather conditions monthly checks were to be done between the 20th and the end of each month. In April and May, the first check was made just before the middle of the month.

Some volunteers already had licences to handle dormice. Following consultation with English Nature, others were given basic training to enable them to check tubes safely and were named as accredited agents, to disturb dormice only, on the licences of more experienced licence holders.

There was no requirement to handle dormice as part of this project and volunteers who were not fully licensed in their own right were instructed not to handle the animals.

Forms were provided to record the presence of dormice or nests, together with other basic data (see Appendix 1 for example).

Habitat recording

Habitat recording forms together with instructions for filling them in were provided for each volunteer (see Appendix 1). Note that the surveyors were not trained ecologists and that their

[1] The Society provides copies of the leaflet to people who purchase tubes (see Appendix 4).

comments on the abundance of plants were based on common English usage rather than the formal terms used by botanists.

Results

Results were received for a total of 117 sites and dormice, or their nests, were recorded at 32 (27.4%) of these (figure 1).

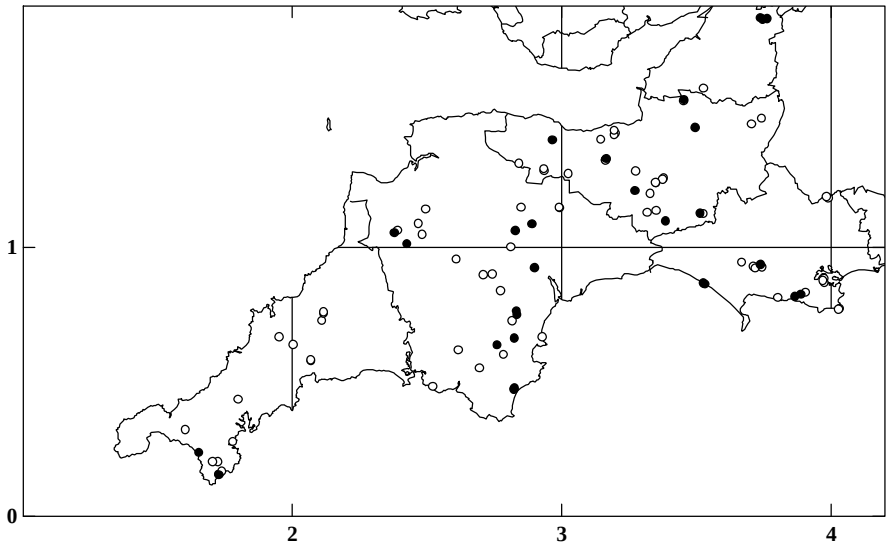

Figure 1 Distribution of sites. Filled circles indicate where dormice were recorded

Dormouse presence

Dormice were recorded in nest tubes in every month of their active season (figure 2) and in all four of the checking periods in April and May. They were most frequently reported in May and September although it should be noted that the additional checking of tubes in April and May inflates the numbers of mice seen during those months. However, if only the end-of-month checks for April and May were used, the two peaks of sightings shown in figure 2 would still persist, with values of three for April and eleven for May (see figure 3).

New nests were also built every month with peaks in May and September. On some occasions dormice were found in tubes before a nest had been constructed.

There is significant seasonal variation in the numbers of both nests and tubes (using only end-of-month checks for April and May) (Nests: $p<0.0001$, $?^2 = 32.38$, 7d.f. Sightings: $p<0.0001$, $?^2 = 20.52$, 7d.f.).

Active dormice were still being recorded at the end of November and new nests were constructed during that month.

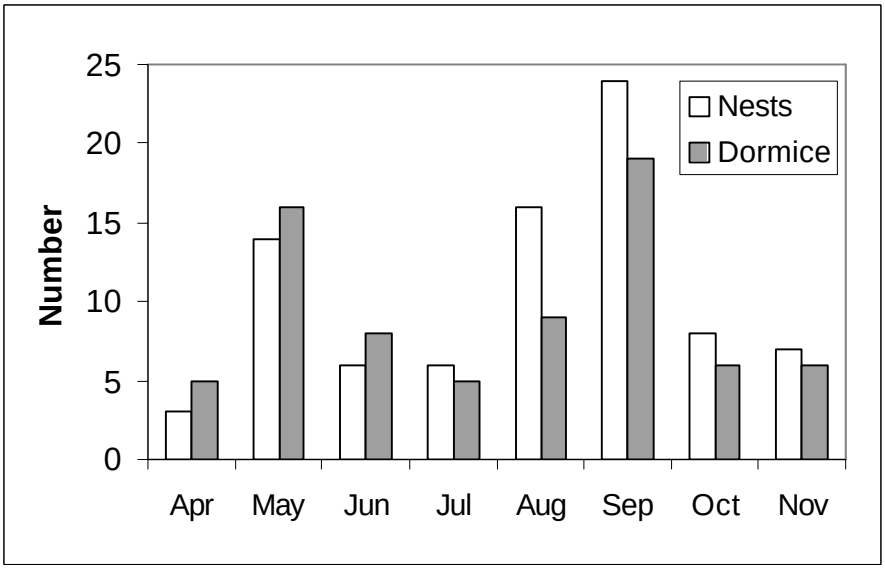

Figure 2 Numbers of dormice recorded in tubes each month and numbers of new nests found

Checking twice per month at the beginning of the year made it possible to record early activity by dormice, some of which were using tubes within only 2 weeks of installation. The first nests were built in the second half of April.

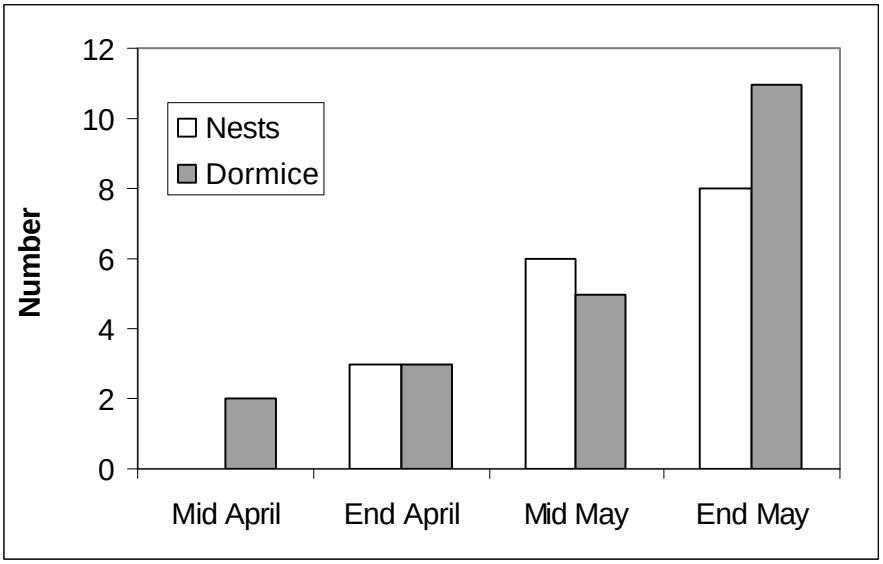

Figure 3 Early activity by dormice

Main habitats

Table 1 shows the numbers of positive sites (i.e. where dormice were recorded) within each main habitat category. Although there appear to be considerable differences between categories (11% of Heath/Grassland compared to 38% for Scrub) the samples are fairly small and the differences are not statistically significant.

Table 1 Numbers of sites surveyed at which dormice were, and were not recorded

	Recorded	Not recorded
Heath/Grassland	1	8
Hedge	13	33
Scrub	12	20
Woodland	6	23
Mixed	0	1

Habitat analysis

Scrub:
There was no association between the presence of dormice and the height of scrub (dormice recorded: 2.25m; not recorded: 2.50m), or methods of management (coppiced, partially cleared, no intervention) or scrub cover (light, dense, continuous).

In addition, habitats associated with the scrub had no discernable influence on whether or not dormice were recorded (table 2).

Table 2 Habitats associated with scrub

	Recorded	Not recorded
Woodland	6	6
Heathland	3	8
Grassland	2	5

Dormice were recorded at three of the six coastal scrub sites.

There was no significant difference between the numbers of tree and shrub species recorded at sites where dormice were recorded (mean = 9.9) and not recorded (mean = 8.5) but dormice were found in both the least diverse site (1 species) and the most diverse (16 spp).

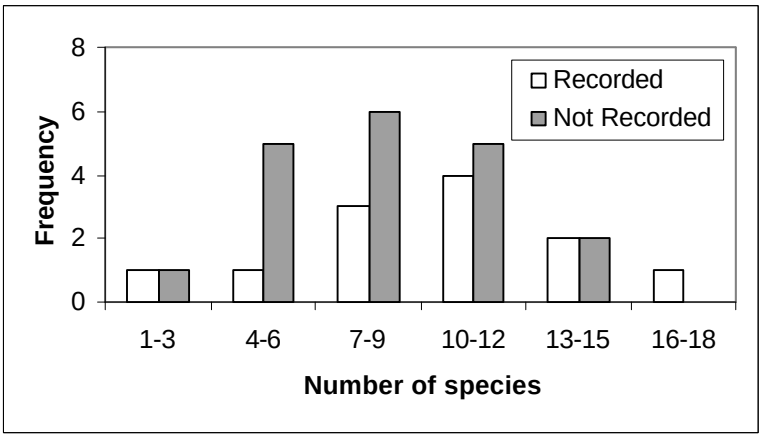

Figure 4 Species richness at scrub sites with and without dormice

The following species were recorded as dominant at sites where dormice were found: ash (*Fraxinus excelsior*), birch (*Betula pendula*), blackthorn (*Prunus spinosa*), gorse, hawthorn (*Crataegus monogyna*).

Hedges:
The was no relationship between size of hedges or the number of standard trees and the presence of dormice, and there was no evidence that the type of management had any impact.

Table 3 Mean height, width and numbers of trees at sites with and without dormice

	Recorded	Not recorded
Height (m)	3.86	3.70
Width (m)	2.47	2.30
No. of Trees	14.44	10.13

Table 4 Management at sites with and without dormice

	Recorded	Not recorded
Managed	7	29
Unmanaged	4	15

Although the number of tree and shrub species recorded in sites where dormice were found (mean = 12.9) was slightly greater than those where they not found (mean = 10.9), there was no significant difference. However dormice were found in the most species poor site (3 spp.) but were not found in the site where most species were recorded (23 spp.).

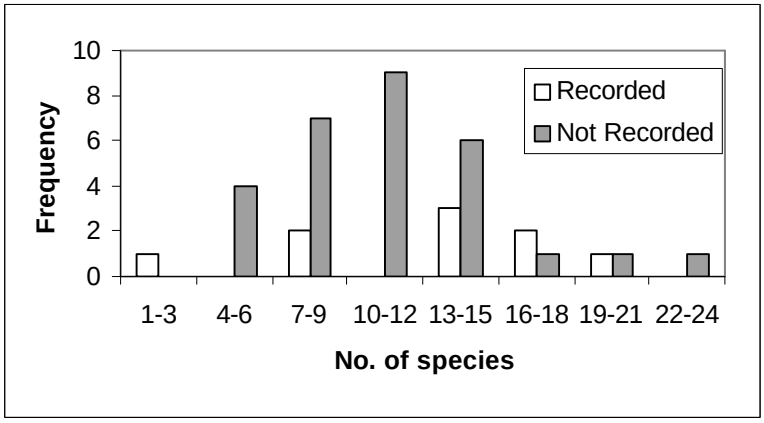

Figure 5 Species richness in hedges with and without dormice

The following species were recorded as dominant in hedges where dormice were found: ash, blackthorn, elm (*Ulmus sp*.), hawthorn, hazel, oak (*Quercus sp*.).

Woodland
The most notable feature of the results for woodland was that three of the six sites where dormice were recorded were in conifer plantations (table 5). Two of these were Douglas fir (*Pseudotsuga menziesii* - ca 15 and ca 20 years old) and the third was Sitka spruce (*Picea sitchensis* - 8 years old).

Table 5 Results from different types of woodland

	Recorded	Not recorded
Deciduous	3	17
Coniferous	3	4
'Laurel'	0	5

Although no dormice were recorded in the five sites with dense growths of laurel (*Prunus laurocerasus*) or rhododendron (*Rhododendron ponticum*), a dormouse nest had been found three years previously at one of them.

Range of habitats exploited

Clearly, the data available from this Project do not make it possible to make many generalisations about habitat use by dormice. However an important objective of this project was to explore the range of habitats in which dormice are found in South West Britain.

Scrub

Dormice were found in a range of scrub types including two sites where the cover was described as 'light' (<25%), one which had been coppiced and four that had been partially cleared. They were recorded in two of the five sites where scrub was no more that 1.5m high as well as one site with very low diversity - an almost pure stand of gorse. Of the six coastal scrub sites, dormice were found at three.

Hedges

Dormice were as likely to be found in managed as unmanaged hedges and although large, less frequently cut hedgerows should provide more food and shelter for dormice than heavily cut ones, several positive sites were in hedges which were less than 3m wide or high.

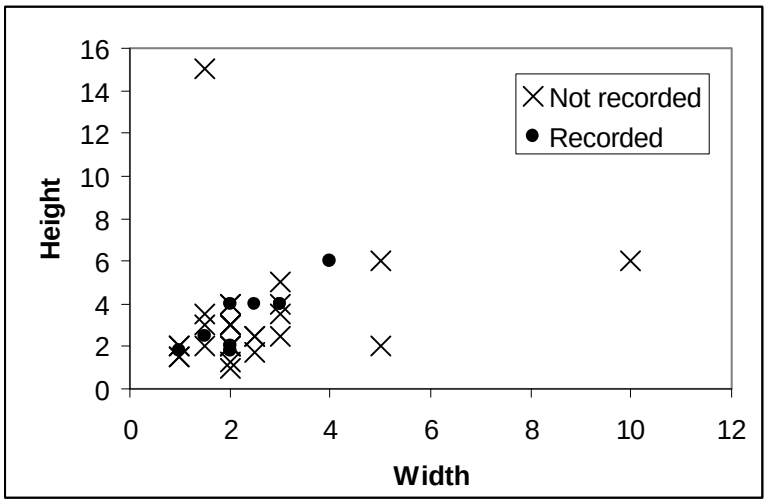

Figure 6 Hedge dimensions and records of dormice

The smallest hedge with dormice present was 1m wide and 1.5m high and described as 'tightly flailed', while at four other positive sites the hedges were less than 3m in both dimensions.

Although dormice were not recorded from most sites where diversity was low (less than 8 species), they were present in one hedge where only three species were recorded (blackthorn, bramble and gorse).

Woodland

The fact that dormice were recorded at three of the seven sites in coniferous woodland may seem surprising, particularly as they were recorded at less than a fifth of the sites in deciduous woodland. This might reflect the fact that dormice do not find many natural nest sites in

dense conifer plantations, while in deciduous woodland there are likely to be plenty of alternative natural places available with the result that tubes in conifers are more likely to be used.

Two of the deciduous woods in which dormice were recorded could be considered as typical dormouse habitat. Both were semi-natural woodland, one dominated by oak and ash the other by oak and beech. Holly (*Ilex aquifolium*), hazel, ivy (*Hedera helix*) and bramble (*Rubus fruticosus agg*.) were present in the shrub layer of both, honeysuckle (*Lonicera periclymenum*) in one and young sycamore (*Acer pseudoplatanus*) in the other. In both cases, canopy shrub and herb layers were either moderate or dense.

The third site consisted of a narrow strip of amenity planting beside a Japanese larch (*Larix kaempferi*) plantation. The canopy was moderate to sparse and dominated by oak and birch while the shrub layer was described as moderate and consisted of gorse and regenerating birch. Honeysuckle, bramble and bilberry (*Vaccinium myrtillus*) were present in the herb layer (described as moderate to dense).

Heath/Grassland

Five of the nine sites surveyed were Culm grassland and one of these was positive. Dormice were also known to be present at a second Culm grassland site, though they were not recorded there during the Project (see below).

An area of short heath adjacent to one of the scrub sites in Cornwall was also found to have dormice when a dead animal was found burnt in its nest after an accidental fire.

‘False negative’ sites

There was evidence for the presence of dormice at (or adjacent to) nine sites where none were recorded in tubes. Three of these were in woodland, four scrub and two heathland. In two cases (one heath, one scrub) live dormice were seen during surveys.

Conclusions

Dormouse habitat 'preferences'

The results of this project confirm the view that has been growing in recent years that dormice are found in a much wider range of habitats than species rich woodlands and hedgerows. In the South West at least, the occasional records of dormice from heathland, Culm grassland, coastal scrub and coniferous plantations do not represent isolated oddities of behaviour but have been replicated in this study. We have recorded dormice nesting in hedges and scrub with very low diversity as well as in a heavily flailed hedge. It is conceivable that in some sites dormice were not resident throughout the year but we feel that it is unlikely that transient animals would build nests while passing through an area. In addition we had evidence of dormice being present for more than one month (repeated sightings or new nests) at seven out of the 14 hedge sites and seven of the 12 scrub sites.

Whether these habitats are 'preferred' by dormice or are even 'suitable' is not clear, we have no information on densities, life history parameters or body condition of the animals. Nevertheless the fact that dormice do occur in these unexpected habitats needs to be recognised by conservation organisations, planning authorities and those involved in land management.

Surveying with nest tubes

The results show that tubes are used throughout the dormouse 'year' with mice and nests recorded in every one of the eight months over which the Project was carried out. Peaks in May and September suggest that tubes are more likely to be used by dormice during these months. Nevertheless it is evident that some dormice are being missed as they were present at some sites where they were not recorded. In addition, the rate of accumulation of new sites had not levelled off by the end of the Project (figure 7). One new site was identified in October and two in November. This also suggests that even if sixteen tubes are left out for the whole of the period when the animals are active, not all sites with dormice will be identified as such in a single season.

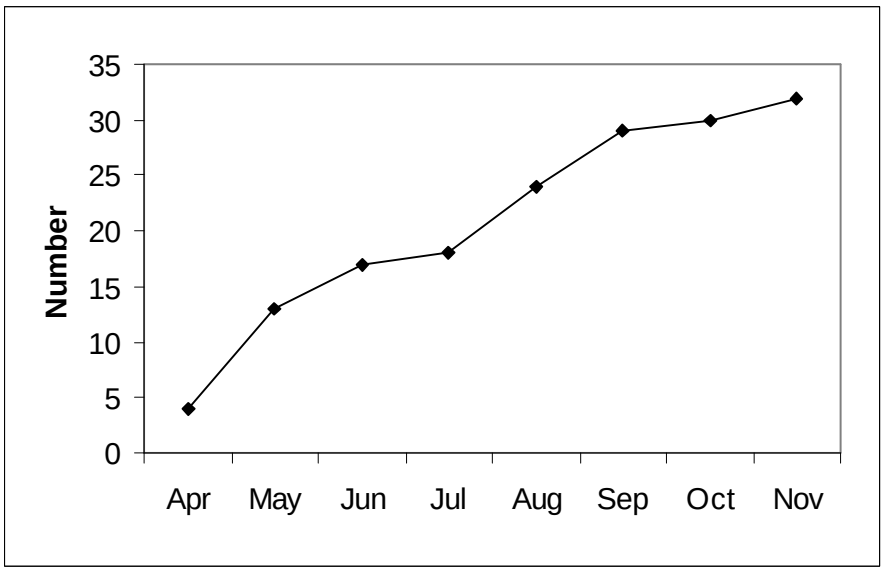

Figure 7 Cumulative number of sites where dormice were recorded

This has important consequences for the use of nest tubes as a tool for dormouse surveys. It is clearly necessary to leave tubes in the field for as long as possible and certainly up to the end of September. However, it is essential to bear in mind that when dormice are not recorded in the tubes it does not necessarily mean that they are not present.

Intuitively it seems likely that tubes would be more effective in areas where natural nesting sites are scarce and our evidence seems to support this.

Recommendations

The following recommendations are based mainly on the results of the South West Dormouse Project and experience gained during it. We have supplemented this with experience we have had in using tubes to carry out surveys at a range of sites, mainly road schemes but also for house building, waste management and mineral extraction. They are particularly designed to be used by environmental consultants who need to carry out dormouse surveys as part of an Environmental Impact Assessment but should also be of value to people surveying dormice for other reasons.

There are two sections:

- In the first we make recommendations which can be used as a protocol for using nest tubes in survey work. These are designed to enable a flexible approach to be taken in planning surveys in a range of habitats while providing common standards against which the survey effort can be assessed.
- The second consists of practical suggestions which are designed to shorten the learning curve for new surveyors.

Each section is arranged chronologically (as far as possible) from planning and preparation of a survey through to checking tubes, identifying the contents and interpreting results.

A standard approach to using nest tubes for surveys

Planning

It is important to bear in mind the limitations of nest tube surveys when planning to use them as a means of detecting the presence of dormice. Generally speaking where fruiting hazel trees are present it is usually quicker and cheaper to do a systematic survey for hazel nuts first.

The intensity of sampling recommended in the Dormouse Conservation Handbook (Bright Morris and Mitchell-Jones, 1996) should be considered a minimum for such work. This involves searching five 10m x 10m quadrats for 20 minutes each. If this reveals the presence of dormice you should then consider what more could be achieved by doing a nest tube survey as well. Unless there is a part of the area that is remote and isolated it is best to assume that dormice are present in all arboreal and scrub habitat throughout the survey area. In which case nothing more can be learned by doing more surveying.

With straightforward sites such as a block of woodland or scrub, a single hedge or a simple network the main decision is likely to be how many tubes to use and how far apart to place them. For large, complex sites such as major developments or road schemes it is likely that there will be many sites where tubes could be sited and decisions may need to be made as to which to use and which not. Suitability of sites not only depends on whether or not the habitat is likely to be used by dormice. You should also consider whether or not tubes might be disturbed or interfered with by people or livestock and how easy it will be to install and inspect them. It is usually necessary to install clusters of tubes at a variety sites and often in groups of varying size.

Clearly, preliminary surveys will be needed to map out the distribution of potential dormouse habitat within an area and also to identify sites which might be best suited for nest tube surveys. At the moment our feeling that dormice might be less likely to use tubes where good alternative nest sites exist does not have a firm statistical foundation. Nevertheless, it would be unwise to assume that the apparently ‘best’ habitat is most likely to reveal the presence of

dormice and we recommend using sites in hedgerow, plantation and scrub as well as deciduous woodland when possible.

Number of tubes and spacing

The Mammal Society leaflet recommends using a minimum of 20 tubes at a spacing of 20m. In the South West Project we used 16 tubes at each site and these, too, were spaced at 20m intervals.

We know that dormice were present in some sites where they were not recorded and also new sites were being identified at the end of the Project so we conclude that it would be better to use a larger number of tubes where possible. We have no firm statistical evidence on which to base a recommendation but since tubes are inexpensive and installation and checking is not very time consuming, we recommend 50 tubes as a suitable minimum but accept that on some small sites it may not be possible to install that number even if the spacing is reduced.

The 20m spacing used in our Project and recommended by the Mammal Society should not be seen as rigid unless an attempt is being made to compare between sites. In practice we have found that it is sometimes beneficial to reduce the spacing in order to install a reasonable number of tubes in small areas.

Where possible we recommend adopting a standard spacing within one site (or within a group of tubes on a very large site) in order to make it easier to locate the tubes for checking. We normally use 15m or 20m spacing (occasionally 10m) depending on the size of the site. In practice it is usually easier to keep to the planned spacing in hedges or in dense habitats than in more open areas. Here you will have to select the most suitable spot close to the measured distance and occasionally, where no suitable place for a tube can be found, you may need to extend the distance to 25 or even 30m in order to maximise the chances of it being used by a dormouse.

Timing and length of survey

It is clear that the length of time tubes are deployed is less important than the time of year. With a minor peak of tube use in May and a more substantial one in August and September, it would be best to ensure that tubes are installed no later than April and finally checked no earlier than October. Leaving them out from early March to the end of November will give the highest probability of detecting dormice if they are present. As an absolute minimum we recommend that tubes are installed before the end of July and finally checked after the end of September. However it should be noted that we only recorded half of the new nests and a third of the sightings during this period so the probability of detecting dormice is significantly reduced by using such a short period, even though it coincides with a peak in nest tube activity.

Table 6 below can be used to assess the likelihood of detecting dormice if present. It is based on the proportion of new nests we recorded each month. Summing the values for months in which tubes are set gives an indication of the reduction in probability of detecting dormice. If 16 tubes are set from March till the end of November they would score the maximum (25) which gives the same (unknown) probability as in the South West Project. Leaving the same number of tubes out from the beginning of May to the end of July gives a value of eight (May, June and July score four, two and two respectively) indicating that the chances of detecting dormice are reduced to a third of those in the South West Project.

Table 6 Index of the likelihood of recording dormice in any one month based on the proportions of new nest recorded each month in the South West Survey

April	1
May	4
June	2
July	2
August	5
September	7
October	2
November	2

Needless to say, using more tubes increases the probability of locating dormice, providing they are put in appropriate places. If 50 are installed instead of 16 the chances of detecting dormice (when present) are approximately 3 times higher. Thus, in the example given above (tubes out from May to July) the chances of detecting dormice are similar to those of the South West Project (multiplying the score of 8 by three).

Using 50 tubes as a standard and table 6 as an index of the 'value' of different months for surveying it is therefore possible to calculate a score which reflects the chances of dormice being discovered if present. This may be used as an indicator of the 'thoroughness' of a survey. Thus, 50 tubes left out for the whole season scores 25, while 100 tubes left out for the same period scores 50. Examples using shorter periods of time are given in the box below.

Using this approach, we recommend that a minimum score of 20 should indicate a thorough survey. Fifteen to 19 might be regarded as adequate where circumstances do not permit more time or more tubes (particularly if other survey methods have also proved negative). We would question whether there is any value in carrying out a nest tube survey if constraints on time and space result in a score of less than 15.

Example 1.

A small quarry was surveyed as part of the 'Review of Mineral Permissions' process. Twenty five tubes were installed in March and removed at the end of May.

The score for April plus May is five (1 + 4) but this has to be halved because 25 tubes were used rather than 50. This yields a total score of 2.5 which would normally be considered a very inadequate survey. However a dormouse was found in one of the tubes during May so the survey was terminated as the presence of dormice on the site had been demonstrated.

Example 2.

150 tubes were installed along the route of a proposed road at the end of April and collected at the end of August. No dormice were recorded.

A total of 13 is scored for the months May, June, July and August (4 + 2 + 2 + 5) and this is multiplied by 3 (number of tubes divided by 50) giving an overall score of 39 which may be considered a thorough survey.

Frequency of checking

In a small number of cases we found dormice in tubes where no nest had yet been built and it was also noted that nests may deteriorate with time, or be taken over by other species such as

wood mice. There are therefore clear benefits in checking tubes at intervals before the end of the study. We recommend a maximum interval between checks of two months. Since dormice were most frequently recorded in nests during May and September, it would be worth while ensuring that checks are carried out out during these months when possible.

Effort
We have found that it is possible to install 100 nest tubes in a day provided there has been sufficient planning to ensure that the locations of the tubes are known in advance and that the distance tubes have to be carried is not too great.

On one site, 150 tubes spread along a proposed road route of ca 6km were checked in a single day.

Interpreting results
It is essential to recognise that nest tubes do not provide an infallible method of detecting the presence of dormice, no matter how many are used, and any recommendations based on a tube survey should acknowledge this fact.

It may also be important to consider the site in the context of nearby habitat. Have dormice been recorded nearby? Is the site isolated or are there continuous links between the site and other, occupied habitat?

In general, the precautionary principle should be employed where the habitat is apparently good for dormice even if they have not been found. This may mean that although, in the absence of evidence for dormice, it is not possible to apply for a licence, it may be appropriate to ensure that a suitably qualified person is present when dormouse habitat is destroyed. As the results of the South West Project have clearly demonstrated, 'dormouse habitat' should be interpreted much more widely than has been the case in the past.

Dormouse licences
Although, technically, a licence is not required for the installation or checking of dormouse tubes, disturbing or handling dormice is a licensable activity. This means that if you find a tube with a mouse or nest in it, you need a licence to do anything further, including checking the remainder of your tubes. Under these circumstances anyone planning to carry out systematic dormouse surveys using tubes is strongly advised to take part in a training course on handling dormice and to obtain some subsequent experience before applying for a licence to handle them. Training courses are organised by the Mammal Society which lists them on its web site (for web and postal addresses, see Appendix 4).

Practical advice on using tubes

Numbering
The main benefit of numbering tubes is that it makes it easier when checking them, particularly where many are involved. Apart from the benefits of keeping a record of where each tube is (see below) it is surprisingly easy to miss one tube and find yourself at the next in the series, particularly in dense habitats.

Marking the plastic outer would probably be best but we have not found a source of suitable numbered, waterproof, stick-on labels. It is simplest therefore to use a waterproof marker pen to write the number on the back of the insert where it can normally be easily seen. It is also worth duplicating the number on the protruding 'landing stage' for tubes sited where the back cannot be easily seen.

Recording
In the South West Project, forms were used to record the habitat at each site and also some information about the habitat surrounding each tube (see Appendix 1). While these were appropriate for this research project we do not recommend their use in normal circumstances when a conventional dormouse habitat survey would be more useful.

However, it is very important to record sufficient information to find the tubes again. We have found it simplest to do this in two ways:

a) a sketch to show the location of the tube line or grid (preferably on a map of 1:25,000 scale or higher);
b) a form recording the positions of individual tubes.

It is usually fairly simple to record the position of the tubes along a hedgerow or where a grid can be laid out but this may need to be adapted in some circumstances. For example, figure 8 shows a line of 10 tubes set out in a small, patchy woodland where a conventional grid was not possible. Tube 61 was placed in the southeast corner and tube 70 at the head of the arrow. A simple sketch like this can be a very useful *aide memoire* two months after the tube is installed.

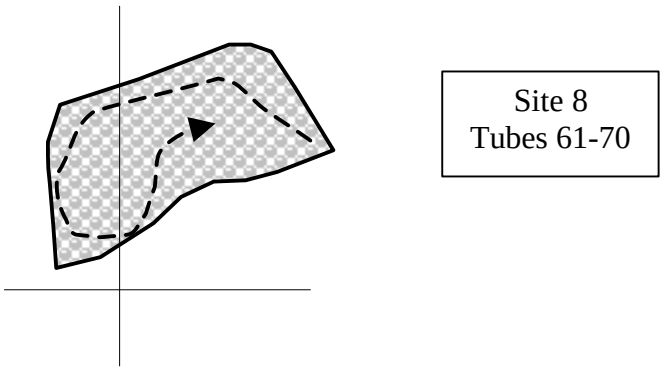

Figure 8 Sketch to illustrate route taken when setting tubes

Bearing in mind that the time between visits is likely to be weeks or a few months, vegetation changes dramatically during the season and one person may have installed dozens or even a few hundred tubes, it is essential that a record of the location of each tube is kept. We have found that a simple form, recording brief details makes it much easier to find them on subsequent visits. We record the tube number, species of tree in which it is installed, height above ground level, distance from previous tube (in paces - see below) and provide space for additional notes. An example is given in Appendix 2.
Keeping these records also makes it easier for someone else to locate tubes if the person who installed them is unavailable. Nevertheless, it is generally much easier to find your own tubes than other people's.

Health and safety considerations
Clearly the normal risks of fieldwork in the British countryside apply but there are two additional hazards which should be borne in mind when setting and checking tubes.

Tubes have to be attached to twigs and small branches, often in quite dense shrubs where particular care should be taken to avoid damage to the eyes. Conventional sunglasses (preferably those that lighten in the shade) or prescription glasses provide sufficient protection or you can buy plastic eye protectors from DIY shops.

Hands and arms are also vulnerable and it is inevitable that scratches will occur when installing tubes in blackthorn, hawthorn, gorse or bramble. This can be reduced by wearing gardening gloves and appropriate clothing (short-sleeved shirts are not suitable for this work). However it is almost impossible to tie the tubes to branches when wearing gloves and we recommend taking appropriate medical precautions as well. These include keeping tetanus inoculations up to date, and having small tweezers and antiseptic wipes available to remove thorns and clean scratches.

Spacing out tubes and finding them again

It is not critical for tubes to be spaced at exact intervals but it is easier to find them again if you can walk to a point very close to where the tube is sited, particularly when the vegetation is dense. Although you can use tape measures or pieces of cord of known length to set out your tube grid or line, in practice it is actually quite difficult to do this without adding considerably to the time taken. If you anchor the tape or cord firmly to the starting point you have to go back to release it. If you don't it is very difficult to prevent it being dragged along.

We have found that pacing out the distance is adequate under most circumstances for both setting out tubes and for checking them. When returning to check the tube, you will usually find yourself within 2 or 3m of the actual site. At this point, the other information on the recording form (tree species and height) is usually sufficient to direct attention to the right area.

Two other factors help in finding tubes which have been installed some time ago. The first is that there are limitations on where they can be installed (size and orientation of branches for example) which limits where you need to look. Second, over a period of time one begins to develop habits about where tubes are placed which makes it easier to find them again. These are further reasons why it is easier to find tubes you have installed yourself. If it is likely that someone else will check the tubes it is important to take more detailed notes.

Siting individual tubes

An analysis of the tree species on which tubes were placed during the South West Project showed that tubes were installed in 30 different trees shrubs and climbers and dormice were recorded in about half of these. All species which had more than 10 tubes installed were used at least once. Overall there was no clear selection for particular species but if only those where dormice were recorded four or more times were compared there was a significant difference in use ($p< 0.05$, $?^2 = 11.91$, 4d.f.). Bramble and birch were used more than expected and hawthorn and hazel less. Use of the fifth species, blackthorn, was close to expectation. These data should be interpreted with caution since birch trees were mainly found at two sites. One of these consisted of birch scrub and four of the seven tubes in birch trees had nests.

We advise particular caution in using brambles as sites for nest tubes, even though dormice readily use tubes in them. The speed with which brambles grow can make it extremely difficult to find the tubes again unless they are very clearly marked. A tube near the edge of a bramble patch at the beginning of the season may be one or two metres inside the patch by the end. If tubes have to be installed in bramble patches we recommend using conspicuous markers such as stakes which are high enough above canopy level not to be swamped by a season's growth.

We found no evidence for selection by height with nests being recorded between 0.6m and 2m above ground level, roughly reflecting the range of heights at which most tubes were set (between 0.3m and 3m). Since natural nests have been recorded both lower and higher than this we conclude that it is probably more important to select sites which are readily accessible

for attaching and checking tubes than at a particular height above the ground. This may not be the case for coniferous trees where the green canopy may be a long way above ground level.

Twigs should be strong enough to bear the weight of the tube plus nesting material and one or two dormice so a minimum thickness of 10mm is recommended. With branches more than 40mm in diameter dormice (which run along the tops of horizontal branches) may not notice the tube so these should be avoided.

We made no recommendation to volunteers about the orientation of tubes other than that the entrance should be lower than the nest to promote drainage. Although it is easier to inspect tubes if the entrance faces outwards (and at least one dormouse constructed a nest in a tube installed this way) we recommend that the entrance should face towards the most sheltered direction in order to reduce the effects of wind and rain.

It is important to remember that heavily managed hedges may be managed. Tubes placed near the outside of a hedge that is flailed will suffer the obvious fate.

Attaching tubes

Garden wire, string and self-locking plastic ties have all been used for attaching tubes but we find that plastic coated garden wire, 1mm in diameter works well and is easy to obtain and cut to length. If string is used it should be treated to prevent rot (e.g. garden twine).

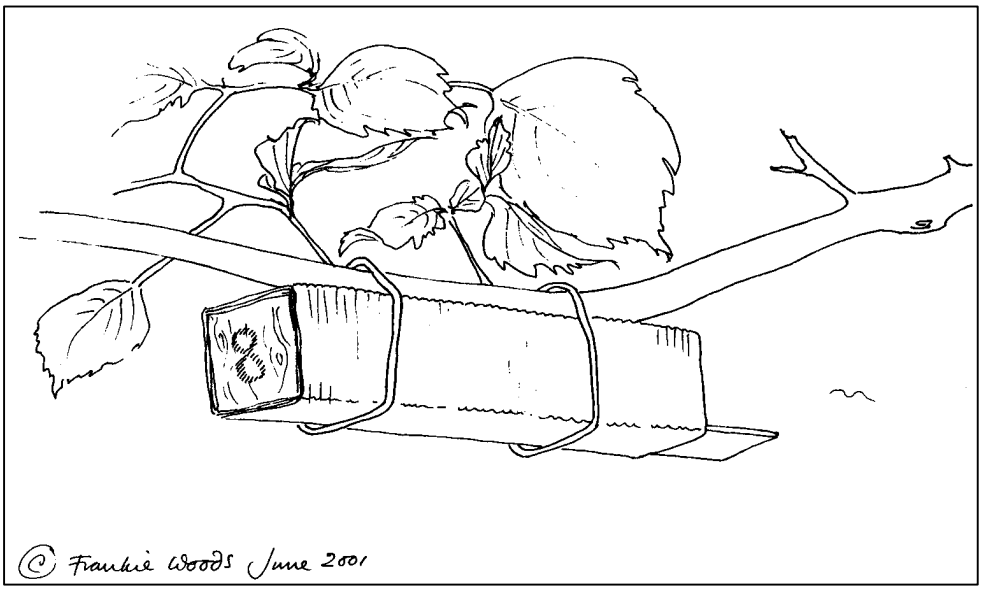

Figure 8 Nest tube in position

It is generally easier to cut the wire before going into the field and a simple way to get large numbers of equal length ties is to wrap the wire repeatedly round a board ca 225mm (9") long. Provided the wire is no more than two layers thick it is possible to cut across the end with a pair of 'tin snips' producing a bundle of ties 450mm (18") long - ample for branches up to 50mm in diameter.

Holding the tube in place while tying it is not easy with two hands and it helps if the tube is first loosely attached by one piece of wire somewhere near the centre of balance. The second piece can be used to firmly attach one end and then the first moved to the opposite end to securely fix the tube in place. One benefit of using wire is that it can be twisted rather than knotted and is therefore easier to undo.

When checking tubes, it is sometimes necessary to slide the wooden tray out a little to see if there is a nest inside so it is preferable to place the tube so that this is possible. Pushing the back up against a twig aids stability but can make checking more difficult.

Marking the site

There are obvious benefits in using conspicuous marks to indicate the positions of tubes but these must be weighed against the risk of them leading other people to them. We have had a number of cases where tubes have been vandalised when set in public places.

Some people use short lengths of bright red wool and others strips of plastic carrier bags. It is worth bearing in mind that a colour which looks conspicuous in spring may be harder to see in the summer or autumn. Also, we have discovered that browsing animals such as cattle will eat strips of plastic used to mark tube locations in hedgerows.

Checking tubes

When nest tubes are used for dormouse surveys there is no need for the animals to be handled so it is not a problem if they escape before the tube is actually inspected. On the other hand, it is important that the surveyor notices them leave since dormice have occasionally been recorded in tubes with no nest.

It therefore pays to approach the tube very cautiously. Even so, being so much lighter than nest boxes they are much more easily disturbed by the movement of branches, particularly as they are often installed in much denser vegetation than is possible with boxes. In these circumstances, it is crucial to keep a careful eye on the tube as you approach it.

When possible, it is quickest to look directly into the tube (or via a small mirror), otherwise you can gently pull the inner tray back to see whether or not there is a nest inside.

Nest Identification

Dormice build domed nests about the size of a small grapefruit. It is usually possible to identify a nest made by a dormouse by the materials used and the method by which it is made. Wherever they can, dormice prefer not to come down to the ground except during the winter for hibernation. Consequently nesting materials generally consist of those available in trees and bushes. Honeysuckle or clematis bark is peeled and then woven to form the nest which is often as tightly woven as a bird's nest and is sufficiently well made to remain intact and in place in a natural site such as bramble scrub well into the winter.

Occasionally dormice will create nests from grass and other tall plants such as bracken. Often nests made in tree holes, nest boxes or tubes are surrounded by leaves, generally in tight layers, and these are usually collected from surrounding trees and bushes rather than the woodland floor. They are, therefore, green rather than brown and become grey over time. It is rare for a mouse or vole to make any sort of woven nest from bark rather than grass and also for them to use living leaves as opposed to dead, brown ones. Generally woodmouse nests in dormouse boxes or nest tubes are just a jumble of brown leaves into which the mouse disappears.

We occasionally found feeding remains in tubes and noticed that the toothmarks on some of the blackthorn (sloe) stones were the same as those on hazel nuts enabling us to confirm that they had been eaten by dormice.

Further research

The South West Dormouse Project has provided answers to a number of questions about using dormouse nest tubes for surveys but there are many others which are of interest. In particular, more information on the most effective way to use tubes would be very valuable.

For example:

- Does the position of the tube affect the likelihood of it being used by dormice? Including:
  - Species of tree;
  - Height above ground;
  - Orientation;
  - Proximity to suitable nesting material.
- Is it true that dormice are less likely to use tubes in habitats where natural nest sites are easily found?
- How does the number of tubes affect the probability of detecting dormice in a habitat?
- What proportion of sites are being 'missed' by tubes?

The fact that dormice occur in unconventional habitats in South West England was already known, though the extent was not fully realised. It seems likely that dormice behave similarly elsewhere and it would be very useful to carry out further studies on this, particularly in the northern parts of their range.

Dormice were recorded in two habitats, Culm grassland and short heath, which are frequently managed by burning and at one of these a dormouse was killed when its nest was burnt. Following this, management of the area (a nature reserve) is being reviewed. This is clearly a situation where there is a conflict of conservation interests and a risk of causing unnecessary suffering to dormice. Further research is needed on the extent to which these habitats are used by dormice as well as ways of managing them to take account of the presence of dormice.

Acknowledgements

We are extremely grateful to the volunteers who took part in the South West Dormouse Project, and especially to those who didn't see any dormice or nests but still continued sending in information which we have used in this report. Thanks also to the landowners whose co-operation made the project possible.

We could not have run the project without the help and support of the county organisers and others who helped with organisation (Alison Cox, Alison Tutt, David Appleton, George Bemment, Ian Parsons, Jack Edwards, Jane Squirrell, Kate Stokes, Nick Harrison-White, Sue Eden and Stephanie Greshon).

We are very grateful to English Nature, who provided the bulk of the funding for the Project and the report writing as well as to Exmoor National Park and Hanson Aggregates whose contributions enabled us to deploy more tubes than initially anticipated.

David Appleton helped us greatly in the production of this report and George Bemment very kindly commented on the text.

We would like to thank the Mammal Society for allowing us to use the drawing of a nest tube. Figure 1 was produced with the aid of DMAP.

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Appendix 1. Examples of South West Dormouse Project recording forms

SOUTH WEST DORMOUSE PROJECT: SPRING RECORDING FORM

Recorder		Please give your name *not* initials. Please record on form as follows: P = *new* partially built nest; N = *new* complete dormouse nest; D = Dormice present, number unknown; 2D = two dormice present etc. If dormice are identified as juveniles, please say so in notes.
Site Name		
Grid Ref		
Installation		Please give date tubes were installed

Please put date of actual survey in first row. 'Ht' = height of tube, to aid relocation

No.	Mid Apr	End Apr	Mid May	End May	Ht	Notes
Date:						
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						

Notes on dormice or signs seen on or near site during surveys	

Please include the following information for each survey. For weather note whether the temperature is high, low or normal for the time of year and the amount of rain. Make a note if there was any frost in the week prior to checking.

	Date	Weather
Mid Apr		
End Apr		
Mid May		
End May		

Please use 'Notes' column or back of form for any additional relevant information. Please return immediately after the fourth check so your county organiser can send the next form to you. Please add any notes, anecdotes and experiences here so we can keep a record of them.

SOUTH WEST DORMOUSE PROJECT: HEDGE RECORD FORM

Site Name		**Locality**	
Grid Ref		**Altitude (metres)**	
Date		**Recorder**	

Structure and management

Length of hedge (metres) Average width (metres)
Average height (metres) No of standard trees

Is the hedge:Remnant (straggly line of trees) ☐ **Laid** ☐
Overgrown:(no undergrowth) ☐ **Cut/clipped** ☐
Overgrown (bushy undergrowth ☐ **Flailed** ☐

What proportion of the hedgerow is made up of gaps?

Less than 10% (ie few gaps) ☐ more than 10% ☐

How many gaps within line of tubes:
Max gap:

Connectivity

Does the hedgerow connect to :

Other hedges		**How many**	
Woodland		**Type**	

(deciduous/conifer)

Species present (tick if present; 'D' if dominant around at least 5 tubes)

Alder buckthorn		Buckthorn		Guelder rose		Spindle	
Alder		Crab apple		Hawthorn		Wayfaring tree	
Ash		Dog rose		Hazel		Wild cherry	
Beech		Dogwood		Holly		Willow	
Birch		Elder		Honeysuckle			
Blackthorn		Elm		Hornbeam			
Bog myrtle		Field maple		Lime			
Bramble		Gorse		Oak			

Sketch of site:

Show on sketch overleaf the boundary of the site, in relation to the surrounding area. Also show any adjacent hedges, remnant hedge banks, watercourses, woodland nearby. Show position of north.

Notes:

SOUTH WEST DORMOUSE PROJECT: HEDGE RECORD FORM

Details of individual tube locations

Tube No.	Species of tree/shrub to which tube is attached	Dominant spp within 5m (by volume)	Other woody species within 5 metres of tube including climbers
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			

Sketch of site and surrounding area

Appendix 2. Form used for recording tube locations

Location: **Route of A123**

Site #1 west end, north side of road					
Tube	**Species**	**Ht***	**Notes**	**Gap***	
1.	Hazel beside Oak	.75	3m from path		
2.	Hazel	1.5	Beside ivy bush	15	
3.	Hazel	1.7		15	
4.	Hazel	1		15	
5.	Hazel	1		15	
6.	Honeysuckle on hazel	1.2		15	All within 10m of edge of wood
7.	Honeysuckle in hawthorn	1		15	
8.	Hazel beside fallen birch	1.6		15	
9.	Hazel	1.2	Base of Ash with twin trunks	15	
10.	Hazel	1.4	Under dead log	24	
Site #2 - Dart copse: 11-18 alongside path through wood, 19 -25 along northern boundary					
11.	Hawthorn	1.4	4m from gate RHS of path		Along lane through wood
12.	Sycamore	2	RHS	20	
13.	Sycamore	1.5	LHS	20	
14.	Hazel	1.7	RHS	20	
15.	Hazel	1.5	RHS - 8m from track	20	
16.	Hazel	.8	LHS	25	
17.	Oak	1.5	RHS	20	
18.	Hazel	1.4	RHS (10m from path)	20	
19.	Guelder rose	1.8	On dead birch branch		After 18, head past beech towards top of wood. Tube 19 is to right of big ash tree
20.	Hazel	1.4		20	
21.	Hawthorn	1.4	On fence	20	
22.	Hawthorn	1.5	Nr fence	20	
23.	Hazel	1.5		20	
24.	Sycamore	2		20	
25.	Sycamore	2		20	

**Ht = height above ground level*
Gap = distance from previous tube

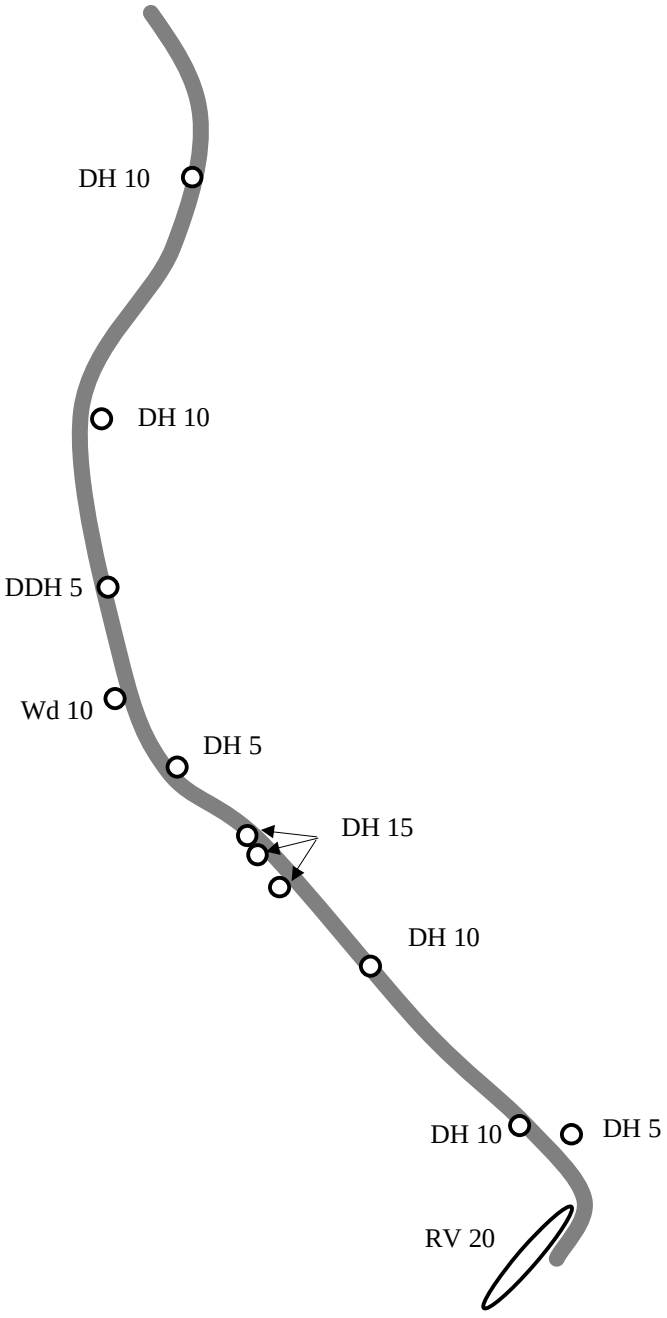
Appendix 3. Case studies

Example 1: Road scheme

The diagram illustrates the location and number of dormouse tubes placed along the proposed route of a bypass of ca 4km.

One hundred tubes were installed on 5th July and removed on 7th November. This yields a score of 32 (16 points for July to October inclusive, multiplied by two because 100 tubes were used). No dormice were recorded.

Habitats are indicated as follows: DH = dense hedge; DDH = dense double hedge (sunken lane); Wd = woodland; RV = dense growth of saplings along roadside verge.



Example 2: Waste management scheme

Sixty four tubes were erected at a waste disposal site located in an old mineral extraction area. Blocks or strips of 16 tubes were deployed in four different habitats in late June and remained in place until late October. All the habitats on the site were connected arboreally although some of these connections were tenuous.

Block 1 was located in broad leaved woodland with an understorey of hazel which was almost completely shaded and hardly fruiting.

Block 2 was among the hardwood trees and shrubs on the edge of a mature softwood plantation.

Strip 1 was in a thin mixed hedge close to mixed hardwood woodland and connected to it in several places.

Strip 2 was in a broad mixed hedge running between two suitable woodland habitats.

Dormice were detected using tubes in strip 2 only, as evidenced by a nest and by characteristically gnawed blackthorn pips found in a tube. It was assumed that dormouse were present throughout the site and proposed developments had to take this into account.

The score for this site is approximately 20 (16 points for the period July to October inclusive multiplied by about one and a third for 64 tubes rather than 50).

Appendix 4. Resources

Nest tubes

The Mammal Society supplies nest tubes at a cost (in 2003) of £2 per tube plus p&p. They may be ordered from the Society's headquarters at:

2B Inworth St
LONDON
SW11 3EP
Tel.: 020 7350 2200
Email: enquiries@mammal.org.uk
Web site: http://www.mammals.org.uk/

Licensing

Licences to handle dormice for survey work are provided by English Nature. Further information and application forms are available at:

http://www.english-nature.org.uk/science/licensing/

or

Licensing Service
English Nature
Northminster House
PETERBOROUGH
PE1 1UA
Tel.: 01733 455000

Licences to disturb dormice in connection with development are issued by Defra. An application form (WLF2) and guidelines (WLF11) are available at:

http://www.defra.gov.uk/corporate/regulat/forms/cons_man/

or

Licensing Office DEFRA
Temple Quay House
2 The Square
Temple Way
BRISTOL, BS1 6EB
Tel.: 0117 372 8291

Training

The Mammal Society organises training workshops for surveying a wide range of mammals, including dormice. Lists of available courses are posted on the Society's website (look under the heading "Society Surveys" for "Training Workshops"), or contact the Society at the address above.

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Middle left: Co_2 experiment at Roudsea Wood and Mosses NNR, Lancashire.
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