

## Using reintroductions to reclaim the lost range of the dormouse, *Muscardinus avellanarius*, in England

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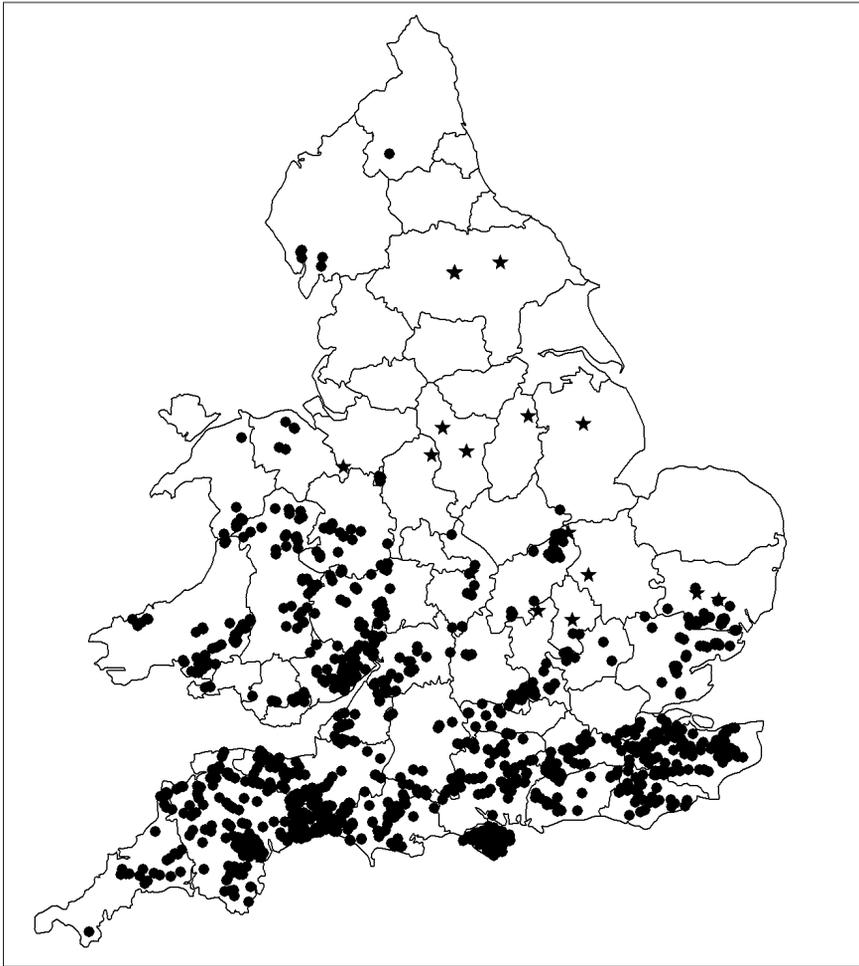
**A b s t r a c t.** The dormouse *Muscardinus avellanarius* has disappeared from a large part of its range in England, probably because of habitat fragmentation and deterioration. Reintroductions, mainly using captive-bred animals, have been generally successful at re-establishing populations within this lost part of the species' range, with only 2, perhaps 3, out of 15 known to have failed. However, the establishment of new isolated populations is not seen as an end point to the project and attention is now focused on improving habitat connectivity around the reintroduction sites, to enable the founder populations to spread to nearby woods.

**Key words:** distribution, landscape connectivity

### The status of the dormouse in England

The dormouse *Muscardinus avellanarius* has suffered a major historical decline in England and is now absent from at least 6 counties where it was recorded in the late 19<sup>th</sup> century (R o p e 1885). At that time, the species was generally considered rare in the north of England and more common in the southern half of the country. Declines in distribution appeared to be in progress at about this time as B a r r e t t - H a m i l t o n & H i n t o n (1910) described it as being rare in the Midlands and locally distributed in the north. Until quite recently, few good data were available on the distribution of the dormouse, but efforts to improve this were associated with English Nature's Species Recovery Programme, begun in 1992. The Great Nut Hunt in 1993, which asked volunteers to search for hazel *Corylus avellana* nuts opened by dormice, produced records of dormice at 334 sites in England and Wales and confirmed the loss of the species from parts of its former range. Data from this survey have been combined with other post-1990 observations to produce the detailed current distribution map of the species shown in Fig. 1 (B r i g h t e t al. 2006). The persistence of two small populations in northern England (Cumbria and Northumberland) is, perhaps, an indication of the extent of the former range of the species, as it was never recorded in Scotland.

The reasons for the observed loss of range are probably multifactorial, involving the fragmentation, deterioration and loss of its specialised habitat as well as wider climatic factors (B r i g h t & M o r r i s 1996). England is not a well-wooded country, with ancient woodland, closely associated with dormice, covering only 2.6% of the land surface (S p e n c e r & K i r b y 1992). In addition, most of these surviving woodlands are small, with 87% of the polygons in Natural England's digitised Ancient Woodland Inventory being smaller than 20 ha and 96% being smaller than 50 ha. An analysis of the occurrence of dormice in woods of different sizes by B r i g h t e t al. (1994) demonstrated clearly that



**Fig. 1.** The current distribution of the dormouse in England and Wales. Black circles – species record 1980-2008; black stars – reintroduction 1993-2006. Updated from Bright et al. 2006.

smaller woods which were isolated were less likely to have dormice than larger woods adjacent to other woods. Habitat fragmentation and isolation is thus a significant factor influencing dormouse distribution.

### Reintroductions

In parts of the lost range of the dormouse, some of the larger woods are now managed by conservation organisations seeking to restore woodland management practices favourable to dormice, such as coppicing. In addition, the value of ancient woodland as a biodiversity resource is now recognised and the rate of loss of this habitat type is now much less than formerly. The Species Recovery Programme thus began a programme of reintroductions in 1992–3 to restore dormice to areas of England from which they had been lost and where natural recolonisation by this poor disperser was highly unlikely. Sites were selected in counties where dormice formerly occurred but where populations are now scarce or absent.

**Table 1.** Success criteria for dormouse reintroductions.

Stage	Success criterion	Timescale
1	Animals released on site and return to the release cages for food	Days
2	Young born at the site, preferably in the first year	Months
3	Animals survive over winter and reappear in nest-boxes the following spring	1 year
4	Birth of second generation (young born to animals born at the site)	1-2 years
5	More adults present than were originally released	> 1 year
6	Animals disperse beyond the reintroduction area within the site (wood)	> 1 year
7	Animals disperse beyond the reintroduction wood	> 1 year

Woodland sites were chosen on the basis of size (> 20 ha, see Bright et al. 1994), habitat suitability and the long-term commitment of the managers of the site to manage it in an appropriate way. A detailed description of the project and the first few releases can be found in Bright & Morris (2002); this paper updates and extends the data presented therein.

The objective of any conservation-led reintroduction project is to establish self-sustaining populations of the species concerned. This is a long-term objective, so a series of shorter term sub-objectives has been adopted to measure progress towards the overall goal. The first six stages, shown in Table 1, are all critical to the establishment of a new population and can thus give a measure of the success of the project over a relatively short time. These original six stages, which focussed on the establishment and spread of the population within the reintroduction site (wood) have here been extended to a seventh stage covering the dispersal of animals beyond the reintroduction site to establish a wider population. Progress through these stages at each site is shown in Table 2.

One of the greatest difficulties with regard to the reintroduction programme in England has been the identification of suitable sites for a release. The woodland is required to be of suitable size (> 20 ha), with good, or potentially good, hedgerow linkage to other local

**Table 2.** Progress at each reintroduction site by 2007. The stages are described in Table 1. For the first 3 releases, animals were released at the site in two consecutive years. This practice was not considered necessary for subsequent releases.

Release	County/site	Year of release	Stage achieved						
			1	2	3	4	5	6	7
	Cambridgeshire	1993–4	✓	✓	✓	✓	✓	✓	
	Nottinghamshire	1994–5	✓	✓	✓	✓			
	Cheshire	1996–7	✓	✓	✓	✓	✓	✓	✓
	Buckinghamshire	1998	✓	✓	✓	✓	✓	✓	✓
	Warwickshire	1998	✓	✓	✓	?			
	North Yorkshire 1	1999	✓	✓	✓	✓		✓	
	Suffolk 1	2000	✓	✓	✓	✓	✓	✓	✓
	Bedfordshire	2001	✓	✓	✓	✓		✓	
	Cambridgeshire 2	2001	✓	✓	✓	✓	✓	✓	
	Staffordshire	2002	✓	✓	✓	✓		✓	
	Lincolnshire	2002	✓	✓	✓	✓		✓	
	Derbyshire 1	2003	✓	✓	✓	?			
	North Yorkshire 2	2004	✓	✓	✓	✓		✓	
	Derbyshire 2	2005	✓	✓	✓	✓	✓		
	Suffolk 2	2006	✓	✓	✓	✓	✓		
	North Yorkshire 3	2008	✓	✓	✓	✓	✓	✓	✓

woodlands, to have appropriate existing habitat and to have a landowner who is both supportive of a release in the short-term and is prepared to commit to a long-term woodland management or maintenance programme. Earlier recognition of suitable sites, or sites that could become suitable with appropriate management, may need to become a higher priority for the continued success of the reintroduction programme, although an earlier investigation commissioned by the project partners failed to identify many candidates.

Although the IUCN guidelines specified that animals should have a veterinary check before release, this was not considered feasible in the early part of the release programme (Bright & Morris 2002). However, the potential disease risks inherent in translocating dormice were soon recognised and careful evaluation of the animals before, during and after the release is now standard procedure.

## **Beyond reintroductions**

A limitation of reintroductions to woods in a fragmented landscape is that the ultimate objective of repopulating significant parts of the lost range of the dormouse cannot be achieved unless dispersal beyond the reintroduction wood is possible. Reintroduction woods, which were generally chosen because they were the largest suitable woods available, should act as sources for repopulation of a wider area. This requires them to be well-connected to other suitable woods, even though these may not be large enough to maintain significant populations in isolation. Without adequate connections, allowing dormice to disperse, there remains a significant risk that the isolated populations created by reintroductions will decline to extinction through stochastic processes (Bright et al. 1994).

Recognising the importance of providing dormouse dispersal routes from reintroduction sites, English Nature and the People's Trust for Endangered Species commissioned a preliminary study in 2004 (Caddick 2005) to map the woodland around reintroduction woods and the connections to them and to prioritise sites where improving connections, principally hedgerows, and managing habitats could assist dormouse dispersal and colonisation. This study also recorded any work of this type already under way at any of the sites. This preliminary study was then followed by the current project (2007–8), which employed one of the authors (IW) to implement the priority actions identified by the preliminary study.

Caddick (2005) assessed 13 of the release sites within a priority categorisation where:

*High*: the surrounding habitat would benefit from immediate work on site i.e. hedgerow connectivity between suitable woodlands, coppicing in adjacent woodlands.

*Medium*: the reintroduction site and surrounding habitats would benefit from some input in the form of grants or other funding, management advice, volunteer recruitment etc. in the short-term.

*Low*: where good working practice for dormice is already underway by a secondary group or the reintroduction site is large enough, and the dormouse population small enough that immediate work would bring no short-term benefit.

It is felt that these categorisations remain appropriate with the exception of 'Low'. Even if the reintroduction site is large or the population small, it is considered highly beneficial to utilise the presence of dormice to facilitate adjacent hedgerow management or reinstatement and to encourage suitable local woodland management, as these changes can take some years to bring benefits. It may also be appropriate to add a category, 'Negative', that could be

**Table 3.** Prioritisation of reintroduction sites for habitat enhancement and connectivity according to C a d d i c k (2005) and W h i t e (2007).

Year	County/site	Site name	Prioritisation	
			C a d d i c k (2005)	W h i t e (2007)
1993–4	Cambridgeshire	Brampton Wood	Low	Low
1994–5	Nottinghamshire	Treswell Wood	Low	Negative
1996–7	Cheshire	Stockton Dingle	High	Medium
1998	Buckinghamshire	Little Linford Wood	High	Medium
1998	Warwickshire	Bubbenhall Wood	Low	Negative
1999	North Yorkshire 1	Rievaulx	Medium	High
2000	Suffolk 1	Priestly Wood	Low	Low
2001	Bedfordshire 1	Maulden Wood	Medium	Medium
2001	Cambridgeshire 2	Bedford Purlieus	Medium	Medium
2002	Staffordshire	Hamps Valley	Medium	Medium
2002	Lincolnshire	Chambers Farm Wood	Low	Low
2003	Derbyshire 1	Leashaw Wood	-	Negative
2004	North Yorkshire 2	Heslett & Peter Woods	Medium	Medium
2005	Derbyshire 2	Monsal Dale	-	Medium
2006	Suffolk 2	Bradfield Woods	-	Low

used to define sites where the reintroduction is considered to have failed and the focus is to resurvey for dormice to ascertain presence prior to the implementation of any further work.

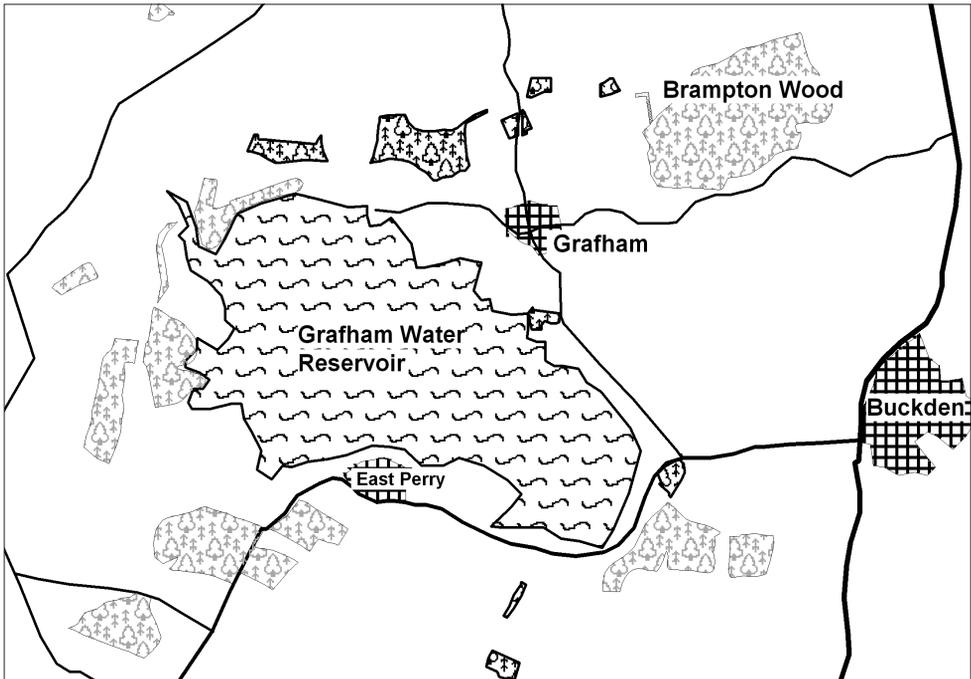
C a d d i c k 's (2005) category assessment of the reintroduction sites was reviewed by W h i t e (unpublished), see Table 3. Two sites had moved from a 'High' category in 2005 to 'Medium' in 2007 as a consequence of woodland management at the release site. One site had moved from a 'Medium' category to 'High' as there had been limited management at the site and although dormice were still being recorded, the population appeared to have declined. Three sites were categorised as 'Negative' as although they were still being surveyed, neither dormice, nor evidence of dormice, had been found in at least the previous two years. Since this assessment was made, a hibernation nest was reported at one of these sites (R. A t k i n s o n, pers. comm.).

The sites that had been reassessed to 'Negative' were similar in their management regimes. Limited woodland management had been undertaken at each site both up to the time that the dormice were released and immediately after.

### Site examples

The original release site at Brampton Wood, Cambridgeshire was identified as low priority for further action in both 2005 and 2007. The wood is owned by the local Wildlife Trust and a large area has been managed as a coppice with standards woodland. The wood (Fig. 2) lies to the south and west of major trunk roads and to the north east of a man-made reservoir, Grafham Water, which is owned by Anglian Water. A number of fragmented woodlands, including Brampton Wood, surround the reservoir and there is a long term vision by the Biodiversity Partnership for Cambridgeshire & Peterborough (2002) to link these woodlands either with new planting or by improving or reinstating hedgerows.

A number of these woodlands have been taken into management by The Grafham Wildlife & Conservation Group, a voluntary organisation that provides support to local



**Fig. 2.** Woodland around Grafham Water reservoir and Brampton Wood. Woods shown in a darker shade are managed by The Grafham Wildlife & Conservation Group, which is also working with landowners to link all woods around the reservoir with new or improved hedges or treelines.

private woodland owners (S. Malt, pers. comm.). The group also undertake and advise on hedgerow management and reinstatement.

Brampton Wood is a site in the National Dormouse Monitoring Programme and dormice have been surveyed annually since 1994. The population appears to have become self-sustaining and can be considered to have reached Stage 6 on the *Criteria of Success* scale (Table 1). Additional surveying will be undertaken in adjacent hedgerows and local woodlands to ascertain whether dormice have dispersed beyond Brampton Wood although this is considered unlikely in the near future due to the immaturity of the immediate hedgerow links.

The possibility of a new reintroduction site 5.5 km to the south west of Brampton Wood is currently being considered. Studies on the territorial and ranging behaviour of dormice (Bright & Morris 1992, Bright 1998) suggest a high site specificity and a low dispersal rate. It is thought highly unlikely that dormice will have dispersed across the unfavourable agricultural landscape to naturally populate the potential reintroduction woodland site. In spite of the close proximity to an existing reintroduction site, a new release may be considered an opportunity to allow a dormouse meta-population to develop in a county with limited suitable woodlands and in an area where substantial woodland and hedgerow management is already being undertaken.

Dormice were released in Treswell Wood in Nottinghamshire in 1994 and 1995. Caddick (2005) assessed the site as low priority and White (unpublished) assessed the site as negative since no dormice and only one hibernation nest had been recorded since 2004. The wood has had a long history of coppice with standards management but

between 1914 and 1958 most of the standards were removed and not replaced. The wood was purchased by Nottinghamshire Wildlife Trust in 1973, but an intensive management regime was not initiated until 1999. In 2002 the body of a dormouse was retrieved from an owl box and one other adult recorded in a bird nest box. An extensive survey in 2003 found no evidence of dormouse presence although four adults were recorded in 2004. A hibernation nest was reported in 2007 (R. A t k i n s o n, pers. comm.). A study by B l a c k (2004) suggested three possible reasons for the apparent unsuccessful reintroduction:

1. The habitat was not ideal to support dormice but there were no other sites that were considered more suitable in Nottinghamshire.
2. Some of the captive bred dormice released in 1994 were in sub-optimal condition.
3. At the time of the release the management requirements of the wood conflicted with the habitat requirements for the dormice.

Fortunately all of these issues either have been, or could be, resolved.

At the time of the release in Treswell Wood in 1994 and 1995, an intensive woodland management programme was to be instigated to return the neglected woodland to its historical management of coppice with standards. It seems highly likely that the instigation of such a programme had an initially detrimental effect on the small and fragile dormouse population. However, as a result of the coppice management, the woodland has now become a more suitable habitat for dormice.

In spite of the previous failed release, Treswell Wood is being considered as a future release site. The 42 ha woodland is a suitable size for a release, there are two other woodlands within 3 km of the site with potentially good hedgerow linkage and the existing and future management of the wood appears assured.

Heslett and Peter Woods are two privately owned woodlands in Yorkshire in which a dormouse reintroduction was undertaken in 2004. The woodlands themselves are managed for game birds and there are a number of other woodlands in the immediate area linked by hedgerows of varying quality. In spite of the recent implementation of the release, northern sites within England are considered to be close to the historical northern edge of the dormouse's range and hence woodland and hedgerow management and maintenance are given a high priority. A questionnaire was distributed via a local Farming and Wildlife Advisory Group (FWAG) to farmers within a 5 km radius of the release site. 17% of these were returned with all the landowners offering support for the project and wishing to encourage dormice onto their land.

Four farmers and landowners within the immediate vicinity of the site have agreed to improve the quality and management of key hedgerows that will benefit arboreal connectivity to woodlands in the area.

## **Conclusions**

The reintroduction programme initiated in 1993 is generally considered to be a success. However, one of the key factors that is believed to have led to the general extinction of dormice within the Midlands and northern counties of England, namely woodland fragmentation, has not significantly changed. This problem may be compounded both by intensive hedgerow management and a lack of woodland management. It is felt that the future success of the dormouse reintroduction programme will rely on the careful selection of sites that are, and will continue to be, suitably managed and the realisation of the opportunity that a reintroduction can be used to promote the wider restoration of habitat linkages and improved woodland management.

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