Species composition of small mammals on Kemerton Estate, South Worcestershire

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Introduction

Agricultural land is a major component of the countryside of England, and a habitat for many species of flora and fauna. Kemerton is an estate in South Worcestershire composed of two farms, orchards, woodland and nature reserves. This includes 750 acres of arable land. The species composition of small mammals was of interest for several sites across the estate, especially where management had increased biodiversity. Floral, invertebrate and avian species surveys have regularly been carried out at Kemerton as part of national schemes, and a 10 year estate-wide monitoring scheme to determine the effects of changing farmland management and conservation techniques. Such management includes set-aside, arable wildflower margins, hedgerow management and managed grazing.

Research has shown that small mammal species such as wood mice and common shrews benefit from habitat corridors and increased food abundance due to sympathetic management of hedgerows and field margins (Hole et al., 2005). Small mammals are important as they provide a food resource for predatory birds and mammals. Therefore this survey of the mammalian species diversity in different habitats at Kemerton was carried out.

A wide range of habitats and the margins between them were studied; arable fields, set-aside, hay meadows, wetland, plantations, ancient and semi-natural woodland, orchards, hedgerows and rough margins. Live-trapping was used to compose a small mammal species list for each of these sites, and complement existing casual observation records.

A map of Kemerton estate and the location of each site is shown on the following page (Figure 1.). Black lines indicate the estate boundaries, and blue lines indicate individual sites.

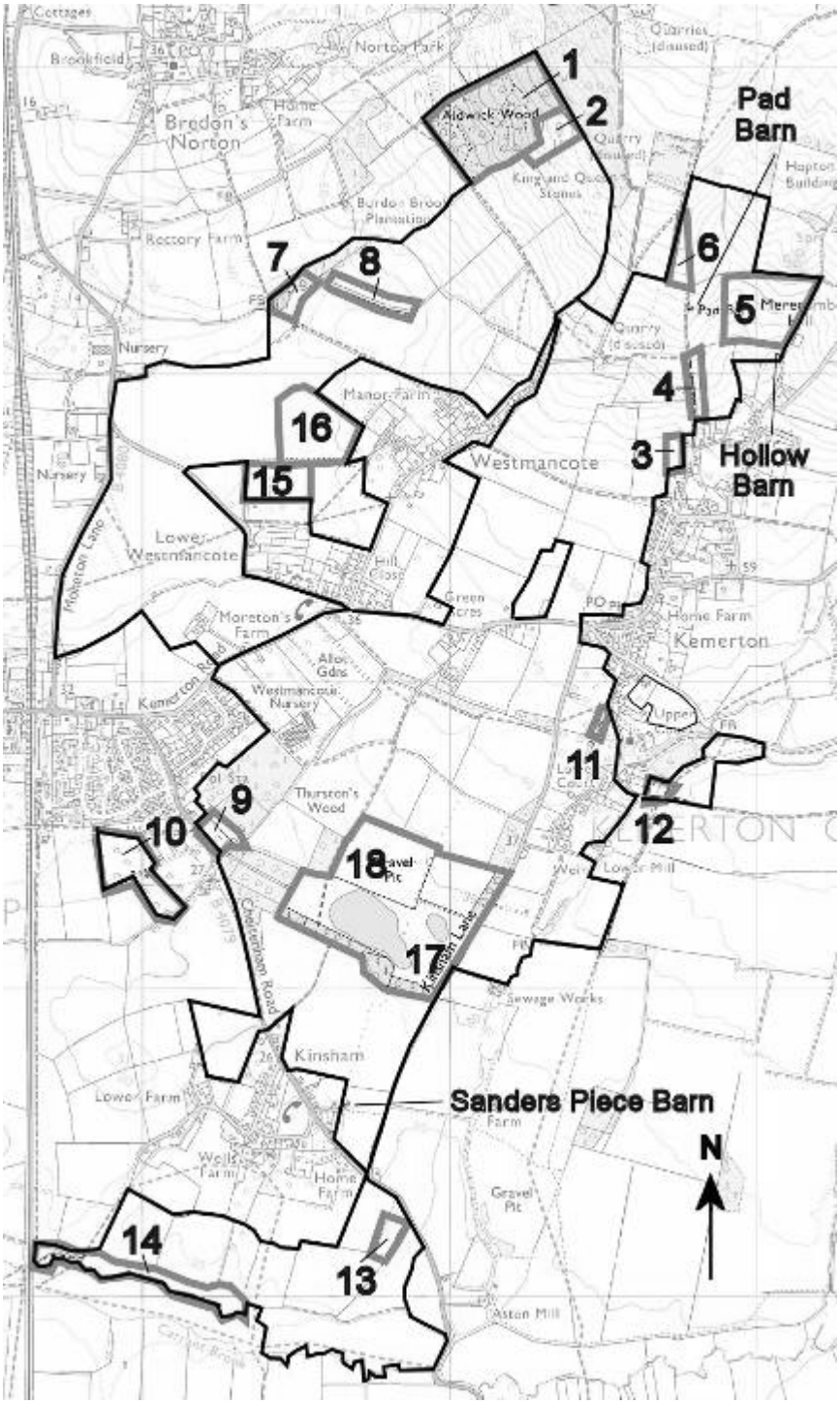

Fig. 1 Survey site locations on Kemerton estate

Site 1 Aldwick Wood
Site 2 The Bushes
Site 3 Daffurn's Orchard
Site 4 Pad Barn Track South
Site 5 23 Acres
Site 6 Roundhill
Site 7 Beggar Boys
Site 8 Deerfield
Site 9 Upstones Orchard
Site 10 Bensham's Wood
Site 11 The Lillans
Site 12 John Moore Nature reserve
Site 13 Cheltenham Road Field
Site 14 The Sling
Site 15 Chapel Field
Site 16 Livery Ground
Site 17 Kemerton Lake plantation
Site 18 Kemerton Lake scrapes

Methods

Live trapping was the main method of determining species composition at each site. Fifteen Longworth traps were set at eight trapping points on each site. Due to the low number of traps, the locations of trapping points were chosen randomly, and biased by characteristics such as vegetation cover, log piles and sources of fruit or seed. All traps were covered by natural vegetation to buffer them from weather conditions. Trapping took place during August and September, for three nights at each pair of sites. This allowed eighteen sites to be surveyed within five weeks.

Hay bedding was used for the traps, with a lining of non-toxic cotton wool bedding (Figure 2). Wheat and crushed peanuts were used as bait, with 'casters' (blowfly pupae) provided as food for shrews. There was no pre-baiting. Traps were checked at 8am and 4pm every day, and bedding and food replaced as needed. Any trapped mammals were removed, and their species, gender and condition were noted before they were released (Figure 3).

Fig. 2 Preparing a Longworth trap

Fig. 3 Examining a wood mouse

Simple habitat descriptions were created for each site, noting the abundance of each dominant vegetation species for each layer of habitat (tree, shrub, field and ground). Where trapping took place in field margins, the vegetation of the margins and not the fields was described. Photographs were taken of the sites.

Owl pellet analysis was also used. Pellets were collected from three barns around the estate, and species were identified from the skulls in each pellet.

Site descriptions

Photographs and descriptions of each site are shown below. For each site, composition of canopy layers in the area of trapping is described. Vegetation species are given a number on a scale from 0-5 depending on the estimated percentage cover (Table 1).

Number	0	1	2	3	4	5
% cover	0	1-5	6-25	26-50	51-75	76-100

Table 1. Scale for estimated percentage cover of vegetation

Site 1: Aldwick Wood Semi-natural ancient pasture woodland

Fig. 4 Aldwick Wood

Tree	Ash 3	Oak 2	Birch 1	Sycamore 1
Scrub	Hawthorn 3	Elder 3		
Field	Stinging Nettle 2	Bramble 2	Grass spp. 2	
Ground	Bluebell 3	Moss spp. 2		

Table 2. Habitat composition of Aldwick Wood

Thin leaf litter, bare ground, branches and logs were present.

Site 2: The Bushes Limestone grassland scrub

Fig. 5 The Bushes

Tree	Sycamore 2	Ash 2	Oak 1	Birch 1	
Scrub	Hawthorn 2	Elder 2			
Field	Grass spp. 3	Stinging Nettle 2	Thistle spp. 2	Ragwort 1	Meadow cranesbill 1
	Cow Parsley 1	Sorrel 1			
Ground	Ground ivy 2				

Table 3. Habitat composition of The Bushes

Thin leaf litter, bare ground, branches and logs were also present.

Site 3: Daffurn's Orchard Community orchard

Fig. 6 Daffurn's Orchard

Tree	Apple 2	Pear 2	Damson 1	Holly 1		
Scrub	Apple 1					
Field	Grass spp. 4	Bramble 2	Cleavers 2	Stinging Nettle 1	Thistle spp. 1	Sorrel 1
	Bird's-foot Trefoil 1					
Ground	Pineappleweed 1					

Table 4. Habitat composition of Daffurn's Orchard

Three sides of the orchard are bordered by fences and hedges with mature trees. Kemerton Conservation Trust have constructed several log piles around the base of trees and in the grass.

Site 4: Pad Barn Track South Arable wildflower bank adjacent to track and fields

Fig. 7 Pad Barn Track South

Tree					
Scrub	Hawthorn 3				
Field	Grass spp. 4	Bramble 2	Field Scabious 2	Greater Knapweed 2	Stinging Nettle 1
	Orchid 1	Traveller's-joy 1			
Ground	Moss spp. 1				

Table 5. Habitat composition of Pad Barn Track South

The field layer was dense, however, leaf litter was present under the hawthorn hedges.

Site 5: 23 Acres Arable set-aside with game-cover strip

Fig. 8 23 Acres

Tree					
Scrub					
Field	Wheat 3	Grass spp. 2	Thistle spp. 2	Sunflower 2	Maize 2
	Cow Parsley 2	Rape 2	Cornflower 1		
Ground					

Table 6. Habitat composition of 23 Acres

The field layer formed a dense canopy, meaning there was no ground vegetation or leaf litter.

Site 6: Roundhill Margin of limestone grassland SSSI

Fig. 9 Roundhill

Tree	Ash 3				
Scrub	Hawthorn 2				
Field	Grass spp. 4	Stinging Nettle 2	Red Dead-nettle 2	Field Bindweed 2	Thistle spp. 1
	Bramble 1				
Ground	Moss spp. 2				

Table 7. Habitat composition of Roundhill margin

A canopy of mature trees was present, and a drystone wall bordered the field. Leaf litter, twigs and bare ground were present.

Site 7: Beggar Boys Sedge bed and willow coppice within wetland site

Fig. 10 Beggar Boys

Tree	Willow 2				
Scrub	Bramble 2	Hawthorn 2			
Field	Water mint 4	Sedge 4	Grass spp. 3	Thistle spp. 2	Teasel 2
	Ragwort 2	Bulrush 1	Cleavers 1		
Ground	Moss spp. 1				

Table 8. Habitat composition of Beggar Boys

A dense field layer was present, and soil was wet away from the banks bordering the area.

Site 8: Deerfield Arable margin, ancient hedgerow and wet ditch

Fig. 11 Deerfield

Tree	Willow 3	Oak 2			
Scrub	Elder 2				
Field	Grass spp. 4	Bramble 2	Stinging Nettle 2	Thistle spp. 2	Horsetail 2
	Teasel 1				
Ground					

Table 9. Habitat composition of Deerfield

Leaf litter and bare ground were present.

Site 9: Upstones Orchard Damson orchard and hay meadow

Fig. 12 Upstones Orchard

Tree	Damson 4				
Scrub	Damson 2				
Field	Grass spp. 5	Stinging Nettle 3	Thistle spp. 3	Herb spp. 3	Sorrel 2
	White Clover 2	Burdock 2	Bramble 2		
Ground	Moss 1				

Table 10. Habitat composition of Upstones Orchard

Leaf litter and bare ground were present, and log piles had been placed against trees. Wood mouse caches of damson stones were found under several of these piles.

Site 10: Bensham's Wood Unmanaged plantation woodland

Fig. 13 Bensham's Wood

Tree	Ash 3	Oak 2	Sycamore 2	Alder 2	
Scrub	Hawthorn 2				
Field	Bramble 5	Grass spp. 4	Stinging Nettle 3	Greater Plantain 2	White Clover 2
	Common Sorrel 2				
Ground					

Table 11. Habitat composition of Bensham's Wood

The canopy layer was dense within the enclosure, leading to a thin field and ground layer. There were logs, leaf litter and bare ground.

Site 11: The Lillans Orchard margin with stream

Fig. 14 The Lillans margin

Tree	Willow 2	Oak 2	Sycamore 1	Apple 1	
Scrub	Hawthorn 2				
Field	Stinging Nettle 4	Grass spp. 3	Sedge 3	Thistle spp. 2	Burdock 2
	Rosebay Willowherb 2				
Ground	Ground Ivy 2	Moss spp. 2			

Table 12. Habitat composition of The Lillans

There was bare ground and leaf litter beneath the trees.

Site 12: John Moore nature reserve Old orchard planted with native trees and shrubs

Fig. 15 John Moore nature reserve

Tree	Ash 4	Oak 2	Sycamore 2	Field Maple 2	Alder 2
	Silver Birch 2	Apple 1			
Scrub	Elder 3	Hawthorn 2	Hazel 2		
Field	Stinging Nettle 3	Grass spp. 3	Ivy 3	Fern spp. 2	Rosebay Willowherb 2
Ground	Ground Ivy 2	Moss spp. 2			

Table 13. Habitat composition of John Moor nature reserve

Leaf litter, log piles and bare ground were present.

Site 13: Cheltenham Road Field Ancient hedgerow/field bank in arable field

Fig. 16 Cheltenham Road Field

Tree	Field Maple 3				
Scrub	Hawthorn 2	Elder 2			
Field	Grass spp. 4	Common Sorrel 3	Field Bindweed 3	Broad-leaved Dock 2	Hogweed 2
	Thistle spp. 2	Stinging nettle 2	Red Dead-nettle 2	Burdock 2	Rosebay Willowherb 1
Ground	Bird's-foot Trefoil 2	White Clover 2			

Table 14. Habitat composition of Cheltenham Road Field

Bare ground and rabbit warrens were present along the length of the hedge. Some leaf litter was present.

Site 14: The Sling Hay meadow bordered by a species-rich hedge and Squitter Brook

Fig. 17 The Sling

Tree	Willow 3	Ash 2			
Scrub	Blackthorn 4	Hawthorn 3	Spindle 2	Buckthorn 2	Dogwood 2
Field	Bramble 4	Stinging Nettle 3	Grass spp. 3	Thistle spp. 2	Common Sorrel 2
	Broad-leaved Dock 2				
Ground	Moss spp. 2				

Table 15. Habitat composition of The Sling

Hay, leaf litter and bare ground were present around the hedge.

Site 15: Chapel Field Unmanaged arable margin located near ditch

Fig. 18 Chapel Field

Tree	Field Maple 2	Pear spp. 1			
Scrub	Blackthorn 3	Hawthorn 3			
Field	Teasel 3	Dog Rose 3	Common Fleabane 3	Common Ragwort 2	Bramble 2
	Grass spp. 2	Thistle spp. 2	Stinging Nettle 2	Burdock 2	Common Sorrel 2
	Herb Robert 2	American Willowherb 2	Marsh Woundwort 2	Red Clover 1	Hoary Ragwort 1
	Hedge Woundwort 1	Black Medick 1	Field Bindweed 1	Hogweed 1	Great Willowherb 1
Ground	Bristly ox-tongue 2				

Table 16. Habitat composition of Chapel Field

There was little leaf litter or bare ground due to the dense vegetation.

Site 16: Livery Ground Arable margin with hedgerow

Fig. 19 Livery Ground

Tree	Willow 2	Oak 2			
Scrub	Hawthorn 3	Blackthorn 3			
Field	Grass 3	Thistle spp. 2	Bramble 2	Broad-leaved dock 2	Stinging Nettle 2
	Teasel 2	Common Sorrel 2	Common Ragwort 1		
Ground	Pineapple weed 2	Creeping Buttercup 1	Moss spp. 1		

Table 17. Habitat composition of Livery Ground

Bare ground, logs and leaf litter were present underneath the willow trees and hedgerow.

Site 17: Kemerton Lake plantation Enclosed plantation, gravel pit nature reserve

Fig. 20 Kemerton Lake plantation

Tree	Field Maple 3	Alder 3	Beech 2	Oak 2	Silver Birch 2
	Spindle 2	Guelder Rose 1	Privet 1		
Scrub					
Field	Grass spp. 4	Thistle spp. 3	Teasel 2	Common Sorrel 2	Rosebay Willowherb 1
Ground	Moss spp. 1	Ground Ivy 1	Bristly Ox-tongue 1		

Table 18. Habitat composition of Kemerton Lake plantation

There was limited leaf litter and bare ground present.

Site 18: Kemerton Lake scrapes Gravel pit nature reserve

Fig. 21 Kemerton Lake scrapes

Tree					
Scrub					
Field	Rosebay Willowherb 3	Grass spp. 2	Juncus 3		
Ground	Moss spp. 1				

Table 19. Habitat composition of Kemerton Lake scrapes

The scrapes were dry, and some bare ground was present.

Results

Due to the low number of traps, no population size estimates could be carried out, and the focus was on species diversity. Below is a map showing differences in species number across the estate (Figure 22). The highest species numbers were found in the Pad Barn area, where a wildflower bank, stream and hedgerows border arable fields. The habitat types of each site are varied, and are more important in determining species composition than their location.

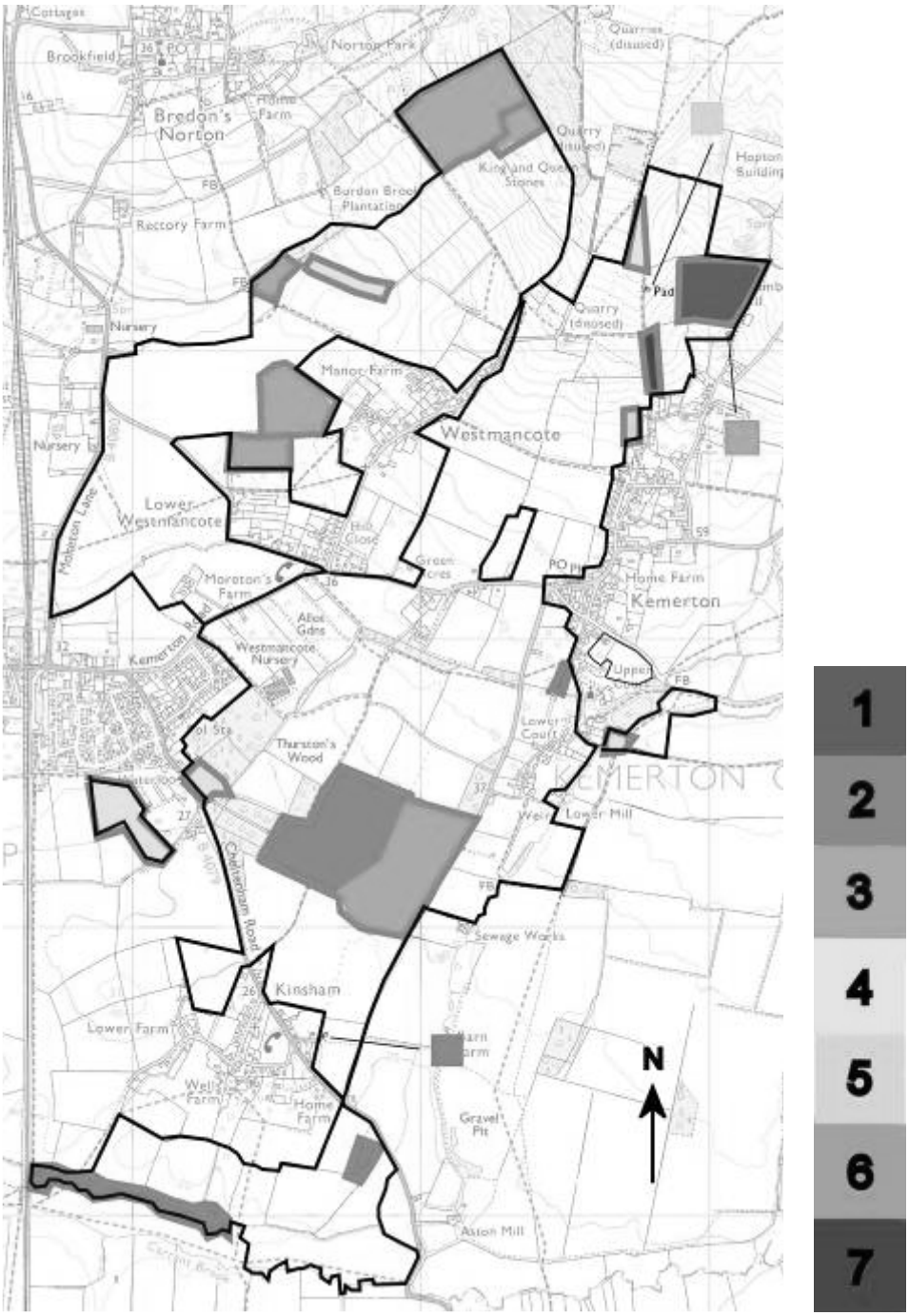

Fig. 22 Small mammal species richness across Kemerton estate

The number of species at each site, and the number of animals captured per trap-night are shown in Table 20 (below). The highest number of species was found at Pad Barn Track South, and the lowest number was at 23 Acres set-aside. The highest number of animals captured per trap-night was at Aldwick Wood, and the lowest was at 23 Acres. Number of species does not appear to have an overall relationship with number of animals captured.

Site no.	Site	No. of species	No. animals/trap-night
1	Aldwick Wood	3	0.94
2	The Bushes	3	0.56
3	Daffurn's Orchard	5	0.60
4	Pad Barn Track	7	0.44
5	23 Acres	1	0.22
6	Roundhill	4	0.53
7	Beggar Boys	3	0.73
8	Deerfield	4	0.31
9	Upstones Orchard	4	0.62
10	Benshams Wood	4	0.76
11	Lillans	2	0.38
12	John Moore	4	0.84
13	Chelt Road Field	2	0.86
14	The Sling	2	0.24
15	Chapel Field	3	0.60
16	Livery Ground	3	0.64
17	Lake plantation	3	0.52
18	Lake scrapes	2	0.48

Table 20. Number of mammal species per site and number of animals per trap-night

The number of individuals caught for each gender of four species is shown below (Table 21). Percentages were not used, because of the variation in the number of individuals of each species. It was not possible to consistently determine gender in other species such as common shrew.

Species
As = Wood mouse, *Apodemus sylvaticus*
Af = Yellow-necked mouse, *Apodemus flavicollis*
Cg = Bank vole, *Clethrionomys glareolus*
Ma = Field vole, *Microtus agrestis*

Species	Male	Female
As	124	140
Af	2	4
Cg	24	17
Ma	16	11

Table 21. Number of males and females caught for each species

Before this survey was carried out, small mammals on Kemerton estate were recorded through casual observation. The efficiency of different methods of recording mammals is therefore an area of interest. Table 22 (below) is a comparison of species

recorded at each study site using different methods of observation. A = Live-trapping in this survey, B = Owl pellet analysis and C = Casual observation

Species
As = Wood mouse, *Apodemus sylvaticus*
Af = Yellow-necked mouse, *Apodemus flavicollis*
Cg = Bank vole, *Clethrionomys glareolus*
Ma = Field vole, *Microtus agrestis*
Sa = Common shrew, *Sorex araneus*
Sm = Pygmy shrew, *Sorex minutus*
Nf = Water shrew, *Neomys fodiens*
Mm = Harvest mouse, *Micromys minutus*
Mus = House mouse, *Mus domesticus*

Site No.	Site	As	Af	Cg	Ma	Sa	Sm	Nf	Mm	Mus
1	Aldwick Wood	A		A		A				
2	The Bushes	A		AC	C	A	C			
3	Daffurn's Orchard	A	A	A	A	A				
4	Pad Barn	ABC		AB	AB	AB	A	A	AB	
5	23 Acres	A								
6	Roundhill	A		A		A	A			
7	Beggar Boys	A		C	A	AC			C	
8	Deerfield	A	A	A			A			
9	Upstones Orchard	AC			A	A	AC			
10	Benshams Wood	A		A		A	A			
11	Lillans	A	A		C					
12	John Moore	A		A		A	A			
13	Chelt Road Field	A				A				
14	The Sling	A				A				
15	Chapel Field	A	A			A				
16	Livery Ground	A			A	A				
17	Lake plantation	AC		AC	C	A				C
18	Lake scrapes	AC		C	C	A				C
-	Sanders Piece Barn			B	B					
-	Hollow Barn	B		B	B					

Table 22. Comparison of small mammal live-trapping, casual observation and owl pellet analysis

Discussion

Number of small mammal species varied widely between different sites on Kemerton estate (Figure 22, Table 20). Unmanaged sites (Chapel Field and Benshams Wood) had an average number of species. Pad Barn Track South was the most species diverse site, and owl pellets from Pad Barn contained five mammal species. This was expected as the wildflower bank and hedgerows provide a wide range of floral species and structural diversity. It was surrounded by arable fields that provide a source of food. There was a stream nearby, which may explain the presence of the water shrews.

Field margins increase biodiversity by providing additional food within the field; total small mammal biomass in autumn may be three times higher on 6-metre-wide

margins than on conventional field margins (Shore et al., 2005). The margins also provide shelter and are therefore used more than the centre of the field (Benton et al., 2003). Trapping in 23 Acres (set-aside) took place towards the centre of the field, near the edge of the game-cover strip. Traps could not be placed away from the margin of the game-cover strip because the set-aside vegetation was too sparse. Below the game-cover, the soil was bare and damp, meaning little food or ground cover. It has been shown that field voles are not recorded on set-aside until 9 months after establishment, due to sparse vegetation cover and lack of a protective layer of litter (Tattersall et al., 2000). These factors may explain why the trapping site in 23 Acres had only one species, and the lowest rate of animals captured per trap-night, despite being in a set-aside field. Roundhill, a nearby field margin site, had four species.

Only two small mammal species were recorded in The Sling. This was unexpected, as other biodiversity surveys showed a high number of species. Trapping in the area of The Sling took place within the edge of a hedgerow in a hay meadow. An old orchard was also present in the area. The hedgerow bordered a small brook, and was composed mainly of hawthorn, blackthorn and brambles – all producing an abundant supply of berries. It is not known why the species diversity was so low, although the cutting of the hay meadow may have caused field voles to leave the area, and the abundance of food in the hedge may have made the baited traps less attractive. Grass fields are a low quality habitat for small mammals (Fitzgibbon, 1997), and this may mean that not many animals visited the edge of the hedge. More species may have been captured if traps had been placed deeper into the hedge, although this would have left traps on the sloping banks of the brook.

Fitzgibbon (1997) showed that dynamics and size of wood mice and bank vole populations are strongly influenced by the presence of adjoining hedgerows and crops, as well as the maturity and density of the woodland. Size of woodland did not have such an important effect. These findings were reflected in this mammal survey, where low numbers of species were found in more isolated habitats such as 23 Acres, the hedgerow in Cheltenham Road Field, and the strip of vegetation bordering the Lillans orchard. In contrast, well-connected sites such as Pad Barn Track South, Daffurn's Orchard and Deerfield (connecting to Beggar Boys) had a higher number of species.

Differences in the location of bank and field voles were considered. Bank voles are rarely found outside woodland and hedgerows (Fitzgibbon, 1997). In contrast, hedgerow is often unsuitable for field voles, and they are usually patchily distributed in young plantations and field margins (Tattersall et al., 2000). When comparing sites where bank and field voles were found present (Table 22), overall this difference can be seen. For example, only bank voles were found in the hedgerow of Deerfield and mature woodland of Aldwick Wood, and field voles were found in the margins of Beggar Boys. Field voles were also found in orchards which have similar vegetation layer characteristics to young plantations. However, there were exceptions, such as only bank voles being caught in the young Kemerton Lake plantation. This may be due to its proximity to more mature woodland, and indeed several tunnels under the wire fence perimeter were observed.

Wood mice were the most abundant species in this survey. In many cases, the majority of traps were occupied by wood mice, especially on the second night of

trapping when animals would have become more used to the presence of the traps. This may have prevented other species from entering, therefore resulting in an incomplete species list for a site. The timing of the survey (August and September) may have affected the number of wood mice in field margins, as harvesting activity would drive the animals out from the centre of the fields. This may have allowed them to out-compete diurnal voles, despite the voles being active for about five hours before nocturnal mice (Pollard and Relton, 1970, Stoddart, 1982). Further to this, wood mice are more likely than bank voles to venture further from hedge bottoms and dense ground cover (Pollard and Relton, 1970), therefore traps in more exposed areas would be more likely to trap wood mice.

There are further factors that affected the chances that each species was caught in the traps. Trapping did not take place near buildings, therefore reducing the chance of capturing house mice. Harvest mice are unlikely to be caught in traps until early winter, and forage in the stalks of dense vegetation (Flowerdew et al., 2004). Therefore the fact that only one was caught was to be expected, as traps were set on the ground. This was exacerbated by the fact that the tripping weight for the treadle varied between traps, despite attempts to standardise it. This may have also excluded juvenile animals, due to their smaller size and weight. Juvenile shrews may have also been able to move underneath the treadle (Flowerdew et al., 2004).

The positioning of the traps may have excluded some species, as the positions were biased by features such as log piles and vole runs. However, animals are unlikely to venture out to areas with no cover or food. Placing the traps linearly may have created an 'edge effect', and there were too few traps to create an effective grid.

Table 21 shows that more female wood mice and yellow-necked mice were trapped than male. The opposite was shown for bank voles and field voles. However, the number of each species varied widely and gender was occasionally difficult to determine, therefore these patterns require further investigation.

Analysis of owl pellets has shown that field voles were the most numerous species (61% of all skulls), which corresponds with them being the main constituent of barn owl diets. Wood mice skulls were also numerous, and it has been indicated that barn owls are able to switch to these when there are too few field voles (Meek et al., 2002). Bank voles were caught by owls at all three sites, although not in great numbers, possibly because their habitat is sheltered woodland. The highest species number was for pellets from Pad Barn, although this may have been because more pellets were available for this site. However, it corresponded with the high species numbers from live-trapping at Pad Barn Track South. It was interesting that common shrews were only found in pellets from Pad Barn, as in other studies they have comprised a significant proportion of the barn owl diet (Meek et al., 2002).

When records of casual sightings were compared to the species found at each site (Table 22), there were some discrepancies. In particular, casual sightings of bank and field voles occurred in sites where no voles were trapped. This suggests that no single method is satisfactory for gaining an accurate species list for a site. However, an intensive trapping survey such as this produces a more comprehensive species list for sites. Owl pellets have obvious disadvantages, as the particular area from which each mammal originates is not known (although harvest mice were found both in owl

pellets and traps at Pad Barn). Therefore species present cannot be related to habitat types and management. However, it is also acknowledged that species such as wood mice can travel considerable distances (Fitzgibbon, 1997), and therefore animals may not inhabit the particular site they are observed or trapped in.

Number of species caught declined towards the end of the survey. This may have been due to the changing season. Repeating the survey at different times of the year may gain a more complete species composition. Further study could also include quantitative data if enough traps were obtained, allowing the calculation of population size and species density.

The effect of trap odour may have inhibited or increased the number of animals caught depending on their species and gender (Stoddart, 1982). Due to the schedule of trapping, traps could not be washed between every session. However, this is only one of many factors affecting the reaction of animals to the new objects in their environment. Individuals react to traps differently, and heterogeneity of habitat affects distribution of animals (Kikkawa, 1964). In the majority of sites in this study, number of animals captured increased on the second night of trapping, as they became accustomed to the traps. It is thought that three nights of trapping is sufficient to allow trap-shy individuals to become accustomed to the presence of the traps (Tanton, 1965).

Weather may have influenced numbers of animals caught, although low temperature does not have an effect on activity at night (Kikkawa, 1964). Fewer animals were caught after damp and cloudy nights (pers. obs.), as supported by Gurnell and Flowerdew (1994).

Although all efforts to minimise trap deaths were made, three shrew deaths occurred. However, other shrews were found live in the same checks, therefore each individual's condition and response to being trapped seem to have an important effect. There were no obvious reasons for the deaths, although shock from the trap or disturbance by predators may plausibly have occurred.

Conclusions

The mammalian species richness of each study site on Kemerton estate does not seem to relate to diversity of other flora and fauna. Overall, individual mammal species were found in habitats where they would be expected, and explanations for seemingly anomalous results have been discussed. Although factors such as vegetation structure and adjacent habitats were often important, species composition was not predictable overall. However, it was seen that arable fields alone do not support many small mammals, and farm woodlands, hedgerows and arable margins are therefore important habitats, especially when interconnected. The UK Environmental Stewardship scheme encourages creation of field margins, and following the results of this survey, this should lead to an increase in farmland mammal biomass. This was supported by a recent study by Shore et al. (2005).

It would be interesting to carry out future studies during different seasons, and with a larger numbers of traps so that small mammal population sizes could be estimated for Kemerton, and further information about the effects of the estate's habitat management could be gained.

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