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# SongBird Survival

# A REVIEW OF THE IMPACT OF MAMMALIAN PREDATORS ON FARM SONGBIRD POPULATION DYNAMICS

Prepared for Songbird Survival

July 2006

**Songbird Survival, PO BOX 311, Diss IP22 1WW**
**Registered Charity No. 1085281**

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# A Review of the impact of Mammalian Predators on Farm Songbird Population Dynamics

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**Prepared by:**

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SONGBIRD SURVIVAL

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## Summary

With intensification of farming methods and inputs in the 1950s to 1980s there were changes in the landscape fabric and issues around toxicity of agricultural chemicals which had an adverse effect on the ecology of farmland. There is still supposition that some current agricultural practices are responsible for a decline in song birds on farmland. However, there is also clear evidence that increased levels of predator activity have a negative impact on song bird and other farm bird populations. Current policies relating to agricultural intensification and selective species protection have favoured the expansion of top predators at the expense of other groups. Expanding raptor populations have taken a toll but there is strong evidence from work (much of which has remained unpublished) involving studies of mammalian predation that certain species may have a devastating impact. In this study the interactions between bird species including Skylark, Meadow Pipit, Wren, Dunnock, Robin, Blackbird, Song Thrush, Blue Tit, Great Tit, Chaffinch, Greenfinch, Yellowhammer, Reed Bunting and Corn Bunting with Hedgehog, Brown Rat, Grey Squirrel, Mink, Stoat, Weasel, Otter, Badger, Fox and Domestic ( including Feral ) Cat are reviewed. The interactions do not cover all possible combinations due to lack of data and physical or geographical separation. Care has been taken to isolate the impact of raptors from that of mammals but where there are interactions between avian and mammalian predators in the data sets an attempt has been made to identify the relative importance.

This review identifies Feral Cats and Grey Squirrels as major mammalian predators across a wide range of bird species and non-cropped/cropped edge habitats. Stoats are heavy predators on a number of species across most habitats. Hedgehogs are heavy predators on some hedge bottom and ground nesting species. Fox activity affects most species, but severe impact is restricted, although specific localised predation (as with the next two species) can be devastating. Mink and Weasels predate a wide range of species but severe impact is localised. Brown Rats predate a number of species, but do not interact with them all. Badgers have an impact on some species in some habitats, especially ground nesting birds, but generally scavenge more than predate, although some nest sites are targeted. Otters, although they will rarely predate, have a very limited impact on the bird species under discussion here.

Where high densities of Sparrow Hawks and Kestrels have been recorded the adult bird mortalities and nest loss of hedge and grass margin nesting bird species may be as high as 85%. High Grey Squirrel densities result in > 93% mortalities in woodland edge/hedgerow nesting species with Cats causing total mortality in some field edge/hedgerow and open field situations. Where both Sparrow Hawk and Grey Squirrel activity is significant there is frequently 100% predation of nests and over 85% predation of adults, with the ratio of bird to mammal predation varying from 35:65 to 75:25.

# Introduction

This review was commissioned by Songbird Survival in April 2005. It is intended to bring together published and new, unpublished research evidence of the impact of mammalian predators on farm bird populations. Much of the information has been derived co-incidentally from medium to long term studies of agricultural areas within the UK which were established to evaluate other aspects, eg. the effects of different farming systems on soil invertebrates ; the significance of non-cropped areas to overall biodiversity ; landscape fabric and vertebrate activity ; small mammal populations on organic and conventional farms. A full list of studies is presented in Appendix 1. It should be noted that the identity and exact location of some sites/studies is not given. Some of the work was carried out on a commercial basis and whilst the incidental findings relevant to bird populations reported here do not form part of that restricted information the overall confidentiality must be respected.

### 1. Rationale

This review has been prepared to evaluate published and unpublished research relating to the role of mammalian predators in farm bird population dynamics. It has been undertaken against the background argument that increased predation is as much of a factor in the decline of farmland birds as modern agricultural production practices. There are clearly many factors involved, such as location, type of farm, landscape fabric, farming system, range and densities of bird species present, range and density of avian and mammalian predators present and reliability and interpretation of the data available.

Ten mammal species and fifteen bird species are discussed below. These are Hedgehog *Erinaceus europaeus*, Brown Rat *Rattus norvegicus*, Grey Squirrel *Scuirus carolinensis*, Mink *Mustela lutreola*, Weasel *Mustela nivalis*, Stoat *Mustela erminea*, Otter *Lutra lutra*, Badger *Meles meles*, Fox *Vulpes vulpes*, Cat *Felis domesticus* ; Skylark *Alauda arvensis*, Meadow Pipit *Anthus pratensis*, Wren *Troglodytes troglodytes*, Dunnock *Prunella modularis*, Robin *Erithacus rubecula*, Blackbird *Turdus merula*, Song Thrush *Turdus philomelos*, Whitethroat *Sylvia communis*, Blue Tit *Parus caeruleus*, Great Tit *Parus major*, Chaffinch *Fringilla coelebs*, Greenfinch *Carduelis chloris*, Yellowhammer *Emberiza citrinella*, Reed Bunting *Emeriza schoeniclus*, Corn Bunting *Emberiza calandra*. Some are widespread and common, others are almost incidental to the farm fauna. To some degree this is reflected in the amount of data available, although some specific interactions are important to understanding the mammal predator-bird prey dynamics and therefore some 'minor studies' assume greater importance..

## 2. Methodology

The information presented here has been collected from many different sources with varied methodologies involved. The generic descriptions of techniques involved is briefly presented and coded here and then the codings and any further detailed explanations are applied to each table representing the output of a particular study or programme. One of the key techniques is the direct analysis of feeding remains and activity patterns on a quantified basis. This technique has been developed by the author over the last 35 years and has the advantage of enabling positive identification of both predator and prey species and this can be used to back up observational 'count' data where limited resources do not permit mark and recapture or other quantified population data.

MAMMAL DATA (M)

Various methods have been used including Population Census by live trapping and mark/release programmes (M1); counts of marked animals (M2); road casualty counts on a quantified basis (M3); 'set point/time' observation of mammal activity (M4); Indices of activity, based on quantified evaluation of signs such as tracks, feeding remains ( including direct bird kills, egg and nest predation ), droppings and homes per unit area/distance (M5); non quantified signs (M6). In some cases detailed analysis of droppings (M5i) has been employed and this is also coded under bird data as a means of gauging the interaction between the mammal and bird species involved. In addition, some studies have involved the controlled manipulation (mainly reduction) of predatory mammals on the target area (M7) or changes/cycles brought about by external, but known intervention (eg. control of Grey Squirrels on adjacent forestry areas (M8). Where general review articles are quoted and no details of methods are known the code M9 is applied.

BIRD DATA (B)

Population dynamics have been assessed by direct census methods including BTO Common Bird Census material (B1), direct counts within study areas (B2), territory/nest counts (B3), carcasses/feather remains (B4); indices of activity based on quantified evaluation of signs such as tracks and feeding signs (B5), non quantified signs such as droppings and moulted feathers (B6). Predation from has been assessed from egg/nest remains (B7) as well as B3 above. Where general review articles are quoted the code B8 has been applied.

GENERAL DATA (G)

Comparisons between farming systems (G1) and cropped/non-cropped areas (G2) are detailed. Other habitat variables are also considered in some studies (G2i). Although not directly relevant studies involving soil invertebrate (G3) or surface invertebrates (G4) are reported. Some projects involve habitat manipulation or intervention (G5).Crop rotation changes (G6) have an impact and general review articles with no details of methodology are coded G7.

# Results

After a qualitative evaluation which summarises the review and research data the results are presented and discussed on a study by study basis.

# 1. Qualitative Summary of Interactions

**Table 1**

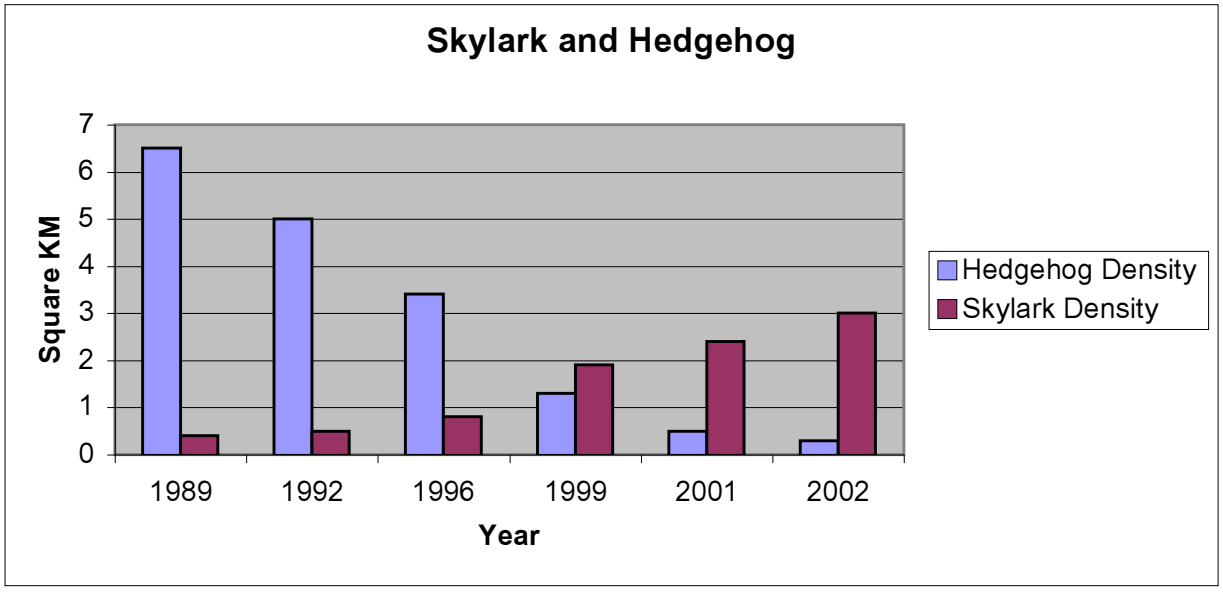
The summary table is based on the sum of the available review and unpublished research information, which is presented for the first time below. It is qualitative and based on the reported or observed frequency of interaction between mammal and bird species and should be regarded as a guide and not a categorical statement. Quantified individual studies are presented below in relation to species. Some predatory mammal species record a universal negative interaction whereas others are largely neutral. Most have some effects on specific bird species and/or specific habitats.

| **Bird Species** | **Mammal Species** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cat | Grey Squirrel | Brown Rat | Hedge-hog | Weasel | Stoat | Fox | Mink | Badger | Otter |
| Skylark | | | | | | | | | | |
| Meadow Pipit | | | | | | | | | | |
| Wren | | | | | | | | | | |
| Dunnock | | | | | | | | | | |
| Robin | | | | | | | | | | |
| Blackbird | | | | | | | | | | |
| Songthrush | | | | | | | | | | |
| Whitethroat | | | | | | | | | | |
| Blue Tit | | | | | | | | | | |
| Great Tit | | | | | | | | | | |
| Chaffinch | | | | | | | | | | |
| Greenfinch | | | | | | | | | | |
| Yellowhammer | | | | | | | | | | |
| Reed Bunting | | | | | | | | | | |
| Corn Bunting | | | | | | | | | | |

**Legend:** **- Highly Negative,** **- Negative,** **- Neutral**

# 2. Quantitative Studies/Results

**Table 2**

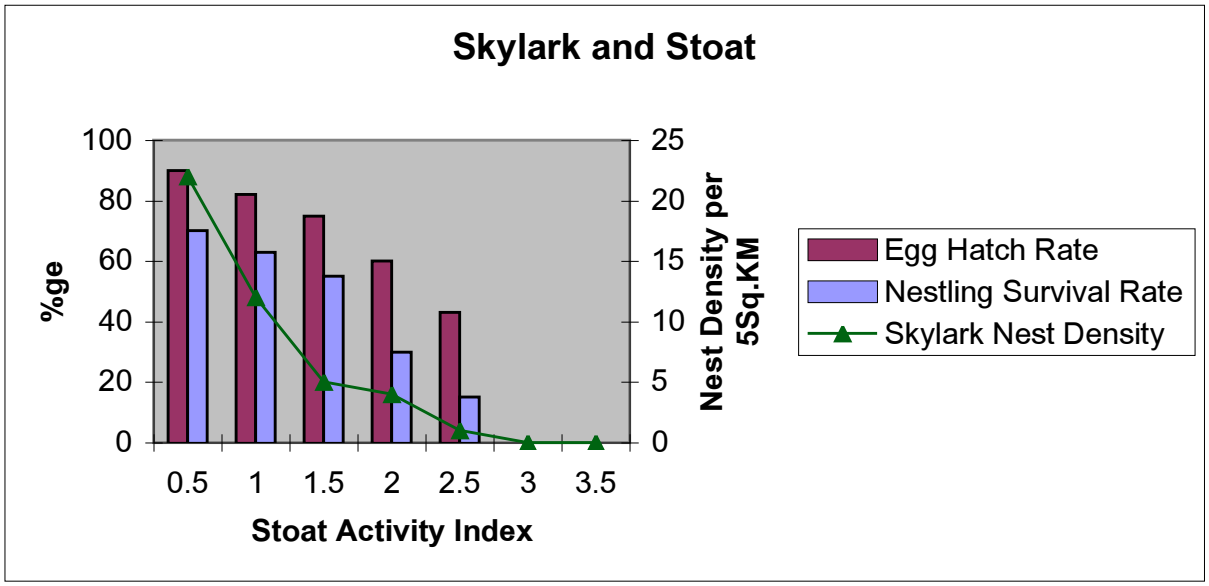



Summary of methods: M3, M4, M5; B2, B3; G2i, G6.

In this project a series of four neighbouring farms on the Essex and Suffolk border were investigated. The farms were all conventionally managed for the period of the study (two are currently managed on minimum tillage regimes) and Good Agricultural Practice (GAP) was applied throughout the period. The hedgehog density and skylark populations were monitored over a fourteen year period. Although no quantitative work was carried out on raptor populations there was an observed steady increase in Sparrowhawk activity. Skylark densities were calculated from field counts carried out on a weekly basis in May to July on ley, stubble and set aside fields in the rotation of each farm. Field sizes are relatively small for the area (x = 8.5ha) and there is a high ratio of non-cropped to cropped area (about 9:1). Hedgehog activity was assessed from feeding remains, dropping density and road mortality. Two major and three minor, but busy, roads border or run through the area giving a 'contact length' of just on 8km. Road casualties were used to finalise the density calculations recorded in Table 2. It is fair to say that little change was made to the agricultural regime on the farms over the period, except that from 2001 onwards the predominantly autumn sowing of crops was moderated with about 30% of fields going onto a spring planting cycle with resultant overwinter stubbles favouring Skylark activity. Insecticide use decreased by about 6% (volume) over the period. However, it is clear from the results between 1989 and 2001 that as hedgehog activity declined skylark activity increased, despite a possible increase in other predators. The increase in bird activity is perhaps not as great as might be expected after the dramatic decline in hedgehog activity if all other factors remained constant.

**Skylark and Stoat**

**Table 3**



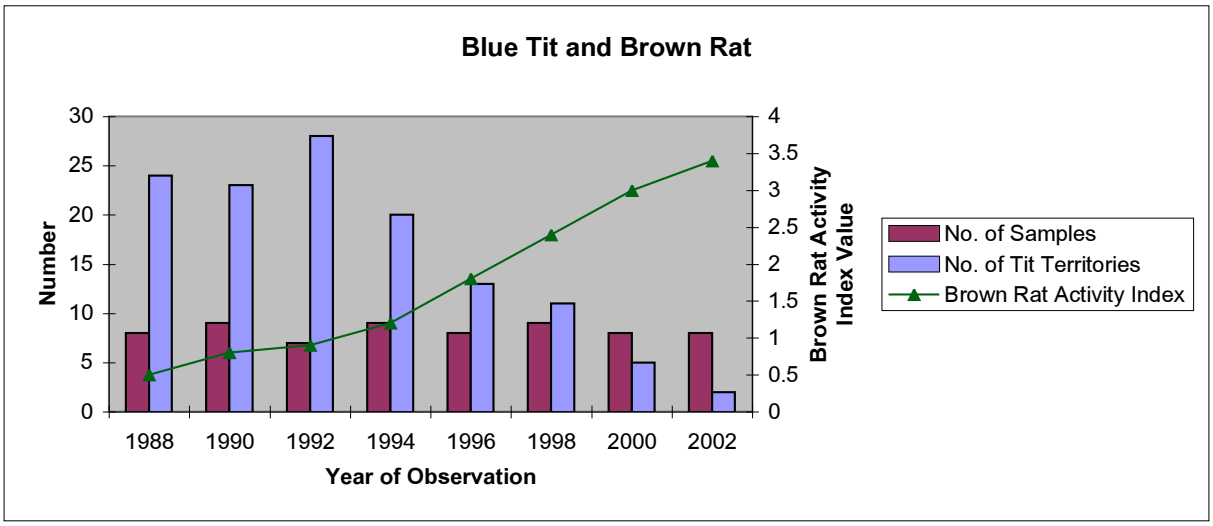

**NB The number of sample areas was 11. The number of years in which nest densities and Stoat activity indicies were recorded was also 11, giving a total data set of 121 recorded 'points'.**

Summary of methods: M3, M4, M5, M8; B2, B3, B4, B7; G2i.

The inbye areas of eleven extensively managed hill farms in the North Pennines were monitored between 1996 and 2002. Game keeper input on neighbouring estates was dramatically decreased and whilst crow and fox activity was regulated, the stoat population was not, and activity levels increased dramatically over the period. There was a drastic decline in skylark nests within a year and although remaining birds, who were perhaps more adept at avoiding predation, managed to maintain reasonable hatching rates for four years nestling survival rate dropped back after three years and by year five all skylark activity had ceased. There were Meadow Pipits present and these also showed decline and virtual disappearance, but no quantitative data on nesting activity and nest densities was collected. Skylark information was based on formal transect analysis from February to July each year and Stoat activity was assessed from intensity of feeding remains and other signs (as per the protocol).

**Blue Tit and Brown Rat**

**Table 4**




**NB Evidence of direct predation on eggs is discussed separately**

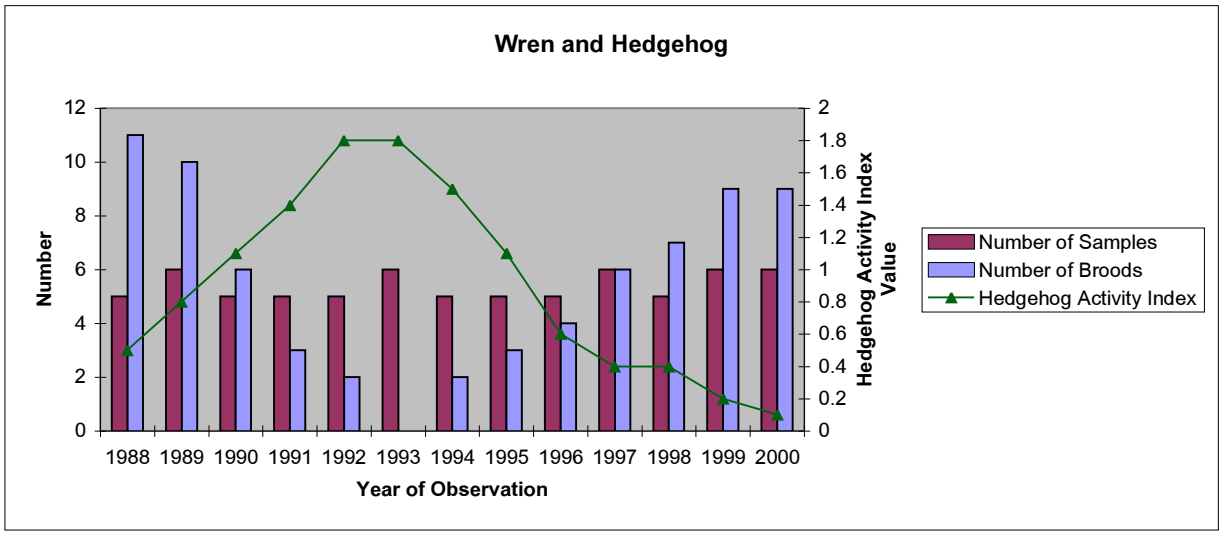
Summary of methods: M1, M2, M5, M6; B3, B7; G2, G3, G4.

This study was carried out as part of a project to assess changes in field margin and hedgerow mammal populations in relation to pilot and then mainstream Countryside Stewardship Schemes in the Vale of Pickering, North Yorkshire. In all cases extended margins and hedgerow regeneration were primary management objectives. Nine farms were involved, but in some years it was only possible to visit 7 or 8 for the annual assessment between March and July. Brown Rat activity was assessed from live trapping/mark/recapture, feeding remains, including direct nest predation, dropping and track densities in sample areas which were regularly cleared of faeces and smoothed to gauge intensity of movement. Tit territories were based on number of established nests.

The data shows clearly the drop in Tit success as Brown Rat activity increases with marked declines once the 1.0 index is reached and again when the 3.0 threshold occurs. This in spite of a habitat in which niches for tit activity would be increasing. Sparrowhawk predation was present, but remained constant over much of the study period and there were no other significant changes either predation levels or farming practice.

## Wren and Hedgehog

**Table 5**



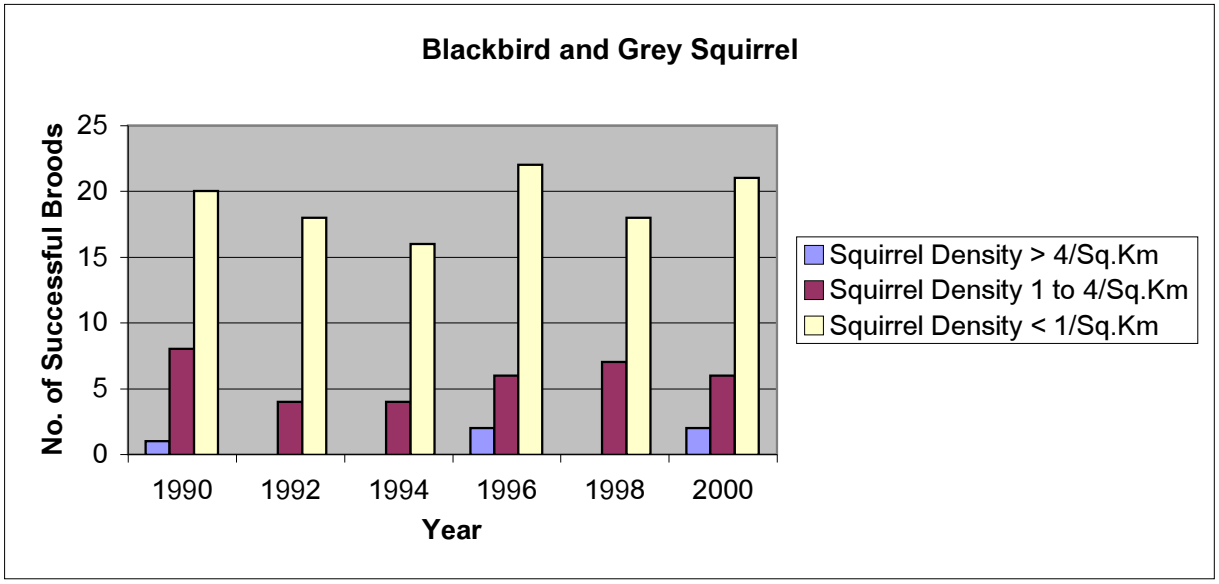

**NB Formal observations not possible from 2001 onwards, but there is evidence of increase in hedgehog activity with a corresponding decline in breeding success again. Other factors have remained constant.**

Summary of methods: M2, M5, M6; B3, B5, B7; G2, G2i, G3, G4.

This long term study was undertaken to investigate hedge bottom invertebrate dynamics on six farms managed through organic conversion. For reasons not fully understood the levels of hedgehog activity were at a low level and then increased before declining again. There was a reciprocal response in the breeding success of the wren population. There was no evidence of changes in levels of other predator activity. Although the causes of change in hedgehog dynamics were not identified and there may have been other factors relating to the changes in wren brood size there was clear cut evidence of direct nest predation by the insectivores.

**Blackbird and Grey Squirrel**

**Table 6**




**Based on one extensive fixed area study in Breckland, Norfolk, England**

Summary of methods: M2, M4, M5, M6; B3, B4, B5, B6, B7; G2.

Squirrel activity was monitored across the farm complex, which had a woodland/plantation complex on its' southern boundary. Over a period of 6 years the number of hedgerow breeding pairs of blackbird was monitored as part of a non cropped area evaluation exercise. It was possible to compare areas with high, medium and low densities of Grey Squirrel in terms of nesting success taking account of year on year background fluctuations. Squirrel densities of 1 to 4km2 dramatically reduced successful blackbird breeding against low densities (less than 1 Grey Squirrel km2) whilst high densities (more than 4km2) saw the virtual cessation of breeding activity, except in years of high competition within the blackbird population when an odd 1 or 2 pairs defied the intense squirrel activity.

Throughout the duration of the study the farming practice remained consistent, although both Sparrowhawk and Feral Cat activity increased. Analysis of predator feeding remains confirmed that cat and Sparrowhawk activity accounted for less than 15% of total losses, the bulk of the losses of eggs and nestlings and abandonment of nests being related to Grey Squirrel activity.

**Presence of Farm Bird Remains in Badger Faeces (based on 93 qualitative studies, abstracted from Hounsome and Delahay 2005)**

**Table 7**

**46 species were recorded, many too large or normally inaccessible to have been killed by badgers. By implication much scavenging has been involved and this may well apply in part to the farm bird species recorded below, although some predation is likely. No quantification is possible from the results.**

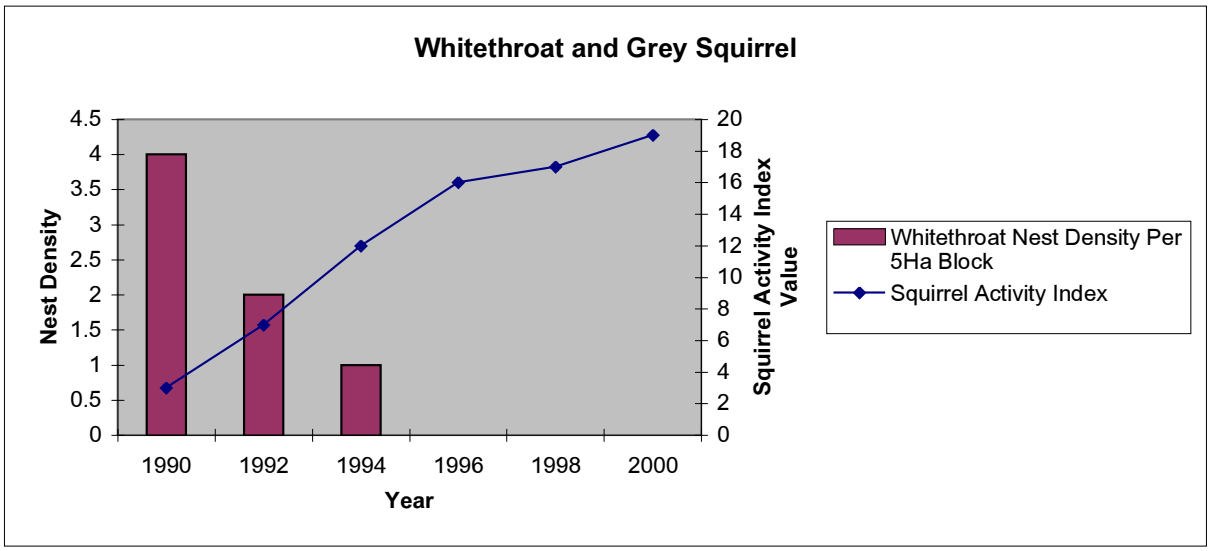
**Skylark**
**Meadow Pipit**
**Dunnock**
**Robin**
**Blackbird**
**Song thrush**
**Titmice**
**House Sparrow**
**Chaffinch**
**Yellowhammer**

Summary of methods: M9; B8; G7.

This review article summarises in a non-quantitative way the involvement of badgers in taking small farm birds (a number of ground nesting species falling outside the remit of the current review are severely negatively influenced by badger activity). It confirms that 10 bird species discussed in this review have been recorded from badger faeces in northern Europe, but no quantified data is included and the relative importance of predation and scavenging cannot be established. Observations from the author's Leicestershire and Essex studies discussed here indicate that Skylark and Meadow Pipit may be vulnerable to direct predation whilst other species are incidental prey. All bird species on the list in table are scavenged.

**Whitethroat and Grey Squirrel**

**Table 8**



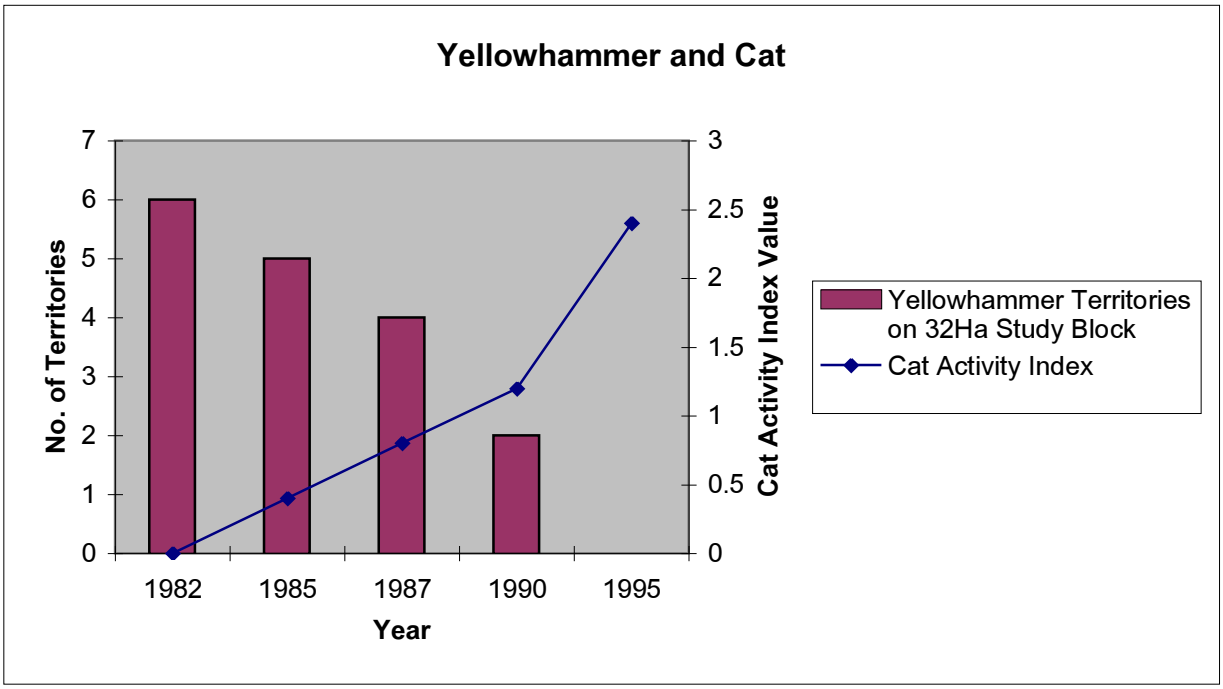

Summary of methods: M4, M5, M7; B2, B5, B7; G2.

The data relates to an eleven year period of observation on three large blocks (about 11ha in total) of deciduous farm woodland adjacent to intensive arable areas with 15 year old (in 1990) coniferous plantation about 100m away in North Yorkshire. The project was established to monitor the impact of Grey Squirrel populations on woodland edge flora and fauna as the intensity of activity increased after initial colonisation/utilisation of the study areas. In addition to direct observational methods and counts of both mammals and birds/nests the study relied heavily on quantified signs (feeding remains, tracks and droppings per unit area) to establish intensity of squirrel activity and nest predation to measure bird response. Moderate levels of squirrel activity resulted in complete loss of breeding whitethroats by year six and no recovery in the following years as squirrel activity and 'questing' into the deciduous areas increased even further.

There was a policy of controlling stoat and crow predation in the deciduous woodland introduced in year three but no other factors were varied in the life of the observational period and the negative impact of even moderate levels of grey squirrel activity is clear.

**Yellowhammer and Cat**

**Table 9**

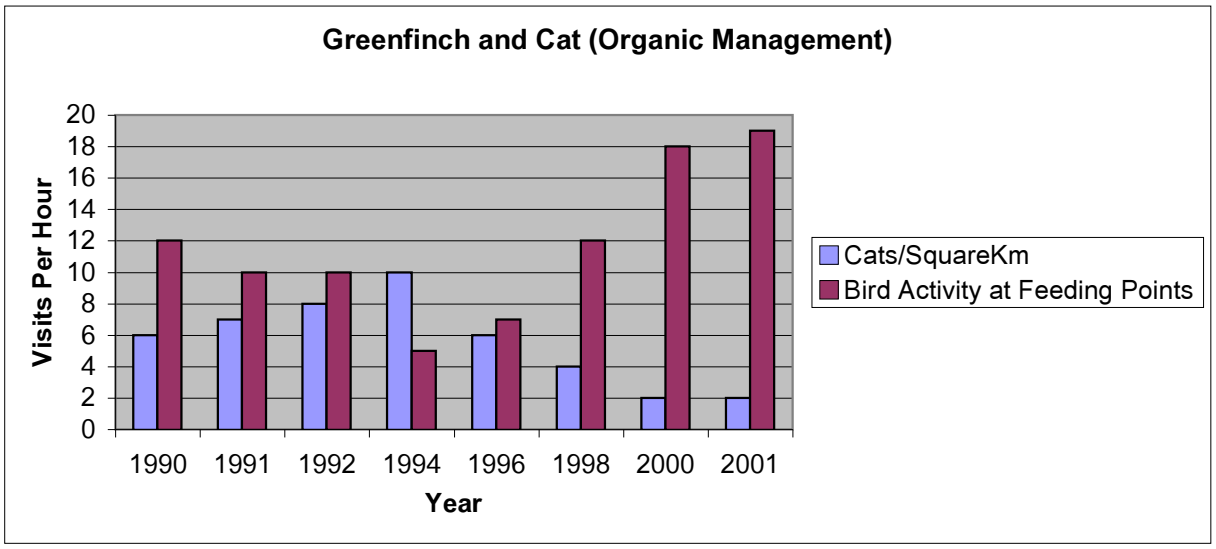


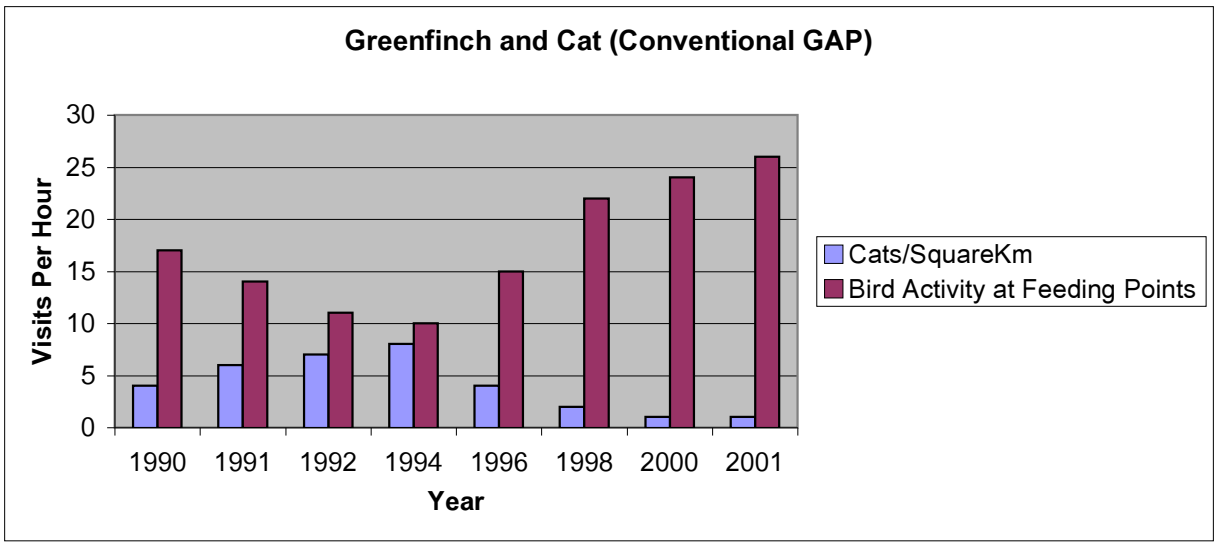

Summary of methods: M4, M5, M6, M8; B3, B4, B5

This small study followed the increase in cat activity as an area within the Milton Keynes boundary (Shenley) was built up with low density housing around a retained agricultural /woodland enclave in the 1980s. Various bird species were monitored, partly by dedicated observation on site and partly by reference to Common Bird Census records, and Yellowhammer showed a dramatic negative response. Much of the predation was confirmed through analysis of feeding remains (especially feather and carcass) analysis. Although some other habitat factors were modified as a result of the building and effective isolation of the study area the direct relationship between increasing cat activity and Yellowhammer decline are clear and substantiated by the 'kill remains'.

**Greenfinch and Cat**

**Table 10**




**Based on observations in January - mid March at feeding stations on adjacent farms with identical crop rotation, but organic with higher cat densities before and after control. Both farms have 4.5% non cropped area.**

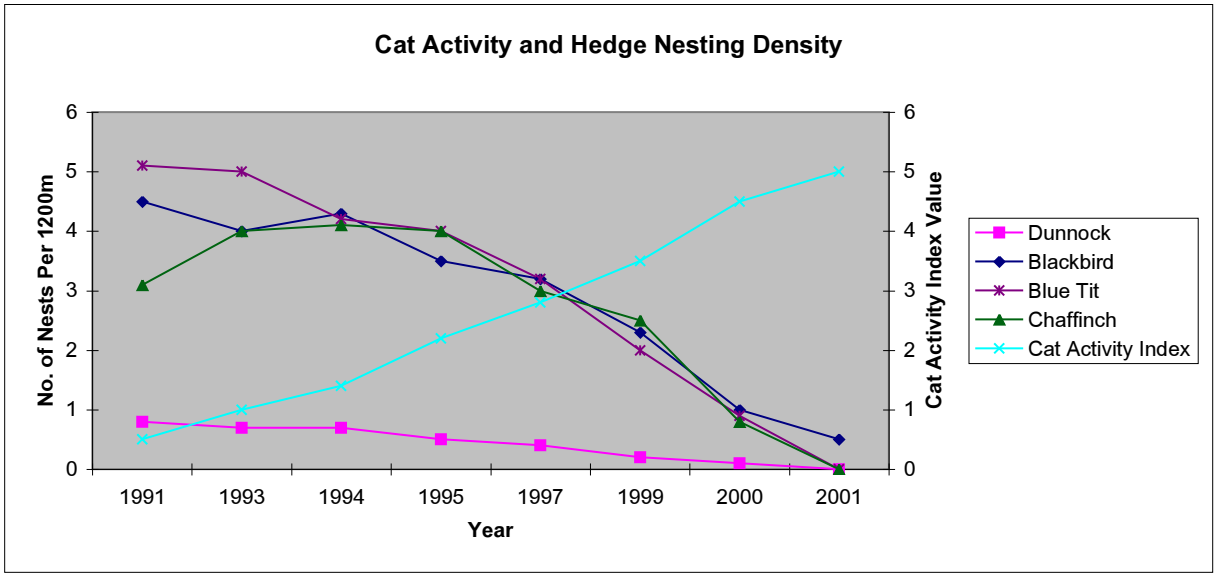
Summary of methods: M4, M5, M7; B2, B4, B5; G1, G2

Over a period of 11 years Greenfinch activity has been monitored on two adjacent farms in Herefordshire, one under organic management the other on conventional GAP. The organic farm was in the second year of conversion in 1990. The main purpose of the study was to examine the differences in biodiversity between the two systems based on vegetation structure and invertebrate activity. The study of bird predation was incidental to the main project. The observations were quantified by frequency of bird visits to winter feeding points. The general characteristics of the two farms were similar with about 4.5% of the total areas being outside cultivation. The second factor was the change in feral cat population. Numbers increased to maximum densities in year five (1994) after which the population was reduced by a neutering programme which resulted in dramatic reductions in cat activity.

In general terms the Greenfinch activity was slightly greater overall on the organic land at all times. In interpreting the differences in both cat and Greenfinch activity between organic and conventional systems it is significant that initial cat density was lower and finch activity was higher irrespective of the differences in management system. In both systems there was an inverse relationship between cat numbers and Greenfinch activity. This was confirmed by feeding remains as well as direct observation, ie. the reduced number of bird visits was a result of reduced numbers due to cat predation. There was no significant change in other predator population/activity levels. The level of cat activity was the overriding factor in moderating Greenfinch (and other species not reported here) populations in the winter months.

**Cat Activity and Hedge Nesting Density**

**Table 11**




**NB These figures are against a background of low level Sparrowhawk presence which remained stable over the duration of the observation period (as did the other potential mammal predators).**

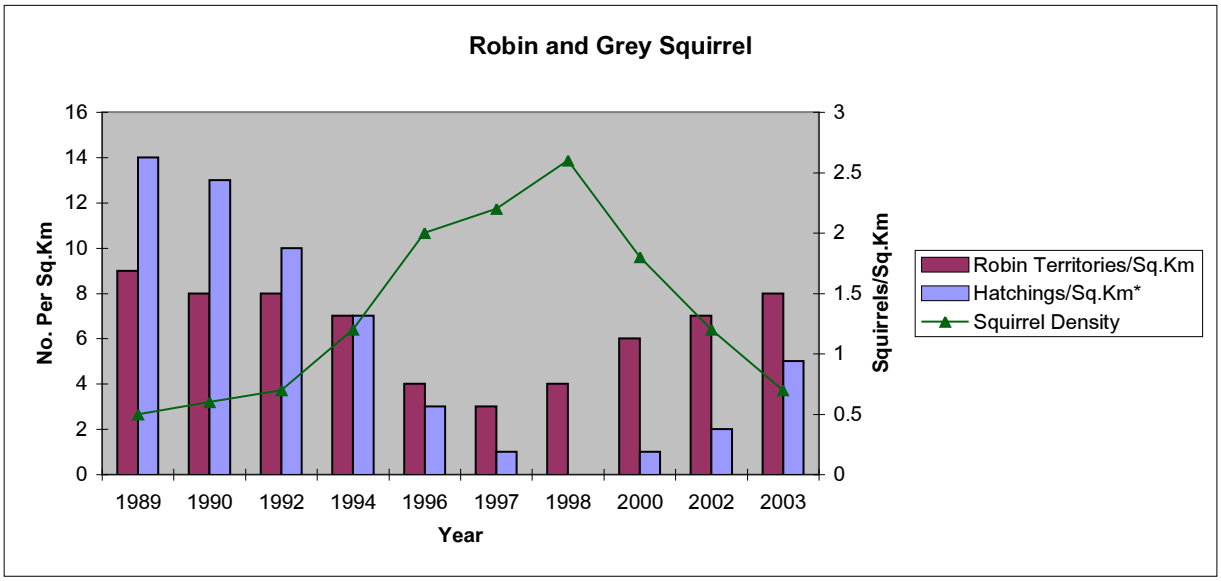
Summary of methods: M4, M5, M6; B3, B4

In this 10 year study of a medium size arable farm under conventional management with targeted inputs and sensitive conservation management of non cropped areas the decline of four long established hedge nesting species was recorded as the intensity of cat activity increased. The higher levels of activity, recorded by direct kill evidence, was brought about by increase in number of dwellings, obviously some with pet cats, as a nearby village expanded and by dramatic upsurge in feral cat activity as a result of escapes and uncontrolled breeding from a semi defunct cat sanctuary (finally closed at the end of 2001).

Although the four bird species had different initial densities the consistent decline is clear in them all. Other than an increase in Sparrowhawk activity from late 1999 other factors remained constant. It is likely that the added bird predation of the last two years hastened the almost complete demise. Although no systematic recording has taken place since 2001 it has been noted that both cat and sparrowhawk activity are at a very low level. Other than a significant Blackbird recovery there has been limited re-establishment of the hedge nesting population.

**Robin and Grey Squirrel**

**Table 12**




*** Numbers from all territories/nests surviving to flying stage.**

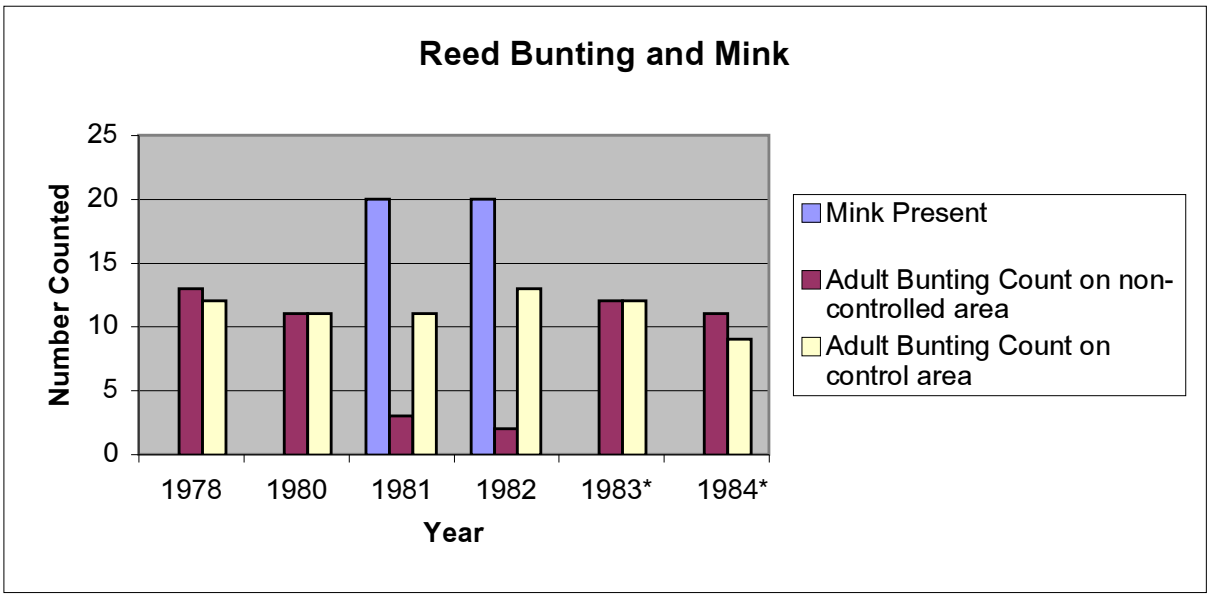
Summary of methods: M2, M4, M5, M7: B2, B3, B5; G2, G5

Although adjacent habitat change may have had an impact on both Squirrel and Robin behaviour from 1992 to 1996 there is a relationship between the increase and then decline in the mammal numbers and levels of activity with the decrease and then recovery of nesting intensity and survival of hatched birds. It has not been possible to sample since 2003 so it is not known if squirrel decline and robin recovery have continued. However, the evidence suggests that Grey Squirrel densities >2km2 may result in a dramatic decline in Robin breeding success in some habitats. In this instance extensive farm woodland and dense hedgerows were involved on three mixed north Midlands farms. It should be noted that recovery trends were rapid as the squirrel density dropped back below the 2km2 level in 2000.

This evidence confirms the significance of Grey Squirrels as a potentially wide ranging predator of both ground, hedge and tree nesting farm bird species.

**Reed Bunting and Mink**

**Table 13**




*** Mink controlled from February 1983 onwards**

Summary of methods: M4, M5, M5, M6, M7; B2, B3, B4, B5.

This study focused on the flash areas over the abandoned Chislet section of the East Kent Coalfield adjacent to arable areas with extensive non-cropped edges and wetland margins. It was particularly valuable as, by sheer co-incidence, there was an inbuilt control. There were two areas of almost equal size. Although when the study areas were established there were no mink present and the objectives of the work did not involve mammal predation the fact that one of the sections remained mink free made for a valuable comparison. In the section where mink appeared in late 1980 there was a dramatic decline in numbers of Reed Buntings in the annual June-July census, but no such decline in the control areas without mink. From the beginning of 1983 the mink were tightly controlled and from that spring Bunting numbers increased in line with those in the controlled section.

There were no other ancillary factors which might have complicated the trends and this appears to be a clear cut cause and effect response. Unlike some of the other studies direct signs of kills were less common, but remains in mink scats confirmed in qualitative terms at least, the direct relationship of mammal/bird interaction.

# 3. Key point summary

- Cats and Grey Squirrels have the ability to range over all habitats and nesting layers from tree top to ground. They are the main universal mammalian predators.
- Grey Squirrels have been recorded predating ground nesting birds at over 500m above sea level and > 3km from the nearest woodland.
- Stoats are heavy predators across all ground and hedge bottom/dyke habitats.
- Hedgehogs are locally very heavy predators on some hedge bottom and ground nesting species, especially where competition is high.
- Foxes predate or scavenge most species, but the activity is only intense at a local level.
- Mink and weasel predate a range of species, but intense activity is localised.
- Brown Rats are heavy predators on some key species.
- Badgers are mainly scavengers as far as the farm songbirds are concerned, but may have a major impact as predators on ground nesting species on rough grazing/moorland edge.
- Otters may predate, but are mainly scavengers and are largely neutral.
- Where there are high levels of Sparrowhawk and Kestrel activity up to 85% of all nests may be predated.
- Intense Grey Squirrel activity may result in 93% nest predation.
- Intense combined Sparrow Hawk and Grey Squirrel activity may result in 100% predation of nests and 85% of adult birds.
- The ratio of bird to mammal predation ranges from 35:65 to 75:25.
- On the basis of these ratios mammal predation is therefore always a significant factor and may be the dominant one.

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# APPENDICIES

**1. Description and Location of Study Sites**

A. Rhone Poulenc Agriculture, Essex.
   i. Boarded Barns Farm. 1992 - 2000. Comparison of Organic and Conventional Agricultural systems.
   ii. Bundish Hall Farm. 1995 - 1999. Integrated (ICM) farm management running in parallel with Boarded Barns Farm.

B. Birds Eye Walls Sustainable Agriculture Project, Humberside East Yorkshire), Lincolnshire, Suffolk and Norfolk. 1999-2001. Study of Vining Peas (with reference to invertebrate ecology: bird and mammal data incidental). Locations at Wrentham, Hickling Broad, Wroxham, Wetwang, Leconfield, North Dalton, Sunk Island, Barton on Humber, Hilbaldstow and Ellingham.

C. Unilever Colworth project, Bedfordshire. 1999 - 2002. Investigation of different agricultural systems and inputs with refrence to soil invertebrates : bird population interactions with predatory mammals incidental.

D. UAP Biodiversity project , East Yorkshire and Oxfordshire.1997 - 1999. Base line surveys on most aspects of the farms' ecology. Specific short term Brown Rat - bird population response investigation included.

E. CWS Agriculture. 1993 - 1997.
   i. Stoughton, Leicestershire. Detailed investigations of soil invertebrates and small mammals in response to Integrated Agricultural/Minimum input systems. Detailed incidental bird population - mammal predation studies.
   ii. Blairgowrie, Castle Fraser ( Aberdeen ), Wisbech and Down Ampney (Herefordshire). One year field margin studies with incidental mammal predation studies.

D. WWF Organic-Conventional Farming Biodiversity comparisons. 1993 - 94. 17 paired sites in Devon, Powys, Hereford, Gloucester, Derbyshire, Suffolk, Norfolk, Lincolnshire and Yorkshire. Detailed mammal - bird predation studies included.

E. One off studies. Time range from 1972 to 2004. Individual details as listed.

1. Davidstow, Bodmin,Cornwall. 1993 - 2004. Breeding bird and mammalian predator interactions.

2. Temple, Bodmin, Cornwall. 1995 -2002. Breeding bird and mammalian predator interactions.

3. Mary Tavy, Dartmoor, Devon. 1997 - 2002. Breeding bird and mammalian predator interactions.

4. Widecombe, Dartmoor, Devon. 1983 - 2000. Semi natural vegetation dynamics, soil invertebrates, moorland birds, avian and mammalian predators.

4. Wheddon Cross, Exmoor. 1991 - 1997. Mammal populations and behavioural patterns.

5. Sproxton, Quantocks. 1992 - 2003. Predatory mammal dynamics.

6. Sturry, Canterbury. 1971 - 1973. Wetland and farmland bird populations; predatory bird and mammal impacts.

7. Thetford, Norfolk. Two studies. 1990 - 2002. Farm biodiversity studies, including bird and mammal predator relationships; farming system comparisons.

8. Stocksbridge, South Yorkshire. 1998 - 2004. Vegetation dynamics, moorland and extensively farmed area bird populations; predators.

9. Patley Bridge, Yorkshire. 2000 - 2004. Marginal farmland birds and predator relationships.

10. Wombleton, North Yorshire. 1975 - 2002. Long term farm (2) ecological studies including farm birds, mammal populations and interactions.

11. Shawnhead, Dumfries. 1997 - 2001. Farmbird population dynamics; mammal activity.

12. Seale Hayne College Farm, Devon. 1989 - 1995. Manipulated farm ecology studies, including bird/mammal interactions.

13. Bishop Burton College Farm, East Yorkshire. 1995 - 1997. As in 12.

14. Swaledale, North Yorkshire. 1995 - 2004. Rough pasture bird populations and predator impact.

15. North York Moors. 1976 - 2000. Merlin and mammalian predation on moorland and moor-margin farmland breeding birds.

16. Glaisdale, North York Moors. 1977 - 1998. Mammal population dynamics.

17. Redmire, Wensleydale. 1999 - 2004. Mammal population dynamics.

18. Powburn, Northumberland. 1997 - 2004. Farm bird and small predatory mammal study.

19. Galashiels, Borders. 1999 - present. Upland farm and moorland bird populations with reference to avian and mammalian predation.

20. Islay, Inner Hebrides. 2001 - present. Farmland bird dynamics under changing management.

21. Auchtararder, Perthshire. 1996 - 2003. As in 20.

22. Callander, Stirling. 1997 - present. As in 20 and 21.

23. Auchnafree, Perthshire. 2003 - present. Rough pasture bird and small mammal predation.

24. Kingussie, Highlands. 2003 - present. As in 23.

25. Carrbridge, Inverness. 1974 - present. Long term, but intermittent, study of large predatory mammal population dynamics and effects on hill and farmland ground nesting birds.

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