# The current status of the brown hare (*Lepus europaeus*) in Britain

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# 6 General discussion

## 6.1 Introduction

Eighty-four percent of the hare population is found in the arable and pastoral landscapes. Since the brown hare is predominantly an animal of low-lying open habitats, in this section we will discuss the results of the survey particularly as they apply to lowland areas, since any changes in marginal upland and upland landscapes will have only a minimal impact on hare numbers overall.

There has been a substantial decline in the number of hares in Britain. This has been most pronounced in western regions, where the decline started over a hundred years ago, and there has been little subsequent population recovery. This was confirmed by the survey; many landowners and farmers in areas devoted largely or exclusively to intensive livestock rearing reported that there were so few hares left that sighting one on their land was a rare event. Changes in the hare population in arable areas have been less dramatic. There was a decline around the turn of the century, but generally hare numbers had recovered by the Second World War. There was however a substantial decline in hare numbers in arable areas during the 1960s and 1970s.

A number of factors have been identified as potential causes of these declines. However, the evidence that predators played a significant role is unconvincing, and the impact of adverse winter weather by itself would only be short-lived. If weather had been the sole, or even a major factor leading to population declines, the infrequency of severe winters over the last three decades would be expected to have led to a general increase in hare numbers. There has been no such change.

All the evidence suggests that the main factors leading to the decline in hare numbers were changes in the pattern of landscape management. These were associated with the intensification in farming practices that led to the east/west arable/pastoral divide in Britain. Hare numbers in arable areas declined with the reduction in habitat richness associated with the loss of the rotational pattern of farming; the change to large fields with less crop diversity between fields was likely to be a major factor in this decline. The use of chemical sprays, coupled with the use of spraying machines with larger booms, has led to dramatic local declines in hare numbers, although some farmers reported that these were reversed by the use of less toxic sprays. The final factor contributing to the decline in arable areas appears to have been the change from spring-sown to winter-sown cereals, thereby leading to a shortage of suitable high-quality forage from the early summer onwards, when hares are facing increased energy demands associated with reproduction (G. McLaren, *pers. comm.*). In the west, it was the increase in stocking densities associated with the increased use of fertilisers and the greater reliance on silage cutting, along with the development of faster silage cutters, that were associated with the decline in hare numbers.

The relative importance of each of the factors contributing to the decline in hare numbers in arable and pastoral landscapes cannot be assessed from a general survey. Instead, a detailed autecological study is needed in both of the lowland landscapes to determine exactly how these changes have affected the population demography of hares, and hence how these changes actually mediated the declines in population size. Only once the underlying causal mechanisms are fully understood will it be possible to manage the landscape in such a way as to provide maximum benefit to hare populations.

It is also clear that hare populations are very susceptible to local changes in culling intensity and the degree of protection that they are afforded, and that these are secondary factors which have led to the large within-habitat variations in hare population densities. The vulnerability of hares to over-culling was first shown by the rapid and widespread decline in hare populations following the introduction of the Ground Game Act 1880, and the impact of culling intensity is still apparent today. In particular, in arable areas poachers, and the policy of deliberately culling hares to deter illegal coursing, significantly reduced hare numbers below the levels observed in areas of comparable habitat where hares received a degree of protection. The importance of these results are discussed in section 6.4 when we consider future changes in hare numbers.

6.2 Problems with monitoring hare population changes

The different patterns of decline in the east and the west, and the greater impact of agricultural intensification on hare numbers in the west, means that the arable areas of Britain now contain over 60 percent of the total hare population, and East Anglia in particular contains around 20 percent in just five percent of the land area of Britain. This clumped regional distribution complicates attempts to monitor hare population changes. The problem is exacerbated because hares are also locally distributed within landscape types. Whilst there were some squares with high hare counts in each land class group, there was also a high proportion of squares in which no hares were recorded - arable 51.1 percent (163/319 squares), pastoral 66.7 percent (154/231 squares), marginal upland 72.9 percent (94/129 squares) and upland 76.3 percent (45/59 squares). With line transect sampling, a zero count does not necessarily mean that hares were absent but rather that numbers were very low.

Thus areas of high hare density were frequently surrounded by much lower densities, forming islands with healthy hare populations, even though the habitat in the surrounding areas was very similar. These islands of high hare densities were often associated with large shooting estates, particularly in the south-east, south-west and north of England and Scotland. The difference in hare numbers between shooting estates and the surrounding countryside was less marked elsewhere in Britain.

Where driven shoots are held, up to 69 percent of the hare population may be removed each year (Stoate & Tapper 1993), and the gamekeepers on some estates estimated that they cull 85 percent of the hares during a single shoot. Yet some of the same gamekeepers reported that a few months after a shoot, hares were often as numerous as before (G. McLaren *pers. comm.*). A closed population of hares could not recover quickly from such dramatic population reductions purely by increased rates of fecundity; this could only be achieved by large-scale immigration from the surrounding areas. In addition, in the arable areas where most of these large shoots are held, three months after the shoot is the period of the year in which food availability is shortest (G. McLaren *pers. comm.*), and so hares will be moving further afield in search of suitable forage (Homolka 1986). The greater habitat richness associated with areas managed by a gamekeeper, and the significant population reduction following a large shoot, would mean that there was plenty of suitable forage available, and these factors could attract large numbers of hares into the estate from the surrounding area, as was shown by the gamekeepers. Thus these estates were acting as population sinks.

However, whilst immigration has undoubtedly helped to maintain hare bags in the past, during the survey some estates reported that they had cancelled driven hare shoots due to low hare numbers. Many of the estates in the south-west had already stopped their hare shoots, and for the first time some estates in East Anglia also had to cancel their hare shoots or postpone them for a year. Thus whereas in the past immigration has helped maintain hare populations on shooting estates, it would appear that recently densities in the areas surrounding some estates have dropped to a level below that which enables immigration on a scale sufficient to compensate for the large reduction in hare numbers following a shoot. This interpretation is borne out by the data collected during the survey; whilst hares were rare in over half the arable squares surveyed, overall there was less difference in hare densities between areas with and without a gamekeeper in East Anglia than south-east and south-west England. It follows therefore that the wider countryside in southern England has fewer hares compared to the areas surrounding large shooting estates in East Anglia.

This is supported by the density estimates shown in Table 3.6 for the three sub-divisions of the arable land class group. Sub-division a consists only of land class 2 (Figure 2.1), which is confined to southern England. It has a substantially lower mean hare density than sub-division b (which consists of land classes in eastern and central England) and sub-division c (which consists of land classes in northern England and eastern Scotland). This difference is also reflected in the National Game Bag Census data, where there are now too few estates in the south-west submitting returns for any regional analysis of hare population trends (see section 1.3). In East Anglia the countryside generally still maintains relatively good hare densities, although since some shoots had been cancelled due to a lack of hares, and many estates reported declining bags during the survey, a situation similar to that in the south-west may be developing in some areas. If so, this is likely to be due to the increase in the level of culling hares away from shooting estates to deter the activities of poachers and/or poaching rather than any landscape changes.

These data also suggest that game bag records and sightings collected whilst hunting with packs of hounds cannot be used as reliable monitors of changes in hare numbers in the countryside generally, since both monitoring schemes are based on areas in which hare numbers are higher than the average for the land class group. For the shooting estates in particular, reduced disturbance and greater habitat richness attracts hares from the surrounding countryside, particularly in times of food shortage. Therefore declines in hare numbers on these estates will only be apparent once the population in the surrounding area has fallen to a level at which it is no longer able to reinforce hare numbers on the estate by immigration. This means that statistics based on areas of high population density rather than a random sample of the wider countryside are likely to underestimate any changes in hare numbers. Thus hunting and game bag records must be interpreted with care. Whether the hare population really has remained stable for the decade from 1983 is not clear; the cancellation of some shoots on large estates suggests that there may have been some undetected local declines in hare numbers in the surrounding countryside.

6.3 How many hares were there prior to 1880?

All the evidence suggests that hare numbers were relatively high in the Victorian period (Tapper 1987b). Whilst no estimate was made at the time of the number of hares, the data from the survey, coupled with the descriptions of the status and pattern of distribution of the hare population in Victorian times, can be used to estimate the approximate number of hares before the introduction of the Ground Game Act 1880.

The biggest change since Victorian times has been the retraction of the hare population to islands of high density, thereby producing the very clumped distribution seen today. If the large number of one-kilometre squares in which no hares were seen in any of the three walks are excluded from the analysis, and the DISTANCE program only run with squares in which at least one hare was seen, the mean density for arable landscapes was 14.44±1.59 (S.E.) hares per square kilometre (with a three-term Fourier series model), for pastoral landscapes 9.80±1.83 hares per square kilometre (with a two-term Fourier series model), for marginal upland landscapes 9.78±2.54 hares per square kilometre (with a two-term Fourier series model), and for upland landscapes 7.28±2.44 hares per square kilometre (with a three-term Fourier series model). The increase in these density estimates over the figures shown in Table 3.5 (arable 2.0, pastoral 2.9, marginal upland 3.9 and upland 7.5 times) shows very clearly the relative clumping of the hare population in each of the land class groups. Ignoring the upland land class group, since the areas of habitat suitable for brown hares are very limited, and repeating the calculations shown in Table 3.5 with these new density figures, would give a mid-winter brown hare population of around 2,000,000, with a much less marked east/west divide in their distribution. This is the hare population that could be present without any increase over present-day densities but simply by eliminating those factors which have led to the current clumped distribution. This more even distribution better reflects the situation described at the turn of the century in the *Victoria County Histories* (Table 1.1).

However, in addition to the clumping of the hare population, there has also been a substantial decline in mean population densities, as shown by game bags from shooting estates. Thus the mean number of hares killed per square kilometre in the early 1990s, as recorded by the National Game Bag Census, was only around a fifth of what it had been at the start of the 1960s (see Figure 1.4). Similarly, the long series of data for the Holkham estate (Figure 1.1) shows that even in the early 1960s, the number of hares shot was only a half to a third of those shot around the turn of the century. It is not justified to assume that these data accurately mirror the population changes (see section 1.2), since with declining hare numbers there is a tendency to shoot fewer animals, so that game bag returns enhance the size of any population decline. However, based on these data, a minimum estimate that overall hare densities have declined to a half would be justified. Using this minimum figure for the decline in density, and allowing for the more even distribution of the hare population, would give a mid-winter population of 4,000,000 hares in 1880. Based on the size of the decline in hare bags from shooting estates, this may well be a conservative estimate. Thus the current hare population in Britain is probably no more than 20 percent of that present just over a hundred years ago.

6.4 What changes in hare numbers are likely to occur in the future?

Since the main factor leading to the decline in hare numbers has been agricultural intensification, it might be anticipated that hare numbers would benefit if this was reduced, particularly where these changes increased habitat richness. Certainly, in arable areas there is the potential to benefit hare numbers with small landscape changes simply by increasing habitat richness in those areas where hare numbers are not significantly reduced by culling. Set-aside is one way of increasing habitat richness, and in arable areas increases in hare numbers were associated with the area of set-aside. However, since the local distribution and numbers of hares in arable landscapes is dependent to a large part on the impact of culling and the degree of protection they are afforded, the potential benefits of set-aside are only likely to be apparent in those areas with established hare populations. Even in arable areas, hares were not recorded in over half of the one-kilometre squares surveyed, and this was due to high levels of culling and/or reduced levels of protection. So in around half the arable area it is unlikely that there will be substantial benefits to hare populations from set-aside or other changes in the pattern of landscape management unless these are coupled with a change in the population pressure from culling.

In pastoral areas, the hare population is even more clumped than in arable landscapes, with no hares recorded in two-thirds of the squares surveyed. However, here the clumped distribution appears to be more directly related to patterns of land use, and in particular high hare numbers were strongly associated with the presence of some arable crops. These areas of arable crops provide refuge for the hares, thereby reducing the levels of disturbance from livestock, and they also increase habitat richness. However, there was no evidence from the survey that hare populations were increasing as a consequence of any set-aside within the pastoral landscapes. This may simply be because replacing some of the arable crops with set-aside does not substantially change the habitat richness of the area, and one refuge from livestock is simply being replaced by another. So more substantial changes in landscape structure, particularly a reduction in stocking densities and patterns of grass cutting for silage, are needed to benefit hare numbers in pastoral areas.

Since any benefits to hare populations from current small-scale landscape changes are likely to be localised, they are also unlikely to have a large impact on the total hare population. However, hares have the potential to respond quickly to changes in landscape management, especially if these are coupled with changes in the degree of protection that they are afforded, and so local population changes can be impressive. On the Loddington estate in Leicestershire, for example, hare numbers increased from around three to a hundred in five years following changes in the pattern of management (S. Tapper, *pers. comm.*). This was a population doubling for each of the five years. How much of it was due to reproduction within the existing population, and how much was due to immigration from outside the estate, is unknown, but it does demonstrate the potential for significant localised changes in hare numbers.

Thus in arable areas it appears unlikely that hare numbers will benefit substantially from current patterns of landscape change, but there is greater potential to help improve hare numbers in the short term by increasing the degree of protection that they receive and/or reducing the culling pressure. For pastoral areas, only a substantial and widespread reduction in agricultural intensification is likely to lead to an increase in hare populations, and there is no evidence that a change in culling pressure would benefit hare populations. However, any increase in hare numbers in arable areas would further enhance the already conspicuous east/west divide in the distribution of the hare population, and so a detailed ecological study of hares in pastoral landscapes to determine which would be the most appropriate measures to take to enhance hare numbers in the west may be a greater conservation priority.