British hunting ban had no effect on fox numbers

A report to
the Royal Society for the Prevention of Cruelty to Animals
and
the International Fund for Animal Welfare
from
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Executive summary

1. Pressure for legislative change to make hunting illegal has fuelled debate about the impact of hunting on fox numbers. Although a recent governmental review concluded that this was minimal (Burns *et al*., 2000), there are no quantified data to support this assertion.
2. A ban on hunting for nearly a year during the outbreak of foot-and-mouth disease (FMD) in 2001 provided a unique opportunity to quantify the impact of hunting on fox numbers.
3. Fox abundance, measured by faecal counts along transects in 160 1-km squares, was compared in the two years immediately preceding the hunting ban with data collected from the same 1-km squares immediately after hunting resumed.
4. The data were collected by a mixture of paid surveyors and volunteers. The 160 1-km squares were scattered around lowland areas of mainland Britain. Each square was walked twice both pre-FMD and post-FMD, once to remove all the existing fox faeces, and a second time two to six weeks later to count the number of fresh faeces.
5. Mean transect length in each 1-km square was 7.0 km pre-FMD, 6.8 km post-FMD i.e. 1120 km of transect was walked twice pre-FMD, 1088 km of transect walked twice post-FMD.
6. The 1-km squares were allocated to one of nine different regions and were classified as "hunted" or "not-hunted" depending on whether they lay within or outside a hunt country.
7. The mean number of faeces recorded post-FMD was 4.7% lower than the mean number recorded pre-FMD.
8. There was no significant difference in the number of squares where faecal density increased compared to those that decreased/did not change in "hunted" and "not-hunted" squares. Nor did the absolute or relative changes in faecal density differ between "hunted" and "not-hunted" squares.

9. There was no difference in the pattern of change in fox abundance between areas within or outside a hunt country and there was no change in fox numbers in seven of nine regions; in one region numbers increased, in one they decreased. The pattern of change was not associated with the normal level of hunting activity in each region.
10. These data show that the ban on hunting had no impact on fox numbers in Britain.

Introduction

Background

Hunting foxes with hounds (hereafter termed "hunting") has been practised in Britain for around 250 years (Itzkowitz, 1977). During the 2000-2001 hunting season Baily's Hunting Directory listed 186 packs of foxhounds in England and Wales and 10 in Scotland. Most of these were formally recognised by the Masters of Foxhounds Association. There were a further 4 packs of harriers hunting foxes and 3 hunting both foxes and hares (Anon., 2000). In addition, there were other packs of hounds used for hunting foxes, particularly in parts of south-west England and Wales. These are mostly gun packs and the number of such packs is unknown (Burns *et al*., 2000).

Despite the large number of packs of hounds used to hunt foxes, it remains unclear whether hunting plays a role in limiting or reducing fox numbers in Britain. The key arguments used in the debate are: (i) the number of foxes killed by hounds is relatively small and so hunting makes no contribution to regulating fox numbers (Macdonald & Johnson, 1996); (ii) hunting plays an important role in limiting fox numbers, particularly in combination with other culling techniques, and so proposed legislative changes are likely to lead to a significant increase in fox numbers with a consequential increase in levels of economic damage and loss of species diversity (Tapper, 1999).

The impact of hunting on fox numbers

Whilst many claims are made about the need to control foxes, there are no quantified data on the cost/benefits of fox control, nor the impact of different methods of fox control on fox numbers. Hitherto, the only data on the contribution that hunting makes to controlling fox populations are questionnaire-derived estimates from studies into the number of foxes killed by farmers, landowners and hunts. Such data are subject to reporting errors e.g. in one study landowners and farmers over-estimated the number of foxes killed on their land by hunts by a factor of 7-12 times (Heydon & Reynolds, 2000a). Consequently this study produced large ranges in the estimates of culling efficacy (Heydon & Reynolds, 2000a, b). Thus, the study by Heydon & Reynolds (2000a, b) does not provide any reliable data on the impact of hunting on fox numbers

and it remains unclear whether current levels of fox culling, and in particular the contribution made by hunting, play a significant role in limiting fox numbers over large spatial scales.

The only rigorous way to assess the impact of a particular control technique on fox numbers is to manipulate culling practices experimentally. An opportunity to do this was provided by the restrictions on hunting during the 2001 outbreak of FMD. Foxes have a very high level of productivity; there are 240,000 adult foxes in Britain and these produce 425,000 cubs each year (Harris *et al*., 1995). So if fox numbers are to remain constant, there needs to be 64% mortality each year. If hunting played a role in limiting fox numbers, there could have been a very substantial increase in fox numbers following the hunting ban during FMD.

Foot-and-mouth disease

The Foot-and-Mouth Disease Declaratory (Controlled Area) Order 2001, made on February 23rd 2001, restricted all hunting. These restrictions were maintained until December 17th, when some hunts were granted temporary licences to resume hunting in FMD-free areas. This system was maintained until 11th February 2002, when the controls were simplified to allow any hunt to meet under licence, provided that they did not trespass within 3-km of restricted farm premises. In a normal year, foxhunting takes place from November 1st to March/April, although hunts may be called out after this period to target "problem foxes" at the request of a farmer or landowner. Cub-hunting lasts from August-October, when the main aim is to kill juvenile foxes prior to dispersal. Therefore, between February 2001 and February 2002 the FMD outbreak prevented any hunting for ten months and severely restricted hunting for a further two months.

Aim of the study

To quantify the impact of hunting on fox numbers in Britain by comparing fox numbers prior to a one-year ban on hunting with fox numbers immediately after the ban on hunting ended. During FMD there were widespread reports from organisations such as the Countryside Alliance and the Farmers Union of Wales that there was a substantial increase in fox numbers following the ban on hunting and that this led to a significant increase in economic losses, particularly lambs. Examples of such assertions can be see in the document entitled *Fresh evidence from the Campaign for Hunting* on the Countryside Alliance website (*www.countryside-alliance.org*) and press releases on the Farmers Union of Wales website (*www.fuw.org.uk*). These claims have been widely reported in the shooting, hunting and farming press, with some magazines claiming that the fox population doubled during the ban on hunting. None of these claims are supported by quantified data: the study reported here provides the only quantified data on the impact of a ban on hunting on fox numbers.

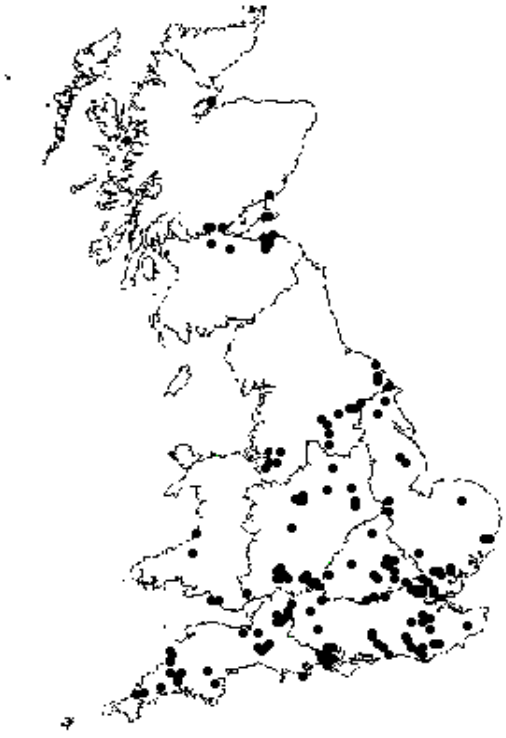
Methods

Rationale for the approach

Relative fox density was determined by counts of faeces (Beltrán *et al*., 1991; Cavallini, 1994; Shar*p et al*., 2001) along transects following linear features (hedgerows, fences, riverbanks, field margins, tracks, etc.) in 160 randomly selected 1-km squares throughout Britain (Figure 1). Linear features were searched since fox movements in winter are largely confined to field margins (Burrows, 1968). Surveys were conducted between February 1st and March 17th in 1999 and 2000 (pre-FMD) and 2002 (post-FMD). This survey period was chosen as it is a period of relative population stability, following the main dispersal period (Harris & Trewhella, 1988) and preceding the period of peak births (Lloyd, 1980). It is also coincident with the end of the peak culling period.

Arable and pastoral landscapes (Barr *et al*., 1993) were selected since this is where most hunts operate. However, the fox population in Britain is mobile, and dispersing animals can move long distances (Lloyd, 1980; Harris & Trewhella, 1988). These dispersal movements are not confined to one landscape. Lloyd (1980) describes the movements of cubs tagged in upland areas of central Wales into lowland areas of England and Wales, and cubs born in Bristol have dispersed out of the city to live on the top of the Mendips south of Bristol. Thus the data collected from this study are indicative of changes in the British fox population as a whole.

Figure 1 *The distribution of 1-km squares included in the survey and the nine regions used in the analyses*



Survey techniques

Each 1-km square was walked twice pre-FMD and twice post-FMD. Pre-FMD, on the first visit the transect walked was recorded on an ordnance survey map and all fox faeces removed. On the second visit the same transect was walked and the number of fresh faeces counted. The second visit was undertaken by the same person who made the first visit. Post-FMD exactly the same protocol was followed, except that the surveyor was provided with a map showing the transects followed pre-FMD and told to follow exactly the same route.

The two walks were conducted 2-6 weeks apart (mean±SD 19.1±4.6 days pre-FMD, 18.7±6.0 days post-FMD). This interval was long enough to calculate faecal accumulation rate (Putman, 1984) but not long enough to allow faeces to disappear through decomposition. Although post-FMD surveyors were asked to follow exactly the same route taken pre-FMD, this was not always possible if a landowner was reluctant to allow the surveyor access to a particular area. Occasionally this was a problem in the immediate aftermath of FMD. Any unavoidable alterations to the route were recorded and as a result there was a small reduction in transect length between the two surveys; mean transect length was 7.0±3.6 km pre-FMD, 6.8±3.6 km post-FMD. Thus the pre-FMD data are based on surveys of transects totalling 1120 km in length, post-FMD on surveys of transects totalling 1088 km in length.

Are the results biased?

Pre-FMD squares were surveyed by two full-time surveyors and 92 volunteers. Post-FMD squares were surveyed by 8 temporary staff and 62 volunteers. Most of the temporary staff were trained prior to the survey. Volunteers were people with good field skills and came from a wide variety of backgrounds. They were given clear guidelines to follow, and only squares where these guidelines were followed were included in the analysis. Volunteers were highly accurate at identifying fox faeces. Pre-FMD volunteers were asked to collect all the faeces for analysis of the food habits of foxes in Britain. Of 8263 faeces submitted for analysis, 97.1% were fox. So error rates in identification were extremely low. For the post-FMD surveys, surveyors were asked to submit any faeces which they were unsure were fox, and these were checked. The data were corrected to take account of any errors in identification.

In the pre-FMD survey, 9 of the 1-km squares were surveyed by paid staff, 151 by volunteers. In the post-FMD survey, 67 1-km squares were surveyed by paid staff, 93 by volunteers. Post-FMD the volunteers covered the same 1-km squares they did pre-FMD, the paid staff covered squares not previously surveyed by them. Of the 93 1-km squares resurveyed by volunteers, the number of fox faeces increased in 45 and stayed the same/declined in 48. Of the 67 1-km squares covered by paid staff, the number of fox faeces increased in 38 and stayed the same/declined in 29. These results are not statistically significant (X^2_1=1.08, P=0.30). The paid

surveyors were not told the results of the pre-FMD survey and so were surveying blind, the volunteers may or may not have remembered the results of their first survey. In addition, being more familiar with the 1-km square on their second visit may have led to an increase in the volunteers' ability to locate fox faeces. However, since the pattern of change is not significantly different between the two samples, there is no evidence of bias in the results.

Stratification of the analyses

For analysis, each 1-km square was allocated to one of nine regions (Figure 1) and classified as "hunted" or "not-hunted". "Hunted" squares were defined as being within a hunt country, based on a map issued with the 1996/1997 edition of *Baily's Hunting Directory* (Alexander, 1996). "Hunted" implies that these squares may have been hunted or were close to areas that were hunted, not that a particular piece of land was necessarily hunted.

Statistical analyses

Faecal density for each transect in each period (F) was calculated as F=S/KD, where S is the number of fresh faeces on the second walk, K the transect length (km) and D the number of days between the two walks. As fox density varies between regions (Harris *et al*., 1995; Heydon *et al*., 2000), absolute differences in faecal density were converted to a relative value (R), where $R=(F_{POST\text{-}FMD}-F_{PRE\text{-}FMD})/(F_{PRE\text{-}FMD}+1)$. R is positive if faecal density increased between the pre- and post-FMD periods, negative if it declined and zero if there was no change. To obtain a normalised distribution, the data were transformed as R'=log(R+1).

Results

Regional changes in fox numbers

Overall, faecal density declined by 4.7% (Figure 2). An ANOVA was used to see if there were any regional differences in the relative change in faecal density. There was a significant difference between regions in the relative magnitude of change in faecal density (ANOVA, $F_{8,145}=2.69$, P=0.01). R' values were normally distributed (Kolmogorov-Smirnov goodness of fit test, Z=0.71, P=0.70) and with homogenous variances between regions (Levene statistic, $F_{8,151}=1.84$, P=0.07). Data for each region were then checked for a significant deviation from a mean of zero (i.e. no change) using a one-sample *t* test. Tukey's HSD *post hoc* comparisons indicated a significant increase in Eastern England (one sample *t* test, $t_{22}=2.52$, P=0.02) and a significant decrease in Southern England ($t_{37}=-2.65$, P=0.01) (Figure 2). None of the other regions differed significantly from zero.

These regional differences were to be expected. Game bag records show that foxes have been increasing in East Anglia since the 1960s despite intensive culling pressure (Tapper, 1992).

Since 1998 The Fox Project, based in Tonbridge, Kent, has observed a decline of up to 40% in the number of calls about foxes in south-east England (Trevor Williams, *pers. comm.*). Based on the number of litters of cubs being reported, Trevor Williams is convinced that this represents a real decline in fox numbers and not simply a change in local attitudes to foxes. Why fox numbers should be declining in Southern England is unclear.

Thus the pattern of change was in accordance with known current trends in fox numbers, with the majority of lowland Britain showing no change in fox numbers irrespective of changes in hunting pressure for a year. The fact that the regional trends identified in this study exactly mirror known trends in fox population changes reinforces the robustness of this technique.

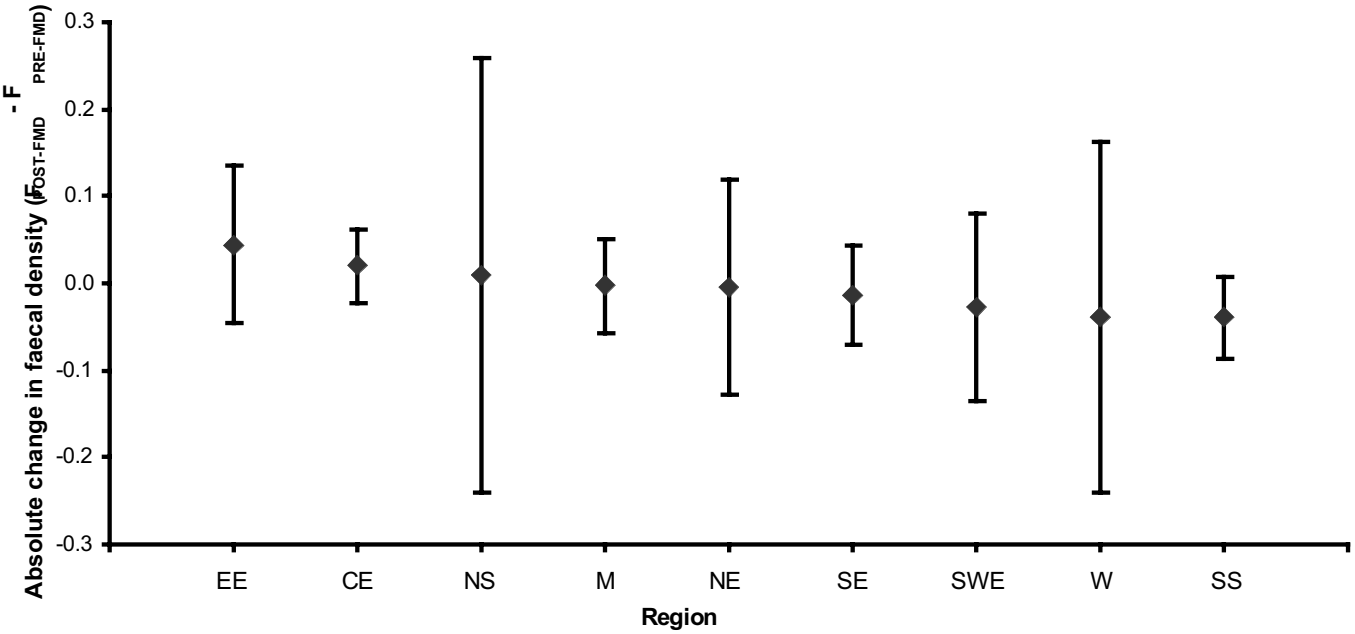


Figure 2 *Mean (±SD) relative change in scat density in each of the nine regions. Sample sizes: Eastern England, N=23; Central England N=16; Northern England, N=15; Wales, N=5; The Midlands N=21; North Scotland, N=8; Southwest England, N=25; Southern England, N=38; South Scotland, N=9*

The relationship between fox population changes and hunting pressure

Since most of rural Britain is allocated to a hunt country, the small number of "not-hunted" squares precluded analysing the data by region. So a chi-squared analysis was used to compare the number of 1-km squares that increased in faecal density versus those that decreased or stayed the same in "hunted" versus "not-hunted" squares. There was no significant difference in the number of squares where faecal density increased (N=83) versus those that decreased/did not

change (N=77) in "hunted" (N=118) versus "not-hunted" (N=42) squares (X^2_1=0.19, P=0.66). Nor did the absolute (t_{158}=0.60, P=0.55) or relative (t_{158}=0.51, P=0.61) changes in faecal density differ between "hunted" and "not-hunted" squares.

To determine whether there was any relationship between the changes in fox numbers following FMD and regional differences in hunting pressure, the relative change in scat density was compared against a regional index of hunting pressure using a linear regression with replication. Packs of foxhounds and harriers that hunted foxes were ascribed to a region based on the location of their kennels; the index was calculated as the total number of days hunted/week/km^2 in the 2000-2001 season as shown in Baily's Hunting Directory (Anon., 2000). Where a hunt did not give details of the number of days hunted (one case), the average number of days for the other hunts in that region was used. Bye-days and occasional days were counted as a half-day, and harrier packs that hunted both foxes and hares were counted as halves. There was no association between the reduction in hunting pressure in each region and the change in relative faecal density (r^2=0.007, $F_{1,158}$=1.18, P=0.28) (Figure 3).

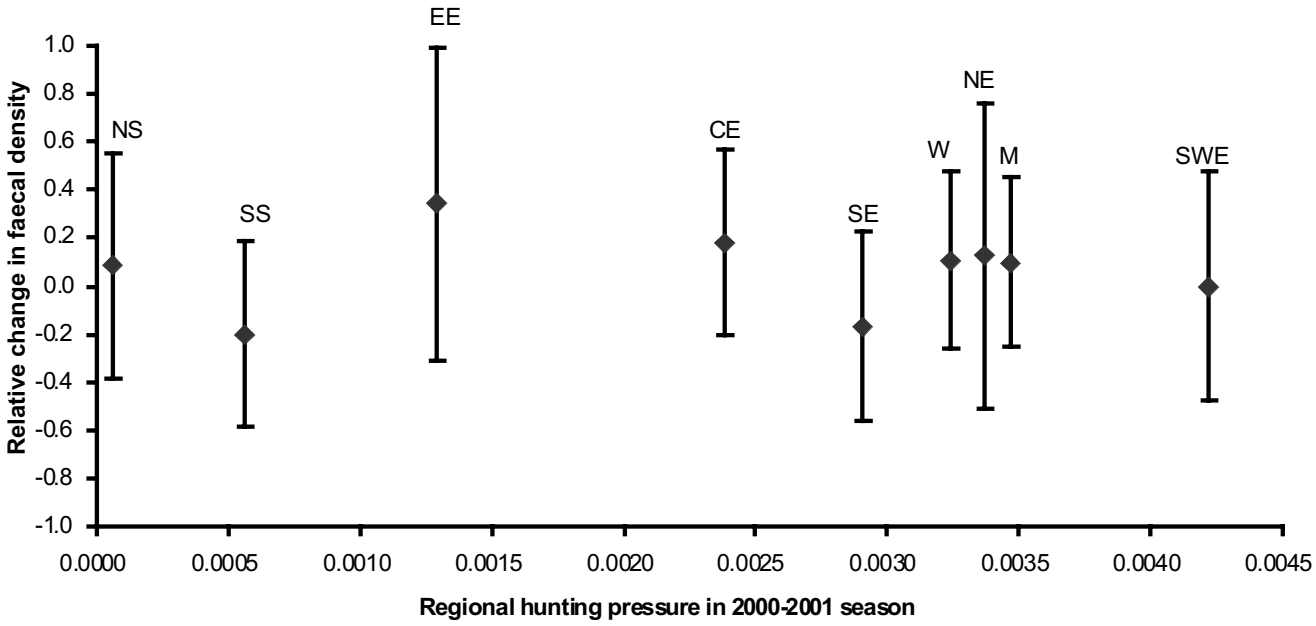


Figure 3 *The relationship between reduction in hunting pressure (no. of days hunted/week/km^2 in 2000-2001 season) and relative change in scat density. Numbers denote regions as follows: NS - North Scotland, SS - South Scotland, NE - Northern England, EE - Eastern England, M - The Midlands, CE - Central England, W - Wales, SWE – Southwest England, SE - Southern England*

Discussion

These results support the view taken by the Committee of Inquiry into Hunting with Dogs in England & Wales (Burns *et al*., 2000), who concluded that a ban on hunting is unlikely to result in an increase in fox abundance. They also refute the claims made by lobby groups that there was a substantial increase in fox numbers during FMD.

In the analyses, it was only possible to quantify the reduction in the level of hunting pressure by those packs of hounds identified in *Baily's Hunting Directory*. This is simply because these are the only data publicly available: there is very little information on the levels of hunting pressure by unregistered packs of hounds, gun packs, etc. However, their activities were also banned during FMD and so the results from this study are equally applicable to all forms of hunting with dogs.

Furthermore, due to FMD restrictions on a variety of rural activities, other forms of fox control could not be increased to compensate for the reduction in hunting pressure. Restrictions on access to farmland during FMD also meant that all forms of fox control were curtailed to varying extents, and certainly there was no opportunity to increase other forms of fox control to compensate for the ban on hunting with hounds. Thus these data also suggest that there is no need to increase other forms of fox culling in the event of a longer-term ban on hunting.

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