National Deer-Vehicle Collisions Project

SCOTLAND
(2003-2005)

Final Report: September 2006

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CONTENTS

10. REFERENCES cited in text

National Deer-Vehicle Collisions Project:
Scotland (2003-2005)

Summary

Background

S.1 Traffic accidents involving deer have presented a major problem in the UK for many years. With recent reported increases in both the numbers and distribution of several deer species in Britain, combined with continuing rise in traffic volumes nationwide, it seems likely that this problem will continue to get worse. Prior to commencement of the present project there had been no system for central collection of data on road traffic accidents involving deer in the UK, and it is clear that this lack of information has posed a major handicap to development of effective management to deal with this problem.

S.2 Earlier analyses commissioned by The Highways Agency (SGS 1998) and The Deer Commission for Scotland (Staines *et al.* 2001) attempted to draw together as much information on Deer Vehicle Collisions (DVCs) as might already be available from a range of potential data sources. Both studies however commented on the difficulty of drawing meaningful conclusions from retrospective analysis of data not specifically collected for such a purpose and recommended that a national system for recording deer/vehicle incidents should be established to assess the true scale and geographical distribution of the problem, and research key factors influencing accident risk.

S.3 The 'Deer/Vehicle Collisions Project' was launched in England in January 2003 by ***The Deer Initiative*** with lead funding by ***The Highways Agency***. Funding made available by The ***Scottish Executive*** made it possible to extend the project to include full coverage of Scotland from June 2003. The main objectives of the study were to build for the first time a national database of road traffic collisions involving deer in Britain occurring during the study period; to collate, verify and evaluate all data accrued and then interrogate the database to help assess the overall frequency of DVCs within the country as a whole, explore any regional differences in frequency of DVCs and identify current or potential future black spots (areas of relatively higher DVC occurrence). In addition the project aimed to investigate the effect of season, road type, roadside habitat and other factors on the risk of deer-related accidents.

Approach and data collection

S.4 Records of traffic accidents involving deer have been obtained during the project from a wide range of differing sources, including Regional Police Forces and Local Authority Road Safety or Accident Investigation Units to provide details on incidents involving human injury/fatality recorded on statutory STATS19 returns. A number of Police Forces were also able to supply information on 'damage-only accidents, or other incidents, by analysing station logs. Data were also sought from Motor Insurance Companies to obtain additional data on damage-only accidents and information on the average level of such claims for material damage. A major effort was made to recruit information from Trunk-Road Maintenance Agents and Council Road Cleansing Departments responsible for uplift or clearance of carcases reported respectively on the trunk-road network and local roads, which can capture information on other accidents which have not necessarily caused significant damage or led to insurance claims. The SSPCA with other animal welfare and rescue organisations were able to provide important additional information in instances where the deer is not killed outright, when they are required to attend for humane dispatch or treatment of the animal at the roadside. Additional information was sought from specific target sources who might be professionally involved in despatch or clearance of carcases from their own area: such as Forestry Commission Scotland. Finally members of the general public were asked to report any incidents, or dead deer seen at roadside either on-line via a dedicated project website set up for that purpose (www.deercollisions.co.uk), or by e-mail or post.

S.5 It was recognised from the outset that different data-source categories are likely to sample quite differing sub-sets of incident types. The present study was therefore set up quite deliberately to seek information from a wide range of different data source categories, some of which may be better suited than others to help answer some specific questions (such as the relative frequency of Personal Injury Accidents (PIAs), the actual economic costs of deer-vehicle collisions or the relative frequency of involvement of different deer species). A further reason for targeting a range of different sources is that this provides opportunities to cross-check estimates of accident frequency and thus offers the potential for extrapolation of findings to areas for which only limited information is available.

S.6 However, collection of data independently from a number of different sources carries with it the potential for duplicate reporting of incidents. These were identified and eliminated from the database by searching for incidents reported with similar locations (grid-references) within the same 3 day time period.

S.7 The primary focus of data collection was to obtain as well-stratified a dataset as possible recording as many as possible of the total number of deer-vehicle incidents occurring within a specific time period (2003-2004 later extended to end of 2005) using as far as was possible consistent recording methods and a consistent network of sources. Where sources indicated that they could also provide some information on DVCs occurring during past years, this information was also sought and logged: for up to three previous years (i.e. Jan 2000 onwards) for all available records of DVCs, and if possible for five previous years (Jan1998 onwards) in case of deer-related PIAs.

Public Awareness

S.8 Approaches to major known potential contributors such as police forces, local authorities, insurance companies, conservation and animal welfare organisations were in the first instance made via phone or written requests near the beginning of the study. In addition, a dedicated project web-site was set-up to provide further information and advice on how to avoid DVCs. The study has also been publicised very widely throughout all three years via several press releases, flyers and posters, car stickers, numerous articles in magazines, and has received regular widespread media interest and publicity; this has included several national and regional television programmes, radio interviews, as well as county shows and conferences. Aside from stimulating reporting of DVCs, the publicity obtained has also helped to fulfil the secondary objectives of raising public awareness; and has helped to raise and maintain interest in the project, as shown by over 1200–1400 unique visits to the project web-site recorded each month ever since January 2004.

RESULTS

National estimates of overall numbers of DVCs

S.9 During the present study we have accrued information on over 32,000 DVCs occurring in Britain between 1/1/2000 – 31/12/2005, including 6062 in Scotland (5713 individual incidents when duplicate reports are removed).

S.10 Data gathered during the present study provide far larger samples of DVCs than have been available to any previous studies of the deer collisions issue in Britain. It is clear however, that even the large annual samples of incidents reported here represent merely a small proportion of all deer road kills or related incidents occurring. An indication of the extent of under reporting was obtained through comparison of numbers of reports received by the Deer Collisions Project for certain specific areas with total numbers of carcases/incidents recorded by more intensive search in a number of specific case studies where DVCs have been recorded much more comprehensively [4.6-4.9]

S.11 An independent estimate of the true number of DVCs which may occur each year may be derived from an analysis of the ratio of human injury records against all other DVC records

obtained within a selection of sites where we believe relatively high proportions of all DVCs tend to be captured. Such analysis indicates that PIAs attributable to deer are likely to represent around 1.1% to 1.5% of all DVCs. On the basis of this estimate taken in combination with a national estimate of around 550 human injury accidents involving deer each year [see E.16 below and main text 5.14], we may calculate that the true toll of DVCs in Britain as a whole is likely to lie in the region of 46,000 (+/- 9000), of which c. 8500 (+/-1500) may be expected to occur in Scotland.

Distribution and relative frequency of DVCs

S.12 Generalised mapping of the distribution of data collected from all sources combined (**Map 1**[**S**]) shows that at least some DVCs have been recorded in the majority of all 10km OS grid squares within Scotland; distribution of recorded DVCs is most continuous through central and north-eastern parts which are also the areas where by far the highest **frequencies** of DVCs have been recorded (**Map 4**[**E**]). Frequency of those DVC reports possible to map confidently at a finer scale of 5 km by 5 km OS squares enables many major local hot-spots to be identified more clearly **Map 6** [**S**].

S.13 We may also identify roads or road sections with particularly high DVC risk by comparing accident frequencies with national averages recorded for given road-types [see 4.19; 7.17] **In Scotland the roads where we have logged the highest 'reported' rates of DVCs include the A835, B9077, M90, M9, A80, A93, B979, A980, A90, A830, A9, and A82.** Number of DVC records available for these routes range from 0.23 to 0.75 per km/year averaged out across the entire length of each route; which is between three to nine fold the national average rate (0.08/km) calculated across all major roads. However, on these, and on a number of other roads, 'recorded' deer collision rates on particular section may rise to between 1 to 2 DVC/km for stretches of 5km more (including for example parts of the A82 Kingshouse, A835 Leckmelm, and A93 Aboyne), and reached over 4 DVC/km for the A9 at Dunkeld (**Table 10**[**S**]).

Human Injury Accidents

S.14 Records of Personal Injury Accidents (PIA) arising through collisions or swerving to avoid deer form an important element of the present study, not merely because of the serious nature and economic cost of these incidents, but also their potential to provide small but very well stratified data with relatively high location accuracy. In Scotland our best set of consistently recorded PIAs data is for Highland Region, where Highland Council have been able to provide directly comparable records across the six years from 2000 to 2006. In those successive years 6, 10, 8, 10, 9, and 9 deer related PIAs have been recorded specifically as having involved deer, including 1 fatal, 9 serious and 42 slight human injury incidents. Only rather less complete records of deer-specific PIA records were available for other Scottish police regions including on average 1 to 2 each per year between 2003-5 reported by police in Fife, Stirling, and Tayside region; these are likely to be minimum estimates as in some sets of figures received only those incidents where a deer was actually known to have been hit (rather than swerving to avoid) were included.

S.15 In addition we are conscious of the fact that many PIA records are 'lost' through lack of detail required by ST19 forms in recording the types of animal responsible for causing the accident. Thus in each set of records, there are a number of instances where animal type is not clearly recorded, and a number of these are also likely to relate to collisions with deer.

S.16 A more accurate estimate of overall numbers of PIAs relating to deer may be determined on the basis of calculation of the proportion of all animal-related PIAs that are known to have been caused by deer in a sample of incident records where animal type is more precisely recorded. Such closer inspection of the complete set of records for 1400 different PIA incidents reported as involving "other animals" (animals other than dogs) obtained from a sample of 14 English counties, indicate that deer are involved in around 23.5% of such incidents overall. Application of this percentage to the total number of PIAs recorded by DfT where carriageway hazard is recorded within the 'other animal' category allows derivation of

an estimated average number of deer-related PIAs in Britain as 554; which are likely to include around 12 fatal, 86 serious and 456 slight injury accidents (see 5.10 & **Table 7**[**A**].). On the basis of the proportion of animal-hazard incidents logged by SEERAD relating to Scotland, we may estimate an annual toll in Scotland of 74 PIAs involving deer, likely to include 1 to 2 'fatal', 16 'serious' and 56 'slight' injury road accidents each year.

S.17 The economic 'value of prevention' of that level of human injury accidents may be calculated to exceed £30M to £40M per annum for Britain as a whole, and around £4.5M for those incidents within Scotland alone (using standard figures for assessing economic costs of injury road accidents: Highways Economic Note 1, 2003). [see 5.11]

Costs of Damage to Vehicles and Insurance

S.18 In addition, based on extensive claims data provided by one major insurance company for 1999-2004 (Fortis Group) we may estimate that around 11,000 private vehicles are likely to suffer significant damage (i.e. above common insurance claim excess of c.£250) as a result of DVCs in Britain each year, costing approximately 13.9 Million in material damage. Of all insurance claims identified as relating to deer within the available Fortis Group sample, 18.5% were located in Scotland, and just 0.5% in Wales. This provides a useful indicator as to the relative proportion of DVCs likely to occur overall in each of the three countries, and here allows separate estimates of the minimum costs of material damage in Scotland at c. £2.6 M, and costs in England at £11.3 Million [see 6.4].

S.19 While these estimates consider merely the actual cost of claims and damage to vehicles, they are likely to be substantial underestimates of the total costs arising from damage-only DVCs. A number of incidents involve levels of damage which are below the policy excess or which drivers voluntarily absorb themselves (rather than lose No Claims bonuses). In addition there are often hidden costs such as necessity of hire of replacement vehicles, loss of time, and in extreme cases loss of work opportunities.

Influence of Road Type

S.20 The number of DVCs recorded (from 2003-05) on Scottish roads, where road type is identified is 3355, with 2692 (80%) of these recorded on A roads or motorways and 663 (20%) on more minor roads (B, C or unclassified). Divided by total recorded road length in Scotland in kilometres as 10682 (A+M) and 46033 (more minor roads), our records suggest average rates of recorded incident on major vs minor roads as respectively 0.252 per km and 0.014 per km, and indicate that deer accidents are much more frequent per unit road length on the more major roads (A and M). However, although 'major' roads only make up 18.8% of the total road length in Scotland they carry 66% of total traffic volume and over 72% of rural traffic. Our finding that near 80% of reported DVCs occurred on major roads is therefore broadly in line with the relative distribution of traffic among road types.

S.21 The frequency of deer related injury accidents on differing road types was not found to differ significantly from the spread of reported DVCs across the road network in general. Among 95 PIAs on which relevant information was available for assessment, 68% occurred on major (A+M) roads and 32% on more minor roads.

Deer Density

S.22 It immediately apparent, even from superficial examination of accident distribution maps [**Map 4**[**S**] that areas of high frequency of DVCs are not simply related in any direct way to deer density. Higher than average levels of DVCs at the landscape scale are determined in the first instance not by the abundance of deer *per se*, but rather an interaction between high deer numbers in areas which also have a high density of roads and high traffic volume. It is clear that the areas with most DVC records do not occur within the Highlands which tend to be associated with highest (red) deer abundance, but instead fall in the Grampian, Tayside and Central regions - those regions where (mostly roe) deer are in practice exposed to some of the highest levels of traffic. The highest frequencies of DVCs reported to date are indeed mostly located within those regions of the country where traffic flows are greatest.

Deer Species

S.23 Information on the deer species involved in reported collisions is only available for just over a third of all records obtained. If analysis is restricted to information provided by our most 'deer-knowledgeable sources, for Scotland this shows the most common species involved to be Roe (69%), followed by Red (24.5%), Fallow (4%) and Sika (3%); but this is based on a rather small sample size of 450 records. Inclusion of records from other sources where level of deer knowledge is not known, raises sample size to 1566, and suggests that the proportion of DVCs with Roe deer may in fact be as high as 77% with only 21% involving red deer. We note however, that while the majority of accidents in both Scotland and England involve roe deer, in practice the species most commonly associated with local 'hotspots' of accident risk throughout the UK as a whole is fallow [see 7.8].

S.24 Among a total of 95 PIAs which could be identified as relating to deer, information on the species of the deer involved is provided in 12 cases (7 red deer, 5 roe). The type of wild animal involved does not have to be recorded by law even for human injury incidents, and many police officers attending may not necessarily be able to differentiate readily between different deer species. From the limited species data available it further appears that the likelihood of species name being stated will be higher when antlered red deer stags are involved, as these tend to be recognised as such by more people and may appear more noteworthy. These limited data do not enable us to offer any firm conclusions regarding the relative involvement of different species in injury accidents compared to general involvement in accidents overall.

S.25 The overall greater number and distribution of DVCs involving roe deer across Scotland as a whole suggests that these are also likely to contribute the highest number of PIAs overall. However, previous research in Europe and North America does indicate that the severity of injury or damage caused tends to be somewhat higher for incidents involving the larger red deer (and moose), than for fallow and for roe respectively.

S.26 In the present study the deer species involved was known for 100 out of 522 DVCs where significant damage to vehicles was reported; the proportion of such damage accidents relating to red deer (47%) was indeed higher than the 'background' proportion of incidents overall for which red deer were noted as being implicated (see S.23 above).

Effects of Season

S.27 Although some DVCs occur throughout the year, for both the species most commonly involved in DVCs in Scotland distribution between months deviates significantly from random (Chi-squared test : $p<0.05$ (red) and $p<0.0001$ (roe).

- For red deer highest numbers of accidents occurs during October to January, most likely associated with the increased movement of deer during and after the peak rutting period during October, and also the co-incidence at this time of year of the peak daily activity periods of deer with highest levels of daily traffic flow.
- For roe deer in Scotland the highest numbers of DVCs consistently occur during May, when almost twice as many incidents were reported than in any other month (**Figure 2**(**b**). This spring peak occurs around the time when young male roe deer tend to disperse from natal ranges, and when adult females may also be more vulnerable to being involved in traffic accidents whilst accompanied by young kids. A secondary peak in DVCs for roe also occurs again between October to December when day length shortens.

Other factors

S.28 A host of other factors which may influence frequency and severity of DVCs include driver speed, vehicle types involved, vegetation near roadside, road tortuosity, deer behaviour, and presence/absence of effective mitigation. In practice, it has proved difficult to undertake detailed analysis of the effects of many of these other features on accident frequency from the data recorded within the database itself, primarily since relatively few respondents logged detail of such (additional) features or sufficient detail of accident location to enable us to assess such features retrospectively by map-reference.

Assessment of Mitigation measures

S.29 In parallel to the present data collection, we have in addition already completed a comprehensive literature review of the different mitigation measures currently being deployed in different parts of Europe and North America, together with an analysis of effectiveness and cost-effectiveness of the different measures available (undertaken as part of a separate contract for the Deer Commission for Scotland; Putman, Langbein & Staines, 2004).

This report is available online on the Deer Collisions website at www.deercollisions.co.uk/ftp/mit_review.doc. The review considers the entire range of mitigation measures available in Europe and the US and patterns of usage, and summarises the conclusions of the various scientific studies which have been undertaken to assess actual efficacy of these different measures.

S.30 Such systematic research into deer mitigation options as has been undertaken has, however, nearly all been carried out in the US or continental Europe, where the deer species, deer management and traffic situations are often quite different from Britain. However, it is noted that specifically within Scotland similar 'trials' are likely to be established, in necessary monitoring of the effectiveness of mitigation measures deployed on the A82, A835 and A87, following the reports to the Deer Commission of the Advisory Panels established to advise on the most effective ways of reducing accident risk in these Priority Site areas.

S.31 A number of practical trials have also been initiated and are now underway in England, to evaluate some newer forms of deterrent, including the use of rumble strips in areas of high accident risk, trials of WEGU-acoustic wildlife warning reflectors, trials of EUROCONTOR Ecopillars, and long-term monitoring of the effect of dynamic Animal- and Speed- activated digital warning signage recently introduced in parts of Hertfordshire [8.4], - and it is recommended that the SE keep appraised also of the results of these additional trials.

Wider utilisation of data

S.32 Information on DVC records and other preliminary results from the database being compiled by the project have already been requested and provided by us to assist HA and SE consultants for a number of surveys of TPI (Targeted Programme for Improvement) trunk road schemes in both England and Scotland, to feed into ecological impact assessments and evaluation of need and if so location of appropriate mitigation measures. To date requests for DVC information for trunk roads in Scotland information has been provided for environmental surveys for the A80/M80 improvements and the proposed Aberdeen western peripheral route. In England requests for input have included TPI schemes on the A419, A303, A11, A74, M27 and M1 widening; and reviews of existing wildlife mitigation on the A35/A30)

S.33 Considerable use is also being made of the database by the Deer Commission for Scotland, as part of their review of road traffic accident frequency in areas where they have received from the public formal Expressions of Concern in relation to deer posing a risk to Public Safety through involvement in RTAs. For three of these roads (sections of the A82, A835 and A87), now confirmed as **Priority Sites** for Action, the Commission has established consultative Panels to investigate more fully the problems and suggest possible solutions. More systematic identification of high/medium/low risk areas is also now possible from interrogation of the database when queries arise.

Conclusions

S.34 The results outlined in this report demonstrate not only the very large numbers and widespread occurrence of DVCs nationwide, but also provide information on regional and local differences in the distribution and frequency of such collisions across differing parts of the country. It is clear, from the extent of use of the database and from the estimates above of the scale of DVCs within Scotland as a whole, that DVCs do represent a serious and continuing problem, whether from the point of view of the animals themselves and the consequent welfare issues, or simply in terms of human injury and the significant economic costs of damage caused by such collisions. It is suggested therefore that some continuing attempt should be made to monitor the number of DVCs occurring within Scotland and their geographical distribution, albeit at a lesser level of intensity than in the current programme.

S.35 In practical terms therefore (given the difficulties experienced in the current project in obtaining data from Insurance companies) it is suggested that the best index of trend might be obtained from a combination of requests logged by the trunk road agents in relation to requests for removal of carcases from the four trunk road regional areas (NW, NE, SW and SE) in combination with continued monitoring of deer and other animal related PIA accident records. The latter is dependent, however, on amendment of the format of the STATS19 form (or at least recording at Scottish Police force level) in such a way as to permit ready identification and abstraction of incidents attributed to deer as distinct from those with other animal types in the carriageway, in a directly comparable manner, for all rather than just some of the eight Scottish Police regions.

1 INTRODUCTION

Background

1.1 Traffic accidents involving deer and other wildlife have presented a major problem in the UK and other parts of Europe for many years, although it is clearly collisions with the heavier-bodied deer which are of greatest significance in terms of economic damage and human injury. From such limited data as are presently available, it is estimated that there are at least 30,000, and perhaps over 50,000, deer-vehicle collisions in the UK each year, with an additional (unknown) number of accidents resulting from drivers swerving to avoid deer in the roadway. Over the past 5 years alone such deer/vehicle collisions in the UK have resulted in some 1500 known cases of injury to drivers and passengers, over 50 human fatalities, as well as resulting in the death or serious injury of some 150,000 or more deer. With recent reported increases in both the numbers and distribution of several deer species in Britain, as well as significant rises in traffic volume and speed, it seems likely that this problem will continue to get worse.

1.2 Until now there has been no system for central collection of data on road traffic accidents involving deer in the UK, and previous attempts to build a picture of the full extent and geographical distribution of deer-related road traffic accidents in the UK have been hampered by the need to rely on retrospective analysis of such patchy data as happened to be available - none of which had been specifically collected to address the questions now being asked of it (SGS, 1998; Staines, Langbein & Putman, 2001). Even when records can be retrieved at all, they have tended to be maintained in a very incomplete and inconsistent manner by those organisations who might collect such information at all (e.g. Police, Council Road Safety Departments, Local Authority Roads Departments, or Departments responsible for Cleansing Services and thus uplift of carcases from the roadside, RSPCA/SSPCA, Wildlife Hospitals, Insurance companies, forest rangers, private stalkers, amongst others). The survey commissioned by the Highways Agency during 1996 estimated that the toll of deer injured or killed annually in traffic collisions in the UK was likely to lie between 30,000 - 50,000 (SGS, 1998), but firm statistics on the true scale of the problem remain unavailable. This lack of information on the scale of DVCs within the UK, with limited understanding of the factors which influence the frequency or risk of DVCs has posed a major handicap to development of effective management.

1.3 Although past data for the UK are very limited, review of figures for other countries in Europe where more regular records are maintained, offers clear illustration both of the true scale of the problem - and of the fact that the numbers of collisions involving deer have been increasing in recent years. In Sweden, for example, some 10,000 road accidents were recorded in 1982 due to collisions with moose, red deer and roe deer; by 1993 the number of deer-vehicle collisions in Sweden had risen to 55,000 (Groot Bruinderink and Hazebroek, 1996). Overall, current levels of deer-related RTAs show annual rates of some 140,000 deer involved in traffic accidents in Germany; over 55,000 in Sweden; 35,000 in Austria; 10,000 in Denmark, and 9,000 in Switzerland. In total it is estimated that the number of deer killed each year on roads in Europe is well in excess of 500,000. Similar estimates are presented for the number of road traffic accidents involving deer each year in the United States where, again, numbers of incidents appear to be increasing (e.g. see Romin and Bissonette, 1996; Putman, 1997; Hedlund, 2003; Putman et al. 2004).

1.4 Studies in other European countries also suggest that between 1% and 5% of all 'reported' deer-related accidents would be expected to involve human injury or death; in continental Europe as a whole, it has been estimated that close to 300 people are killed and 30,000 people injured in collisions with deer and other hoofed game each year. Estimates of material damage caused as the result of such accidents are harder to assess, but lay in the region of 1billion Euro a year.

1.5 As noted above, while it is estimated that the annual toll of deer involved in collisions with vehicles in the UK as a whole is in excess of 30,000, accurate information on the actual scale of this problem within Scotland, England and Wales, patterns of geographical distribution and the systematic location of accident black-spots within each country have been lacking. The paucity of reliable recording of such incidents across a range of authorities and other potential data sources was highlighted in the short-term studies commissioned by the Highways Agency in 1997 (ed. Smith & Langbein, SGS Environment, 1998) and the Deer Commission for Scotland in 2000 (Staines, Langbein, and Putman, 2001). The authors of both the above studies strongly recommended that a national system for recording deer/vehicle incidents should be established, and jointly put forward proposals to develop such a database to assess the true scale and geographical distribution of the problem, and research key factors influencing accident risk (Langbein et al. 2001), in order to help identify and better target suitable preventative measures in the future.

1.6 From that basis the 'National' Deer/Vehicle Collisions Project' was launched in England early in January 2003 under the auspices of The Deer Initiative, with lead funding provided by The Highways Agency. The project was extended to include full coverage of Scotland from June 2003, with funding made available by the Scottish Executive. Further financial assistance has been provided by the National Forest Company, Woodland Trust, and the Deer Study & Resource Centre, as well as assistance in kind by numerous other organisations and individuals to help publicise the study and contribute information. The project has not researched incidents as fully for Wales, as in the case of Scotland and England, but where nationwide data sources (such as Insurance companies) have been able to provide records for Wales these have also been retained for the combined database.

1.7 It was proposed at the outset that the projects in both England and Scotland should span a minimum of two full data collection years (2003 & 2004); and this study period was subsequently extended in both countries to include information also for any incidents occurring up to the end of 2005. In Scotland the project officially concluded in March 2006, although, because of time lags in collation of data, some important sources were not able to submit all of their 2005 records to the project until more recently; in consequence our own collation of inputs continued till the end of May in order to ensure capture of as complete as possible a dataset up to the end of 2005. In England the project remains on-going with data collection planned to continue throughout 2006.

1.8 The present document focuses on the final findings of the study in **Scotland** throughout the 2003–2005 contract period. However, the objectives and approach followed are very similar for the studies in both Scotland and England: much of the background will be of interest to both and in many cases specific cross-comparison between the two situations is also extremely illuminating. Where appropriate, preliminary findings available for England up to end 2004 are thus also presented in this report for comparison with Scottish results, while a fuller report on the English project should be available later in 2006. To facilitate ready identification of findings within the report relating specifically to either country, numbers for all Tables, Maps, and Figures are given a suffix according to whether they are based on information that relates specifically to Scotland [**S**], England [**E**] or All of Great Britain [**A**].

1.9 **Contractors and Sub-Consultants:** The Deer Collisions Project for both Scotland and England has been administered by The Deer Initiative. The direction and planning of the study was undertaken for the DI under sub-contract by Deer Management Research Consultants Dr Jochen Langbein and Professor Rory Putman, to oversee data collection and analysis in England and Scotland respectively.

Objectives

1.10 The main deliverables laid down at commencement for the overall project were:

- To design and initiate a well-stratified, nation-wide system for the collection of standardised information on DVCs from all relevant sources in England and Scotland over an initial 2-year period, and to collate, verify and evaluate all data accrued.

- To investigate factors which may affect accident risk and explore the effectiveness of differing mitigation measures; on that basis make recommendations regarding potential improvements in the design, installation and maintenance of deterrents aimed at reducing accidents.

1.11 More specific goals include :

i. ascertain the overall and comparative level of DVCs in different counties or regions and land-type classes.
ii. determine the key factors associated with increased frequency/risk of DVCs in differing parts of the country and in relation to road types, deer species involved, traffic volume, presence/absence of differing types of mitigation and other influencing factors (daylight, time of day, roadside habitats, fencing, road signs, type of vehicle involved etc.).
iii. identification of localities with relatively high risk of DVCs (black-spots), where installation of deer mitigation may more readily justifiable than in others,
iv. increase public awareness of deer related traffic collisions and how to avoid them.

1.12 The project was later extended for one further year in Scotland (to March 2006), and at present still remains ongoing in England.

1.13 **NOTE** - **Terminology**: For purpose of the present report the term **DVCs** (Deer/Vehicle Collisions) refers to all reported incidents where it may be concluded that a deer has either collided directly with a vehicle, or that a deer has been involved in an accident as a 'carriageway hazard' causing the driver to swerve or take other avoiding action. As such, evidence that a DVC has occurred may come either from observation of a deer found dead or injured on or close to the carriageway, or from the accident description provided (usually to police and/or insurance) recording that a deer has been hit or is reported to have been involved in causing the accident. As there is no requirement at present in law to report collisions with deer or other wildlife, nor for police to maintain details of such cases unless one or more people have been injured, only a small minority of such incidents would generally be included in official DfT Road Traffic Accident (RTA or RTC) statistics. Those DVCs where it is known that human injury or fatality has also resulted (generally based on police records) are referred to as **deer-related PIAs** (personal injury accident).

2 APPROACH AND METHODOLOGY

Range of differing data sources targeted, and their use for corroboration of findings

2.1 A very wide range of differing organisations and individuals were identified as potentially able to provide some information to the study on deer road kills and traffic accidents involving deer. The type of data and sub-set of DVCs on which they hold information may, however, be expected to vary widely between organisations, and it was anticipated from the outset that different datasets might be more or less suitable for differing questions. Thus for example:

2.1.1 Police, and/or County Council Road Safety or Accident Investigation Units can (theoretically!) provide data for all incidents involving human injury / fatality, which must be recorded on STATS19 returns. In practice detail of animal type may not always be recorded in accident descriptions and even where included in original police records, that same detail is not currently retained or retrievable from the collated national records maintained by SEERAD and DfT.

[The information from ST19 returns maintained for cases where an animal was implicated as a carriageway hazard distinguishes only between either 'dog', or 'other animal or pedestrian', and hence interrogation of the national DfT road accident database cannot at this time provide the detailed data required for the present study]. In addition some, but not all, Regional Police Forces also retain information on such 'damage-only' traffic incidents as are reported to them in similar format as for ST19 form.

2.1.2 Motor Insurance Companies could (equally theoretically!) provide data on accidents involving sufficient damage to justify an insurance claim and information on the cost of such claims for material damage. However, once again, not all incident reports clearly identified the cause of accident and in addition even where insurance data attributable to deer may be abstracted, this would at best only 'sample' those incidents where damage was both comprehensively insured and also sufficiently severe to warrant a claim (i.e. exceeding policy 'Excess', or sufficient to be worth risking loss of No-Claims-Bonus), and so will underestimate the true numbers of damage accidents. Insurance reports would also not capture information on other incidents where no significant damage occurs but the deer is nevertheless killed or injured.

2.1.3 Main Trunk Road Agents [contracted by Scottish Executive and Highways Agency to maintain the trunk network of major strategic road links in their respective regions of the UK], and Regional Authority TEC Services Departments responsible for uplift of carcases reported on the local authority network, can capture information on deer road kills which have not necessarily caused significant damage or led to insurance claims. Once again however, these if taken alone would certainly under-record overall accident frequency since they relate only to those incidents which result in death of the animal concerned and only those which represent an actual carriageway hazard or are otherwise reported to them by the public Many incidents will go unreported; many carcases may be removed by other agencies or members of the public without being reported, and only incidents resulting in death of the deer (rather than injury) are likely to be logged by such sources.

2.1.4 RSPCA and SSPCA; Vets; deer-stalkers, and animal rescue centres. By contrast, these individuals, and organisations can often provide important additional information in those same instances where the deer is not killed outright, but they were required to attend for humane dispatch or treatment of the animal at the roadside; in most case such organisations will not, however, attend if called to remove an animal known to have been killed on the road.

2.1.5 Finally, members of the general public may be encouraged to report dead deer seen at roadside or incidents they have been involved in direct to the project (or via our website). Some of these are regular reporters (stalkers, members of BASC, SGA or BDS and others) who may be expected to have detailed knowledge of deer and thus can provide more accurate information of species, age and sex, but such information will tend to provide 'samples' of unknown and variable size, affected by extent and timing of publicity about the project and need for such data.

2.2 Aside from 'sampling' quite different sub-sets of incidents, the different source types will also tend to vary widely in the amount and reliability of detail available, as well as their potential to provide well stratified samples needed to enable direct and fair comparisons across regions, or between road types or other features. Thus, while records from e.g. insurance claim data or animal up-lifts by road maintenance departments may have potential to provide some of the largest and geographically representative samples of data, such sources will often lack precise details on exact location, or details on deer species / age / injuries. This increased level of detail is more likely to be available from those accidents where a deer manager, vet or others knowledgeable about deer attended. Unfortunately however, those more detailed reports may often be restricted to certain road-types or specific regions and may thus not be particularly well-stratified as a sample, or (if relating only to PIAs) may wholly under-represent total accident frequency.

2.3 It is important to stress from the out-set that the present study was set up quite deliberately to seek information from a very wide range of different data sources, not simply to increase the overall numbers of records collected - but explicitly in response to our recognition that different data sources will provide information better tailored to answering some questions than others. In consequence, parts of the analysis presented in these pages have to be addressed by interrogation restricted to particular sub-sets of the overall database (even if comparatively small) best suited to addressing specific questions. There is inevitably some risk that through approaching a wide range of sources, records of the same incident may on occasion be received more than once; screening procedures have therefore been used to identify possible duplicate records (with e.g. similar – even if not exact same date, and same local authority region, and road number or other location information) in the combined database to ensure that these are counted only once when assessing total numbers of reported incidents. However, as long as they are screened in this manner, duplicate reports can in some instances be useful in adding additional information, such as whether damage occurred to the vehicle, which may not have been available if another reported merely a dead deer at the road side.

2.4 A further reason and major benefit of acquiring collisions records from across differing source types, some of which are largely independent of one another, is that they provide opportunities for corroboration and cross calibration of source types and provide the potential for identification of key groups which might be used for future monitoring work. For example, where we have found that the number of incidents returned from any one given source type (such as the number of personal injury accidents recorded in different counties; or, as a different example, the number of incidents attended by the SSPCA/RSPCA or captured by those Insurance companies able to provide some data) shows a very clear and consistent relationship to the total numbers of DVCs retrieved through other means (e.g. full searches of all deer related calls logged by police control rooms), this can enable us to assess the minimum actual numbers of DVCs occurring in other counties where no data from such fuller searches been possible. Similarly, data from some particular local case studies where special efforts are made to record the majority of all deer casualties (such as undertaken by DCS and police through road-verge carcass searches along some roads in 'Priority Sites' in the Scottish Highlands) may be used in assessments of the minimum level of under-recording which would result from relying purely on records retrievable from our more 'conventional sources' such as road maintenance departments or official road accident records [see 4.6 - 4.10]

2.5 An overview of the major different categories of data sources contacted, the type of data they can provide, and the main outputs for which information from each category may best contribute is provided in **Tables 1**[A] & **2**[A].

Period for data collection

2.6 Although previous studies attempting to collate national records on past DVCs (SGS 1998; Staines et al. 2001) were hampered by inconsistent and/or sparse recording among many of the potential data sources, many individuals and organisation approached at that time indicated that they might be able to retain better detail over a given period if given advance warning. The present study was therefore set up with primary focus on collection of information on a high proportion of DVCs occurring during an initial 2 year study period (from April 2003 in Scotland) In practice the project in Scotland was granted funding to allow data collection to continue to cover any 2005 incidents obtainable before official conclusion in March 2006. In England the project remains on-going with data collection planned to continue through all of 2006.

2.7 The first 12 months of the study were anticipated to provide a lead-in period whilst identifying, recruiting and where necessary training data sources, and that actual data input over that initial 12 months would most likely be somewhat less comprehensive. It was hoped however that data sources would be fully up and running during the project's second year and that thus data provided during 2004 and 2005 would be more widely representative. Although complete recording of all DVCs would be an unrealistic goal, the study would aim to record as large a sample as possible each year based on comparable sources and methods of data collection across different regions.

2.8 While the major part of data recording was restricted to 2003 onwards, where contributors indicated they could also provide some information on DVCs occurring during previous years, this information would also be sought and logged: for up to three previous years (i.e. 1 January 2000 onwards) for all available records of DVCs, and for five previous years (Jan.1998 onwards) in case of deer-related human injury accidents (PIAs).

Calls for Data / Contributors

2.9 The majority of organisations likely to be able to contribute records to the study (see **Table 1**[A] were in the first instance contacted directly by phone/ letter near the beginning of the study. In addition, a dedicated project web-site was set-up to provide further information and a ready point of contact with the project for these and additional contributors, and opportunity to submit records directly on-line. The study was also publicised widely via press releases, articles in magazines, and other publicity including via TV, radio, county shows and conferences.

2.10 ***Mail shots/Direct approaches*** - Major sets of key organisations contacted in the first instance via mail shots have included Regional Police Forces, Roads and Cleansing Services Departments of Local and Regional Councils , Trunk Routes maintenance agents, Council and or Police Road Safety / Accident Statistics Departments, Forestry Commission, and RSPCA/SSPCA. Initial approaches were followed up in the majority of cases by telephone or personal visit to ensure that requests for assistance were addressed to the most appropriate *individual* within each organisation and to establish personal contact. Articles were included in the magazines of the both the Scottish and English Gamekeepers' Association, Scottish Association for Deer Management Groups and the British Association for Shooting and Conservation, RSPCA, Mammal Society and many others. In addition later agreements with e.g. the British Deer Society enabled mailing out of records forms to all their members (c. 5000) via 'Deer' magazine.

2.11 ***Web-site -*** To ensure a ready point of contact with the project from the out-set, a dedicated web-site www.deercollisions.co.uk was activated in February 2003 and up-dated soon after confirmation of expansion of the project to Scotland in June 2003. This Internet web-site provides a range of differing pages including introduction and latest news about the project, and links to facility for entering data on-line, downloads of record forms and posters, and preliminary advice on accident avoidance:
[home] background | objectives | participation | avoidance | links | form | downloads].
Visits to the web-site increased steadily after its launch to around 400 unique visits per month (i.e. numbers of visitors viewing more than one page) in 2003, but rising to an average of 1200 visits for 2004, and over 1400 per month in 2005 (with peaks in excess of 2000 unique visits in some months usually following any major press releases and media coverage for the project during the preceding month (e.g. in Nov. 2004 and Nov. 2005).

2.12 ***Publicity/Promotion of study*** - To help launch the study and maintain its momentum, numerous interviews have been given on national television, national and local radio programmes, and general Press releases given to Newspapers and magazines. Further, more specific articles about the project were submitted and published in specialist magazines such as Deer, Veterinary Record, Mammal News, Shooting Times, Scottish Gamekeepers' Association Magazine, Scottish Wildlife, as well as on other web-sites including National Farmers Union, National Forest, and The Deer Initiative. A brief initial Progress report was prepared in March 2004 and circulated once again to the Press, and to all current contributors to the project; with further such up-dates publications, and press releases also regularly added to the web-site since. All media 'releases' serve the dual purpose of maintaining momentum of the project, but also in increasing public awareness of the risk of DVCs; the majority, including in particular a press release organised jointly with the RAC, have also contained specific advice to individuals on how to minimise the personal risk of accident. In addition several hundred colour posters and flyers were produced early on during the project for inclusion with mail shots, distribution at shows / events, and have more recently also been made available for download at the web-site. Since then production of 3000 'Slow-down-for-Wildlife' car-stickers was funded through separate sponsorship – showing also Wildlife warning signs and the Deer Collisions web-site URL, to continue to help raise awareness of the issue.

Data Input / Consolidation / Validation

2.13 As expected, the quality and detail available per incident reported varies widely between source types. In general only those records with an accurate or at very least an approximate date of the incident, and reasonable detail regarding location are of value for retention in the main database, as without these it is not possible to protect against duplicate recording. However, in the great majority of cases additional identifiers such as time, precise location details, road number, deer species and/or sex/age tend to make identification of potential duplicates fairly straightforward; while those where location details are too vague to identify them clearly as a distinct incidents have generally been excluded from final analysis.

2.14 One major, often time consuming task during data entry has been ascribing map locations (OS grid references) and associated accuracy levels to records where the location has been reported only imprecisely. Thus, while all contributors were asked to provide six-figure or better OS grid references whenever possible, people noting a dead deer on the roadside or reporting a collision often do not actually know exactly where they were at the time. Thus, many reports received may state e.g. "A9 between Perth and Dunkeld" (thus defining an actual section of road, even if not an actual point along that particular section), or "A9 near Dunkeld" in which case incident could be located within a few miles to either side. Even though neither of these records would be possible to include for identifying specific localised black-spots, such records are nevertheless extremely useful in building up a complete picture of total numbers of DVCs for a county as a whole, or along a specific road, district, 10km or smaller grid square. Records where some reasonable location details but no grid references were provided by the source were therefore checked against basic computer mapping programs (OS Interactive atlas for PC) or hard copy maps, and a grid reference

allocated to place the record close to the relevant road section. Whenever possible a six-figure reference has been allocated, so as to map the record on the road if named, but recording also a ‘level of accuracy’ based on the location description; that is, to indicate whether a given record is actually likely to be accurate to within 100m (as implied by the six fig reference), or may in fact be only accurate to somewhere within 1km, 2km, 5km or more to either side. Allocation of six figure alpha-numeric grid references (e.g. SU345635) helps to avoid mapping records at grid corners instead of at the appropriate roadside, while the ascribed level of accuracy enables identification of the sub-sets of those records which may legitimately be included in total counts e.g. per 10 km^2 or 1km^2 OS grid square.

3 DATA SOURCES – LEVEL AND QUALITY OF RESPONSES

3.1 The number of different organisations from which data were requested by us are summarised in **Table 3**[**S**] for Scotland [and for comparison in **Table 5**[**E**] for England] broken down according to the broad source categories described in section [2.1-2.5], and by local authorities. Also shown are the number of those organisations approached which provided usable data, the volume of reports received during our main three year (2003-05) study period, as well as numbers of different incidents after exclusion of any identified as possible duplicates submitted by more than one source. **Table 4**[**S**] shows the numbers of reports received in the main individual study years, and additional records received for incidents occurring prior to 2003; figures are also provided in the same Table for the length of the public road network in each local authority area.

3.2 Within Scotland, information was requested from the Traffic/Roads Departments of all Local and Regional Councils; from Council Cleansing Departments responsible for uplift of carcases from the roadside; from Regional Police Authorities; from Trunk Roads Agencies (BEAR Scotland and AMEY); SSPCA; members of the SGA and BDS as well as members of the general public. A number of attempts were made to obtain accident information from NFU Scotland as a representative insurer but with no success.

3.3 Success rate in obtaining data from other, statutory sources was also variable. This inevitably means that, despite the apparent volume of returns generated from some source types (**Table 3**[**S**]), reports are not necessarily as well-stratified across the whole country as we would have wished. Even within our largest datasets (those generated by Council Cleansing Departments) coverage is incomplete, and while it is possible that those Councils who did not supply data to the project failed to do so simply because accident frequencies in their area were in any case low, we cannot be sure that this is the case- and it is possible that there is significant under-representation of recording of incidents in particular areas both within data from individual source-types and consequently within the database as a whole.

Regional Police Authorities

3.4 As noted above, each regional Police Force is required to record and forward a statutory return (ST19) to the Department for Transport for all those road traffic incidents where human injury has occurred. Unfortunately, however, the level of detail of PIAs submitted to SEERAD and subsequently DfT for centralised collation does not suffice at present to distinguish readily between incidents involving differing types of animals other than dogs and ridden horses (see 2.1.1). Fortunately however, many Police Forces and/or Council Roads Departments do keep their own copies of original, more detailed reports, and where these are maintained on computer database have kindly offered to search accident descriptions within the database using key words such as <deer> or <stag> to try and extract specifically deer-related incidents. While this does not recapture all incidents, it is helpful in extracting at least a minimum indication.

3.5 Some Police Forces, although not all, also keep a record of such damage-only accidents as are attended or reported to police, in the same details as retained for PIAs. In addition, over the course of this project, active interest and involvement by members of a number of Forces has led to some Forces now retaining some more limited but still useful information within computerised “Station logs” of all enquiries/reports received from the public in relation to involvement in DVCs, whether or not these have resulted in injury or damage.

3.6 Reports of varying detail were received on a regular basis from Central Scotland, Tayside Police, Fife, Grampian and for Northern Constabulary (both direct, as well as additional incidents searched out from police data by Highland Council). Despite repeated requests almost no records have ever been made available by Lothian and Borders Police, or Dumfries and Galloway (although early pre-2003 records for the latter were received through the Roads Department of Dumfries and Galloway Council). Despite offering support to the

project, few records have in practice been received from Strathclyde police since one initial entry.

Local Councils Roads/Traffic Management Departments

3.7 In a number of cases, Personal Injury Accident statistics are maintained centrally in Accident Investigation Units covering a relatively wider area. Thus there are separate AIUs covering Aberdeenshire, Falkirk, Stirling and Clackmannanshire, and Highland. All are providing us with some data, but in some cases it is hard to distinguish accidents relating to DVCs. Additional statistics are provided directly by Roads Departments of Angus, City of Edinburgh, Fife, Morayshire, Dumfries and Galloway and West Lothian. No other Departments have supplied data. However, this is not seen as compromising the project overall since in the majority of cases Council Roads Department's information simply duplicates PIA information already held by Regional Police Forces (above).

Council Cleansing Departments or TEC Services Departments

3.8 At the outset of the project, relatively few Authorities actually kept records of carcases uplifted from the roadside, but in response to our requests an increasing number agreed to establish and maintain simple recording procedures. Of a total of 29 Councils contacted, only 11 (Aberdeen City, Argyll and Bute, Clackmannanshire, East Dumbartonshire, Fife, Renfrewshire, East Renfrewshire, Midlothian, Scottish Borders, Stirling and West Dumbartonshire) have not submitted records. However, response from the (extensive) Highland Region is also incomplete with only 3 out of 8 districts submitting regular reports (Lochaber, Skye and Lochalsh, Ross and Cromarty). This patchiness of response does cause us some concern in terms of the even-ness of cover of the country as a whole .While it is possible that those Councils who did not produce data did not bother to supply data to the project simply because accident frequencies in their area were in any case low, we cannot be sure that this is the case- and it remains possible that DVCs in some areas are under-represented in our data.

3.9 A number of Councils have however also been able to provide comprehensive data going back over a number of years (to 2000). These include Angus, Dumfries and Galloway, Fife, Perth and Kinross, Morayshire.

Trunk Road Agents

3.10 Trunk Roads in Scotland are divided into 4 major sectors, which for the period of our study were under the responsibility of BEAR Scotland (NE and NW) and AMEY Highways (SE and SW). Full records of all carcases uplifted throughout the trunk road network have been made available to the project from 2001 for BEAR and from 2004 via AMEY (although final records for 2005 only became available in May 2006) - and, while restricted only to the trunk road network, this dataset perhaps constitutes our best-stratified data in terms of even coverage of the country as a whole.

Forestry Commission (Scotland)

3.11 Enormous support for this project has been received from the Forestry Commission. The timing of this project coincided with an internal review of recording procedures for all carcases processed by Commission staff and thus it has been possible to institute a standardised format for recording information on Road Casualties in the future. The Commission's Inverness Office has also devoted considerable time and resources to extracting for us details of RTAs recorded by forest area since 2000, through search of past cull return sheets (where such incidents are recorded but in a far from standard format).

SSPCA and other Wildlife Welfare/Rescue Organisations

3.12 The SSPCA have also been supportive of the project and have made available to us in hard copy, extracts from their computer log of all call-outs, where these relate to DVCs. The Society receives relatively few callouts related to deer so this provides a relatively small number of cases only. However, unlike many other sources records generally provide good detail including fate of deer and in many cases the deer species.

4 RESULTS

Overview of data collated and used for analysis

4.1 Two short-term pilot studies commissioned by The Highways Agency and The Deer Commission for Scotland have previously attempted to draw together as much retrospective information on DVCs as could be obtained across a range of potential data sources for Britain as a whole (SGS 1998) and more recently specifically within Scotland (Staines et al. 2001). For both of these studies, the *sample* of different incidents on which usable information could be retrieved for any one year was limited, and estimated as probably representing less than 5% of the true numbers of collisions occurring per year. The nationwide SGS study accrued 1723 records for incidents occurring in the 12 months between November 1995 and October 1996, with a total of 2533 records obtained for 1995+1996. In the DCS study restricted to Scotland alone, the highest number of records collated for any one year was 427 (in 2000), with an overall sample of just 954 records available for the five year period to Dec 2000. The main limitation of those datasets for assessment of national patterns was not just the limited number of records found, but more that the great majority of data were restricted to a small number of counties or districts where some system of regular recording of DVCs had already been in place, with no data available in many other areas.

4.2 The primary task for the present study was to build up a much more comprehensive database based on collection of as high a proportion as possible of recent Deer-Vehicle Collisions (DVCs) occurring throughout the country over a specific period. Following commencement of the project in January 2003 in England, and its extension to Scotland confirmed from April 2003, it was decided to focus effort foremost on compilation of the most extensive information for any incidents occurring during a two year data collection period from 1 January 2003 to end December 2004. The study was later extended to enable data collection for a further year up to December 2005. However, where sources indicated they could also provide some information on DVCs occurring during previous years, this information would generally also be sought and logged: for up to three previous years (i.e. Jan 2000 onwards) for all available records of DVCs, and for five previous years (Jan 1998 onwards) in case of deer-related personal injury accidents (PIAs).

4.3 The main initial purpose for the database was to provide a source for:

i) assessment of the overall scale and distribution of the problem [*based on analysis of data specifically recruited in complete years 2003-2005*].
ii) identification of accident hot-spots, where levels of recorded DVCs are noted to be notably above average compared to the surrounding region. [*all data*]
iii) evaluation of factors which may influence risk of deer-vehicle collisions, such as e.g. traffic volumes and speed, road types, road side habitats, deer species and density, time of day / year. [*all data*]
iv) design of a simplified longer term monitoring programme for DVCs.

4.4 During the present study we have accrued over 32,000 records relating to DVCs occurring in Britain between 1/1/2000–31/12/2005, including 6062 reports submitted for Scotland (5713 individual incidents when duplicate records are removed). The way these different records are broken down between study years (and between different source-types and Regional Council areas) is shown in **Tables 3**[**S**] and **4**[**S**]; [breakdowns of data for England are included for comparison at **Table 5**[**E**].

4.5 The greatest number of records were collated during the two most recently completed years (1598 individual incidents logged during 2004, and 1564 during 2005). Records were somewhat lower in the initial year of the project (2003) when we were still in the process of contacting potential sources and engaging their cooperation in the project, but even in this period the number of unique incident logged were only slightly lower at 1114.

[Numbers of DVC records accrued in the parallel study in England are considerably greater, at over 6000 per annum, but as discussed below [see 7.6], such higher numbers of records would be expected in part due to the ca. ten-fold greater traffic volumes and consequent overall road accident tolls in England].

Actual Number of deer- vehicle collisions

4.6 It is important to emphasise that such statistics (as in **Tables 3**[**S**] & **5**[**E**]) simply refer to the number of reports received by the study (or after elimination of duplicate reports, the number of **incidents** reported); this should not be seen as an indication of the number of DVCs actually **occurring**. Even these comparatively large 'samples' of near 7500 incidents logged nationwide annually remain, we believe, only a small proportion of the true annual toll of collisions with deer in Britain each year. As suggested in section 2.4, however, the actual extent of such underreporting may be estimated from comparisons of the rate of data capture by differing sources from within those regions where data from several types are available; or in some instances from case studies where much more intensive recording of DVCs has been undertaken within localised areas.

4.7 Firstly, there are a number of instances where independent counts have been made on a regular basis, of deer carcases seen within 50 metres of the road verge on both sides of a stretch of carriageway. For example one police officer from Highland region based at Mallaig, undertook regular searches during 2004 to record all deer carcasses he was able to find for a 20km stretch of the A830 between Glenfinnan to the Ardbuith viaduct, and has also explored how many of these actually corresponded to entries in police call-logs received by their control room; carcase counts can also be compared with all reports we have ourselves received from all other sources during the present study (see table below).

A total of ten records were obtained for that particular stretch of road from police call logs and other sources for 2004; the more intensive carcass searches indicated that a minimum of 28 deer had been killed here as result of collisions with vehicles during that one year. The true total of incidents is likely to be higher still, as some deer casualties tend to be removed and 'used' by the public without any reporting; however, these figures suggest that in this instance at best 35% (10/28) would have been captured in our database if just police call-log data and our normal level of public reporting had been available.

Road	Searches by	Length searched	Carcasses found'04	DVC recorded via all other data sources
A830	Mallaig Police (2004)	19 km	28	10
A82	DCS 1/1/04 to 1/3/05	48 km	33	19
A835	DCS 1/1/04 to 1/3/05	47 km	29	33
A87-A887 Shiel Bridge - Invermoriston	DCS 1/1/04 to 1/3/05	55 km	39	6

4.8 Similar programs of carcase searches have been organised by DCS at least two to three times a year for defined sections in a number of 'priority sites' along the A835-A832 , A82, and A87. Carcasses found are marked or removed to avoid re-recording at subsequent searches. Results of these carcase searches are summarised in the Table below (together with those for the A830) and these DCS counts may also be compared against the number of reports received over the same period by the present study. Although in case of the A835, carcase searches revealed a similar number (29/33) to the number we recorded through other reports, in case of the A82, reports from other sources made up at most 57% , and in case of A87-A887 no more that 15% of the minimum number revealed by carcase searches.

As indicated before even **this** will underestimate the actual level of underreporting, as many of the incidents reported to us from other sources are likely to be additional rather than the same as those found during roadside searches, as e.g. BEAR or local council and stalkers called to dispatch injured deer will often remove carcasses when called out unless they are too badly damaged to remove completely, and thus an unknown number would not be available to be found by the above road side searches.

4.9 A further indication as to what %age of all DVCs occurring annually nationwide we have been able to capture during the present study may be estimated by assessing the ratio of the numbers of human injury (PIA) incidents involving deer across given areas, against the total number of DVCs recorded in a number of specific areas (such as major community forests or FC woodlands under single ownership) where comprehensive long-term systems have been in place to record a very high proportion of all deer road casualties. Such assessments are explored further in sections 5.12 to 5.15 below, but indicate that our samples of around 7500 DVCs records obtained each year in Britain during the course of this study are likely to represent no more than between 13% to 19% of all DVCs occurring annually.

4.10 Such analysis suggests that the true number of DVCs in Britain as a whole is likely to lie in the region of 46,000 (+/- 9000), of which c. 8500 (+/-1500) may be expected to occur in Scotland.

Are DVCs increasing?

4.11 One of the first questions often posed is whether, or by how much, DVCs have been increasing compared to past years; and if this is attributable largely to the perceived rise in deer numbers over recent decades. The question of whether DVCs have in fact increased significantly in recent years over and above what might be expected as a result of higher levels of traffic is however difficult to answer. Although it is unquestionable that there has been a considerable expansion in the distributional range of most our deer species over the last 25 years, there is a lack of quantitative information on both a) the actual extent to which deer numbers have actually increased over recent years; and b) the actual number of DVCs which were occurring in previous decades to compare to results of the present, first systematic attempt at recording DVCs nationwide. However, it is **known** that traffic volumes on roads in Britain have doubled over that same period, and in the case of rural roads have nearly trebled (see **Figure 1[A]**). Therefore, even without any rise in deer numbers the annual incidence of DVCs would be likely to have increased substantially in the UK over recent decades.

4.12 The only analyses we can undertake within our own data relate to changes apparent over relatively recent short periods (e.g. 2000 to the present), where perhaps little change in accident frequency would be expected given the 'run' of years is short, and neither deer populations nor traffic volumes are likely to have changed dramatically over that period. However, data relating to motor accident claims to the Fortis Insurance Group, in respect of accidents known to have involved deer [discussed further in section 6.1-6.4] , are now available to us in the same form for six consecutive years.

Figures are presented for the UK as a whole:

Fortis Insurance	year 1999	2000	2001	2002	2003	2004
DVCs	214	287	217	307	366	409

The exact figures may be affected to some extent by changes in numbers of claims handled, but the percentage of market share held by Fortis group has remained at around 4 – 4.5 % of private motor polices. Figures thus do suggest an increasing trend in the number of claims relating to deer.

National Spread of all reported DVCs

4.13 **Map 1**[**S]** shows all those different 10km Ordnance Survey grid squares where we have information on at least one or more DVC record collected since Jan.2000 based on a sub-set of 2921 records with location details sufficient for mapping at this scale. This illustrates clearly the very wide nationwide spread of DVCs throughout almost all parts of Scotland .Distribution is more or less continuous throughout central and north-eastern parts of Scotland, but in practice there are almost no 10km grid squares for which we do not have any recent reports of DVCs.

4.14 An almost equally wide distribution pattern remains preserved even when using less than half our dataset, by restricting distribution mapping to include only data for the more comprehensive data logged in the specific study years 2003-05 (**Map 2**[**S**]). When viewing these frequency maps it must be noted that patterns apparent may to some extent be skewed as a result of somewhat fuller systems of recording in some areas than in others, in addition to real geographical differences in deer collision frequency

Distributional differences in patterns revealed by data source types

4.15 In **Maps 3 (a-h)** [**S**] the distributional data for 2003-05 have been broken down further to help explore any regional differences in recording between our main source categories. Some regional bias is likely to arise among the samples of individual recorders (categories D and G) according to where we have been most successful at recruiting regular contributors to the project (although that in itself tends to be easiest in areas where there are indeed highest deer numbers and hence greatest concern about DVCs). In addition, as above, we are aware of 'gaps' in continuity of recording within data provided by Council Cleansing Departments and Police Forces in some geographic regions [see 3.6, 3.8] However, in terms of overall distribution the patterns emerging based on each of the separate source categories are in fact broadly similar, and the same predominance of records in the Central Belt and in north-eastern Scotland remains apparent even among the rather smaller, but well stratified sample of records, provided by Insurance Companies [**Map 3(a) & Map 8**[**A**], Trunk Road Agents [BEAR and AMEY: **Map 3(e);** and also for entries submitted by the General Public **[Map 3(d)**.

Relative Frequency of DVCs in differing parts of England and Scotland

4.16 Although recent DVCs have been reported to us from virtually all parts of mainland Britain, [see 4.13; & **Map 5**[**A**]] very clear differences are apparent in the ***frequency*** of such collisions between different regions. **Map 4**[**S**] provides an overview of relative DVC distribution for Scotland as a whole, highlighting those areas where we have recorded the highest numbers of DVCs between 2003-05. To indicate relative differences in DVC occurrence all records with location details provided with sufficient accuracy have been allocated to the relevant 10 km by 10 km OS grid square, distinguishing on the map between those squares with 1-10, 11-20, 21-30, 31-50, and over 50 collision reports. [A comparative overview of relative DVC distribution recorded across all of Britain is provided in **Map 5**[**A**] for 2003+4 data]

4.17 These maps are created using the entire database, and it must be noted that patterns apparent may to some extent be skewed as a result of somewhat fuller systems of recording in some areas than in others [see 3.3-3.8] in addition to real geographical differences in deer collision frequency, although as discussed above (4.10) this would appear to be a lesser problem than at first anticipated. As a further caution, it must be emphasised that **patterns of higher or lower frequency of DVCs do not relate in a simple way to deer density.** The risk of DVC in any area is influenced in the first instance not by the abundance of deer *per se*, but rather the combination of high deer numbers in areas which also have a high density of roads and traffic; whilst numerous additional factors such as the mix of deer species present, road types, verge habitats, and deer management will also have effects on levels of DVCs[see Section 7].

Local regions of peak DVC occurrence

4.18 Perhaps more valuable therefore than simply as illustration of differences in DVC abundance between regions, **Maps 4**[**S**] **& 5**[**E**] help to identify some more localised areas where collision rates are seen to be considerably higher than those in surrounding areas. In these maps however, in order to make use of the maximum number of records, data have been mapped only to an accuracy of a 10 km grid square (i.e. 10,000 hectares); at this scale, some more localised differences and particular black-spots will tend to be obscured. While we cannot locate all incidents more precisely, a subset of reported incidents can be much more accurately identified to within 1 km, or at worst 5km. **Map 6[S]** provides such a closer view for Scotland of that sub-sample of 2168 DVC records from 2003 - 2005 which may be located with this greater precision, and enables presentation of 'relative' frequencies at finer resolution of 5 km by 5 km OS grid square. At this scale the location of some of the most significant local collision 'hot-spots' become much more readily apparent.

DVC rates and hot-spots on specified roads

4.19 For many DVCs the actual road number has also been provided by our contributors or could be added retrospectively where good grid reference detail was provided. Assessment of the database in relation to specific roads, can also help in identification of those routes (or route sections) which currently experience relatively high frequencies of DVCs – and thus to help target future mitigation efforts and/or identify potential trials sites for more detailed field research.

4.20 **Table 10**[**S**] summarises information for those roads in Scotland for which we currently hold the highest numbers of DVCs reported during our two study years with most complete records (2004 – 2005). To identify those roads with highest DVC rates, the total number of records for each named road was first totalled and then divided by the approximate length of that road to provide a minimum estimate of the rate of (reported) DVCs/km for the entire road. Unsurprisingly the highest overall numbers of DVCs per annum have been recorded for some of the longest routes, such as the A9, A82, A90, A93, and A92, with rates of DVCs 'reported' per annum when averaged for each of these routes as a whole ranging from 0.15 to 0.32/km/year; higher rates still of between 0.4 to 0.75/km were recorded on five routes: A835, M90, M9, A80 and B9077.

4.21 To put these figures into context: Overall road lengths in Britain are estimated 387,674 km, with 56,715 km in Scotland. At an *estimated* 46,000 DVC per annum (+/- 9,000) [see 5.15), this suggests an average 'actual' rate overall of approximately 0.12 DVCs/km/annum across British roads; while our estimated toll of 8500 DVC in Scotland suggest the average rate may be somewhat higher here at 0.15/km (+/- 20%). Based merely on our samples of 4276 records collated for 2003-05 in Scotland (which we know to be a sample only of the total number of incidents which do occur) we may calculate a minimum *confirmed* rate of, on average, 0.025 DVCs /km/annum for the entire Scottish road network. [Note that this latter figure is calculated in relation to our *recorded* incidents only; not the higher true number of DVCs which we estimate may be occurring].

4.22 However, around three quarters of our current reports of DVCs relate to 'A' roads plus Motorways; in this case the number of **reported** DVCs in our sample suggests a minimum rate of approximately 0.08 DVCs/km/annum across major roads (A + M) in Scotland. Against such background values it is clear that all the named roads identified above record significantly greater (from double to near ten-fold) the rates of DVCs 'typical' for major roads elsewhere; and along some identifiable sections of 5km or more rates recorded rise to over 20 to 40 fold that general average.

4.23 Having identified those roads in Scotland with the highest overall rate of DVCs [**Table 10** [**S**], we may also determine within these the sections showing the highest average rates (DVC/km) sustained over significant stretches; i.e. to pinpoint some of the worst hot-spots within each route, and to see how this compares to the route as a whole. For a 5km section

in the Dunkeld area of the A9, for example, the rate of reported incidents rises to over 4 DVC/km/annum. Given the background of average or 'normal' rates of 'recorded' incidents on major roads outlined in the previous paragraph, we may also re-examine the database for other road sections which show very significantly higher than the average rate of reported accidents. **Map 6** [**S**] highlights those 5km by 5km OS grid squares in Scotland where we have recorded the greatest local frequency of DVC; and closer inspection of records within those squares with from 16 to over 50 reports allows identification of further road sections on individual roads where DVC rates reach over 1 to 3/km per annum; i.e. from 10 to 30 fold the average recorded on major roads across Scotland as a whole [summarised in **Table 10**[**S**].

Deer Species Involved

4.24 Details of the deer species are available only for about one third of all DVC records received by the project, as this information is generally not available in the case of most reports from police control rooms, human injury reports, insurance records and road clearance departments. In addition, even in those cases where such reports do provide details on deer species, the accuracy of that information cannot always be guaranteed. In considering differences in the proportion of DVC involving different species it is useful therefore to restrict assessment in the first instance at least to that subset of data sources with greatest reliability of reporting. Of a total of 6708 DVC for England and Scotland available to us for which the species was stated (restricted to records for 2003-2005), 4386 came from data sources where contributors are likely to be able to distinguish species with a good level of accuracy (i.e. members of BDS/BASC/SGA/DI/DCS/FC/RSPCA/SSPCA, other wildlife rescue or Mammal Society).

4.25 In Scotland - data from the most reliable sources show the most common species involved to be Roe (69%), followed by Red (24.5%), Fallow 4%) and Sika (3%); but this is based here on a rather small sample size of 450 records. Inclusion of records from other sources where level of deer knowledge is not known suggests that the proportion of DVCs with Roe deer may in fact be as high as 77% with only 21% involving red deer (**Table 11**[**A**]). Note however that these national 'patterns' mask local differences. Where, for example, analysis is restricted to Highland region (where red deer are relatively more common than in other regions of Scotland) red deer contribute 70% and roe only 28% of all those DVC records where the species was reported.

In Scotland only one DVC was reported as having involved a muntjac deer (logged by a member of the general public not known directly to the project).

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4.26 By comparison, in England, analyses based on provisional 2003-5 figures suggest that Fallow were the most common species reported for involvement in DVCs (38%), followed closely by Roe (34%) and Muntjac (25%), with less than 5% relating to other species (Red, Sika, Chinese Water Deer). This proportional representation is in fact not greatly altered if analysis is extended beyond this initial 'most accurate' subset of data to include all records, from whatever source, where species has been attributed (see **Table 11 [A]**).

4.27 The distribution of the sub-sample of those DVCs reports within Scotland for which deer species was stated and reasonable location details are available is illustrated in **Maps 9**[**S**[, plotting for each species all those 10 by 10 km OS grid squares for species-specific records during 2003 to 2005.

5 IMPACT IN TERMS OF HUMAN INJURY

Deer related Vehicle Collisions leading to Human Injuries (PIA)

5.1 Although deer related PIAs fortunately make up only a small percentage of all DVCs, human injury records do potentially provide an extremely useful and well stratified source of information countrywide. Unfortunately, however (see paragraph 2.1.1) the level of detail of PIAs collated centrally for the UK by DfT (or within Scotland by SEERAD) does not suffice at present to distinguish readily between incidents involving differing types of animals other than dogs and ridden horses. Thus, the main ST19 returns completed by police for any human injury road accidents (and collated by DfT for national statistics) for cases where an animal is implicated as a carriageway hazard will distinguish only between either 'dog', or 'other animal or pedestrian', and hence interrogation of the national DfT databases cannot at this time provide the detail required for the present study. From January 2005 a new version of the ST19 form was introduced with some changes on how live animals and 'objects' (including dead animals) are recorded, but still does not enable systematic centralised abstraction of animal types.

5.2 However, in the original reports maintained by Police forces or by Council accident investigation departments, more detail is often retained in form of a short free form text description of the accident circumstances as noted by the attending police officer. In many cases, after we had contacted them directly, Regional Police Forces, or County/Regional Accident Investigation Units were able and willing to abstract and release those data to us in sufficient detail to enable identification of those incidents known (or else alleged by the driver) to have involved deer.

5.3 Personal Injury Accidents (PIA) arising through collisions or swerving to avoid deer form an important element of the present study, not merely because of the serious nature and economic cost of these incidents, but also because such data when available are also generally of high quality, with precise details on location, date/time, severity of casualties, and road conditions. Fairly comprehensive information on deer related PIAs has been assembled for 3 out of the 8 Scottish police force regions, with good data for another two in one or two study years. Several of the others were able to provide only sparse data, or reported that they are so far unable to identify 'deer' incidents separately from other animal related PIAs in their road accident databases.

5.4 In Scotland our best set of consistently recorded PIAs data is for Highland Region, where Highland Council have been able to provide directly comparable records across the six years from 2000 to 2005. In those successive years 6, 10, 8, 10, 9, and 9 deer related PIAs have been recorded specifically as having involved deer, including 1 fatal, 9 serious and 42 slight human injury incidents; for around 20% of all animal related incidents the animal type is not stated in the original police records, with some of these also likely to relate to deer. Such details as are available about road types and deer species involved in PIAs are explored in sections 7. 9 and 7.16 .

5.5 Rather less complete records of deer-specific PIA records were available for other Scottish police regions and in only some of our study years; including on average 1 to 2 each per year between 2003-5 reported by police in Fife, Stirling, and Tayside regions. These figures are likely to be underestimates however since in some sets of figures received only those incidents were included where a deer was actually known to have been hit (rather than swerving to avoid), while (as above) in other cases type of animal involved was not clearly recorded. An estimate of the true number of PIAs per year across the country is derived in paragraphs 5.8-5.10 below).

5.6 **Table 9**[**E**] provides by way of comparison a summary of deer-related PIAs for 24 English Counties (mostly for 5 years each), broken down by severity and numbers of casualties. Highest annual levels of deer PIAs have been recorded over recent years in Hampshire, Essex, Suffolk and the Thames Valley (Bucks/Berks/Oxon), averaging between 12 to 25

such accidents per year in each of these areas. Somewhat lower levels of 4 to 9 PIA with deer are recorded in less densely populated counties, such as for example Dorset and Devon and Lincolnshire, where despite comparable levels of deer abundance, levels of traffic flow are much lower than in Southeast England (see also **Table 6** [**A**]).

Are deer more commonly involved in PIAs than other wild mammals?

5.7 Figures for PIAs recorded in different English counties are included above not simply to offer comparisons to accident rates in Scotland, but for a further specific purpose. While the main focus of the present study is on deer-vehicle collisions, to help put these into a wider context we took the opportunity to inspect and collate also data on PIAs for a sample of Police forces who agreed to provide information on all animal related traffic accidents. Incident descriptions for all those PIAs between 1998-2003 in which "animals other than dogs" (as recorded by STATS19 forms) were involved as carriageway hazards, were assessed across a sample of 14 different English counties, and included 1450 human-injury RTAs involving animals. Of these: 603 were due to wild mammals (mainly deer, fox, badgers and lagomorphs), 558 due to domesticated animals and birds, and 290 recorded merely as 'animal' in road. For those PIAs involving 'wild' mammals, deer were by far the most common cause (50%), with rather fewer with rabbits and hares (21%), foxes (20%) and badgers (9%) [see **Table 8**[**E**]; from Langbein, 2003].

Overall, deer related incidents were assessed as making up 23.5% of all the 'other animal' related PIAs in the sample of over 1400 'other animal in road' ST19 records inspected.

Estimates of the actual number of deer related PIAs per year, and their economic cost

5.8 As noted above (5.1 - 5.5) estimates available for the number of PIAs involving deer within given administrative regions are likely to be underestimates, either because the actual animal involved in the reported incident is not recorded in many instances, or because records do not include accidents caused by swerving to avoid the animal. In addition we have consistent records only for a small number (3/8) of Police regions (paragraph 5.3). We have therefore undertaken an independent analysis to attempt to estimate the true number of PIAs occurring in Scotland each year which are attributable to deer.

5.9 From figures made available to this project by the Department for Transport, we may calculate that over the past 5 years PIAs which were attributed wholly or in part to the contributory factor of "other animals in the carriageway" (whatever species) have consistently remained between 2275-2568 (mean 2356) accidents per year, including around 360 serious injuries and 50 fatal collisions. On the basis of the considerations of paragraph 5.7 it seems probable that on average 23.5 % of these, nationwide, are likely to involve deer.

This allows us to derive an independent estimate of the total numbers of PIAs in Britain relating to deer at around 554 per annum, including approximately 12 fatal, 86 serious and 456 slight injury accidents (see **Table 7**[**A**].

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5.10 Among the average annual toll of 2350 animal related PIAs logged by DfT, 315 (13.5%) of these related to incidents in Scotland; using the same estimator for the proportion of deer related incidents, this suggests a likely annual figure in Scotland of 74 PIAs, including 1 to 2 fatal, 16 'serious' and 56 'slight' injury accidents.

5.11 The value to the economy of the prevention of Road Accidents, is outlined in regular updates of 'Highways Economics Note 1' published by the Department for Transport, and used in part for the purposes of assessing various road safety schemes. At 2003 values, the expenditure considered to be justifiable for the prevention of road traffic accidents was :

Average 'Value of Prevention' per accident by severity -

- Fatality: £ 1,492,000
- Seriously Injured: £ 174,500
- Slightly injured: £ 17,500
- **Average across all PIA incidents: £ 61,120**

Based on the above estimate that in excess of over 500 human injury DVCs per annum (@ mean £61,000 per incident) suggests a total potential value for their prevention at > £30,000,000 per annum. The 'value of prevention' of the likely average number (74) of deer related PIAs each year in **Scotland** amounts to around £4.5M.

Estimating the total number of DVCs on basis of proportion showing up in PIA records

5.12 Several previous studies in the United States and Europe have suggested that in some countries as many as 2% to 5% of all deer collisions may result in human injury (Hartwig 1993, Conover et al. 1995). However, these figures are in practice mostly calculated not as a proportion of all DVCs which may occur, but simply as a proportion of those incidents actually **reported** to police or insurance companies. Since accidents which are worthy of report are likely to be biased towards those which involve human injury or material damage sufficient to warrant an insurance claim, and many accidents which do not cause (human) injury or significant vehicle damage will remain unreported, it would seem probable that such calculations will overestimate actual rate of human injury accidents as a proportion of the real total of **all** deer road collisions occurring.

5.13 Even our own database offers a significant under-recording of DVCs overall [see 4.6 - 4.10]. Indeed if we accept (as at paragraph 5.9) that the number of human injury accidents occurring per annum in the UK lies around 554, and IF we relate this to the actual total number of incidents recovered by us during the present study (c. 7000 per annum), it is simple to calculate that this would suggest that around 8% of such DVCs would result in human injury. However, in reality evidence presented below [5.14, 5.15] based on several of those localities where DVCs have been logged most diligently for many years shows that the actual rate of PIAs resulting from deer collisions is far lower, and unlikely to exceed more than around 1 to 1.5 %.

5.14 The most complete DVC records available to us tend to be associated with the major lowland forest regions such as Thetford, the New Forest, Forest of Dean and Ashridge in England, each of which lie in counties where we also have good ST19 information on PIAs. During the four year period from January 2000 to December 2003, in just these four forest areas combined we have been able to record a total of 2029 deer road casualties. Within those same four regions during that period we know of 23 PIAs which have involved deer as a carriageway hazard. On the basis of these figures, the percentage of human injury incidents amount to just over 1.1% of all the 'recorded' DVC. In reality the percentage of PIAs may be lower still, as even in these major forests a significant proportion of deer casualties are known not be reported. On the other hand, in about 20% of PIAs logged in official police records the animal type is not discernible from the accident description (e.g. when this simply states that the driver hit or swerved to avoid 'an animal' in the road, without giving the type), and thus actual numbers of deer related ones may also lie a little higher.

5.15 On the basis of the above figures, and assuming that similar proportions of animal-hazard accidents result in PIA in Scotland and England, we may conclude that **it is unlikely that human injury accidents make up more than 1% to 1.5 % of all DVCs occurring in Britain.** Taken in combination with our estimate that annually there are in the region of 550 human injury accidents (PIAs) [see 5.9, and **Table 7**[**A**]], then backward extrapolation enables us to derive a range of between 37,000 to 55,000 (or c. 46,000 +/- 9000) as the best current estimate of the annual toll of DVCs in Britain over recent years. This nationwide estimate is of not dissimilar magnitude to the upper level proposed some years ago by SGS in 1998 (20,000–42,000), despite being derived here using entirely differing methods of calculation.

6 NUMBERS AND COSTS OF VEHICLES DAMAGED IN DEER RELATED COLLISIONS.

6.1 Input of information from all but one major Insurance Company have been very disappointing, with most claims managers stating that they are unable to readily extract those claims relating to deer, as computer logs at best tend to enable extraction of all 'animal' related incidents; suggesting that thereafter searches would require time-consuming (& thus costly) individual retrieval of paper files if its feasible at all. A regional claims manager for NFU Mutual did ask all his claims staff to try and record any deer related incidents from beginning of the study, but very few data have been received as yet.

6.2 By sharp contrast, however, Fortis Group Insurance (with c. 4% of the UK private motor insurance market) provided an extremely useful source of data on DVCs, with information on 1800 deer related claims now available from their policy holders throughout a six year period from 1999 – 2004. A map of the distribution of Fortis Grp. DVC records is shown in **Map 8**[**A**] illustrating the very widespread sample provided by this one company alone. Though representing only 4.25 % of the national private insurance market, the above records from Fortis are determined from searches of over 200,000 motor claims arising from the c. 1.3 million private motor policies held by Fortis Group in Britain. [Although a further annual up-date was requested early during 2006, unfortunately Fortis Group have not been able to submit their 2005 records as yet for inclusion in this report].

6.3 In 2003 and 2004 the number of deer related claims identified by Fortis rose to 366 and 409 respectively, with an average cost per deer related claims of £1320 (closely similar to the average across all types of motor claims).

6.4 On the basis of the extensive claims information for 1999-2004, together with knowledge of the market share held by Fortis, and numbers of comprehensive / third party insured vehicles, we may derive an estimate that around 10,700 vehicles may be expected to be damaged significantly (i.e. above insurance excess level) as a result of DVCs in Britain each year, at an approximate cost of around 13.9 Million. Of all claims identified, 18.5% were located in Scotland, and just 0.5% in Wales; allowing separate estimates of the minimum costs of material damage in Scotland at c. £ 2.6 M, and costs in England at £ 11.3 Million. While these estimates consider merely the actual cost of claims and damage to vehicles, they are likely to be substantial underestimates of the total costs arising from damage-only DVCs. As noted earlier, a number of incidents involve levels of damage which are below the policy excess or which drivers voluntarily absorb themselves (rather than lose No Claims bonuses). In addition there are often hidden costs such as necessity of hire of replacement vehicles, loss of time, and in extreme cases loss of work opportunities.

6.5 In the present study the deer species involved was known for 100 out of 522 DVCs where significant damage to vehicles was reported; the proportion of such damage accidents relating to red deer (47%) was substantially higher than the 'background' proportion of incidents overall for which red deer were noted as being implicated (see para. 4.25)

7. FACTORS ASSOCIATED WITH INCREASED FREQUENCY OR RISK OF DVC

7.1 It is clear from the published literature (reviewed by SGS 1998, Staines et al 2001; Putman et al 2004; Hedlund et al. 2004) that variations in frequency of DVCs in different areas or on different road stretches may be affected by a multiplicity of contributing factors such as (*inter alia*) season, time of day, deer species, deer density, traffic volume, road types, average traffic speed, road tortuosity (and thus driver visibility), presence (and character) of vegetation close to the roadside (affecting both visibility of deer to the driver, and visibility of approaching vehicles to the deer themselves, as well as the probability that deer may be close to the carriageway in the first place) . While not all of these factors are susceptible to management (and thus cannot necessarily be manipulated in order to reduce accident risk in particular instances) some may offer such potential. More importantly, fuller understanding of all contributing factors (and their interaction) may be very helpful in predicting likely current or future problem areas to target alternative measures of mitigation.

7.2 In the event, the quality of data submitted to the database, and the form in which the data are provided by some sources types restricts formal analysis for all but a few factors. However, we offer below some general observations which may be deduced from particular sub-samples of those records in the database for which additional information about road characteristics or animals involved is available.

Deer Density

7.3 It is immediately apparent, even from superficial examination of accident distribution maps presented above in section 4, that areas of high frequency of DVCs are not simply related in any direct way to deer density. Higher than average levels of DVCs at the landscape scale are of course determined in the first instance not by the abundance of deer *per se*, but rather an interaction between high deer numbers in areas which also have a high density of roads and high traffic volume [see also 4.17]
The highest frequency of DVCs reported to date are indeed mostly located within those regions of the country where traffic flows are greatest.

7.4 In Scotland **[Map 4**[**S**] it is clear that the areas with most DVC records do not occur within the Highlands which tends to be associated with highest (red) deer abundance, but instead fall in the Grampian, Tayside and Central regions - those regions where deer (mostly roe) are in practice exposed to some of the highest levels of traffic. By comparison, in England – the region with highest numbers of DVCs lies within the South-East, which is the region with by far the highest traffic volumes not only in England but Great Britain overall [see: **Table 6**[**A**] / **Map 5 [E]**] rather than necessarily highest density of deer.

7.5 While it is unsurprising that the total number of deer collisions (as indeed traffic accidents in general) is likely to be highest in those regions and on those roads with most traffic, this should not be misunderstood as implying that the actual 'risk' for drivers being involved in collisions with deer is necessarily lower in more remote areas with lower road density and traffic volume but often greater deer abundance. On the contrary, while the overall total number of accidents may be lower in such areas the risk to any individual driver of being involved in a deer collision may well be as great or greater in areas with high deer density despite lower traffic volumes overall.

7.6 This interaction between deer density and traffic volume is well illustrated by considering the level of DVCs recorded for Scotland and provisional data available for England to end 2004. Only some 19% (2712) of all DVC incidents logged by us in Britain during 2003+2004 were located in Scotland. However, traffic in Scotland contributes only around 9% to the total traffic volume for both countries combined. Thus the average risk to drivers of hitting a deer in Scotland per driven mile may be assessed as being approximately twice as high as in England. By converse, the risk to deer themselves being involved in a collision is far greater

in England. Thus, an estimated total population of deer in England as c. 700,0000 head (all species combined) suffers a (minimum) of 28,000 vehicle collisions - equivalent to 4 per 100 deer. In Scotland, a somewhat higher total population of c.750,000 deer suffers a smaller number of collisions overall (estimated at a minimum of 7000 collisions), thus 1 per 100 deer.

Deer Species

7.7 It is apparent in addition that different species of deer are differentially implicated in DVCs throughout the year. [For breakdown by species see Table 11[A] & 4.24 - 4.27]. Within Scotland, the vast majority of accidents involve roe and red deer.

7.8 However, while the majority of deer accidents in Scotland and Britain overall involve roe deer, in practice the species most associated with localised 'hotspots' of accident risk throughout the UK as a whole is fallow. For those areas in England where we have so far recorded the highest concentrations of collisions (i.e. >30, and in some cases as many as 85 per year within single 5km by 5km OS grid squares) the great majority of these relate to locations with very high fallow deer density. Curiously enough, while fallow deer are not widespread through Scotland, and contribute a very small proportion of all DVCs recorded there overall, the location with the overall highest concentration of DVC in Scotland lies near Dunkeld; and at that localised site the majority of DVCs also relate to fallow [**Map 6**[**S**] ; and see species **Map 9** [**S**].

7.9 The severity of DVCs, at least in cases where a vehicle actually collides with the deer rather than incidents causing drivers to swerve, may generally be expected to increase with the size of the animal or deer species concerned. Hartwig (1991) in a study of DVCs reported to police authorities in Germany found that 97.5 % of collisions with roe deer caused only minor damage (up to 3000 DM) and therefore often go unrecorded, with the remainder causing more extensive damage and/or injury. For red deer, equivalent figures were 88% of collisions leading to minor damage, and 12% with major damage or injury; while figures for fallow were intermediate with 93% causing minor damage and 7% major damage or injury. Similarly, Haikonen and Summala (2001) in Finland estimated that the percentage of white-tailed deer-vehicle collisions resulting in human injuries lies at 1.3%, but rises to 9.9 % for incidents involving moose.

Only rather sparse comparable information is available to us from the present study to explore differences in the risk of human injury through involvement in DVCs with differing deer species in Scotland. The type of wild animal involved does not have to be recorded by law even for PIAs, and many police officers attending traffic incidents may not necessarily be able to differentiate readily between different deer species. As a result, among our sub-sample of 95 DVC reports in Scotland that are known to have caused human injury, information on the species of the deer involved is only discernible from the accident descriptions in 12 cases (7 with red deer, 5 with roe). Among these limited species specific PIA records, in four instances the involvement of red deer was only indirectly implied by mention that a 'stag' had been involved; and involvement of a red deer stag may itself well be more likely to be reported as these are more readily identified by the attending police officer or members of the public. Of those seven PIAs where red deer are known/thought to have been involved, six occurred within Highland region, where red deer also make up the majority (>70%) of all other DVC records where species is known (see 4.25). By contrast, for Scotland as a whole roe deer make up over 75% of all DVCs for which the species is known, and were also the most common type reported in human injury accidents in all other regions aside from The Highlands.

7.10 The deer species involved was also known for 100 out of 522 DVCs where significant damage to vehicles was also reported. Here the proportion of such damage accidents relating to red deer (47%) was indeed much higher than the proportion of red deer noted among all those DVCs for which species information is available (21%; see 4.25); supporting the above findings from other countries that DVCs involving the larger deer species are likely to cause more severe accidents than those with smaller species.

Effects of Season

7.11 Several previous studies in the UK have demonstrated clear peaks in DVCs during late autumn (Langbein, 1985; SGS, 1998; Staines et. al, 2000) and also a further peak during late spring. By way of illustration **Figures 2(b) and 2(c)[S]** summarise the seasonal distribution of accidents recorded during the present study separately for roe and red deer in Scotland, based on all records where species identification is reported (sample size for DVCs positively identified as involving fallow (24) was in sufficient for similar analysis). Although some DVCs occur throughout the year, for both species distribution among months is non-random (Chi-squared test : $p<0.05$ (red) and $p<0.0001$ (roe). For red deer highest numbers of accidents occurs during October to January. This is likely to be associated both a) with the increased movement of deer during and after the peak rutting period during October; and b) the co-incidence of the peak daily activity periods of deer around dawn and dusk with also highest levels of traffic flow at that time of year. A secondary peak is apparent in this Scottish data for red deer during the month of May. For roe deer the highest incidence of DVCs in Scotland consistently occurs during May when almost twice as many incidents are reported than in any other month [**Figure 2(b)**]. This spring peak beginning from late April and lasting into mid-June, occurs at the time of year when young male roe deer tend to disperse from natal ranges, making them more likely to cross main roads, while adult females and young may also be more vulnerable to being involved in traffic accidents whilst accompanied by young kids. A secondary peak in roe DVCs occurs again between October to December when day length shortens, but in this case not associated with their mid-summer mating period.

Influence of Road Type

7.12 Among our collated sample of incidents recorded in Scotland (2003-2005) the road type for the incident is at present known for 3355 (see Table below; the table also presents provisional data for England based on reports in 2003/04, for comparative purposes).

	No. of DVC where road type known	**Motorway**	**'A' Roads**	**'B' roads**	**'C' roads**	**Un-Classified**
Scotland 3 yrs (2003-05)	**3355**	258 (7.7%)	2434 (72.5%)	507 (15.1%)	27 (0.8%)	129 (3.8%)
England 2 yrs (2003-04)	**7866**	471 (6%)	4326 (55%)	1573 (20%)	470 (6%)	1023 (13%)

7.13 **NOTE** – some caution is required when interpreting these results from the overall database of records submitted to the study, as for several reasons the likelihood of the road type and/or road number given for DVC reports received might be prone to overrepresentation of the more major roads: Firstly, contributors reporting deer casualties are more likely to know the road type and or number of the road they are travelling on for major roads when noting a deer casualty or being involved in a DVC themselves. Secondly, the level of reporting of deer casualties via roads maintenance departments is more comprehensive for motorways and trunk roads, than for minor roads. Although some local authorities also provide very extensive data to us, such reporting is far less complete across local roads departments than it is in case of the trunk road network. Finally, analysis is also confounded by the relative total length of roads of different type within the road network overall, and proportion within rural and urban/sub-urban areas.

7.14 The total road length in Great Britain (2004) is 387,674 kilometres. This divides among countries and major road types as follows (km):

	Motorways + all A roads	**All minor roads**	**Total**
England	35195 (12%)	262584 (88%)	297779
Scotland	**10682 (19%)**	**46033 (81%)**	**56715**
Wales	4315 (13%)	28865 (87%)	33179
Total	**50192 (13%)**	**337482 (87%)**	**387674**

7.15 The overall number of DVCs recorded (from 2003-05) on Scottish roads, where road type is identified, is recorded in the summary Table above [see para.7.10]. Pooled for Motorways + A roads, and for B and other Minor roads, numbers are respectively 2692 (80%) and 663 (20%), even though the major roads make up merely 19% of total road length in Scotland.

7.16 The same high representation of major roads remains apparent when restricting assessment to DVCs logged within individual complete datasets provided by specific Accident Investigation Units, or Council Road Accident departments; which provide well-stratified samples of DVC involving damage-only as well as human injury incidents. In Highland region for example, 71% (n=156) of such DVCs were reported on A-roads, which contribute just 33% of total road length for the region; within the more populated regions covered by the Tayside + Fife Police areas A-roads plus motorways make up only 19% of the road network, but account for 69% of deer related traffic accidents attended by police.

7.17 To consider whether the relative proportion of accidents occurring on different road types remained similar for more serious incidents, we explored again the smaller sub-sample of 95 incidents collated during the present study that are known to have resulted in human injuries. Amongst such PIAs for Scotland overall 68% occurred on major (A+M). roads and 32% on minor roads. These proportions are essentially similar to those recorded for all accident types, especially since in this latter analysis samples were biased towards Highland region (see 7.16 above).

7.18 In Scotland, "The total volume of traffic on major roads (Motorways and A roads) in 2004 was estimated to be 28.2 billion vehicle-kilometres. Traffic on Motorways totalled an estimated 6.1 billion vehicle kilometres (14% of all traffic). This was less than the estimated 9.9 billion vehicle kilometres on trunk A roads (23% of the total), and the 12.2 billion on non-trunk A roads (29%). Most of the traffic on A roads was on roads in rural areas accounting for 16.6 billion out of the A roads total of 22.1 billion" (Scottish Transport Statistics No 24: Scottish Executive, 2005).

7.19 In summary: although 'major' roads only make up 18.8% of the total road length in Scotland, they carry 66% of total traffic volume and over 72% of rural traffic. The finding in this study that near 80% of all DVCs were recorded on major roads (see 7.13 above), is therefore broadly in line with the relative distribution of traffic among road types. Major roads also accounted for 68% of all known human injury accidents involving deer, closely similar to the proportion of the overall traffic volume carried by such roads.

7.20 However, the very high proportion of DVCs in Scotland on major (A + M) roads, also suggests that any future monitoring programme aimed at monitoring trends in DVCs could effectively sample the bulk of all incidents even if restricted to monitoring accident rates on major roads or the Scottish trunk road network alone [see 9.6].

7.21 The figures presented above for numbers of DVCs by road type, when divided by total recorded road length in Scotland for all major and for all minor roads, suggest 'average' rates of reported DVCs on major vs minor roads as respectively 8.3 per 100km/year and 0.5 per 100km/year. This provides us with an additional estimate of what constitute 'normal' average

rates of reported DVCs overall by road type per kilometre, and can serve as a useful guide in terms of identifying notable blackspots, where for example, recorded rates lie well in excess of that average level [see 4.19 - 4.22; and **Table 10**[**S**].

Other factors

7.22 As noted above (7.1) a host of other factors which may influence frequency of DVCs include river speed, vegetation near roadside, road tortuosity, deer behaviour, and presence/absence of effective mitigation. In practice it has proved difficult to undertake detailed analysis of the effects of these features on accident frequency from data recorded within the database itself. This is due to a number of factors.

7.23 In the first place relatively few recorders have specifically noted roadside vegetation at the location of the incident, or presence/absence of fencing or other mitigation. Further, given the lack of precision of recording of location (grid reference), it is not often practicable for us to determine these attributes retrospectively (if an accident description is accurate only within a 2 km stretch of road, it may not be possible to determine for example, whether the particular location of the accident was in wooded or open country, or whether there may have been warning signs, reflectors or fencing at the accident location, even if we were able to determine presence or absence of such measures on that particular stretch of road as a whole. Thus the available number of incidents where roadside vegetation, or presence/absence of mitigation are recorded is rather small.

7.24 Secondly, even if on interrogation of the database we find that some number of accidents are associated with cases where roadside vegetation has been accurately recorded as woodland, while a (different) number of accidents are recorded as associated with open moorland, this in itself does not tell us whether accidents are more, or less, likely to occur in wooded stretches of roadway by comparison with more open stretches, **unless we actually know what proportion of the overall road network is wooded or open in nature in the first place**.

[Thus, for example, if 30% of those incidents in which habitat is accurately recorded occur in wooded areas while 70% occurred in open habitats, this might imply that accidents are more *likely* in open areas, but does not show that actual accident risk is affected by habitat. There may in effect be no effect of habitat on accident risk, if the 30:70 ratio observed in wooded or open stretches of road reflects nothing more than the fact that 70% of the road network as a whole is 'open' in nature, while only 30% has woodland near to the road verge on one or both sides. Without detailed knowledge of the actual proportion of different habitats along the road network at a relatively fine level, it is not feasible to assess with a good level of confidence whether accident frequencies are affected by habitat or are in effect randomly distributed.]

Similar problems of lack of 'control' data affect feasibility of analyses of the effectiveness of roadside fencing (unless it is known what proportion of the overall road network is fenced against deer and or other livestock), or effectiveness of deer mirrors or other forms of mitigation.

7.25 Finally, problems in analysis also arise from the fact that all entries in the database are unitary, and all relate to actual incidents. We do not have control data for any given incident for the number of similar locations where **no** accident has occurred. Nor, given the unitary nature of each record (and the frequent lack of precision of locational information) can we readily calculate accident ***rates, or frequencies*** on stretches of road with certain given characteristics, for comparison with accident frequencies on stretches of road with different characteristics [i.e. wooded vs non-wooded].

7.26 While such considerations limit present analyses in relation to factors such as road side habitats, road alignment and presence / absence of mitigation, these could usefully be addressed through means of ground-truthing studies for a selection of roads or road sections;

to determine the background data for significant sections of road, against which the subset of records with good location references in our data could then be evaluated in greater detail. For purpose of the present study however any exploration in the paragraphs that follow of the influence of different contributory factors to the risk of DVCs, is necessarily descriptive rather than analytical:

Effects of roadside habitat

7.27 Of the 6062 reports now available in the database for DVCs in Scotland, some indication of roadside habitat was recorded by contributors for 1480 incidents;121 of these recorded woodland on both sides of the road. A further 384 records reported woodland on one side of the road but did not specify the vegetation of the opposite side of the road. We may presume that in the majority of cases, such 'omission' may be taken to imply either i) that the road as a whole was wooded, or ii) that (in the cases of a wide road or dual carriageway) only the habitat character of the side of the road from which the deer may be presumed to have come carries any significance. In total some 505 records may thus be presumed to have occurred in areas where the dominant (influencing) vegetation was woodland. A further 101 incident reports record woodland on one side of the road coupled with open habitats (farmland or open moorland) on the opposite side.

7.28 Open habitats were reported on both sides of the road for 293 incident reports, with a further 466 reporting open habitat on one side but not bothering to record the habitat on the opposite side of the road. With the same assumption as above, we may conclude that 759 incidents records may thus have occurred in areas where the surrounding landscape was largely open. Over the entire period from 2003 - 2005, only some 24 incidents were reported to have occurred within predominantly built up areas.

7.29 From such limited statistics it would appear that slightly higher number of incidents (in those cases where habitat is recorded at all) were recorded in predominantly open landscapes (759), rather than in wooded areas (606), suggesting a greater proportion of accidents occur within more open landscapes. However, as noted above, without detailed knowledge of the proportion of wooded / open locations along the road network, it is not possible to assess conclusively whether accident risk is affected by habitat or whether in effect DVCs are randomly distributed. That said, although exact figures are not available at this time, we may presume that a comparatively rather smaller proportion of the total road network is wooded, or has woodland close to the roadside. In such case it would appear likely that accident frequencies may be higher per unit km of roadway in areas with woodland on at least on side of the road rather than open environments. Such conclusion would accord with various studies in continental Europe that have reported higher collisions rates with roe deer where roads were located between forest and fields (Kofler & Schultz, 1987; Seiler, 2004).

Presence of mitigation measures

7.30 Among our sample of 5713 DVCs, a total of 687 incidents recorded presence or absence of different forms of wildlife mitigation in Scotland. The great majority (604) of these records were provided by Aberdeenshire Council Roads Cleansing Departments, who recorded not only presence but also absence of deer fencing, other (stock) fencing, and wildlife signs whenever possible, and thus provide the most useful sub-sample for assessment here.

7.31 In this dataset for Aberdeen, accidents were reported in the presence of deer fencing just 16 times, stock fencing 102 times, while 470 accidents occurred in areas where lack of any roadside fencing was recorded. Wildlife warning signs were recorded as present in 67 and absent in 60 cases. The presence of wildlife warning reflectors was noted for only three records.

7.32 Once more, interpretation is handicapped by the fact that all records relate to actual incidents and the fact that we do not know for example what proportion of the total road network is fenced/unfenced (and thus how often we might expect accidents in the presence or absence of fencing even if fencing had no effect). Further the presence of mitigation itself

implies a problem (or a perceived problem) with DVCs in the past which has led to the installation of mitigation measures in the first place. Thus such sites may be 'atypical' with an *a proiri* presumption of higher than average accident frequencies in the first place. Subsequent comparison of accident rates in areas where mitigation is present by comparison with those where absence of mitigation is recorded may reveal higher rates of accident in areas with mitigation present (even if that mitigation is partially effective in reducing accident frequency), simply because these are areas of intrinsically higher accident rate.

8. OTHER PROJECT OUTCOMES

Efficacy of Mitigation measures

8.1 Alongside the main aim of the project in development of a nationwide system for collection of data on DVCs, a secondary objective was to investigate such aspects of deer behaviour and deer management which may affect accident risks and effectiveness of differing mitigation measures. Although comparatively little useful information on the effectiveness or lack of effectiveness of different mitigation has emerged from interrogation of the main DVC database [7.24 - 7.26 above), we have independently completed a comprehensive literature review of the different mitigation measures currently being deployed in different parts of Europe and North America, together with an analysis of effectiveness and cost-effectiveness of the different measures available, as part of a separate, but parallel contract for the Deer Commission for Scotland (Putman, Langbein & Staines, 2004). This report is available online on the Deer Collisions website at www.deercollisions.co.uk/ftp/mit_review.doc . The review considers the entire range of mitigation measures available in Europe and the US and patterns of usage, and summarises the conclusions of the various scientific studies which have been undertaken to assess actual efficacy of these different measures.

8.2 Such systematic research into deer mitigation options as has been undertaken has, however, nearly all been carried out in the US or continental Europe, where the deer species, deer management and traffic situations are often quite different from Britain.

8.3 Specifically within Scotland it is noted that similar 'trials' are likely to be established on the A82, A835, and A87, in implementation of the recommendations made to, and now endorsed by the DCS of the Advisory Panels established to advise on the most effective ways of reducing accident risk in these Priority Site areas. Some programme of monitoring will undoubtedly be required to assess the effectiveness of any mitigation measures implemented in response to the recommendations put forward by these Panels and this will provide useful 'ground-testing' within the UK situation of a number of established and more novel deterrents.

8.4 A number of new types of mitigation have recently been brought onto the market including new types of acoustic reflectors, rumble strips, and novel types of animal- or speed- activated signage (Langbein, 2006; Langbein & Putman, 2006). In response to this a number of practical trials have been initiated and are now underway in England to evaluate some of these newer forms of deterrent. While this current report has explicitly focused on DVC statistics accumulated for Scotland, that work was integrated within a UK-wide, National Deer-Vehicle Collisions Project, which is still continuing in England and Wales; DCS and the Executive are thus urged to keep appraised on the progress and results of these additional trials in England as a further input into determining the best available measures for future mitigation needs.

Raising Public Awareness of DVCs

8.5 As noted above (2.12), the present study has been widely publicised over the last two years not only via the dedicated project web-site, but also in numerous magazine articles, and through numerous local and national radio and TV interviews. Although aimed initially at publicising the database and maintaining momentum of data input, such interviews/articles also help to fulfil another of the study's objectives; that is, increasing public awareness of the problems of deer-related RTAs, and in offering advice on how to minimise risk of accidents.

In addition to an initial publicity drive to inform people about the study, at the launch of the project, further major media releases were undertaken during October 2004 with assistance of RAC Foundation, and various regional TV and radio stations, to coincide with timely advice just prior to the common seasonal peak in incidence of DVCs during October to December.

8.6 This was repeated with further widespread media coverage in autumn 2005 about the general issue of DVCs , and more specifically following widespread media interest in the trials of novel deterrents [see 8.3] commenced around the same time. Since beginning of the study in 2003, the DVC issue and Deer Collisions Project has now been discussed in well in excess of 100 newspaper articles, as well as also in many longer magazine and journal articles written by the project team, and also numerous TV and radio interviews and news items about the study.

8.7 While we continue to make efforts to raise awareness among the general public, it is also seen as important to attempt to increase understanding of the issues surrounding DVCs among professionals, including local authorities, road builders and ecological consultants. To this end presentations about the project have been given by members of the project team to several specialist conferences over the project period, including a papers on the wider economic implications of all wild mammals on roads at the *Mammal on Roads* Conference organised by Mammal Society and Highways Agency (November, 2003); presentations to the Institute of Civil Engineers Municipal Group in Scotland (February 2005), and The Transport Statistic User Group (at DfT October, 2005). Numerous other talks about the Deer Collisions project have included presentations to the DI Conference in March 2003; Mammals Trust UK conference Feb'04; Sheffield Urban Deer seminar, April'04; IEEM Transport and Ecology conference, May'05; numerous talks to Wildlife Trusts and British Deer Society. Publications targeted specifically at a range of relevant 'professionals' concerned with deer collisions have included amongst others several articles in Veterinary Record, Deer Magazine, In-Roads and Surveyor Magazine (for details, see reference list).

9. CURRENT AND POTENTIAL FUTURE USE OF DVC DATABASE IN ROAD SAFETY AND ENVIRONMENTAL IMPACT ASSESSMENTS

9.1 The information gathered by the Collisions Database on location and seasonality of DVCs is already proving of direct value for Highways Agency and Scottish Executive in providing important background information on DVC accident frequencies and current or potential hotspots, for consideration within their Targeted Programme for Improvements (TPI) of the trunk road network. Ecological and Engineering Consultants from several different Highways Agency TPI schemes in England, as well as Scottish Executive schemes have contacted the Deer Collisions project over the past two years with requests for local information on known DVCs to help inform their decisions as to whether detailed surveys of deer are likely to be required prior to environmental statements in proposed road schemes, or at later stages when planning optimal location of mammal mitigation.

Requests for data received for road impact assessment

9.2 To date requests for DVC information for trunk roads in Scotland information has been provided for environmental surveys for the A80/M80 improvements and the proposed Aberdeen western peripheral route. In England, requests for input have included TPI schemes on the A419, A303, A11, A74, M27 and M1 widening; and reviews of existing wildlife mitigation on the A35/A30).

9.3 Considerable use is also being made of the database by the Deer Commission for Scotland, as part of their review of road traffic accident frequency in areas where they have received from the public formal Expressions of Concern in relation to deer posing a risk to Public Safety through involvement in RTAs. For four of these roads (sections of the A82, A835 and A87), now confirmed as **Priority Sites** for Action, the Commission has established consultative Panels to investigate more fully the problems and suggest possible solutions.

(These Panels include representation from the Police, Highland Council Roads Department, local Community Councils, local Deer Management Groups, BEAR Scotland (or other competent trunk roads Agent) and Scottish Executive). The Deer Collisions Project has regularly been asked to provide supporting information to these 4 Panels on location and frequency of accidents as well as appropriate mitigation measures available.

9.4 In England, information on DVCs from the present project have also been utilised by county councils to assist with planning of several traffic calming and deer mitigation schemes on non-trunk roads, including B1106 in Suffolk, B4506 in Hertfordshire/Buckinghamshire and A39 in Somerset. There is thus clearly a real potential for further practical application of the DVC database in road impact assessment.

Longer term monitoring of DVCs using restricted data sources

9.5 It is apparent from the increasing use made of the DVC data by the DCS and other agencies that the development of the database has proved a valuable resource. It is similarly clear, from the extent of use of the database and from the estimates above of the scale of DVCs within Scotland as a whole (estimated above at between 7,000 and 10,000 per annum), that DVCs do represent a serious and continuing problem, whether from the point of view of the animals themselves and the consequent welfare issues, or simply in terms of human injury and the significant economic costs of damage caused by such collisions. It is suggested therefore that some continuing attempt should be made to monitor the number of DVCs occurring within Scotland and their geographical distribution, albeit at a lesser level of intensity than in the current programme.

9.6 Long-term annual collections of data from all of the diverse sources utilised in the present study would most likely be prohibitive and inefficient in terms labour. However, as discussed in section 4.15, the overall pattern of incidents reported from a number of source types is quite similar, and it is probable that a good indicator, at least of gross changes in national and regional DVC frequency may be derived from a relatively small number of well-stratified sources. It is also apparent from analyses of paragraph 7.14 that the frequency of incident is significantly higher on major roads and that an efficient system of monitoring could be targeted primarily on the trunk road system. We would suggest that the data source categories emerging as the best candidates on which to build a relatively simple and efficient longer term system of assessing DVCs are:

- ST19 PIA records involving deer ; taken in combination with
- Trunk road deer carcass up-lift requests,
- Insurance claim records from at least one or more major national insurance companies (if they can be recruited to continue to provide regular data).

9.7 The relatively small sample of such DVCs causing human injuries annually (making up possibly only around 1% of the total) is unlikely to suffice on its own to enable identification also of local regions or road sections with high or low DVC risk. Further, at present records of deer-related accidents are not immediately identifiable in ST19 records maintained at DfT (where these are simply 'lost' within a larger category of "other animal". Monitoring of PIAs would thus either need a revision of the ST19 itself or simply require a request to all Police Regions or the Roads/Traffic departments of the 29 Councils in Scotland, requiring them to provide annual listings of all their animal related PIA records (which need to include the short text accident description giving information on animal types involved, that are not currently available for central searches via DfT, nor in some cases currently maintained on computerised accident records by individual police forces).

9.8 Trunk-road up-lift data would clearly sample only the small percentage of all roads nationwide made up by the strategic trunk net-work (8%); but it is clear that in Scotland this is where a very high percentage of recorded DVC incidents occur. Further this source has the advantage of being able to provide a surprisingly well-stratified sample of comparable information countrywide, and is potentially relatively easily collected available through contact

with a small number of major trunk route maintenance agents. It should not be difficult for SE to ask for standardisation of returns on deer (and other animal) incidents as part of the terms of Trunk Road Contracts. As in the case of ST19 records, trunk road records can potentially be recorded to a relatively good degree of location accuracy, by reference to marker posts when available, chainage or other reference points along each route.

9.9 Insurance data providing information on accident claims relating specifically to vehicle collisions with deer remains potentially one of the most comprehensive ways of nationwide sampling of DVC frequency (and is extensively used for this purpose in the US; e.g. McGowan, 2006), not least as we estimate that around 20 to 25% of all DVCs in the UK may lead to insurance claims. However such information has proven difficult to obtain from all but one major company to date, as most companies inform us that they are not readily able to retrieve deer related claims from among other animal related incidents.

9.10 In practical terms therefore (given the difficulties experienced in the current project in obtaining data from Insurance companies) it is suggested that the best index of trend might be obtained from :

i) a combination of requests logged by the trunk road agents in relation to requests for removal of carcases from the four trunk road regional areas (NW,NE,SW and SE), in combination with

ii) continued monitoring of deer and other animal related PIA accident records, using the more detailed records maintained by Police Regions or Local/Regional Councils, where a brief accident description commonly permits ready identification of accidents attributed to deer as distinct from those of 'other animal in the carriageway'.

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DVC Scotland Final Report (2003-2005)

APPENDIX I : MAPS 1 – 9

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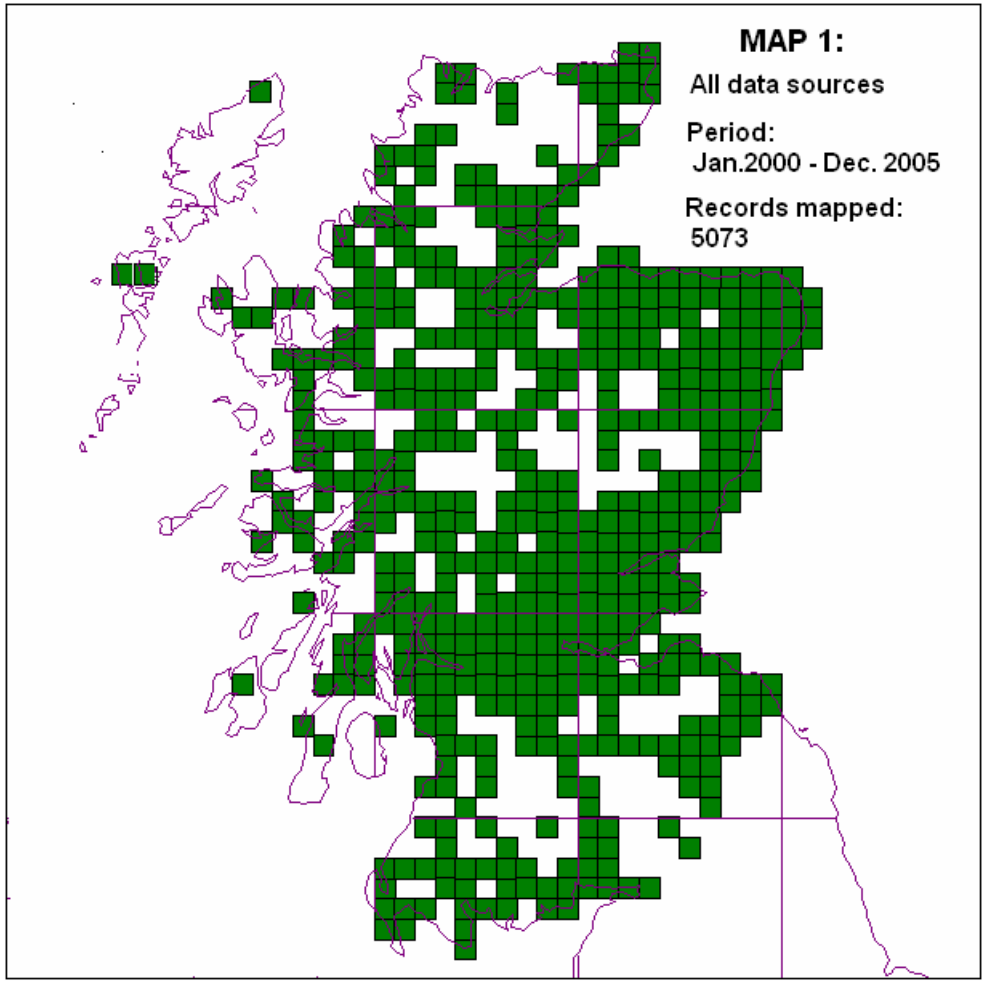
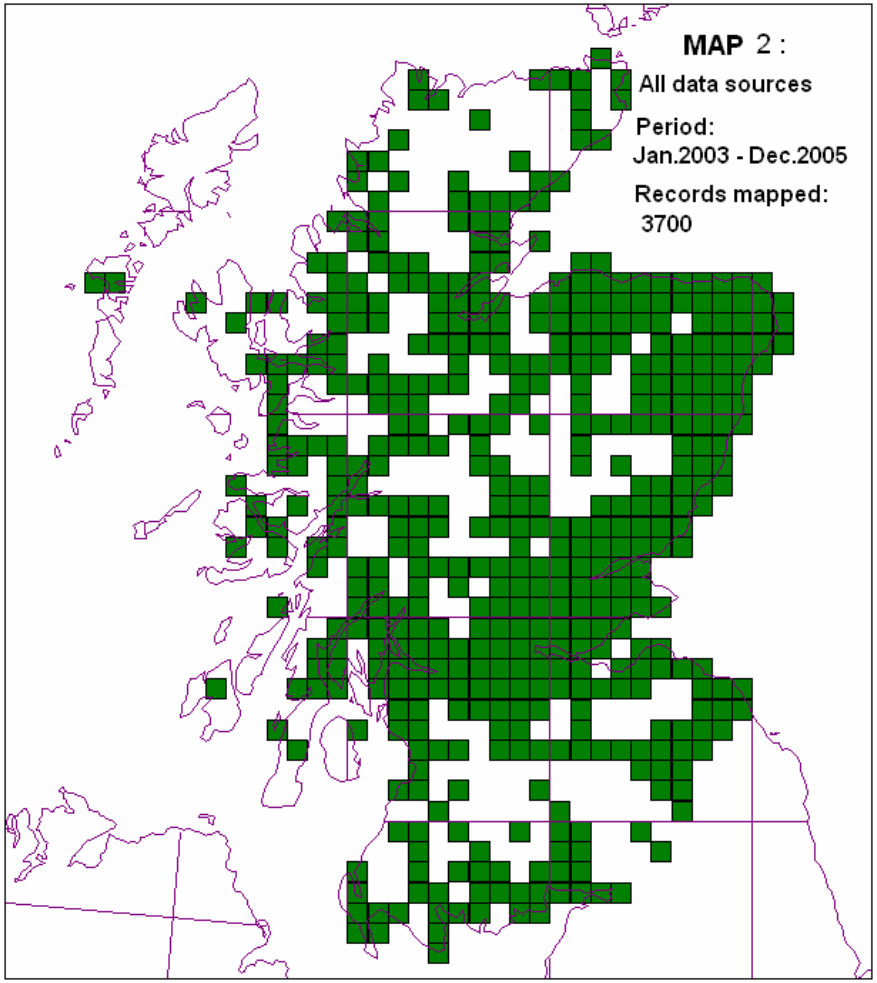
General distribution of Deer-Vehicle Collisions (DVC) in Scotland : **Map 1** and **Map 2** [S]

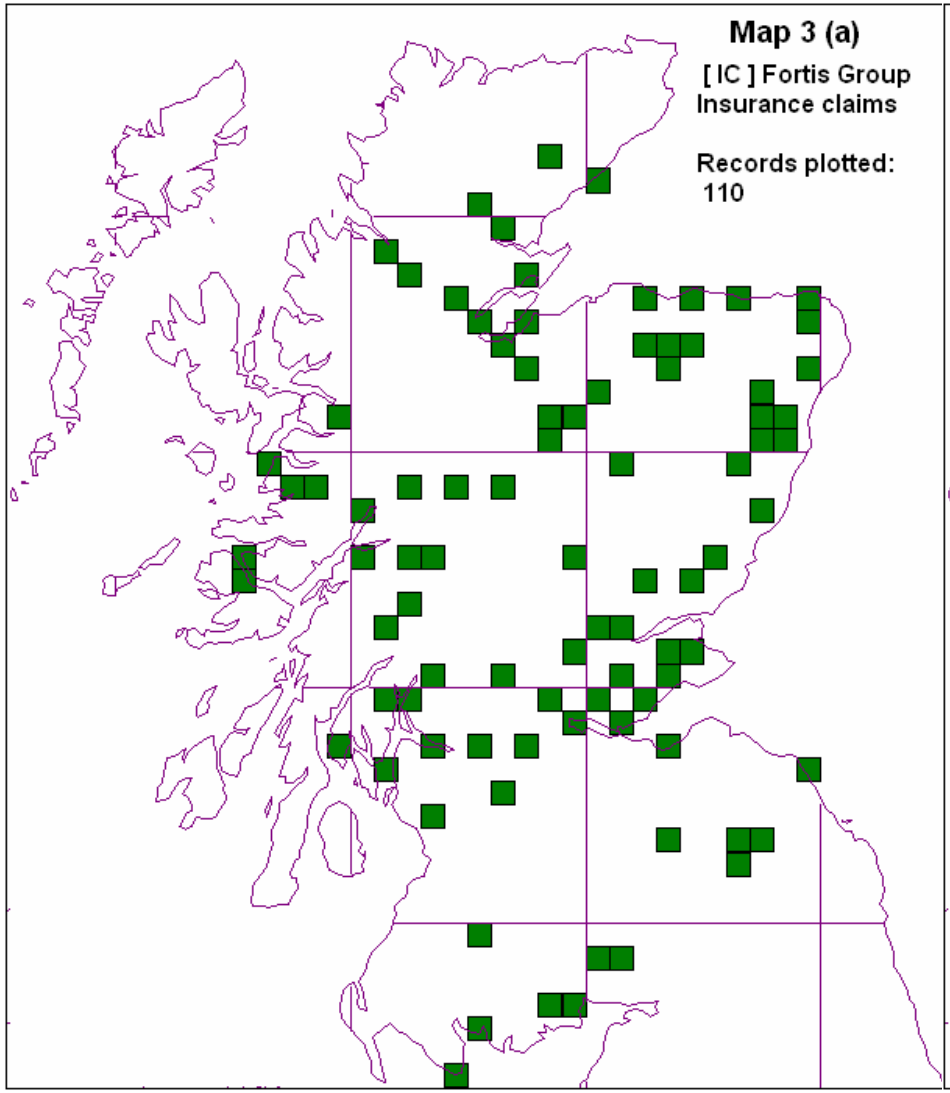
Filled squares shows the distribution of all 10km Ordnance Survey Grid squares for which at least one or more DVC have been reported to the project. Map 1 shows distribution if including all records for which adequate location details are available for incidents during January 2000 to December 2005; Map 2 replots data restricted to records collected for the main three year study period (2003 – 2005).



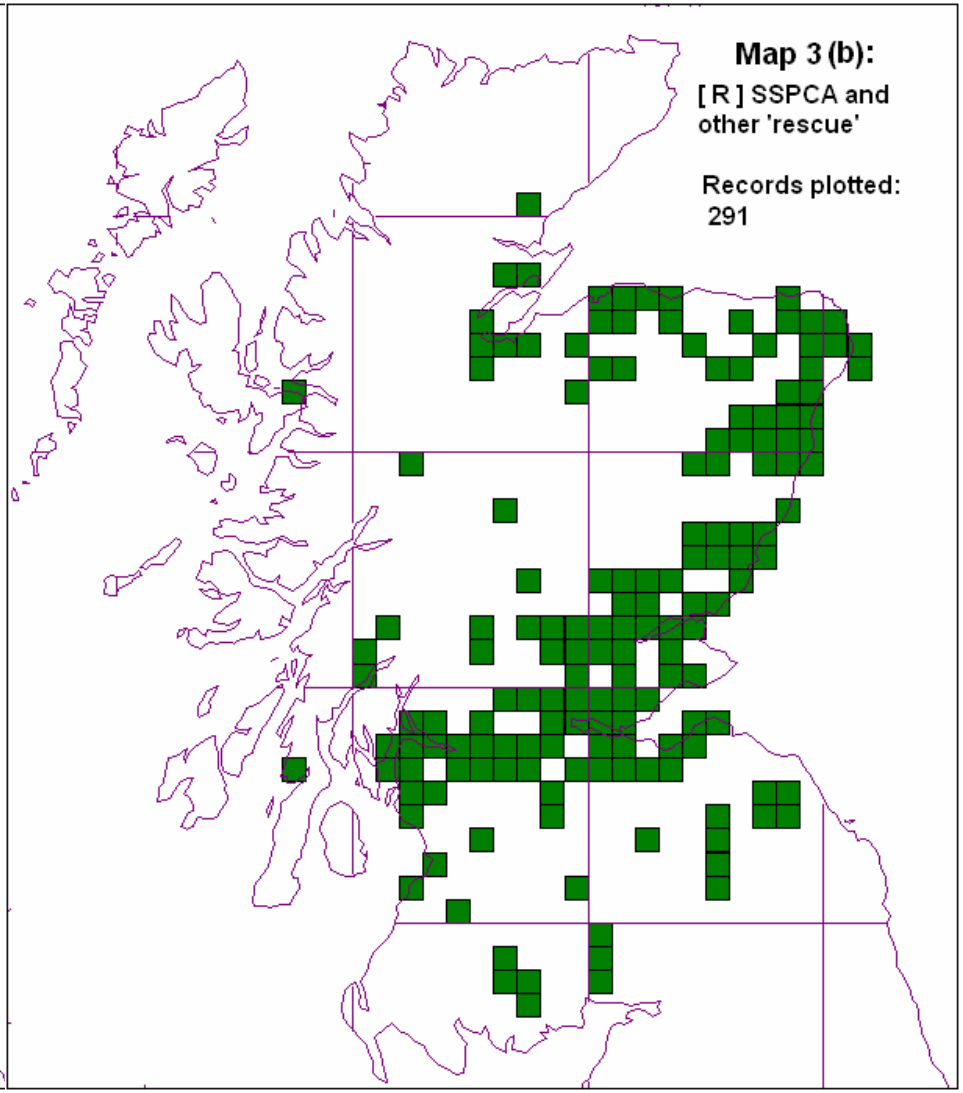


Map 3 [S]: **(a – h)** Distribution of Deer-Vehicle Collisions (DVC) reported by differing source categories during main study period (Jan. 2003 to Dec. 2005). Filled squares indicate at least one or more records in that 10km Ordnance Survey Grid square.

Map 3 (a)

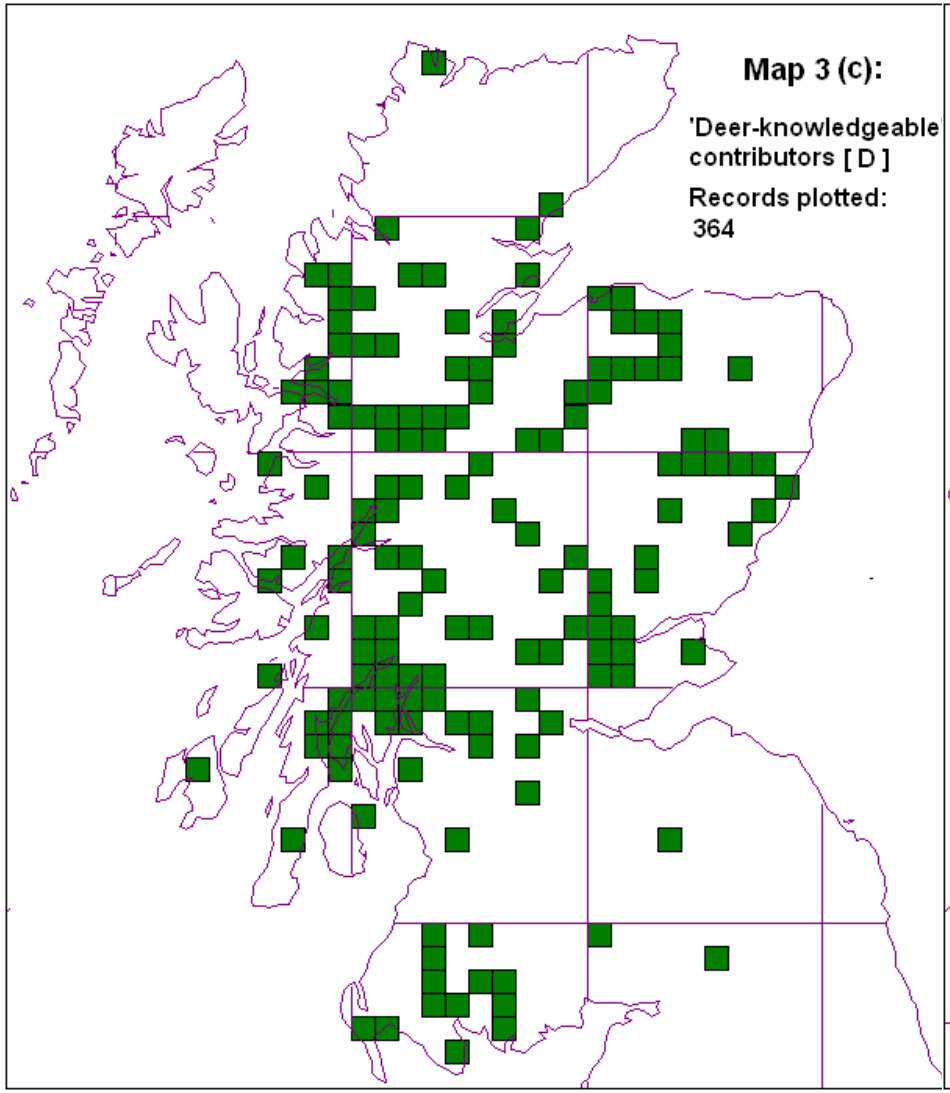


Map 3 (b)

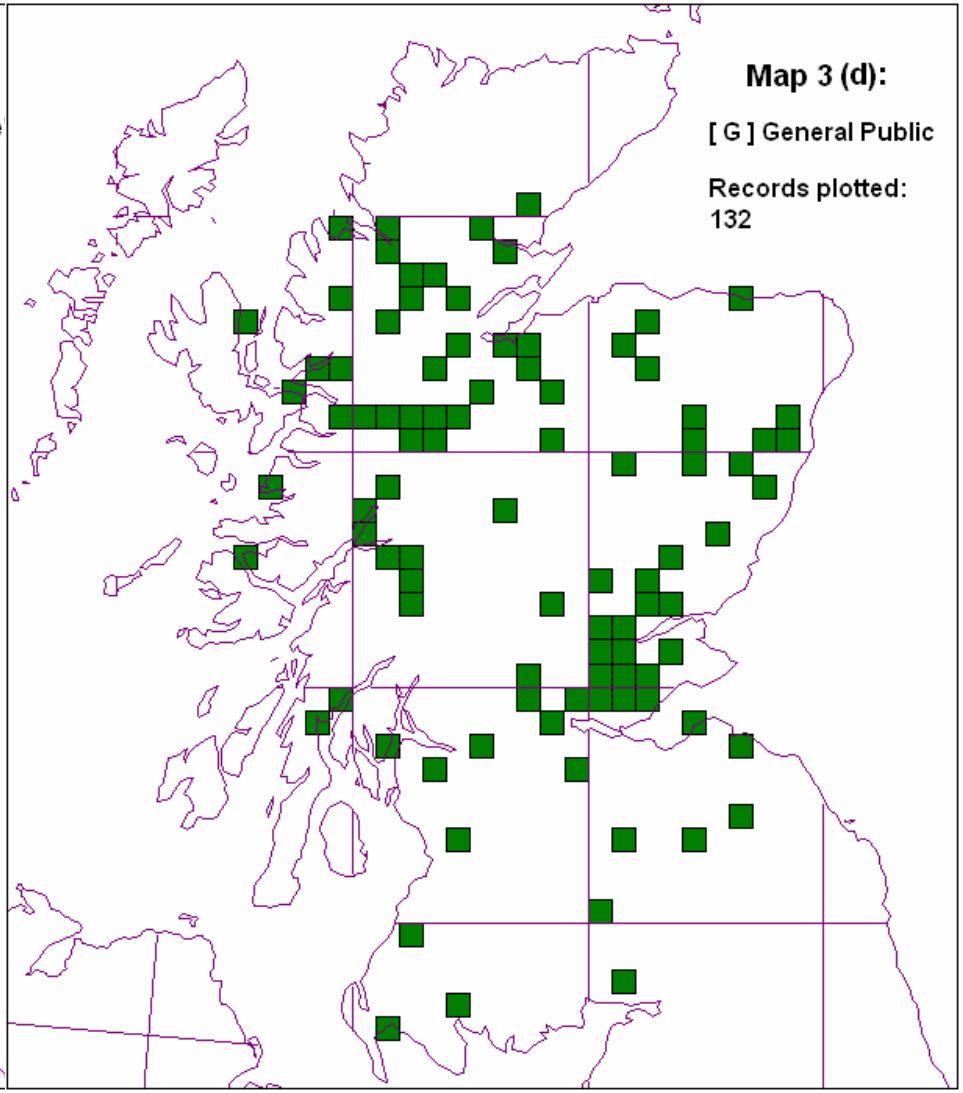


Map 3 [S]: **(a – h)** (continued..)

Map 3(c)

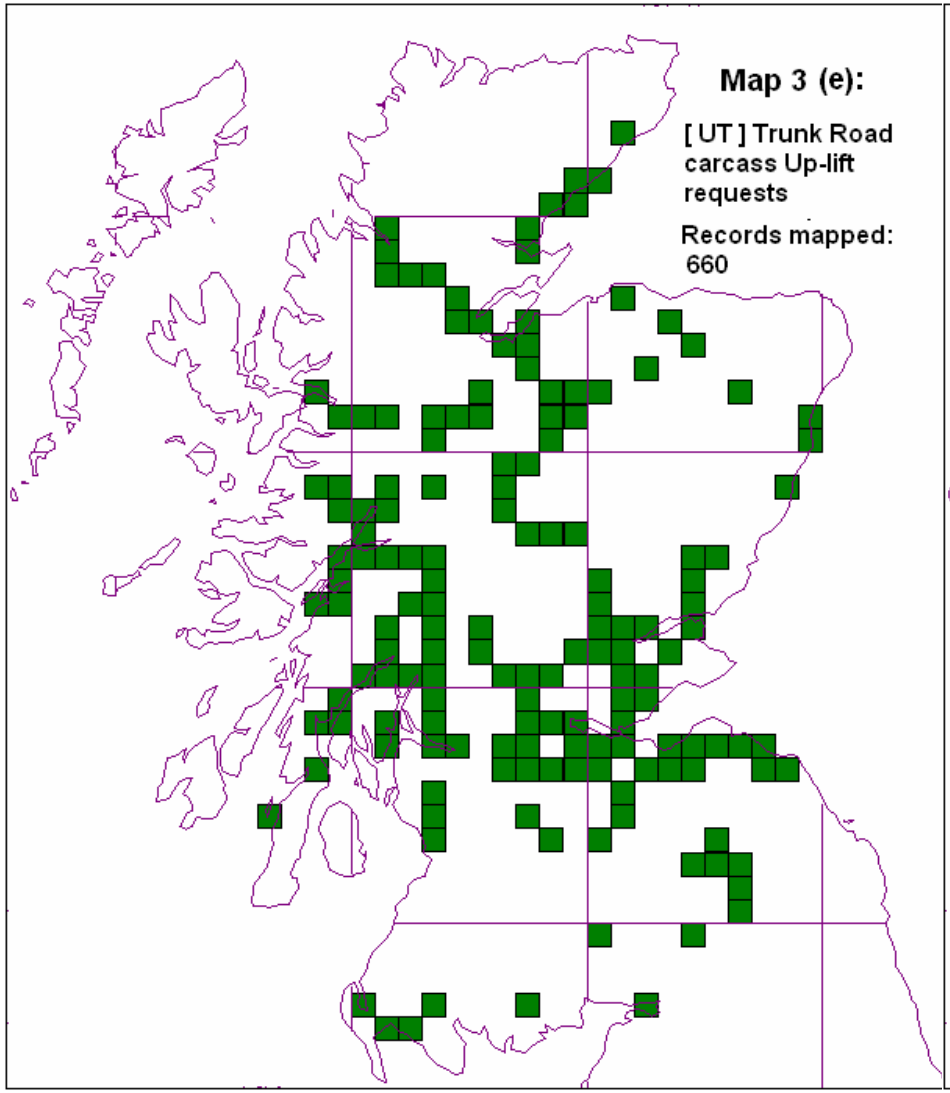


Map 3(d)

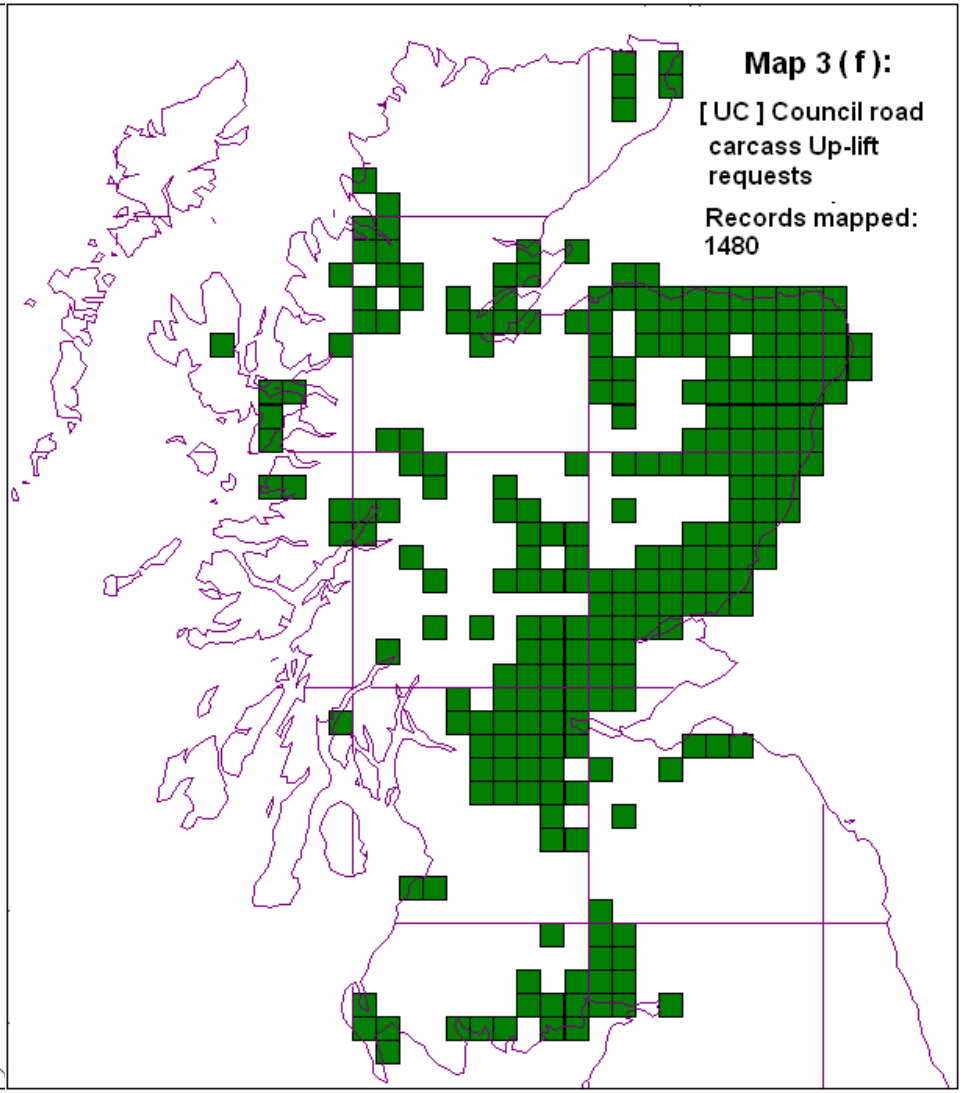


Map 3 [S]: **(a – h)** (continued..)

Map 3(e)

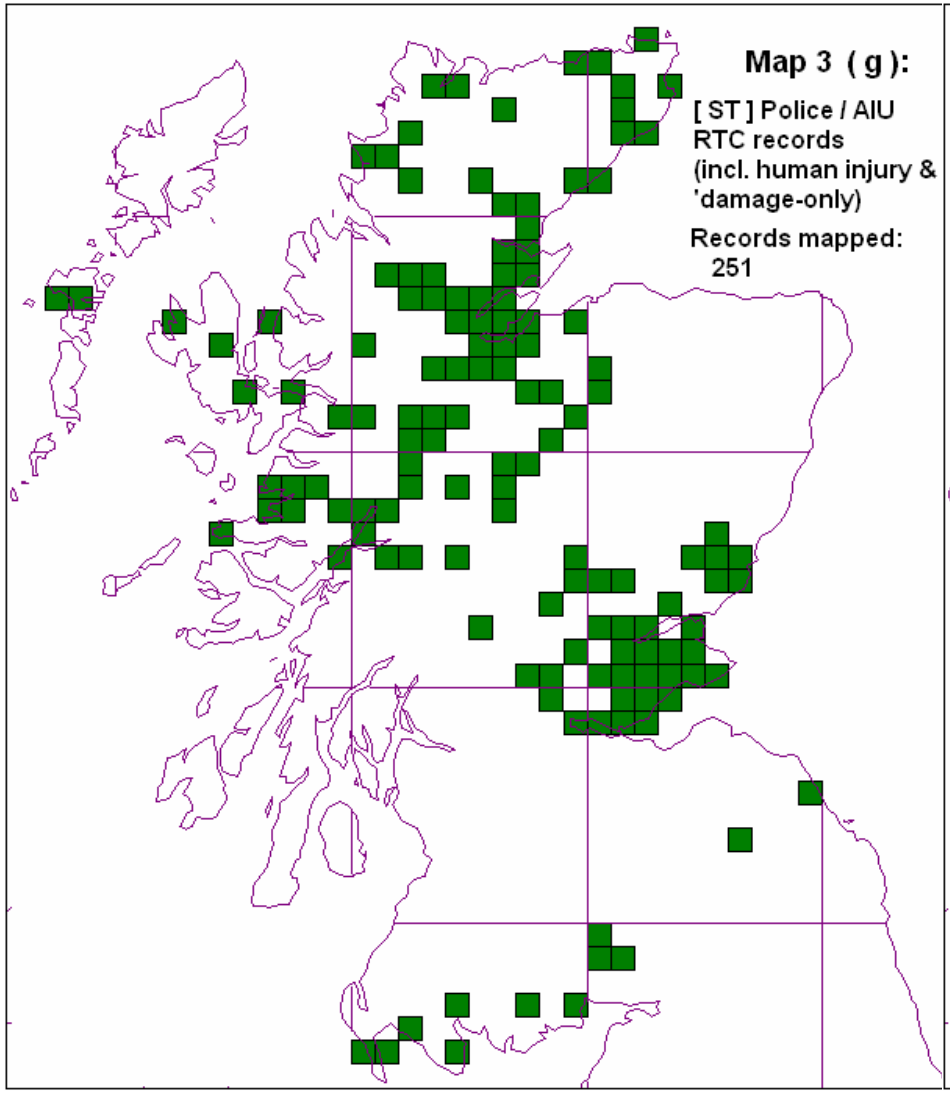


Map 3(f)

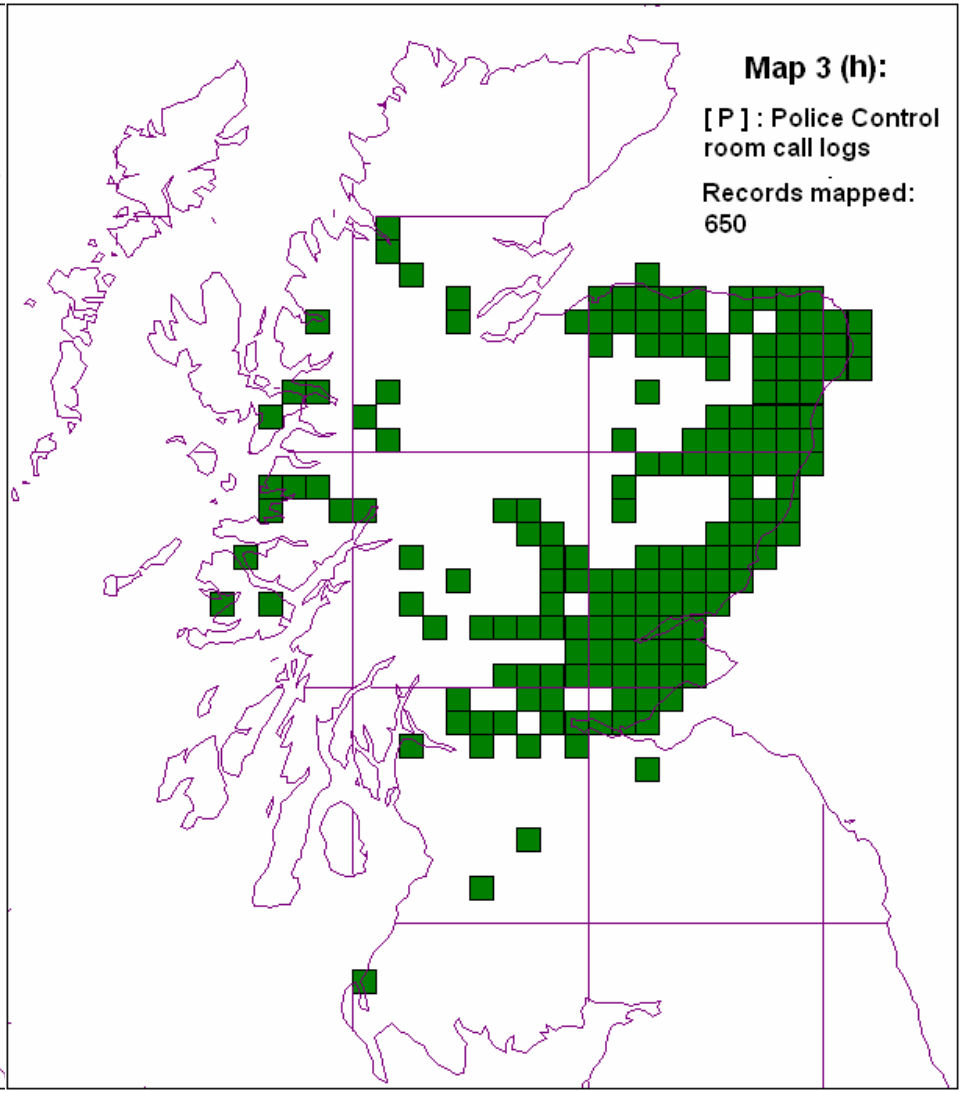


Map 3 [S]: **(a – h)** (continued..)

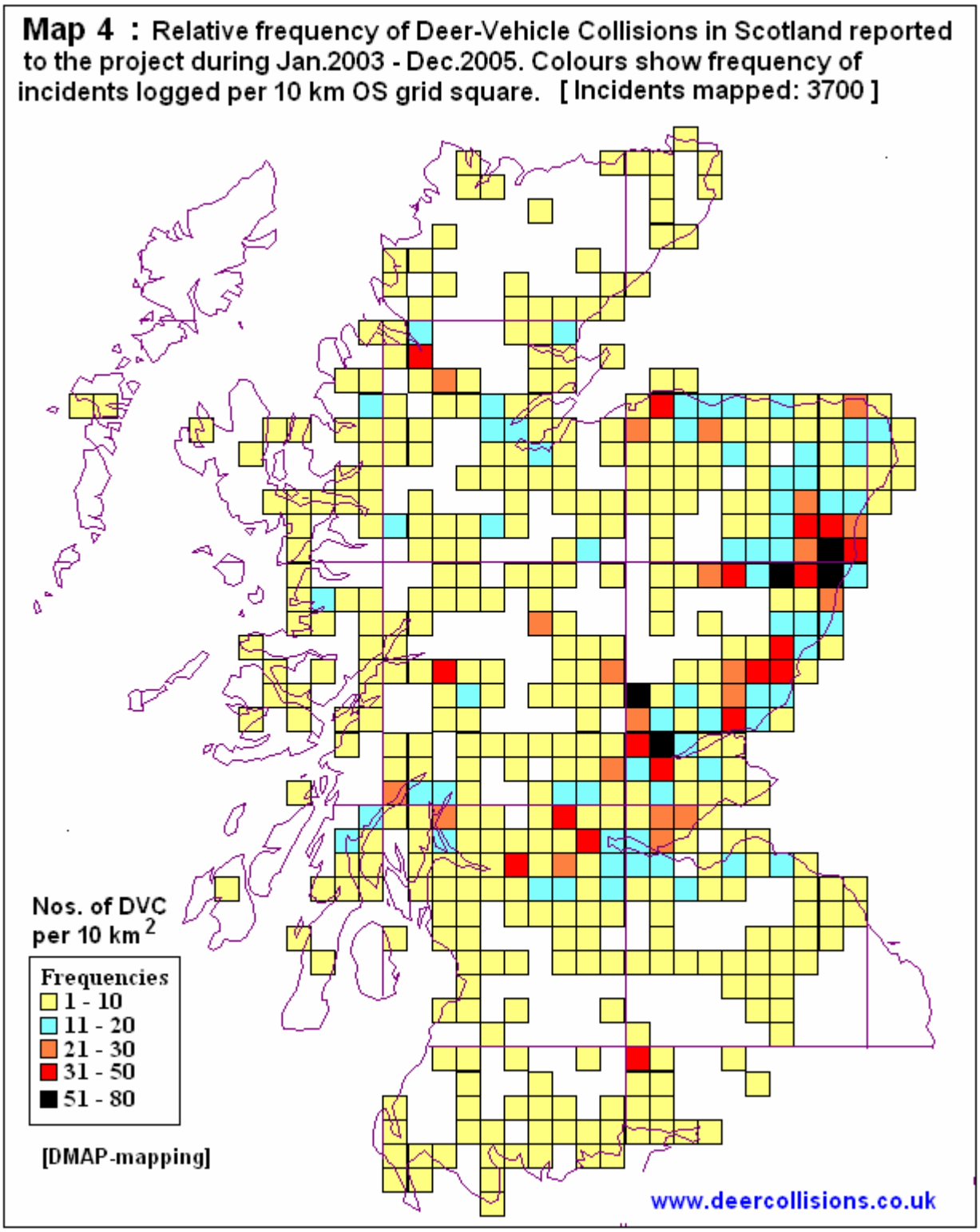
Map 3(g)



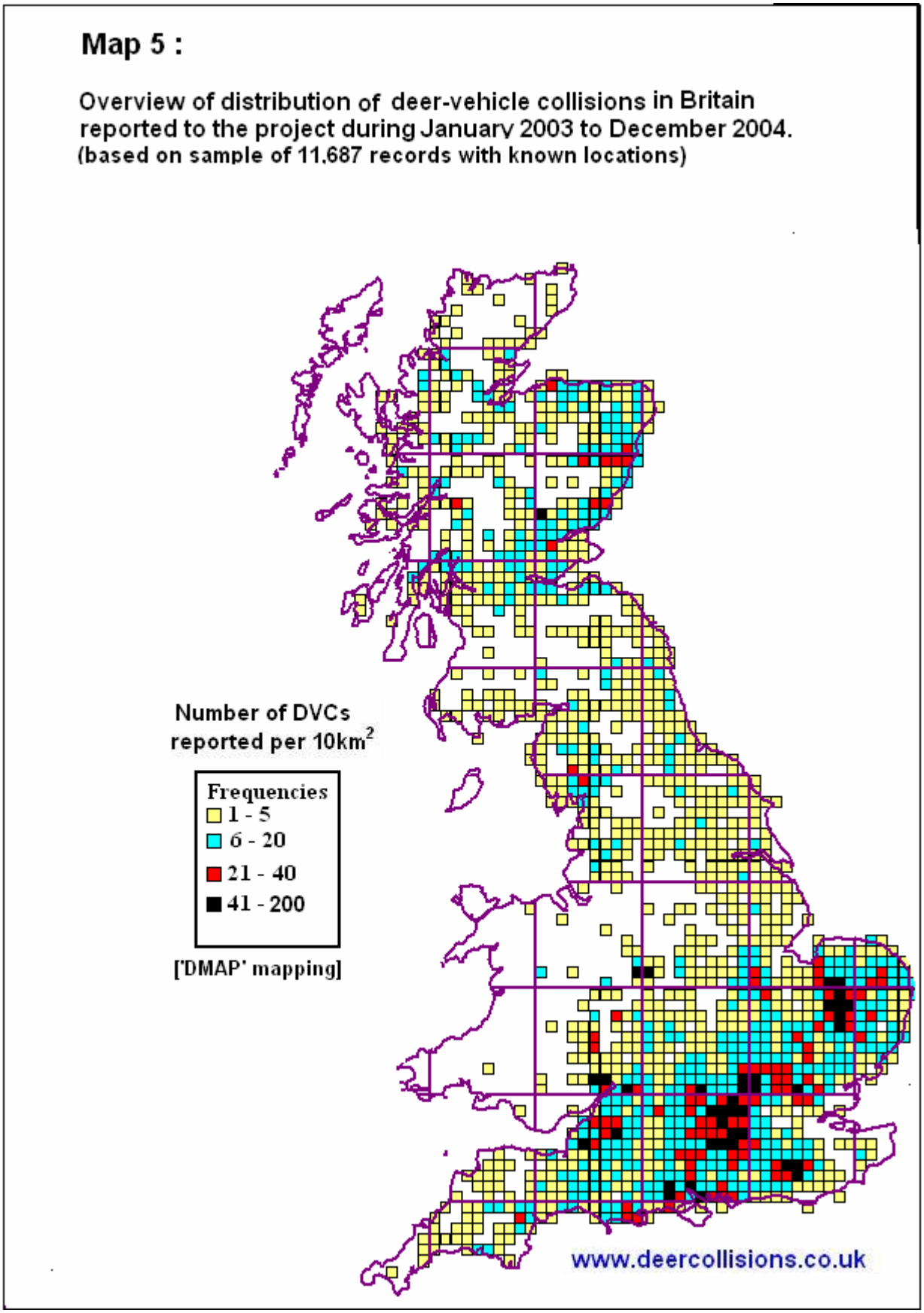
Map 3(h)



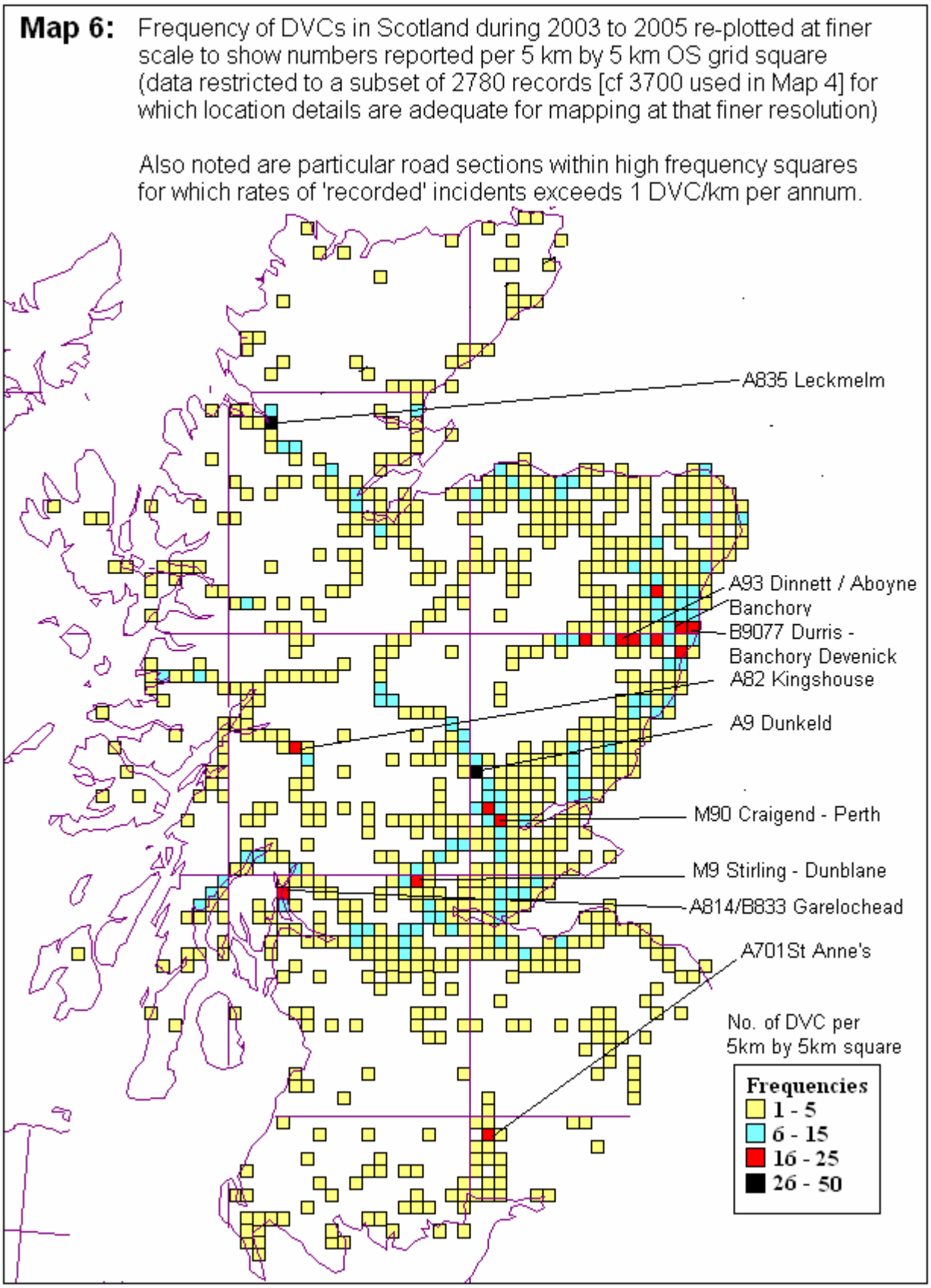
Map 4 [S] :


Map 4 : Relative frequency of Deer-Vehicle Collisions in Scotland reported to the project during Jan.2003 - Dec.2005. Colours show frequency of incidents logged per 10 km OS grid square. [Incidents mapped: 3700]
Nos. of DVC per 10 km 2
Frequencies
1 - 10
11 - 20
21 - 30
31 - 50
51 - 80
[DMAP-mapping]
www.deercollisions.co.uk

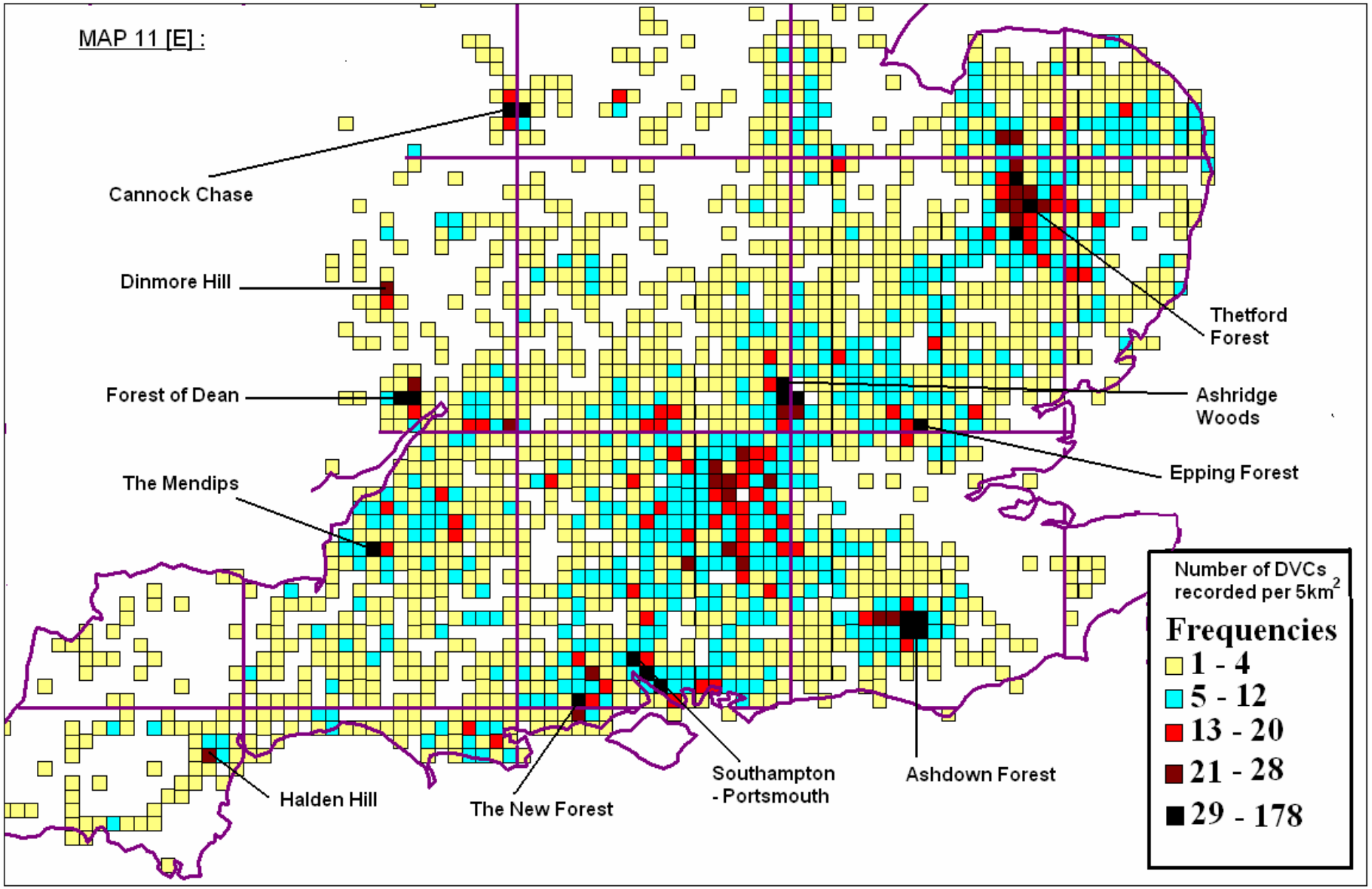
Map 5[A] (Comparative overview for Britain including provisional data for England)



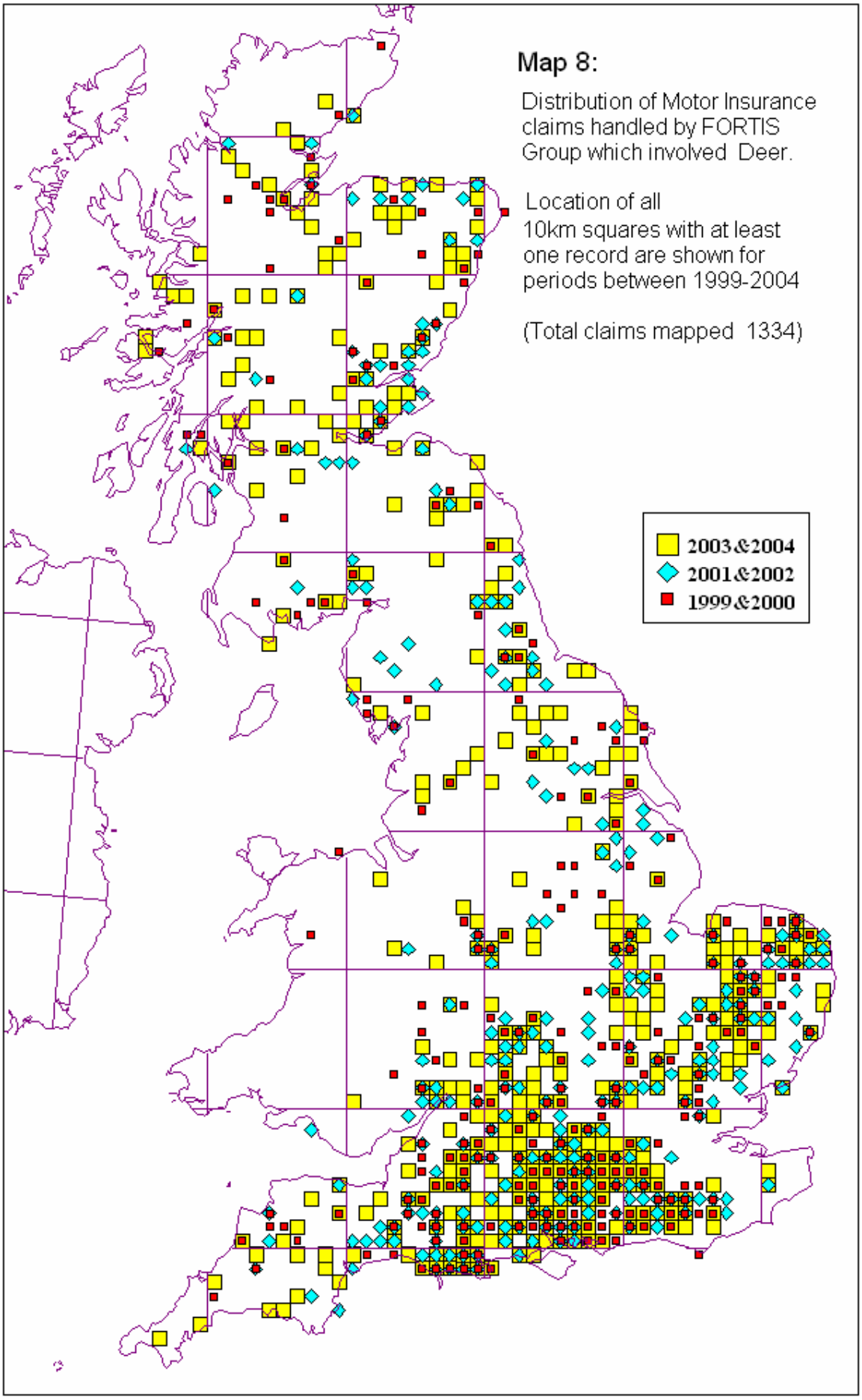
Map 6 [S]:


Map 6: Frequency of DVCs in Scotland during 2003 to 2005 re-plotted at finer scale to show numbers reported per 5 km by 5 km OS grid square (data restricted to a subset of 2780 records [cf 3700 used in Map 4] for which location details are adequate for mapping at that finer resolution)
Also noted are particular road sections within high frequency squares for which rates of 'recorded' incidents exceeds 1 DVC/km per annum.
A835 Leckmelm
A93 Dinnett / Aboyne
Banchory
B9077 Durris - Banchory Devenick
A82 Kingshouse
A9 Dunkeld
M90 Craigend - Perth
M9 Stirling - Dunblane
A814/B833 Garelochead
A701St Anne's
No. of DVC per 5km by 5km square
Frequencies
1 - 5
6 - 15
16 - 25
26 - 50

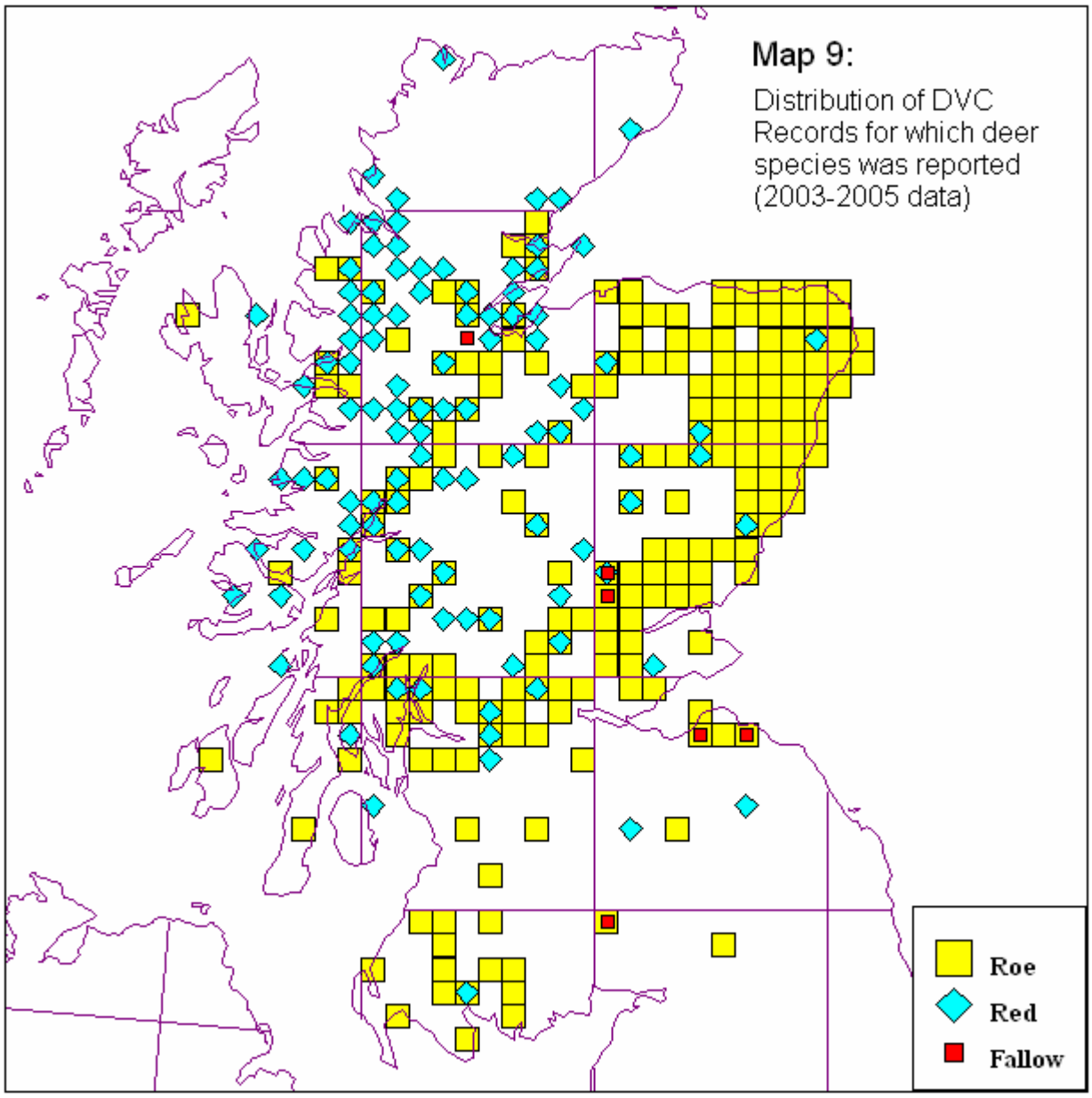
Map 7 [E]: Comparative overview of frequency of Deer-Vehicle collisions in southern England within 5km by 5km grid squares (based on records for 2003-2004)



Map 8 [A]


Map 8:
Distribution of Motor Insurance claims handled by FORTIS Group which involved Deer.
Location of all 10km squares with at least one record are shown for periods between 1999-2004
(Total claims mapped 1334)
2003&2004
2001&2002
1999&2000

Map 9 [S] : Distribution of Deer-Vehicle Collision records where Species is known.



DVC Scotland Final Report (2003-2005)

APPENDIX II : TABLES (pages 1 – 12)
&
APPENDIX III : FIGURES (see pages 13 - 14)

APPENDIX II : TABLES

Table 1 [A] **Data Source Categories Approached**	
U	Carcase Clearance / Uplift requests (recorded by Trunk Road Maintenance Agents [**UT**]; or Local Authority Departments [**UC]**)
IC	Motor Insurance Claims Departments; Motoring Roadside Rescue Companies ; major Nationwide Car hire firms.
D	'Deer-knowledgeable' contributors : incl. wildlife managers / gamekeepers for landholding organisations (e.g. Forestry Commission rangers, MOD Deer Management, National Trust, Community Forests & County Parks) ; Independent Deer Managers / Stalkers; members of BDS, BASC, DCS; Ecological Consultants; Mammal Recorders and Researchers.
R	Animal Welfare/Rescue organisations: RSPCA / SSPCA / Vets / Wildlife hospitals and Rescue Centres
P	Police Control Call Rooms & Wildlife Liaison Officers (for logs of any calls relating to deer / vehicle incidents);
ST	Road Accident Statistics Departments (Regional Police Forces ; and/or Council Road Safety teams, including ST19 records)
G	General Public contributors (via web-site, email or direct contact)

Table 2 [A]	**Main Outputs / Issues to be assessed**	**Main data sources best suited to contribute**
Minimum total numbers of Deer/Vehicle Collisions ;		**U; IC; D; R; P; ST;G;**
Human and Economic Costs (Personal injuries accidents and fatalities; Car repair / insurance cost costs)		**ST; IC; G;**
Relative frequency and Geographical distribution		**U; IC; R; ST;**
Deer Species involved; effects of age/sex; fate / injuries;		**D; R;**
Effects of other key influencing factors: Road type & layout ; roadside habitats, mitigation measures, season, time of day;		**D; ST; R; (G – part);**
Identification and characterisation of local 'hot-spots' (i.e. requires records with reasonably precise location detail)		**D; ST; P; U (part); G part;**

Table 3 [S]: Number of Deer-Vehicle Collisions reports obtained in each of the main study years and for earlier years.
Also shown are the total length for major (A-roads and motorways) and for 'All' public roads by Council area.

	Public road lengths (km)			Number of Deer-Vehicle Collision Reports submitted						
Local Authority .	Major Roads (A + M)	Total of All roads		Year:	2000 to 2002	2003	2004	2005	Total Reports received	Total excluding duplicates
Aberdeen City	90	916			1	9	15	55	80	74
Aberdeenshire	866	5,520			32	322	266	421	1041	998
Angus	238	1,815			167	78	107	142	494	437
Argyll and Bute	780	2,540			159	85	114	62	420	414
Ayrshire (E+W+S)	586	3,469			9	8	11	9	37	34
Clackmannan	50	266					2	4	6	6
Dumfries and Galloway	856	4,478			78	55	66	66	265	261
Dunbartonshire (E+W)	113	848				1	17	7	25	25
Dundee	60	554			6	1	3	8	18	17
East Lothian	140	960			14	12	20	21	67	66
Edinburgh City	188	1,394			4	4	7	12	27	27
Falkirk	159	952			23	8	29	28	88	85
Fife	447	2,471			11	29	95	57	192	186
Glasgow City	225	1,814			1	2	11	6	20	19
Highland (+Islands)	3059	10842			369	185	333	233	1120	1088
Inverclyde	48	385			2	2	1	4	9	9
Mid Lothian	122	669			8	3	6	12	29	29
Moray	254	1,604			85	67	85	111	348	302
North Lanarkshire	165	1,553			15	2	20	35	72	72
Perth and Kinross	683	2,676			342	163	222	206	933	830
Renfrewshire	145	1282				1	1	6	8	8
South Lanarkshire	399	2,292			3	9	5	12	29	29
Stirling	349	1,123			50	40	87	69	246	212
The Borders	631	3,112			14	12	15	17	58	57
West Lothian	197	1,010			14	6	9	20	49	49
(un-certain)					93	64	130	94	381	379
Grand Total	**10850**	**54,543**			**1500**	**1168**	**1677**	**1717**	**6062**	**5713**

TABLE 4 [**S**]: Source organisations contacted and Number of DVC reports obtained during main study period (1/1/2003 to 31/12/2005)

		Trunk Road Uplift requests	Coucil road /cleansing departments	Police / AIU RTA records incl. ST19	Police Control call logs	Fortis Gourp - Insurance Claims	SSPCA and other wildlife rescue	Deer 'informed' individuals	General public and 'others'	Total Reports received	Total incidents excluding duplicates
Souce code:		UT	UC	ST	P	IC	R	D	G		
Nos. sources contacted:		*2*	*29*	*10*	*15*	*c.30*	*3*	*nk*	*nk*		
Nos. submitted records:		*2*	*19*	*5*	*9*	*1*	*1*	*64*	*c.100*		
Local Authority	**Traffic Mvkm***	**Number of Deer-Vehicle Collision Reports submitted**									
Aberdeen City	***1,354***	1	3		58	2	14		1	79	**73**
Aberdeenshire	***2,665***	6	723		183	16	38	33	10	1009	**966**
Angus	***990***	24	184	9	86	3	13	4	4	327	**288**
Argyll and Bute	***874***	107	3		5	12	5	121	8	261	**256**
Ayrshire (E+N+S)	***2,690***	4	5	0	2	4	8	3	2	28	**27**
Clackmannan	***292***		1	1	2		1		1	6	**6**
Dumfries and Galloway	***1,916***	15	99	13		14	7	34	5	187	**185**
Dunbartonshire (E+W)	***1,142***	2	0	0	0	2	18	3	0	25	**25**
Dundee	***858***	2	1		5	2	1		1	12	**11**
East Lothian	***830***	25	16			1	9		2	53	**52**
Edinburgh City	***2,943***	14				1	8			23	**23**
Falkirk	***1,430***	43	11		4	1	4	1	1	65	**62**
Fife	***2,788***	45	4	59	32	9	26	1	5	181	**175**
Glasgow City	***3,369***	1	2			2	14			19	**18**
Highland (+Islands)	***2,966***	139	118	155	60	38	17	163	61	751	**725**
Inverclyde	***531***	1			2		3	1		7	**7**
Mid Lothian	***619***	14	1		1		5			21	**21**
Moray	***709***	9	161		54	6	11	19	3	263	**219**
North Lanarkshire	***2,955***	20	11		1	1	21	2	1	57	**57**
Perth and Kinross	***2,260***	104	251	19	125	8	30	38	16	591	**519**
Renfrewshire (incl.E)	***1,959***	3					4		1	8	**8**
South Lanarkshire	***2,336***	5	15		1	2	3			26	**26**
Stirling	***1,153***	60	36	2	41	5	9	37	6	196	**162**
The Borders	***1,162***	17		2		6	14	2	3	44	**43**
West Lothian	***1,680***	21	1		1		10		2	35	**35**
(un-certain)		73	1		159	10	39	4	2	288	**287**
Grand Total	***42,471***	**755**	**1647**	**260**	**822**	**145**	**332**	**466**	**135**	**4562**	**4276**

**(Total road traffic in Million vehicle kilometers for 2004 based on estimates published by Department for Transport, 2005)*

Table 5 [E] : Overview of number of different sources approached, and provisional numbers of DVC reports received for parallel on-going project in ENGLAND (to end Dec. 2004 – based on Interim report to Highways Agency, 2004)

Source Category		No. of main sources approached	No. already submitting usable data	No. of records collated post'2000	No of records Jan.2003 to Dec.2004
ST **(a)** **(b)**	Human Injury RTAs, and 'recorded' damage-only incidents) via Police Forces *(and/or)*[1] Council Road Traffic Accident Departments	 40 (36)	28	1194	543
U	Carcase clearance requests to: i. Trunk Route Maintenance Agents & DBFOs [UT]; ii. Local Authority Roads Departments [UC]	22 c.350	16 39	1882 1774	1164 1237
IC	Major Motor Insurance Companies; Motor Breakdown Assistance; Nationwide Car hire firms.	32	1	1296	617
D	'Deer-knowledgeable' contributors: including wildlife /deer managers, rangers, amateur stalkers, members of BDS, BASC, DCS; Mammal Society, Ecological consultants and researchers.	unknown	c. 165	4471	2802
R	Animal Welfare/Rescue organisations: RSPCA / Wildlife hospitals and Rescue Centres	c.80	7	7908	3297
P	Police Force Control Rooms & WLOs (for logs of any calls relating to deer / vehicle incidents)	40	8	1533	1030
G	General Public (via web-site, email or direct contact)	unknown	c. 525	687	585
Total				20,645	11,275

[1]Records on relevant 'reported' RTCs are provided to us in some cases direct by police or/else by Council Road Safety departments, who may also further collate those same police data (although both sources may have been approached in some areas, records received from any region generally come from one or other and only unique records are retained).

Table 6 [A]:

Traffic Flow by Country & Region 2004

(in Billion Vehicle Kilometers driven)

Scotland	**42.5** *
Wales	**27.3**
England	**428.8**
of which in England:	
South East	**86.6**
London	**32.7**
North West	**56.6**
East of England	**55.1**
West Midlands	**48.6**
South West	**47.1**
Yorks&Humbers.	**41.6**
East Midlands	**40.7**
North East	**19.9**

***For details of traffic volume by Unitary Authority within Scotland see Table 4 [S]**

Source: National Road Traffic Survey, DfT.

Table 7 [S]:

Number and severity of Personal Injury Accidents (PIA) recorded in National Road Accident Statistics , for which animals (excluding dogs) were noted to have been involved as a carriageway hazard, as recorded under the 'Other animal' ST19 category.

Year	Slight	Serious	Fatal	Total
2000	2056	460	52	2568
2001	1897	337	52	2286
2002	1921	354	49	2324
2003	1889	344	42	2275
2004	1935	340	50	2325
mean per year Britain:	**1940**	**367**	**49**	**2356**
[of which in Scotland]:	**[226]**	**[68]**	**[4]**	**[315]**
estimated number with Deer (if make up 23.5%)* :				
In Great Britain	**456**	**86**	**12**	**554**
[of which in Scotland]	**[56]**	**[16]**	**[1]**	**[74]**

* **(see Table 8)**

Table 8 [E] :
Involvement of differing animal types in Personal Injury Road Accidents where carriageway hazards was recorded in the 'Other animal in Road' category of ST19 accident forms.
(based on inspection of sample data from 14 English counties for 1999-2003 where comparable data were available for inspection in sufficient detail – making up c.33% land area of England)

Animal Type	Nos. Injury RTAs	Number of Casualties			% age
		Slight	KSI (Killed or Seriously injured)	Total	
Wild Mammals					
Deer	292	309	63	372	48%
Badger	52	58	11	69	9%
Fox	123	127	18	145	19%
Rabbit/Hare	127	151	18	169	22%
Others	9	16	1	17	2%
Total	603	661	111	772	100%
Birds and Domesticated mammals					
Pheasants	87	81	5	86	12%
Other Bird	47	71	2	73	10%
Horse/Pony	222	258	35	293	41%
Cows	83	100	14	114	16%
Sheep	29	40	2	42	6%
Cats	90	105	4	109	15%
Total	558	655	62	717	100%
Non-Specific 'Animal' in road	292	349	32	381	
Overall Total	1453	1665	205	1870	

(from Langbein, 2003)

Table 9 [E]:

Deer-Vehicle Collisions (DVC) leading to human injury as identified from within county road traffic accidents records in a provisional sample of 24 English Counties where records provided comparable detail (making up c.55% land area of England)

Deer - 5yrs J98-J03 [County]	Nos. Injury RTAs	Number of Casualties			Ann. Mean
		Slight	KSI	Total	
Hampshire	94	108	22	129	25.8
Bucks/Berks/Ox.	84	106	16	122	24.4
Suffolk	54	55	9	64	12.8
Essex	51	56	18	73	14.6
Sussex(E+W)	41	40	7	47	9.4
Surrey	32	32	7	39	7.8
Norfolk	35	30	9	37	7.4
Devon	29	31	4	32	6.4
Hertfordshire	27	29	9	38	7.6
Glos(+SGlos)	22	24	4	28	5.6
Dorset	21	25	3	28	5.6
Bedfordshire	20	16	5	19	3.8
Cambs	20	21	5	26	5.2
Somerset	18	21	4	23	4.6
Wiltshire	18	18	3	21	4.2
Lincolnshire	17	14	3	17	3.4
Warcs	14	12	6	18	3.6
Lancashire	6	4	2	5	1
Kent	5	5	0	5	1
Cornwall	0	0	0	0	0
Total	608	647	134	771	154.2

(KSI = people killed or seriously injured) (from Langbein, 2003)

Table 10 [S]

a) The 25 roads in Scotland with the highest total numbers of reported DVCs during 2004-5. Roads are listed in according descending rank of average annual rate of DVC/km 'reported' to the study divided by total length of each route.

Road Number	Total length of route *(kilometres)*	Reported DVCs 2005	Reported DVCs 2004	Mean DVC/year	DVC per km/year	
B9077	***22***	16	17	**16.5**	**0.75**	v.high
M90	***51***	37	24	**30.5**	**0.60**	v.high
M9	***52***	25	28	**26.5**	**0.51**	v.high
A835	***106***	45	58	**51.5**	**0.49**	v.high
A80	***22***	10	8	**9**	**0.41**	v.high
A93	***174***	45	65	**55**	**0.32**	v.high
B979	***44***	8	17	**12.5**	**0.28**	v.high
A980	***33***	15	3	**9**	**0.27**	v.high
A90	***236***	33	80	**56.5**	**0.24**	v.high
a830	***69***	25	8	**16.5**	**0.24**	v.high
A9	***435***	116	86	**101**	**0.23**	high
A82	***267***	71	51	**61**	**0.23**	high
B977	***44***	11	7	**9**	**0.20**	high
A923	***48***	11	8	**9.5**	**0.20**	high
A96	***164***	29	32	**30.5**	**0.19**	high
A947	***65***	9	14	**11.5**	**0.18**	high
A98	***82***	16	13	**14.5**	**0.18**	high
M8	***81***	13	15	**14**	**0.17**	high
a1	***89***	13	16	**14.5**	**0.16**	high
A83	***157***	29	21	**25**	**0.16**	high
A92	***227***	32	38	**35**	**0.15**	> average
A701	***110***	12	17	**14.5**	**0.13**	> average
A832	***185***	36	10	**23**	**0.12**	> average
a87	***160***	19	17	**18**	**0.11**	> average
A85	***155***	18	15	**16.5**	**0.11**	> average

(average DVC/km for all major (Motorways + A-roads = 0.08 /km/ year)

b) Local hotspots where rates for individual roads sections of extending for 5km or longer have averaged more than 1 DVC/km/annum (ie . 10 to 30 times the national average for major roads (see above, and also **Map 6**)

Road No.	Road Section				DVC/ km/ year	SW corner of 5km Square
A9	Dunkeld - (Birnham - Kingcraigie)				> 4.0 / km	NO 00/40
A835	Leckmelm- (Ardcharnich-Ullapool)				> 1.5 / km	NH 15/85
A701	St Anne's				> 1.0 / km	NY 05/90
A814/B833	Garelochead				> 1.0 / km	NS 20/90
M9	Stirling - Dunblane				> 1.0 / km	NS 75/95
M90	Craigend - Perth				> 1.0 / km	NO 10/20
A82	Kingshouse				> 1.0 / km	NN 25/50
A93	Dinnett to Aboyne				> 1.0 / km	NO45/95
A93	Potarch to Banchory				> 1.0 / km	NO 60/95
A93	"				> 1.0 / km	NO 65/95
B9077	Kirkton of Durros - Maryculter				> 1.0 / km	NO 75/95
B9077	Maryculter - Banchory Devenick				> 1.0 / km	NJ 85/00
B979	Netherley - Maryculter				> 1.0 / km	NO 85/90

Note: (above rates of Deer-Vehicle Collisions are based only on those reported to the study, and true figures are likely to be significantly higher in some cases)

Table 11 [A] : Proportion of DVCs involving different deer species

(During 2003-2005 species detail was avaialble for 6702 Deer road casualties)

a) For data restricted to only those submitted by known 'deer-knowledgeable' contributors

	Number	Roe	Red	Fallow	Muntjac	Sika	CWD	TOTAL
England	4370	34.3%	1.6%	37.7%	24.6%	1.0%	0.8%	100.0%
Scotland	450	69.1%	24.4%	3.8%	0.0%	2.7%	0.0%	100.0%
Total	4820	37.4%	3.7%	34.6%	22.3%	1.1%	0.7%	100.0%

b) Including records from all sources for analysis where species stated (i.e. in addition to the above includes submissions by general public and road cleansing departments

	Number	Roe	Red	Fallow	Muntjac	Sika	CWD	TOTAL
England	5142	34.1%	1.8%	36.9%	25.4%	1.0%	0.7%	100.0%
Scotland	1566	76.9%	20.5%	1.5%	0.1%	1.0%	0.0%	100.0%
Total	6708	44.1%	6.2%	28.6%	19.5%	1.0%	0.5%	100.0%

DVC Scotland Final Report (2003-2005)

APPENDIX III : FIGURES (see pages 13 - 14)

Figure 1 [A] :
Increase in Road vehicle traffic in Britain 1965 - 2004
(measured in billion vehicle kilometers driven per annum)

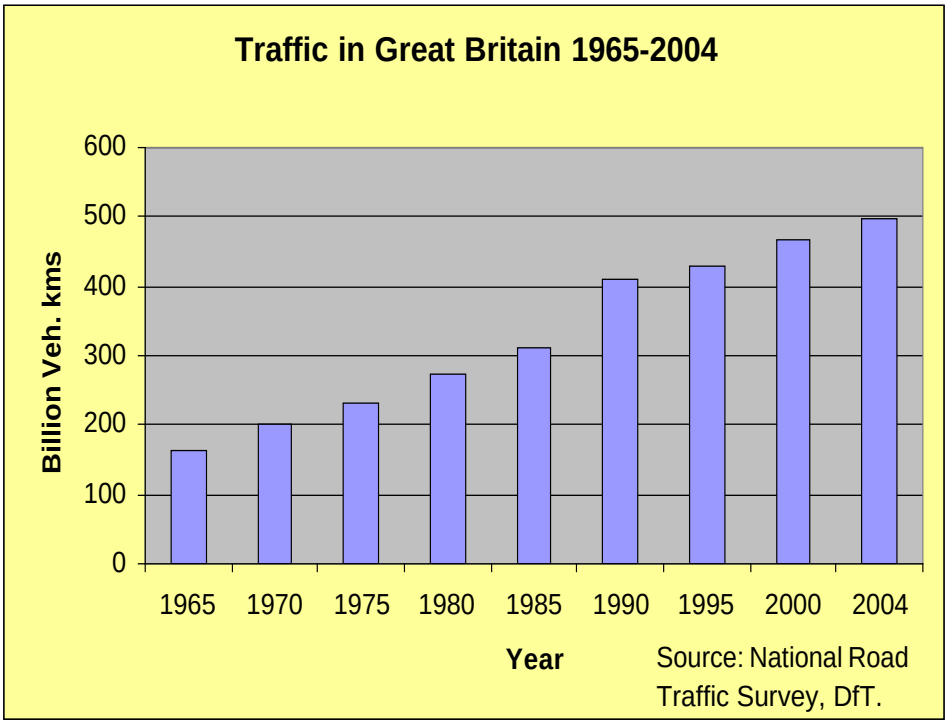
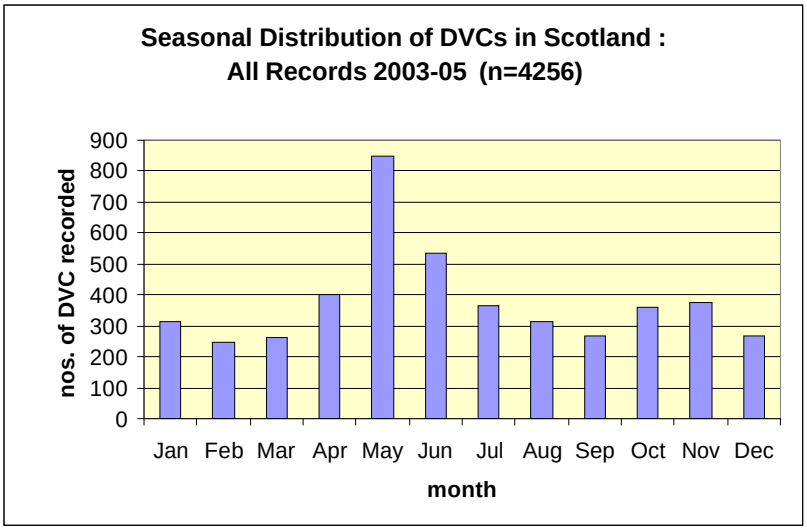
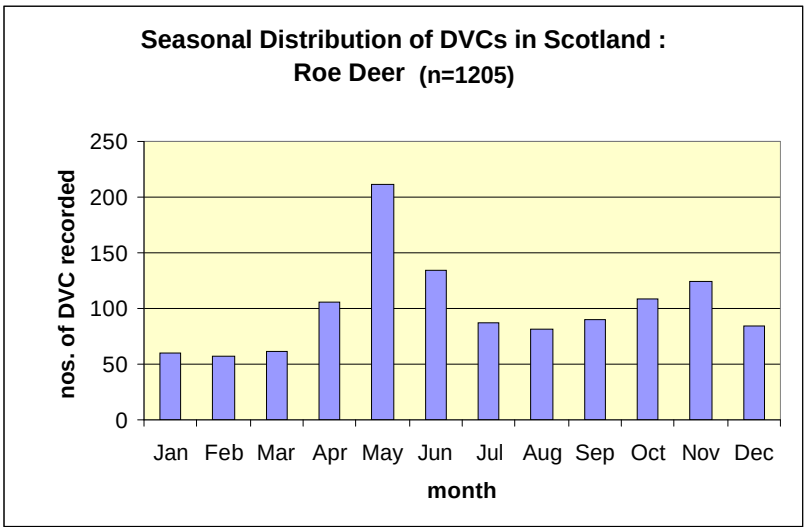


Figure 2 (a – c) [S] : Seasonal distribution of Deer-Vehicle Collisions recorded in Scotland January 2003 to December 2005.

a) All DVCs (incl. where species not reported)



b) Roe deer



c) Red deer