



*Deer Vehicle Collisions in Scotland
Monitoring Project 2008-2011*

July 2011



J Langbein



July 2011



Deer Vehicle Collisions in Scotland Monitoring Project 2008-2011

***Final report
to Scottish Natural Heritage***

Prepared by Jochen Langbein

**Deer Initiative Research Report 2011/2
July 2011**

Copyright © The Deer Initiative Limited 2011

Further information can be obtained from:

**The Deer Initiative
The Carriage House
Brynkinalt Business Centre
Chirk
Wrexham LL14 5NS**

www.thedeerinitiative.co.uk

Or email: admin@thedeerinitiative.co.uk

Contents:

	page
Executive Summary	i.
1. Background	1
2. Approach and sampling strategy	1
3. Overview and trends in data volume from present and past studies	3
3.1 Overview of updated database	3
3.2 Trends in DVC records from key data sources	5
4. Review of findings from different data source categories	6
4.1 Trunk Road data overview	6
4.2 Change in frequency of DVC records for specific trunk routes	10
4.3 Animal Rescue / SSPCA incidents	13
4.4 Human Injury DVC records	16
4.5 Secondary data sources	20
4.6 DVC Priority Site carcass searches and comparison with trunk agent data	25
5. Monitoring change of national and seasonal patterns	30
5.1 Stratification and data limitations	30
5.2 Numbers of DVC from principal data sources available by council area	32
5.3 Comparative seasonal patterns of DVCs by Road type and Region	35
6. Conclusions and recommendations	38
Acknowledgements	44
References	44
Appendix I - Supplementary Map Figures (Figures 10 to 12)	[on CD]

Deer Vehicle Collisions in Scotland Monitoring Project 2008-2011

Executive Summary

- i. The primary objective of the present 'DVC Scotland 2008-11 Monitoring Project' commenced in May 2008 has been to re-establish the DVC database built up during 2003 to 2005, and include also as far as possible information for the intervening years when data collection was paused. This will enable monitoring of long-term changes in DVC occurrence countrywide, as well as between and within regions and for specific roads.
- ii. Over 6500 new records (for 2006-2010) have been added to the DVC Scotland database during the present project. This is a larger sample of records than obtained in the previous study, despite new data collection having focussed on a more restricted set of the most consistent source organisations. The *DVC Scotland Database* now overall includes more than 12,500 DVC records for the ten year period 2001 to 2010.
- iii. Greatest improvements in data coverage and volume have been achieved for:
 - deer collision reports and carcass uplift records obtained through trunk road operating companies (TOs); and
 - information on requests to attend to live deer injured in traffic collisions handled by the SSPCA.
- iv. Extension of coverage of data from TOs, to encompass since 2008 all rather than only part of the trunk road network, has contributed to a near threefold increase in DVC records accrued for trunk roads. Records obtained annually through the SSPCA, where manner of recording has remained stable across years, have also more than doubled, from fewer than 175 available per year pre 2006, rising to 295 to 349 per year since 2008. The significant increase in SSPCA records provides confidence that the increasing trends shown (see Figure 1) do at least in part reflect a real underlying increase in DVCs across Scotland since 2005. Increases in records from both sources also appear to have been sustained since 2008, from when on most even countrywide recording has been achieved.
- v. Improved mapping and use of available records within a GIS now enable more ready assessment of changes in numbers of incidents available for any given route or district over set time periods. Trunk road sections with highest recent frequency of DVC reports (see Table 7, and Figure 10a-r) include among others the A9 (Dunblane to Perth; Bankfoot to Pitlochry; Kingraig to Inverness, and Dornoch to Helmsdale); A835 (Garve to Ullapool); A85 (Methven to Perth); A90 (Dundee to Brechin; Stonehaven to Aberdeen); M80 (J1 to A80M Hags); A1 (Mussleburgh to Lamberton). The areas where greatest numbers of peri-urban DVCs have been recorded to date are centred on Glasgow and Aberdeen (see Figure 4).

SNH roadside deer carcass surveys

- vi. While significant improvements have been attained in reporting of deer casualties via trunk operation companies countrywide, comparative analysis against results of more intensive roadside searches undertaken annually at a number of priority case study sites by SNH indicate that TO records are unlikely to capture on average more than 50% of all DVCs that occur on trunk roads. These studies also indicate that for two out of three DVC priority sites where vehicle activated deer signs were installed in 2008, significant falls in DVC occurrence have occurred over the subsequent two years [see Table 8, and Figure 11a-c].

Human injury DVCs

- vii. The number of deer related personal injury accidents for those four Scottish Police Regions for which equivalent results from official RTA database searches are available to us for each of the last three years (Highland, Fife, Central and Grampian) has averaged 22 per annum. The road network covered by this is sample (among the 8 police forces in Scotland) contributes 31% of total annual traffic flow (i.e. just under 1/3rd) based on 2009 values (TfS, 2010). On that basis tentative extrapolation allows estimation that the annual toll of DVCs

leading to human injury is likely to lie in the region of 65 to 70 per year. This figure remains very close to estimates arising during the 2003-2005 study; but should be viewed against background national statistics which indicate that as a result of improvements to road safety human injury traffic accidents recorded overall in Scotland have shown a decline by around 10% over the past ten years.

Economic impact

- viii. While in view of general under recording of animal involvement and animal types in police accident records the true annual toll of human injury DVCs in Scotland may be rather higher, even 65 personal injury accidents through DVCs carry a very substantial economic cost. Department of Transport guidelines ([DfT, 2009](#)) value the economic cost of human injury traffic accidents across all severities at £ 75,000 per incident; so that the annual estimated economic burden posed by 65 human injury DVCs in Scotland per year would be calculated at £ 4.9 million.
- ix. Estimation of the overall total numbers of DVCs that occur countrywide across Scotland was not a specific project objective, with identification of high risk sites and monitoring of trends and local changes considered more important. However, it is apparent from several of the independent datasets accrued that the total number of DVCs in Scotland will amount to at very least several thousand per year, and most likely regularly exceeds 7000. The majority of these incidents will lead to at least some minor material damage to vehicles, while for close to a quarter (i.e. c.1750) they may be expected to incur more significant material damage ranging from moderate repairs to total write-offs with average reported insurance claim costs of £1350 (Langbein, 2007). The level of material damage to vehicles involved in DVC may be estimated to incur a further 2.3 million cost to the Scottish economy.

Seasonal DVC patterns and implications for mitigation

- x. Review of the extended DVC database with respect to seasonal distribution across Scotland, reconfirms a general peak in DVCs overall during May & June as shown by previous studies, and furthermore that some such peak occurs for all road types (Figure 8). However, it demonstrates particularly clearly that in Scotland this peak is most pronounced by far for major roads, where close to 60% (motorways) and 35% (A-class trunk roads) of incidents occur in these two month alone. The importance of this finding, from view of minimising risk of deer incidents on the Scottish trunk road network, is that it re-affirms that a high proportion of deer collisions on the most major roads may potentially be addressed through seasonally targeted mitigation such as VMS signage focussed on May to June alone. On the other hand, similar seasonally restricted mitigation for non-trunk roads is less likely to be as (cost) effective in general.

Recommendations for future countrywide DVC monitoring

- xi. The two principal data sets which in combination are likely to continue to provide the most consistent and best stratified information both at a countrywide and regional basis are:
- deer collision reports and carcass uplift records handled by the four main trunk road operating companies and two DBFOs responsible for day to day maintenance of the Scottish trunk road network; and
 - information on requests to attend to live deer injured in traffic collisions handled by the SSPCA, supplemented by similar call-outs attended by Forestry Commission rangers and others regularly called on to humanely dispatch live deer road casualties.
- xii. The comprehensive database of known DVC incidents in Scotland already accrued consistently from these above sources from 2007 onwards, as well as in some areas for earlier years, now provides a good level of sampling right across all regional and city council areas of mainland Scotland. Focus of countrywide monitoring primarily on these two main data sets, which are least prone to overemphasis of some areas over others due to recording bias, should also suffice for initial identification of existing and new localised DVC hotspots.

1. Background

- 1.1. Over the last two or three decades, in Scotland as in the rest of the UK, the number of wild deer and volume of traffic have both increased significantly. Deer-vehicle collisions (DVCs) have also increased, with significant costs in human death and injury, animal welfare and material damage. Following the recommendations of earlier studies to comprehensively record, analyse and monitor the problem, from 2003 to 2005 the Scottish Executive commissioned the Deer Initiative (DI) to develop a national DVC database (linking up with a parallel project in England), assess the scale and distribution of DVCs, and investigate contributing factors. (See Langbein and Putman, 2006.)
- 1.2. It was intended that continued monitoring and analysis of the DVC database, together with other work on DVC mitigation measures, would help to identify hotspots (high-risk areas) and appropriate action to reduce the number and seriousness of DVCs. In May 2008 the Deer Commission for Scotland (since incorporated within Scottish Natural Heritage) determined to fund a new project - the Deer-Vehicle Collisions Scotland Monitoring Project 2008-2011 - to be undertaken for SNH by the DI.
- 1.3. The main objectives of this project are:
 - To re-establish the Scottish database of known DVCs from 2008 through to March 2011; and include any possible collection of retrospective data for incidents that occurred during 2006 and 2007 (after the end of data collection for the previous 2003-2005 study).
 - To provide as complete as possible a continuation of DVC data collected during 2003-2005 for the entire Scottish Trunk Road network.
 - To establish trends of DVCs also on more minor roads across Scotland, and specifically the level and associated risk in peri-urban areas.
- 1.4. An interim report for 2008/9 (Langbein, 2009) reported on data collection primarily up to end 2008. This report provides an update of the further data gathered and incorporated into the database during the present study commenced in June 2008, and review and comparison of all DVC records now accrued during the present and previous SNH/DCS funded studies for the full ten year period from 2001 to 2010.

2. Approach and review of main data sources

- 2.1. The primary potential data sources identified at the beginning of the study and utilised also during the previous study from 2003 to 2005 are shown in Table 1. These same broad data sources and codes are used in presentation of data throughout this report:
- 2.2. Considering issues surrounding data quality and overlap between sources discussed in the 2008/9 interim report (Langbein, 2009), the main emphasis of data collection has been on improving the consistency, quality and comparability of data collected Scotland-wide from the categories shown in bold above (UT, R, ST and st-dam). The consistency of data capture across study years and their combined coverage across the Scottish mainland is relatively high, and between them are considered to provide the most reliable basis of monitoring changes between years within and across regions.

UT	Trunk Road deer casualty Uplift requests on (recorded by 4 main Scottish Trunk Road Operating Companies plus the M74 & M77 DBFOs)
R	Rescue/Welfare (mainly SSPCA & some other wildlife rescue organisation call-out requests to dispatch or treat ' <u>live</u> ' injured deer road casualties)
ST & St-dam	<u>Recorded</u> Road Traffic Collisions involving deer causing HUMAN injury; plus some damage-only [St-dam] RTCs, if recorded in official AIU records compiled by Regional Police Forces or Council Road Safety Teams.
D & D-carr	Records from 'deer-knowledgeable' contributors (esp. FC rangers; other deer managers, biologists and naturalists; plus D-Carr – DCS/SNH roadside carcass surveys.
UC	Council Road deer casualty Uplift requests (as recorded by LA Roads Departments) [for predominantly non-trunk road incidents]
P	Police Force Control Room logs of deer road casualties or deer RTCs (not consistently retrievable for all regions).
IC	Motor Insurance Claims sample (Fortis Insurance) - comparable records not available post 2007
G	General Public occasional contributors (via web-site, email or direct contact)

(All records in the DVC database are allocated to one of the above nine main data categories and various sub-categories, to enable independent abstraction and evaluation of potential overlap between datasets. Greatest uncertainty regarding potential duplication as well as lack of countrywide availability and general data quality concerns UC records, with therefore lesser emphasis placed on obtaining and incorporation of these in more recent years of the study)

2.3. Several of the other data source categories can also provide useful information on particular aspects or in specific regions. The availability and detail of input from the remaining categories was however found to be highly variable both during the 2003-5 study and found to remain so during the first year of the present study. In particular, although carcass uplifts from non-trunk roads handled by local authority road cleansing departments and or notified to police control rooms do have the potential to capture high numbers of incidents nationwide, the availability of such records (and willingness by the organisations concerned consistently to extract and provide these free of charge to the study in the form required) is extremely variable. That is, not only variation between regional councils and police forces, but also in many cases between smaller sub-divisions within each local authority. Even when available these records can often provide only limited detail on locations or actual dates of incidents (rather than date(s) when calls to uplift received); making individual incidents difficult to distinguish from multiple calls about the same incident to the same organisation, or from logs from other data sources potentially referring to the same incident.

2.4. Input from some of the sources within the UT/P/D/G categories has continued to be obtained and collated where of reasonable quality, or if of value for specific assessments. For example, information from SNH-road side carcass searches (D-carr) can help assess minimum likely extent of under-recording if using trunk records from roads maintenance companies alone. Other records, from for example some but not other local council departments, that in many cases may contain records which duplicate ones also logged in trunk road uplift records or by SSPCA, have been retained and archived for potential utilisation and grid referencing if required later for specific more detailed localised assessments; but have generally been excluded from national mapping or other comparisons between regions to retain even sampling and minimise potential use of duplicate records.

3. Overview and trends in data collated during the present and past studies

3.1. Overview of updated database

- 3.1.1. At the time of writing scheduled data collection and processing for inclusion into the database and GIS is largely¹ complete, both for the main study period January 2008 – December 2010, as well as for such retrospective records as have been possible to obtain for the two years (2006-7) prior to commissioning the present work.
- 3.1.2. An overview showing the breakdown by year of the numbers of DVC reports obtained and collated from differing sample sources for 2001 to 2010 is shown in Table [2]. Over 6499 new deer road casualty or related traffic collision records (2006-2010) have already been added to the DVC Scotland database during the present project. This is an overall larger sample of records than was gathered during the initial study (6055) ending in 2005 (for 2001-2005); that is, despite the fact that the new study has been restricted to focus on data collection from a smaller set of the most consistent sample sources, with the aim of building as representative and comparable a picture across differing regions of Scotland as possible.
- 3.1.3. Data collated during the present study include >2000 records gathered retrospectively for the years 2006 (900 records) & 2007 (1279 records), when there was a break between contracts. Records obtained for the last three years have risen to 1415 (2008), 1555 (2009) and 1350 to date for 2010 (with small numbers of further records for 2010 likely to come in should the study continue throughout 2011).
- 3.1.4. Overall the *DVC Scotland Database* now includes more than 12,500 DVC records for the ten year period 2001 to 2010 (as well as a few hundred for earlier years). As also shown in Table 2, map references have been allocated to over 10350 (83%) of the records received with adequate location details, all of which have been uploaded to a GIS (Geographic Information System), to enable ready extraction and analysis of sub-sets of data currently available for any specific time period, road, region or other area within Scotland.
- 3.1.5. It should be noted throughout that the above figures merely represent samples of all deer vehicles collisions and road casualties that occur annually in Scotland on which details are available to the study. The majority of deer collisions very likely continue to go unreported. The above figures are given here therefore mainly to provide an indication of the base of information accrued and available for analysis of the distribution, incident hot spots and changes across years; they do not represent estimates of the total numbers of incidents occurring. Estimation of the true annual total of incidents remains difficult, as the proportion of all incidents captured by each of our sample sources is unknown; but such estimation will be discussed in more detail in Section [6].

¹ Only a small number (50) of further records for 2010 and possibly some earlier years are expected, limited mostly to human injury records should they become available via four others of the eight Scottish police regions.

Table [2]: Samples of Deer-Vehicle Collisions reports for Scotland obtained for period 2001-2010 and breakdown among differing data source categories.

Source Type		Year										Total
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
		<i>(pre-study)</i>		<i>(original study)</i>			<i>(study paused)*</i>		<i>(present study)</i>			
Trunk Road uplifts UT	GIS	61	121	168	231	278	104	271	486	676	722	3118
	n/m	9	12	20	14	44	19	125	38	18	1	300
		70	133	188	245	322	123	396	524	694	723	3418
SSPCA R	GIS	0	2	7	139	146	196	250	319	291	206	1556
	n/m	0	0	0	36	5	4	12	3	4	143	207
		0	2	7	175	151	200	262	322	295	349	1763
Human injury RTA ST19	GIS	13	12	14	16	10	18	16	30	20	13	162
	n/m	0	0	0	0	4	0	0	0	0	0	4
		13	12	14	16	14	18	16	30	20	13	166
Police non-injury rec ST-dam	GIS	70	81	70	74	64	91	63	56	55	49	673
	n/m	1	1	0	5	3	0	0	1	0	0	11
		71	82	70	79	67	91	63	57	55	49	684
Other police call logs P	GIS	32	41	66	151	435	0	83	68	220	74	1170
	n/m	0	53	46	88	38	0	1	0	3	3	232
		32	94	112	239	473	0	84	68	223	77	1402
SNH-carcase searches D-carr	GIS	0	0	34	59	117	75	99	85	55	55	579
	n/m	0	0	2	28	0	0	0	0	0	0	30
		0	0	36	87	117	75	99	85	55	55	609
Deer-familiar contributors D	GIS	26	33	124	173	86	71	66	41	58	67	745
	n/m	68	70	68	34	2	64	65	94	10	1	476
		94	103	192	207	88	135	131	135	68	68	1221
Insurance (Fortis) IC	GIS	20	28	47	65	0	74					234
	n/m	6	7	17	20	62	8					120
		26	35	64	85	62	82					354
Reg. Council Uplifts UC	GIS	137	176	475	513	520	99	4	1	5		1930
	n/m	20	11	44	78	46	29	200	175	214		817
		157	187	519	591	566	128	204	176	219		2657
Oth. General public G	GIS	2	10	44	46	44	24	11	4	4	2	191
	n/m	2	0	3	4	3	24	13	14	12	14	89
		4	10	47	50	47	48	24	18	16	16	280
mapped	GIS	361	504	1049	1467	1700	752	863	1090	1384	1188	10358
not mapped	n/m	106	154	200	307	207	148	416	325	171	162	2196
Grand Total		467	658	1249	1774	1907	900	1279	1415	1555	1350	12644

GIS = nos. of records to which grid references allocated, and included for GIS analysis and mapping.

n/m = nos. of records not yet fully mapped, mostly as submitted with insufficient location details.

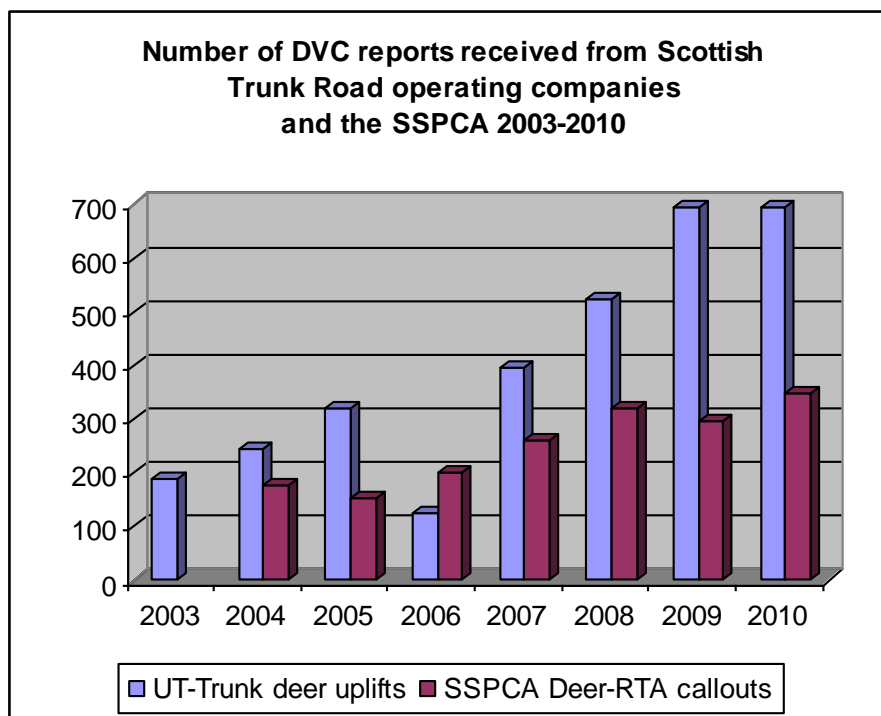
Primary sources for countrywide focus of present 2008 - 2011 study shown in bold at top of table. *For years when study was paused records obtained retrospectively are mostly less comprehensive.

3.2. Trends in DVC records from major sources

3.2.1. Despite having focused on collection of data from a more limited set of only the best data sources, the mean annual samples of records obtained per complete data year remains almost as high now as during the earlier 2003-2005 project. This has been possible to achieve mainly through a substantial improvement in the number, data quality and countrywide coverage of information obtained each year through trunk road operating companies (UT) and the SSPCA (R). As shown in Figure [1] DVC records obtained from these two data sources alone have almost doubled over the last five years, with currently around 1000 records submitted by them each year.


3.2.2. A proportion of the increase noted in records from trunk road companies might be the result of more efficient recording and abstraction of records by them on behalf of this project. However, the steady rise shown in also the numbers of SSPCA incidents (for which recording and extraction of data has remained very similar since 2004 – the first complete year since when these records are available to us - provides confidence that the trends shown in Figure [1] do at least in part reflect a real increase in the frequency of DVCs in many parts of Scotland over the past ten years.

Figure [1]: Number of DVC records per year provided for 2003 to 2010 by Scottish trunk road operating companies and by the SSPCA.



4. Review of findings from individual key data source categories

4.1. Trunk Road DVC Data (UT)

- 4.1.1. The Scottish Trunk road network based on 2008 figures excluding slip roads encompasses around 3250 km of motorways and major A roads considered of national strategic importance (Scottish Transport Statistics, 2009). These trunk roads contribute just 6% of total road length in Scotland but carry 37% of all traffic and 62% of all heavy goods traffic. Day to day maintenance responsibility for the trunk road network (see Figure 2), including dealing with requests to remove debris or dead animals, is split between four main regional trunk road operating companies (OC) contracted by Transport for Scotland: (NW: ScotlandTranServ; NE: BearScotland-NE; SW: Amey; SE: BearScotland-SE); in addition two routes are maintained under separate Design-Build-Finance-Operate (DBFO) contracts (M77 - Connect and A74M - AutolinkM6).
- 
- 4.1.2. From call-out records to deal with dead animals, these six companies between them now provide a very large, widespread and representative sample of deer road casualties and related vehicle collision records for major roads throughout Scotland. Trunk road records were also available to the previous (2003-2005) study, though with much variation in the details and time periods covered by the different regions. In the case of two of the regions new OC have been appointed since our previous study.
- 4.1.3. Contact was established with all six of the present trunk OCs/DBFOs near the beginning of the present project (with the assistance of staff from Transport of Scotland), to request provision of information on any incidents related to deer road casualties a) from the start of the new project in 2008 through to 2011, and b) any retrospective records available for 2006 & 2007. To help standardise the information provided by each OC, a spreadsheet template was provided showing the 'ideal' fields of information required for our database as far as available, regarding date, location and other details for each incident. By early in 2009, all six of the trunk road companies submitted at least some useful data for the present study for a) May 2008 onwards; and b) with the exception of one region (SE), substantial numbers of earlier records were also obtained for either all or part of 2006 and 2007.
- 4.1.4. As shown in Table 3 below, good coverage is now available for most of the trunk regions from 2007 through to end 2010; the one exception being SE where full coverage is available from Spring 2008. For much of northern and southeast Scotland uplift records are also available for the earlier 2003-2005 study period or else 2004-5, with somewhat less comprehensive records obtained retrospectively for 2006 & 2007 while the study was paused. For SW Scotland only few comparable trunk uplift records through OCs are available to us prior to 2007.
- 4.1.5. Substantial progress has also been made since the 2009 interim report in allocating additional information to all the records held in the DVC database with respect to their mapped locations and distance from nearest trunk or other

roads, so as to enhance capabilities of GIS analysis and mapping of all data. In many instances among those records received with grid references, the precision of such mapping is rather variable (with the consequence that a proportion of incidents had often not been positioned directly on the reported road and/or the reported road not stated). To overcome this, all referenced records in the database have been re-assessed using a GIS to help allocate each incident according to whether it is mapped i) on or within no further than 150m from a trunk road, ii) within 150m of a non-trunk road, or iii) mapped (less precisely) over 150m from any known road. In case of the trunk road network this now enables much more ready extraction than previously of the numbers of known DVC records available for any particular section of road or within any other specific areas; and analysis of how the frequency of records available for any section has changed between years.

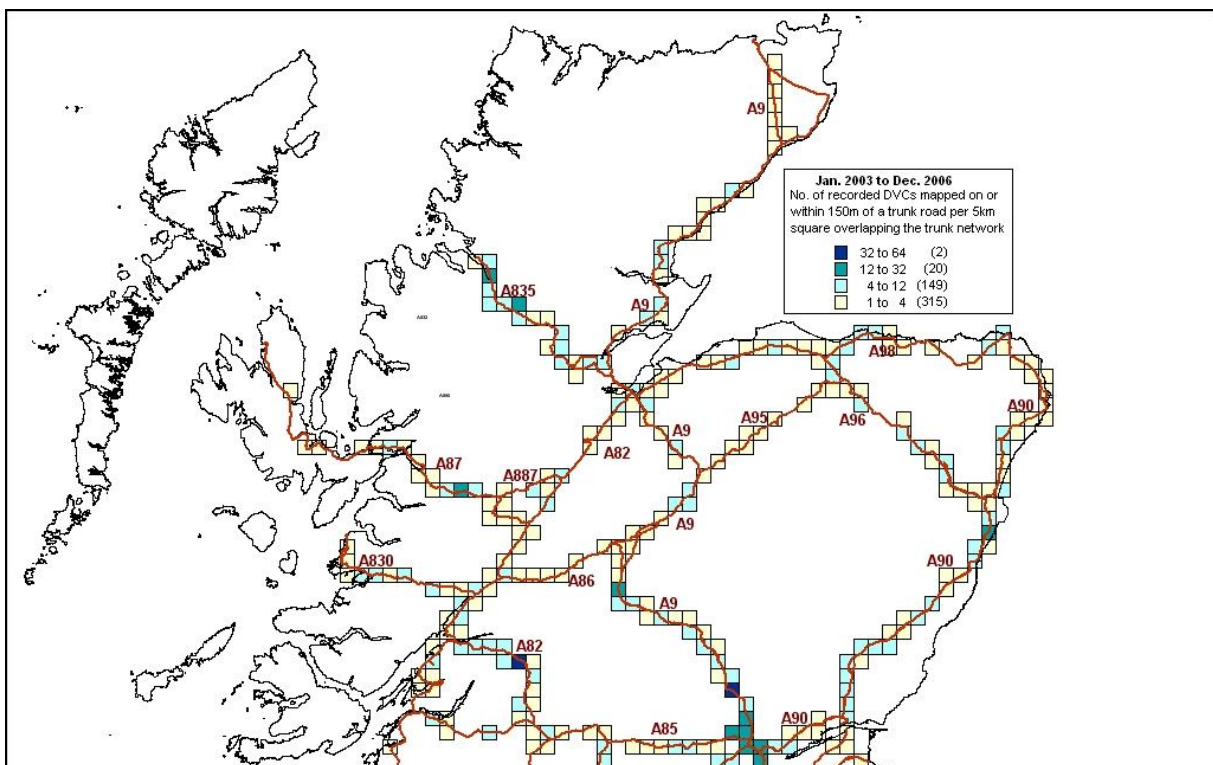
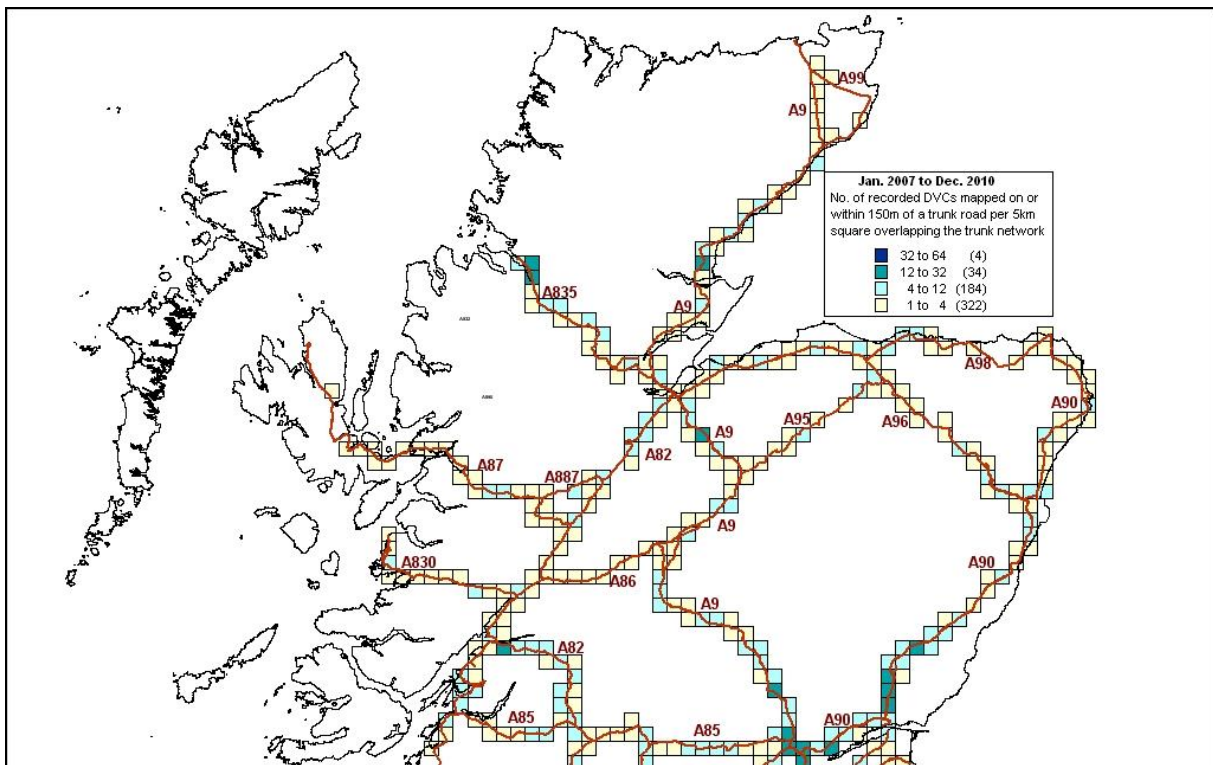
Table 3: DVC records obtained from trunk road Operating Companies by year

Trunk Network Management Units	2003	2004	2005	2006	2007	2008	2009	2010	Total
North West Unit [road length 1308 km]	98	101	138	89	216	213	212	260	1327
North East Unit [road length 629 km]	61	67	75	8	84	116	150	138	699
South East Unit [road length 503 km]	26	75	109	1	0	78	125	106	520
South West Unit [road length 692m]	3	2	0	14	84	111	194	213	621
SW: A74/M74 DBFO [road length 91 km]				8	10	4	9	6	37
SW: M77/GSO DBFO [road length 25 km]				3	2	2	4	0	11
Total [trunk network ca. 3214 km]	188	245	322	123	396	524	694	723	3215

4.1.6. A series of overview maps showing the relative distribution of available DVC records for trunk roads for the last 4 years (2007-2010), and for comparison also for the previous 4 years (2003-2006), is provided in Figures [3a-d] (broken down across separate maps for the northern and southern half of the country to enable closer views). The 5km OS grid overlaid on the trunk network here highlight areas where relatively high, medium and low numbers of incidents have been reported.

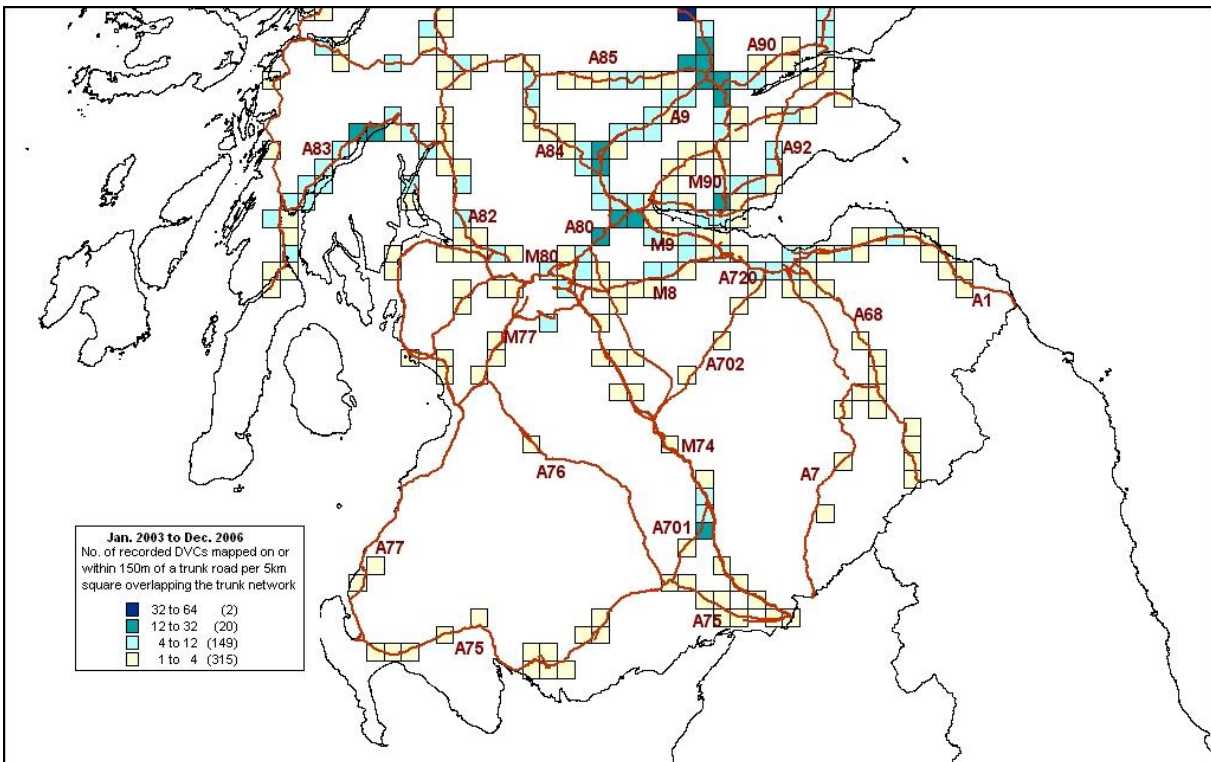
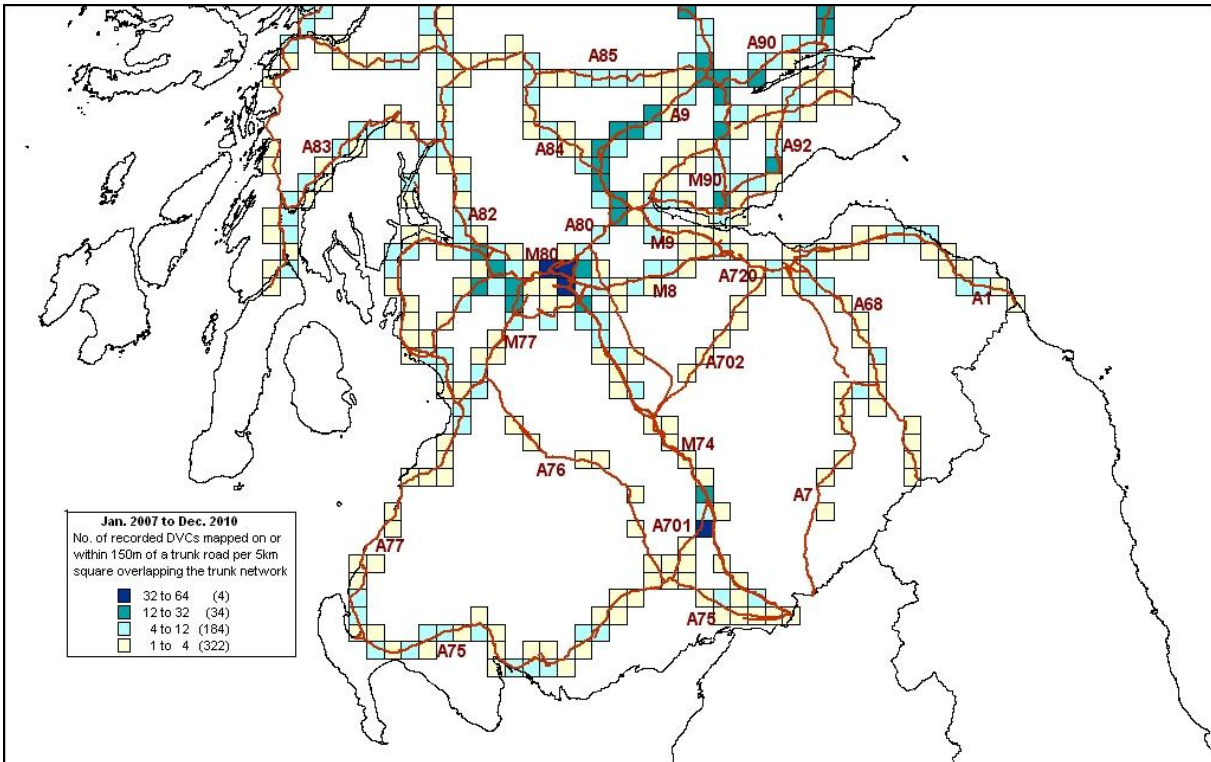
4.1.7. For Figures [3 a-d] all database records mapped on or no further than 150m of the trunk network are included, including those reported by trunk route operating companies as well as ones from other contributors to the project. Nevertheless, in considering the frequency of records mapped at each location, it should be borne in mind that only a proportion of deer road casualties will actually be reported, as in particular any injured deer running some way off from the carriageway before dying being much less likely to be logged unless a serious accident resulted. (Records arising from the intensive carcass surveys conducted by SNH in only a selected number of DVC priority areas (see section 5) in the Highlands are also excluded from these regional maps, to avoid distortion of the relative patterns shown).

Figure 3a& 3b: Comparative distribution of DVCs reported along the Trunk Road Network in northern Scotland during **a) Jan. 2007 to Dec. 2010** and **b) Jan. 2003 to Dec. 2006**.



NOTE: Only records falling within <150 metres of a trunk road verge included above; numbers in brackets show total number of squares for Scotland at each frequency range; For larger scale maps see Appendix I. [Based upon Ordnance Survey material with the permission of the Controller of HMSO © Crown copyright (2011) Licence no. 100017908]

Figure 3c & 3d: Comparative distribution of DVCs reported along the Trunk Road Network in Southern Scotland during a) Jan. 2007 to Dec. 2010 and b) Jan. 2003 to Dec. 2006.



NOTE: Only records falling within <150 metres of a trunk road verge included above; numbers in brackets show total number of squares for Scotland at each frequency range; For larger scale maps see Appendix I. [Based upon Ordnance Survey material with the permission of the Controller of HMSO © Crown copyright (2011) Licence no. 100017908]

4.2. Changes in frequency of DVC records for specific trunk routes

4.2.1. Although rather higher numbers of trunk road DVC records are available overall for the most recent 2007-2010 four year period - in particular for southern Scotland - many of the same route sections were also shown to have relatively heightened levels of DVC during the earlier 2003-2006 study period. A closer examination of annual tolls of DVCs along some of those routes with highest levels of reports is provided in Table [4].

4.2.2. As the range of different source organisations and numbers of years for which data have been provided to the project from each has varied between years and regions, figures in Table 4 are restricted to incidents obtained through the trunk road operating companies alone. Broadly comparable information on such trunk road uplifts is now available from the OCs for at least five or six different study years for the Northwest / Northeast and Southeast network units; for the Southwest available directly comparable records span only the three years 2008 to 2010 to date.

4.2.3. Table [4] shows that whilst there is considerable variation in numbers of incidents logged each year, for the great majority of the routes assessed (18 of 23) the overall highest annual toll has been recorded during one of the last two study years. Although overall higher numbers of incidents have been recorded for most parts of the trunk network in the last three years, nine road sections (shown underlined in Table 4 and see below) stand out for which average number of DVCs recorded over the last three year are greater than double the average recorded during 2003 to 2005 (i.e. >100% increase). Smaller increases from 5% up to 80 % have been recorded for nine others.

4.2.4. Those routes where average numbers of reports via trunk road agents for 2008-10 have more than doubled since the 2003-05 study, include some where relatively high levels of DVCs were also already being recorded in past years (and reported in the 2009 interim report) including :

- A835 Garve to Ullapool (Fig. 11c);
- A9 Bankfoot to Pitlochry (Fig.10k);
- M80 Junction 1 to A80 Stepps to Hags (Fig. 10d);

However, review of Table 4 highlights also a number of other road sections where greatest recent increases in DVCs have been noted, including :

- several further sections of the A9 – such as between Dunblane to Perth in particular southwest of Auchterader (Fig. 10h); Aviemore to Inverness (Fig.10q); and Dornoch to Helmsdale (Fig. 10r).
- the A85 from Methven to Perth (Fig.10h);
- the A1 from the Scottish border to Musselborough (Fig. 10f);
- the A90 Stonehaven to Aberdeen, especially Newtonhill to Porthleven (Fig. 10p).

By contrast, a significant fall in average annual DVC frequency has been noted for only two of the 23 routes assessed (A83 Lochgilphead to Cairndow [Fig 10g] and M90 Dunfermline to Kelty [Fig.10i]). Further large scale maps showing recent (2008-2010) distribution and DVC hotposts also along other trunk routes are provided in Appendix I (Figures 10a-r & 11 a-c).

4.2.5. Trunk roads carry over 37% of all road traffic in Scotland. As illustrated by Figures 3(a-d) records for the trunk network as a whole also provide a geographically widespread sample of DVC incidents recorded in a comparable manner across much of the country, enabling general regional trends across years as well as route specific changes in DVCs to be monitored. Nevertheless, as trunk uplift records are limited to information from motorways and major strategic A-class roads with high traffic volumes, these records can provide limited information regarding the relative DVC frequency on non-trunk A-roads or B, C and other more minor roads. The latter are examined in further detail in the following sections dealing with records on deer hit and injured in DVCs obtained through the SSPCA, and samples of human injury RTA records received through regional police and road safety departments.

Table [4]: Change in number of DVC records obtained through trunk route operating companies for selected routes. [Bold figures show the year with highest no. of reports; roads for which the yearly toll during the 2008-10 study is greater than double the annual average for the 2003-5 study are shown underlined. Grey boxes indicate study years when records are only available for part of the year].

Trunk Road Section	dist. km	2003	2004	2005	2006	2007	2008	2009	2010	Total
A82 Bridge of Orchy to Glencoe	42	7	6	11	3	5	10	8	14	64
A83 Lochgilphead to Cairndow	55	15	16	11	15	6	8	8	14	95
<u>A835 Garve to Ullapool</u>	52	1	9	17	9	13	17	15	22	103
<u>A85 Methven to Perth</u>	7	0	0	1	2	0	9	6	2	20
A87/A887 Shiel Bridge to Loch Ness	58	2	4	5	2	5	7	8	5	38
<u>A9 Bankfoot to Pitlochry</u>	33	5	4	5	5	2	9	11	11	52
<u>A9 Dornoch to Helmsdale</u>	45	2	6	0	1	7	19	11	8	54
<u>A9 Kingraig to Inverness</u>	56	4	4	3	2	9	10	14	23	69
A9 Pitlochry to Dalwhinnie	46	8	5	7	3	4	1	7	13	48
<u>A9 Dunblane – Perth</u>	43	6	7	6		9	11	24	33	87
A90 Dundee to Brechin	43	9	8	9		11	13	14	18	64
<u>A90 Stonehaven to Aberdeen</u>	21	1	0	0		2	4	6	4	14
A92 Dunfermline to Glenrothes	26	3	9	3		7	15	1	6	39
M9 Dunblane – Stirling	12	2	8	7		0	5	6	11	39
M90 Dunfermline – Kelty	14	5	9	3	1	8	3	1	2	31
M90 Kinross – Perth	24	14	17	13		12	21	23	17	104
<u>A1 Mussleburgh to Lamberton</u>	75	1	13	16			12	28	23	93
M8 Edinburgh to Coatbridge	47	4	9	12			4	9	17	55
<u>J1 M80 to A80 Steps to Hags</u>	25		10	7	1	5	16	17	11	67
M9 Stirling to Newbridge	41	6	17	20			7	24	20	94
A701 Beatoch to St Anns	12	1	1	5	1	3	13	19	19	62
A75/A77 Castle Douglas to Ballantrae	110	2	1	4	3	11	16	23	30	90
M73 incl. M8 interchange	10			5		13	18	22	19	77
Total	897	98	163	170	48	132	248	305	342	1459

(For large scale maps of DVC distribution along each of the above routes see Map-Appendix I)

4.3. Animal Rescue/SSPCA data (R)

4.3.1. Incident reports relating to requests to attend to live deer injured in collisions with vehicles provided to the current study by the SSPCA for January 2006 onwards have increased substantially as compared to 2003-2005. Only 150 - 175 such incidents per year were logged during the previous 2003-5 study, but have steadily risen from 200 in 2006 to near 350 in 2010 (see Figure 1; Table 2). Improvements in recording and abstraction of relevant records from SSPCA call-logs submitted to the study could possibly have contributed to some extent. However, the sustained nature of this increase through the last five years is more likely to reflect a real underlying trend and a more general rise in overall numbers of deer being hit by vehicles on Scottish roads. As noted in the previous sections, a similar upward trend in records is also apparent for carcass uplifts from trunk roads over the last five years (Table 2).

Incident logs received from SSPCA mentioning injured deer included numerous additional ones relating to dog-attacks, fence injuries and orphaned fawns, but only those mentioning RTC or RTA (Road traffic collisions or accidents) specifically have been incorporated for the present database, and allocated as far as possible to map locations based on location details provided].

4.3.2. SSPCA records sample mostly just incidents where a deer survives the initial collision but remains injured at the roadside and someone has called for assistance for humane dispatch or treatment. The overall proportion of DVCs where the deer is not killed outright but leads to live injured deer at the roadside has been estimated previously by us (Langbein, 2007) to lie between 20% to 25% [tending to be closer to 20% where small deer species such as roe and muntjac predominate, but rising to a third in case of larger species such as fallow and red deer]. Only 150-175 incidents dealt with by SSPCA per year were available to the previous 2003-5 DVC project. In recent years these have steadily risen from 200 in 2006 to near 350 in 2010 (see Figure 1; Table 2). As discussed above, SSPCA records are drawn only from the limited sample of all DVCs that result in live-injured deer at the roadside (and therefore even if SSPCA were called to all such incidents would be likely to represent at best 25% of all DVCs that occur countrywide). Nevertheless, samples of SSPCA records accumulated over a number of years are likely to provide similar patterns in terms of identification of DVC hotspots to those that would arise if rather more complete information on all deer road casualties (including those killed outright) were available in any single year.

4.3.3. SSPCA records are of particular value for the present study, also as they provide some samples of DVCs right across all Regional Council areas of Scotland, including incidents on both minor as well as major roads. The breakdown of SSPCA records for different study years among different local authorities is shown in Table 9. Even though a degree of distributional bias could potentially affect this dataset (with possibly a greater likelihood of injured deer being reported to SSPCA in more populated areas and less so in remote areas), these records are particularly valuable in helping to identify those Scottish cities and towns affected most by the spread of deer into peri-urban areas, where consistent recording through other organisations tends to be most deficient.

4.3.4. SSPCA records currently provide the largest and most widespread nationwide annual sample of incidents for non-trunk roads. Among over 1500 mapped SSPCA records for 2001-2010, 18% occur along trunk roads (motorways and

major strategic A-roads), while the remaining 82% are incidents on non-trunk road roads (including other A-roads, B, C, and minor roads). Map Figures 13a & 13b [see Appendix I] show the relative frequency and distribution per 5km OS grid square for all mapped SSPCA records available for the most recent four year period (2007-2010), and by comparison also for the previous four year period (2003-2006). Although the overall numbers of incidents from this source have doubled over the more recent study period, their distribution in the main highlights the same regional hotspots.

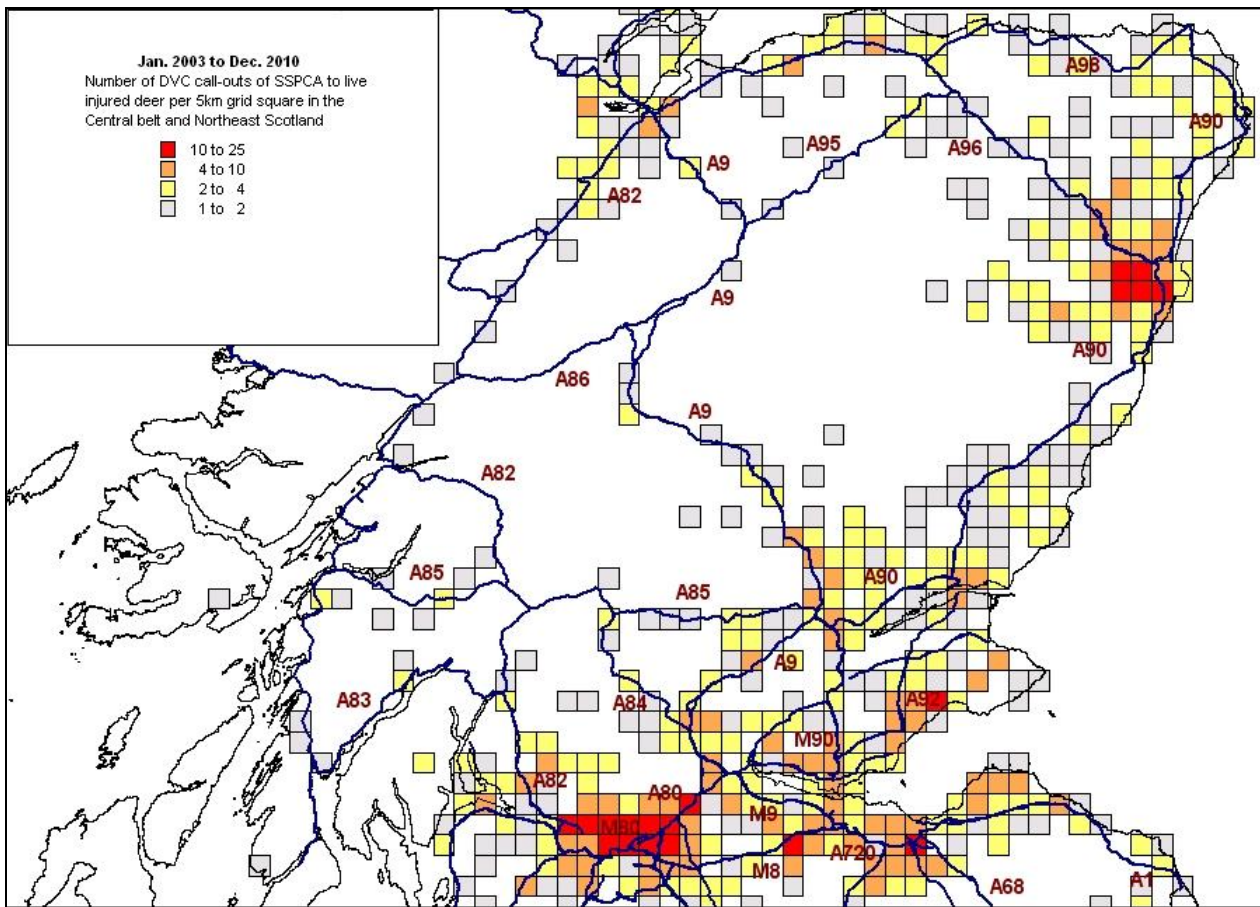
4.3.5. The notably highest frequency of SSPCA call-outs to deer RTAs in both periods are located in peri-urban areas around Glasgow and Aberdeen.

- Near Glasgow DVCs are reported most commonly on the northern edge of the city – between Clydebank to Bearsden and Milngavie; Bishopsbriggs and Cumbernauld, regularly including incidents along the A809, A803 and A80(M), but also many others on more minor local roads.
- Near Aberdeen DVCs are widespread around the periphery of the city with highest numbers recorded to the southwest including along the A93, B9077, and A90 and well as southwest of Aberdeen, but also many incidents on more minor local roads.

Records from SSPCA alone over the least three years include 138 located within 10 miles of the city centre of Glasgow (46 per year), and 79 located within 10 miles of Aberdeen city centre (26 per year). On average 14 to 15 of these incidents per year are logged within merely 5 miles of the city centre. As SSPCA logs (limited to attendance of live casualties; see 4.3.2) are thought to make up at most 25% of all DVC incidents, it is highly likely that actual numbers of DVCs per year will number over 60 within 5 miles of each of these city centres.

4.3.6. Further peri-urban concentrations of SSPCA incidents occur in the commuter belts southeast and southwest of Edinburgh, as well as near Glenrothes, Dunfermline, Perth, Stirling, and Inverness. Given the similarity of distribution noted among records from the earlier and present study, all available SSPCA records 2003-2008 have been pooled for Figure [4], providing a general overview of their distribution across the above areas. For maps showing closer views of the periurban area where highest numbers of DVCs have been recorded see Appendix I (Figures 10d, 10e, 10k, 10p)

Figure 4 : Distribution and frequency of DVC call-outs to live injured deer at roadsides handled by the SSPCA between 2003-2010 within the Central Belt and Northeast Scotland. [for Scotland wide views comparing differing time periods see Appendix I - Figure 13 a&b]



[Based upon Ordnance Survey material with the permission of the Controller of HMSO
 © Crown copyright (2011) Licence no. 100017908]

4.4. Human injury DVCs [ST]

- 4.4.1. Obtaining countrywide records of personal human injury accidents (PIA) arising from Road traffic collisions (RTCs) involving deer via Regional Police forces, Accident Investigation Units or Regional Council Road Safety teams had proved difficult during the previous 2003-2005 study, as several of the Scottish 8 police forces responded to request for information saying they were not able to abstract deer-specific incidents from their official RTC records at the time. Good records were however already available to the earlier study for some police regions, in particular for Highland Region (via the regional council road safety department, who around ten years ago added a specific code to enable more ready extraction of deer-related RTCs); as well as some but less comprehensive records available at the time for Central, Tayside, Fife and Dumfries & Galloway Police.
- 4.4.2. Although PIAs are estimated to represent only a quite low percentage of all DVCs (estimated at from 1.0 to 1.2% in England, Langbein, 2007), they do constitute an important part of assessing the issue of DVCs, not least in terms of evaluating the road safety risk and economic costs posed by such collisions. Requests have therefore continued to be made for this information through police or council road safety departments. Obtaining consistent reporting on human injury DVCs across all regions has continued to prove difficult. However, improved information – including for several years retrospectively (2006 to 2009) - has now been obtained for one more regions (Grampian) for which no human injury records had been possible to abstract for us in the past; and Lothian & Border expect to be able to provide similar later in 2011; while comparable full road traffic collision databases searches for deer related incidents were also done for us again by Road Safety teams or police in Highland, Fife, and Central Region.
- 4.4.3. An overview of the expanded numbers of known human injury records now accrued for years 2003 onwards, and logged in the DVC Scotland database by year and police regions, is provided in Table 5. Aside from human injury records, the numbers of additional damage-only DVCs (st-dam) involving deer, that were attended by and also logged in official police / council RTC databases are also shown in Table 5 for those forces which do maintain such records. It should be noted that when comparing across regions, however, that only a (variable) proportion of damage-only incidents will be logged by police, and procedures for doing so will differ between regions (and years). This occurs as, by contrast to human injury accident statistics, there is no obligation on police forces to maintain detailed records on damage-only collisions that they attend for national statistics collated by Department of Transport.
- 4.4.4. The most extensive records by far on both human-injury and damage-only incidents from the official accident databases remain those for Highland Region, with between 7 to 13 human injury road traffic collisions involving deer logged per year throughout years 2000 to 2010 (mean 9.8 per annum). Although no statistically significant trend is discernible from these numbers, it is interesting to note that over the last decade traffic accidents overall in Highland Region have fallen by over 20% and also by more than 10% in case of human injury accidents (Highland Council web-site). While no significant decline in injury DVCs is apparent so far for Highland regions from the figures given in Table 5, in case of damage-only DVCs numbers of records do appear to have dropped since peak figures ranging from 43 to 53 per year reached between 2004 to 2006, to fewer than around 30 per year logged since.

Table [5] : Number of available records on DVCs leading to human injury (st), and on other DVC causing damage-only but attended and logged fully by police (st-dam).

Police Region	type	2003	2004	2005	2006	2007	2008	2009	2010	Total
Highland	st	10	9	13	7	9	13	9	9	79
	st-dam	30	53	43	43	28	20	28	-	245
Fife	st	0	3	1	2	0	3	3	2	14
	st-dam	14	18	20	32	17	19	26	22	168
Central	st	1	2	0	6	2	7	0*	1*	19
	st-dam	0	0	0	16	18	18	0*	0*	52
Grampian	st	-	-	-	3	5	7	8	5	28
	st-dam									0
Tayside	st	1				2	1			4
	st-dam	15	8	4						27
Dumfries & Galloway	st	2								2
	st-dam	11								11
Lothian&Borders	st		2							2
	st-dam									0
Sub-total-a	st	14	16	14	18	16	30	20	18	146
Sub-total-b	st-dam	70	79	67	91	63	57	54	22	503
Grand-total		84	95	81	109	79	87	74	40	649

[Grey boxes highlight police regions or years where comparable data are not available. Note that st-dam type incidents are logged only by some police forces and in variable manner, as standardised records for national accident statistics are only collected for human-injury incidents, but these too do not have to record whether a deer rather than another animal was involved]

4.4.5. In case of Central Police region (encompassing Clackmannanshire, Falkirk and Stirling) Table 5 shows high level of variation between years in the number of recorded incidents, not only of PIAs but in particular damage-only accidents. Directly equivalent traffic accident data searches were undertaken and re-checked for us in 2011 by Falkirk and Stirling councils for the entire central region for throughout 2003-2010 for human injury and damage only incidents respectively. In case of human injury accidents – analysis by the road safety teams suggest that this level of variation is not statistically significant and does not necessarily mean that records have been missed in more recent years. However - in case of the damage-only incidents the very sharp drop (from an average of 17 per year between 2006 to 2008, to zero for 2009 & 2010) does raise questions about whether there may have been some changes in how incidents are logged; - possibly in some way that the type of animal is no longer mentioned in searchable text accident descriptions. Clearly - it could be that a real reduction in damage-only deer incident may have occurred, but in view of the scale of change it seems unlikely to explain the observed variation in full. This highlights the continuing problem regarding inconsistent manner of the detail in which animal accidents tend to be logged. A similar problem was noted in records abstracted for us for the first time by Grampian police, for all human injury incident mentioning 'deer' in accident text descriptions. In this case, a fair number of deer related incident did show up in each data year, but on the first computer search excluded 2 fatal accidents in which deer were involved and already known to the project.

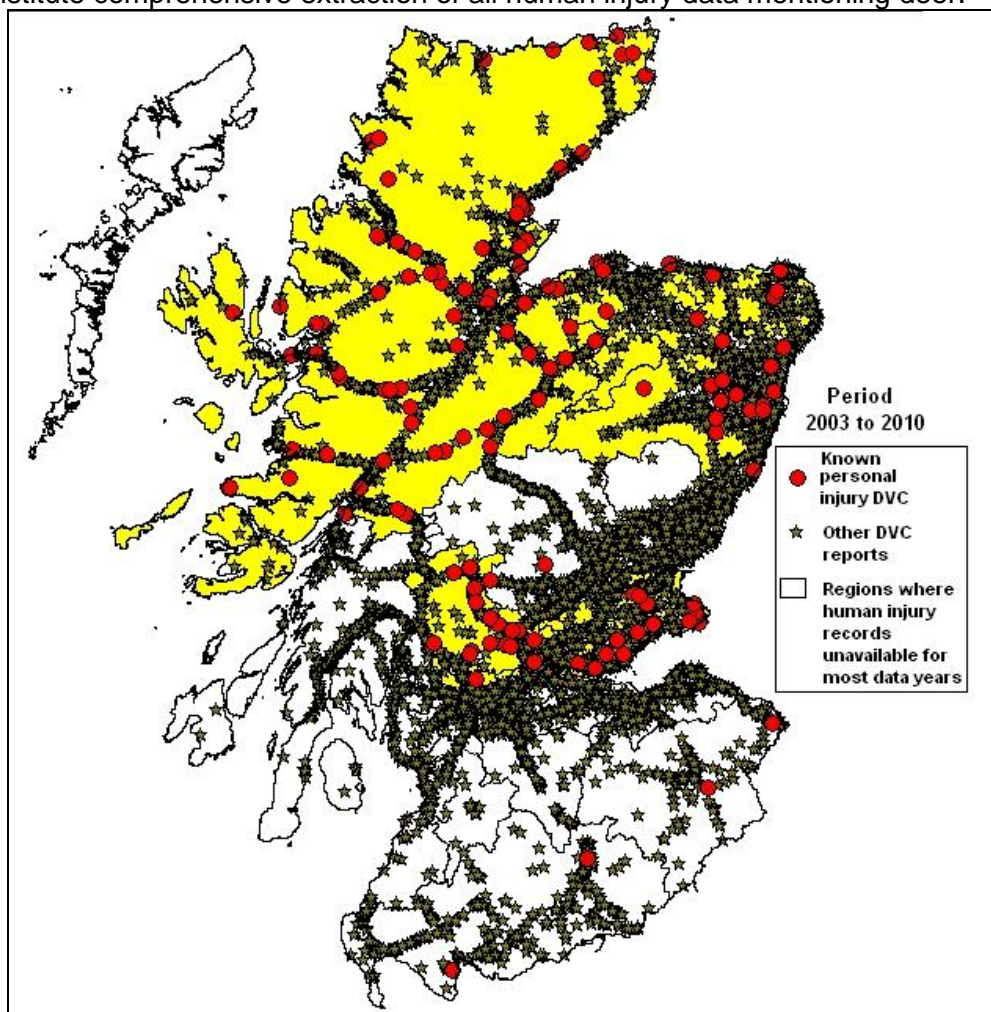
4.4.6. Anomalies and under-reporting as above seem to appear mainly due to general inconsistency in which accidents where animals are believed to have

been involved as a carriageway hazard or other contributory factor are recorded nationally; not least from view of whether the type of animal (whether deer / badger / cat etc.) is logged and spelled in a readily retrievable manner in accident text descriptions. This arises mainly as the type of animal does not require to be stated on official ST19 returns which police need to complete for all human injury traffic collisions, unless a ridden horse is involved. Until there is a change in ST19 forms, to require the actual type of animal to be stated for all human injury accidents where a live or dead animal on the road is believed to have been a hazard or contributor factor, the numbers of deer related accidents are likely to continue to be greatly underestimated.

4.4.7. Although for reasons discussed above retrievable records on human injury DVCs are likely to represent only an unknown proportion of a rather higher actual number of such incidents, they do constitute one of few available samples of DVC records that may be assumed to be fully representative without significant bias in relation to their geographical distribution, or the types of road (trunk / or local authority main or minor roads), or season and times of day. The distribution of recorded human injury DVCs for 2003 to 2010 is shown in Figure [5] overlaid on a map of all DVCs recorded during this period. The map also highlights those four police regions for which results of comprehensive searches of human injury databases for incidents mentioning 'deer' or 'stag' undertaken for the project by Regional Road Safety departments are now available for a span of between 5 to 8 years; and those others where major gaps in human injury data availability remain – but where such incidents are nevertheless also very likely to occur each year based on the distribution and frequency of DVC reports in general.

4.4.8. It is interesting to note in this context also, as shown in Table 6, that the proportions of human injury DVCs (and also in case of recorded damage-only incidents) on trunk roads is almost directly in line with the percentage of total traffic volume carried by trunk roads in three of the regions. The one exception being Grampian, where only 17% were logged on trunk roads which carry 28% of total traffic in that region. For the four regions taken overall the proportion of human injury incidents recorded on trunk roads (42%) lies only a few percent higher than the proportion of total annual traffic flow carried by trunk roads in these regions (38%). The latter is in fact also very close to the percentage of traffic flow carried by trunk roads for Scotland as a whole (i.e. 37% of all road traffic; Transport for Scotland, 2010). This close correspondence of the proportion of injury as well as damage only DVCs with total traffic flows on different road types (i.e. rather than road length), suggests a high likelihood that at a national basis trunk roads will incur in the region of 37 - 42 % of all DVCs countrywide; while by converse the remaining 60% or so may be predicted to occur on local authority roads.

Figure 5 : Distribution of human injury traffic collisions with known deer involvement 2003 – 2010 in Highland, Grampian, Central, and Fife ; only more occasional records on human injury collisions are available for the other Scottish police regions (shown in white) and there do not constitute comprehensive extraction of all human injury data mentioning deer.



[Based upon Ordnance Survey material with the permission of the Controller of HMSO © Crown copyright (2011) Licence no. 100017908]

Table [6] Comparison of the proportion of human injury and damage-only DVCs recorded in official police RTC records that occur on trunk roads, with proportion of Traffic volume carried on the trunk network.

Region	Injury / damage - only	Nos. records available for analysis	% on Local authority roads	% on Trunk network roads	% of traffic carried on trunk roads
Highland	st	79	48%	52%	59%
	st-dam	245	44%	56%	
Fife	st	14	64%	36%	31%
	st-dam	168	69%	31%	
Central	st	19	58%	42%	34%
	st-dam	52	71%	29%	
Grampian	st	28	83%	17%	28%
	st-dam	-		-	-
Combined	st	136	58%	42%	38%
	st-dam	465	57%	43%	

4.4.9. In summary, over the most recent three year period the number of deer related personal injury accidents for those four Police Regions for which results of consistent official data searches are available has averaged 22 per annum. The areas covered by this is sample of 4 police regions (of the total of 8 police forces in Scotland) together contribute 31% of total annual traffic flow (i.e. just under 1/3rd) as assessed in 2009 (TfS, 2010). It seems reasonable therefore to put forward a tentative estimate that in the event that equivalent information were available for all eight Scottish police force regions, the total number of deer related human injury records would be predicted to lie in the region of 65 to 70 per year. While for reasons discussed above the true annual toll of human injury DVCs in Scotland is likely to be somewhat higher, even 65 personal injury accidents would carry a very substantial economic cost to the country. Department of Transport guidelines ([DfT, 2009](#)) value the economic impact of human injury traffic accidents assessed across all severities at £ 75,000 per accident; so that the annual estimated economic burden posed by 65 human injury DVCs in Scotland per year would be calculated to lie close to £ 4.9 million at 2008 costs.

4.5. Other secondary data sources

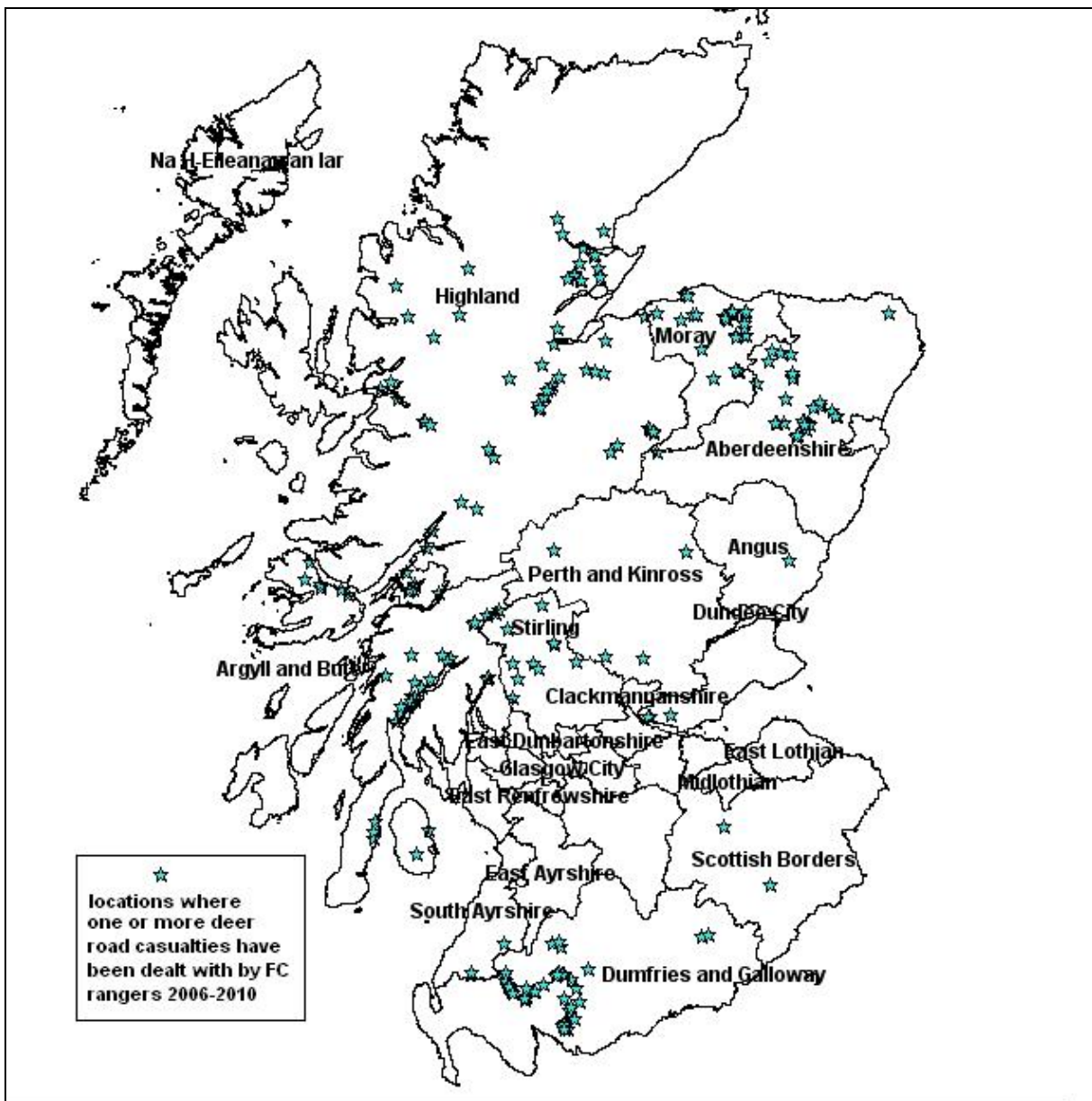
4.5.1. Around 350 records per year (< ¼ of total) have continued to be obtained also from various other data source categories over the past 3 years, but are available only on a much more localised basis and/or for some years but not others. As such these datasets are mostly only of much more restricted value as supplementary data for specific local assessments, rather than for stratified monitoring of long term changes and assessment of relative hotspots on a regional or countrywide basis.

Forestry Commission rangers reports

4.5.2. One further relatively consistent, though geographically restricted data set received annually are records abstracted as part of this study from the Forestry Commission's national deer cull database. Most FC management districts tend to log incidents of any deer road casualties attended by FC rangers referenced in that database as 'RTAs', which their staff may at times be called on locally to help dispatch at roadsides in the vicinity of FC holdings (although as a matter of national policy, increasingly FC rangers are able to attend to such incidents only during work time and only for incidents occurring on roads actually adjacent to FC holdings). The distribution of FC DVC records for Scotland collated since start of the present 2008-11 study (including retrospectively for 2006 & 2007) are shown in map Figure 6. Unsurprisingly, the majority of these incidents are recorded in The Highlands, Moray, Aberdeenshire, Argyll & Bute, and Dumfries and Galloway, where the majority of FC forests are located, with only much more intermittent records available via FC for most other regions of Scotland.

4.5.3. However – as these FC records, mainly occur in more rural areas where information from SSPCA tends to be less extensively available, but also sample in the main separate incidents also relating to attendance to live injured deer at the roadside, they complement and provide a useful extension of the combined annually replicable data available together with the SSPCA dataset; and help to extend the sample of records available for non-trunk roads for which least other records are available to us across the country as a whole other than via SSPCA.

Figure [6] : Distribution of records of DVCs obtained via Forestry Commission , of incidents handled by FC rangers between 2006 to 2010 (n = 269)

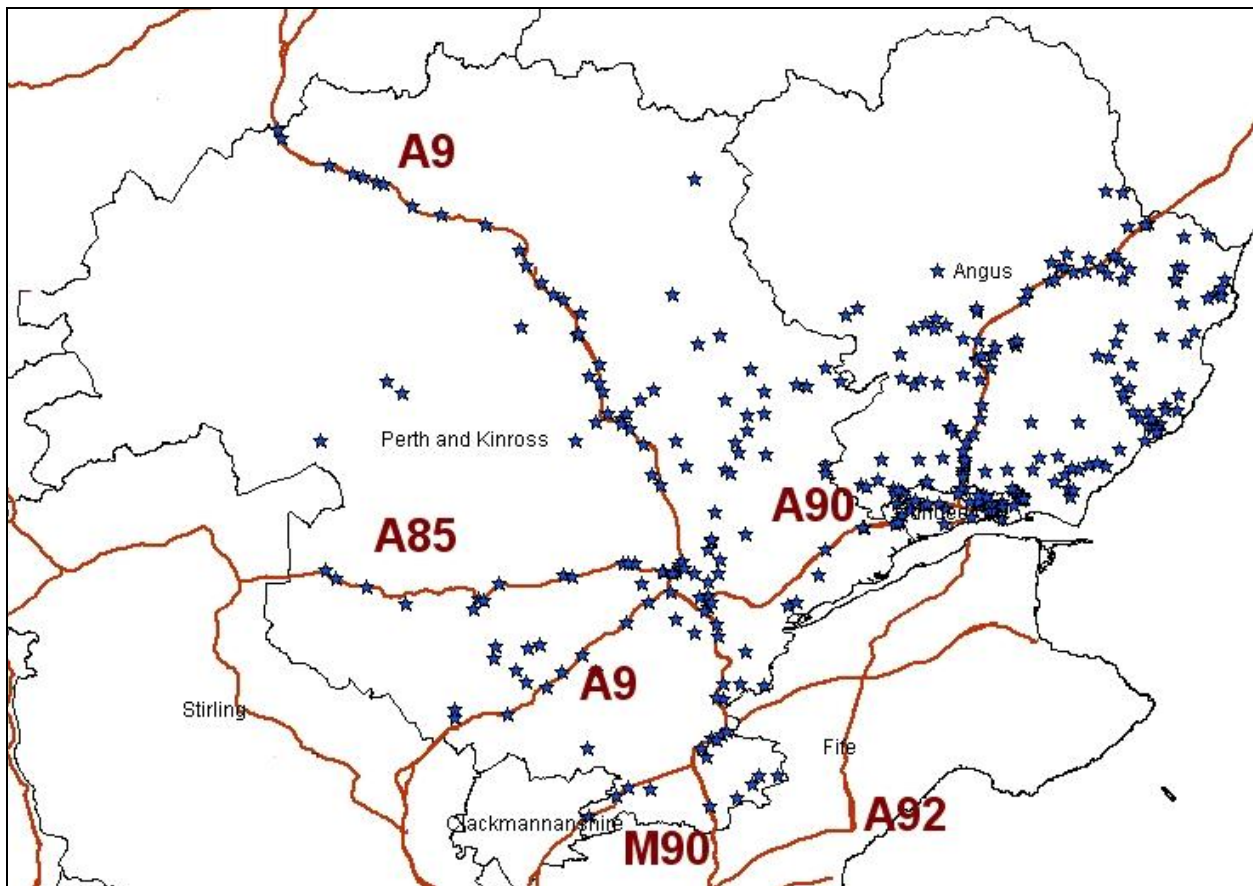


[Based upon Ordnance Survey material with the permission of the Controller of HMSO © Crown copyright (2011) Licence no. 100017908]

Police control room logs

- 4.5.4. Tayside is the only Police Force region for which extensive records have been obtained during the present project for 2007 onwards from searches of general police call room logs and other incident reports (P). The details made available in this instance have included map grid references as well as dates and times for around 70 to 90 DVCs per year since 2008, and enable more ready checks for potential duplication with other sources than is often the case for, e.g. local authority road uplift requests (where there is often uncertainty whether dates relate to days of incidents or up to several days later when members of the public may have asked for a decomposing animal to be cleared from the verge. The relatively good detail via Tayside police are however useful at least to help assess the distribution and hotspots within that region, covering Angus as well as Perth & Kinross (Figure 7).
- 4.5.5. However – a more detailed assessment of police call logs undertaken by Tayside police on our behalf (restricted to the six month period between 1 Feb. to 31 July 2009, found over 263 call-logs reporting incidents involving deer on roads (i.e. members of public reporting they have hit a deer, or that there is a dead or injured deer in the roadway etc..). This more intensive search was undertaken by replicate searches for mention of “deer” across a wide series of ‘opening-codes’ used by police, rather than being restricted to the main code 27-2 (apparently animal related) that was normally used to retrieve relevant records. Around a quarter of the records found were identified as likely duplicates relating to different calls about the same incident. Nevertheless, over 200 records related to separate incidents for the above six month period; which is over twice the number that has generally been received for Tayside per full 12 month periods; and suggest the true total DVCs reported to Tayside police may be as high as 400 per annum. However, for Jan. to Dec. 2010 the total number of records provided by Tayside again fell back to 77 records; and although requested a further detailed search for additional records logged under different control room codes was not deemed feasible due to the police time required for this. This illustrates the continuing difficulties of obtaining complete or more importantly consistent input via some of these secondary data sources.
- 4.5.6. Some occasional control room logs began also to be submitted to the project in 2008/9 by Central police, but have been provided only rather intermittently. Following discussion with operations personnel, it was suggested it would be easiest for police if their control room staff on duty would email information on any deer related incidents to the project as and when they occur. It however transpired that only very few records were received intermittently, probably as some but not other control room staff tended to send through records. A request made to Central police to ask instead for an occasional computerised search of control logs at monthly or longer intervals to identify any that mentioned deer, was felt by to require too many resources in term of police time to provide this on a regular basis.

Figure [7] : General distributional spread of records of DVCs obtained via searches of Tayside Police incident logs mentioning deer road casualties or traffic collisions involving deer that have been reported to, but not necessarily attended by Tayside between 2006 to 2010 (n = 445). [A significant proportion of these records may duplicate others logged in particular also among trunk route carcass uplift requests to trunk operating companies or injured deer call-outs attended by the SSPCA, but provided potential duplicates are excluded can be useful extending available information for specific localised assessments].



[Based upon Ordnance Survey material with the permission of the Controller of HMSO © Crown copyright (2011) Licence no. 100017908]

Local authority carcass uplift requests

4.5.7. Carcass uplifts from non-trunk roads handled by local authority road cleansing departments (and or often first notified also to police control rooms) do have the potential to capture high numbers of incidents nationwide. However, for the various reasons discussed more in earlier sections (Section 2.3 – 2.4) availability of such records (and willingness by the organisations concerned consistently to extract and provide these free of charge to the study in the form required) continues to be highly variable. That is, not only i) in terms of variation between regional councils as to whether they log such incidents in a manner allowing deer uplifts to be identified from other animal/debris calls, but also ii) in many cases whether comparable information is available for smaller sub-divisions within each local authority that may have differing systems or contractors dealing with such uplifts.

4.5.8. During the present study further attempts were made to obtain wider input of records from local authority road departments. Around 700 such records have

been received overall for between 2006 to 2010, including however, information from still only fewer than 1/3 of all regional councils. In the case of several councils although following initial contact they felt they could provide such information, despite several follow up request no data has in the end been provided. The majority of available local authority records have to date still been obtained via from Aberdeenshire, Perth & Kinross, and Angus Council – though in case of the latter two ironically similar volume of mostly replicates of the same records are also available via Tayside police. Even where available - records obtained from local road departments often include only sparse detail on locations or actual dates of incidents (rather than date(s) when calls to uplift received); making many individual incidents difficult to distinguish from multiple calls about the same incident to the same organisation, and also to check against potential duplication with other sources (in particular SSPCA, trunk route uplifts and police logs).

4.5.9. Also - whilst records of calls to uplift deer received by Local authority roads departments might be expected to relate to non-trunk roads only, closer inspection of records has shown this not to be that case, because a) often the general public phoning in such request will be unaware of whether a given road is managed by trunk operating companies, and b) depending on arrangements between individual local authority departments and trunk agents, some may deal with animals carcasses clearance from verges of certain A-class trunk roads but not motorways. Closer inspection of for example records provided by Aberdeenshire Council during 2009, showed as many as a third of around 200 unique records received related to the A90 trunk road – thus potentially most of these overlapping with records received also through the regional trunk operating company. For non-trunk roads, SSPCA have over recent years on average provided records for a sample of around 60 incidents per year for Aberdeenshire (incl. Aberdeen City), the majority of which maybe expected to lead also to subsequent calls for councils to remove the carcass for those live-injured deer that are humanely dispatched by SSPCA.

4.5.10. The fact that local authority records are available in some areas but not others, makes it difficult to make more than just localised use of these records (to add to others for that particular area), even though the time and resources required to gather, map and collate these records (given often very limited detail) is often rather greater than required for the more consistent and countrywide samples of records obtainable via trunk companies, SSPCA and official RTC databases. Therefore lesser emphasis has been placed on further collation and analysis of council uplift records during this study. The 700 or so UT records obtained have nevertheless been archived for the time being, so that they may be used and grid references allocated if required for local assessments in specific areas in future.

4.6. DVC Priority site deer carcass searches and comparison with other data

- 4.6.1. One other substantial data-set that is helping to provide an insight to the minimum likely level of under-recording of DVCs via our countrywide samples, is the Priority Site Deer Carcass Search Survey set up in 2003 by the Deer Commission for Scotland, which has also continued since via SNH through until 2010/11. This work is organised independently from the present project, but records from it have been made available here to allow comparisons to be drawn between the two studies.
- 4.6.2. In brief - three main DVC 'Priority sites' were identified by Deer Commission for Scotland in 2003 within Highland Region, along a number of sections of trunk roads known to have had particularly high rates of deer accidents in past years.
- A835 Garve - Ullapool (50 km)
 - A82 Bridge of Orchy – Glencoe (42 km)
 - A87/A887 Shiel Bridge – Loch Ness and Inverlaggan (68 km)
- 4.6.3. Commencing in May 2003, a programme of monthly road verge carcass searches was organised at each route by the former DCS (SNH) for eight consecutive months between October to May each year; with the aim of helping to identify DVC hotspots more precisely and to ascertain additional numbers of deer casualties that are not recorded through other means. One separate local person was contracted to assess each route monthly, to grid reference and mark or remove any deer carcasses or skeletal remains found to avoid re-recording at subsequent searches. A note was made also to give an estimate of the state of decomposition / days since death of each carcass (e.g. as fresh / < 3 days / <1 week / < 2weeks / < 4 weeks / older). As the searches only span 8 months of the year, this helps in particular with identification of what proportion of carcasses noted during October surveys (usually undertaken towards the end of the month), may have resulted from accidents in earlier months between June-September.
- 4.6.4. Results of these carcass searches are now available for part of 2003 and for 7 full subsequent years, and extend to records on over 700 separate road-kill deer across the three above routes. The number of different deer carcasses recorded each year along each priority site by these SNH roadside searches is shown in Table [7]. Also shown in each case are the separate numbers of 'dead deer on road' reports provided to the present and previous countrywide DVC monitoring projects for these same road sections obtained through the trunk route operating companies that are responsible for day to day management of trunk roads within NW Scotland Unit (formerly BEAR Scotland; then Scotland Transerv as from April 2006). These include clearance from live carriageways of dead animals and other debris that may cause a hazard to traffic.
- 4.6.5. In September 2008, several years after commencement of the carcass searches, a number of Vehicle Activated Deer Warning signs were installed by Transport for Scotland along each of the three DVC priority sites. The availability of consistent DVC monitoring records before and after their installation at each of these sites also enables assessment of the effectiveness of that signage, which will be discussed further in section 4.6.12. below.

Table 7: Comparison of i) numbers of deer uplift request or other DVC logs received annually from records provided by Trunk road operation companies for specific DVC-Priority road sections, and ii) numbers of carcasses found during dedicated monthly searches for remains of deer carcasses. (Surveys for carcasses commenced in May 2003, with hence records for only 4 rather than 8 months available that year).

A835 Garve - Ullapool (32 miles)	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2008-10
i. Incidents logged by Trunk Agents over full year	1	9	17	9	11	15	12	17	14.7
ii. No. of carcasses found by SNH surveys over 8mth	6	13	33	22	22	17	24	22	21.0
iii. Minimum number NOT logged in trunk agent records	5	4	16	13	11	2	12	5	6.3
iv. Likely additional numbers missed Jun-Sept. (see text)	1.3	1.0	4.0	3.3	2.8	0.5	3.0	1.3	1.6
v. Maximum % of all incidents captured by Trunk agent sample	17%	69%	52%	41%	50%	88%	50%	77%	72%
vi. Likely % of incidents captured adjusted for carcasses missed June to September.	14%	64%	46%	36%	44%	86%	44%	73%	68%

A82 Bridge of Orchy – Glencoe (24 miles)	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2008-10
i. Incidents logged by Trunk Agents over full year	7	8	10	3	6	6	8	15	9.7
ii. No. of carcasses found by SNH surveys over 8mth	18	27	33	22	47	32	13	6	17.0
iii. Minimum number NOT logged in trunk agent records	11	19	23	19	41	26	5	0	10.3
iv. Likely additional numbers missed Jun-Sept.	2.8	4.8	5.8	4.8	10.3	6.5	1.3	0.0	2.6
v. Maximum % of all incidents captured by Trunk agent sample	39%	30%	30%	14%	13%	19%	62%	100%	60%
vi. Likely % of incidents captured adjusted for carcasses missed June to September.	34%	25%	26%	11%	10%	16%	56%	100%	57%

A87 Shiel Bridge-Invergarry & A887 Bun Loyne -Loch Ness (50 miles)	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2008-10
i. Incidents logged by Trunk Agents over full year	2	4	5	2	5	7	8	5	6.7
ii. No. of carcasses found by SNH surveys over 8mth	3	19	35	25	29	36	18	27	27.0
iii. Minimum number NOT logged in trunk agent records	1	15	30	23	24	29	10	22	20.3
iv. Likely additional numbers missed Jun-Sept.	0.3	3.8	7.5	5.8	6.0	7.3	2.5	5.5	5.1
v. Maximum % of all incidents captured by Trunk agent sample	67%	21%	14%	8%	17%	19%	44%	19%	27%
vi. Likely % of incidents captured adjusted for carcasses missed June to September.	62%	18%	12%	7%	14%	16%	39%	15%	24%

Extent of likely under-recording of DVCs based on trunk agent records alone

- 4.6.6. At least a proportion of those dead deer reported to the operating companies will be removed and taken away for incineration each year, and as such would represent additional carcasses to those remaining available to be found by the monthly carcass searches along the verges. However, the proportion of deer casualties which are actually uplifted and cleared from the site by road maintenance crews rather than just being pulled some way off the road to avoid them being a hazard to traffic is unknown. Nevertheless, comparison of the numbers of carcasses found during the dedicated surveys with numbers of reports received from the trunk operating company (TO), enables estimation of the **maximum** proportion of all deer casualties likely to be represented by the reports contributed to the project annually by the TO.
- 4.6.7. It is evident from the figures in Table [7] that throughout the great majority of years on each of the three roads, the carcass surveys determined a significant additional number of road killed deer over and above the number identified from reports from operation companies (see row iii. in each sub-table). That is, despite the fact that the carcass searches only spanned 8 different months each year rather than twelve; and that some deer reported to OCs will have been uplifted and removed from the area.
- 4.6.8. The maximum percentage of all DVCs represented by the Trunk agent sample, maybe therefore be calculated simply based as a proportion of the total numbers of actual carcasses found during searches (see row 'v.' in each table). In addition, as carcass searches did not cover June to September, an adjustment may be calculated by estimating the number of additional carcasses that would be likely to have been found if searches covered all twelve months. [On average for the three road sections combined (2003 – 2010 data) 27.5% of all DVCs records provided by the operating company occurred during the 4 months June – September. Review of the records from all SNH carcass searches undertaken during October, showed that only a very small proportion of carcasses (< 3%) were judged to have been killed 1 or more month prior to re-start of surveys usually during late October. It would therefore seem a safe assumption that additional carcasses likely to have been missed over the summer period would amount to around 25% of the number found during Jan-May and Oct-Dec. each year; [see Table 7rows iv.].
- 4.6.9. On the basis of the above comparisons, the maximum percentage of all deer casualties captured in reports from operating companies for the full years for which data are available prior to the present study between (2004-2007) averaged 53% in case of the A835 (Garve to Ullapool), and just 22% and 15% for the A82 and A87 and A877 priority sites respectively. Making an adjustment as outlined above for the fact that carcass searches did not cover June to September each year, reduces these average figures to just 48%, 18% and 13%. However, over the most recent 3 years since re-start of our monitoring project in 2008, the percentage made up by reports via operating companies appears to have improved significantly in case of all three routes: with comparable average percentages for between 2008-2010 rising, for the A835 to 72% (68% adjusted), for A82 to 60% (57% adj.) and for A87_A877 to 27% (24% adj.).
- 4.6.10. The somewhat higher percentages captured through reports abstracted for us by the operating companies in recent years are likely to be due in part through improved record keeping (including in particular better location

details and many more now being grid references at source allowing them to be more reliably allocated to particular road sections). This is reflected also in actual numbers of reports received from OCs showing an increased over the last three years for all three routes, while numbers of carcasses found during SNH searches have remained relatively stable or else decreased over the last three years (possibly also due to a higher proportion of deer being uplifted and removed from the area by the OCs). Nevertheless, taken across all three routes combined, we may conclude that trunk agent reports even over the last 3 years are unlikely to represent more than 50% of all deer casualties along trunk roads in the Highlands.

- 4.6.11. Possibly most surprising is the continuing variation in levels of under-recording between the three routes (see Table 7), and the particularly low numbers of trunk agent reports for the A87 and A887 despite very high (fourfold) numbers of carcasses revealed through carcass searches. It may be surmised that such differences arise through differing practices between routes with regard to removing deer carcasses entirely from the area or local feasibility of moving animal carcasses some distance away from the verge where they are out of sight and can decay naturally without presenting a traffic hazard.

Before and after comparisons in relation to installation of VA Signs

- 4.6.12. Following the acceptance of Reports on Deer Mitigation Proposals on the A82, A87 and A835 compiled as a result of the deliberations of the Deer Panels set up under Section 4 of the Deer (Scotland) Act 1996, Transport Scotland instructed the installation of Vehicle Activated Deer Warning Signs at eight sites on the network. Four of the sites are on the A82 through Glencoe, two on the A87 between Cluanie Inn and Shielbridge and two on the A835 between Aultguish and Braemore Junction (see Figures 11a to 11c). A report produced by Scotland Transerv (2010) provides fuller background and details to these installations and an initial evaluation of their effectiveness. In brief, their findings showed a reduction in traffic speed after a vehicle has passed a VA Sign at all the trial sites with the exception of one site on the A82 south of Kingshouse.
- 4.6.13. In addition initial comparisons by Scotland Transerv (2010) of data provided by SNH from their deer carcass searches (available at the time only up to Nov. 2009) already indicated a significant reduction in deer carcasses recorded on both the A82 and A87 since the installation of the VA Signs, but without similar reductions apparent in case of the A835. The additional SNH deer carcass survey data collated since (Table 8) now allows extension of the before and after comparisons to two full study years. This further confirms a significant reduction by over 50% in deer carcasses noted along the A82 and A87_A887 priority site, but still no reduction in case of the A835. These changes in frequency and also distribution of deer carcasses found before and after the VA deer warning signs were installed are illustrated in Figures 11a – 11c (Appendix I).

Table 8 : Numbers of deer carcasses found per month by SNH contractors at DVC priority roads during 2 years Before and After September 2008 when Vehicle Activated Signs were installed. [note – dedicated carcasses searches were restricted to October through to May each year]

BEFORE (Oct.2006 to May2008)					AFTER (Oct.2008 to May2010)				
Month	Year	A87_A887	A82	A835	Month	Year	A87_A887	A82	A835
Oct	2006	7	7	4	Oct	2008	0	6	3
Nov	2006	4	3	5	Nov	2008	1	2	2
Dec	2006	8	0	7	Dec	2008	3	2	2
Jan	2007	6	2	6	Jan	2009	1	0	1
Feb	2007	2	5	2	Feb	2009	3	0	6
Mar	2007	6	6	2	Mar	2009	0	1	1
Apr	2007	3	7	2	Apr	2009	0	3	2
May	2007	2	2	1	May	2009	0	2	2
Oct	2007	3	9	5	Oct	2009	2	0	7
Nov	2007	4	6	2	Nov	2009	7	7	3
Dec	2007	3	10	2	Dec	2009	2	0	2
Jan	2008	6	7	5	Jan	2010	1	0	8
Feb	2008	4	0	4	Feb	2010	3	0	3
Mar	2008	18	9	0	Mar	2010	5	0	3
Apr	2008	4	3	1	Apr	2010	5	0	1
May	2008	0	3	0	May	2010	4	0	5
Total		80	79	48	Total		37	23	51

[For extent of priority site roads sections covered by deer carcass surveys see Table 7]

Comparison of hotspots determined through carcass searches and OC records

4.6.14. From the findings described earlier (and see Table 7), it seems unlikely that total numbers of records obtained annually via trunk road agents make up more than 50% of all the DVCs that occur on trunk roads in Highland Region. Nevertheless, as shown by the annual numbers summarised in Table 7, trunk agent records received do also still provide substantial size samples of incidents for each of the priority sites, and that the records retrievable in this way have become more comprehensive in recent years. When taken cumulatively over a number of years, these data also highlight approximately the same hotspots along each route as revealed by the more intensive (and more precisely recorded) dedicated carcass searches. Sample comparisons of the frequency and relative distribution of incidents per 5km section reported since 2007 to 2010 by the trunk agents and those recorded during the monthly SNH carcass surveys for the same years are shown in Figures 12a & b (Appendix I).

4.6.15. In summary, deer casualties logged as such by trunk route operating companies during the last three years have on average recorded 30% to 70% fewer incidents than the number recorded during the dedicated carcass searches undertaken by SNH on the three priority site roads. Nevertheless, cumulative data accrued from Trunk OCs over a number of years do produce broadly comparable results in terms of identification of main deer strike hotspots, and provide a less labour intensive for long-term monitoring of changes in frequency of DVCs throughout the trunk network.

5. Monitoring change of national and seasonal patterns in DVC occurrence

5.1. Stratification and data limitations

- 5.1.1. During the initial 2003 to 2005 project to develop a countrywide database of DVCs for Scotland a significant weakness was the inconsistent availability of data of comparable quality for different regions, and lack of well stratified data sets of substantial size able to provide even, countrywide coverage. As a consequence it has often been difficult in the past to separate out actual differences in abundance of DVCs between local authority areas or other subdivisions, from the effects of DVCs being recorded more commonly and in a more readily retrievable manner in some areas than others. For example, while only around a third of all Scottish local authority roads departments were able to provide any records including dates and locations of deer uplifted from roads, some others contributed several hundred such records each year. Similarly for the national trunk road network, which is not under local authority control, records on animal road kill were available consistently for some management units but with almost no records accessible in others. However, even from such quite limited truly nationwide datasets as were available then (e.g. through one insurance company and the SSPCA contributing just 50 and 150 records a year at the time) it was known that at least some DVCs do occur in almost every part of the Scottish mainland.
- 5.1.2. The primary objective of the present 'DVC Scotland 2008-11 Monitoring Project' has been to build and maintain a database that enables monitoring of long-term change in DVC occurrence between and within regions and for specific roads. Increased emphasis has therefore been placed on enhanced collection and quality of DVC records from those sources that on their own, or in combination with others, can provide stratified samples of DVCs giving widest possible national coverage but minimal avoidable recording bias; and likely to be obtainable in a replicable manner in future years.
- 5.1.3. One recommendation arising from the 2003-2005 (Langbein & Putman, 2006) was that any future monitoring of DVCs particularly in Scotland should ensure that comparable standardised information is obtained for the entire Scottish Trunk road network. This diverse network (Figure 2) makes up 3250 km of motorways and A roads of strategic importance to connect Scotland's cities, rural communities and the ports that serve the islands, ranges from ten-lane motorways in the centre of Glasgow, to some single carriageways in the West Highlands. Although it represents only just over 6% of the total Scottish road network it carries 37% of all traffic and 62% of heavy goods vehicles.
- 5.1.4. From results discussed in earlier sections (see 4.4.8) it is likely also that around 1/3rd or more of the national toll of DVCs in Scotland occurs on trunk roads. In terms of monitoring DVCs the network is therefore not only of importance in its own right, but also from view of its potential to offer very widespread sampling of a large proportion of all DVCs that occur annually. As outlined in detail earlier (see 4.1) much more comprehensive and standardised samples of records (mainly of requests received by trunk operating companies to remove dead deer from carriageways) from across all network management units have been gathered and collated during the present project, and now present one of key data sets available for monitoring national changes.
- 5.1.5. Although as discussed in 5.3 above, the trunk network in case of Scotland provides for wide geographic sampling on quite diverse road types, it cannot provide direct information on the incidence of DVCs on non-trunk A-roads, B-

roads and other minor roads. Obtaining comparable input of DVC records from across all or even the majority of the 30 or more Scottish Regional council and other local authority roads departments has not proved possible to achieve even for a single data year so far; and in view of reliance on voluntary abstraction of data by each council would be highly unlikely to be possible to maintain in comparable manner year on year to enable changes in DVCs to be monitored accurately, without far greater allocation of resources than available for this project.

- 5.1.6. The best alternative dataset from a single source that is available to sample DVCs countrywide across all road types is offered by records maintained by the SSPCA. Their national database of all animal welfare related calls received included frequent records of incidents where SSPCA are asked to help deal with live deer injured in traffic accidents (which their inspectors may attend themselves or pass on to other suitably qualified vets or other contacts). Such data were also available to the previous study for two years (2004/5) but at that time extended to fewer than 175 usable records a year countrywide. During the present project the size of this sample, has increased considerably, with close to 1000 records now available for the last 3 years (2008-10), as well as 450 further incidents collated and added to the database for 2006&7 while the monitoring study was paused.
- 5.1.7. These SSPCA records of calls to live deer road casualties now represent an extensive national sample of incidents occurring on minor as well as more major roads. Around 82% of those mapped for since 2006 relate to non-trunk roads, and thus provide very useful sample that is complementary to our other major countrywide sample available for main roads only through the trunk road operating companies. A possible (assumed) drawback of SSPCA records is that involvement or calls for SSPCA to assist may be somewhat more likely in less rural more heavily populated areas, whereas injured deer in more rural locations may be less likely to be reported at all or else reported to local forestry or estate wildlife rangers. However, maps of the actual distribution of SSPCA DVC calls (see Appendix I - Figures 13 a&b; and Table 9) show that samples of SSPCA incidents are now available in every mainland local authority region of Scotland.
- 5.1.8. In the parallel study in England (Langbein, 2011b, in prep.) it has been found that in most areas where the RSPCA are not the primary organisation called to attend live injured deer on the road, the next most common tend to be Forestry Commission rangers, except in a few large community forests managed by local authorities or the National Trust; and hence combination of the two data sources may provide an improved reflection of DVC distribution overall. In the present study records of DVCs obtained from FC rangers (c. 60 per year) have a fairly localised distribution compared to those from SSPCA (>300 per year), reflecting main concentrations of FC woodland in Scotland (see Figure 6). Both these data sets tend to relate foremost to live injured deer and hence complement rather than duplicate one another; and by contrast to SSPCA, records from FC are more common in more remote rural areas where the SSPCA may tend relatively to undersample DVC distribution on their own. As FC records are also available to us for most of the recent data years, be it in quite low numbers, these have therefore been included within the SSPCA records (see SSPCA+, Table9) as our second main base data set for monitoring differences between years and regions.

5.2. Numbers of DVC from principal data sources available by council area

5.2.1. Table 9 presents collated total numbers of DVC records from the best stratified countrywide datasets discussed above (UT and SSPCA+). The breakdown is shown here broken down among a) the 29 different Local Authority Regions on the Scottish mainland and b) the main study periods of the previous (2003-2005) and present (2008-10) three year projects.

5.2.2. In the first instance Table 9 illustrates the very wide sampling of DVCs throughout Scotland offered by the 'SSPCA+' data. Over the duration of the 2003-2005 study these already provided at least some small numbers of records in all but one mainland council area. Following the substantial increase in annual volume of SSPCA records received during the 2008-2011 project, these now regularly include samples of DVC for all 29 of the mainland council areas, including those covering the smallest areas such as Clackmannanshire and Inverclyde.

Table 9 : Numbers of DVCs incidents recorded per Scottish Council area by the best stratified countrywide data samples available (Trunk Operating Companies and SSPCA+ ; see text 5section .6) during the present and previous study period.

Number of DVCs:	2003-5				2008-10			
	Trunk OC	SSPCA+	Total	Rank	Trunk OC	SSPCA+	Total	Rank
REGIONAL / CITY COUNCIL								
HIGHLAND	142	140	282	1	339	120	459	1
PERTH_AND_KINROSS	107	53	160	2	234	112	346	2
DUMFRIES_AND_GALLOWAY	16	40	56	7	162	41	203	3
STIRLING	65	39	104	4	154	39	193	4
ARGYLL_AND_BUTE	96	49	145	3	130	46	176	5
ABERDEENSHIRE	6	52	58	6	45	126	171	6
GLASGOW_CITY	1	13	14	18	119	40	159	7
FIFE	44	26	70	5	54	74	128	8
NORTH_LANARKSHIRE	20	26	46	9	61	57	118	9
SOUTH_LANARKSHIRE	5	3	8	21	76	15	91	10
SCOTTISH_BORDERS	17	15	32	13	52	34	86	11
FALKIRK	43	5	48	8	63	19	82	12
EAST_LOTHIAN	25	9	34	12	44	23	67	13
RENFREWSHIRE	3	4	7	23	46	17	63	14
MORAY	9	30	39	10	15	40	55	15
ANGUS	24	13	37	11	31	23	54	16
ABERDEEN_CITY	1	14	15	17	4	49	53	17
MIDLOTHIAN	14	5	19	16	19	29	48	18
EAST_DUNBARTONSHIRE	0	12	12	19	0	41	41	19
WEST_LOTHIAN	21	10	31	14	18	23	41	20
SOUTH_AYRSHIRE	0	3	3	25	25	9	34	21
NORTH_AYRSHIRE	4	5	9	20	24	9	33	22
CITY_OF_EDINBURGH	14	8	22	15	15	16	31	23
WEST_DUNBARTONSHIRE	2	6	8	22	25	5	30	24
EAST_RENFREWSHIRE	0	0	0	29	14	5	19	25
EAST_AYRSHIRE	0	2	2	27	13	5	18	26
INVERCLYDE	1	3	4	24	12	4	16	27
DUNDEE_CITY	2	1	3	26	5	6	11	28
CLACKMANNANSHIRE	0	1	1	28	0	5	5	29
Grand Total	682	587	1269		1799	1032	2831	

- 5.2.3. In case of deer road kill records obtained through trunk operating companies, during the 2003-2005 study no such records were available for five council areas, while numbers for a further 10 council regions were only in single figures across those three years combined - a reflection mainly of the incomplete availability of records across all trunk management areas at the time. However, Table 9 shows that national coverage through the trunk OCs has now been improved greatly, with the only two council areas for which no Trunk OC DVC records are available in the 2008-10 study being those devoid of any trunk roads (Clackmannanshire and East Dunbartonshire); while the only two others where fewer than 10 trunk OC DVCs have been logged over the recent study each contain less than a 30km length of trunk roads within the council boundaries (Aberdeen City and Dundee City).
- 5.2.4. Unsurprisingly, those six council regions with the greatest overall share of the annual sample of DVCs (Highland, Perth&Kinross, Argyll&Bute, Dumfries & Galloway, Stirling and Aberdeenshire), are amongst the ten councils of greatest overall area, and also (with exception of Stirling) among the top council according to total road length (see Table 10). Interestingly, however if rather than ranking councils according to the total number of DVCs in our sample, but instead by the number of DVCs in relation to total traffic flow (i.e. DVC total divided by million vehicle kilometres – based on TfS 2008 traffic flow figures), then Argyll & Bute, Highland, Stirling, Perth&Kinross and Dumfries and Galloway also remain ranked as the five councils with highest DVC rates per driven kilometre (Table 10). In other words, these relatively large councils have high shares of DVCs not merely due to their overall larger size and total road length, but also an actually higher risk of collisions with deer per driven mile.
- 5.2.5. From view of monitoring future changes, a key finding here is that our two principal data sets discussed above do now provide a good level of sampling right across all of mainland Scotland. Whilst data coverage through these sources was less complete during the earlier 2003-2005 study, having from start of the present study established much more complete and even recording across all areas, maintenance of these principal data sets in the same manner for future years should enable long-term changes in DVC occurrence to be more readily monitored at the landscape or regional scale, with relatively modest resources.
- 5.2.6. Focussing countrywide monitoring primarily on the above two main data sets, which are less prone to overemphasis of some areas over others due to recording bias, should also suffice for initial identification of existing and new localised DVC hotspots as they arise. It is suggested that, if and when the countrywide monitoring highlights a significant increase in DVCs for a council area as a whole or concern about DVCs for specific roads within it, that should be the time to trigger collation of additional data for that council or other region. In the first instance this could draw on closer review of any such past archived records available from other data sources as may already be available in the DVC Scotland database, followed by one-off approaches to local authority roads departments, police control room logs, local rangers and Wildlife Trusts. Whilst obtaining records from such local sources consistently year-on year for our national monitoring study has not been feasible, greater support would seem probable for such local one-off requests where a local DVC issue has been identified and extra information is required to evaluate need for and possible options for mitigation.

Table 10 : Local authorities and their rank according to the number of DVCs recorded between 2008 – 2010 by Trunk OCs and SSPCA, and when ranked on various other road variables.

Local Authority (Unitary City Councils in bold)	Trunk OC plus SSPCA+ DVCs		Traffic flow million veh. km		Road length km		DVC tot divided by Traffic flow		DVC total divided by Road length	
	Total	Rank	Total	Rk	Total	Rk	Total	Rank	Total	Rank
HIGHLAND	459	1	2,623	6	7,664	1	0.175	2	0.060	12
PERTH & KINROSS	346	2	2,292	8	2,693	5	0.151	4	0.128	2
DUMFRIES & GALLOWAY	203	3	1,998	9	4,493	3	0.102	5	0.045	15
STIRLING	193	4	1,234	14	1,146	16	0.156	3	0.168	1
ARGYLL & BUTE	176	5	900	19	2,590	6	0.196	1	0.068	11
ABERDEENSHIRE	171	6	2,762	5	5,585	2	0.062	11	0.031	21
GLASGOW CITY	159	7	3,485	1	2,290	9	0.046	15	0.069	9
FIFE	128	8	2,894	4	2,512	7	0.044	17	0.051	14
NORTH LANARKSHIRE	118	9	3,025	2	1,612	12	0.039	20	0.073	6
SOUTH LANARKSHIRE	91	10	2,491	7	2,400	8	0.037	21	0.038	19
SCOTTISH BORDERS	86	11	1,198	15	3,106	4	0.072	10	0.028	24
FALKIRK	82	12	1,505	11	970	20	0.054	12	0.085	3
EAST LOTHIAN	67	13	862	21	980	19	0.078	6	0.068	10
RENFREWSHIRE	63	14	1,382	12	869	22	0.046	16	0.072	7
MORAY	55	15	729	24	1,631	11	0.075	7	0.034	20
ANGUS	54	16	1,086	16	1,834	10	0.050	13	0.029	23
ABERDEEN CITY	53	17	1,329	13	937	21	0.040	19	0.057	13
MIDLOTHIAN	48	18	661	25	682	23	0.073	9	0.070	8
EAST DUNBARTONSHIRE	41	19	547	27	505	25	0.075	8	0.081	5
WEST LOTHIAN	41	20	1,747	10	1,040	18	0.023	25	0.039	17
SOUTH_AYRSHIRE	34	21	983	18	1,246	14	0.035	22	0.027	25
NORTH AYRSHIRE	33	22	782	22	1,084	17	0.042	18	0.030	22
CITY OF EDINBURGH	31	23	2,978	3	1,467	13	0.010	29	0.021	26
WEST DUNBARTONSHIRE	30	24	646	26	360	28	0.046	14	0.083	4
EAST RENFREWSHIRE	19	25	749	23	490	26	0.025	24	0.039	18
EAST AYRSHIRE	18	26	1,037	17	1,197	15	0.017	26	0.015	29
INVERCLYDE	16	27	533	28	388	27	0.030	23	0.041	16
DUNDEE CITY	11	28	885	20	570	24	0.012	28	0.019	27
CLACKMANNANSHIRE	5	29	331	29	282	29	0.015	27	0.018	28
Total	2831		43674		52623		0.065		0.054	

5.3. Comparative seasonal patterns of DVCs by Road type and Region

- 5.3.1. From previous studies on DVCs (Staines et al. 2001; Langbein, 1985, Langbein & Putman, 2006; Langbein et al. 2011) it is well known that although deer accidents may occur throughout the year, a prominent peak in accidents commonly occurs around May and in some areas a secondary peak during late autumn. The spring peak may be associated with dispersal of young deer born the previous year (in particular in case of roe deer; Langbein et al. 2011) leaving their natal ranges around that time, as well as females with young at heel generally more prone to being hit by vehicles. This pattern of DVCs can also be attributed to the fact that deer will cross many minor roads fairly commonly throughout the year, in some cases even on a daily basis during foraging for food (Langbein, 1985; 2007b).
- 5.3.2. Recent initiatives (including by Transport for Scotland and SNH) to raise driver awareness of DVCs through publicity campaigns and digital Variable Message Signs (VMS) have focussed on in particular the spring peaks to forewarn drivers of the heightened risk of collisions with deer at this time. With the much more extensive information on DVCs accumulated during the present study not only overall but also on differing road types, it is appropriate to review the seasonal pattern emerging in further detail.
- 5.3.3. The percentage distribution of DVCs occurring throughout Scotland in different months of the year is shown in Figure [8], based on all those records available in the database for 2001-2010 for which the road type as well as month is known. The graph is broken down to enable comparative examination of the seasonal pattern for Trunk roads (divided into Motorways and A-class trunk roads) and Non-trunk roads (divided into A-class local authority roads and other more Minor non-trunk roads [B-road and smaller]).
- 5.3.4. This reconfirms a peak in DVCs overall during May & June on all road types. However – it demonstrates particularly clearly that in Scotland this peak is most pronounced by far for motorways and A-class trunk roads. In case of motorways close to 60% (n > 1000) of incidents are recorded during May & June, while for A-class trunk roads this falls to 35%. In case of other A-roads and all smaller roads a regular annual peak is still apparent but here makes up only 25%. The importance of this finding, from view of minimising risk of deer incidents on the Scottish trunk road network, is that it re-affirms that a high proportion of deer collisions may potentially be addressed through seasonally targeted mitigation such as VMS signage focussed mostly on May to June alone. On the other hand, similar seasonally restricted mitigation for non-trunk roads is less likely to be as (cost) effective in general.
- 5.3.5. The Scottish Trunk Road network, as discussed in earlier sections, is divided into four major management units (NW / NE / SE / SW), which contain quite different proportions not only of motorways but also of dual and single A-class trunk roads. Northwest unit, which covers mainly Highland Region and Argyll & Bute, in particular contains no motorways at all and has high proportion of single rather than dual carriageways.

Figure 8: Seasonal pattern of DVCs in Scotland on trunk roads (motorways plus strategic A-roads) and non-trunk roads (other A-class roads and Minor roads).

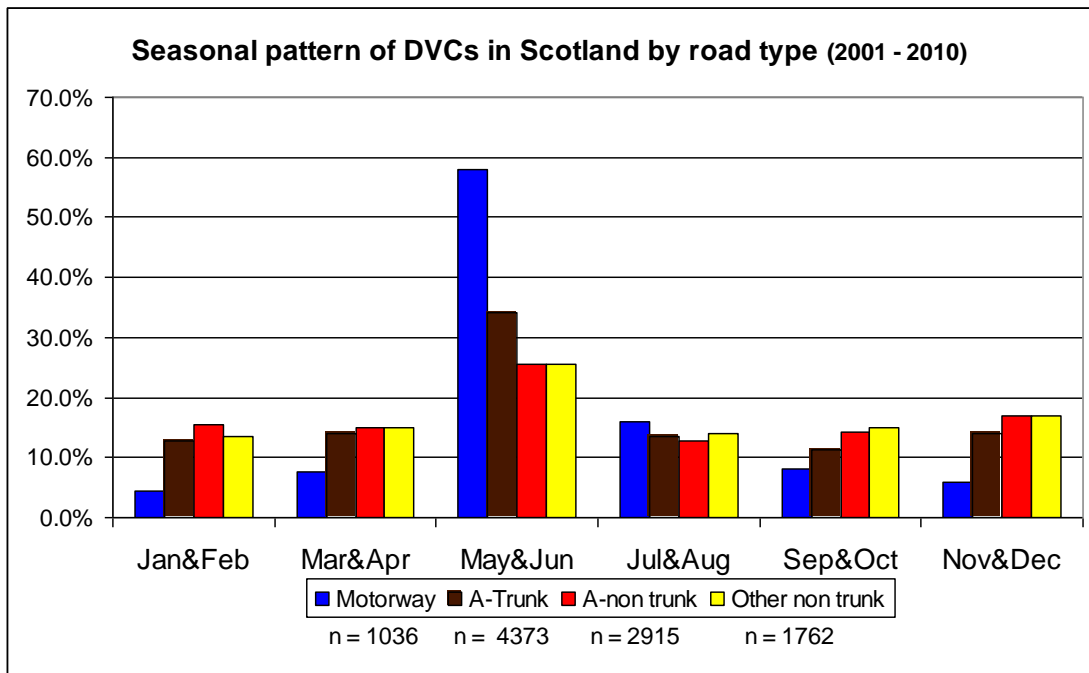
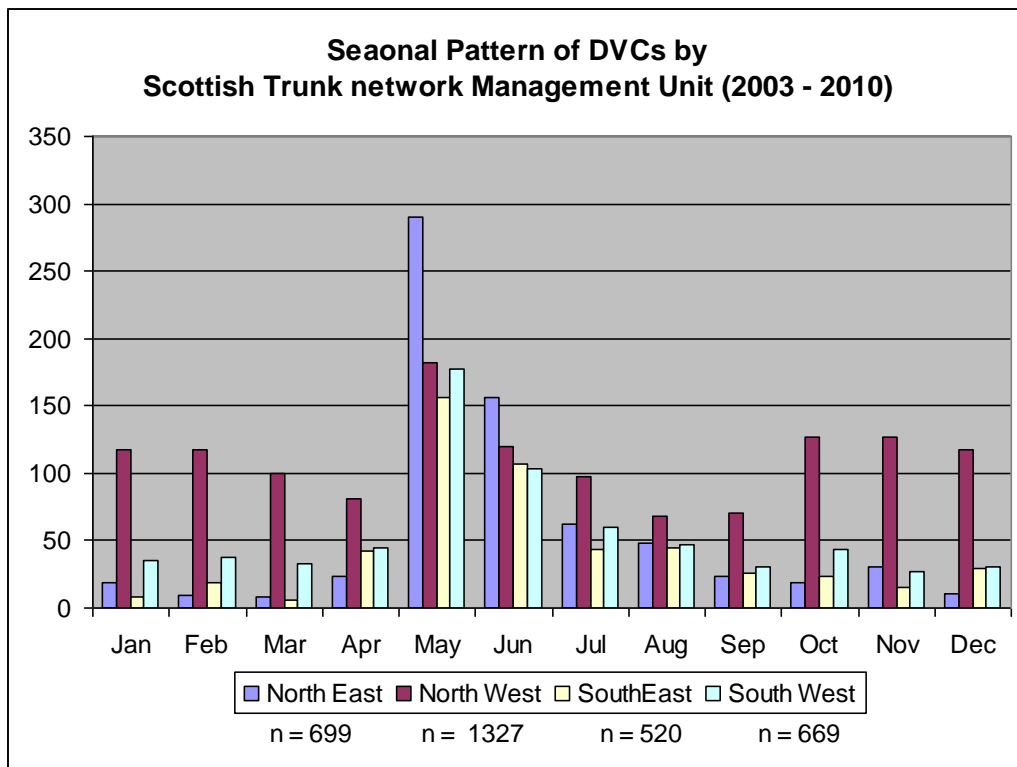


Figure [9] : Seasonal patterns of DVCs on trunk roads in the four different TfS Trunk Network Management Units.



- 5.3.6. Figure [9] provides a comparison of the seasonal pattern of DVCs recorded on trunk roads in the four management units. With exception of NW unit, all three other trunk units reflect the same pattern as also illustrated in Figure [8]; with a pre-dominant peak during May followed by June contributing from 42% to 64% for these two months combined. For Northwest Unit, while May is still the month when highest numbers of DVCs are recorded. May+June make up only 23% of the annual toll here, whereas a secondary peak begins in October and continues through into February.
- 5.3.7. The rather wider spread of incidents in NW is likely to relate to the higher proportions of red deer (and sika and fallow) present in NW unit, as these larger species become much more mobile and cross more roads while moving from summer ranges to autumn mating areas and back. In addition, in the Scottish Highlands many deer herds will move to lower lying ranges during the winter months, often bringing them into increased contact with major roads. This again has important implications for any seasonally targeted measures, such as VMS and other driver awareness campaigns. In case of the NW Scotland in particular these should aim to encompass not only the spring accident peak, but extend also through late autumn into winter in order to maximise their effectiveness.

6. Summary and Conclusions

- 6.1. The primary objective of the present 'DVC Scotland 2008-11 Monitoring Project' commenced in May 2008 has been to re-establish the DVC database built up during 2003 to 2005, to include as far as possible also information for the intervening years when data collection was paused. The main function of the database is envisaged to enable monitoring of long-term changes in DVC occurrence countrywide, as well as between and within regions and for specific roads.
- 6.2. Over 6500 new records (for 2006-2010) have been added to the DVC Scotland database during the present project. This is an overall larger sample of records than was gathered during the initial study (6055) ending in 2005 (for 2001-2005), despite new data collection having been focussed on a more restricted set of the most consistent data source organisations. Overall the *DVC Scotland Database* now includes over 12,500 DVC records for incidents during the ten years 2001 to 2010. For over 83% (10350) grid references have been possible to allocate for mapping and GIS analysis (Table 2).
- 6.3. In the original 2003 to 2005 study a significant weakness was inconsistent availability of data of comparable quality for different areas, and lack of well stratified data sets of substantial size that could provide even, countrywide coverage. As a consequence it was difficult to separate out actual differences in abundance of DVCs between areas from the effects of DVCs being recorded more commonly or in a more readily retrievable manner in some areas than others. In the present study increased emphasis has therefore been placed on improving collection and quality of DVC records from those sources that on their own, or in combination with others, can provide the best stratified samples of DVCs countrywide with minimal avoidable recording bias; rather than on collection of all possible DVC records obtainable.

Principal data sets: Trunk OC uplifts, and injured deer call-outs to SSPCA+ FC

- 6.4. The most significant improvements in data coverage and volume have been achieved for
- deer road casualties reports and carcass uplifts handled by the four main trunk road operating companies and two DBFOs responsible for day to day maintenance of the Scottish trunk road network, and
 - information on incidents involving live deer injured in traffic collisions handled by SSPCA, supplemented by similar call-outs attended by Forestry Commission rangers and some others involved regularly with humane dispatch of live deer road casualties.

Taken together the above two datasets provide the principal datasets now available in a comparable, replicable level of sampling across all regional and city council areas of the Scottish mainland, and as such are likely to be the most valuable in terms of assessing national and regional changes in future.

- 6.5. While good records from trunk road operating companies were available for some regions during the previous study, few or none had been available for others. During the present study much fuller coverage of comparable DVC records has been possible to achieve, with equivalent information now available for most of the trunk regions from 2007 through to end 2010; the one exception being SE where full coverage is available from Spring 2008. Total numbers of DVC records obtained from trunk operating companies during the 2003 to 2005 study ranged from 188 to 322 per year. The much more comprehensive trunk network-wide data accrued during 2008-2010 through this data source category alone has more than doubled to between 534 and 723 records per year.

6.6. Records extracted annually from information provided by the SSPCA have also more than doubled, from the 175 or fewer available per year pre 2006, rising to 295 to 349 per year since 2008. Importantly, assessment of the distribution of the much increased numbers of SSPCA deer road casualty call-outs shows that these now provide annual samples of DVC for every local authority region on the Scottish mainland; making them a valuable resource for monitoring changes. It is expected that some degree of potential bias in frequency of recording towards more populated areas may be associated with SSPCA incidents, as their members of the public may be more likely to notice, and if so, call SSPCA rather than a local estate game keeper or other person for assistance. However, as shown in Figure 13 (Appendix I), SSPCA records do provide samples of DVCs throughout mainland Scotland, and potentially lesser input in more rural areas is redressed to some extent by further records of attendance to deal with similar injured road casualty deer handled by Forestry Commission often in more remote rural locations.

6.7. Although in case of DVC records from trunk road operating companies a large part of the increase in records noted may in part be due to better recording / abstraction of data for some areas not well covered previously, the significant increase also in SSPCA records (for which no major change in recording has occurred) provides some confidence that the trends shown (see Figure 1) do reflect some real underlying increase in DVCs since 2005 for Scotland as a whole. The changes also appear to have been sustained since 2008, from when on most even recording has been achieved.

6.8. Improved mapping and greater use of available records within a GIS has enabled more ready assessment of changes in numbers of incidents available for any given route or area over set time periods. In case of trunk roads, review of data for 23 routes major routes for which relatively high numbers of incidents were also reported previously (highlighted in the 2009 interim report), in case of 18 of these the highest annual toll of DVCs has been recorded during one of the last two study years. In some areas improvements in recording and abstraction may have contributed to part of the increase, but for 9 of the road sections concerned average annual frequency of incidents recorded for 2008-2010 are seen to have in fact more than doubled (Table 4). While these include several routes with a long known history of high DVC occurrence, the greatest proportional changes since 2008 highlight a number of other road sections of increased concern over recent years, including

- several further sections of the A9 – including Dornoch to Helmsdale, Kingraig to Inverness, and Dunblane to Perth;
- the A85 from Methven to Perth;
- the A1 from the Scottish border to Mussleborough;
- the A90 Stonehaven to Aberdeen.

On the other hand, a significant reduction in numbers of trunk DVCs recorded is so far apparent only for the A83 Lochgilphead to Cairndow and M90 Dunfermline to Kelty; as well as some indication that DVCs have also decreased in the major longstanding DVC priority area along the A82 Bridge of Orchy to Glencoe and A87 Shiel Bridge to Invergarry (see also 6.13 below).

6.9. In complement to the wider and now relatively consistent sampling of DVCs along the entire trunk network via the trunk operating companies, SSPCA records provide the largest widespread nationwide sample of incidents for non-trunk roads. Among over 1500 mapped SSPCA DVC records from 2001 to 2010 (of which near 1000 for 2008-2010), 18% relate to trunk roads (motorways and major strategic A-roads), while the remaining 82% are incidents on non-trunk road roads (including other A-

roads, B, C, and minor roads). The two regions with the notably highest frequency of SSPCA call-outs to deer RTAs are located:

- on the northern edge of Glasgow – between Clydebank to Bearsden and Milngavie (A809 and side roads) and A80 Cumbernauld, and
- within and around the western periphery of Aberdeen City, including in particular though not exclusively B9077 Banchory Devenick to Kirkton of Durris, and A93 Peterculter to Banchory;

Records from SSPCA alone over the least three years include 138 located within 10 miles of the city centre of Glasgow and 79 located within 10 miles of Aberdeen city centre. On average 14 to 15 of these incidents per year are logged within merely 5 miles of the city centre. As SSPCA logs (limited to attendance of live casualties; see 4.3.2) are thought to make up at most 25% of all DVCs in these areas, it is highly likely that actual numbers of deer collisions per year will number over 60 within merely 5 miles of each of these city centres. Other more localised hotspots of SSPCA incidents occur in particular in peri-urban areas southeast and southwest of Edinburgh, and near Glenrothes, Dunfermline, Perth, Stirling, and Inverness.

Human injury DVCs

6.10. Over the most recent three year period the number of deer related personal injury accidents for those four Scottish Police Regions for which equivalent results of official RTA database searches are available to us for all years (Highland, Fife, Central and Grampian) has averaged 22 per annum. Roads in the areas covered by this is sample (among the total of 8 police forces in Scotland) together contribute 31% of total annual traffic flow (i.e. just under 1/3rd) as assessed in 2009 (TfS, 2010). It seems reasonable therefore to put forward a tentative estimate that if equivalent information were available for all eight Scottish police force regions, the total number of human injury RTCs identifiable as having some involvement of deer would be predicted to lie in the region of 65 to 70 per year. This figure remains close to that estimated also during the 2003-2005 study; but should be viewed against a background that as a result of improvements to road safety human injury traffic accidents recorded overall in Scotland have shown a decline by around 10% over the past ten years.

6.11. Although only a limited sample in terms of size, over the years human injury DVCs, and for some police regions separate records on damage-only RTCs attended by police, provide one of the best stratified unbiased sets of DVC data from which to assess relative occurrence of DVCs on differing road types. For the above four police regions 42% of all known human injury DVCs occur on trunk roads, which is almost directly in line with the proportion of traffic (38%) carried by trunk roads in those areas. Trunk roads in Scotland overall make up 6% of road length but carry over 37% of all traffic and 62% of heavy good traffic, and it seems likely from these and other findings of the present study that trunk roads will account also in the region of 37% of all DVCs in line with the proportion of all traffic carried by them.

Police control room and Local authority road department records

6.12. The availability of usable DVC records from police control room logs (noting non-injury collisions with deer or reports from the public of dead or injured deer on roads, and similar data from local authority roads departments [see sections 4.5.4 & 4.5.7 respectively]) has continued to be highly variable, both between local authorities and inconsistency of provision across years. The fact that local authority records are available in some areas but not others, makes it difficult to make more than just localised use of these, even though the time and resources required to gather, map and collate these records (given often very limited detail provided) is generally greater than required for the more consistent and countrywide samples of

records obtainable via trunk companies, SSPCA and official RTC databases. Therefore less emphasis has been placed during this study on further gathering and collation of council uplift and police control room logs (many of which may also duplicate one another. The 700 or so 'UC' and 400 'P' type records obtained have nevertheless been archived for the time being, so that they may be used and grid referenced as far as possible if required for specific localised assessments in future.

SNH roadside carcass searches and evaluation of under-sampling

6.13. Parallel practical studies set up by the DCS in 2003 (and continued since through to 2011 via SNH) to assess the numbers of deer carcasses found during monthly searches along the verges and ditches of three main DVC priority roads in the Highlands (A835 Garve to Ullapool; A82 Bridge of Orchy to Glen Coe, A87 & A887 Loch Ness to Shiel Bridge; see section 4.6), have provided extensive additional information to help define and monitor hotspots more precisely for those routes. Comparison of these data for 2 full years before and after installation by Transport for Scotland (in September 2008) of enhanced vehicle activated deer warning signage along each route (for summary see Table 8), indicate that a significant reduction in total numbers of DVCs has occurred within the A82 and A87 priority sites. A similar reduction is however not apparent for the A835 Garve to Ullapool where numbers of DVCs per annum remain very close to previous levels.

6.14. With respect to the present countrywide study, comparative analysis of numbers of carcasses found by the SNH roadside surveys with records for those same road sections of dead deer reported to / via the trunk operating companies (TO) enables assessment of the 'maximum' proportion of all DVCs likely to be captured by that less intensive recording. For the three main priority routes, compared against the higher numbers recorded in SNH carcass searches, the number of incident records provided by TOs for these roads during the 2003-2005 study made up 48% (A835), 18% (A82) and 13% (A87) (adjusted for the fact that carcass searches only cover 8 month per year). However, over the most recent 3 years since re-start of our present monitoring project in 2008, the percentage made up by reports via TOs appears to have improved significantly in case of all three routes: with comparable average percentages for 2008-2010 rising to 68%, 60% and 24%. Nevertheless, taken across all three routes combined, we may conclude that trunk agent reports even over the last 3 years are likely to represent no more than 50% of all deer casualties along trunk roads in the Highlands in general.

6.15. Nevertheless, comparison of carcass search records and trunk reports (Table 7) show that the latter do also still provide substantial size samples of incidents for each of the priority sites. In summary, although trunk route reports at present tend to record a smaller sample of incidents overall, (and are less accurate with regard to exact position of DVCs along each road), in terms of initial identification of major hotspots and also for long-term monitoring of changes in frequency of DVCs the less labour intensive recording via trunk road companies does still effectively produce closely comparable results in term of distribution (Figure 15a & 15b).

Seasonal DVC patterns and implications for mitigation

6.16. Review of the extended DVC database with respect to seasonal distribution across Scotland, reconfirms a general peak in DVCs overall during May & June as shown by previous studies, and furthermore that some such peak occurs for all road types (Figure 8). However – it demonstrates particularly clearly here that in Scotland this peak is most pronounced by far for major roads, for which close to 60% (motorways) and 35% (A-class trunk roads) of incidents occur in these two month alone. In case of other A-roads and all smaller roads a regular peak is still also

apparent in May & June, but makes up only 25% of all incidents. The importance of this finding, from view of minimising risk of deer incidents on the Scottish trunk road network, is that it re-affirms that a high proportion of deer collisions on the most major roads may potentially be addressed through seasonally targeted mitigation such as VMS signage focussed mostly on May to June alone. On the other hand, similar seasonally restricted mitigation for non-trunk roads is less likely to be as (cost) effective in general.

- 6.17. Differences between seasonal patterns are also apparent for trunk roads falling within NW Scotland (Figure 9), and the three other trunk road units (NE, SE, SW). The latter three all closely reflect the pattern found on motorways in general, with a single very pronounced peak during May & June. In case of NW, while a May peak is also apparent, secondary peaks of comparable size occur not only in June, but also from October through to February. This again has important implications for any seasonally targeted mitigation measures. In case of the NW Scotland in particular these should aim to encompass not only the spring accident peak, but extend also through late autumn into winter in order to maximise their effectiveness.

Countrywide estimation of numbers and economic cost of DVCs

- 6.18. Estimation of the true actual numbers of DVCs that occur nationally across Scotland was not a specific project objective, with identification of high risk sites and monitoring of trends and local changes considered a more important overall aim. However, the question of the overall toll and cost of deer accidents is often raised by the media and others. Such estimation remains extremely difficult as the proportion of incidents sampled by each of our sources remains unknown. Previous estimates proposed on the basis of the 2003-2005 study suggested that the total number of DVCs in Scotland is likely to lie in excess of 7000 and possibly as high as 12,000 per annum (Langbein & Putman, 2006). These estimates were derived foremost from extrapolations based on numbers of human injury DVCs and the proportion (c.1%) these tend to represent among overall numbers as determined in specific case study sites. Based on more recent figures available for 2008-2010, we estimate that numbers of DVCs leading to human injury remain in the region of 65 to 75 per year, and that 7000 DVCs overall per annum in Scotland remains a reasonable minimum estimate.
- 6.19. A number of alternative means of estimating countrywide tolls also suggest that the minimum toll of DVCs must amount to at very least several thousand incidents per year. For example, records retrieved via Trunk Operation companies alone now regularly produce near 750 incidents per year merely on trunk roads, but intensive carcass searches at case study sites (see 6.14) indicate that such records are likely to capture less than 50% of all DVCs on these major roads; and that hence the actual toll on trunk roads alone is likely to exceed 1500 per year. As trunk roads make up merely 6% of the road network by length though carrying just over a third of all traffic, extrapolation of these figures based on traffic volume produces an alternative minimum figure of 4500 DVCs, although much greater figures would arise if making additional allowance for the much greater proportion of total road length contributed by minor roads.
- 6.20. While for reasons discussed in earlier sections, the true annual toll of human injury DVCs in Scotland is also likely to be rather higher, even 65 personal injury accidents arising through DVCs carry a very substantial economic cost. Department of Transport guidelines ([DfT, 2009](#)) value the averaged economic impact of human injury traffic accidents across all severities at £ 75,000 per accident; so that the annual estimated economic burden posed by just those 65 human injury DVCs in

Scotland per year alone would be calculated to lie close to £ 4.9 million. For the other 7000 or more DVCs overall, the majority will also lead to at least some minor material damage sustained to vehicles, while close to a quarter (i.e. c.1750) may be expected to sustain more significant material damage; ranging from minor repairs to total write-offs with average insurance claim costs of £1350 (Langbein, 2007). Such level of material damage to 1750 DVCs incidents per annum is likely to incur a further 2.3 million in direct economic costs arising through DVCs in Scotland, in addition to the estimated £ 4.9 million through personal injury DVC incidents.

6.21. Over and above the direct costs of DVCs, further indirect costs may arise to other road users who are not themselves involved in a DVC : through traffic delays and diversions, including additional financial cost, wasted time, lost productivity, and environmental disbenefits. The indirect costs associated with DVCs have recently been considered by a separate study on behalf of SNH (JMP, 2011), concluding that where such incidents cause a four-hour closure on a main link of the trunk road network quantified indirect costs may also amount to over £75,000. However, the proportion of all DVCs likely to cause this level of disruption has not been determined at this stage.

Recommendations for future countrywide DVC monitoring

6.22. Complete or even near-complete recording of the majority of all DVCs occurring in Scotland is unlikely ever to be achievable or maintain year on year nationwide. On the other hand, results presented in the previous sections show that despite having focussed data collection during the present 2008-2011 study predominantly on improving collation of DVC records from a smaller number of key data sources than in the previous study, the total number of records obtained has been possible maintain as high or higher. More importantly the geographical coverage of records obtained now provides much more even sampling, less skewed by superior recording in some areas than others.

6.23. From view of monitoring future changes, the two principal data sets which in combination are also likely to continue to provide the most consistent best stratified information at a countrywide and regional basis are:

- deer road casualties reports and carcass uplifts handled by the four main trunk road operating companies and two DBFOs responsible for day to day maintenance of the Scottish trunk road network, and
- information on requests to assist with dispatch or treatment of live deer injured in traffic collisions handled by SSPCA; and supplemented by similar call-outs attended by Forestry Commission rangers also regularly called out to and able to provide records on humane dispatch of live deer road casualties.

6.24. The comprehensive database of known DVC incidents in Scotland already accrued consistently from these sources from 2007 onwards as well as for some earlier years, now provides a good level of sampling right across all regional and city council areas of mainland Scotland. Continued focus of countrywide monitoring primarily on these two main data sets, which are less prone to overemphasis of some areas over others, should also suffice for monitoring of known and identification of new localised DVC hotspots when they appear in different regions.

6.25. It is recommended that, where and when such countrywide monitoring based on the principal data sources highlight a significant increase in DVCs for either a given council, particular smaller district or specific road sections within, this should be the time to trigger collation of additional data for the location of concern. In the

first instance such additional information gathering could draw on closer review of any such past archived records already available in the DVC Scotland database, followed by one-off approaches to local authority roads departments, police control room logs, local rangers and Wildlife Trusts. Whilst obtaining records from such local sources consistently year-on year for our national monitoring study has not been feasible, greater support would seem probable for such one-off requests where a local DVC issue has been identified, and extra information is required to assess the feasibility of DVC reduction and to help develop local mitigation measures.

Acknowledgements: The assistance of all the organisations and individuals who have provided records and contacts for this project in the past and continue to do so is gratefully acknowledged. Many thanks are due also to Jamie Hammond and Peter Watson for assistance with management of the project on behalf of SNH and DI respectively as well as for helpful comments on draft versions of this report

References:

DfT (2009) - Department of Transport web-site. A valuation of Road accidents and casualty costs [[web-link](#)].

JMP Consultants (2011) The Indirect Costs of Deer Vehicle Collisions. Final project report to Scottish Natural Heritage, Inverness.

Langbein, J. (1985) North Staffordshire Deer Survey 1983-85: I. Research and development. The British Deer Society. Fordingbridge, UK.

Langbein, J. and Putman, R. J. (2006). National Deer-Vehicle Collisions Project : Scotland 2003-2005. Final report to Scottish Executive. *The Deer Initiative, Wrexham*. [[web-link](#)]

Langbein, J. (2007a) National Deer-Vehicle Collisions Project : England 2003-2005. Report to The Highway Agency. *The Deer Initiative, Wrexham*. [[web-link](#)]

Langbein J. (2007b) Use of remote video surveillance to investigate deer behaviour in relation to wildlife deterrents, roads and vehicles. Presentation at „Deer on our Roads Seminar, Ashridge, UK, October 2007. [[web-link](#)]

Langbein, J. (2009) Deer Vehicle Collisions in Scotland Monitoring Project 2008-2011. First Annual Progress Report 2008/2009. Research Report 09/03. The Deer Initiative, Wrexham.

Langbein, J., Putman, R.J., and B. Pokorny (2011). Road Traffic Collisions involving deer and other ungulates in Europe and available measures for mitigation. In: Ungulate Management in Europe: Problems and Practices (eds. R.J. Putman, M. Apollonio and R. Andersen). Chapter 8, pp. 215 – 259. Cambridge University Press.

ScotlandTranserv (2010) North West Area A82, A87, A835 Vehicle Activated Deer Warning Signs. Final Report 07/NW/0805/046. Scotland Transerv, Perth.

Smith, G. and Langbein, J. (1998) (eds). The Prevention of Wildlife Casualties on roads through deterrents: Prevention of casualties amongst deer populations. Final Report SW335/V3/11-98 to Highways Agency. *SGS Environment Ltd*.

Staines, B.W., Langbein, J. and Putman, R.J. (2001) Road traffic accidents and deer in Scotland. Report to the Deer Commission, Scotland.