DEER AND ROAD TRAFFIC ACCIDENTS: A REVIEW OF MITIGATION MEASURES: COSTS AND COST-EFFECTIVENESS

1. A recent survey undertaken for the Highways Agency, (SGS Environment, 1998), concluded that road traffic accidents (RTAs) involving deer in the UK as a whole probably numbered in excess of 30,000 per annum. These figures however remain best guesses, rather than formal estimates – and it is in large part the lack of concrete information about the actual numbers of incidents and their distribution which has hampered the development of effective management. It was in direct response to this that the Deer Collisions project was launched last year through the partnership of organisations which make up the Deer Initiative – with lead funding in England and Wales from the Highways Agency and funding in Scotland from the Scottish Executive.

2. The background to this project and preliminary findings will be presented in more detail in a complementary talk by Dr Jochen Langbein. Its main objective is to develop a well stratified, nation-wide system for collection of standardised information on deer related RTAs throughout mainland UK, and to collate information on as high a proportion of all such incidents occurring throughout the project period .

However, we do not simply seek to get a handle on the actual number of incidents occurring in any year and their broad geographic distribution, simply to assess the overall scale of the problem. The information which is collected on the circumstances of individual incidents will also be examined very carefully to try and factor out the key factors associated with high risk or frequency of accidents: things like season and time of day, but also factors such as road type, traffic volume and speed, roadside habitats etc. Through this we hope that, as well as identifying current 'blackspots', we may be able us to predict other areas of high potential risk, in order to help target effective mitigation in the most appropriate places.

3. In parallel with this "incidents database" one of the other key objectives of the project as a whole is to explore the effectiveness of differing mitigation measures employed to reduce accident risk. By coincidence, the Deer Commission for Scotland (DCS), have been becoming increasingly concerned about the number of deer-vehicle collisions reported to them (and others emerging from our preliminary data). Part of their remit concerns responding to situations where deer pose a problem to public safety. And in recognition of this responsibility, and an awareness of the seriousness of the problem, they commissioned Dr Jochen Langbein, Professor Brian Staines and myself to undertake a review of the range of different options available which may be used to try and reduce accident frequency, and an analysis of their perceived effectiveness.

We undertook this review for them this last year and presented our report in February 2004

4. To try and structure our discussions later today on the options for mitigation, I will try and summarise here the main conclusions from that review, introducing the range of measures available, and some idea of what is the experience of use of these different measures in UK, but also more widely in Europe and North America. This will by necessity be a very brief introduction only, but will offer some framework perhaps for later discussion. Those wanting further detail can refer to the original report which (by kind permission of the Deer Commission for Scotland), is now available for free download on the DeerCollisions UK website at www.deercollisions.co.uk/ftp/mit_review.doc .

5. In this talk therefore I aim to examine the effectiveness (and required specifications for effectiveness) of a variety of mitigation options available for

i) **Preventing, or controlling crossing**, by the use of highway fencing, roadside wildlife warning reflectors, reductions in local deer population density, and less conventional methods such as chemical fences or the fitting of warning whistles to vehicles
ii) **Increasing driver awareness**, through the use of various driver warning systems – whether through the use of fixed signage, or signage responsive to driver speed, or the actual presence of deer on the roadside
iii) **Provision of safer crossing places** for deer by the installation of dedicated overpasses or underpasses, by modification of existing structures to dual use, or by the creation of designated 'cross-walks' across the carriageway itself.

6. Perhaps the most important thing to stress from the outset is that this is not a specifically UK problem, but a problem very widespread throughout Europe and North America - and as a result, there is a far greater case-lore of experience and information on all this than you might at first imagine.

7. However, I should also stress that I am presenting here by way of introduction is simply a summary of our current thinking, which for many mitigation methods is based however on rather limited / and often frankly rather poor scientific trials. What I am presenting is therefore 'the best idea we have at the moment' and we must stress that in many instances there is a need for better information. Thus we ourselves hope to get feedback from all those present today in relation to your own practical experience with some of these different measures and your own perception of their effectiveness, as well as discussing how we might better test these across a range of sites in the future.

PREVENTING or CONTROLLING CROSSING

8. **High tensile roadside fencing** is likely to remain the primary method used to try and reduce road-crossings and resultant accidents at identified sites of high risk. However such fencing must be of adequate specification (height/mesh size) and be designed not with the expectation, or aim, of attempting to prevent road-crossings altogether, but rather to channel animals towards a safer crossing point.

Complete barrier fencing attempting to prevent road-crossings altogether is likely to prove ineffective and may result in animals forcing the fence to cross roadways (with the added risk that they may then become trapped within the carriageway, unable to escape). At the very least, where effective as a total barrier to movement such fencing causes fragmentation and isolation of previously continuous populations of deer and other larger wildlife.

9. In a similar way, **roadside reflectors** are designed not to stop animal movement across roads, but to delay these at times when there is traffic in the carriageway until the roadway is free of traffic. Working on the principle that light from approaching headlights is reflected onto the verge to provide a flash warning, or continuous visual barrier (depending on reflector type and deployment) they are designed to alert deer to oncoming traffic at night, to startle them or present them with a continuous light barrier and thus delay crossing until the road is clear.

10. Because of relatively low cost, these reflectors are amongst the most common form of mitigation deployed - perhaps because it satisfies the need to be seen to be doing *something*. In practice they can, by definition only be effective at night and on roads of low traffic volume and while there remains some controversy about their effectiveness, the majority of published research in both Europe and North America indicates little or no sustained reduction in accident rates in the long term where such reflectors have been installed.

11. Proprietary 'chemical fences' (repellent chemicals encapsulated in slow release organic foam and applied to roadside posts or trees) have been trialled in Germany, with claims by the manufacturers of some efficacy in reducing the frequency of deer-vehicle collisions. More detailed assessment showed that although roadkills were reduced by 30-80 % within the test sections, accidents outside of the trial areas actually rose and other, independent, studies have suggested that such scent- fences are not in practice as effective as claimed. More information is needed also on maintenance requirements and costs.

12. **Car-mounted warning whistles**. Various commercial companies are now offering for sale a device for attachment directly to the front of a motor vehicle which emits a high frequency whistle claimed to be a deterrent to deer or other roadside wildlife. In the only formal study undertaken of the response of deer to such whistles, deer showed no behavioural response to suggest acknowledgement or avoidance of vehicles equipped with such devices, nor could any reduction in the number of deer-vehicle collisions be demonstrated. Indeed a separate study of many of the commercial products established that the sound emitted was outside the auditory range for deer, and/or indistinguishable from general traffic noise (tyres on tarmac)

13. A number of published studies have now demonstrated a relationship between the frequency of deer-vehicle collisions and local deer densities, which suggests that more **general reduction of deer densities**, in association with other mitigation techniques may help to reduce accident frequencies. Despite this, formal studies of the effectiveness of a local reduction in deer numbers are few and contradictory. While we may cite a number of such instances where population reductions would appear to have been accompanied by reductions in the frequency of accidents, there are other published cases where no such relationship has been established. It is patently clear that there must exist some relationship between deer numbers and accident frequency, but this relationship is probably not linear, and other factors may be more important in determining the actual level of accident risk, such that manipulation of deer numbers may not achieve much of a response.

In addition, another factor which may limit the effectiveness of such a measure is the fact that any local reduction in densities may rapidly be filled in again by immigration of animals from the wider surrounding area.

14. The **management of roadside vegeta**tion – and specifically, the clearance of woodland or scrub from a margin at the road edge- may have benefits both in increasing driver awareness of deer at the roadside, and increasing visibility of oncoming traffic to the deer themselves. In addition, removal of such vegetation and the cover that it provides may also reduce the probability of deer approaching so close to the road edge in the first place. The method and timing of removal of such vegetation may however be critical. While the removal of vegetation within transportation corridors may help improve driver and animal visibility, simple cutting of encroaching shrub and tree growth may at the same time increase the subsequent attractiveness of these cut-over areas as foraging sites by deer. Such measures might thus actually result in an increase in the number of deer utilising the roadside- ultimately increasing the risk of accident.

INCREASING DRIVER AWARENESS

15. **Deer warning signs** (to increase driver awareness) are the most frequently used approach to reducing deer-vehicle accidents. Such signs are however only likely to be of benefit if erected on approaches to known regular crossing points. In practice, warning signs are relatively rarely so precisely targeted. Further, it is doubtful whether such signs are in any case very effective in the long-term, since drivers readily habituate to them unless the message is reinforced by actual experience of deer crossings.
Various suggestions have been made to increasing the effectiveness of such signs. They should be used only in warning of known and regular deer-crossing points along a roadway. Driver habituation might also be reduced if signs were only exposed at particular times or seasons where accidents are known to be more frequent.

16. Alternatively, lighted signs might be illuminated only if vehicle speeds in known problem areas exceeded some (advertised) threshold level, or specifically when large animals approach the roadway. Such 'dynamic signage' has now been extensively tested in the US and in Europe and appears to have some potential, although it is hard to assess what may be the actual cost-effectiveness of animal-sensitive devices versus cheaper devices which simply enhance warnings in relation to driver speed in known trouble spots..

SAFER CROSSING:

17. As noted earlier, highway fencing is at its most effective if it seeks not to prevent animals crossing the road, but to direct them to safer crossing points. There are a number of structures which may be developed to achieve this- in the construction of dedicated overpasses and underpasses – and the requirements for these have been surprisingly extensively researched such that there are now developed pretty standard specifications.

18. These structures are not always as expensive as commonly assumed, even when fitted retrospectively to existing roads. Finally, on roads of lower traffic volume/speed, consideration may given to the construction of specified 'cross-walks' for wildlife actually across the carriageway surface, but in well-delimited and well-signposted locations, thus limiting crossing to defined areas where proper warning can be given.

COSTS

19. Costs of effective mitigation are hard to summarise, since much depends on the individual scheme and local topography. Some examples are presented in the main report to the DCS which is now available (By permission from DCS) on the DeerCollisionsUK website. Costs of effective mitigation appear high. However these must be viewed within their proper context and in relation to the actual costs incurred in deer-vehicle collisions themselves. The 'value to the economy of the prevention of Road Accidents', is outlined in regular updates of 'Highways Economics Note 1' published by the Department for Transport, for the purposes of assessing various road safety schemes.

20. At 2001 values, the expenditure which was considered to be justified in the prevention of a road traffic accident leading to

- human fatality was £1.185 million per fatality averted by appropriate mitigation
- serious injury £ 133,170 per casualty averted
- slight injury £ 10,270 per casualty averted

with a weighted average over all accidents resulting in injury or fatality at £ 53,902 per accident.

21. While costs above are given separately according to severity per casualty, each human injury accident tends on average to have more than one casualty; allowing for this and based on the general average of RTAs by severity, an alternative simpler measure is therefore also provided in the Information Note, suggesting that on average prevention of every human injury accident presents a saving to the economy of around £50k (£53.9k at 2001 costs). Placed in context, this means that on any given stretch of road, mitigation measures which might be expected to reduce human injury accidents by, say, 3 per year over a 10 year period, would justify capital expenditure of £1.6 million based on these 'accident prevention values' alone (and without taking into account the wider costs of damage-only deer collisions, carcass clearance costs, venison losses and the 'ecological' benefits of providing (in case of over/under passes) mitigation measures which are used also by other wildlife).

SUMMARY OF MAIN CONCLUSIONS:

22. In offering recommendations for the most effective measures which might be adopted in the future, we note again that this represents our best current advice based on evidence available to us to date. But it is offered as preliminary suggestion only and we in part presenting this today deliberately to try and get some initial feedback from those present as to whether they would generally agree / disagree with our advice.

23. But based on what we have seen, and what we know from other countries, we would at present recommend that for motorway and high-speed trunk roads, highway fencing remains the most effective measure against accidents (with appropriate one-way gates or deer leaps to permit escape of animals trapped on the carriageway). Such fencing should whenever possible be combined with the provision of dedicated crossing places (overpasses, underpasses, or well-signed crossing areas/cross-walks) to avoid producing absolute barriers to animal movement and fragmentation of populations.

24. On more minor roads, or where deer fencing is not a feasible option for landscape or other reasons, mitigation measures should in the first instance be targeted at reduction of driver speeds in areas of known high deer collision risk. Such speed limitation, if enforced, would appear to be one of the simplest and most effective ways of reducing accident frequency and severity.

25. It is however crucial that each mitigation scheme should be tailored to the particular local situation and deer movement patterns; given, in addition, a degree of context-related variability in the effectiveness and cost-effectiveness of various measures, actual mitigation installed in each case will necessarily be dependent on local conditions.

26. In summary, we would suggest that, **on existing roads of relatively low traffic volume** , fencing, leading to dedicated cross-walks, overpasses or underpasses, would seem the best available option at sites of known, or predicted future, blackspots. Fencing should be designed to lead animals away from those crossing points where accidents have occurred in the past (or are predicted in the future) to safer crossing areas, which should be well-signposted.

If fixed signs are used, we believe these should be new signs specially designed to advertise such crosswalks, rather than simply the standard (much ignored) wildlife warning signs. Alternatively, consideration should be given to installation of one of the new dynamic signs coupled with sensors, which are activated only when deer are actually approaching the crossing zone. Experience elsewhere in Europe and North America suggest that these measures are more effective if accompanied by a mandatory speed restriction.

27. On other sections of road where deer occur at relatively high density in the general area, and roadside fencing is not appropriate, presence of deer and risk of accidents should be advertised by adequate signage. Speed restrictions should again be imposed and supported by simple matrix signs which are activated by excess vehicle speed and remind drivers to slow down. Given their universal availability and relatively low cost, the utility of proprietary deer-reflectors should be further explored, in investigation of differences in effectiveness resulting from differences in placement and direction of reflected light.

28. On **existing roads of high traffic volume** , the only effective measure in reduction of deer-vehicle collisions would appear to be longer lengths of fencing, providing a complete barrier on either side of the carriageway, between existing crossing points already available (as bridges or underpasses). Fencing should be to full highways specifications and there should be adequate provision of one-way gates or deer-leaps to permit escape of animals which do stray onto the carriageway.

29. Mitigation measures appropriate for consideration in planning of **new road schemes of low traffic volume** will be similar to those already outlined for existing roads – simply because of the high costs involved in more complex provision, which will not be justifiable on relatively minor roads. For **new roads of high traffic volume** , barrier fencing on both sides of the carriageway should be coupled with adequate provision of underpasses or green bridges at regular intervals. In addition, all additional bridges or tunnels required for other purposes (footpaths, minor roads crossing the carriageway, machinery tunnels, culverts etc.) – other than those specifically dedicated as wildlife passages, above - should be designed and built as dual purpose structures.

30. Concern in preventing collisions between road traffic and deer (or other wildlife) has in the past often tended to be treated foremost as an animal welfare issue and funding allocations to address this in Scotland (and UK as a whole) have tended to be minimal (not least if compared to other European countries and US).. Although it does indeed present a major welfare issue, it is becoming increasingly clear however, that in addition to these welfare implications, there are also very real major costs to the economy. Human injury RTAs alone, involving deer, are estimated to be worth in excess of £40m to the UK economy annually with at least a further £11m incurred through damage to vehicles. We would suggest therefore that a greater expenditure on mitigation would appear to be justified and that it would be appropriate to allocate a significant annual budget at national (trunk roads) and regional levels (non-trunk roads), targeted at reducing the annual deer collision toll and associated costs.