Overview of approaches to Deer collisions Mitigation and their advantages and disadvantages in different contexts (after Langbein et al., 2011).
[Note – that the authors stress that in general best results are achieved through use of a range of complementary measures, rather than reliance on any one of the individual approaches listed]

Mitigation measures	**Suitable situations and supporting measures**	**Potential effectiveness / Advantages**	**Disadvantages**
Fencing	Major high risk roads of high traffic flow; most effective when leads to safer crossing point, and contains escape ramps / leaps.	Well proven effectiveness where of appropriate mesh size and height, and sufficient length to prevent 'end-runs'. [1,2,3,4,5]	High maintenance cost; barrier effect also to other wildlife. [6]
Overpasses & Green bridges	Major high risk roads; most effective with lead-in fencing, and natural ground cover.	Well proven effectiveness; ungulate usage increases with width; but smaller structures can also help alleviate wildlife collisions. [7,8,9]	High cost; feasibility dependent on landscape. More readily installed on new-build than for existing roads. [8]
Underpasses & Viaducts	Major high risk roads; most effective with lead in fencing, and natural ground cover.	Good - where of adequate specification. Mostly lower cost than overpasses of similar size. [7,9,10]	High cost; feasibility dependent on landscape. Often longer delay before used by ungulates than in case of overpasses. [7,9]
Highway cross-walks	Low to medium speed routes; needs to be supported by fencing, signage, speed restriction, and ideally deer-grids.	Good – if well signed. 11]	Not likely to be acceptable on major routes where traffic has to be kept flowing.
Optical wildlife warning reflectors	Roads of low traffic volume providing some traffic free periods. Vegetation around reflectors needs to be kept clear.	Limited convincing evidence of success. Relatively low cost; do not prevent normal range use. [12,13]	Rapid habituation where lit up by frequent traffic. Can at best only function during night. Many trials indicate ineffective. [14,15,16,17,18]
Acoustic wildlife warning devices	Roads of low traffic volume, where habituation least likely, and providing safe crossing periods.	Variable evidence. Lasting effects likely to depend on type and variability of signals. [19,20]	General effectiveness remains unproven. Limited potential on roads of high traffic volume. Much higher (x10) cost than optical reflectors. [17,21]
Chemical / Olfactory deterrents	Roads of low to moderate traffic flow	Limited convincing evidence of success. Most intend to raise level of alertness, rather than prevent animals crossing. [22]	Limited independent evidence of effectiveness. Requires renewal at regular intervals. Likely habituation [17,19,23,24]
Vehicle mounted ultrasound whistles and electronic horns		Poor effectiveness. [25] Some types very cheap to install.	No convincing evidence of effectiveness. Signals mostly drowned out by traffic noise. [26,27,28]
Standard wildlife warning signage	Any road type, but should be targeted to forewarn of short, well defined sections of high risk.	Can help absolve legal responsibility of road authorities or population managers. Moderate cost.	Over-abundance of wildlife and other signage leading to reduced effect on driver behaviour. Low effectiveness (if any) at reducing collisions. [29,30,31]
Interactive speed-activated wildlife + speed signage	Any road type, but should be targeted to forewarn of short, well defined sections of high risk.	Some potential , but yet unproven for DVC reduction. Increased driver perception. [32,33]	Driver habituation over time, if not reinforced by seeing animals near the crossing point, and as digital signage in general becomes more common. [34,35]
Interactive animal activated signage	Major well-defined animal crossing points on roads of moderate traffic flow.	Promising effects on driver awareness and local speed reduction. [36,37,38]	High cost compared to standard or speed activated signage. Variable reliability of differing sensor types. [35]
Speed limits	Low to moderate traffic flow routes. Speed sign at same site as wildlife sign preferable.	Good – provided well enforced. Reduces severity of accidents if not necessarily frequency.	Feasibility / acceptability for major roads limited.

		[for refs. see 4]	
Reduction of local deer density	Prevention of increase, if not reduction, of deer numbers required in order for most other measure (including fencing) to remain effective.	Good – provided undertaken over wide area, and as one part of overall DVC reduction strategy. [39,40,41,42]	Localised culling may shift rather than reduce collisions, and destabilise population. Public understanding of need to control wildlife limited. [14,43]
Immuno-contraception	Isolated, self-contained populations.	Non-lethal; higher public acceptability in some countries / situations than culling. Limited / short term effectiveness. [44]	Requires high proportion of herd inoculated. Ethically questionable. Very high cost. [5]
Reducing animals disturbance	Forests with high human / dog disturbance.	High potential – where dog walking and human activity often panics deer to cross roads. Low cost if achieved through restrictions on activity in specific high-risk areas.	Difficulty to achieve compliance; e.g. keeping dogs on leads. May be contrary to other policies to increase public use of forests and countryside.
Verge clearance and maintenance	All roads. Ideally verges re-sown with grass mixtures of low digestibility. Clear verges also a pre-requisite if reflectors in use.	Promising. Improved forward visibility for drivers and animals; dependant on width possible to clear. [45,46,47]	Effect on collisions reduction not fully proven. Increased forage production on verge may attract animals if not timed carefully. [17,48]
Public awareness raising and driver education	Increasing importance as traffic and collision risk escalates. Animal hazard awareness should be built into national driver syllabuses.	High potential – relatively low cost if based on leaflets and printed media. Can be integrated with other road safety campaigns.	Effects unclear; may be short-lived unless replicated. Responsiveness of driving public questionable.

1 - Reed *et al.* (1982), 2 - Ward (1982), 3 - Ballon (1985), 4 - Putman *et al.* (2004); 5 - Mastro *et al.* (2008), 6 - Feldhammer *et al.* (1986), 7 - Ohlbrich (1984), 8 - Iuell *et al.* (2003), 9 - Georgii *et al.* (2007), 10 - ECONAT (1992), 11 - Lehnert and Bissonette (1997), 12 - Schaffer and Penland (1985), 13 - Gladfelter (1982), 14 - Waring *et al.* (1991), 15 - Reeve and Anderson (1993), 16 - Woodward *et al.* (1973); 17 - Voss (2007); 18 - D'angelo (2006), 19 - Pokorny *et al.* (2008), 20 - Pokorny and Poličnik (2008), 21 - Langbein (2007b), 22 - Kerzel and Kirchberger (1993), 23 - Lebensorger (1993), 24 - Lutz (1994), 25 - Tracy (2003, in DVCIC, 2003), 26 - Romin and Dalton (1992) 27 -Schober and Sommer (1984), 28 – Scheifele *et al.* (2003), 29 - Putman (1997), 30 - Hedlund *et al.* (2004), 31 - Stanley *et al.* (2006), 32 - Sullivan *et al.* (2004), 33 - Hardy *et al.* (2006), 34 - Pojar *et al.* (1975); 35 - Hujser *et al.* (2006), 36 - Gordon *et al.* (2003), 37 - Hammond and Wade (2004), 38 - Mosler-Berger and Romer (2003), 39 - McCaffery (1973), 40 - Schwabe *et al.* (2002), 41 - Rondeau and Conrad (2003), 42 - Sudharsen *et al.* (2006), 43 - Doerr *et al.* (2001), 44 - Rutberg and Naugle (2008), 45 - Jaren (1991), 46 - Staines *et al.* (2001), 47 - Lavsund and Sandgren (1991), 48 - Rea (2003).