

Methods for control of wild deer appropriate for use in the urban environment in England

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Contents	Page
Executive summary	3
1. Introduction	5
2. Review of the problem in the UK	8
3. Management Approaches in the UK	11
4. Review of the problem (and management response) elsewhere within Europe	14
5. Review of the problem within the US	14
6. Management Approaches in the US	15
7. Options for urban and peri-urban deer control in England	21
8. Conclusion	28
References	29
Appendix 1: respondents to the urban deer management questionnaire	35
Appendix 2: urban deer management questionnaire	36
Appendix 3: summary of questionnaire responses	38
Appendix 4: Costs of different control methods in the US, from the literature	43
Appendix 5: a comparison of deer management models on several key decision-making dimensions (from Decker et al. 2004)	44

Executive summary

All species of deer are increasing in numbers and expanding their ranges in England. Fallow, roe and muntjac deer are now widespread, while red and sika are locally abundant. There is currently no reason why the trend in increasing deer numbers and range expansion should not continue. The negative impacts upon habitat are likely to be exaggerated in the short-term through increased development pressures across the rural and urban landscape.

Deer are increasingly becoming established within urban areas in England where their impacts may cause potential conflict with human activity, additionally conflicts are occurring in areas where human activities and habitation impinges on current and potential deer range. Deer are implicated in road traffic accidents, have the potential to pose a risk to human health and can have impacts on property such as gardens. Animal welfare concerns are also significant.

In urban areas, there has been increasing colonisation of larger towns and cities over recent decades by, in particular, muntjac (*Muntiacus reevesi*) and roe deer (*Capreolus capreolus*). Deer of one or the other of these species are now established well within the centres of cities such as Bristol, London, Manchester and Southampton. There are also well publicised incidences of larger deer species, including fallow (*Dama dama*) and red deer (*Cervus elaphus*) entering urban conurbations such as Milton Keynes causing disruption and potentially causing serious deer vehicle collisions.

For the purposes of this review, we would make a clear distinction between truly urban areas (the centre or suburbs of cities, towns and other conurbations) and peri-urban areas, which are predominantly semi-rural, but “infiltrated”, as it were, by suburban extension, “out of town” developments (commonly industrial or retail) and the associated infrastructure or the urban fringe (roads etc). We would consider peri-urban areas also to include rural towns or villages, which while not supporting resident populations of deer, are inevitably influenced by established deer populations in the surrounding peri-urban area.

Shooting by conventional hunters is currently probably the most widely employed method of control in the peri-urban urban environment. In the urban and occasionally in the peri-urban environment other methods are used by a variety of agencies and others including the emergency services, animal welfare organizations like the RSPCA and Local Authorities.

We believe the choice and implementation of effective control methods in England face a number of key obstacles:

- landownership patterns make co-ordinated management problematic.
- public attitudes to culling may constrain any lethal control
- the typically ad-hoc nature of responses reflects a lack of recognition of the scale of the problem and a consequent lack of a standardized protocols and training.
- deer legislation does not recognize the issues involved in urban deer control
- There is a lack of awareness by practitioners of the legislative constraints

The major issue that this review has raised is the legal status of urban deer control operations. It seems likely that almost all current options that are undertaken by the police or surrogates are in contravention of one or more sections of the Deer Acts.

There are no other methods currently in use in Europe or the US that offer significant advantages over our current suite of options. The only adaptation is that of 'sharpshooting' which modifies conventional hunting techniques. These adaptations should include use of modern night vision equipment and incorporate advances in ammunition technology

Immuno-contraception may still offer possible options for the future but it is unlikely to be available in the short term for deer control in this country.

Trapping, although well developed in this country for scientific purposes in earlier times, has become largely ignored but is used elsewhere to good effect. Trapping advice and training need to be updated and could then be used for a wider range of applications subject to legislative changes).

There are a number of areas that require further development if the methods above are to be employed for urban and peri-urban they are to be used in a coherent manner to ensure that the highest animal welfare and human safety requirements are achieved and any activity receives the necessary public acceptance.

We would suggest further work is required in the following areas:

- Coordination and standardisation of approaches including identification of relevant skills in organisations and individuals to address the growing deer issues in the urban environment.
- Developing live capture techniques for individual and groups of animals and adapting current legislation and Best Practice to enable the use of these techniques
- Examining developments in firearms and ammunition to establish suitable criteria to improve 'sharpshooting' capability and adapting current legislation and Best Practice to enable the use of these techniques
- Ensuring local community involvement in the decision-making process, even if not in the actual control to be carried out,

1. Introduction

Background

1.1 All species of deer are increasing in numbers and expanding their ranges in England. Fallow, roe and muntjac deer are now widespread, while red and sika are locally abundant. There is currently no reason why the trend in increasing deer numbers and range expansion should not continue. Deer are increasingly becoming established within urban areas in England (and Scotland) with a range of impacts including deer-vehicle collisions (DVCs) and damage to gardens. In addition conflicts are occurring in areas where human activities and habitation impinge on current and potential deer range.

1.2 For the purposes of this review, we would make a clear distinction between urban areas (the centre or suburbs of cities, towns and other conurbations) and peri-urban areas, which are predominantly semi-rural, but “infiltrated”, as it were, by suburban extension, “out of town” developments (commonly industrial or retail) and the associated infrastructure or the urban fringe (roads etc). We would consider peri-urban areas also to include rural towns or villages, which while not supporting resident populations of deer, are inevitably influenced by established deer populations in the surrounding peri-urban area. Definitions are taken from *Dandy et al (2009)*.

1.3 In England, the phenomenon of urban foxes has been recognised, publicised and widely studied for many years (Harris 1980, Harris & Rayner 1986). In contrast, deer have only more recently been recognised first as occasional visitors to our cities (Chapman 1991) and then as inhabitants (Prior 2000).

1.4 Within fully urban areas, there has been increasing colonisation of larger towns and cities over recent decades by, in particular, muntjac (*Muntiacus reevesi*) and roe deer (*Capreolus capreolus*). Deer of one or the other of these species are now established well within the city centre of cities such as Bristol, London, Southampton etc, with the most closely-documented history of colonisation reported for Sheffield (McCarthy and Rotherham, 1994; McCarthy *et al.* 1996; McCarthy *et al.* 1999).

1.5 This issue of incursion into urban areas by smaller deer was highlighted in the Defra review of current and future deer management options (Wilson, 2003); we are aware however that since this was written red and sika deer have become present in significant, localised, populations in towns and villages in areas such as the Midlands and Dorset and therefore the range of management techniques available must be responsive to most if not all of the species currently found in England.

1.6 In truly urban areas there is concern in relation to damage to gardens and garden plants (see for example Chapman *et al.*, 1994; Coles, 1997), structural damage to fences, increased risk of road traffic accidents involving deer (i.e. deer-vehicle collisions, DVCs), as well as some concern about the possible implication of deer in the transmission of disease (but see Watson *et al.* 2010). Welfare concerns extend to the physical condition of deer established within urban sites, which is often poor by comparison to deer within more natural habitat (Green, 2008).

1.7 In the peri-urban situation, in essence, human habitation and infra-structure encroach on established deer range. There may be ethical considerations in terms of required management because human activity has reduced the area of habitat formerly available (and there may be some need for proportional reduction in deer population number). Within this same peri-urban area, deer may be implicated in DVCs, in damage to agriculture (and especially horticulture: market gardens or orchards in the peri-urban area), damage to amenity plantings, farm woodlands or community forests – and once again presence of established deer populations may raise issues of their potential as reservoirs or vectors in the transmission of diseases to humans or livestock.

1.8 These problems are, of course, not restricted to the UK; while not widely documented in Europe (see below), problems associated with urban and peri-urban deer are of increasing concern in many parts of the US – with problems identified similarly associated with DVCs, damage to horticulture, risks of deer involvement in the transmission of diseases to livestock or humans, as well as damage to horticulture and other farm crops. In the USA urban deer problems have been documented and considered for over 20 years (e.g. Connelly *et al.*, 1987).

Management constraints

1.9 Management in urban areas is necessarily reactive to local problems but there are significant constraints on accepted forms of control in areas of high human concentration, where there may be significant problems associated with use of, for example, high-powered rifles, and where effectiveness of capture and translocation is unproven. In addition, there is often strong pressure from the general public against any form of control and especially lethal methods of control (Chapman *et al.*, 1994; Philip and Macmillan, 2003; and see below, paragraphs 2.13-2.15; 3.8 and 6.24-6.26).

1.10 In peri-urban areas, in general, we believe traditional methods of control may be employed - whether on control of impacts *per se* (by fencing, or for example deployment of individual tree guards in amenity plantings or farm woodlands: Putman 1996, 2004) or by control of deer populations themselves. It appears to us that the main problem of management in this peri-urban context is that it tends to be reactive rather than pro-active. Conflicts are therefore often more difficult to resolve without significant expense and multi-agency involvement.

Rationale for this review

1.11 These issues are of sufficient concern to prompt investigation. One recent project (Dandy *et al* 2009) investigated deer-human interactions in a peri-urban area in Scotland and made a number of recommendations for managing these interactions and the factors underlying them. Some of the issues were also explored in a recent seminar organised by the British Deer Society (Kenyon, 2009). However, neither of these specifically addressed the feasibility and appropriateness of the various control methods available, which is the focus of this review.

1.12 This project sets out to:

- Review problems experienced in the UK, elsewhere in Europe and the US.
- Consider the different approaches used to deal with these issues across Europe and the US identify what approaches are applicable for England
- Offer proposals and recommendations for a strategy for management of urban deer populations and how this could be administered/structured.

1.13 This review concentrates upon actual and potential methods of dealing with deer when they are causing problems within residential and commercial areas. Management techniques such as diversionary feeding, fencing, scarers, road design etc. are not addressed, though we acknowledge they have a significant role to play in manipulating deer behaviour and potentially reducing the conflict with human activity. The mitigation of deer impacts upon the urban and peri-urban environment, particularly by physical barriers, deterrents and diversions is discussed elsewhere, for instance in Natural England (2008) and Dandy *et al* (2009).

Methods

1.14 A literature review was undertaken to explore available literature on urban deer issues and related management approaches.

1.15 In practice there was found to be very little published material available on problems elsewhere in Europe and the literature was dominated by publications from the United States, where there is clearly a longer history of both problems and management response. To fill the apparent gap, direct approach was made to professional wildlife biologists in a number of different European countries (30 countries in all) seeking information on:

- The extent to which deer in their countries have colonised urban areas or the urban fringe;
- Conflicts seen to result from this colonisation;
- Management methods currently employed in, or adjacent to urban areas.

The results of this survey are reported here (see Appendices 1, 2 and 3).

1.16 To complement this, and given that the greatest experience of conflicts and management of deer in urban and peri-urban areas appears to be in America, personal contacts were established with a number of academics and managers prominent in this field within the US, to explore further the various approaches adopted there in management of urban deer issues. We would like to take the opportunity of recording here our thanks to the many colleagues in both Europe and US who gave so freely of their time and experience.

1.17 Based on this review we suggest possible approaches which might be considered for management of urban and peri-urban deer populations in the UK context. In both urban and peri-urban contexts we are aware that there are a number of potential methods which might be acceptable elsewhere in the world that would not be acceptable within a UK context – in particular use of toxins and poisons. Therefore in this review we have restricted consideration to methods we believe are, or could be, generally acceptable.

2. Review of the problem in the UK

Background

2.1 Within urban areas, there has been increasing colonisation of larger towns and cities over recent decades by, in particular, muntjac (*Muntiacus reevesi*) and roe deer (*Capreolus capreolus*). Deer of one or the other of these species are now established well within the centres of cities such as Bristol, London, Manchester, Southampton, Glasgow and Edinburgh, etc., with the most closely-documented history of colonisation reported for Sheffield (McCarthy and Rotherham, 1994; McCarthy *et al.* 1996; McCarthy *et al.* 1999). There are also well publicised incidences of larger deer species, including fallow (*Dama dama*) and red deer (*Cervus elaphus*), entering urban conurbations such as Milton Keynes¹ causing disruption and potentially causing serious deer vehicle collisions.

2.2 In urban areas there is concern in relation to damage to gardens and garden plants (see for example Chapman *et al.*, 1994; Coles, 1997), structural damage to fences, increased risk of deer-vehicle collisions, as well as some concern about the possible implication of deer in the transmission of disease to both humans and domestic pets (Bohm *et al.* 2006, Simpson, 2002). Welfare concerns are significant. The physical condition of deer established within urban sites is often poor by comparison to deer within more natural habitat, and thus urban populations may be of concern purely from the point of view of welfare of the deer themselves (Green, 2008). There is also an increased risk of accidents associated with incidents such as deer trapped in fences, canals and industrial premises etc. These may also expose any human rescuers to risk of injury.

2.3 In the peri-urban situation, in essence, human habitation and infra-structure encroach on established or potential deer ranges. Within this same peri-urban area, deer may be implicated in DVCs, in damage to agriculture and especially horticulture: market gardens or orchards in the peri-urban area, damage to amenity plantings, farm woodlands or community forests. Important botanical and horticultural collections have been damaged by urban deer, for instance the University Botanical Gardens in Cambridge, which have been forced to adopt anti-deer measures to protect plants of international importance from muntjac damage. The presence of established deer populations may raise issues of their potential as reservoirs or vectors in the transmission of diseases to humans or livestock (Rutberg & Naugle, 2008).

2.4 There may be ethical considerations in terms of required management since it was human activity that reduced the area of habitat formerly available to the deer. Although there may therefore be some need for proportional reduction in deer numbers to compensate for loss of habitat, some people may believe that any lethal control is unacceptable (Chapman *et al.*, 1994; Wilson, 2003; Philip and Macmillan, 2003; and see below, paragraphs 2.13-2.15; 3.8 and 6.24-6.26).

Deer-vehicle collisions (DVCs):

2.5 Specifically, study of the patterns of distribution of DVCs in relation to urban areas shows that among a sample of over 30,000 DVCs logged in the recent nationwide DVC project, 21% occurred within the c. 8% of the land area of England classed as 'urban' by Defra/Natural England (Langbein, 2008). If we define a peri-urban zone as ring as 1.6 km around such conurbations, then the published figures show that a further 23% of all recorded

¹ The Daily Mail, 7 October 2008

DVCs fall inside this extremely conservative definition of the peri-urban zone and in total 44% of all recorded accidents fall within 1 mile of conurbations (Langbein, 2008) The large concentration of total numbers of DVCs in the peri-urban and urban sector is the combined result of the much greater levels of road traffic, human habitation, and disturbance compared with truly rural areas and the increasing extent to which deer have colonised the sub-urban fringes. Deer in these areas are essentially exposed to much greater risk of collisions than a deer population at similar density residing in more rural or remote regions.

Damage to horticulture/market gardens:

2.6 There have also been growing numbers of reports of damage to horticulture/market gardens. Between 1987 and 1989, 5.7 % of complaints relating to deer received by the COSTER database (**C**omputerised **S**ummary of **T**echnical **R**eports) maintained by MAFF's Wildlife Services Branch (WSB) related to horticultural damage (Putman, 2004). In a subsequent study (Doney and Packer, 1998, Packer *et al.*, 1999) four specific areas of England were selected for more detailed survey, and information on the presence of deer and extent of damage to agricultural interests was sought in questionnaires distributed to approximately 2590 farms in Gloucestershire/ Somerset; Essex/Suffolk; lowland Yorkshire; Northamptonshire. In response 1192 returns were received to the questionnaire, with 69% of respondents reporting deer present on their holdings. Cereals were perceived by respondents to be the crop-type most likely to suffer damage from deer (362 respondents of the 822 reporting deer on their land), with damage also reported to grass crops (50/822), farm woodlands (241/822) and lower incidence of damage reported to root crops, top fruit, vegetables and oilseed rape (Doney and Packer, 1998, Packer *et al.*, 1999).

Deer as agents for transmission of disease:

2.7 Deer may also be implicated in the transmission of disease to humans, their livestock or their pets (Bohm 2007). Such a potential epidemiological role is economically more important in the rural environment, where the transmission of tuberculosis, bluetongue disease, internal parasites and other pathogens may have significant impact (Delahay *et al.* 2007, Froliche *et al.* 2002, Mackintosh & Beatson 1985). It is important to note that deer may themselves be unaffected by harbouring organisms that cause disease in other animals or people. Recent work has confirmed that deer will carry and multiply Bluetongue virus types 1 and 8, but remain apparently disease free (Gortazar, Lopez-Olvera, Vincente *et al.* 2009).

2.8 In the urban and peri-urban environment, there appears to be little direct or confirmed evidence of the presence of deer increasing disease prevalence, but there is evidence that the public perceive that deer are responsible for diseases such as Lyme Borreliosis (Barbour & Fish 1993).

Recent Developments

2.9 Recently in England the England and Wales Deer Research Working Group² has identified a number of areas for urgent research to support the sustainable management of wild deer in England and agreed a series of priorities including novel methods of deer control suitable for the urban environment.

² The Deer Research Working Group, facilitated by the Deer Initiative and chaired by Defra, brings together UK Government Departments and NGOs who are [o]major commissioners of research on wild deer to identify future requirements.

2.10 The recent BDS/DI Urban Deer Seminar highlighted the issues in relation to deer in the urban and peri-urban environment. Natural England highlighted an "increasing public intolerance of lethal control" which needed to be addressed and that management needed to be tailored to specific problems. "Organisations need to be more bold and truthful and must not shy away from the media and the realities of deer management". Among the seminar conclusions were:

- the deer sector should develop a media strategy to tackle current mis-perceptions about deer issues.
- the deer sector should develop a "tool kit" approach to offer authorities and stakeholders a range of solutions as deer impacts increase in urban areas.

2.11 In Scotland the presence of wild deer in and around Scotland's urban areas, and the issues this raises, are significant concerns for the Scottish Government and its agencies. As a result of its 'Consultation on the Close Seasons' in 2005, the Deer Commission for Scotland was charged with developing a 'Responsibility of care for deer managers', aimed at achieving consensus from stakeholders on the principle of 'who is responsible for what' in relation to deer welfare.

2.12 It is considered that in peri-urban areas incidences of dog or airgun attacks and DVCs involving deer may effectively be taking the place of established control methods more appropriate to the maintenance of high deer welfare standards. Consequently 'doing nothing' in these areas *may* constitute a welfare or responsibility 'issue' under the Deer (Scotland) Act 1996. Further concerns noted in this sector are the potential impact of wild deer upon natural heritage/biodiversity interests, private gardens and other publicly important sites (such as graveyards, parks and golf courses) in urban and peri-urban areas.

2.13 Dandy *et al.*, (2009) have established, that in the Central Belt of Scotland Scotland at least, that whilst culling is, for members of the local community, clearly the least favoured management method, within discussion groups it has widespread support at a general level, although this is strongly contingent upon key additional criteria being fulfilled. These were that:

- all other practical management options have been attempted (i.e. culling is a "last resort"),
- there is an existing and problematic overabundance of animals in area in which the cull is to take place,
- and any culling activities are selective, humane and legal.

2.14 There was also a tendency in the discussion groups to assume that 'the public' more widely would object to culling. This argument starts from the perception that deer are not overabundant and that it should thus be possible to manage their impacts without culling. Further to this other participants expressed the opinion that the 'natural' alternatives, such as predation, could actually be a worse option than management by humans, particularly in terms of deer welfare. Indeed welfare arguments are, in fact, commonly deployed by community members in support of selective, 'professional' and humane culling.

2.15 Perhaps unsurprisingly, the deer managers and land managers who participated in the research were more accepting of the practice of culling as a regular deer management technique – an experience also widely reported from studies in America (e.g Decker and Purdy, 1988; McAninch, 1995; Kilpatrick *et al.*, 1996; Loker *et al.*, 1999; Kilpatrick and LaBonte, 2003, and see paragraphs 6.24-6.26). Having said this, broad concerns were expressed regarding its appropriateness in a peri-urban environment, relating primarily to the practical difficulties involved and public opinion. Several managers also noted that often the way in which culling was conducted was more important, in terms of acceptability to ‘the public’, than the fact that it was done at all. There was a particular concern expressed that elected officials (especially within Local Authorities) were ‘afraid’ to support culling, and this was important due to the significant amount of land owned by these Authorities in the peri-urban environment.

3. Management Approaches in the UK

Traditional Deer Management by Shooting

3.1 In rural areas culling with a high powered rifle is the generally accepted method of controlling deer numbers in the context of wider deer management. Deer are normally killed at ranges of up to 200 m although most lowland deer are probably killed at ranges in the region of 50-100 m. In the UK the majority of those culling deer (89%, according to Marshall and McCormick, BASC 2006) do so as a recreational activity and even the largest employer of deer controllers in the UK (the Forestry Commission) currently has less than 100 rangers employed on culling deer in England (in addition to other wildlife management tasks).

3.2 The shooting of deer in England is governed by the Deer Act 1991 (as amended). Statutory close seasons in England for the deer species all dates inclusive) are shown below.

Species	Sex	Open season (England, Wales and Northern Ireland)
red	stags	August 1 st – April 30 th
	hinds	November 1 st – March 31 st
fallow	bucks	August 1 st – April 30 th
	does	November 1 st – March 31 st
Sika	stags	August 1 st – April 30 th
	hinds	November 1 st – March 31 st
Roe	bucks	April 31 st – October 31 st
	does	November 1 st – March 31 st
Red/sika hybrids	stags	August 1 st – April 30 th
	hinds	November 1 st – March 31 st
Chinese water deer (only found in England)	bucks	November 1 st – March 31 st
	does	November 1 st – March 31 st
muntjac	(both)	All year round (as muntjac breed all year round; it is recommended that when culling, immature or heavily pregnant does are selected to avoid leaving dependant young).

3.3 Section 3 of the Act prohibits the shooting of deer at night (i.e. between the expiration of the first hour after sunset and the commencement of the last hour before sunrise), except where the action is taken to prevent suffering by an injured or diseased deer.

3.4 Under Section 8 of the 1991 Act (as amended), licences can be issued to shoot deer during the close season or at night to:

- (i) preserve public health or public safety or;
- (ii) to conserve the natural heritage, or;
- (iii) to prevent serious damage to property.

However, such licences can only be issued where there is a serious risk of deer of the species and description to which the application relates causing the problem concerned and where, to achieve the purpose in question, there is no satisfactory alternative to taking or killing the deer in the close season or at night.

3.5 In England (and Wales) the ammunition is specified as being soft nosed or hollow pointed and has traditionally used a copper jacketed, lead cored bullet. This guidance means that a safe 'backstop' is required behind the deer and is one reason why 'high seats' are commonly employed where the ground offers limited opportunities to identify natural backstops.

Urban and peri-urban deer control

3.6 Defra's review (Wilson, 2003) suggested that there would be serious problems in using culling as a management tool in the urban/suburban environment. All the rifle calibres permitted under the Deer Act 1991 (as amended) have potentially lethal ranges of several hundred metres: this raises serious safety concerns in relation to their use in confined areas such as gardens and allotments.

3.6 Under section 19 of the Firearms Act, 1968 it is an offence "without lawful authority or reasonable excuse" to have a loaded shotgun or loaded air weapon or any other firearm (e.g. a rifle), loaded or not", together with suitable ammunition for that firearm, in a public place." in addition the Deer Regulatory Reform Order 2007 amended section 4(4) of the Deer Act, 1991 to permit the shooting of deer from a mechanically propelled vehicle (including an aircraft or boat) provided that it is stationary and the engine switched off.

3.7 Moreover Section 161 of the Highways Act, 1980 states that: "It is an offence without lawful authority or excuse to discharge any firearm within 50 feet of the centre of the highway and in consequence of which a user of the highway is injured, interrupted or endangered." Although a complaint from a road user is required to invoke this legislation it is best to avoid shooting near highways and certainly not across them.

This legislation applies only to public roads used by vehicles, not public footpaths, other rights of way or buildings

3.8 In residential and commercial areas the size of gardens, properties and open spaces makes traditional culling extremely difficult, not least because the co-operative

consent of many landowners is required". Thus any management strategy needs to be coordinated unless management is focussed merely on land in public ownership / jurisdiction.

3.9 Shooting by conventional hunters (including Forestry Commission Rangers) is currently probably the most widely employed method of control in the peri-urban urban environment. In the urban and occasionally in the peri-urban environment other methods are used by a variety of agencies and others such as (Local Authorities, animal welfare organizations and the emergency services) but in a reactive ad-hoc manner. These include:

- Trapping for rehabilitation and release
- Darting for rehabilitation and release
- 'Sharpshooting' by police and other marksmen

3.10 In summary we believe the choice and implementation of effective control methods in England face a number of key obstacles:

- landownership patterns make co-ordinated management problematic.
- public attitudes to culling may constrain any lethal control
- the typically ad-hoc nature of responses reflects a lack of recognition of the scale of the problem and a consequent lack of a standardized protocols and training.
- deer legislation does not recognize the issues involved in urban deer control
- There is a lack of awareness by practitioners of the legislative constraints (see for example para 3.11 below).

3.11 The difficulties of the current lack of an agreed reactive control strategy and legally agreed methods was illustrated by the reaction to the "Milton Keynes stag" in October 2008. In the course of a day police marksmen tried to shoot the deer, a local Animal Sanctuary tried to net the deer and a vet tried to dart and anaesthetize the animal. All these actions took place in the centre of Milton Keynes, but on a variety of land-ownerships. The first option was clearly lethal control but it seems likely that the latter 2 would have resulted in either translocation of the animal or captivity, assuming it survived the trauma. Discussions with the police suggest that the rationale behind the attempted killing/capture of the animal was carried out under Common Law 'to protect people and property' (pers comms Watson/Thornley). It appears that at no time was consideration given to the Deer Acts. It is almost certain that any action that had resulted in the death or capture of the stag would have been in contravention of at least one part of the Acts. Whilst acting to protect people and property might be a defence for the police or others acting on their behalf they cannot claim exemption from this legislation though it is unlikely that the Crown Prosecution Service would consider a prosecution to be in the public interest, nevertheless, the possibility exist of a private prosecution.

4. Review of the problem (and management response) elsewhere within Europe

4.1 A thorough literature review (through two academic search engines) failed to discover any published literature on urban deer or their management in any other European countries (although we have learnt that two papers have recently been submitted for publication from UK). We have therefore undertaken our own survey of colleagues (wildlife biologists and management biologists) in 30 different European countries in order to assemble what unpublished information may be available (contributors are listed in Appendix 1). All contacts were provided with a standard questionnaire to facilitate response (Appendix 2).

4.2 Responses from this survey suggest that urbanisation of deer is not generally considered a widespread problem in other European countries (except in regard to increased risk of DVCs), and in general no specific management or specialist management approach is developed to deal with the problem (a summary of responses is at Appendix 3).

4.3 It should be noted however that the fact that urbanisation of deer is not generally recognised as a problem in these other countries should not be taken to imply that it is not a potential problem for the future, or that our perception of a growing problem in the UK is an over-reaction or actually incorrect. Rather the conclusion we should emphasise is that no specific management or specialist management approach is developed to deal with the problem. It is also the case that many European countries have lived with roe deer within their residential areas for many years and do not perceive them as a “new problem”, having designed and adapted properties to cope with what they consider normal and inevitable deer presence since the middle of the twentieth century.

5. Review of the problem within the US

5.1 In the United States most problems (or conflicts) with deer would appear to be associated with suburban or peri-urban areas, although deer have also become established within a number of truly urban parks (see for example papers in McAninch (ed), 1995; Baker and Fritsch, 1997; Decker *et al.*, 2004, Kilpatrick and LaBonte, 2007 for overview).

5.2 The main species implicated are white-tailed deer (*Odocoileus virginianus*) with more locally, problems also experienced with mule deer (*Odocoileus hemionus*), and wapiti (*Cervus canadensis*). Primary concerns relate to increased risk of DVCs and risk of transmission of disease – especially concerns that large peri-urban deer populations may maintain an increased population of ticks and therefore be implicated in the epidemiology of tick borne diseases such as Lyme disease, Babesiosis and Ehrlichiosis (Decker and Gavin, 1987; Stout *et al.*, 1993; Conover, 1995; Kilpatrick *et al.* 1996, Kilpatrick and LaBonte, 2007). There are also concerns about transmission of TSEs (Transmissible Spongiform Encephalopathies) to pets or domestic livestock, since deer in US are now widely infected with Chronic Wasting Disease (CWD) (Doherr 2007, Sigurdson & Aguzzi 2007, Williams *et al.* 2001).

6. Management Approaches in the US

6.1 In most cases, management effort involves control or reduction of local deer population abundance. There is a growing literature on the relative efficacies of different lethal and non-lethal approaches to population control (e.g. Jordan *et al.*, 1995; Stradtman *et al.*, 1995; ver Steeg *et al.*, 1995; deNicola, et al., 1997, 2000; Doerr, McAninch and Wiggers, 2001) and the public reaction to these different styles of management (e.g. Stout, Knuth, and Curtis, 1997; Messmer *et al.*, 1997a; West and Parkhurst, 2002; Kilpatrick *et al.*, 2007). Based on the literature, a summary of the relative costs of these control methods is included at Appendix 4.

6.2 Whilst there is continuing debate about the potential of non-lethal techniques, such as capture and translocation, or immuno-contraception, in the vast majority of instances, only lethal methods (increase in conventional hunting pressure, sharp-shooting by rifle or bow, or capture for euthanasia) would appear to be generally effective (e.g. deNicola and Williams, 2008), although local successes with immuno-contraception have been reported (Rutberg & Naugle 2008b).

6.3 Control is often carried out within designated open areas (e.g. public parks) but may also be targeted more widely through suburban areas (deNicola and Williams, 2008) reporting on control programmes directed specifically at reducing rate of DVCs on Iowa City, Iowa; Princeton, New Jersey and Solon, Ohio, or Rutberg & Naugle (2008b) documenting reduction in DVCs on a 233 ha research campus).

Non-lethal methods

Capture and translocation

6.4 Relatively little has been published on the effectiveness of live-capture and translocation. It is clearly an appropriate method only where relatively small numbers of animals are causing a specific problem in an identifiable local area and is not perhaps more widely applicable to more generalised problems or ongoing population control. deNicola and Williams (2008) note that it is no longer an option in most States because of high costs, unsuitability of release sites, risks of transmission of disease within deer populations (e.g. Chronic Wasting Disease) and concerns over stress caused to captured deer (on capture and relocation; Ishmael and Rongstad, 1984; O'Bryan and McCullough 1985; Witham and Jones 1990; Conover, 2002). Conover for example notes that few relocated deer survive even as long as a year after relocation.

Immuno-contraception

6.5 Immuno-contraception as a technique is widely advocated and perhaps favoured as a first recourse by the general public. Two immuno-contraceptive vaccines have been developed and tested in the USA to the point of applying for product registration. These are Spay-VacTM, an adjuvanted vaccine based upon porcine zona pellucida glycoprotein, and GonaConTM, an immuno-contraceptive GnRH vaccine. Both have been proven to be effective in single-dose delivery to deer. Unfortunately the production of Spay-Vac has now ceased, because of commercial considerations (Fraker pers comm.). GonaConTM now has regulatory approval from the US Environmental Protection Agency (EPA) for use in female white-tailed deer (*Odocoileus virginianus*) (USDA 2009). Ongoing studies at the National Wildlife Research Centre, USA are exploring expanding application of this product to other species, including securing Experimental Use Permits from the EPA to treat female fallow deer (*Dama*

dama) and female elk (*Cervus elaphus*) (Fagerstone *et al* 2008) GonaCon™ is currently used in the UK under a licence for research by workers at the Food and Environment Research Agency (Massei *et al* 2008). The majority of research and field trials have taken place in North America, although some of the species on which trials have been undertaken are species which occur within the UK (red, sika, fallow and muntjac (e.g. Fraker *et al.*, 2002; Deigert *et al.* 2003).

6.6 Immuno-contraceptive vaccines have been shown to be effective in a wide range of mammalian species including a number of deer species (e.g. Miller *et al.* 2000, Fraker *et al.* 2002). GonaCon™ has been shown to reduce fawning rates in white-tailed deer by 86% (Gionfriddo *et al.* 2006). No detrimental effects of vaccination of female white-tailed deer with GonaCon™ have been identified that could jeopardize normal health (Curtis *et al.* 2008).

6.7 However, there can be significant welfare issues associated with the use of these techniques (see Putman, 1997; Green, 2007). Specifically treatment of male deer with GnRH vaccines such as GonaCon™ leads to atrophied antlers that do not harden or shed their velvet with possible negative health and welfare consequences (Killian *et al.* 2006). Female deer treated with PZP immuno-contraceptive vaccines continue to cycle and show normal reproductive behaviour thus extending the rut (Fraker *et al.* 2002). It has been widely speculated that this extension could lead to exhaustion of males and increased deer-vehicle collisions, although there are no empirical data to support such contentions (Rutberg & Naugle 2008b).

6.8 Fertility control can be effective in deer (e.g. *inter alia*: Kirkpatrick *et al.* 1997, Rudolph *et al.* 2000; Curtis *et al* 2002, Rutberg *et al.* 2004; see also wider reviews by Putman, 1997 and Green 2007). In a recent study over a twelve year period using immuno-contraception and discouragement of feeding, the population of white-tailed deer in an urban island community increased by 11% per year for the first 5 years and then declined by 10% annually as the contraception and management changes took effect (Rutberg & Naugle 2008a). Actual population reduction is comparatively slow and dependent on natural mortality, or some additional agent of imposed mortality. However, (Rutberg & Naugle 2008a) demonstrated that, in white-tailed deer, the population will decline provided that productivity is reduced to below 0.4 fawns per doe per year. Nevertheless, it has been argued that deer are not ideal candidates for immuno-contraception because of their relatively low productivity and high survival rates, especially as some have argued that fertility control is potentially more effective for small-sized, r-selected species, characterised by high productivity and low survival (e.g. Hone 1992). However, this view only reflects the length of time taken for population effects to occur and not the amount of effort required in terms of the proportion of populations that need to be rendered infertile to realise population reductions (see Cowan *et al.* 2006). For instance, Cowan & Massei (2008) concluded that even modest levels of infertility can reduce populations of species with low intrinsic rates of increase, but it will take longer for these effects to be realised in long-lived species.

6.9 Furthermore, it is now clear that contraception can cause significant population effects in long-lived wildlife species (e.g. Kirkpatrick & Turner, 2008). Various authors have suggested that more than 50% of fertile females will need to be maintained infertile to achieve meaningful reductions in ungulate numbers (e.g. Swihart and deNicola, 1995; Seagle and Close, 1996; Hobbs *et al.* 2000; Rudolph *et al.*, 2000; Walter *et al.*, 2002; Merrill *et al.* 2003). Hobbs *et al.* (2000) developed an ungulate population model that concurs with

this general view but also indicates that fertility control can potentially be more efficient than culling, in terms of the numbers of animals treated annually.

6.10 There is good evidence that long-term immuno-contraception of large herbivores can lead to enhanced survival of barren females (Turner and Kirkpatrick 2002). Following the onset of contraceptive treatments, a population of white-tailed deer declined only by an average of 7.9% per year in one study in Gaithersburg, Maryland; Rutberg *et al.* (2004) while Seagle and Close (1996) argued a need for a 5-10 year planning horizon to see real changes in equilibrium population size. For projects where immuno-contraception has been successful, it is notable that the deer were initially habituated to human presence and that darts were delivered at ranges of only 15-20 metres. It is possible that darting could lead to increased movement away from study areas (Rutberg & Naugle 2008a). However, there is no empirical evidence for this effect which mirrors similar conjecture with respect to culling by hunting (e.g. Brown *et al.* 2000).

6.11 The majority of research and field trials have taken place in North America, although some of the species on which trials have been undertaken are species which occur within the UK (red, sika, fallow and muntjac (e.g. Kirkpatrick *et al.*, 1996; Fraker *et al.*, 2002). Limited investigation indicates however that muntjac, one of the species most likely to present problems in urban UK situations, are much less responsive to manipulation of endocrine function and require frequent booster doses of GnRH agonists (Asa & Boutelle 2007, Penfold *et al.* 2007).

6.12 No robust general assessments have been made of the relative costs of immuno-contraception although, given the need for at least one capture to inject the immuno-contraceptive vaccine, it is likely to be inherently more costly per treated animal than culling by hunting (e.g. Kilpatrick *et al.* 2007). Furthermore, the use of immuno-contraception alone cannot rapidly reduce overabundant deer populations. Instead, it is probably a tool to be used mainly in conjunction with other wildlife management methods, for instance, in urban fringe residential areas and parks where methods such as hunting are not routinely feasible, and especially where deer populations are small and discrete (e.g. Rudolph *et al.* 2000). In this context, Hobbs *et al.* (2000) predict that permanent contraception poses a higher extinction risk to small populations than culling while Bradford & Hobbs (2008) suggest ways of identifying the optimum combination of culling and contraception to manage overabundant ungulate populations.

Lethal methods

Capture for culling

6.13 In some instances, control of numbers has been attempted through trapping, or darting of animals prior to euthanasia. This approach can in principle be used in areas where there is some concern about discharge of firearms in close proximity to human habitation; however such an approach has been assessed or considered only in a few locations (Jordan *et al.*, 1995; deNicola *et al.*, 2000). Trapping methods have included box traps, drop nets or rocket nets, but as with capture for relocation, costs tend to be prohibitively high (deNicola *et al.*, 2000).

Conventional hunting with rifles

6.14 The management and administrative structures for management of deer populations in the US are significantly different from those operating in the UK where in effect landowners determine policy and practice, mostly unilaterally, or more rarely as part of a voluntary Deer Management Group (Putman 2009a).

6.15 In the US, state wildlife agencies have the legal responsibility to manage wildlife so that their abundance and occurrence are compatible with habitat and consistent with public interest (Messmer *et al.*, 1997b). The state determines policy (and population limits) and culling is controlled by issue to hunters of individual licences to take up to a specified number of deer of a given species, age and sex. Under such a system (also operative in *some* parts of Europe, such as France, parts of Switzerland; Putman 2009b), licences may be issued up to the quota desired by the appropriate wildlife agency.

6.16 Thus some control over population levels or overabundance can be achieved simply through the device of increasing the number of licences (or licensees) authorised under conventional hunting systems (see examples in Decker *et al.*, 2002, 2004; Kilpatrick *et al.*, 2007).

6.17 However, in a number of areas, firearm hunting has been limited as a result of perceived concerns about safety and firearms discharge regulations (Kilpatrick *et al.*, 2007). The success of hunting-based deer management programmes depends in US as in UK on access to private lands. Reduced hunter access, resulting from, for example, attitudes regarding hunting or opposition to lethal methods of control, health and safety concerns, reduced size of land holdings in residential areas, or even deed restrictions on public land (Messmer *et al.*, 1997b) may have a profound influence on efficacy of such an approach.

6.18 One solution to this has been through approval of increased quotas delivered through much more controlled hunting within large parks or wildlife refuges (e.g. Doerr *et al.*, 2001, Decker *et al.*, 2002, 2004). Alternatively population reductions may be delivered by highly trained riflemen (“sharpshooters”) working within publicly-owned areas (parks or other public open space). This may be assisted by deployment of feed (baits) to attract deer to a safe area for shooting (see below). Improved rates of population control have been achieved in peri-urban situations in some States by initiating “earn a buck” schemes, in which hunters are only permitted to take a trophy male when they have culled three deer without antlers (Kilpatrick and LaBonte 2007).

Bow-hunting

6.19 In some States, although not the majority, it is legal to hunt deer with a bow. In Pennsylvania and Maryland, use of compound bows was legalised specifically to overcome problems associated with the discharge of high velocity rifles in urban areas in the management of urban deer populations (Kilpatrick *et al.*, 2007). Use of bows may be accepted as part of a strategy of general increased hunter licensing (Kilpatrick *et al.*, 2007) or as part of an approach based on controlled hunts within parks and other open areas (e.g. ver Steeg *et al.*, 1995; Kilpatrick and Walter, 1999).

‘Sharpshooting’

6.20 In the majority of cases, it would appear, control of urban and peri-urban deer populations in the US is carried out by experienced, highly trained and often professional, riflemen operating in safe zones within truly urban areas or within country parks (e.g.

Deblinger and Rimmer, 1995; Jones and Witham, 1995; Stradtman *et al.*, 1995; Doerr *et al.*, 2001; deNicola and Williams, 2008).

6.21 Doerr *et al.* (2001) consider the relative cost and effectiveness of four different population management methods used in Bloomington, Minnesota, to reduce white-tailed deer populations citywide. Deer removal methods evaluated were:

- controlled hunts within large parks and refuges (as above)
- opportunistic sharpshooting by conservation officers on patrol,
- sharpshooting over bait by park rangers in a county park,
- sharpshooting over bait by police officers on small public land tracts.

6.22 The controlled hunt was the only method that generated revenue (fees charged to hunters) but nonetheless cost \$117/deer killed to operate (1993 prices). Costs/deer killed using conservation officers and park rangers as sharpshooters were similar - \$108 and \$121, respectively. The highest cost (\$194/deer killed) occurred when police officers were used as sharpshooters but the highest kill rate (0.55 deer/hr) was achieved when 'sharpshooters' shot deer over bait.

6.23 Doerr *et al.* (2001) concluded that in the US urban context, sharpshooting over bait is the most adaptable method and can be used in many urban situations. Doerr *et al.*'s review of comparative costs was published in 2001; we have attempted to update this with a summary of more recent published analyses in Appendix 4. It should be noted however that relative costings do not necessarily translate directly to the UK situation.

Public acceptability of different forms of control

6.24 Inevitably, the general public have a mixed attitude both to recognition of any need for deer control in urban areas, and in relation to a preference for lethal or non-lethal methods (O'Donnell and Vandruff, 1983; Kilpatrick *et al.*, 1996, 2007; Messmer *et al.*, 1997a; Stout *et al.*, 1997; Decker *et al.*, 2002, 2004; West and Parkhurst, 2002). Many urban residents enjoy seeing wildlife in residential areas (Connelly *et al.*, 1987; Decker and Gavin, 1987; Conover *et al.*, 1995) and thus experience some conflict in understanding need for control. Managing deer can thus be especially problematic in urban situations, both because hunting-based deer management strategies may not be feasible in many urban-suburban areas but also because of active public opposition to lethal methods of control (Kellert, 1988; Decker and Richmond, 1995, McAninch, 1995; Messmer *et al.*, 1997a).

6.25 An apparent increase in public opposition to lethal control may lead managers to perceive that stakeholders are more likely to accept non-lethal than lethal techniques to reduce the damage associated with overabundant deer in urban environments (Curtis *et al.* 1993, Wright 1993; Messmer *et al.*, 1997a). However, as noted, few non-lethal methods are especially effective, and general consensus among wildlife managers is that lethal methods of control are required to control deer populations in urban situations.

6.26 In practice, recent evidence suggests that as damage levels caused by deer in urban environments increase, tolerance towards deer declines (Decker and Purdy, 1988; Kilpatrick *et al.*, 1996; Loker *et al.*, 1999) and residents are more likely to accept lethal population control techniques (McAninch, 1995; Loker *et al.*, 1999; Messmer and

LaBonte, 2003). Siemer *et al.* (2004) found that homeowner acceptance of lethal management strategies increased if residents were themselves directly affected by deer problems.

Who carries out the control in the USA?

6.27 This depends upon the strategies adopted for control: whether or not this involves non-lethal methods of control or authorised sharp-shooting (above), or is mediated through encouragement of an increased hunter harvest through granting of an additional quota of conventional licences, or through controlled hunts in reserves or other public areas. Control may be carried out in the US by:

- Government or local Government employees (eg. staff of Fish and Wildlife Service, countryside rangers);
- experienced riflemen (contract sharp-shooters; police), or with;
- community involvement

It is noted however that the most effective approaches generally involve use of experienced riflemen (e.g., again, Doerr *et al.*, 2001; deNicola and Williams, 2008 and above 6.20-6.23)

6.28 However, because of public “involvement” with wildlife in the urban area, and because so many urban residents identify with deer which colonise urban and peri-urban areas, some measure of community involvement is strongly advocated by many authors, even if this is only to confer some measure of involvement or ownership of the decision-making process.

6.29 The importance of this involvement of the community in the decision-making process, even if not in the actual control to be carried out, is highlighted by many authors (Messmer *et al.*, 1997a; Siemer *et al.*, 2000, 2004; Decker *et al.*, 2002, 2004; Raik *et al.*, 2006; Kilpatrick and LaBonte, 2007; Decker *et al.* 2002, 2004) present a number of different models through which this can be achieved as:

- EIS (Environmental Impact Statement)/Public Consultation
- Agency partnership with local community councils
- Homeowners’ Associations
- Direct community vote for action
- Direct citizen action

Decker *et al.* present examples of each of these models (summarized in the table at Appendix 5, from Decker *et al.*, 2004) and develop detailed case histories of experience in each of the different type of stakeholder involvement.

7. Options for urban and peri-urban deer control in England

7.1 Our review has led us to conclude that in any approach to the management of deer within the urban and peri-urban environment it would not be feasible to seek to eradicate deer or totally prevent colonisation. We believe that those responsible for determining strategy should, in development of those policies, acknowledge that people like to see wild deer and, where possible and appropriate, this consideration should be integrated into local wildlife and habitat management strategies.

7.2 We would suggest that there are four areas to consider for any deer control strategy in the urban or peri-urban environment:

- (i) Who makes decisions?
- (ii) When should action be taken?
- (iii) What action should be taken?
- (iv) Who carries out the action?

This section deals with the last two aspects in the greatest detail, as the control methods used and the personnel involved are closely linked and are a key focus of this review.

(i) Who makes decisions?

7.3 Evidence from the US (Messmer *et al.*, 1997a; Siemer *et al.*, 2000, 2004; Decker *et al.*, 2002, 2004; Raik *et al.*, 2006; Kilpatrick and LaBonte, 2007) and Scotland (Dandy *et al.*, 2009) highlights the importance of community involvement in the decision-making process, even if not in the actual control to be carried out. We accept this evidence and believe that we should ensure community involvement in urban and peri-urban deer management decision making. Dandy *et al* recommend that such an approach should facilitate broad partnerships where responsibility for action is shared, which enables innovative management solutions to be implemented including, where necessary, affecting changes in the behaviour of people and communities.

(ii) When should action be taken?

7.4 Options available to address potential problems in urban areas should start with prophylactic measures in the surrounding peri-urban area. If not there is a real risk that if management is only reactive (ie when negative impacts are high), then it is already too late and much more stringent reactive management will be required..

7.5 Prophylactic action using conventional hunting techniques would seek to take action to prevent colonisation of urban areas by deer in the first place (or reduce additional recruitment to existing populations). This could be done by control operations in the urban fringe or peri-urban areas to create a zone of reduced deer density which would in turn reduce the number of available colonists. Even with such prophylactic action it is likely that additional management effort would be needed to respond to individual local issues as and when these occur.

7.6 The prophylactic element of this approach requires ongoing management, at an appropriate scale. This element of any deer management policy should be continuous and

integrated into routine deer management in the wider landscape. We believe that this can only be effectively achieved as part of a formal, planned, deer management strategy agreed in advance by all the relevant stakeholders.

7.7 The reactive element of any strategy will, by necessity, be responsive to particular individual problems. However, approaches and methods to be used should have been previously debated and appropriate methods agreed in advance, to facilitate a rapid response in case of need.

(iii) What action should be taken?

7.8 Whilst not addressed in this review we would stress that in both the urban and peri-urban environments part of any control effort should be focused on control of impacts (agriculture, horticulture, commercial forestry, amenity woodlands, etc.) by the use of preventative measures (fencing, tree guards etc.). This should include raising the awareness of all concerned that deer are present in the surrounding area and incorporating some consideration of their presence in forward planning to take appropriate precautionary action.

7.9 Some part of the control strategy must inevitably be directed towards control of deer populations themselves. In addition to conventional hunting, our research and enquiries have identified possible control methods in addition to conventional hunting that might be considered for use in peri-urban and urban areas.

Non-lethal methods

Immuno-contraception

7.10 “Contraception is not a substitute for hunting” as a means of reducing populations (Fagerstone *et al.*, 2008). As we have indicated earlier, the methodology *is* available for immuno-contraception, but all the constraints and considerations of efficacy, expense and effort required mean that from a human resource perspective, it is unrealistic in practical terms. The delivery of contraceptive doses to free ranging deer can only currently be achieved by darting or by injection. There are no proven immuno-contraceptives that can be given orally to wild deer. Oral contraceptives, based upon steroid hormones, can be given to captive animals, but would be unacceptable in non captive animals because of environmental contamination via urine and faeces and because venison from such deer would be dangerous.

7.11 In practice immuno-contraception is likely to be effective only in limited circumstances (and primarily in treatment of enclosed populations of deer, such as in parks or zoological collections). The withdrawal of the PZP Product Spay Vac™ has limited available preparations and although GonaCon™ is being trialled in the UK under the auspices of the Central Science Laboratory, recent efforts to obtain this product for use in deer parks have been unsuccessful. UK workers indicate that any use of GonaCon™ must be in strictly controlled situations where deer can be captured, sampled and tested to determine efficacy and indices of therapy and toxicology. The recent licensing of Gonacon in the USA may alter some of these constraints, but the supply of the product will remain limited for some time (Cowan pers comm.).

7.12 In summary immuno-contraception is known to be:

- a) expensive;
- b) problematic (catch for injection or dart), and;
- c) extremely time consuming (effective control requires treatment of a large proportion of the entire female population).

In reality we do not believe that currently the use of immuno-contraception can replace conventional management to reduce densities of deer in peri-urban areas.

Capture for translocation

7.13 The capture of deer, either in conventional nets or traps is inevitably stressful and has a high incidence of traumatic injury. There is also no evidence to prove deer do not return to the area from which they have been removed; finally, trans-located white-tailed deer rarely survive even a year (Conover, 2002) begging the question of why one should put in all the time, effort and expense, and the inevitable stress caused to the animal in such attempts.

7.14 As already stated the capture of deer, either in nets or traps is stressful and has a high incidence of traumatic injury. There is ample evidence that restraint and distress induce significant alterations of physiological parameters which rapidly become pathological (Neilsen 1999). It is questionable whether the compromise of welfare associated with capture outweighs the welfare implications of humane killing for a species that is abundant rather than scarce. Furthermore, the species in the UK that is most amenable to being trapped, the muntjac, is extremely vocal when restrained, which is likely to lead to public anxiety if trapping is undertaken in an urban environment.

7.15 Darting with narcotic agents is extremely difficult in smaller, free ranging deer. Apart from the costs of the drugs and darts (in excess of £45 for a muntjac at 2010 prices), all available agents take at least a few minutes to achieve a knock-down, by which time the darted deer may have moved a considerable distance at significant speed. None of the agents are safe to leave in the environment and the risk of lost darts, primed with potentially fatal drugs, is very great indeed. Darts fitted with radio-tracking transmitters are available at costs in excess of £100 per dart, but only currently available in 13mm calibre, which are less accurate than the 11mm counterparts. The increased weight of the dart severely limits the effective range. Under the terms of current UK legislation, a licence is required to “take” deer by means of dart-delivered anaesthetics (and then only for scientific research).

Lethal methods

7.16 In the USA the most effective control method appears to be the use of accurate “sharpshooters”, with cull rates improved further by using baits to attract the deer (see for example Deblinger *et al.*, 1995; Jones and Witham, 1995; Stradtman *et al.*, 1995; Doerr *et al.*, 2001; deNicola and Williams, 2008). The American urban situations in question are however, much more open and less densely built-up than the UK counterparts with larger gardens and more open spaces than in the UK residential and commercial areas where muntjac and roe are becoming established. There is no doubt that the use of firearms and ammunition necessary to kill deer humanely is problematic in UK built-up areas, but recent and current developments may alter the margin of safety.

Frangible Ammunition

7.17 Frangible, or “soft,” rounds are designed to break apart when they hit walls or other hard surfaces to prevent ricochets. They were originally designed for close-quarters combat or law enforcement applications. Frangible ammunition represents the first viable revolutionary change to firearms science in the past 100 years. Frangible bullets are not made from a lead projectile covered with a copper jacket, but are composites of hybrid materials either pressed together at high pressure or glued together with adhesives.

7.18 Frangible bullets will break up into small, less harmful, pieces upon contact with anything harder than they are. This maximizes the transfer of energy from the bullet to the object and minimizes the chances that pieces of the bullet will exit the object at dangerous velocities. Each of the small fragments quickly loses any energy and therefore poses very little danger to any secondary targets. This means that full-power frangible bullets can be fired at targets at all practical ranges down to muzzle contact without any worries that the bullet or case will ricochet and potentially hurt either the shooter or others. Additionally, it should be noted that there is growing evidence that the lead from shot and bullets is a significant environmental and health problem.

Night shooting and weapon sight design

7.19 The recent developments in thermal imaging (TI) and image intensifiers have the potential to increase safety in night shooting in addition to making such operations significantly more effective and reducing disturbance. However, current deer legislation evolved during a period when poaching was considered a major issue and thus developments that are perceived to increase the risk of poaching have been proscribed in law. In addition whilst modern weapon sights are available they have been developed for the military market and are still expensive and their use is also constrained by anti-terrorist legislation. The cost of a thermal imaging (TI) weapon sight is typically in the order of £5,000 with support imagers costing from £20,000 to £50,000.

Sound moderators

7.20 One significant difference between US conventional hunting and the UK is the use of sound moderators (not silencers) for culling deer. In England a significant number of hunters now use sound moderators to reduce hearing damage and disturbance. This is now generally accepted by the police and the use of sound moderators allows deer to be culled discreetly close to human habitation during the day and at night. Research is currently underway to confirm the efficiency of sound moderators in reducing disturbance of humans and wildlife and the results should be available shortly (pers comms Watson/Ellis BASC).

Shotguns

7.21 Section 4 of the 1991 Act (as amended) currently prohibits the use of smooth-bore guns (including shotguns) except in certain specified circumstances. However, where there are reasonable grounds to believe that deer are causing damage to property, under Section 7(2) shotguns may be used where the gun is 12-bore or more and loaded with certain ammunition. NE advise that anyone considering using a shotgun to kill deer in an urban/suburban environment must have regard for the exact wording of the Deer Act 1991 (as amended) and satisfy themselves that they meet the criteria within the Act. In particular, it should be noted that Section 7 of the Act only applies to certain people, for example the occupier of the land in question, or those with the right to kill or take deer on that land.

7.22 Experience elsewhere in the world suggests that at close range (50-100 yards) a shotgun shooting slugs can work well for hunting deer and other large game animals. However, shotguns using solid slugs are not intrinsically safer than rifles and conventional ammunition and are considerably less accurate.

Hunting with bows

7.23 The perceived safety issues relating to firearms suggest that it may be necessary and sensible to consider the use of accurate, high powered bows and arrows or bolts for the shooting of urban deer. Both muntjac and roe are relatively small and have thin skin. Modern broad head hunting arrows are capable of inflicting fatal wounds by means of severe haemorrhage and of achieving rapid death in such small animals.

7.24 The accuracy of both compound hunting bows and crossbows exceeds the accuracy of dart rifles and both bows and crossbows are silent in comparison with firearms. However, understandable public anxiety might be generated by the consideration of such weapons for these purposes. It would therefore be essential to preface any such proposal with strictly controlled trials and with the clear understanding that there was no proposal to sanction bow hunting in general in the UK.

7.25 In particular recent studies into wounding rates and hunter success in the USA suggest that although this might offer a potential additional option for urban deer control it may not be possible to address the potential animal welfare implications of even strictly controlled use of these weapons (pers comms Watson/Johnson).

Use of baits

7.26 Personal experience of one of the authors of this report (Peter Green) suggests that muntjac can be attracted to bait (carrots, feed beans, maize kernels) easily for the purposes of darting for re-location, but that roe take many weeks of baiting before they regularly loiter at feeding stations, even when other food is scarce. Wild free ranging red deer and fallow deer are rarely short of food in lowland UK and attempts to dart them by attracting them to feed stations have been unproductive. These species are less likely to establish urban populations than smaller species.

Capture for culling

7.27 Live capture using rudimentary single animal traps is routinely used in US experimental stations and is extremely successful for mule and white-tailed deer. We are also aware that baiting has been used successfully for live-trapping of roe and wild boar, in for example Sweden, France and the Netherlands. However we would suggest that harsh winters with a consequent lack of available feed is a major factor in the success achieved and it is unlikely that such conditions will occur regularly in the UK given the current mild climate and the ready availability of garden and amenity planting.

7.28 Emparkment for culling, or the enclosure of larger numbers of animals in a permanent or temporary fenced enclosures, may offer an alternative option at least in the peri-urban situation (if not within truly urban contexts) and there is a historical precedence for trapping wild deer on a large scale in England to start or enhance collections. An adaptation of this technique (by baiting for example) could provide a cost effective approach for the capture of the larger species (red, sika and fallow). The Deer Commission for Scotland (DCS) have

recently employed capture for culling on red deer range and have developed guidance to support such operations to address practical and welfare issues (pers comms Watson/Fraser; DCS). We recognise however that this would only be effective in specific situations.

7.29 Clearly any form of trapping (whether box-trap or baiting into larger enclosures) would not be problem free, not least as members of the public may cut fences if not fully supportive of such operations. However, for peri-urban areas such as Ashridge and Ashdown, it seems likely that a major proportion of the population could be baited into purpose-fenced areas.

7.30 This approach would require:

- Legislative change - such 'trapping' would need to be given exemption from the Deer Act (to be included as an option where other control methods are ineffective or impractical).
- Influencing public attitudes.

7.31 For less extreme cases in more urban parks / disused industrial estates etc, we believe a similar approach at smaller scale, enclosing perhaps just 2 to 5 ha in selected areas may also have some potential. The main issue in each case would be to identify most suitable locations that can be fenced securely, and within which culling by rifle could be made safe (i.e. where fences not likely to be cut; and where public access can be controlled). However, for urban areas, aside from parks, brownfield sites are often present and could probably be utilised to create trapping-enclosures.

7.32 Muntjac trap enclosures: the 'deer park' type trap enclosures described above are most likely to be successful in areas with high fallow deer densities (or high numbers of other large herding deer – such as sika and red deer). For muntjac and roe, which tend to live in much smaller home range areas, a single trapping enclosure located within a given landscape may be insufficient to attract and capture enough individuals. Nevertheless, muntjac have a tendency to attempt to exploit any gaps in fences by pushing underneath, which could be utilized in designing capture pens, e.g. by provision / testing of **muntjac gates** into trap pens (possibly designed along similar lines to badger gates though somewhat larger).








7.33 In the case of muntjac, some development work may be required:

- to test differing one-way gate or deer leap designs to see whether they will readily take to them;
- to design and test differing, possible mobile fencing designs.

As muntjac live in relatively small territorial ranges, the capture-enclosure approach might work best if capture locations are quite small (perhaps just 1 ha) to fence in possibly some dense scrub cover within selected areas; and then once a few have been captured and dispatched, dismantling the pen and re-erecting in another part of the range.






Determining appropriate control methods

7.34 The table below summarises our view of the relative merits of the methods outlined above and their appropriateness in the two environments.

Non-lethal methods	Peri-urban	Urban	Comment
Immuno-contraception	x	x	Currently not yet developed to allow use in any open environment.
Capture for translocation	x		Costly but potentially necessary for rehabilitation and where lethal control is unacceptable.
Darting	x		For rehabilitation and where lethal control is unacceptable.
Lethal methods	Peri-urban	Urban	Comment
Conventional hunting		x	Remains the most cost effective approach if public support and collaboration can be achieved.
Sharpshooting			Preferred option, but costly and many potential developments and constraints. Legislative change may be required. (See section 3).
Bowhunting	x	x	Public acceptability of potential wounding rates probably preclude even if legislation allowed.
Capture for culling			Costly but potentially necessary for culling where sharpshooting cannot be carried out safely.

(iv) Who should carry out control?

7.35 We have briefly examined the potential options for who should carry out deer control in both the urban and peri-urban environments. The current options are broadly:

Personnel	Peri-urban	Urban	Methods
Police			SS
Local Council	?	?	
Natural England			CT, D, CC?
Professional and recreational hunters			CH, SS,
Specialist task forces			CT,SS, D, CC

Key	
	SS = Sharpshooting
	CT = Capture for translocation
	D = Darting
	CC = Capture for Culling
	CH = Conventional hunting

7.36 All of these deer control methods require specific competences. Many man-hours of shooter or darter or hunter input are required and teams of deer managers have found that the demands of one small community area have occupied much if not all of their available time (deNicola et al 2000). Suitably trained, qualified and indemnified *local* people are therefore most likely to be successful. The current high proportion of competent recreational hunters and deer managers in this country and the relative paucity of professional wildlife managers means that unless priorities change dramatically the most effective way of providing sufficient local controllers is to provide training, equipment and the legal framework

for recreational hunters to carry out prophylactic management and where possible reactive management under professional guidance.

7.37 We believe that reactive urban control is and should remain primarily a police role (with support where necessary) and this action must be focussed on managing any incident to guarantee public safety rather than trying to ensure the survival of the deer, nevertheless any action taken must be carried out by trained, competent individuals using the method most appropriate to the situation.

8. Conclusion

8.1 There are a number of areas that require further development if the methods above are to be employed for urban and peri-urban they are to be used in a coherent manner to ensure that the highest animal welfare and human safety requirements are achieved and any activity receives the necessary public acceptance.

8.2 We suggest further work is required in the following areas:

- Coordination and standardisation of approaches including identification of relevant skills in organisations and individuals to address the growing deer issues in the urban environment.
- Developing live capture techniques for individual and groups of animals and adapting current legislation and Best Practice to enable the use of these techniques
- Examining developments in firearms and ammunition to establish suitable criteria to improve 'sharpshooting' capability and adapting current legislation and Best Practice to enable the use of these techniques
- Ensuring local community involvement in the decision-making process, even if not in the actual control to be carried out.

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Appendix 1: respondents to the urban deer management questionnaire

Information on the status of deer in urban areas and level of response in different European countries was kindly provided to us by:

- Austria:** Professor Fritz Reimoser, Research Institute of Wildlife Ecology, Vienna Veterinary University, Austria.
- Belgium:** Dr Jim Casaer, Research Institute for Nature and Forestry, Scientific Institute of the Flemish Government, Geraardsbergen, Belgium.
- Czech Republic:** Drs. Miroslava Barančková and Jarmila Prokešová, Dept. Mammal Ecology, Institute of Vertebrate Biology, Academy of Sciences of the Czech Republic, BRNO, Czech Republic.
- Finland:** Drs. Vesa Ruusila and Ilpo Kojola, Finnish Game and Fisheries Research Institute, Finland.
- France:** Dr Mark Hewison, Director, Laboratoire de Comportement et Ecologie de la Faune Sauvage, Institut National de la Recherche Agronomique (INRA), Toulouse, France.
- Germany:** Dr Jorg Beckmann, Institut fur Wildbiologie, Deutsche Forstverein, Gottingen, Germany.
- Hungary:** Professor Andras Nahlik, Faculty of Forestry, University of West Hungary, SOPRON, Hungary.
- Italy:** Professor Marco Apollonio, Department of Zoology and Evolutionary Genetics, University of Sassari, Italy; Dr Stefano Focardi, Istituto Superiore per la Protezione e la Ricerca Ambientale, Ozzano nell'Emilia (BO), Italy.
- Netherlands:** Dr Sip van Wieren, and Dr Geert Groot Bruinderink, Resource Ecology Group, Wageningen University, The Netherlands.
- Norway:** Dr. Erik Lund, Directorate for Nature Management, Trondheim, Norway.
- Portugal:** Professor Carlos Fonseca, Department of Biology/CESAM, University of Aveiro, Aveiro, Portugal.
- Slovenia:** Dr. Bostjan Pokorny, ERICo Velenje, Velenje, Slovenia.
- Spain:** Professor Juan Carranza, Department of Biology and Ethology, University of Extremadura, Caceres, Spain.
- Sweden:** Dr Petter Kjellander, Grimso Wildlife Research Station, Riddarhyttan, Sweden.

Appendix 2: urban deer management questionnaire.

PROBLEMS OF URBAN AND PERI-URBAN DEER AND THEIR MANAGEMENT

- 1. Country:** **2. Respondent** (Name and contact details) :

A. PRESENCE OF DEER IN URBAN AREAS

- 3. Is colonisation of urban areas widespread in your country?** **Yes/No**

If Yes:

- 4. In what cities/ towns** [please name]

- 5. Which species of deer are involved in urban areas?**

- 6. Please list the ways in which urban deer are already considered to be causing problems in your country.** (Ring all those issues listed below which apply)

damage to gardens/parks; damage to buildings/paths/infra-structure

increased risk of deer-vehicle collisions; increased risk to human health;

increased risk of transmission of disease to household or domestic livestock;

Other reasons: (please list):

B. Management

- 7. Is**
a) general (background) management carried out to keep urban deer populations low?
or b) is management carried out only in response to an actual problem arising?

Answer (a) or (b)

8. What management is carried out in cases of problems?

- i) Regular control of urban deer populations to low levels with high velocity rifle?
- ii) Shooting of problem individuals with high velocity rifle?
- iii) Shooting, but exemption under the law to allow use of shotguns, small calibre rifles or other weapons?
- iv) Capture for culling?
- v) Capture for translocation?
- vi) Other method (please specify?)

9. Who carries out management/control? (Please ring the appropriate answer)

Private individuals; Local gamekeepers, or local hunters association;

Public employees (municipal or regional staff)?

Other. (Please take space to explain)

10. Do you consider the methods used to manage urban deer populations in your country

Effective / Not effective?

Please add reasons why you consider this management approach effective or not effective.

Also now please add any other additional information not covered in this form which you consider relevant – and what improvements you think could be made to the management of urban deer in your country.

With many thanks for your help
Rory Putman.

Appendix 3: summary of questionnaire responses

Country	Is colonisation of urban areas widespread in your country?	Which species of deer are involved in urban areas?	In what ways are urban deer causing problems?	Is management prophylactic or responsive?	What management is carried out in cases of problems?	Who carries out management/control?	Do you consider the methods used to manage urban deer populations in your country	NOTES
Austria	No, widespread colonisation of urban areas by deer, and also no signs of increased problem (up to now). Only red fox and other predators (e.g. badger, marten) are problematic in urban areas.		Problems with deer are rare (e.g. in gardens or cemeteries at the outer areas of cities and settlements).		Any problems are usually managed individually between land owner and the hunter or hunters' group responsible for the hunting district. ³	The hunters or Hunters' Association to which the Game Management District has been allocated.		During the winter period there is widespread supplementary feeding of roe deer and red deer, and therefore the pressure of deer to come into urban areas is not high.
Belgium; Flanders	Peri-urban, not urban. Flanders can be considered as one big 'peri-urban area'.	Roe, occasionally fallow.	Damage to gardens/parks/ plantations and small scale forestry. Increased risk of DVCs.	Prophylactic; general management to keep populations at acceptable levels. None in truly urban areas where where regular hunting activities with high velocity rifles is not possible.		[Peri-urban] Local individual hunters or local hunters associations.	Acceptable population levels of roe deer are achieved in the peri-urban landscape; but in urban areas it has not been possible to achieve lower risks for DVCs nor damage to	The law requires an area of at least 40 ha of 'hunting rights' before hunting with high velocity rifles is possible – this forms a limitation for population control in urbanised

³ In Austria even built-up areas fall within approved a hunting districts, whether or not it is possible to shoot there; cf. Czech Republic.

							gardens and parks.	areas.
Czech Republic	Not urban, but suburban.	Roe can be seen in villages (gardens, cemeteries, sometimes also inside the village), small towns, or the suburbs of big towns and cities.	No formal reports other than DVCs.	These are not considered part of licensed hunting grounds and no regular hunting management occurs.	Animals found are usually left alone, only very rarely are they caught and removed (translocated) by police (or special groups).	Police or Wildlife Groups.		
Finland	Not widespread.	White-tailed deer, moose.	Increased risk of deer-vehicle collisions; increased risk to human health.	Both, but predominantly reactive to individual issues.	Regular control of urban deer populations to low levels; shooting of problem individuals with high velocity rifle.	Local hunters association; public employees: municipal staff or police officers.	Effective.	
France	No; greater concern with wild boar.		Increased risk of deer-vehicle collisions although this is not an especial problem of urban areas. More than 9000 DVCs involving wild boar in 2008, and more risk in urban areas.	Generally prophylactic, through ongoing management, but increased quotas may be granted in peri-urban areas in response to specific problems.	Regular control of deer populations in the wider area using standard hunting methods.	Agents responsible for organising the control of pest species (either through hunting, trapping, etc.) over a given local area.	Not really effective: difficulties in hunting near human habitations and where people are present.	
Germany	Yes; examples from Hanover (Lower Saxony) Gluecksburg (Schleswig-	Mostly roe and fallow; occasionally also wild boar (Berlin).	Increased risk of deer-vehicle collisions.	Prophylactic; general peri-urban management to keep populations	Regular control of urban/peri-urban deer populations with high velocity	The hunters or Hunters' Association to which the Game Management	Effective.	

	Holstein) Berlin.			at acceptable levels.	rifle.	District has been allocated.		
Hungary	Not widespread, but roe do occur in urban parks and in peri-urban areas.	Roe. Urbanisation of deer is a rare phenomenon in Hungary affecting mainly roe deer. There are however increasing problems with urbanization of wild boar.	Some damage to gardens and parks, but not a widespread issue; increased risk of DVCs.	Reactive.	Shooting of problem individuals with high velocity rifle; also exemption to permit use of shotguns, small calibre rifles and crossbows.	Local gamekeepers, or local hunters association responsible for game management in the surrounding area.	Yes	
Italy	Not extensive; but colonisation in (e.g.) Bolzano, Arezzo, Pisa.	Red deer, Roe, Fallow.	Increased risk of DVCs; increased risk to human health.	Reactive only.	Shooting, but exemption under the law to allow use of shotguns, small calibre rifles Capture [presumed for translocation]	Public employees (municipal or regional staff).	Effective for solution of individual cases, but unlikely to be effective in the long run because it is not linked to a specific policy but just to the needs of the moment.	
Netherlands	No.	Roe; fallow	damage to gardens/parks; increased risk of DVCs.	Both In general, it is attempted to separate deer areas from urban areas by fences. If this does not work, then <i>ad hoc</i> management is applied.	Shooting of problem individuals with high velocity rifle. Capture for translocation (generally this does not work and people move to culling).	Local gamekeepers, or local hunters association.	It is effective because we do not really have URBAN deer but more peri-urban deer (in large parks or agricultural fields) where they can be shot without problems for humans.	

Norway	No colonisation inside towns, with exception of roe deer in some areas, but (as Sweden) deer populations in areas surrounding the towns, frequently visit the populated areas.	In the western part of Norway red deer are the most common. Roe deer are most frequent along the coastline from Stavanger to the Swedish border, from Oslofjord to Lake Mjøsa and around Trondheim. In all other parts moose are the most frequent visitor.	Damage to gardens/parks; increased risk of deer-vehicle collisions; increased risk of transmission of disease to domestic livestock (already apparent in some rural areas).	Prophylactic.	Regular control of urban deer populations to low levels with high velocity rifle, with increased quotas agreed in problem areas.	Private individuals and public employees.	Effective.	
Portugal	No, but increasing deer populations imply increasing risk; some problems in <u>peri-urban</u> areas.	Red (roe).	Peri-urban: impacts on agriculture and forestry from red deer especially.	Largely reactive.	Standard management methods with increased quota in areas where damage is acknowledged.	Local game managers; individuals.	Not effective.	
Slovenia	Only limited cases; e.g Ljubljana.	Roe.	Damage to gardens; crop damage in areas with intensive vegetable production; increased risk of DVCs.	None.	None. Hunting in urban areas, as well in suburban areas of is totally forbidden.	Hunting not allowed in urban areas.	Hunters have no possibilities to resolve the problem, although they have to compensate the damages.	Inside the area of Ljubljana about 1000 ha of forests (called "green belt") are found. They represent good to moderate roe deer habitat, with additional feeding space in edge areas. Due to recreational use any hunting

								was banned.
Spain	No, but local problems.	Roe deer (mainly in the north and northwest of Spain (Asturias, Galicia). Red deer in some areas in the southwest (Extremadura).	DVCs (roe deer in north); Disease transmission to livestock (red deer in livestock areas in the south and southwest).	Reactive, but in practice little is done.	Routine game management in peri-urban areas; nothing specifically in towns/cities.	Game managers, in accordance with agreed culling plans, but nothing special regarding urban areas.		
Sweden	For animals fully resident in the urban environment, Stockholm, Gothenburg and perhaps Malmö, are the only towns in Sweden big enough. If you define urban deer as animals visiting urban or suburban areas seasonally or on an occasional basis, then the problem is widespread.	99% roe deer and the remaining 1% would be in a few areas with fallow and occasional young moose.	Damage to graveyards; damage to private gardens and parks; increased risk of DVCs.	Reactive.	Shooting, but exemption under the law to allow use of shotguns, small calibre rifles or other weapons.	Municipal staff.	Effective in solving immediate, short-term issues.	

Appendix 4: Costs of different control methods in the US, from the literature.

Method	Cost (US\$)	Date	Reference	Comment
“Sharp-shooting”	91 - 260		de Nicola <i>et al.</i> 1997; 2000	summarising many studies
by general hunters	108-121	1991-1993	Doerr <i>et al.</i> 1994	
by Police	194	1991-1993	Doerr <i>et al.</i> 1994	
	144	1997	Butfilowski <i>et al.</i> 1997	\$144 for 1127 deer
by contractors	354	2008	deNicola & Williams, 2008	\$354 for 3400 deer
Capture –relocate	400- 2931	1984, then 1995 prices	Ishmael & Rongstad, 1984; Ishmael <i>et al.</i> , 1995; Drummond, 1995; Mayer <i>et al.</i> 1995	
	431		O’Bryan & McCullough	\$431 per deer, but with 85% mortality
Immuno-contraception	1000	mid-1990s	Kilpatrick <i>et al.</i> , 1997	\$1000 for 145 deer

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Appendix 5: a comparison of deer management models on several key decision-making dimensions (from Decker et al. 2004)

Model type	Examples Location (veteran)	Who makes decisions about firearms discharge?	Who makes decisions about lethal control of deer?	How are deer management decisions made?
Community vote	Bedford Township (Deblinger)	Town selectmen	State wildlife agency and Town selectmen	By popular vote at town meetings
	Moneghan Island (Lavigne)	Town selectmen	State wildlife agency and Town selectmen	By popular vote at town meeting
EIS/public consultation	Gettysburg NMP (Frost)	Federal land manager (Gettysburg NMP)	Federal land manager (Gettysburg NMP in this case)	EIS process, plus other forms of citizen participation with local and national stakeholders (including local and state government)
Agency partnership	Montgomery County (Gibbs)	Director, Montgomery County Parks	State wildlife agency and county parks administrators	By park director, with input from a multi-agency deer management work group (county, state, and federal stakeholders)
Homeowners' association	Mumford Cove (Kilpatrick)	Homeowners' association and individual homeowners	State wildlife agency and homeowners' association	By vote of the governing board of a homeowners' association
	Governor's Land (West)	Homeowners' association and individual homeowners	State wildlife agency and homeowners' association	By vote of the governing board of a homeowners' association
Citizen action	Irondequoit CTF (Hauber)	Homeowners' association	State wildlife agency and city, town, and county governments	By approval of county legislature, considering recommendations from a CTF and coordination with city and town officials
	North Haven CTF (Lowery)	Town government	State wildlife agency and village board	By vote of a village board, with consideration of recommendations made by a CTF
	Cayuga Heights (Riehlman)	Village trustees	State wildlife agency and village trustees	By vote of village trustees, with consideration of recommendations made by a village deer committee
Citizen-agency partnership	Union County Parks (Lund)	Board of freeholders (for county parks)	State wildlife agency and board of freeholders	By vote of board of freeholders, with consideration of CTF recommendations

