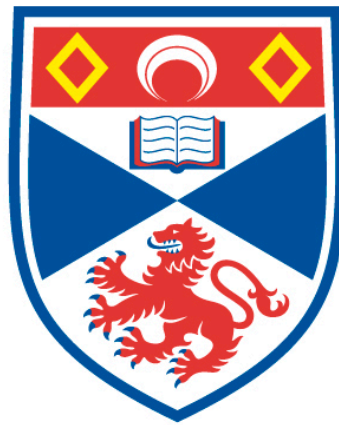


Managing urban deer in Scotland : understanding perceptions to
shape policymaking

Abigail Claire Ella Whitefield

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Dedication

For Mum, Little Grandma and Big Grandma.

Mum, thank you for taking me on those Scottish Highland coach trips from Suffolk.

Little did we know, I'd fall in love with the place.

I hope I have made you all proud.

Abstract

Rising populations of deer in Scottish urban areas are creating increased potential for conflict, raising questions about whether they need to be managed. Yet, there has been little research or policy focus on urban deer in Scotland thus far. This thesis investigates perceptions of urban deer and their management in Scotland, including the role of Local Authorities, to help shape future policymaking on the topic. Four methods were used: (i) interviews with experts, (ii) a Q-methodology study with Local Authority staff, (iii) an online survey of local councillors and (iv) a postal survey of the public. Whilst urban deer are generally welcomed in Scotland, views on whether deer numbers are too high differed between stakeholders. Perceptions of the impacts of urban deer were also varied, but deer-vehicle collisions and deer welfare were the issues recognised most frequently. There was broad consensus that urban deer need to be managed. However, current practices are perceived to be insufficient, with NatureScot and Local Authorities having paid limited attention to urban deer thus far. Views differ on which management methods should be used in the Scottish urban context. Clear differences between rural and urban deer management emerged, with fragmented landholdings (such as in dense housing areas) and higher human populations adding challenges to management. There is overall support for Local Authorities taking responsibility for urban deer management on their own land and beyond their landownership. Obstacles to their engagement include concerns about public and councillor perceptions, safety, and a lack of resources, experience and support. Three factors impacting effective urban deer management in Scotland are recognised: the need for context specific understandings and responses, the need for awareness-raising amongst stakeholders to gain support and increase action, and the need to fill gaps in data and research. A policy framework for future effective urban deer management in Scotland is proposed.



Figure 0.1: Deer in urban areas of Scotland. Sources: top left, bottom right and bottom left - David Quarrell; top right - an anonymous survey participant in Perth.

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1. Introduction

1.1. Introduction

When wild animals move into urban areas they inevitably interact with people, creating the potential for human-wildlife conflicts but also offering positive opportunities. By 2050, two-thirds of the world's population is expected to live in urban areas (United Nations, 2018), and this expansion of cities will be accompanied by increased frequency of interactions between humans and wildlife. Urban areas often provide novel habitats for animal and plant species whose natural rural habitats may have declined, with synanthropes (species living in close proximity to humans) often thriving, but sometimes negatively affected by human presence (Hadidian and Smith, 2001; Gehrt, Brown and Anchor, 2011; Collins, Magle and Gallo, 2021). However, despite the wide range of animal species which have lived within urban areas for centuries, urban wildlife, and human interactions with urban ecology more broadly, have been under-researched (Soulsbury and White, 2015; Perry *et al.*, 2020). Although there is growing interest in both urban ecology and human-wildlife interactions in built-up areas, such studies remain few in number compared to those investigating rural wildlife. Social science studies have been highlighted as a priority area for future research on urban wildlife to improve our understanding of human-wildlife interactions and conflicts (Basak *et al.*, 2022). This need is particularly acute for understanding urban deer, which are amongst the largest wild animals that reside in urban areas, with red deer being the largest wild land mammal in the UK (NatureScot, 2022a).

Numerous deer species have progressively settled within urban, suburban and peri-urban areas, resulting in a widespread increase in impacts and management pressures, notably in the USA, Europe and Australia (Figure 1.1) (Putman *et al.*, 2014; Burgin *et al.*, 2015; Adams and LaFleur Villarreal, 2020). Deer can adapt to living in urban environments: they are able to deal with louder and busier environments which would easily spook them in rural areas, and can even benefit from human presence, for instance through increased provision of food (Lowry, Lill and Wong, 2013). This may result in them being considered synanthropes (Hadidian and Smith, 2001; Gehrt, Brown and Anchor, 2011). The increasing frequency of human-deer conflicts has, however, raised pressing questions about appropriate

management responses. Within North American cities, such questions have been on the environmental management research agenda since the mid-1980s, but this is not the case elsewhere, perhaps due to smaller urban deer populations or fewer associated impacts. Within Europe, growing populations of urban deer have rarely been studied, especially in comparison to other urban-dwelling mammals such as foxes and wild boar (König, 2008; Cahill *et al.*, 2012). There has also been limited research on urban deer, and indeed urban wildlife, further afield (Honda *et al.*, 2018; Collins, Magle and Gallo, 2021).

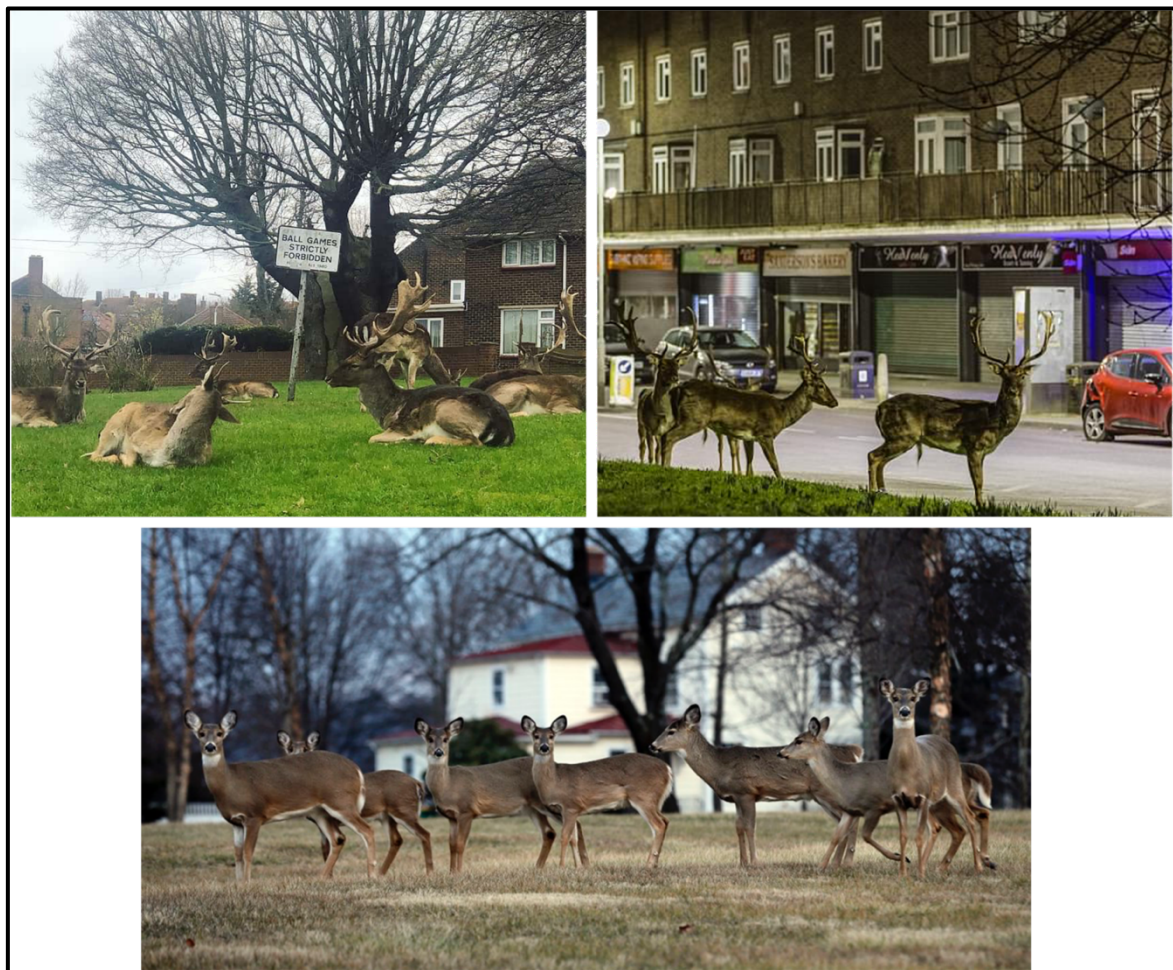


Figure 1.1: Deer in urban areas of the UK and USA (Gordon, 2017; Kolson Hurley, 2017; Mellor, 2020).

1.2. Context: urban deer and deer management in Scotland

Historically, most political, public and academic attention on deer in Scotland has focussed on upland and rural environments (Clutton-Brock *et al.*, 2004; MacMillan and Leitch, 2008;

Davies and White, 2012; Scottish Government, 2014), which reflects the distribution of deer – especially red deer (*Cervus elaphus*) - and the conflicts associated with them. However, it is increasingly believed that urban deer populations are rising in Scotland, meriting more attention (Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). Urban deer present a range of opportunities but also many challenges for humans, the environment and the deer themselves, and in some instances may need to be managed. Local Authorities have been highlighted as potentially playing a key role in urban deer management in Scotland, but no studies have explored their perspectives or preparedness to do so, and many are currently thought to be unengaged (Pepper, Barbour and Glass, 2019). Consequently, one focus of this thesis is to better understand the role of Local Authorities within urban deer management and the obstacles to their involvement.

Understanding stakeholders' views can help to minimise negative interactions, inform suitable policies and increase the credibility of management decisions for successful and sustainable urban deer management (Lauber and Knuth, 2000b). When managing deer in urban areas, perceptions of the public are even more important than in rural areas, because of increased human-deer interaction as a result of higher human population densities. Within Scotland, several studies have examined public perceptions of deer management (Dandy *et al.*, 2011, 2012; Ballantyne, 2012; Hare, Daniels and Blossey, 2021; Whitefield *et al.*, 2021), but prior to the research reported here, none have specifically focussed on perceptions of deer in urban areas and their management, or on views of other urban stakeholders.

Defining urban areas is a recognised challenge within urban wildlife research and is important for management decision-making (Perry *et al.*, 2020), yet very few studies on urban wildlife define what urban means, making it difficult to understand and compare these studies. Economic activity, population density, infrastructure availability, lack of agricultural activity, scale and ground cover are just some of the criteria used to define urban areas and their boundaries (Roca and Arellano, 2017; Wineman, Alia and Anderson, 2020). However, authors such as Roussea (1995) and Weeks (2010) believe that urban areas cannot simply be defined on the above measures, and need to include aspects such as the composition, feel of a place and type of society. Within the Scottish Government's

classification of urban, population numbers and density are the primary criteria, but the UK Government defines urban differently (Department for Environment Food and Rural Affairs, 2016; Scottish Government, 2016). In the context of Scottish deer management, definitions remain inconsistent, thus proving a challenge for urban deer management (Scottish Natural Heritage, 2019a; Pepper, Barbour and Glass, 2019). Defining where urban becomes rural, and what constitutes suburban or peri-urban (areas which are usually a mix of urban and rural, and terms often used in the deer management literature – areas lying on the rural-urban continuum), is also debated (Forsyth, 2012; Ahmad, Shivamallu and Nusrath, 2014).

Within this thesis, urban deer are defined as those that reside within urban environments, using the Scottish Government's definition of settlements with a population of over 3000 people, or immediately on the edge of these urban environments (for instance, in a field with at least one side touching urban infrastructure) (Scottish Government, 2016). The study focusses on deer in built-up urban areas. In this way, this study differs from studies on peri-urban deer management, where landscapes are predominantly rural but with some urban infrastructure. Additionally, deer can live in areas that 'seem urban' (e.g. through having relatively dense housing or infrastructure), but are classified as rural environments by the Scottish definition, such as in small towns and villages. Essentially, this thesis defines urban deer as those that live in built-up areas, surrounded by a mix of housing, infrastructure, development sites, roads, railways and/or parks (i.e. not surrounded by fields or countryside), making human-deer interactions likely. These urban deer populations can be both within the uplands and lowlands but differ from rural upland or lowland deer populations.

1.3. Aim and objectives of this thesis

The aim of this thesis is to understand perceptions regarding urban deer and their management in Scotland, alongside the role and obstacles to the engagement of Local Authorities, to help inform future policymaking. This study will therefore identify the complexities of deer management in urban environments. To fulfil the research aim, three research objectives (RO) and ten research questions (RQ) have been defined (Figure 1.2):

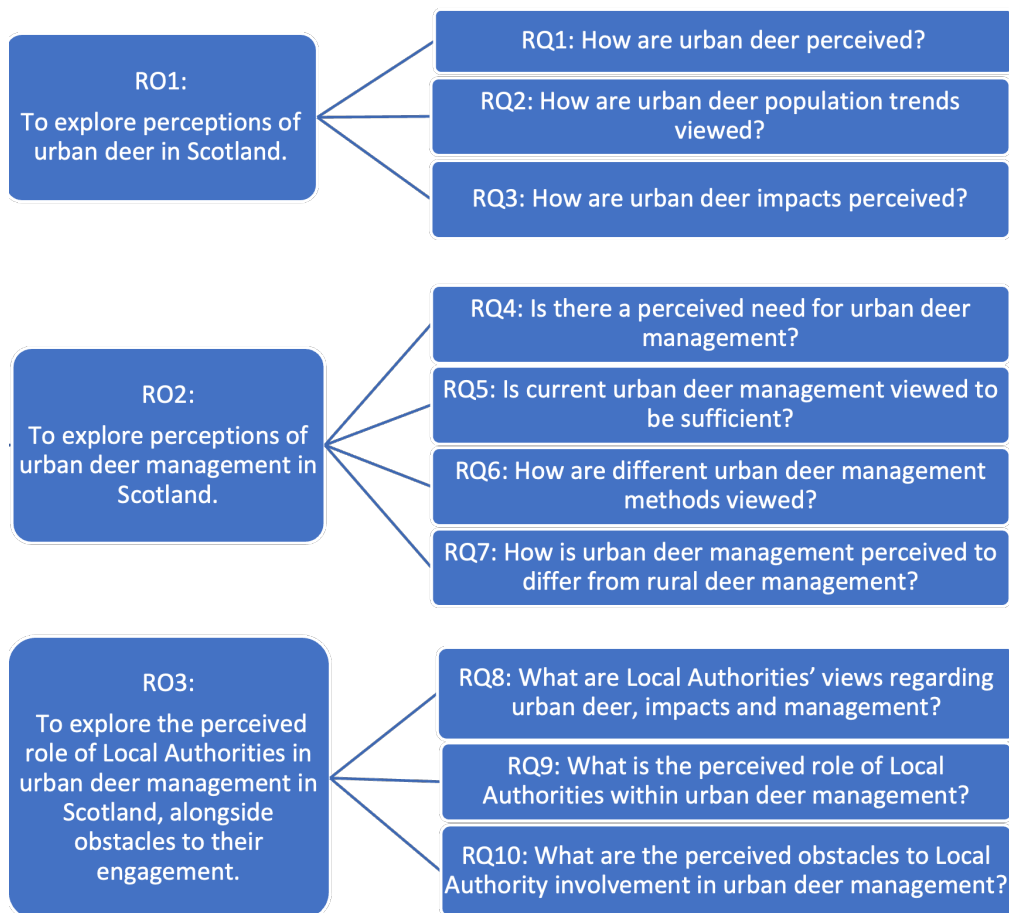


Figure 1.2: The research objectives and questions of this thesis.

To address these research questions, a mixed methods and mixed participant approach has been utilised to gather the perceptions of the key stakeholders within urban deer management in Scotland. Four methods are utilised to gather the perceptions of the four groups of stakeholders:

1. Expert interviews
2. A Q-methodology study of Local Authorities
3. A public survey
4. A local councillor survey

Expert and public participant perceptions are used to address RO1 and RO2, with RO3 predominantly focussed on Local Authority perceptions, supplemented with those of the public, expert and local councillor participants.

1.4. Thesis structure

This thesis is structured into eight chapters. In Chapter 2, relevant Scottish and international literature is reviewed to contextualise this study. A brief overview of deer in Scotland is presented, before focussing on the structure of urban deer management, drivers of their population growth, their impacts and management methods. The importance of perception studies is outlined to situate the research aim, objectives and questions. Chapter 3 presents the thesis methodology, including the rationale for the four methods of data collection and analysis, alongside the limitations of this study. Chapters 4-6 present and discuss the results. Chapter 4 explores perceptions of urban deer in Scotland (RO1, RQ1-RQ3), utilising and discussing findings from the expert interviews and public survey. Drawing further on the expert interviews and public survey, Chapter 5 presents and discusses the findings regarding perceptions of urban deer management in Scotland (RO2, RQ4-RQ7). Chapter 6 focusses on the perceived role of Local Authorities in urban deer management in Scotland and identifies obstacles to their involvement (RO3, RQ8-RQ10), focussing on the Q-methodology study of Local Authorities, supplemented with the councillor survey, expert interviews and public survey. Chapter 7 highlights three factors which could impact the effectiveness of urban deer management in Scotland. It also provides a policy framework towards effective urban deer management and proposes areas for further research. Chapter 8 concludes this study by summarising the main findings in reference to the research aim, objectives and questions and highlights the contributions of this thesis.

2. Urban deer and their management in Scotland

2.1. Introduction

Within Scotland, most research and political attention on deer has historically focused on upland, rural environments. However, there is growing recognition of urban deer, and a widespread perception that their populations are increasing (Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). There has been limited research or policy attention on urban deer in Scotland, perhaps because they have not previously been perceived to be problematic enough to require attention. The only academic studies which have mentioned urban deer in Scotland have either focused solely on perceptions of peri-urban deer, which did not focus on heavily built-up areas, or on locations of deer-vehicle collisions, which were studied across Scotland (DVCs) (Dandy *et al.*, 2009, 2011, 2012; Langbein, 2011, 2019; Ballantyne, 2012). Consequently, much of this review is based on international urban deer literature. However, it should not be assumed that international experience is directly transferable to the Scottish context (7.2.1).

Firstly, a brief overview of deer in Scotland and controversy surrounding their management is presented, highlighting their expansion into urban areas (2.2). Current urban deer legislation, guidance and responsibilities in Scotland are outlined (2.3), highlighting significant gaps within current policy. A review of drivers of urban deer population growth (2.4) and impacts of urban deer is then discussed (2.5). A review of management methods follows this (2.6). Finally, the importance of understanding perceptions of urban deer management is highlighted (2.7), presenting the research gap that the work presented here has addressed.

2.2. Deer in Scotland: a history of controversy

Four deer species reside in the wild in Scotland: red (*Cervus elaphus*), roe (*Capreolus capreolus*), fallow (*Dama dama*) and sika (*Cervus nippon*) (Figure 2.1) (Pepper, Barbour and Glass, 2019).¹ Deer, specifically red, are seen as symbolic of Scotland's highlands, history and culture (Phillip *et al.*, 2009). Deer are of great public interest, having been highlighted by the Scottish public as the species most associated with Scotland (Granville, 2020), and are positively regarded, valued for their existence (2.5.1) (Dandy *et al.*, 2009; Scottish Government, 2014; Scottish Wildlife Trust, 2019; Whitefield, 2019).



Figure 2.1: The four species of deer known to be present in the wild in Scotland. Top left: roe buck. Top right: red stag. Bottom left: fallow buck. Bottom right: sika stag. Source: © Jochen Langbein, used with permission.

¹ Muntjac (*Muntiacus reevesi*) have also been recorded in the wild in Scotland, but it is thought that these sightings do not represent a truly wild population (Scottish Government, 2014; British Deer Society, 2017; Pepper, Barbour and Glass, 2019).

Deer populations in Scotland have changed in number considerably over the years. Roe deer were considered almost extinct in the eighteenth and nineteenth centuries in Scotland, with deer populations thought to total 125,000 in 1920 (Phillip et al., 2009; Ritchie, 1920; Whitehead, 1964). The latest estimates of deer populations in Scotland are 360,000-400,000 red, 200,000-350,000 roe, 25,000 sika and 8000 fallow (Scottish Government, 2014). Deer populations, including roe, have drastically increased, partly due to developments in the way deer are managed in Scotland, which were led by Queen Victoria's purchase of the Balmoral Estate in 1852 (Warren, 2009). The purchasing of highland estates for stalking by aristocrats and industrial magnates became a cultural phenomenon in the late 19th century, with large areas of the highlands dedicated to sport (around 2.5 million hectares at their peak) (MacMillan & Leitch, 2008; Phillip et al., 2009; Warren, 2009). This led to expansions in deer populations as numbers were kept artificially high for ease of stalking, and deer populations have since grown in number, density and range in much of Scotland (Pepper, Barbour and Glass, 2019). Fallow and sika deer, originally kept for stalking on estates, are thought to have first escaped from deer parks in the early twentieth century, forming wild populations.

Growth in deer populations has become more marked since the 1950s, with forest expansion believed to be a dominant cause, alongside milder winters, fewer sheep competition, winter feeding and insufficient culls (Clutton-Brock et al., 2004; Gill & Beardall, 2001; Pepper, Barbour and Glass, 2019). High-density populations of deer are thought to now be widespread throughout much of Europe, with their populations and ranges expanding, with deer present across much of Scotland (Figure 2.2) (Nilsen *et al.*, 2007; Fiorini, Yearley and Dandy, 2011; Carpio, Apollonio and Acevedo, 2021). Deer densities are believed to be beyond environmental and social carrying capacity in many areas, increasingly resulting in negative ecological and societal impacts (Albon *et al.*, 2019). Consequently, numerous authors have called for improved deer legislation and management (Davies and White, 2012; Pepper, Barbour and Glass, 2019; MacMillan, 2022).

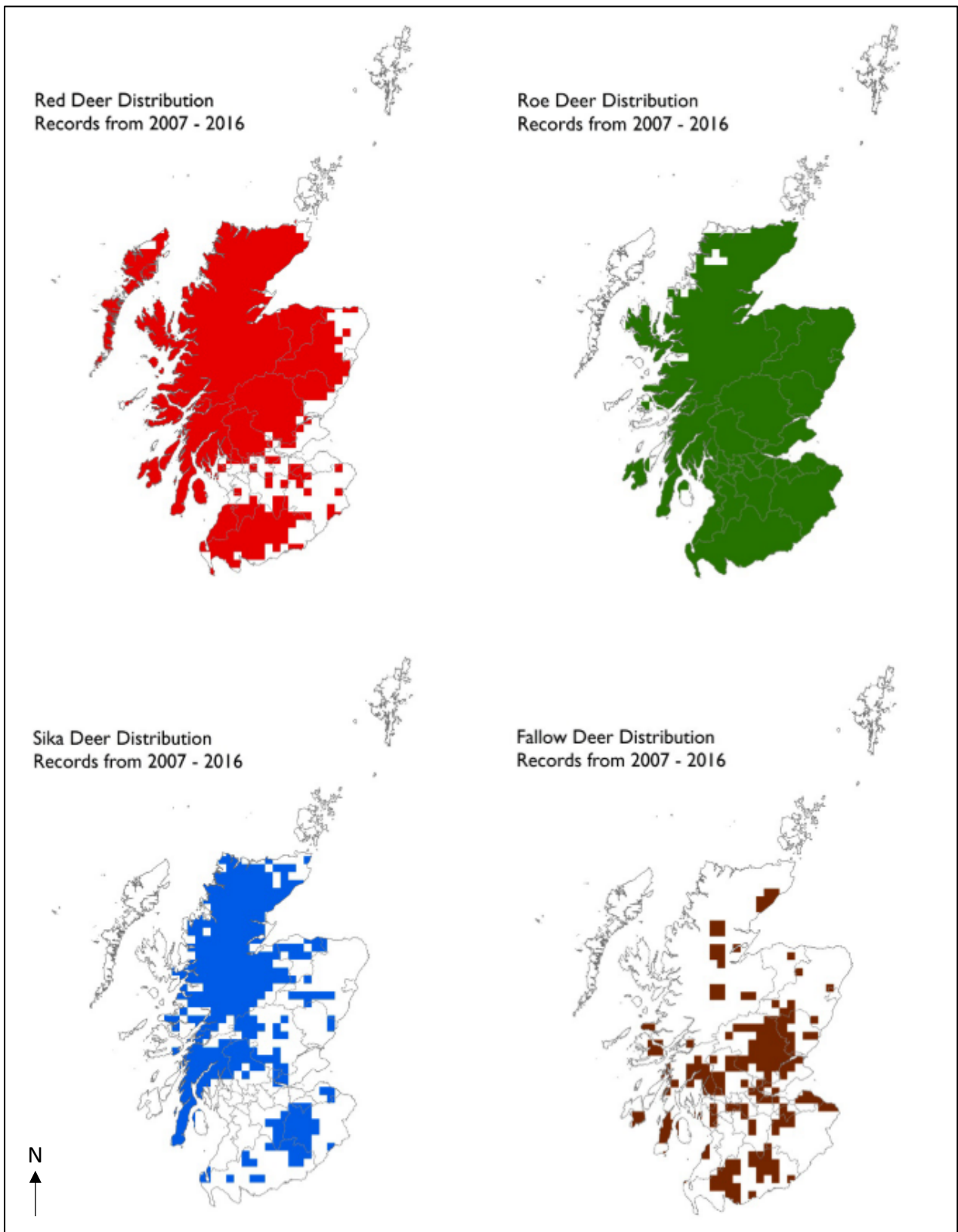


Figure 2.2: Distribution of deer in Scotland, from 2007 to 2016. Source: Graphic from Pepper, Barbour and Glass, 2019, with data from the British Deer Society Deer Distribution Survey.

Deer and their management, predominantly in the upland setting, have been the focus of controversy in Scotland for almost two centuries and remain in the political spotlight today. Under Scots Law, deer are '*res nullius*', meaning they are owned by nobody until they are captured or killed and are free to roam across landholdings (Davies and White, 2012). Consequently, their management is shared between landowners or managers, many of whom have competing interests (e.g. game sport, forestry or crofting) (MacMillan and Leitch, 2008; Scottish Natural Heritage, 2012; Kirkland *et al.*, 2021). Since the late 19th century, controversy about deer in Scotland has focussed on the damage caused by red deer to agricultural and forestry interests in the uplands, prompting numerous governmental inquiries and the creation of the Deer (Scotland) Act 1959 (Warren, 2009; Pepper, Barbour and Glass, 2019).

Despite deer management becoming increasingly regulated over the last sixty years in Scotland, the 'voluntary principle' of Scottish deer management, with landowners deciding how many deer to cull, remains in place (Pepper, Barbour and Glass, 2019). There has been much opposition from the deer management sector to an interventionist approach to deer management, with political, organisational and philosophical tensions present between deer managers and environmental conservation groups who would prefer to see greater regulation (Warren, 2009; Scottish Government, 2010; Nicholson, 2015). Controversy about the management of deer has continued, with the Scottish Parliament frequently considering the topic over the last ten years, including the inclusion of deer in the Land Reform (Scotland) Act 2016 (Pepper, Barbour and Glass, 2019). Debates about intervention, as well as deer population numbers, continue today in Scotland and are largely dominated by upland red deer, although the range of conflicts has grown as deer have expanded their range and numbers in lowland and urban contexts (Pepper, Barbour and Glass, 2019; Cooke, 2020; Kirkland *et al.*, 2021).

2.3. Urban deer management responsibilities, legislation and guidance in Scotland

Although deer have been managed by humans in Scotland since the Normans, modern laws governing deer management in Scotland have only been developed since the mid-20th century, with clear guidance and responsibilities only created much more recently (Edwards and Kenyon, 2013; Pepper, Barbour and Glass, 2019; Phillip *et al.*, 2009). Scotland's deer have been the responsibility of the Scottish Government since devolution in 1999 but were previously the responsibility of the UK Government (UK Government, 2019). A well-developed and extensive policy framework and management structures are in place to manage Scotland's (upland) deer resource, although few of these contain an explicit focus on urban deer, perhaps because their presence and impacts were not previously of concern, especially compared to historically problematic upland deer (2.2). This section outlines the legislation, responsibilities and guidance for urban deer management in Scotland, noting the omission of urban deer from these structures and highlighting the major gaps in policy concerning urban deer in Scotland.

2.3.1. Responsibilities

A wide variety of stakeholders and organisations are responsible for or involved in urban deer management in Scotland. These responsibilities have largely been established for rural and upland deer management contexts, with no formal legislation having been put in place to address deer in urban environments. Figure 2.3 highlights the hierarchy of the key bodies and stakeholder groups with responsibility for, or interest in, urban deer management in Scotland. These are examined in more depth below.

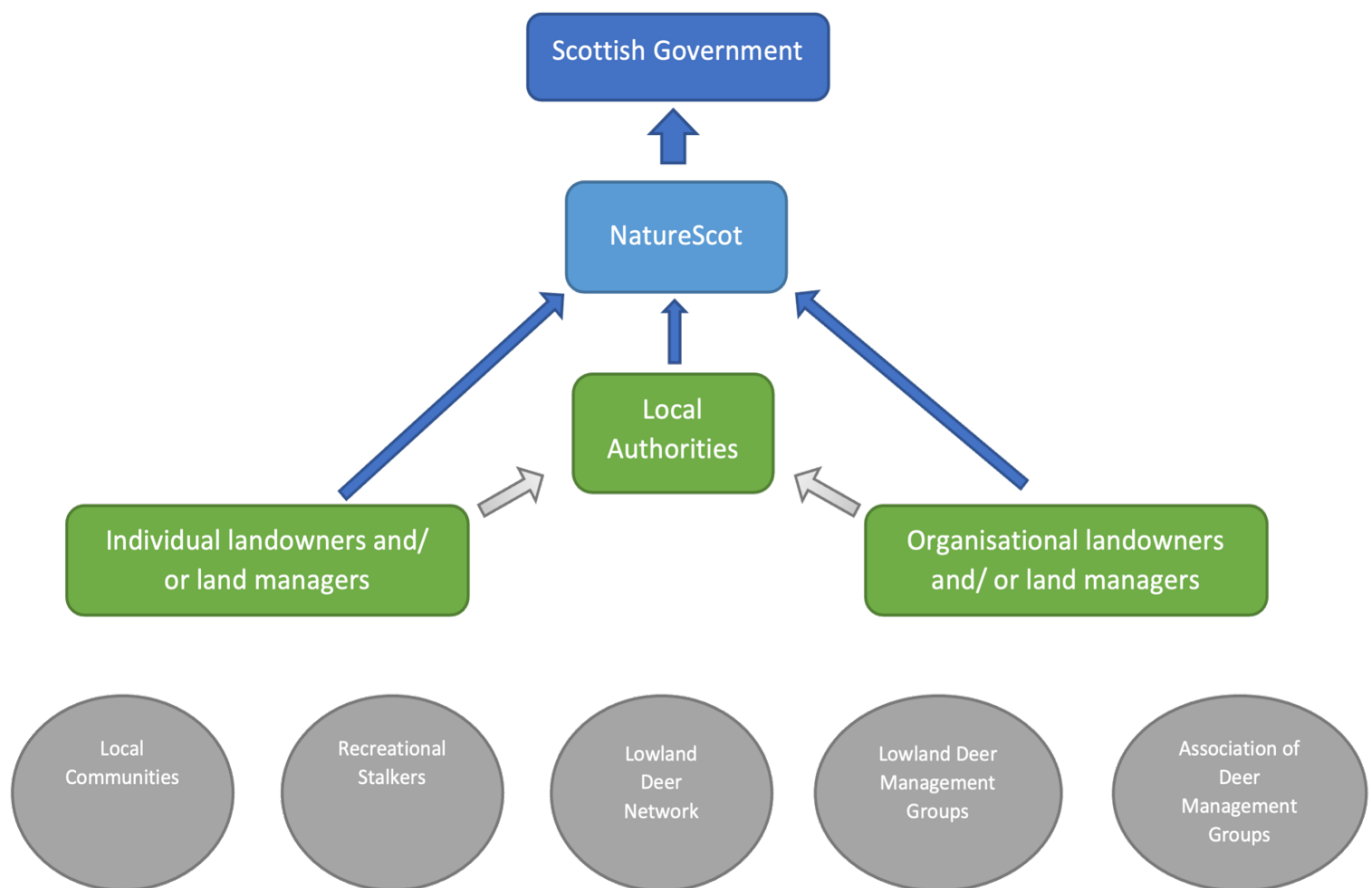


Figure 2.3: A schematic showing the hierarchy of urban deer management. NatureScot have overall responsibility for urban deer management and report to the Scottish Government. Landowners are responsible for urban deer management on their land, and NatureScot is mandated to act if this is not occurring effectively. Local Authorities are suggested to fulfil an intermediate role between landowners and NatureScot, although they currently have the same role as other landowners. Blue arrows show existing responsibilities, with the grey arrows showing proposed relationships as highlighted in existing literature (Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). The grey circles represent wider interests in urban deer management beyond these main stakeholders.

2.3.1.1. NatureScot²

NatureScot has overall responsibility for deer, including within urban areas, having been tasked with deer management through the Public Sector Reform (Scotland) Act 2010 (Scottish Natural Heritage, 2016; Scottish Government, 2018). NatureScot advises the Scottish Government, whilst helping to implement sustainable deer management. Its deer

² Before 2020, NatureScot were known as Scottish Natural Heritage. They are referred to as NatureScot throughout this thesis, but citations may refer to Scottish Natural Heritage depending on their name when documents were published.

responsibilities cover all matters to do with deer, including preventing deer from having adverse impacts on protected sites, ensuring deer are managed collaboratively, protecting deer welfare and improving public safety (Scottish Natural Heritage, 2019d). NatureScot is responsible for working with land managers in urban areas to develop site-specific solutions for urban deer management, whilst overseeing urban deer management on a national level (Scottish Parliament, 2017; Scottish Natural Heritage, 2019b; NatureScot, 2022a). Despite these responsibilities, NatureScot has given limited attention to urban deer, instead restricting much of its focus to rural upland deer management, where it has also been criticised for failing to use its control powers³ (Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). NatureScot is consequently under pressure to make progress and act as a leader for urban (and rural) deer management.

2.3.1.2. Landowners

Landowners and managers in Scotland have responsibility for managing deer across their landholding, in rural and urban areas (Scottish Natural Heritage, 2012). Within urban environments, land ownership is very fragmented, which means a large number and variety of landowners are responsible for urban deer management, adding complexity to management (Pepper, Barbour and Glass, 2019). Landowners and land managers in urban areas range from individual homeowners or small businesses to larger companies and institutions which own or manage bigger landholdings, such as developers, Local Authorities, Forestry and Land Scotland, the NHS or Network Rail (Pepper, Barbour and Glass, 2019). Within current legislation (detailed in 2.3.2), all of these different stakeholders are responsible for managing urban deer on their land, which does not appear to be an effective way of managing deer within urban areas, as there is no collective body to enable and coordinate deer management decision-making or practices. This is important as deer

³ Control powers were bestowed on NatureScot by the Deer (Scotland) Act 1996 - Appendix 1 (UK Parliament, 1996). Control powers include control agreements (where NatureScot agree deer management measures with a landowners where deer are problematic), control schemes (where NatureScot decide the measures for the landowner as there is no agreement) and emergency measures (where NatureScot undertake deer management without the agreement of the landowner if deer are threatening the natural heritage or human safety). Criticism for not using these measures has been present from environmental groups, the Scottish Government (Scottish Government, 2017a) and the Deer Working Group (Pepper, Barbour and Glass, 2019), as natural heritage has been put under threat because of poor deer management.

are likely to have territories bigger than individual landholdings and therefore need to be managed collaboratively.

2.3.1.3. Local Authorities

Local Authorities are potentially well-positioned to take a leading role in urban deer management, with some authors encouraging NatureScot to support and develop them as an intermediate mechanism for deer management (Dandy *et al.*, 2009; Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). This is not a role that they have played in rural areas, nor are they mentioned in existing deer legislation (except for their responsibilities as a landowner). Greenspaces such as parks, cemeteries, verges, woodland walks and surrounding council-owned estates or buildings in urban areas are often owned and managed by Local Authorities and may provide suitable habitat for deer. Additionally, Local Authorities have responsibility for most urban roads, where deer may compromise public safety (Pepper, Barbour and Glass, 2019). Like NatureScot, Local Authorities have shown limited engagement with urban deer management thus far (Holland *et al.*, 2017). This may be due to a lack of awareness of deer or concerns regarding public views, but the obstacles to Local Authority engagement need to be better understood (Holland *et al.*, 2017; Lowland Deer Panel, 2019). NatureScot have recently tried to increase their engagement with Local Authorities, to highlight Local Authorities' role to them, although this is thought to have had limited success, with few having created a deer management plan thus far (Scottish Natural Heritage, 2019a; NatureScot, 2022a). This thesis aims to understand Local Authorities' role in greater depth, alongside obstacles to their involvement (RO3).

2.3.1.4. Other stakeholders

In addition to NatureScot, landowners and Local Authorities, other stakeholders will also affect the success of urban deer management in Scotland, even if they do not have defined responsibilities. Local communities represent a large stakeholder group, with greater potential for human-deer interaction and conflict surrounding urban deer management

(Pepper, Barbour and Glass, 2019). The importance of informing, involving and consulting local communities about urban deer management is highlighted throughout the deer literature as a means of gaining support for management methods, preventing local opposition and increasing trust in decision-making and actions (Stout and Knuth, 1993; Knackmuhs and Farmer, 2017; Lowland Deer Panel, 2019). Recreational⁴ deer managers are a further group of stakeholders involved in urban deer management, as they may undertake deer management in urban areas on behalf of landowners. According to the Lowland Deer Panel (2019) and Holland *et al.* (2017), recreational deer managers feel that they are underutilised in managing deer within urban areas. They may provide a key resource of experienced deer managers. Voluntary organisations such as Lowland Deer Groups, the Lowland Deer Network and the Association for Deer Management Groups may also have an interest in urban deer management, but have failed to engage thus far, instead focussing on rural areas.

2.3.2. Legislation

Modern legislation to protect public interests from deer in Scotland began emerging in the early 20th century, with the Deer (Scotland) Act 1959 the first to focus on deer in Scotland (UK Parliament, 1959). This was consolidated and replaced by the Deer (Scotland) Act 1996 which remains the principal statute on deer management today (UK Parliament, 1996). Three subsequent Acts have included aspects relating to the management of deer in Scotland: the Public Services Reform (Scotland) Act 2010, the Wildlife and Natural Environment (Scotland) Act 2011 and the Land Reform (Scotland) Act 2016 (Scottish Parliament, 2010, 2011, 2016). Details of these Acts can be found in Appendix 1. The management of deer in urban areas was not specifically mentioned in legislation in Scotland until the Wildlife and Natural Environment (Scotland) Act 2011 (WANE Act) (Scottish Parliament, 2011). The WANE Act updated the Deer (Scotland) Act 1996 to include the need to manage deer in urban and peri-urban areas. Under this update, NatureScot must take action when there is deemed to be a need to manage deer populations in urban and peri-

⁴ Recreational deer managers in this regard are most often unpaid, undertaking deer management for pleasure or voluntarily, on behalf of landowners. They predominantly focus on culling deer. In this regard, recreational stalkers do not include hunting tourists who pay to hunt on landowners' land.

urban areas (Pepper, Barbour and Glass, 2019). The fact that urban deer were not mentioned within deer management legislation until 2011 highlights how little attention urban deer have received in Scotland. No further Scottish legislation specifically refers to urban deer populations.

2.3.3. Guidance documents and reports

There are many guidance documents and reports on deer management in Scotland, but few give specific guidance or report on urban deer. The three prominent guides which form the basis of deer management in Scotland (detailed in Appendix 2) - Best Practice Guides, the Deer Code and Scotland's Wild Deer: A National Approach - give limited attention to urban deer, especially compared to rural populations. Within Table 2.1, the governmental guidance documents and reports that mention or omit urban deer management in Scotland are highlighted, demonstrating significant gaps in governmental understanding of and guidance surrounding urban deer. The first document to show an awareness of urban deer was published in 2008, but many have failed to acknowledge urban deer since (Scottish Government, 2008). In many of these documents, urban deer are not mentioned, which particularly seems to be the case in reports written by, or commissioned for, NatureScot, highlighting the lack of attention they have given urban deer thus far. The recent 2019 Lowland Deer Panel Report, 2019 Deer Working Group Report and 2021 Scottish Government Report give more attention to urban deer, with actions recommended (Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). These three most recent reports should make it increasingly apparent to NatureScot that urban deer populations need to be managed, with Local Authorities suggested to play a key role within this.

In summary, urban deer management legislation, guidance and responsibilities have been very slow to develop in Scotland (Pepper, Barbour and Glass, 2019). Deer legislation has mostly ignored the urban dimension, while NatureScot, Local Authorities and lowland interest groups have largely failed to engage with urban deer or their management (Lowland Deer Panel, 2019). However, due to growing awareness of urban deer populations and their impacts, there is an increased focus on the need for urban deer management in

Scotland, and a recognition that guidance documents, legislation and responsibilities need to be updated to rectify this (Pepper, Barbour and Glass, 2019; Scottish Government, 2021).

Table 2.1: Governmental guidance documents and reports on deer management in Scotland, with a focus on information provided or omitted about urban deer.

Guidance document or report	Content related to urban deer, or where urban deer are omitted
Scotland's Wild Deer: A National Approach (Scottish Government, 2008)	<ul style="list-style-type: none"> - Demonstrates awareness that urban roe deer are increasingly present, and presenting a variety of impacts, including deer-vehicle collisions. - Aims to increase awareness surrounding the need for management of urban deer. - Presents very little detail surrounding urban deer, their impacts and management overall.
The Management of Roe Deer in Peri-Urban Scotland (Dandy <i>et al.</i> , 2009) ⁵	<ul style="list-style-type: none"> - Recognises the increasing encroachment of deer into urban areas. - Creates a Decision Support Framework for managing peri-urban deer. - Largely focusses on peri-urban deer populations and not urban. - Presents very little detail surrounding urban deer, their impacts and management overall.
Code of Practice on Deer Management (Deer Code) (Scottish Natural Heritage, 2012)	<ul style="list-style-type: none"> - The code applies to wherever deer are, including urban areas. - No specific guidance is given as to how it should be implemented in urban areas.
Scotland's Wild Deer A National Approach: Including 2015 – 2020 Priorities (Scottish Government, 2014)	<ul style="list-style-type: none"> - Identifies lowland and urban deer as a priority for the 2015-2020 period. - Predominantly focusses on rural deer and does not go into any other detail about urban deer.

⁵ This report was commissioned by the Scottish Government.

<p>Deer Management in Scotland: Report to the Scottish Government from Scottish Natural Heritage (Scottish Natural Heritage, 2016)</p>	<ul style="list-style-type: none"> - Recognises that deer management in urban and peri-urban areas is becoming increasingly important as roe populations expand. - The rest of the report is rural focused, with no further attention given to the complexities of urban deer management.
<p>Best Practice Guides: Deer in Towns and Deer in Towns 2 (Scottish Natural Heritage, no date a, no date b)⁶</p>	<ul style="list-style-type: none"> - Outlines potential complexities of the relationships between deer and humans as they enter urban environments, in regard to deer management. - Outlines the application of the Deer Code and practical guidance for responding to urban deer problems. - Lacks as much detail as is provided for rural deer management.
<p>Lowland Deer Management: Assessing the Delivery of Public Interests (McMorran, Gibson-Poole and Hamilton, 2019)⁷</p>	<ul style="list-style-type: none"> - Focusses on the management of lowland rural (and to some extent peri-urban) deer, largely focussing on spatial data. - No explicit focus on urban areas.
<p>Lowland Deer Management: Assessing the Delivery of Public Interests – Phase 2 (Chetwynd, 2019)⁸</p>	<ul style="list-style-type: none"> - Focusses on the management of lowland rural (and to some extent peri-urban) deer, concentrating on stakeholder deer manager views. - No explicit focus on urban areas.
<p>Assessing Progress in Deer Management - report to Scottish Government from Scottish Natural Heritage (Scottish Natural Heritage, 2019a)</p>	<ul style="list-style-type: none"> - Focusses on progress in upland rural deer management. - No explicit attention given to urban deer, despite a large section focusing on progress in lowland deer management.

⁶ The Best Practice Guides are not solely written by NatureScot. They are created in consultation with other stakeholders in the deer sector.

⁷ This report was commissioned by NatureScot.

⁸ This report was commissioned by NatureScot.

<p>Lowland Deer Panel Report to Scottish Natural Heritage (Lowland Deer Panel, 2019)</p>	<ul style="list-style-type: none"> - More focus on urban deer than previously seen. - Highlights gaps in legislation regarding urban deer. - Recognises the impacts of urban deer, the importance of public perceptions and obstacles to their management in urban and peri-urban areas. - Suggests that further research is needed to improve urban deer management, including on coordination and standardisation of urban management approaches, local-community involvement and the development of management techniques suited to urban environments. - Highlights the importance of Local Authorities in urban deer management, the need for education, and the need to use recreational deer managers' expertise in such areas. - Predominantly focusses on rural lowland deer and much of its content is not relevant to managing urban deer.
<p>The Management of Wild Deer in Scotland: Report of the Deer Working Group (Pepper, Barbour and Glass, 2019)⁹</p>	<ul style="list-style-type: none"> - More focus on urban deer than previously seen, highlighting increasing recognition. - Provides explicit recommendations for urban deer management. - Highlights issues including the expansion of roe deer into urban environments, impacts of these deer and the difficulties of managing deer populations within an urban setting. - Recommends that ongoing dispersal of deer in peri-urban and urban areas should be limited, with increasing focus on implementing urban deer management. - Recommends that Local Authorities should be developed as an intermediate level for deer management.

⁹ This report was commissioned by the Scottish Government.

	<ul style="list-style-type: none"> - Most of this report is focused on rural deer and only gives explicit focus to urban deer on the side.
<p>Scottish Government Response to the Report from the Deer Working Group on 'The management of wild deer in Scotland' (Scottish Government, 2021a)</p>	<ul style="list-style-type: none"> - Highlights that action should be taken regarding urban deer populations. - Recognises that increasing urban and peri-urban deer populations are of serious concern. - Accepts the recommendation that ongoing dispersal of deer into peri-urban and urban areas should be limited. - Accepts the recommendation that there should be increased focus on implementing effective urban deer management. - Highlights that there should be an increased focus on educating and communicating to local communities about the need for urban deer management. - Accepts the recommendation that SNH should be developing Local Authorities as an intermediate level for deer management. - The majority of the recommendations in this report are focussed on rural deer.

2.4. Drivers of urban deer population growth

Increasingly, deer populations are believed to be residing in lowland, peri-urban and urban areas in many countries in Europe (Dandy *et al.*, 2009; Putman *et al.*, 2014; Carpio, Apollonio and Acevedo, 2021). Roe deer especially are believed to be populating urban areas across Scotland, although other deer species are also thought to be present in some urban environments (Pepper, Barbour and Glass, 2019). Sightings of deer in urban areas have received increasing levels of media attention throughout the UK (Figure 2.4) (Hartley-Parkinson, 2017; Hendrie, 2018; BBC News, 2019; Ingram, 2019). Little is known about the numbers or locations of urban deer populations in Scotland, as large-scale surveys of urban deer populations have not taken place¹⁰.



Figure 2.4: Roe deer in Edinburgh and Glasgow. Left: three roe does near Edinburgh University; right: a roe buck on the main shopping street, Buchanan Street, in Glasgow (Cawthorn, 2020; Lennon, 2020).

Numerous factors are thought to be responsible for the growth of urban deer numbers in Scotland, although there is a lack of empirical evidence as to which factors are playing a part. These are also likely to vary from area to area. The creation of green corridors,

¹⁰ Some local surveys have taken place. These include those reported in Gill, Thomas and Stocker (1997), in peri-urban areas of Scotland (Dandy *et al.*, 2009). Surveys in urban Scotland have not been published.

connecting fragments of urban green habitats, enables and encourages deer movement into urban areas (Rotherham, 2001; Goldberg, 2003). Deer can be funnelled into urban areas along railway tracks, rivers or roads, as well as through planted biodiversity corridors (McCarthy, Baker and Rotherham, 1996; Rotherham and Walker, 2015). This behaviour may be further encouraged by some habitats outside urban areas being suboptimal for deer, due to a lack of territory, food resource or shelter, which may be exacerbated by competition due to high deer densities (Watson, Putman and Green, 2009; Dandy *et al.*, 2012; Ciach and Fröhlich, 2019).

‘Greening’ of urban areas in Scotland is expanding suitable habitats, through woodland, parks, gardens, golf courses, verges and nature reserves. Scottish government woodland planting targets are leading to woodland expansion in urban areas, through initiatives such as ‘woodlands in and around towns’, which provide habitat in urban settings for deer (Scottish Forestry, 2020; Scottish Government, 2020). Growing deindustrialised areas and wastelands also provide suitable habitat, and such abandoned areas are often relatively undisturbed (Goldberg, 2003; Holland *et al.*, 2017). Such green spaces may be providing food (sometimes through deliberate feeding by humans) and higher protection from culling, allowing populations to thrive in urban areas (McCance, Campbell and Baydack, 2015; Adams and LaFleur Villarreal, 2020).

Additionally, as the countryside turns ‘green to grey’ through urban sprawl, urbanisation may encroach into previous deer habitats, increasing urban deer populations (Dandy *et al.*, 2009; Stillfried *et al.*, 2017; Curtis, 2020). Deer will have been present before humans moved into some areas, which may explain why they are now present in some urban environments (Dandy *et al.*, 2012). Deer can adapt to living in urban areas, benefitting from human presence (through increased food provision, whether deliberate or accidental) which may result in their increased presence, although they can also be negatively affected (through cruelty, collisions and poaching) (2.5) (Hadidian and Smith, 2001). All of these factors are likely to be playing a part in facilitating the colonisation of urban spaces by deer.

2.5. Impacts of urban deer

As deer move into urban areas, new opportunities and risks emerge for people, the environment and to deer themselves (Soulsbury and White, 2015; Valente *et al.*, 2020). Although many of the impacts discussed below also occur in rural areas, in urban areas increased human proximity with deer can exacerbate impacts (Dandy *et al.*, 2009; Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019). Little is known about the extent of urban deer impacts in Scotland at present. For this review, impacts of urban deer are categorised into opportunities and drawbacks, with known perceptions of these impacts (in urban/suburban USA and peri-urban Scotland) highlighted throughout.

2.5.1. Opportunities

Deer in urban areas can have a range of positive effects on biodiversity and society. Although the biodiversity benefits of sustainable deer populations have been studied by academics in rural areas (Gill and Beardall, 2001; Côté *et al.*, 2004), the impacts in urban areas are poorly understood. Here and in 2.5.2, rural knowledge is therefore utilised to inform understanding of the potential environmental impacts. Deer may play an important role in urban ecosystems, helping to open scrub cover and connect fragmented habitats through their movement, digestion and browsing, which can result in increased seed dispersal in areas where mechanisms are otherwise limited (Scottish Natural Heritage, no date a; Gill and Beardall, 2001; Dandy *et al.*, 2009). This may result in increased biodiversity and ecological variance in urban areas, however the effects of this will be variable, as discussed in 2.5.2 (Gill and Beardall, 2001). Despite this, deer may increase floral diversity which is likely to raise faunal diversity, leading to increases in overall urban biodiversity (Scottish Natural Heritage, no date a; Rotherham, Derbyshire and Wolstenholme, 2012).

Secondly, studies in the urban USA and peri-urban and rural Scotland have found that deer are perceived positively, contributing existence, aesthetic and cultural values to humans (Siemer *et al.*, 2000; Conover, 2001; Dandy *et al.*, 2009; Davies *et al.*, 2011). Red deer are often seen as iconic, charismatic and representative of Scottish culture and history (Warren, 2009; Granville, 2020). Viewing deer, or wildlife in general, is highly valued, providing a

pleasurable experience and potential mental wellbeing benefits (Decker and Gavin, 1987; Soulsbury and White, 2015; Mumaw, Maller and Bekessy, 2017; Perry *et al.*, 2020). In peri-urban and rural Scotland, enjoyment of seeing deer has ranged from 89-96% of public respondents (Dandy *et al.*, 2009; Whitefield, 2019; Hare *et al.*, 2021). Connelly *et al.* (1987) reported that 85% of respondents enjoyed viewing deer in suburban New York. Stout and Knuth (1993) propose that the social benefits of seeing deer may negate any negative experiences. It is not known how this translates to urban Scotland.

Urban deer populations make these perceived benefits more accessible for more people, providing the novel and often valued experience of seeing large wildlife close to home (Dandy *et al.*, 2009; Rotherham and Walker, 2015; Scottish Natural Heritage, 2016). Knowing deer exist locally can, in itself, be beneficial to urban populations and can help connect residents with nature (Dandy *et al.*, 2009; Perry *et al.*, 2020). Urban deer also present an environmental education opportunity (Scottish Natural Heritage, 2012; Rotherham and Walker, 2015). Local populations can become more engaged with their local environment as they begin to see deer, which can lead to increased recognition and valuation of greenspaces (Rotherham and Walker, 2015). These opportunities may be more prevalent than in rural areas, where human-deer interactions are scarcer (Scottish Natural Heritage, 2012; Edwards and Kenyon, 2013).

Thirdly, some economic benefits could potentially be derived from urban deer populations, predominantly through tourism and venison production and consumption (Dandy *et al.*, 2009). With deer holding cultural and aesthetic values, if deer populations are frequently visible, tourists may be attracted to the area, as has been found in locations such as Richmond Park in London and Phoenix Park in Dublin (Burns and Westbrook, 2000; The Royal Parks, 2020; McLaughlin *et al.*, 2022). Additionally, if deer populations are large enough to need to be culled, stalking and consequent venison availability may provide some local economic opportunities (Burns and Westbrook, 2000; Edwards and Kenyon, 2013). However, these benefits are likely to be minimal, with stalking in urban areas presenting many challenges and controversies, especially relating to safety and human perceptions (2.6.2).

2.5.2. Drawbacks

Urban deer can also have a range of negative impacts on greenspaces, their own welfare, and the health and safety of humans. Positive public perceptions of deer have been found in the USA to generally decrease as the impacts of deer increase (Fulton *et al.*, 2004; Dowle and Deane, 2009). Firstly, just as in rural areas, deer populations can cause damage to the natural environment, through trampling, over-grazing, bark stripping and browsing (Gill and Beardall, 2001; Côté *et al.*, 2004; Betras *et al.*, 2022; Loeb and Garner, 2022). Damage to flora by deer can cause detrimental impacts to fauna, as food resources are altered or removed (Baines, Sage and Baines, 1994; Gill and Beardall, 2001; Côté *et al.*, 2004). The selective influence of deer over which species are distributed or browsed, could lead to the spread of invasive non-native species, as they may assist with seed movement into new areas (through transport in their coats, or digestion) or may prefer browsing native species, allowing non-native species to thrive¹¹ (Gill and Beardall, 2001; Knight *et al.*, 2009). Additionally, less tree biomass due to deer browsing can lead to lower levels of carbon sequestration, which reduces the potential for plants to act as carbon stores (Hirst, 2021). Impacts on greenspaces, trees and plants may be more obvious to humans in populated areas than in rural environments (Pepper, Barbour and Glass, 2019). Concerns have been raised in Scotland and further afield about the impacts on gardens, golf courses, cemeteries, woodlands, botanical collections, and allotments within urban areas, with this linked to calls for their management in the USA and peri-urban UK (Decker and Gavin, 1987; Dandy *et al.*, 2009; Lowland Deer Panel, 2019; Jenkins and Howard, 2021). Deer damage has already been recognised on urban botanical collections elsewhere in the UK, for instance at Cambridge University Botanic Garden (Watson, Putman and Green, 2009). A USA study found that 75% of people who saw deer on their property reported deer damage to plantings (Connelly, Decker and Wear, 1987). Although most greenspace concerns are related to the damage that deer can cause to nature in urban areas, damage may also occur to wooden structures, such as fences and benches (Putman *et al.*, 2014; Manning, 2021).

¹¹ This is also the case with native species, as highlighted in the opportunities section.

Secondly, urban areas present risks to deer welfare. Lack of food, the wrong foods, habitat fragmentation and small populations can lead to a reduced gene pool and deterioration in the condition of individual deer (Putman *et al.*, 2014; de Jong *et al.*, 2020; McLaughlin *et al.*, 2022). Risks of entanglement and injury are also greater in urban areas than in rural environments, with more nets, fences, roads and canals present for deer to navigate (Scottish Natural Heritage, 2012; BBC News, 2020). Increased disturbance, light and noise pollution may also affect urban deer by increasing stress levels and affecting natural deer behaviour, including communication, courtship, movement and biological rhythms (Reimoser, 2014; Ciach and Fröhlich, 2019; Jasińska *et al.*, 2022). There is evidence that acts of cruelty towards deer and poaching also occur in urban, peri-urban and lowland areas (Dandy *et al.*, 2009; Rotherham, Derbyshire and Wolstenholme, 2012; Lowland Deer Panel, 2019). These can be both unintentional and intentional, with unintentional examples including dogs attacking and chasing deer when taken on walks (Watson, Putman and Green, 2009; BBC News, 2013). Intentional attacks on deer also occur, with media reports highlighting the killing of deer in a number of towns and cities in the UK (Mills, 2009; Milmo, 2009; McGivern, 2019). In Glasgow, in 2009, multiple cases of mutilated deer were reported (Mills, 2009; Milmo, 2009). Deer were attacked with dogs and air rifles, intentionally coursed for entertainment and left hanging in trees (Milmo, 2009). Dandy *et al.* (2009) state that these acts of cruelty may be taking place in the absence of official control methods. Additionally, DVCs in and around urban areas are causing injury, distress and death of deer (Langbein, 2011, 2019; Rotherham, Derbyshire and Wolstenholme, 2012). Despite this recognised range of potential deer welfare impacts, these have received limited political or academic attention, with no existing Scottish or international studies explicitly focussing on welfare of deer in urban areas.

Thirdly, urban deer can present risks to human health and safety, creating public concern (Jonker *et al.*, 2006; Dandy *et al.*, 2009, 2011; Urbanek, Allen and Nielsen, 2011). DVCs are a significant issue, with frequency increasing in Scotland and Europe (Langbein, 2019; Lowland Deer Panel, 2019; Valente *et al.*, 2020). The most comprehensively documented deer impact in Scotland is DVCs (Langbein, 2019). 5500 DVCs were reported in Scotland between 2016 and 2018, a 20% increase on the previous three years, with real numbers of collisions expected to be closer to 12,000 per year (Langbein, 2019). The increases have been largest

in South Lanarkshire, Clackmannanshire, Falkirk and East Renfrewshire, which may reflect increased deer abundance in peri-urban and urban areas (Langbein, 2019). DVCs not only injure and kill deer but sometimes result in injury and death of vehicle users and cause significant damage to vehicles (Conover, 2001; Rotherham and Walker, 2015; Nelli *et al.*, 2018). In the UK, an average of 12 human fatalities¹² are thought to occur per year due to road incidents involving deer, with numbers of injuries believed to be much higher (Langbein and Putman, 2006; Department for Transport, 2020). When deer enter urban and peri-urban areas, the risk of DVCs can increase, as road networks are more concentrated and there are greater volumes of traffic (Dandy *et al.*, 2009; Watson, Putman and Green, 2009).

The spread of diseases is another risk to human health in urban areas, with the most commonly known being Lyme disease (*Lyme borreliosis*) which is carried by ticks that can be transported by deer (Rizzoli *et al.*, 2014; Hansford *et al.*, 2017, 2022; Ikushima *et al.*, 2021). Lyme disease cases appear to increase as deer populations increase, although this relationship is not linear as deer are not the only hosts of ticks (Gilbert *et al.*, 2012; Putman *et al.*, 2014; Rizzoli *et al.*, 2014). Not all ticks carry Lyme disease, but studies have shown higher levels of infected ticks in urban areas than in rural areas (Hansford *et al.*, 2017). The risk of disease is also increased as human populations may have higher exposure to ticks in urban areas (as there are more people present) and may be less aware of Lyme disease than rural dwellers and therefore less proactive at preventing and responding to tick bites (Medlock, 2014; Rizzoli *et al.*, 2014; Hansford *et al.*, 2022). The presence of ticks in gardens is also increasing, providing more opportunities for ticks to be brought into homes by pets (Medlock, 2014; Smith, 2017). Annual costs of Lyme disease are estimated to be over £500,000 in Scotland, although as misdiagnosis is common, actual costs may be much higher (Holland *et al.*, 2017). Impacts on sufferers are also often very significant. Lyme disease is not the only disease that deer may spread to humans, with tick-borne encephalitis also problematic but less common (Côté *et al.*, 2004; Gilbert *et al.*, 2012; Holland *et al.*, 2017). In addition, deer can spread a variety of diseases amongst themselves and to other species,

¹² This is out of around 1700 fatalities on the UK's roads each year (Department for Transport, 2020).

including bovine tuberculosis, chronic wasting disease and COVID-19 (Dolman *et al.*, 2010; Holland *et al.*, 2017; Hale *et al.*, 2021; Ikushima *et al.*, 2021).

Finally, on rare occurrences, deer can also be a direct threat to human safety. Large deer, especially stags in antler, can cause serious injuries to humans if they panic and charge (The Guardian, 2013; Duarte *et al.*, 2015; Pepper, Barbour and Glass, 2019). In 2013, in Essex, a charging deer hospitalised a woman and knocked over pedestrians on a busy high street (ITV News, 2013). Similar cases have occurred in the USA, with does regularly injuring humans during the fawning season on a university campus (Hubbard and Nielsen, 2009).

2.5.3. Balance of impacts and thresholds for management

The frequency, magnitude and effects of urban deer impacts will be different in every urban area, depending on deer and human populations, locations and human perceptions and values (Fox and Bekoff, 2011; Furnas *et al.*, 2020). Despite there being new challenges as deer colonise urban areas, a lack of negative impacts may be perceived by the public because of limited people-deer interactions, or positive views regarding deer (Fox and Bekoff, 2011; Pepper, Barbour and Glass, 2019). However, in some areas, including in areas of Scotland, urban deer populations are believed to exceed the social, cultural, biological or environmental carrying capacity¹³, leading to negative impacts and perceptions, and calls for them to be managed (Talboys, 2017; Pepper, Barbour and Glass, 2019; Adams and LaFleur Villarreal, 2020; Scottish Government, 2021a). Some studies have found carrying capacities to be exceeded. A study in suburban New York, for instance, found white-tailed deer populations exceed ecological carrying capacity of 20 deer/ km² (Porter, Underwood and Woodard, 2004), and this is thought to be the case in areas of upland Scotland, such as in the Cairngorms National Park (densities of 15-20 deer/ km², in areas thought to have a capacity for 10 deer/ km²), where populations and environmental impacts cannot be

¹³ Carrying capacities are difficult to define and their use is debated. They are not a universal measure (Seidl and Tisdell, 1999). Biological and environmental carrying capacities are often based on deer densities or environmental impacts, although measures are not easy to define. Debates around using densities to decide when deer need to be culled are highlighted further in footnote 14. Cultural and social carrying capacities are likely to be much harder to define, as they will vary dependent on individual's views, experiences or levels of impacts.

sustained (Pepper, Barbour and Glass, 2019). Stewart's (2011) study in suburban and urban Indiana, reported that 50% of respondents believed that there were too many deer present, despite enjoying the presence of deer, demonstrating an area nearing social carrying capacity. This has not been found in studies in Scotland, although few have taken place, and social or cultural carrying capacities have not been defined. In a study by Connelly *et al.* (1987) in suburban New York, 60% of respondents who enjoyed seeing deer stated concern about their impacts. Enjoying seeing deer, therefore, does not stop people from having concerns about their effects. Perceptions are nuanced, multivalent and intertwined. It is not known how near social, cultural, biological or environmental carrying capacity populations of deer in urban Scotland are, with this likely to vary from area to area.

Urban deer present a 'wicked problem' with a complicated weaving of positive and negative impacts. No clear thresholds for the management of urban deer impacts in Scotland have been agreed, making it challenging to define when urban deer management is needed, or which responses would be best suited (McCance, Campbell and Baydack, 2015; Curtis, 2020). Thresholds could be based on environmental or cultural carrying capacities, and these have received some attention both in the USA (Minnis and Peyton, 1995; West and Parkhurst, 2002; Kilpatrick and LaBonte, 2003) and in rural areas of Scotland (Pepper, Barbour and Glass, 2019). Watson *et al.* (2009) have sought to identify thresholds for deer impacts and management in England, but this is not suited to urban Scottish environments. A decision support framework for deciding when deer management is needed has been recommended and drafted for peri-urban environments (Dandy *et al.*, 2009). Although this study did not focus on heavily built-up areas, it could provide a useful basis for the development of thresholds and decision-making tools for urban Scotland. Dandy *et al.*'s (2009) framework will need to be adapted for fully urban areas because of the different nature of deer impacts, data sources and proposed responsibilities within these areas. Clearer guidelines, frameworks and thresholds are needed to help inform urban deer management decision-making in Scotland.

2.6. Urban deer management methods

2.6.1. Introduction

In Scotland, deer impacts have primarily been managed using culling with rifles and barriers to protect habitats (fencing and tree tubing), but a variety of other methods have been used in the USA and elsewhere (e.g. fertility controls, relocation, trapping and dispatching) (Dandy *et al.*, 2009; Watson, Putman and Green, 2009). Some of these alternative approaches may need to be considered in Scottish urban environments, as the traditional methods may not be suited to urban areas, due to the higher prevalence of human populations, relative to rural areas, and therefore greater safety, access and perception concerns (Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Adams and LaFleur Villarreal, 2020). Public acceptability of management methods is important as this will affect which methods are suitable for managing deer. The effectiveness of management practices is likely to consist of both practical and social elements, including personal ethics and values, with all affecting decision-making (Fox and Bekoff, 2011; Dubois *et al.*, 2017; Gamborg, Sandøe and Palmer, 2020). Resistance to management in urban areas of the USA has been shown to increase with the severity of management methods, with the tolerance of methods increasing with the severity of deer impacts (Loker, Decker and Schwager, 1999; West and Parkhurst, 2002; Johnson, 2014). It is not known whether perceptions in urban Scotland are similar. This section reviews the large range of methods which may be suitable for urban deer management in Scotland and identifies the benefits and drawbacks of each method. Much of the literature within this section stems from the USA, as no methods of urban deer management have been evaluated in Scotland.

2.6.2. Lethal methods

Culling can reduce deer populations, and associated pressures, rapidly, and is often argued to be the most efficient and cost-effective method of controlling deer (DeNicola and Williams, 2008; Watson, Putman and Green, 2009; Grund, 2011). Culling can occur to keep deer to an agreed population level¹⁴, although this does not have to be the case, with culling also able to take place to ‘utilise the deer resource’, for leisure, or to reduce impacts on humans and the environment (The Deer Initiative, 2009; Pepper, Barbour and Glass, 2019). They are managed to meet both private and public interests (Scottish Government, 2014). Culling often aims to get rid of those deer from the herd which would have been taken by predators if they were still present in the country e.g. the most vulnerable, such as the elderly or injured (Warren, 2009). Rifles are used to cull in Scotland, with legal limitations on the specifications of firearms used (Scottish Natural Heritage, no date c; UK Parliament, 1985). Culling is the predominant deer management method in Scotland, with 99% of Deer Management Groups utilising it as their primary deer management method (PACEC, 2016), and it has been employed in a few urban areas in Scotland, including (controversially) in Aberdeen (Quarrell, 2012; Ewen, 2015; Talboys, 2017; Scottish Natural Heritage, 2019a).

Culling in urban areas is, however, complex, problematic and potentially inadequate (Watson, Putman and Green, 2009; McCance *et al.*, 2017). This is due to pervasive human presence, fragmented land ownership and densely built-up areas, which present practical safety issues, permission problems and concerns regarding human perceptions (Creacy, 2006; Putman *et al.*, 2014; Pepper, Barbour and Glass, 2019). Culling has faced vocal opposition in some urban areas of Scotland (BBC News, 2015), and suburban areas of the USA (Raik *et al.*, 2005; Urbanek and Nielsen, 2012), with some communities going so far as to restrict its use (Rondeau and Conrad, 2003; Raik *et al.*, 2005; Creacy, 2006). Lethal control has also been viewed as a last resort and/or unacceptable by the public in some areas (Creacy, 2006; Dandy *et al.*, 2009; Urbanek, Allen and Nielsen, 2011). However, lethal methods are not always rejected (Kilpatrick and Walter, 1997; Fulton *et al.*, 2004; Urbanek

¹⁴ This is often calculated through deer densities – e.g. 10 deer per km². However, the use of density to define when deer should be culled has been debated, with Putman *et al.*, 2011 stating that the density of deer alone should not be used to decide when deer should be managed, as impacts also require consideration.

et al., 2012), with Whitefield *et al.* (2021) finding culling selected as a second preference management method in rural Scotland, with many residents citing that it is a necessary practice. Acceptance of culling in urban areas of the USA has been found to increase with damage levels, if done humanely and professionally and if a decline in impacts has been visible because of a cull (Messmer *et al.*, 1997; Siemer *et al.*, 2004; Kilpatrick, LaBonte and Barclay, 2007). Hare *et al.* (2021) found strongest support for culling deer in Scotland to reduce the spread of Lyme disease or to reduce risk of deer starvation, and least support of culling for venison or stalking opportunities, alongside reducing road accidents. Even where deemed necessary, culling is unlikely to ever be accepted universally by local communities, due to the moral and ethical concerns it raises (Peterson *et al.*, 2003; Fulton *et al.*, 2004; Gamborg, Sandøe and Palmer, 2020). It is not known how culling is viewed in urban Scotland.

Current Scottish legislation regarding culling does not reflect the issues found in urban areas, and the lethal methods most suited to urban deer management (e.g. shooting in urban areas, shooting at night, with less noisy/ powerful/ more precise weapons) contravene the Deer Acts and the Firearms Act 1968 (UK Parliament, 1959, 1968, 1996; Watson, Putman and Green, 2009). There are also questions regarding the skillset that deer managers in urban areas should have, prompting calls for specific urban deer management qualifications to be introduced (Watson, Putman and Green, 2009; Duarte *et al.*, 2015; Lowland Deer Panel, 2019). Despite these concerns, culling of deer in peri-urban areas can help to reduce the number of deer entering urban areas, thereby reducing urban deer pressures (Honda *et al.*, 2018; Pepper, Barbour and Glass, 2019). Alterations to traditional culling methods, such as shooting over bait or sharpshooting (e.g. using more highly qualified marksmen, night-vision equipment and advances in ammunition technology) have been found to increase the suitability and safety of culling to urban environments, and have been successfully used in the USA and recommended in the UK (Schwartz *et al.*, 1997; Hodnett, 2005; DeNicola and Williams, 2008; Putman *et al.*, 2014; Lowland Deer Panel, 2019).

Three additional lethal deer control methods - bowhunting, trapping or darting for later dispatch, and poisoning - could be used to lethally manage urban deer populations,

although all are currently illegal within the UK under the Wildlife and Countryside Act 1981 (UK Parliament, 1981; UK Government, 2020). Bowhunting has been legalised in some USA states specifically to assist in suburban deer management and is considered a cost-effective and successful management method (Kilpatrick, LaBonte and Barclay, 2007; Putman *et al.*, 2014; Duarte *et al.*, 2015). Bowhunting overcomes some of the safety and public perception concerns associated with rifles - due to arrows going shorter distances than bullets, and at less speed, with less noise - making it a preferred management response in some states in the USA (Lauber and Knuth, 2000b; Kilpatrick, LaBonte and Barclay, 2007, 2010; Putman *et al.*, 2014). Darting deer with a tranquiliser or trapping deer for later dispatch can be utilised instead of shooting, although both are problematic (Schwartz *et al.*, 1997; Watson, Putman and Green, 2009). Darting deer raises concerns about accidental effects on humans, welfare impacts on deer and risks around human consumption of meat that has been tranquilised (Schwartz *et al.*, 1997). Trapping is often considered unacceptable and opposed by the public, can be very stressful for deer, and is expensive and time-consuming (Lauber and Knuth, 1998; Rondeau and Conrad, 2003; Kilpatrick, LaBonte and Barclay, 2007; Stewart, 2011). Poisoning could be utilised, although any proposal to use poisons in urban areas would likely be strongly opposed on grounds of human safety and animal welfare (Fraser, 2006; Bishop *et al.*, 2007).

2.6.3. Fertility controls

Methods of fertility control may address some of the concerns (e.g. safety and human perceptions) regarding lethal urban deer management methods (Nielsen, Porter and Underwood, 1997; Walter *et al.*, 2002). Fertility controls are generally supported by the public, and are often preferred over lethal methods, as found in the suburban USA (Lauber and Knuth, 2000a; Kilpatrick, LaBonte and Barclay, 2007; Urbanek and Nielsen, 2012). However, in the USA, public support of fertility methods has been linked to a lack of awareness of the effectiveness and impacts associated with such methods, with support for fertility methods decreasing with education on the topic (Lauber and Knuth, 2000a; Urbanek, Allen and Nielsen, 2011).

Immunocontraception is a form of fertility control used and highly researched in the US, with two vaccines developed, but these have yet to be used on wild deer in the UK (Miller, Johns and Killian, 2000; Walter *et al.*, 2002; Gionfriddo *et al.*, 2011). One of these vaccines has regulatory approval in the USA and has been used in trials for badger control within the UK (Watson, Putman and Green, 2009; Cowan *et al.*, 2019; Westerfield *et al.*, 2019).

Immunocontraception is proven to reduce deer populations, maintaining populations at 30% to 70% of the local carrying capacity (Miller, Johns and Killian, 2000; Rudolph, Porter and Underwood, 2000; Gionfriddo *et al.*, 2011; Rutberg, Naugle and Verret, 2013).

Hormonal contraception and surgical sterilisation have also been used and show some effectiveness at reducing deer populations (Warren, 2000; Massei and Cowan, 2014; Curtis, 2020).

There are still many unanswered questions about the suitability of fertility methods, as a result of which they are often trivialised compared to traditional deer management methods (Baker and Fritsch, 1997; Rutberg *et al.*, 2004). It is only likely to be effective in small populations of deer with limited immigration, as new females entering the population would be fertile (Rudolph, Porter and Underwood, 2000; Putman *et al.*, 2014). Population reduction is also likely to be slow, given the need to treat a large proportion of deer (at least 50-80%) to have any limiting effect on population growth (Grund, 2011; Boulanger *et al.*, 2012; Westerfield *et al.*, 2019). Additionally, fertility methods are time-consuming and expensive, with darting often proving impractical in urban areas, and leading to potential adverse effects on deer, the environment and meat for human consumption (Rudolph, Porter and Underwood, 2000; Warren, 2000; Green, 2007; Massei and Cowan, 2014). It is not believed that fertility controls can currently act as a substitute for culling, and they are perceived by many wildlife managers in the UK as being experimental and limited in effectiveness (Watson, Putman and Green, 2009; British Deer Society, 2018).

2.6.4. Non-lethal and non-fertility methods

Non-lethal and non-fertility methods of deer management do not affect deer population numbers. Instead, they focus on moving deer away from areas of interest, and on altering human behaviours to reduce conflict with deer. Perceptions studies in the suburban USA

and peri-urban Scotland have predominantly found that non-lethal methods are more acceptable to the public than lethal methods, even if they are less effective at reducing deer populations, and this is often connected to their limited effects on deer welfare (Green, Askins and West, 1997a; Lauber and Knuth, 2000b, 2000a; Dandy *et al.*, 2009). Barrier methods, relocation, deterrents, habitat management, changing human behaviour and coexistence are all additional options for managing urban deer populations.

Firstly, barrier methods of deer management, such as fences and tree guards, are extensively used within Scotland to protect areas from browsing and to reduce DVCs, but they are utilised less often in urban environments (Putman, 1997; Hedlund *et al.*, 2004; Pepper, Barbour and Glass, 2019). Fences can be used in conjunction with overpasses, underpasses, or culverts, especially to cross roads (Putman, 1997; Hedlund *et al.*, 2004), although use of these methods has not been studied in the UK and have not been mentioned in Scottish deer policy or reports. Barrier methods help to reduce deer damage in site-specific areas but can result in adverse impacts where deer are displaced (DeNicola *et al.*, 2000; Dolman *et al.*, 2010), or be ineffective if breached (Zuberogoitia *et al.*, 2014). Fences and tree guards can have aesthetic drawbacks, can fragment landscapes - affecting wildlife and humans, which is of particular concern in Scotland, where there is the right of responsible access (often referred to as the right to roam) (Warren, 2009) - and tree guards also create a plastic waste problem¹⁵ after their job is done, as well as both methods being expensive to implement (and maintain) over large areas (Watson, Putman and Green, 2009; Dandy *et al.*, 2012; Duarte *et al.*, 2015). Although fences are well suited to protecting interests in rural areas, they work less well in urban environments where access issues and displacement of deer may present serious adverse impacts (Heltai, 2013; Honda *et al.*, 2018). However, Dandy *et al.* (2009, 2011) found fencing to be the most preferred deer management method in peri-urban areas of Scotland, as did Whitefield *et al.* (2021) in rural areas of the country. It is not known whether this view translates to managing deer within urban Scotland.

¹⁵ A range of biodegradable tree guards are currently being developed and trialled (Woodland Trust, 2022).

Relocating urban deer populations has occurred in many areas of the USA (O'Bryan and McCullough, 1985; Cromwell, Warren and Henderson, 1999; Beringer *et al.*, 2002; Peterson *et al.*, 2003), although it has not been reported in Scotland. Despite removing deer from areas of concern, the method results in high mortality. The process of trapping or darting deer can be very stressful and can result in immediate injury or death of deer, alongside threats to human safety (Ishmael and Rongstad, 1984; Cromwell, Warren and Henderson, 1999). High mortality rates (up to 85% mortality found by O'Bryan and McCullough (1985)) after relocation arise from unfamiliarity with a new location and exposure to new hazards. As a result, Cromwell *et al.* (1999) concluded that translocation of deer was less humane than culling. However, relocation is popular amongst the suburban American public (Green, Askins and West, 1997a; Lauber and Knuth, 2000b; Urbanek, Allen and Nielsen, 2011). Selecting suitable areas for the relocation of deer is problematic, especially in countries such as Scotland, where many areas are already experiencing high deer densities (O'Bryan and McCullough, 1985; Beringer *et al.*, 2002; Duarte *et al.*, 2015).

Deterrents include devices which aim to deter deer by using sound, light, ultrasonic waves, smell or taste (Bomford and O'Brien, 1990; Hedlund *et al.*, 2004; VerCauteren, Shivik and Lavelle, 2005). These include wildlife warning whistles on cars, roadside reflectors, or using chemicals or plants that taste or smell bad in areas likely to be browsed (DeNicola *et al.*, 2000; Hedlund *et al.*, 2004). These can be used to scare deer away from roads or specific areas, or to reduce deer damage from browsing (DeNicola *et al.*, 2000). Deterrents were favoured by the public in a study in peri-urban Scotland (Dandy *et al.*, 2009). Most deterrents have yet to be fully evaluated, but there are concerns that deer quickly habituate to such devices or ignore them, therefore rendering them ineffective (Bomford and O'Brien, 1990; Hedlund *et al.*, 2004; VerCauteren, Shivik and Lavelle, 2005). There are also questions regarding their suitability to urban environments, where they may have adverse impacts on humans and other animals e.g. other wildlife or pets (DeNicola *et al.*, 2000; Decker, Lauber and Siemer, 2002).

Habitat management can help reduce deer-human conflict, by removing shelter and habitat for deer (DeNicola *et al.*, 2000; Found and Boyce, 2011; Langbein, 2019). Whilst it is unclear whether clearing roadside vegetation is effective at reducing DVCs, clearing woodland and

scrub in urban areas could limit food availability and shelter, thereby reducing the carrying capacity of an area (Hedlund *et al.*, 2004; Duarte *et al.*, 2015). These habitat-clearing options are unlikely to be accepted and utilised widely, with clear opposition on landscape, aesthetic, moral, biodiversity and safety grounds (Duarte *et al.*, 2015).

Changing human behaviours in relation to deer could help to manage human-deer conflicts, and Dandy *et al.* (2011) found these methods to be preferred within peri-urban Scotland. Stopping humans from feeding deer may help to limit deer presence in urban areas, with studies on supplementary feeding in urban areas having taken place in Canada and Dublin (McCance, Campbell and Baydack, 2015; Freyne, 2019; McLaughlin *et al.*, 2022).

Supplementary feeding of deer (or planting palatable species where deer are present) can be problematic in urban areas as it inflates the ecological carrying capacity, which can result in higher deer populations and increased pressure on local ecosystems (Green, Askins and West, 1997a; DeNicola *et al.*, 2000; Shono and Smith, 2003). This can also result in deer habituating to human presence, which can have negative impacts on deer welfare and result in increased conflict, with unsuitable foods potentially negatively impacting deer health (DeNicola *et al.*, 2000; Honda *et al.*, 2018; McLaughlin *et al.*, 2022). Prohibiting feeding deer in problematic areas can help limit the number of deer that a local area can support, reducing pressure from urban deer populations (Green, Askins and West, 1997a).

Reductions in speed limits and the use of deer warning signs can help warn drivers of the dangers of deer in specific areas to slow traffic down to reduce the impacts and frequency of DVCs (DeNicola *et al.*, 2000; Putman, Langbein and Staines, 2004; Mattila and Burgin, 2014; Burgin *et al.*, 2015). Electronic road signs are used around Scottish urban areas at times of expected increases in DVCs to aid awareness, with permanent deer warning signs present in many high-risk areas (Langbein, 2019; Scottish Natural Heritage, 2019e; Warnock, 2019). However, Hedlund *et al.* (2004) suggest that these methods are ineffective at altering the behaviour of drivers and are therefore unlikely to reduce DVCs.

Finally, choosing to coexist with urban deer populations, or doing nothing to manage urban deer, are other 'management' options. Allowing coexistence sustains the rights of deer to live within urban areas, and requires an active decision to do so (Dubois *et al.*, 2017;

Connors and Short Gianotti, 2021). Choosing not to manage deer through coexistence, or simply doing nothing, can result in continued negative impacts for deer, humans and the environment, and can be unpopular with the public if deer are perceived to be having adverse effects (Green, Askins and West, 1997b; DeNicola *et al.*, 2000; Beringer *et al.*, 2002). Additionally, this could result in unintentional consequences, such as increases in unofficial management (such as illegal poaching) taking place (Dandy *et al.*, 2012). Coexistence, or simply doing nothing to manage urban deer, may simply not be suitable options where impacts of and on urban deer are perceived to be too high. Doing nothing to manage deer has been perceived by the public to be unacceptable in some areas of the USA and rural and peri-urban Scotland (Fulton *et al.*, 2004; Dandy *et al.*, 2009, 2011; Whitefield *et al.*, 2021).

2.7. The importance of perceptions in urban deer management

Deer management is often more about managing people-deer interactions, than managing deer alone, which makes the views of stakeholders significant (Dandy *et al.*, 2009; Lowland Deer Panel, 2019; Adams and LaFleur Villarreal, 2020). Understanding stakeholders' beliefs is key to effective and sustainable land management decision-making and can help inform and improve management practices, thus enhancing the credibility of management decisions (Racevskis and Lupi, 2006; Gerner *et al.*, 2011; van der Wal *et al.*, 2014). Within urban areas, perceptions are likely to be more important for deer management than in rural areas, due to the greater interaction of people with deer and their management, the higher number of stakeholders and therefore the greater chance of conflict over views or ethical values (Raik, Siemer and Decker, 2005; Burgin *et al.*, 2015; Gamborg, Sandøe and Palmer, 2020). Additionally, perception studies can help to improve awareness about management issues and identify gaps in knowledge or misunderstandings, which can then be addressed through improved communication or education (Stewart, 2011; Knackmuhs and Farmer, 2017; McCance *et al.*, 2017). It is therefore essential that the perceptions of stakeholders are understood regarding urban deer management in Scotland, to support future policies and practices.

Previous studies of public perceptions of deer and deer management in Scotland have not focussed on built-up urban environments (Dandy *et al.*, 2009, 2011, 2012; Ballantyne, 2012; Whitefield, 2019; Hare, Daniels and Blossey, 2021; Whitefield *et al.*, 2021). In the early 2000s, it was often reported that urban populations may have significantly different views to their rural counterparts, with Scottish (and North American) urbanites thought to be less familiar with deer management and less supportive of deer management practices (especially lethal methods), despite these assumed differences having not been investigated at that time (Goldberg, 2003; Warren, 2009; Dandy *et al.*, 2011; McCance *et al.*, 2017). However, some studies which have since emerged have shown little or no difference between rural and urban public perceptions of deer and deer management in Scotland and North America (Urbanek *et al.*, 2012; Whitefield, 2019; Hare, Daniels and Blossey, 2021; Whitefield *et al.*, 2021). It is unknown how views within existing studies in Scotland translate to deer in urban areas, and therefore it is important that public perceptions of urban deer

management are understood. Additionally, no studies have focussed on stakeholder perceptions of urban deer management beyond the general public in Scotland, and it is important that views of the range of stakeholders involved with urban deer management (e.g. experts, Local Authorities and local councillors) are known, to support future policymaking. Considering the key role that Local Authorities are positioned to take within urban deer management, increased understanding of how their role is perceived and of barriers to their involvement is potentially valuable. This thesis, therefore, aims to fill this gap in understanding, by exploring the perceptions of stakeholders on urban deer and urban deer management (RO1 and RO2), and the role and obstacles to Local Authority engagement within it (RO3), to help shape future policymaking.

3. Methodology

3.1. Introduction

The research reported here was undertaken during the COVID-19 pandemic. Consequently, all research had to take place remotely, in line with Government and University Guidelines, to decrease the risk of virus transmission. Effects of COVID-19 on the research process are identified throughout this chapter. Ethical approval was gained for this study and a letter of approval is available in Appendix 3.

3.2. Research design

This section explains how the research objectives and questions were developed, how stakeholders were identified, and provides an overview of the methods utilised. The research questions, methods and stakeholders are summarised in Table 3.1, and sample sizes and analysis software are summarised in Table 3.2, with these methods detailed further in the subsequent sections.

Table 3.1: Research questions, methods and stakeholders.

Research objectives (RO) and questions (RQ)	Method(s)	Stakeholder(s)
RO1: To explore perceptions of urban deer in Scotland.		
RQ1: How are urban deer perceived?	Interviews, public survey	Experts, public
RQ2: How are urban deer population trends viewed?	Interviews, public survey	Experts, public
RQ3: How are urban deer impacts perceived?	Interviews, public survey	Experts, public
RO2: To explore perceptions of urban deer management in Scotland.		
RQ4: Is there a perceived need for urban deer management?	Interviews, public survey	Experts, public

RQ5: Is current urban deer management viewed to be sufficient?	Interviews	Experts
RQ6: How are different urban deer management methods viewed?	Interviews, public survey	Experts, public
RQ7: How is urban deer management perceived to differ from rural deer management?	Interviews	Experts
RO3: To explore the perceived role of Local Authorities in urban deer management in Scotland, alongside obstacles to their engagement.		
RQ8: What are Local Authorities' views regarding urban deer, impacts and management?	Q-Methodology	Local Authorities
RQ9: What is the perceived role of Local Authorities within urban deer management?	Q-Methodology, interviews, public survey	Local Authorities, experts, public
RQ10: What are the perceived obstacles to Local Authority involvement in urban deer management?	Q-Methodology, interviews, public survey, councillor survey	Local Authorities, experts, public, local councillors

Table 3.2: Research methods, sample sizes and main analysis software

Method	Sample size	Main analysis software
Interviews	16	NVivo 12
Q-methodology	30	KenQ (KADE)
Councillor survey	353	SPSS 28
Public survey	318	SPSS 28

3.2.1. Research objective and question selection

The research objectives and questions were developed based on a review of the existing literature, and through initial informal talks with NatureScot. This enabled key gaps in the understanding of urban deer and their management within Scotland to be identified, leading in turn to the formulation of the research questions. Urban deer populations are believed to be increasing in Scotland (2.4), yet little is known about these deer or how people view them, their impacts or management (Pepper, Barbour and Glass, 2019). Consequently, perceptions of urban deer, their populations trends and impacts need to be understood (RQ1-3). Better knowledge of how urban deer management is perceived is also needed, as people can affect the success of urban deer management practices, and their views can inform management decisions, increasing their credibility and reducing conflict (2.7). Perceptions of key stakeholders are relevant for understanding whether urban deer management is needed in Scotland, whether current levels of management are sufficient, and how different methods of management are viewed (RQ4-6). An understanding of how urban deer management is perceived to differ from rural deer management sheds light on this new context for managing deer in Scotland (RQ7). Finally, given that Local Authorities are regarded as potential key players within urban deer management (2.3.1.3), it is important that their views on the topic, as well as their perceived role within urban deer management, are recognised (RQ8 and RQ9). Given the limited current engagement of Local Authorities with urban deer management, obstacles to their involvement also need to be understood (RQ10).

3.2.2. Stakeholder selection

To address the research questions, appropriate stakeholders of interest were selected. Expert participants with experience or knowledge of urban deer management in Scotland were recruited to address RO1 (RQ1-3) and RO2 (RQ4-7), alongside aspects of RO3 (RQ9 and RQ10). Given the degree of potential interaction between deer and people in urban areas (2.4, 2.5 and 2.7), the public's views are important, as they can affect the impacts of/on deer and the success of deer management practices. The public help to address RO1 (RQ1-3), RO2 (RQ4 and RQ6), alongside aspects of RO3 (RQ9 and RQ10). Input from Local

Authorities addresses RO3 (RQ8 – RQ10) because of their potential key role in urban deer management (2.3.1.3). Local councillors may affect Local Authority involvement in urban deer management, as permission is often needed from councillors before policies or actions are undertaken, and therefore their support can be crucial (Marsh, 2013; Scottish Government, 2022). They provide an untapped audience which environmental research in Scotland has not previously involved. Local councillor views help to address RO3 (RQ10).

3.2.3. Mixed methods study design

This mixed methods study utilises four methods to provide a mix of qualitative and quantitative data (Bryman, 2006). This approach combines the strength of statistical detail from quantitative methods with the depth of insight that is possible through qualitative research (Pluye and Hong, 2014). There are many examples of mixed methods studies in environmental management (Loker, Decker and Schwager, 1999; MacMillan and Leitch, 2008; Dandy *et al.*, 2009), in keeping with Newing's (2011) premise that the mix of information they provide can inform environmental and conservation policymaking.

Different methods were applied to gather perceptions from each of the four participant groups in this study. This is due to differences in the numbers of participants targeted within each group, and the need to gather different forms of information from them (e.g. deep understandings of expert views, compared to frequencies of public views) to address the research questions. Using different methods to generate different types of data allows triangulation and facilitates increased completeness of understanding (Valentine, 2005; Bryman, 2006, 2016; Tashakkori, Johnson and Teddlie, 2020). The qualitative data gathered (in the expert interviews) also provides context to help ground subsequent (more quantitative) methods within the sequential research design (Bryman, 2006; Tashakkori, Johnson and Teddlie, 2020). Overall, a mixed methods approach provides a more complete dataset for this study, whilst suiting the different participant groups.

3.2.4. Overview of methods

The four research methods used in this study are presented in Figure 3.1. The flow diagram highlights how each component builds on the preceding method, in a sequential process where reflection on each method and data collected helped to inform the next (Bryman, 2006; Tashakkori, Johnson and Teddlie, 2020). The sequential structure of the research design allowed local councillors to be identified as a key group of stakeholders in urban deer management from the expert interviews, and so their views were incorporated through a short survey. Building on the interviews and local councillor survey is a Q-methodology study with Local Authorities from across Scotland. The study culminates in a public survey of three urban areas of Scotland. All research methods took place in English. Each of these methods is detailed in turn.

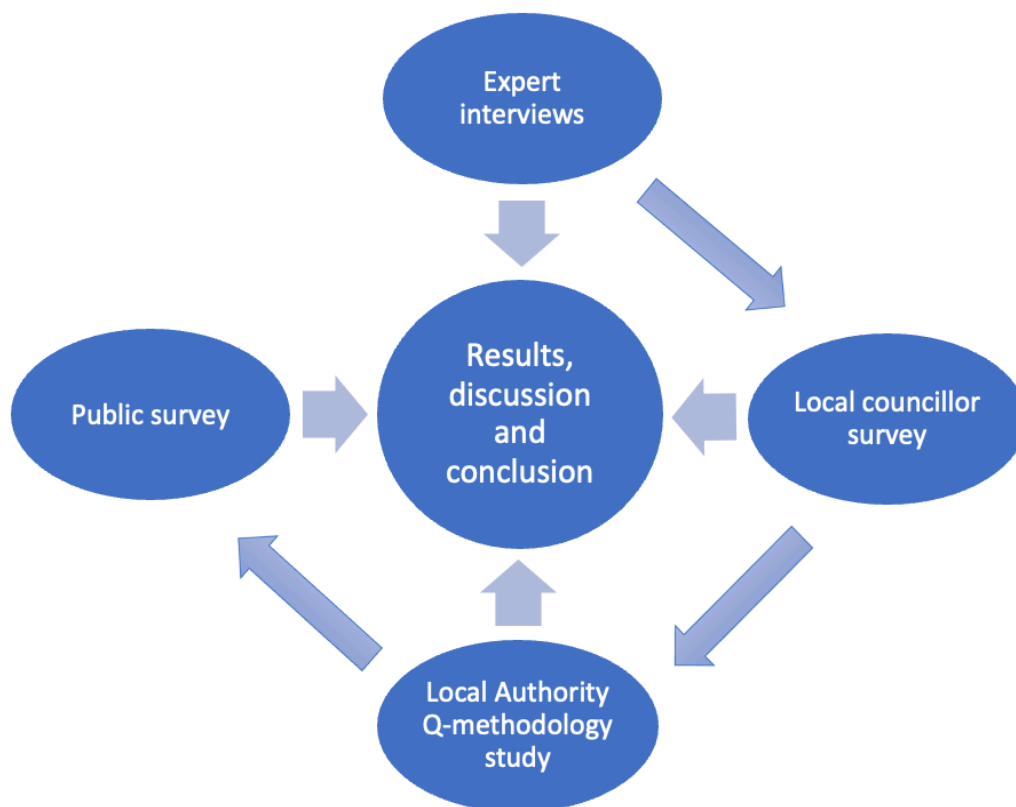


Figure 3.1: An overview of how the research methods build on each other and inform the results, discussion and conclusions of this thesis.

3.2.5. Positionality and objectivity

The researcher (the author of this thesis) was aware of the impact of their own¹⁶ and their participants' positionality throughout the data collection process, as this may affect respondents' responses and the interpretation of these (Bryman, 2016). The researcher understands that although they aimed to be objective throughout the research process, their own personal appearance, accent, history, knowledge and circumstances will have affected their interactions, understanding and interpretation. To mitigate some of the direct effects of the researcher's positionality on the research participants, the researcher distanced themselves from participants (through online/ postal surveying), refrained from providing their own views when speaking with participants, and ensured that questions were phrased neutrally. However, the mere presence and interest of the researcher (and the participants) on the topic will have had some effect on the respondents' participation, which should be considered when reviewing the research results. The mixed methods approach utilised in this study uses Phillip's (1998) 'objective-subjectivity', where subjectivity in individual responses is recognised, whilst acknowledging that the researcher aims to provide as objective an understanding of the real world as possible (Philip, 1998).

¹⁶ The researcher is white, English, aged 23-26, female, PhD student at the University of St Andrews, interested in deer management, part-funded by Forestry and Land Scotland and the Scottish Alliance for Geoscience, Environment and Sustainability.

3.3. Methods

3.3.1. Interviews

3.3.1.1. *Rationale*

Expert interviews helped to address RQ1-7 and RQ9-10. Interviews were utilised as they allow rich qualitative data and narratives on experiences and opinions to be gathered (Valentine, 2005; Bryman, 2016; Dunn, 2016). Qualitative research methods, such as interviews, have been used previously within wildlife management research and on land management debates (Loker, Decker and Schwager, 1999; Deruiter, 2002; Lauber and Brown, 2006; MacMillan and Leitch, 2008). Semi-structured interviews were used in this study as they allow rapport with interviewees, with the interviewer able to ask specific questions of interest (which are asked to each participant), but the interviewee also has the space to go off-topic to areas of interest that the interviewer may not have previously identified, which can lead to new discoveries (Bennett, 2002; Bryman, 2016; Dunn, 2016).

Online interviews (via video call) and telephone interviews were used because of the restrictions on movement of the COVID-19 pandemic. Having interviews remotely provided some logistical benefits, including saving time, expense and carbon emissions, whilst increasing personal safety and enabling both interviewee and interviewer to feel more comfortable in their own spaces (Hanna, 2012; Iacono, Symonds and Brown, 2016; Krouwel, Jolly and Greenfield, 2019). Not being able to hold the interviews in person may however have reduced potential rapport with the participants, due to the distance virtual interaction can create between people, making it harder to perceive body language, and may have been more technically challenging for those who participated (Bryman, 2016). Eye contact and visual cues improve the rapport of the interview environment, so interviews via video call were preferred over telephone interviews (Opdenakker, 2006; Hanna, 2012; Deakin and Wakefield, 2014).

3.3.1.2. *The interview process*

In total, sixteen expert participants were interviewed (Table 3.3), fourteen of whom were purposively¹⁷ targeted. These participants were selected either because of the relevant roles that they held in organisations involved in deer management in Scotland, and/or because they have produced research on deer in Scotland and/or due to their experiences with deer in urban environments. Two additional participants with experience in urban deer management were recruited through snowball¹⁸ sampling. These sixteen participants are believed to represent those individuals and organisations with the most knowledge regarding urban deer within Scotland. It is common for expert knowledge to be utilised in environmental research, but the validity of it is questioned, with internal biases and frailties in expert judgement, and expert selection, questioned (Burgman *et al.*, 2011; Drescher and Edwards, 2019). There are debates around defining what constitutes an expert, whether it should be based, for example, on levels of knowledge, academic qualifications, professional membership, reputation or years of experience (Bogner and Menz, 2009; Burgman *et al.*, 2011). Not all experts are equal in their knowledge or experience of a topic (Dorussen, Lenz and Blavoukos, 2005), and this was evident in the differing expertise and focus of the interviewees.

Key players in the deer sector were chosen to be interviewed because they would have the most knowledge regarding deer and their management in Scotland. It is however recognised that few of these participants were experts on urban deer, having had limited direct experience of their management (4.2.2), and this therefore presented a limitation of this study. Although these experts were chosen as they should have been the most knowledgeable on the topic, it may have been beneficial to speak to people outside of the deer sector to hear a broader view on urban deer, where people may have had more urban wildlife management experience or other relevant knowledge. However, this was not undertaken in this study. Using the experts selected means that the interviews were very deer focussed, often with confusion surrounding urban and rural deer, and this needs to therefore be considered when understanding their views.

¹⁷ Targeted for particular characteristics, in this instance their known experience with urban deer - on purpose.

¹⁸ Where new participants were identified as being knowledgeable about urban deer by purposive participants, but had not been previously purposively targeted by the researcher.

The number of interviewees selected for interview was purely determined based on the number of experts on urban deer in Scotland identified by the researcher, and was not due to the researcher having pre-determined the number of participants they wished to interview. However, sixteen interviews allowed a wide range of views to be heard, yet kept analysis achievable within the time constraints of this research, considering the demands of the other methods utilised.

Table 3.3: Details of the expert interviewees' roles and the pseudonyms used within this study.

Type of organisation/ role	Participant
Government Organisation: Government or local government organisation working on deer in urban areas of Scotland.	Mr A, Mr E, Mr F, Mr H, Mr I
Non-Government Organisation: Charitable, voluntary or registered organisation related to deer management in Scotland.	Mr B, Mr C, Mr N
Deer Manager: Urban deer manager in Scotland.	Mr D, Mr L
Academic: Academic working on deer in the UK.	Mr G, Ms J, Mr O
Consultant: Consultant on deer issues in the UK.	Mr K, Mr M, Mr P

Each participant was approached via email, provided with a participant information sheet and asked to sign a consent form before the interview took place (Appendix 4 and Appendix 5). The interviews occurred from October to November 2020, via video call, except one that took place via telephone at the participant's request. All video calls were encrypted. All interviews were audio recorded via a smartphone, with the recordings stored in a password protected cloud and deleted from the device, to allow later transcription. This allowed the researcher to concentrate on listening, probing and building rapport with the participant, which facilitated the conversation (Bryman, 2016). Additional notes were also taken where

audio recording would not be sufficient alone to ensure the record was as complete as possible (Dunn, 2016). Interviews ranged in length from 47 minutes, to 1 hour and 42 minutes.

All interviews were undertaken using an interview guide (Appendix 6) (Dunn, 2016). The questions began with topics about the individual's role and experience within urban deer management, and then moved on to cover urban deer populations, impacts and management (addressing RQ1-7). This led to final discussions surrounding the roles of Local Authorities in urban deer management (addressing RQ9-10). These questions were piloted with the thesis supervisors and three independent participants, which led to some rewording of questions, some deletion of questions and some replacements. Although a set topic list was used, not every topic was relevant to every participant and some participants brought up new ideas or raised them in a different order to what was expected, so the semi-structured nature of the interviews allowed flexibility to follow the interviewee's lead.

3.3.1.3. Analysis

All interviews were transcribed by the researcher or research assistants, with the aid of Express Scribe. An auto-generated transcription created by Microsoft Word Online was created for some of the interviews to enable time savings. These automated transcripts were reviewed and edited. All transcriptions by the research assistants were reviewed by the researcher.

Once transcribed, all transcripts were subject to thematic analysis in NVivo 12 (Bryman, 2016; Dunn, 2016). The transcripts were subject to three rounds of coding, resulting in more precise themes emerging each time. All of the transcripts were initially coded openly on broad areas of research interest (e.g. deer, deer impacts, deer management, Local Authorities). Once complete, a second round of coding took place to generate more precise themes. These themes were then narrowed down even further, so they became clear themes which were well evidenced. These themes were self-creating, not imposed, using grounded theory, where the theory (or themes) are grounded in the participants' perceptions, with the aim of the themes not being affected by the researcher's assumptions

and preconceptions¹⁹ (Newing, 2011; Bryman, 2016; Moon *et al.*, 2016). These themes were recorded alongside interesting quotations which evidenced the theme and were mapped to the research objectives to build a narrative of responses.

¹⁹ Pure grounded theory is almost impossible to undertake, as research questions, interview questions and pre-reading occur before research takes place (Newing, 2011). However, the author used grounded theory by reading the interview transcripts and creating themes from them, rather than pre-creating themes which were imposed on the dataset.

3.3.2. Q-Methodology

3.3.2.1. Rationale

A Q-methodology study with representatives of Local Authorities was used to address RQ8-10. Q-methodology provides a tool for systematically and rigorously understanding human subjectivity (McKeown and Thomas, 1988; Watts and Stenner, 2012). It reveals key groups of thought which represent the viewpoints of multiple participants, which can be understood holistically and in detail, to identify patterns within perspectives (Brown, 1993; Watts and Stenner, 2012; Zabala, Sandbrook and Mukherjee, 2018). Those groups of thought can be compared, to see where areas of consensus and contestation lie on a topic (Steelman and Maguire, 1999; Deary, 2015). Q-methodology provides a means of identifying and comparing different Local Authority viewpoints on urban deer, their impacts and management, their involvement in urban deer management and obstacles to their engagement. This can enable a better understanding of viewpoints for policy, which can help organisations such as NatureScot tailor responses to groups of Local Authorities with similar (or different) beliefs.

Other social research methods do not enable the holism that Q provides, in which viewpoints are recognised as a whole rather than as a sum of their parts, nor do they identify clear groups of thought (Watts and Stenner, 2005, 2012; Deary, 2015). Additionally, Q-methodology bridges the quantitative-qualitative divide, utilising a quantitative method for analysing and interpreting qualitative opinions and viewpoints (Cross, 2005; Deary, 2015; Ramlo, 2016). The combination of statistical rigour and qualitative power make it ideal for understanding the complex nature of Local Authority views on urban deer management in Scotland (Cross, 2005; Zabala, Sandbrook and Mukherjee, 2018).

Table 3.4 explains the main terms used in Q-methodology, and Figure 3.2 outlines the overall process. The salient advantages and disadvantages of Q-methodology are outlined in Table 3.5. The following sections explain the method and its implementation in more detail.

Table 3.4: Definitions of the terminology used within Q-methodology.

Term	Definition
Concourse	A comprehensive list of statements that represent every possible opinion on a topic.
Item	A single statement on the topic.
Q-set	A representative sample of items from the concourse, which will be ranked during Q-sorting.
P-set	The participants selected to undertake the Q-sort.
Q-sort	The placing (ranking) of statements into a ranking grid (of a forced distribution) by the P-set.
Condition of instruction	The instruction that the P-set should use for sorting the items (e.g. from most disagree to most agree or from most like me to least like me).
Factor analysis and rotation	The type of analysis and rotation undertaken on the completed Q-sorts.
Factor	The output of factor analysis. Each factor represents a group of individuals that thought about the research topic in a similar way.
Factor array	An average Q-sort which represents the views present in a factor.
Consensus statement	An item placed in a similar position in all of the factor arrays.
Distinguishing statement	An item placed in a different position by one factor compared to the other factors.

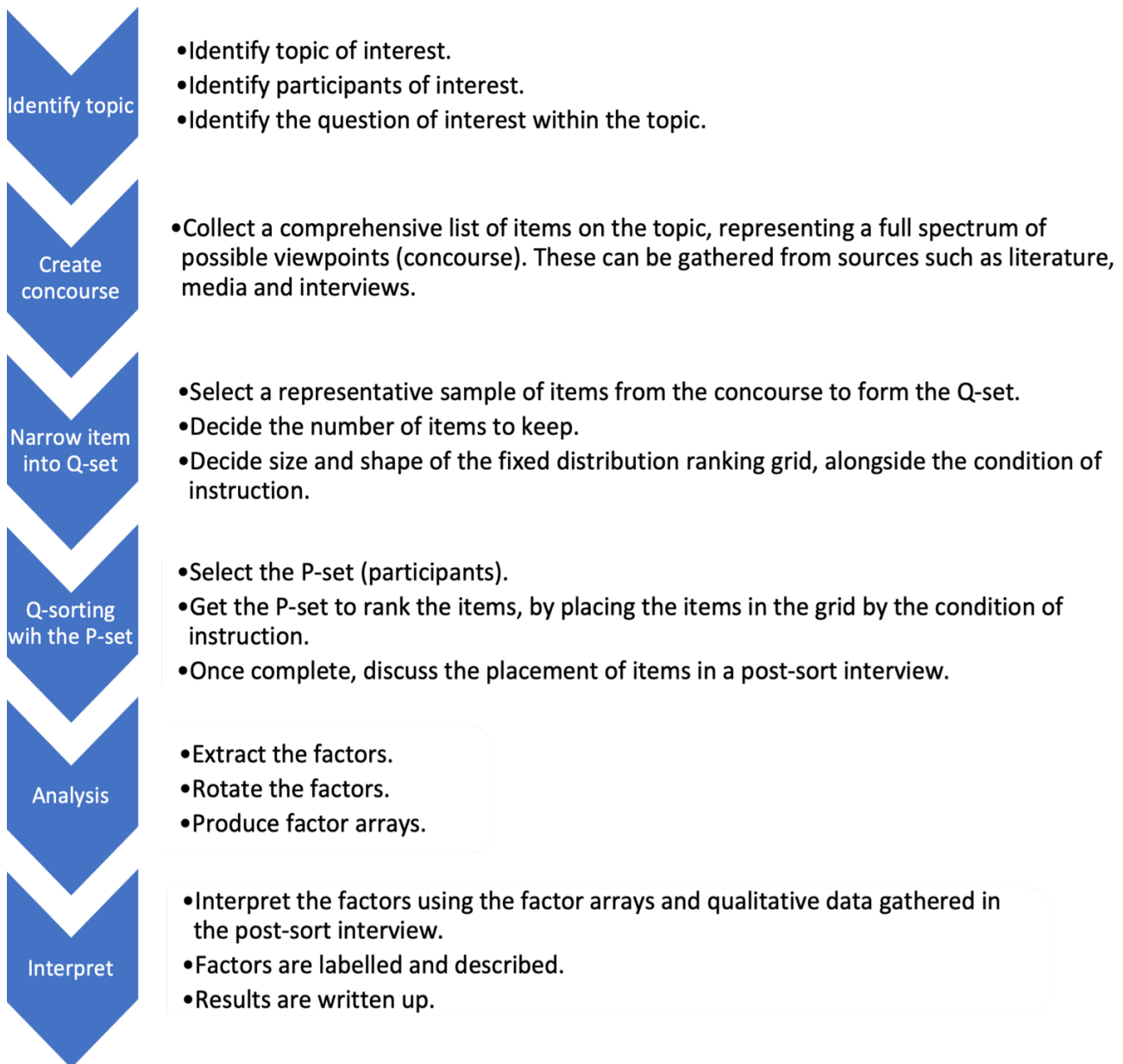


Figure 3.2: Details of the process of Q-methodology (figure inspired by Zabala, Sandbrook and Mukherjee (2018) and Deary (2015)).

Table 3.5: Advantages and disadvantages of Q-methodology.

Advantages	Disadvantages
Consolidates opinions and views into factors for quantitative analysis (Deary, 2015; Watts and Stenner, 2012).	Restricts opinions into ready-made statements (Cross, 2005; Deary, 2015; Watts and Stenner, 2005; Zabala, Sandbrook and Mukherjee, 2018).
Produces holistic data which looks at the whole of a viewpoint rather than individual parts (Deary, 2015, Watts and Stenner, 2012).	Concerns over effect of making respondents fit statements into a forced distribution (Watts and Stenner, 2005).
Allows potential points of conflict to be identified along with clear synthesised perspectives (Zabala, Sandbrook and Mukherjee, 2018).	Q-set will never fully cover the range of opinions present amongst participants (Watts and Stenner, 2005).
Middle ground between structure of surveys and depth of interviews (Zabala, Sandbrook and Mukherjee, 2018).	Does not look at the representativeness of viewpoints of populations – not generalisable or extrapolatable (Cross, 2005; Deary, 2015; Zabala, Sandbrook and Mukherjee, 2018).
Can reduce response bias by sorting selected statements which may have been forgotten or not mentioned by participants (Zabala, Sandbrook and Mukherjee, 2018).	The selection of statements is of critical importance and can cause issues of validity and researcher bias (Cross, 2005; Watts and Stenner, 2005; Zabala, Sandbrook and Mukherjee, 2018).
Interesting research process for participants (Deary, 2015; Eden, Donaldson and Walker, 2005).	Demanding of participants and potentially challenging and frustrating (Deary, 2015; Zabala, Sandbrook and Mukherjee, 2018).
Does not require a large number of participants (McKeown and Thomas, 1988; Steelman and Maguire, 1999; Watts and Stenner, 2005; Ellis, Barry and Robinson,	Time consuming and complex process for the researcher to undertake (Eden, Donaldson and Walker, 2005; Previte, Pini and Haslam-McKenzie, 2007; Watts and

2007; Deary, 2015; Zabala, Sandbrook and Mukherjee, 2018).	Stenner, 2005; Zabala, Sandbrook and Mukherjee, 2018).
Helps understand the range and diversity of views present (Cross, 2005).	Repetition does not necessarily yield the same results leading to questions regarding reliability (Cross, 2005).
Combines the strengths of quantitative and qualitative analysis (Cross, 2005; Deary, 2015; Eden, Donaldson and Walker, 2005; Ellis, Barry and Robinson, 2007; Zabala, Sandbrook and Mukherjee, 2018).	Disliked by some researchers due to the hybridity of qualitative and quantitative methods (Eden, Donaldson and Walker, 2005; Ramlo, 2016).
Bridges positivist and non-positivist paradigms (Cross, 2005; Ellis, Barry and Robinson, 2007; Ramlo, 2016).	Researcher bias can be introduced when interpreting analysis or as a result of presence during sorting process (Cross, 2005; Zabala, Sandbrook and Mukherjee, 2018).
Can be analysed without an in-depth knowledge of statistics (Brown, 1993).	Requires strong analytical skills (Cross, 2005).
Free from group biases (Zabala, Sandbrook and Mukherjee, 2018).	Not meeting participants can cause distance between researcher and participants and may be detrimental (Previte, Pini and Haslam-McKenzie, 2007).
Can be done online with no need to meet participants (Previte, Pini and Haslam-McKenzie, 2007).	Administratively difficult if wanting to complete face-to-face (Previte, Pini and Haslam-McKenzie, 2007).

3.3.2.2. The method

3.3.2.2.1. Creation of the concourse and Q-set

The first stage of a Q-methodology study is to set an overall question or statement which covers the discourse of the study, and which participants focus on when undertaking the Q-sorting process (Figure 3.2) (Previte, Pini and Haslam-McKenzie, 2007; Watts and Stenner, 2012). For this study, participants were asked to consider their perceptions of urban deer and urban deer management within their Local Authority area, as a Local Authority employee.

With this in mind, a concourse can be formed, where statements are collected to capture a comprehensive list of the range of views on a topic (Brown, 1993; Rogers, 1995). Ideally, this concourse should be as complete as possible, although it is recognised that creating a fully comprehensive concourse is practically impossible (Zabala, Sandbrook and Mukherjee, 2018). The concourse is usually selected from a range of sources on the topic, and in this study was constructed from the existing literature and expert interviews. This resulted in a concourse of 273 items.

The concourse is then reduced to create a Q-set, a representative and comprehensive sample of statements found in the concourse (Watts and Stenner, 2005; Zabala, Sandbrook and Mukherjee, 2018). These are the statements which are ranked by the participants (P-set). The Q-set in this study was refined to cover five topics of interest thoroughly, while removing duplicates and factual statements about Local Authority activities regarding deer (these were instead collected in a survey ahead of the Q-sorting process). The topics covered by the Q-set were perceptions of urban deer, impacts and management, perceptions of Local Authority involvement in urban deer management and the main obstacles to Local Authority involvement. Final Q-sets can range between 10 and 100 statements, typically between 30 and 60 (Cross, 2005; Previte, Pini and Haslam-McKenzie, 2007; Rogers, 1995). The Q-set in this study consisted of 48 statements, which can be found in Appendix 7.

3.3.2.2.2. Q-sorting process

The next stage is the Q-sorting process during which participants are asked to arrange the Q-set statements (items) within the forced distribution of a ranking grid, by a condition of instruction (McKeown and Thomas, 1988; Brown, 1993; Watts and Stenner, 2012). In this study, the condition of instruction was ranking the statements from 'most disagree' to 'most agree'. Participants must decide how they rank each statement relative to the other statements. The ranking grid allows space for more items to fit into neutral columns, with progressively fewer spaces for items being ranked towards the extremes of the grid (i.e. the statements about which participants feel most strongly) in a bell-shaped distribution (Cross, 2005; Watts and Stenner, 2012). The number of statements is the same as the number of spaces in the sorting grid, so that each one is placed in a space. The study employs a -5 to +5 grid, as suggested by Brown (1980) for Q-sets of 40-60 statements (Figure 3.3).

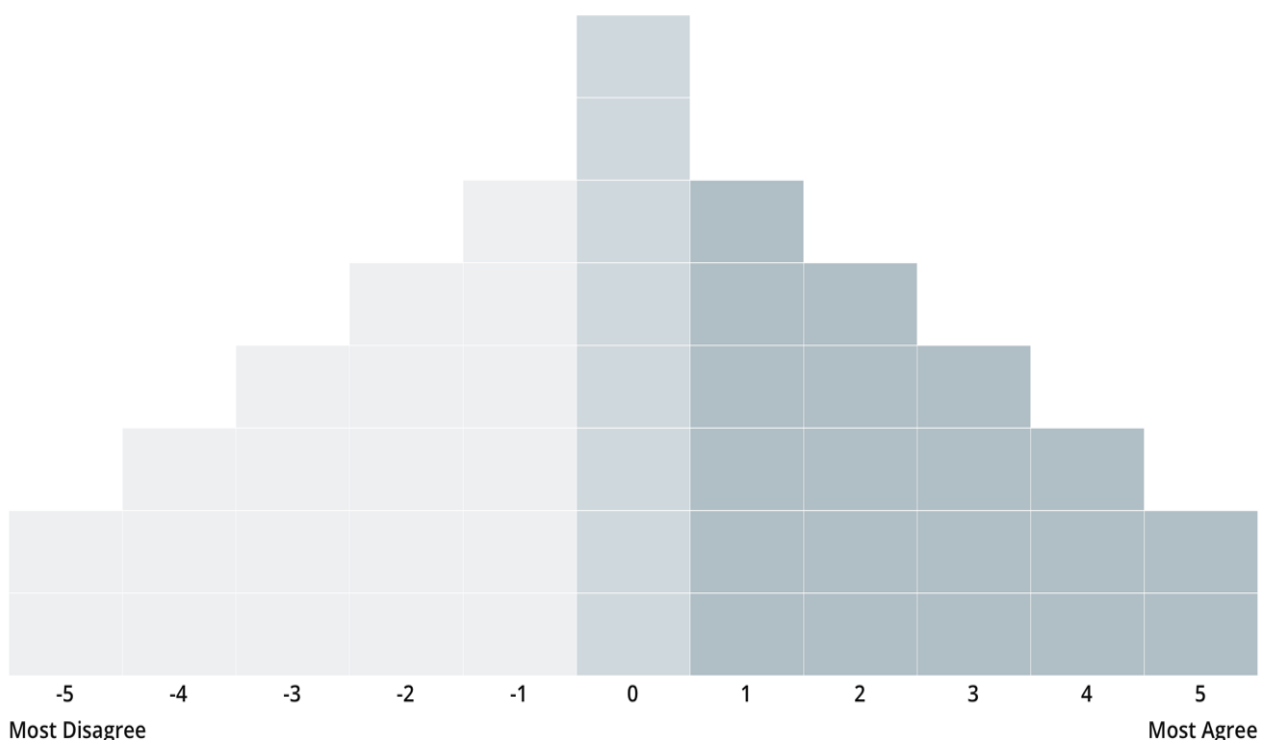


Figure 3.3: The Q-methodology distribution grid used within this study.

The Q-sorting process normally takes place in person, with participants placing physical cards on a grid (Previte, Pini and Haslam-McKenzie, 2007; Watts and Stenner, 2012). However, online Q-sorting has become increasingly common, especially during the COVID-19 pandemic, with studies – including this one – having to take place online. At the time this study was undertaken, almost no literature existed on the best ways of undertaking an online Q-methodology study, but it is now developing (Alanazi *et al.*, 2021; Meehan, Ginart and Ormerod, 2022). Although there are multiple software packages available for online Q-sorting²⁰, none fully replicate the flexibility of the in-person sorting process. In this instance, Q Method Software was selected to provide a user-friendly experience for researcher and participants, whilst being robust and long-standing enough to work consistently. This was important, as it was unknown how computer-literate the participants would be. A pilot of the full Q-sorting experience was undertaken with fourteen volunteers, who included academics knowledgeable on deer or with Q-methodology, deer management professionals and members of the public. Resulting adjustments mainly consisted of improving the clarity of the instructions throughout the process.

With the Q-sorting process finalised in Q Method Software, the participants (the P-set) were selected. As this Q-methodology study aimed to address RQ8-10, Local Authority participants were approached to form the P-set. A gatekeeper with knowledge of Local Authorities and deer issues provided contact details for the staff member who they believed would know most about deer in each of the 30 Local Authority areas in which deer are present²¹. An invitation was sent to each Local Authority, inviting the person most experienced with deer in urban areas of their Local Authority to participate in the study. In total, one participant²² from each of the 30 Local Authorities of interest took part in the study in March to April 2021.

Before participating, the members of the P-set were provided with a participant information sheet and a consent form (Appendix 8 and Appendix 5). All participants completed the study

²⁰ Available software packages include Html-Q, Q-Perspectives, Q Assessor and Q Method Software.

²¹ All Local Authority areas in Scotland have deer present, except from the Orkney Islands and Shetland Islands (British Deer Society, 2017)

²² Details of these participants can be found in 6.2.1.

individually, whilst on an encrypted video call with the researcher, so that the researcher could assist if any clarification was needed on the Q-sorting process. When participating, the participants were first provided with an overview of the study, and then invited to participate in a short pre-sort survey (Appendix 9) which covered their role in the Local Authority, their Local Authority's activities regarding urban deer and some demographic questions. Following this, the participants were given more information about the Q-sorting process. They were invited to initially sort the items into three piles – those that they agreed with, those that they disagreed with and those that they were neutral or unsure about. This is a common practice in Q-sorting, as it simplifies the process for participants, preparing them for the main sorting exercise (Watts and Stenner, 2012). Once complete, the participants were presented with the Q-sort grid and their three piles of statements, along with detailed instructions. The participants were invited to place the statements into the grid in accordance with their views as a Local Authority employee. After all statements had been placed in the grid, the participants were asked to review their choices, to confirm that they accurately represented their views (Watts and Stenner, 2012). Once checked and submitted, a post-sort discussion took place, focussing particularly on those statements ranked at either end of the grid, along with the placement of the neutral statements, to provide additional qualitative depth which helped the interpretation of the Q-sorts (Brown, 1993; Eden, Donaldson and Walker, 2005; Deary, 2015). The whole process took between 30 and 60 minutes, and was audio recorded – on a smartphone, with the recording deleted from the device and stored on the cloud – so that the researcher could review what was discussed in the session (Watts and Stenner, 2012).

3.3.2.2.3. Analysis

Once the completed Q-sorts and survey data had been downloaded from Q Method Software, the Q-sort analysis took place in KenQ (KADE), the most up-to-date analysis package. There are two main steps of Q-methodology analysis: extraction (of factors) and rotation (Zabala, Sandbrook and Mukherjee, 2018). A correlation matrix of the Q-sorts was initially created, to see how correlated all Q-sorts were (Watts and Stenner, 2012).

Centroid Factor Analysis was undertaken using Brown Centroid Factors, to extract factors from the dataset (Watts and Stenner, 2012). Centroid Factor Analysis was selected as it is the original form of analysis used in Q-methodology and allows the data to be explored using factor rotation (Brown, 1980; Watts and Stenner, 2012). The output of Centroid Factor Analysis was then reviewed using various analytical criteria to decide how many factors should be extracted. These included the Kaiser-Guttman criterion (where factors are selected with an Eigenvalue²³ larger than one), Significant Loadings (where factors are selected if they have two or more significant loadings at the 0.01 level), and Humphrey's Rule (where factors are selected if they are significant, where the cross-product of the two highest loading Q-sorts exceeds twice the standard error (strict) or exceeds the standard error (less strict)) (Watts and Stenner, 2012). This process was repeated multiple times with different numbers of factors, until the best solution was selected. A 3-factor solution was selected as the best factor solution for this study as it accounted for the highest number of Q-sorts (22 significantly loaded sorts or 28 including confounded sorts) with the smallest number of factors, with all factors passing the Kaiser-Guttman, Significant Loadings and Humphrey's Rule (less strict) criteria, and all but one factor passing the Humphrey's Rule (strict) criterion.

Once extracted, the factors were rotated using Varimax rotation, with KADE enabling this to happen digitally. During rotation, the mapping of the relative positions of all the Q-sorts in the study takes place, making the position of each factor clear, and increasing their interpretability (Watts and Stenner, 2012; Zabala, Sandbrook and Mukherjee, 2018). The angles from which the Q-sorts are viewed are altered, but their relative positions stay the same, with the angles simply enabling factors (or groups of Q-sorts) to be observed more easily. Varimax rotation accounts for the maximum amount of study variance and was therefore selected for use in this study over manual rotation (Watts and Stenner, 2012). A significance level is set which reveals which Q-sorts load on which factors, which Q-sorts load on multiple factors (are confounded) and which are not significant (non-loading on any factor) (Watts and Stenner, 2012). For this study, a 1% (<0.01) significance level was applied.

²³ An Eigenvalue is the sum of the squared loadings of all the Q-sorts on the factor.

Once rotated, factor arrays were created. A factor array represents the viewpoint of each factor (Watts and Stenner, 2012). Factor arrays provide an average Q-sort of each factor and are created based on the z-scores of each individual item (Watts and Stenner, 2012). Factor arrays make it easier for the factors to be understood, allowing the viewpoint as a whole to be seen (Brown, 1980; Watts and Stenner, 2012). These factor arrays were then interpreted by looking at distinguishing and consensus statements, and statements (items) that were sorted towards either end of the Q-sort grid. In this study, Watts and Stenner's (2012) crib sheet method was utilised to aid interpretation, with the initial themes covered in the Q-set acting as a structure for the interpretation. These methods formed the basis of the factor-by-factor interpretation (6.3.2).

The pre-sort survey data were subjected to descriptive analysis and frequency tables were created. The audio recordings of the Q-sort process and post-sort discussion were transcribed using Otter.ai, reviewed, and thematically analysed in Microsoft Word using themes that emerged from the factor analysis. These were used to help interpret the factors.

3.3.3. Surveys

3.3.3.1. Rationale

Surveys are a frequent method used to gain insights on perceptions of topics from a large group of people, and many have taken place previously on deer management in the UK, Europe and US (Lauber, Anthony and Knuth, 2001; Kilpatrick and LaBonte, 2003; Parfitt, 2005; Dandy *et al.*, 2011; Valente *et al.*, 2020). Questionnaires are recognised as an important tool within human geography for understanding attitudes, behaviour and experiences (Parfitt, 2005). Surveying has been previously recognised as one of the most effective ways of understanding public perceptions of deer management in Scotland (Green, 2013).

Surveys of local councillors and the public were undertaken to understand their perceptions. The local councillor survey was short and targeted, to help address RQ10. The public survey was much broader, focussing on RQ1-4, RQ6, RQ9 and RQ10. Surveys were selected as the research method suitable for understanding perceptions of councillors and the public as they allow a large number of responses to be gathered in a shorter amount of time than methods such as interviews or focus groups (Vaske, 2019). Self-administered surveys were used to limit the researcher's influence on the respondents and to reduce social desirability bias (Bryman, 2016; McGuirk and O'Neill, 2016; Vaske, 2019).

A disadvantage of utilising self-administered surveys is that the researcher is not able to clarify or prompt questions, and therefore surveys have to be very clearly designed and well tested so that they can be completed by the respondent on their own (Bryman, 2016; McGuirk and O'Neill, 2016; Vaske, 2019). The researcher is also unable to control the order questions are answered in. Additionally, contextual information on the reasons for answers cannot be gathered from respondents, unlike in interviews, which means potential useful qualitative data is not collected (Bryman, 2016; Vaske, 2019). Although these concerns could have been addressed by the researcher being present whilst the survey was being undertaken, this was not possible due to the restrictions at the time of the COVID-19 pandemic. Nevertheless, understanding the perceptions of a larger sample remains valuable

for understanding community perspectives on urban deer management. These surveys produced quantitative datasets which were much quicker to analyse than the equivalent number of interviews and provided statistics on how representative perceptions are of the sample (Vaske, 2019).

Following Bryman (2016) and Vaske (2019), closed questions were used throughout both surveys, with one open question to allow any further comments to be given. Closed questions are often easier for respondents to answer, quicker to analyse and easier to compare. The surveys were both designed so that they would not be affected by respondents completing them in a random order.

3.3.3.2. Councillor survey

The survey of local councillors took place online as a rapid means of contacting all councillors across Scotland (Bryman, 2016). The initial survey was piloted with seven volunteers comprising a mix of academics, government employees and the public. Revisions were made based on the comments of these volunteers to improve clarity of questions, and the finished survey was then distributed, hosted on Qualtrics (Appendix 10).

All 1171 councillors from the 30 Local Authorities in Scotland that have wild deer populations were invited to participate in the online survey in March 2021, with a reminder sent out a week after the first email. This provided a purposive sample of a complete population of interest. The full survey was only available to those councillors who declared that they represented urban areas within their Local Authority; not all 1171 councillors were therefore eligible to complete the full survey.

The survey began with a participant information sheet (Appendix 10), followed by demographic questions about the respondent and their experience as a councillor, questions regarding their views of their Local Authority undertaking lethal or non-lethal urban deer management, and on public awareness of urban deer management. This was followed by space for additional comments. The survey was purposively very focussed, with limited questions, and therefore its results are only used to supplement the findings

presented in Chapter 6. However, it does present the viewpoints of a novel audience, who are previously untapped in Scottish wildlife research.

In total, 427 responses were received. The survey responses were entered into SPSS 28, cleaned of missing, duplicate, and rural-only responses, and then coded for analysis. 353 of these responses were complete enough for analysis to take place, representing a 30.2% response rate.

3.3.3.3. Public survey

A postal survey was selected as the most appropriate surveying method for the public as it allowed specific localities to be targeted (via purposive sampling), with random samples of households selected within the defined areas (Bryman, 2016). Although costly and time consuming, the benefits of being able to target surveys at specified areas of interest outweighed these resource demands. The use of postal surveys did cause some constraints on the sampling method, as the Open Register (an opt-in register of households on the electoral roll) had to be used to gather addresses to select the random sample. This meant that not every household in the specified areas had an equal chance of being selected for the survey, because if they were not on the Open Register, their address could not be accessed. 59% of households on the electoral roll chose not to be on the Open Register in 2020 (National Records of Scotland, 2021). Consequently, the random sample selected could only include 41% of households in the specified areas. If the COVID-19 pandemic had not been occurring, a door-to-door survey would have been utilised instead, which may have improved response rates and would have enabled a sample in which every household had a chance of being selected for the survey (Vaske, 2019). However, a postal survey was the most appropriate method given the circumstances, and although this may have lowered the response rate, it could also have limited the effects of interviewer bias (Vaske, 2019).

Areas for public survey were selected based on the literature review, interviews, and Q-methodology study. Three locations within Aberdeen, Glasgow and Perth (Figure 3.4²⁴) were

²⁴ Maps without citations were created by the researcher using QGIS.

chosen since urban deer presence has been recognised as potentially problematic in all cases, they are all built-up urban cities, but each represents a different stage of management, as summarised in Table 3.6. Differences and similarities in the geography of these sites are also highlighted in Table 3.6, which may shape respondents' views. Addresses were collected for the electoral ward closest to the areas of interest (for Aberdeen, Torry/Ferryhill; Perth, Perth City Centre and Glasgow, Baillieston), with the nearest postcode areas selected. In Aberdeen, these were AB11 7, AB11 8 and AB11 9, giving a sample of around 2800 addresses (Figure 3.5). In Glasgow, G32, G69 7 and G71 7 were selected, giving a sample of around 2500 addresses (Figure 3.6). In Perth, the postcode area was PH2, yielding a sample of around 2000 addresses (Figure 3.7). Once purchased from the Open Register, duplicate addresses were removed. A random sample within each of the areas was created using Microsoft Excel, and the first 1000 addresses in the random sample from each location were selected for inclusion in the survey.



Figure 3.4: The study locations of Aberdeen, Perth and Glasgow, where surveys were distributed to the public. The Basemap is satellite imagery provided by ESRI.

Table 3.6: Reasoning for the selection of the research locations for the public survey.

Location	Reasons for selection	Type of area
Torry and Ferryhill, Aberdeen	Deer are present in the Tullos Hill area and are actively culled by the Local Authority due to their impacts on plantings. Public opposition has been received against this culling, including local and international media attention.	A large city. An area of the city which is bordered by a large park to the south and the sea and golf course to the east. High levels of deprivation (Scottish Government, 2021b).
Baillieston, Glasgow	Deer are present near the M74 and the Greenoakhill area and are known to have been at high densities causing adverse impacts. Forestry and Land Scotland manage deer in the area and have culled at Greenoakhill. Forestry and Land Scotland lease some Local Authority land and manage deer on it, although have been banned from culling on it, despite them believing it is needed. The East End of Glasgow has received media attention due to poaching incidents. There has been no known media attention of the culling.	A very large city. An area of the city which is surrounded by housing but close to motorways and not far from rural areas. Moderate to high levels of deprivation (Scottish Government, 2021b).
Perth City Centre, Perth	Deer are present on Kinnoull Hill. Half of Kinnoull Hill (nearest the city) is owned by the Local Authority and the deer are not managed. The other half of the hill is owned by Forestry and Land Scotland, where deer are actively culled. The Local Authority recognise that deer do cause some adverse impacts and may need to be culled. Some residents have seen evidence of culling by Forestry and Land Scotland.	A small city. An area which is urban but is also somewhat surrounded by the countryside, especially to the east. This area has lower levels of deprivation than the areas selected in Glasgow and Aberdeen (Scottish Government, 2021b).

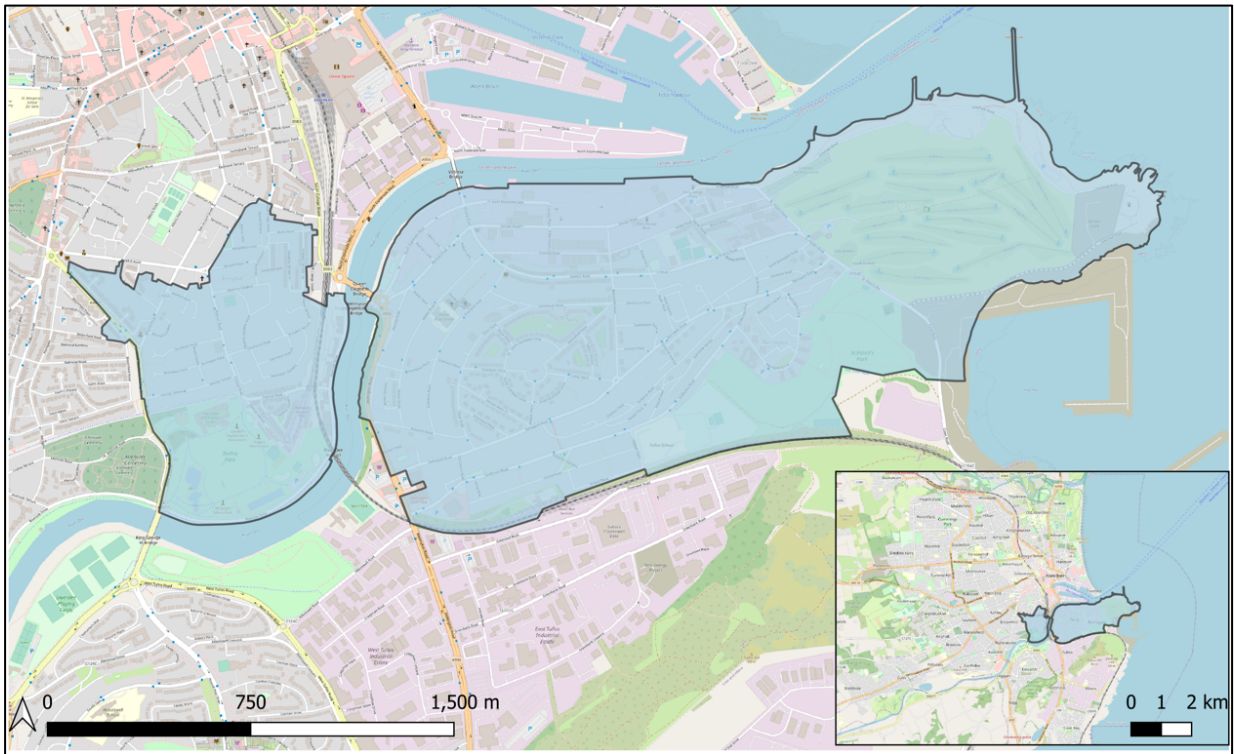


Figure 3.5: Survey locations within Torry and Ferryhill, Aberdeen (the blue polygon represents the surveyed area). Basemap provided by QGIS.

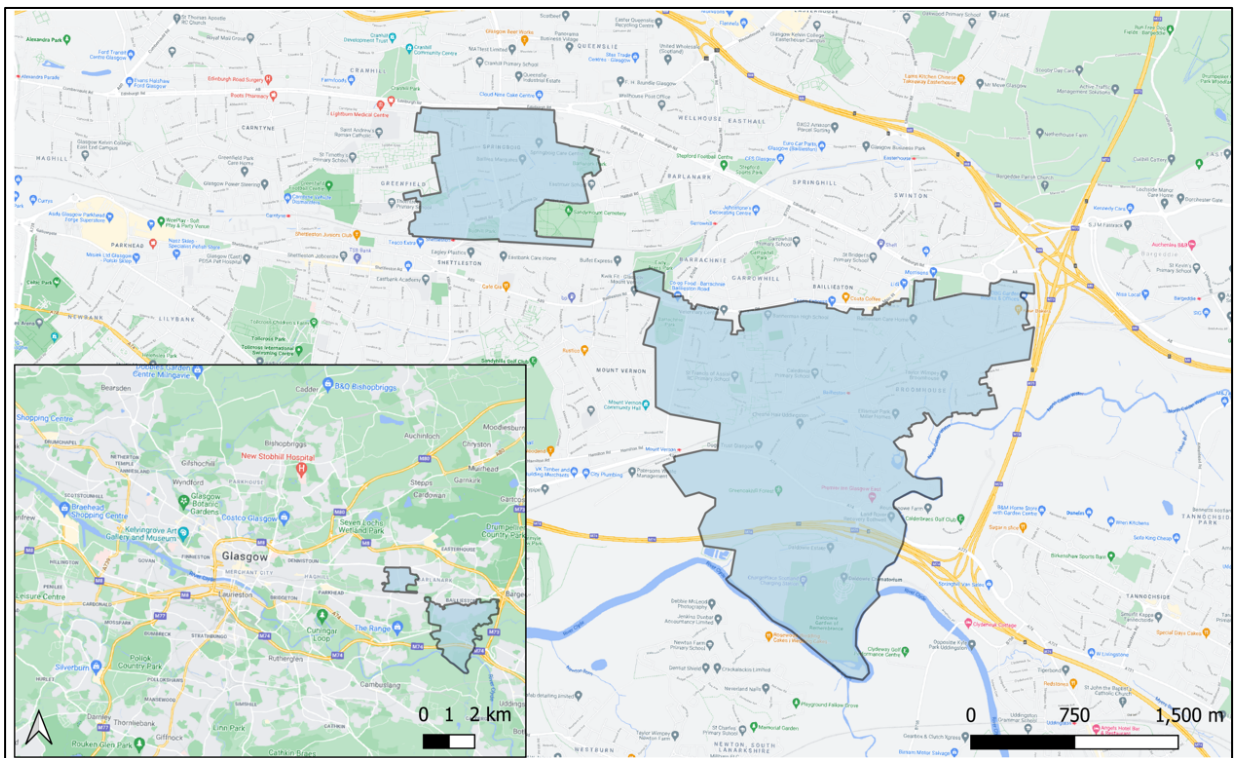


Figure 3.6: Survey locations within Baillieston, Glasgow (the blue polygon represents the surveyed area). Basemap provided by QGIS.

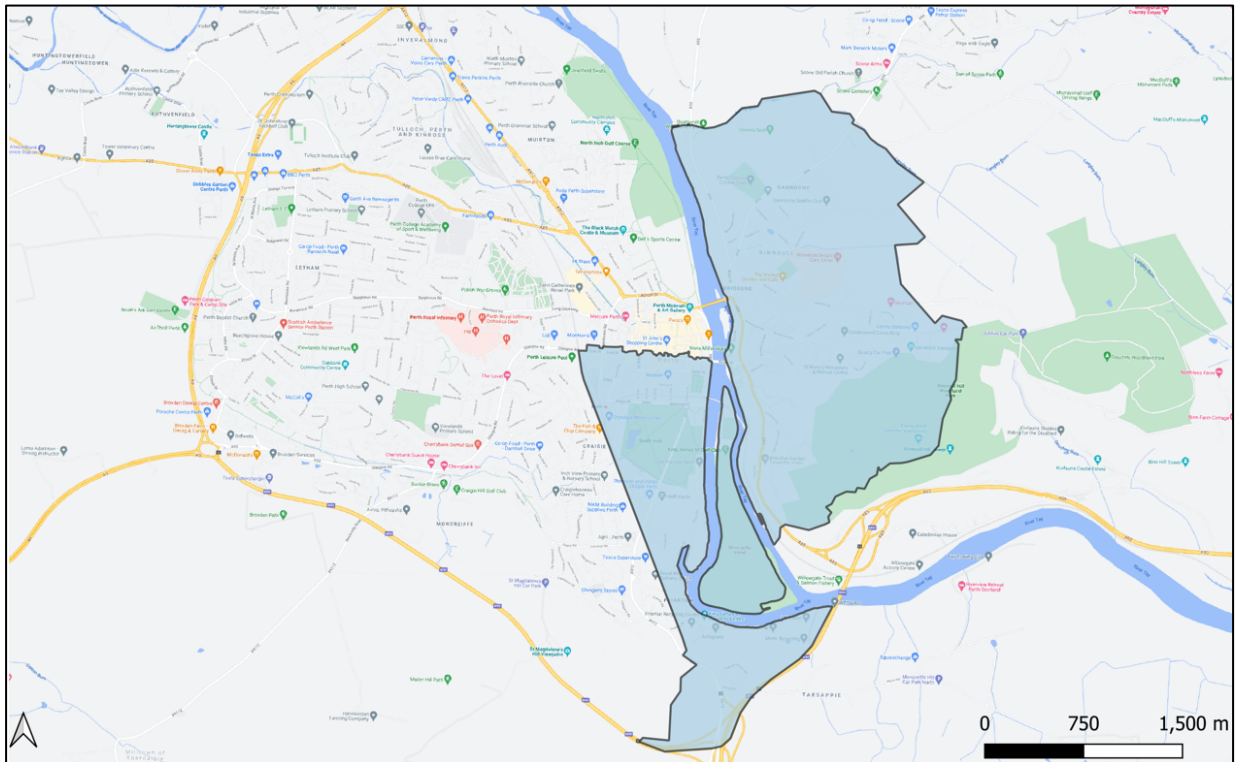


Figure 3.7: Survey locations within Perth City Centre, Perth (the blue polygon represents the surveyed area). Basemap provided by QGIS.

Surveys were distributed in July 2021 to each of the 3000 addresses, enclosing a stamped-addressed return envelope, a cover sheet and a participant information sheet, with a request for one resident from each address to complete and return the survey (Appendix 11). Each survey included a QR code and a Qualtrics link so that the survey could be filled out online if preferred (Bryman, 2016). A code was put on every survey and was required when filling out the online form, to ensure that duplicate responses from the same household could be recognised and removed (Vaske, 2019). These codes were removed from the survey responses once duplicates had been identified, so that the addresses of the respondents could not be linked to the survey responses. A reminder postcard was sent to each household one week after the surveys had been posted to encourage participation (Appendix 12) (Albaum and Smith, 2012; Henninger and Sung, 2012; Vaske, 2019). An incentive of entering a draw to win one of two £50 gift cards for a store of the respondent's choice was used to encourage participation (Toepoel, 2012; Bryman, 2016; Vaske, 2019).

The survey questions were created with the existing literature, interviews, Q-methodology study and councillor survey in mind. The survey was piloted with 23 individuals, including a mix of academics, government employees, deer managers, and members of the public. The main alterations to the survey were based on the language used to describe deer managers, to better describe their role, the rewording of some questions, and the reduction of academic language which could alienate respondents. The survey was extensive (109 questions or statements in total), but feedback during the pilot stage did not suggest that this was problematic. The distributed version of the survey included sections on knowledge and perceptions of deer, views and experiences of urban deer and their impacts, perceptions of urban deer management and views of the role of Local Authorities in urban deer management. This was followed by space for open comments and a section for demographic information.

In total, 332 responses were received, consisting of 286 postal returns and 46 online returns. The online sample was too small to be compared to the postal surveys so both returns were therefore combined and treated as one dataset. The survey responses were entered into SPSS 28, cleaned of missing, incomplete, and duplicate responses and then coded for analysis. 318 of these responses were complete enough for analysis to take place (Table 3.7), representing a 10.6% response rate. However, the response rate differed substantially between the three locations surveyed, with responses from Perth alone similar in number to those from Aberdeen and Glasgow combined. Many factors could account for this, but it is hypothesised that it could be related to the area surveyed in Perth being less deprived than the areas surveyed in Aberdeen and Glasgow (Scottish Government, 2021b). Socio-economic status is known to affect survey response rates, with those with higher socio-economic status more likely to respond to surveys (Sheikh and Mattingly, 1981; Hoonakker and Carayon, 2009).

Table 3.7: Survey respondent numbers and response rates from Aberdeen, Glasgow and Perth.

	Aberdeen	Glasgow	Perth	Overall sample
Number of participants	80	78	160	318
Response rate	8.0%	7.8%	16.0%	10.6%

3.3.3.4. Analysis

For both surveys, descriptive analysis of all variables took place, with frequency tables and bar graphs created. Qualitative comments were removed from the public survey dataset and were thematically analysed. These are used to understand more fully some of the themes apparent in the quantitative data.

To provide further depth of analysis of the public survey²⁵ and investigate associations between the variables and city of residence, Chi-square (where less than 20% of expected cases had under 5 responses) and Fisher’s Exact testing (where more than 20% of expected cases had under 5 responses) were applied, as has been previously used in studies on perceptions of deer (Lauber, Anthony and Knuth, 2001; Dandy *et al.*, 2011; Field, 2014; Whitefield *et al.*, 2021). All tests used Monte Carlo significance. Only summary information on variations between cities is presented, with significant associations presented in Appendices 13, 14 and 15.

²⁵ Due to the very small number of local councillor participants from each Local Authority area, their perceptions were not compared using Chi-square or Fisher’s Exact testing.

3.4. Limitations

As with any research, it is important to recognise the limitations of the study design. Firstly, the COVID-19 pandemic restrictions meant that all methods had to be implemented remotely to conform with Government and University regulations, which may have affected response rates and rapport with participants. The effects of the pandemic also led to constraints on the researcher's time, as additional research had to be undertaken to learn how to facilitate a postal survey, and a considerable amount of manual labour, administration and understanding of University procurement systems had to be undertaken. Limited literature on undertaking an online Q-methodology study also led to a significant amount of time having to be utilised to explore all possible methods and software. These additional draws on the researcher's time limited the time available for undertaking the rest of the thesis²⁶. The pressures of adjusting to living within a pandemic will also have affected this research.

Additionally, the minimal existing understanding and knowledge regarding urban deer in Scotland constrained this study. Very little literature on the topic exists, with most relevant research focussed in the USA and much of this around 20 years old. This led to a limited knowledge-base for this study.

Regarding the councillor survey, respondents were not fully representative of the wider body of councillors (e.g. of the political parties or Local Authorities) (6.2.2). A quota system would have enabled a more representative sample to be collected. As the councillors represent political interests, and deer are a topic which have long been politically contested in Scotland, there are concerns about whether councillors answered the survey with their own views or concealed these due to concerns about electorate perceptions. Although the councillors were told that responses were confidential, this may nevertheless have affected responses on such a 'hot' political topic. This was taken into consideration when analysing their responses.

²⁶ The researcher did, however, gain a 3 month COVID-19 extension.

The main limitation of the Q-methodology study with Local Authorities was that individuals had to fill out the Q-sort on behalf of their organisation. This presented participants with the dilemma of whether to express their own views or attempt to represent their organisation's views. Ideally, it would have been better if all of the relevant individuals who work on deer at each Local Authority had participated, to gain a better understanding of the range of views within each Local Authority, but this was not realistically possible.

The public survey also had some significant limitations. Firstly, the survey response rate was lower than hoped. This may have been due to the postal method of this survey, which was necessary due to COVID-19. This method was time consuming and costly for the researcher to undertake for a relatively low response rate, and resources may have been better used in another way, such as through a targeted online quota survey. The relatively small response rate required the online and postal responses to be combined into one dataset, whereas larger samples would have enabled comparison between these datasets which might have thrown light on how the methods affected responses. Additionally, as already noted, the postal method was restricted by addresses being gathered from the Open Register, of which not everyone is a member, and this affected the representativeness of the survey sample. The demographics of the participants were also not representative of the target population (4.2.1), which could have been improved through quota surveying. Within both surveys, participation was self-selecting and therefore respondents are unlikely to have reflected the wider population, as they are likely to be the people most interested in the topic, which means that the results cannot be generalised to the general public. Additionally, as the surveys were targeted to known areas of deer impacts or management, the responses may not reflect the views of the wider public where urban deer, impacts and management may be less visible or of less concern. Despite these limitations, this study is based on rigorous datasets, which provide ample high-quality data for this thesis.

4. Exploring perceptions of urban deer in Scotland

4.1. Introduction

This chapter presents and discusses the results which explore perceptions of urban deer in Scotland (RO1). These results stem from the expert interviews and public survey, providing complementary perspectives, with the interview data providing in-depth insights regarding urban deer, and the survey data predominantly providing descriptive statistics of public perceptions. These data are presented together to generate a holistic understanding of perceptions of urban deer in Scotland, based on each research question, enabling areas of contention and consensus to be identified. Local Authority perceptions are presented separately (Chapter 6), to enable their viewpoints to be understood as a whole, in line with Q-methodology norms. Discussions within this chapter are centred around three research questions:

RQ1. How are urban deer perceived?

RQ2. How are urban deer population trends viewed?

RQ3. How are urban deer impacts perceived?

4.2. Overview of the datasets

4.2.1. Public survey dataset

A demographic breakdown of the public survey respondents is presented in Table 4.1. Comparison with 2011 census data for Scotland shows that the sample is not representative of Scotland's adult population, with a bias towards higher educational attainment, older age categories and men (Scotland's Census, 2021). The bias towards respondents with higher educational qualifications is characteristic of survey outcomes (Green, 1996). While there is no clear relationship recognised in the literature between age and survey response rates (Green, 1996), previous research on perceptions of deer in Scotland has also reported an oversampling of older participants (Whitefield *et al.*, 2021). With a higher sample of male participants (54.3%), this sample contrasts with patterns usually found in survey literature, where females typically predominate (Green, 1996). This could be due to the survey topic, since deer management in Scotland is typically dominated by male voices (as demonstrated through the sex of the expert participants (4.2.2)), and wildlife management is generally thought to be a topic of more interest to males than females (Kellert, 1976; Sanborn and Schmidt, 1995). Within the public sample, a minority of respondents had experience in deer management (6%), in land-based or environmental sectors (21.4%) or had lived in rural areas (44.8%) (Table 4.2). The effect of these demographic variables on public perceptions was not analysed due to the scope of this thesis, with time constraints limiting the analysis, with a conscious choice not to focus on how perceptions are shaped. A further study could be beneficial to analyse this information.

Table 4.1: Demographic statistics of the public survey respondents, compared to the 2011 census (Scotland's Census, 2021).

		Respondents	2011 Census
Number of participants		318	
Age (%)	18-35	10.2	29.1
	36-55	28.3	35.9
	56-75	47.5	26.3
	76+	14.0	8.7
Gender (%)	Male	54.3	48.5
	Female	45.7	51.5
Highest educational attainment level (%) <i>(census data is for over 16s)</i>	No qualifications or Level 1: Standard Grades or equivalent	16.8	49.9
	Level 2: Higher Grades or equivalent	10.6	14.3
	Level 3: HNC, HND or equivalent	17.1	9.7
	Level 4: Undergraduate or postgraduate degree or professional qualification	55.5	26.1

Table 4.2: Statistics regarding environmental involvement of the public survey participants.

	Do you or have you had any involvement with deer management or deer culling?		Do you have any experience within land-based or environmental sectors?		Have you ever lived in a rural area?		How often do you use local greenspaces?			
	Yes	No	Yes	No	Yes	No	Daily	Weekly	Monthly	Less than monthly
Respondents (%)	6.0	94.0	21.4	78.6	44.8	55.2	39.5	37.0	11.0	12.5

4.2.2. Expert interviewee dataset

Full demographic data were not collected from the expert interviewees, but, notably, 15 of the 16 interview participants were male, in contrast with the more equal gender split amongst survey participants. The expert participants all had extensive experience and knowledge of deer management and in land-based or environmental sectors, in most cases over many decades within Scotland, with some having experience in the wider UK. However, many of the expert interviewees had limited personal experience with urban deer or their management. For example, this was evident through confusion regarding the terminology surrounding urban deer (4.3.1). This lack of urban-specific knowledge is perhaps unsurprising as urban deer have yet to receive much attention across Scotland (Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). Despite this, these participants were selected as the experts with the most experience and knowledge of urban deer management in Scotland.

4.3. How are urban deer perceived?

4.3.1. Definitions

Within the expert interviews, a variety of concerns about defining urban deer were apparent, echoing the difficulties previously highlighted in defining urban areas (1.2). There was confusion about the use of the terms urban²⁷, peri-urban²⁸ and lowland²⁹ in the context of deer management. The terms lowland³⁰ and urban were used interchangeably by some participants (Theme A, Table 4.3), as were the terms peri-urban and urban (Theme B, Table 4.3), which have also previously been used interchangeably in Scotland's deer literature (Dandy *et al.*, 2009; Chetwynd, 2019; Lowland Deer Panel, 2019; McMorran, Gibson-Poole and Hamilton, 2019). Within the Lowland Deer Panel Report (2019) the term lowland is used, yet the focus is on rural areas, not taking into consideration urban environments. Dandy *et al.* (2009) focus on peri-urban areas, yet predominantly used the term urban with their participants. The importance of not using these terms interchangeably was highlighted by Mr O (Theme C, Table 4.3), who saw conflation as problematic because deer may have different impacts in the two areas (2.5) and because suitable management methods may therefore differ (2.6) depending on the degree of urbanisation. The inconsistent use of these terms also made it challenging to identify whether respondents were really focussing on urban areas when expressing their views. The widespread failure to differentiate between lowland and urban, and peri-urban and urban, is evidence of a lack of existing attention and guidance surrounding urban deer in Scotland, with definitions and differences yet to be clarified. This may compromise the effectiveness of deer management practices as respective management needs and responsibilities may not be identified for these areas. The terminology surrounding urban deer needs to be defined and used in a more consistent

²⁷ Urban areas are by the Scottish Government's Rural-Urban definition, settlements with a population of over 3000 people, as defined in Chapter 1, and as this thesis defines them, urban deer are those that live surrounded by a mix of housing, infrastructure, development sites, roads, railways and/or parks (i.e. not surrounded by fields or countryside), making human-deer interactions likely.

²⁸ Peri-urban areas are usually a mix of urban and rural, although where this boundary lies is debated (Chapter 1).

²⁹ Lowland areas in Scotland are areas outside of the Highlands, largely to the south and east of Scotland. The Highlands (or uplands) constitute much of the north and west of the country.

³⁰ Urban areas (as defined in 1.2) can exist in lowland (and Highland/ upland) contexts, but large parts of the lowlands are rural.

way to enable improvements in understanding and managing urban deer populations in Scotland.

Table 4.3: Data from expert interviewees highlighting difficulties in defining ‘urban deer’.

Theme	Data and participant
A. Conflating lowland and urban	<p><i>“I need to caveat with something around what we mean by lowland deer, urban deer.”</i></p> <ul style="list-style-type: none"> - Mr I, Government Organisation <p><i>“I prefer referring to it as the lowland scenario, rather than urban and peri-urban.”</i></p> <ul style="list-style-type: none"> - Mr P, Consultant
B. Conflating peri-urban and urban	<p><i>“It was a very mixed response on how they valued peri-urban deer, if you want to call them peri-urban or urban.”</i></p> <ul style="list-style-type: none"> - Mr B, Non-Governmental Organisation <p><i>“From our perspective it started off as sort of urban deer, then peri-urban deer you will see... so traditionally someone will say peri-urban deer and think we’re talking about roe deer in the middle of Glasgow.”</i></p> <ul style="list-style-type: none"> - Mr I, Government Organisation
C. Distinguishing urban and peri-urban	<p><i>“I’m very conscious of a distinction between formally urban, which is paved streets and little city parks and peri-urban, which is where either the suburbs are stretching out into the countryside or there is a countryside surrounding a town or a city which is increasingly used by people for recreation. I think there are real problems if you don’t accept that distinction. They pose the same problems in peri-urban environments that they do anywhere in the countryside. In a peri-urban environment, we manage in a completely</i></p>

	<p><i>conventional way. The management practicalities are so different [in urban areas]."</i></p> <p>- Mr O, Academic</p>
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4.3.2. Perceptions of deer

Attitudes towards urban deer were largely positive amongst the public survey participants and expert interviewees. Most public respondents enjoyed seeing deer in urban areas, regarding them as beautiful (98.7%) and part of Scottish culture (88.06%), and believing that they improve human wellbeing (49.67%) (Figure 4.1 and 4.2) (Theme A, Table 4.4). Positive views of deer are noted in the existing literature from Scotland and the USA (Connelly, Decker and Wear, 1987; Dandy *et al.*, 2009; Whitefield, 2019), with benefits for human wellbeing previously recognised in literature produced by and for the Scottish Government (Scottish Government, 2014; Scottish Natural Heritage, 2016; Pepper, Barbour and Glass, 2019). Seeing deer within urban areas was perceived by most public (64.11%) and expert participants as helping to connect the public to nature (Figure 4.2) and by experts as providing residents with an exciting and often rare opportunity to see larger wildlife near where they live (Theme B, Table 4.4). Seeing urban wildlife has been highlighted in the literature as helping to educate and inspire urban residents about the environment, which could be a positive effect of urban deer presence in Scotland (Dandy *et al.*, 2009; Soulsbury and White, 2015; Mumaw, Maller and Bekessy, 2017).

Although urban deer are viewed positively in this study (61% of public survey respondents like seeing urban deer) (Figure 4.1), previous Scottish studies have reported stronger positive views, such as Dandy *et al.*'s (2011) study of peri-urban Scotland which found that 88.5% of respondents enjoyed seeing deer. Similar findings are reported by Hare *et al.* (2021) (91.7%) and Whitefield (2019) (96%). The proportion found in this thesis was more similar to Decker and Gavin's (1987) urban study (57%) and Urbanek *et al.*'s (2013) suburban study (65%). This finding may suggest that positive views of seeing deer in urban areas may be lower than in rural environments. This may be because of worry about the potential impacts of deer (especially on the environment (4.5.1)) and concern about their welfare (4.5.4), which may explain why there were mixed views as to whether urban deer

should be present (Figures 4.1 and 4.2) (Theme C, Table 4.4). Overall, however, the majority of public respondents are generally not worried or annoyed about urban deer presence (Figures 4.1 and 4.2) and appear to benefit from them.

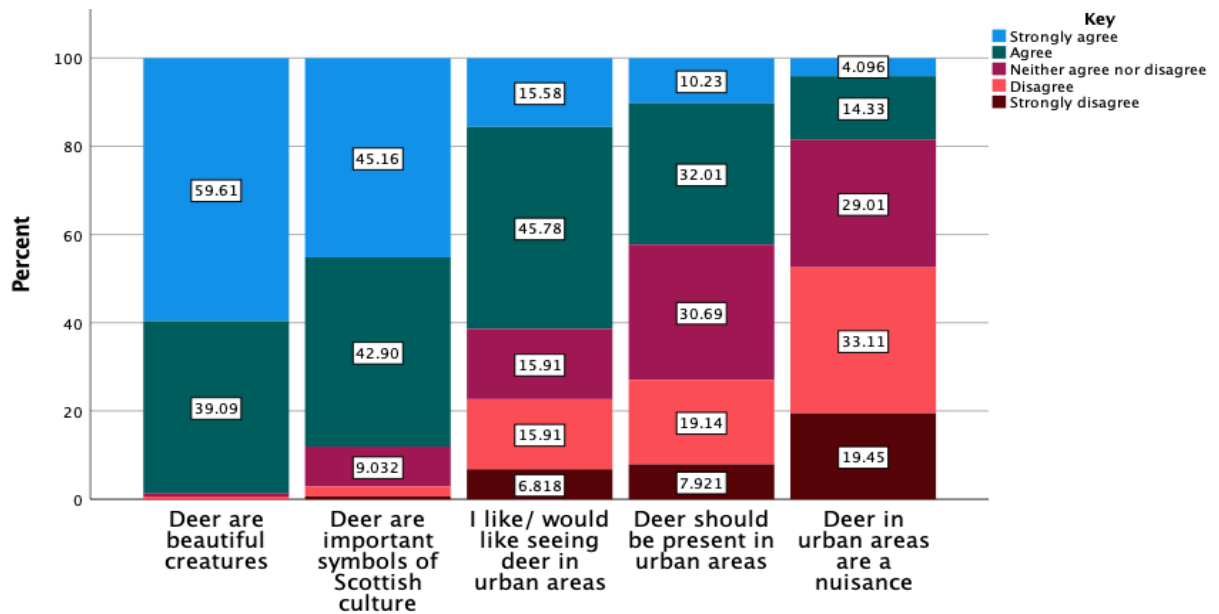


Figure 4.1: Public survey respondents' perceptions of deer.

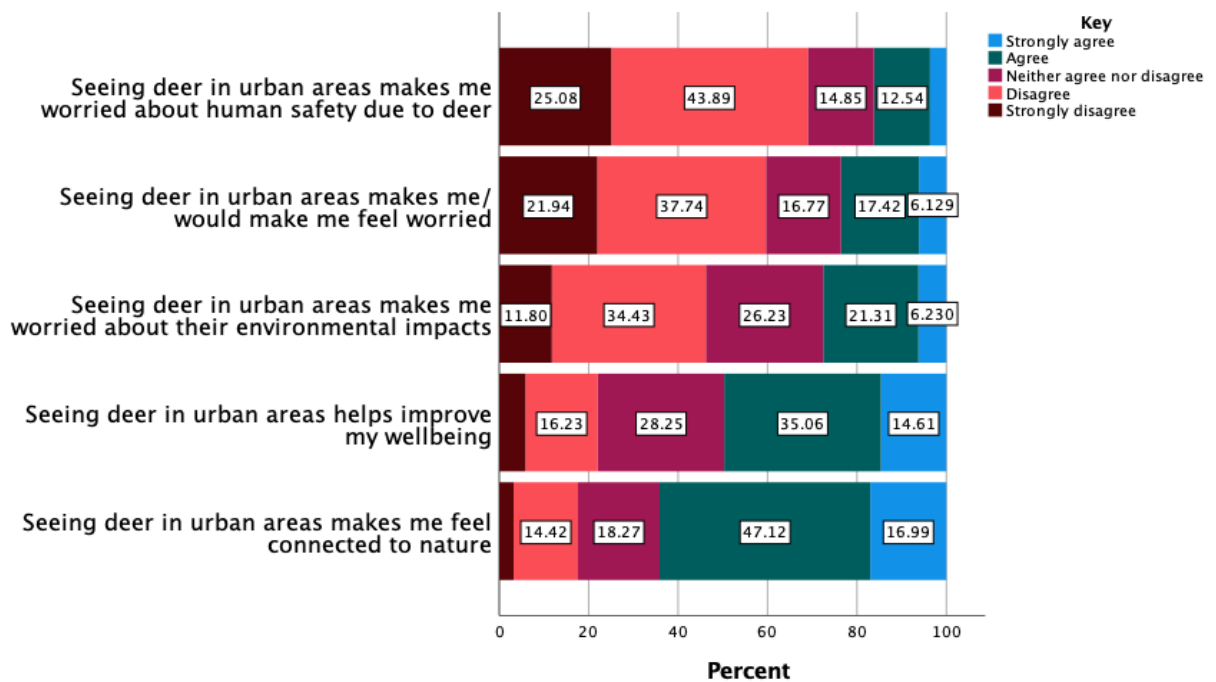


Figure 4.2: Public survey respondents' views of the effects of seeing deer in urban areas on themselves.

Table 4.4: Data from public survey participants and expert interviewees regarding perceptions of urban deer.

Theme	Data and participant
<p>A. Enjoy seeing deer in urban areas/ positive effect on human wellbeing</p>	<p><i>"I must admit that I feel joy on occasions when I catch sight of deer in local green areas."</i></p> <p>- Male survey participant, Glasgow</p> <p><i>"It's gotta be recognized that for some people in these urban areas, seeing a deer is a major positive boost for them... so that aspect shouldn't be underestimated for human health."</i></p> <p>- Mr B, Non-Government Organisation</p>
<p>B. A rare opportunity to see large wild animals</p>	<p><i>"It might be their only grasp of nature. We're probably fortunate enough to jump in the car and go and see wildlife somewhere else so a lot of people in these urban areas won't have that luxury. They wouldn't know where to look, they wouldn't know anything. So to see a deer walking up the street or in a park might actually be their only engagement with nature in its widest sense, in the year for them."</i></p> <p>- Mr B, Non-Government Organisation</p> <p><i>"People who maybe don't have access to the countryside, they're actually getting to see probably the biggest land mammal they'll see in their lifetime perhaps. And that's that's a big tick. It's like a great opportunity for them."</i></p> <p>- Mr A, Government Organisation</p>
<p>C. Concerns regarding urban deer welfare</p>	<p><i>"I worry that deer are only in the urban environment because their natural environment is encroached or disturbed by humans."</i></p> <p>- Female survey participant, Aberdeen</p>

	<p><i>"I worry deer coming into urban areas make them more at risk from harm whether it be human or animal attack."</i></p> <p>- Female survey participant, Perth</p> <p><i>"You've got deer living in these places and people see them. And if they're that way inclined they're immediately concerned that there may be something wrong with the deer? Or they might be just generally worried about them or they're worried for their wellbeing, their welfare, so they think they shouldn't be there or they should be taken away and moved."</i></p> <p>- Mr I, Government Organisation</p>
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4.4. How are urban deer population trends viewed?

4.4.1. Urban deer population numbers and trends

Public survey respondents were unsure as to whether urban deer populations had increased in their areas (Figure 4.3) (39.91% don't know, 21.02% neither agree nor disagree), in direct contrast to the widely held expert view amongst interviewees and in the Scottish literature that deer populations are increasing in urban areas across the country (Themes A, Table 4.5) (British Deer Society, 2017; Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). Despite this expert consensus, the public survey results suggest that urban deer populations have not changed significantly enough in Glasgow, Aberdeen or Perth to be visible to residents.

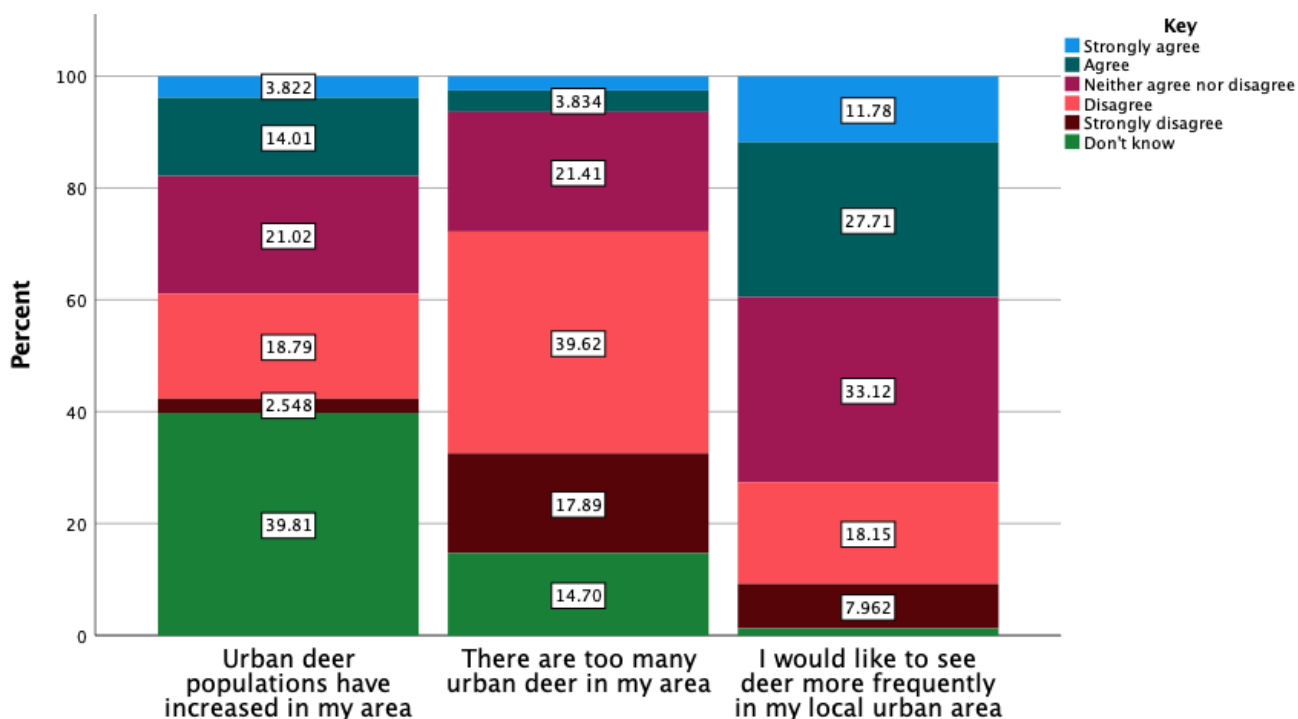


Figure 4.3: Public survey respondents' perceptions of urban deer population trends in their local area.

Table 4.5: Data from public survey participants and expert interviewees regarding urban deer population trends.

Theme	Data and participant
<p>A. Urban deer populations are increasing across Scotland</p>	<p><i>“Scotland’s deer population whether you like it or not is on the increase in these urban areas.”</i></p> <ul style="list-style-type: none"> - Mr F, Government Organisation <p><i>“Practically every town or city will have roe deer in it. It’s not something unique to a few areas. It’s quite extensive... the fact remains there are clearly substantial populations of deer in urban areas all over Scotland.”</i></p> <ul style="list-style-type: none"> - Mr C, Non-Government Organisation
<p>B. Would not like to see deer more often</p>	<p><i>“Seeing deer should be a rare and special moment, not a quotidian event.”</i></p> <ul style="list-style-type: none"> - Male survey participant, Aberdeen
<p>C. Urban deer presence is extensive and densities can be high</p>	<p><i>“In Easterhouse... I think on one stretch of road it was 30 plus deer we saw. It was in the space of like 2 miles. For me as a deer manager that’s quite concerning. And we’re seeing this during the day... it’s so plagued by them.”</i></p> <ul style="list-style-type: none"> - Mr A, Government Organisation <p><i>“A brownfield site [in Musselburgh]... so I went and done a thermal count and there was in excess of forty roe deer in this area. And that’s where I contacted [Forestry and Land Scotland], he said I’ll go and give this guy lip service, he’s probably just making these numbers up and he was actually put back on his feet how many there were actually in there.”</i></p> <ul style="list-style-type: none"> - Mr L, Deer Manager
<p>D. Lack of urban deer population data</p>	<p><i>“We haven’t really got a long track record of monitoring national populations of deer. What we have is a long track</i></p>

	<p><i>record of counting open range red deer. But not roe deer for example.”</i></p> <ul style="list-style-type: none"> - Mr E, Government Organisation <p><i>“I expect any council that has sat up and taken notice of this as an issue will be struggling to get real population data to help inform what changes are occurring, where they are. So that's a real challenge I think, the data.”</i></p> <ul style="list-style-type: none"> - Ms J, Academic
E. Challenges in undertaking urban deer population surveys	<p><i>“Deer are not going to go ‘hi, here we are’ you know it’s very difficult even with thermal imaging in colour its very, very difficult to get a precise number on them.”</i></p> <ul style="list-style-type: none"> - Mr L, Deer Manager

Most public survey participants did not believe there were too many deer in their locality (in Glasgow, Perth and Aberdeen), with only 26% not wanting to see urban deer more frequently (Figure 4.3.). This suggests that the same or higher populations of deer would be welcome in these areas. A minority of public survey respondents (26.11%) did not want to see more urban deer, with one respondent expressing the view that such sightings should be a rare event (Theme B, Table 4.5). Experts also appeared concerned about urban deer presence, highlighting that in some areas they are at worryingly high densities (Theme C, Table 4.5). Concerns and apprehension about urban deer impacts and welfare, as highlighted in section 4.3.2, may explain why these respondents do not want to see urban deer more often. Because of the considerable challenges and costs of counting deer systematically in urban areas, and the limited attention that urban deer have received, counting has not been undertaken in Scotland (Themes D and E, Table 4.5) (Pepper, Barbour and Glass, 2019). It is therefore difficult to estimate with any certainty how abundant urban deer are, or how numbers are changing, despite expert views. The effects of a lack of population data are further discussed in 4.5.6 and in 7.2.3.

4.4.2. How deer enter urban environments and where they reside

Corridors (such as woodlands, roads and railways) were recognised by the expert interviewees as pathways for deer into urban areas in Scotland (Theme A, Table 4.6), as previously described in England (McCarthy, Baker and Rotherham, 1996; Rotherham and Walker, 2015). Additionally, experts highlighted that when rural areas with resident deer are urbanised, this creates new urban populations (Theme B, Table 4.6). It is thus unlikely to be simply deer moving into urban environments that causes urban numbers to increase (Dandy *et al.*, 2009; Rotherham, Derbyshire and Wolstenholme, 2012; Adams and LaFleur Villarreal, 2020). The ability of urban design to affect the location and movement of urban deer was mentioned by some expert interviewees (Theme C, Table 4.6), with a need to consider deer when planning urban areas to reduce potential conflicts. This has previously been recognised by Duarte *et al.* (2015). Wildlife-inclusive planning (where the needs of wildlife are actively considered during the planning process, with biodiversity seen as desirable) could help to mitigate any potential impacts of urban deer, although is yet to be the norm in town planning processes, with many barriers to its implementation (Apfelbeck *et al.*, 2020; Kay *et al.*, 2021). NatureScot has recently published a report encouraging the Scottish Government to support integrated land use planning for biodiversity, where measures for biodiversity are ecologically coherent, integrated into habitat networks, to provide resilience of habitats and species (NatureScot, 2020b). The National Planning Policy now includes protecting biodiversity and strengthening nature networks in the National Planning Framework 4 (Scottish Government, 2023). This provides an opportunity to integrate awareness of deer into urban design in Scotland, to prompt planners and developers to proactively consider wildlife (including deer) and their management (7.3.2).

Many examples of suitable urban deer habitats were provided by expert participants, from large development sites and parks to small areas such as roundabouts and secluded pockets of greenery (Theme D, Table 4.6). These habitats highlight the ability of deer, particularly smaller deer species such as roe, to adapt to and feel safe within a variety of urban environments with varying levels of disturbance. The adaptability of urban wildlife has previously been recognised in the literature (Lowry, Lill and Wong, 2013), with synanthropic species, which deer may be considered to be, adjusting to human presence and sometimes

benefitting from their close proximity to humans (Hadidian and Smith, 2001; Gehrt, Brown and Anchor, 2011). Although many larger habitats have been identified in previous studies (Rotherham, 2001; Burgin *et al.*, 2015; Adams and LaFleur Villarreal, 2020), there has been little recognition of the smaller urban spaces where deer can reside (e.g. roundabouts and secluded pockets), which could present increased opportunity for conflict with humans if displaced.

Table 4.6: Data from expert interviewees regarding where urban deer reside.

Theme	Data and participant
A. Pathways into urban areas	<p><i>“We’re creating landscapes that take the deer safely and securely right into the most urban catchments.”</i></p> <p>- Mr G, Academic</p> <p><i>“The way that the main trunk roads come into Glasgow... it’s been spaced, woodland, easy for deer to come in and out of the city.”</i></p> <p>- Mr I, Government Organisation</p> <p><i>“The railways and road embankments are probably fairly good corridors for lowland deer.”</i></p> <p>- Mr P, Consultant</p>
B. Urban areas expanding into deer habitats	<p><i>“Is it a matter of deer are colonizing urban areas, bit like urban foxes, or is it just a natural progression of our towns and cities expanding into deer range? So who was there first? The deer or the people. There’s a kind of argument on it or conversation I’ll have with a lot of people. You know when they’re blaming the deer for coming in. It’s like well hang on a minute we are moving out all the time and developing areas.”</i></p> <p>- Mr I, Government Organisation</p>

<p>C. Importance of planning urban areas for deer presence</p>	<p><i>“For planning and greenspace expansion, all of that stuff... it's trying to get all of these people thinking about deer early on in the process so they don't build a load of houses and then go shit. What are we going to do with all these deer now? It's a bit late.”</i></p> <p>- Mr I, Government Organisation</p> <p><i>“The design of Glasgow was to bring everything towards a central core. It's like spokes through a wheel and all of the spokes are designed to bring wildlife into the centre of the city, but nobody thinks about what the implications of bringing all the wildlife to the centre of a city might be.”</i></p> <p>- Mr M, Consultant</p>
<p>D. Examples of areas where urban deer reside in Scotland</p>	<p><i>“Notably for example in Inverness the graveyard is a very attractive place for roe deer. Apart from anything else, it's relatively peaceful and tranquil.”</i></p> <p>- Mr E, Government Organisation</p> <p><i>“Imagine a brownfield site which Cala homes or Persimmon Homes have bought. It's got Heras fencing around it, it looks overgrown... it might be like that for years. And deer find a way in there, and they set up camp... it's good habitat for them.”</i></p> <p>- Mr I, Government Organisation</p> <p><i>“So they've got lots of greenspace, country parks, development sites, woodland planting... we try and make our towns and cities look nice and plant trees... But it doesn't take long for roe deer to realize that's ideal habitat for them.”</i></p> <p>- Mr I, Government Organisation</p>

“You know, you get... motorway interchanges, and the roundabout is often completely green. Nobody goes in there and they’re little islands where deer suddenly become very accustomed to the noise, but they’re undisturbed there.”

- Mr K, Consultant

“They don't need much of a secluded pocket in terms of some broadleaf trees, scrub, bramble, to make them feel that they've got a fairly secure spot with feed source close by.”

- Mr P, Consultant

4.5. How are urban deer impacts perceived?

Most public survey respondents did not believe or did not know whether urban deer caused most of the negative impacts listed and had not experienced them (Figure 4.4 and Figure 4.5). Overall, however, there was more public awareness of the impacts which urban deer have on the environment and on their own welfare (Figure 4.2 and Figure 4.4) and less awareness about deer impacts on humans (except for DVCs). This contrasts somewhat with the American literature, which suggests that human safety issues are of higher public awareness and concern than environmental impacts (Connelly, Decker and Wear, 1987; Kilpatrick and Walter, 1997; Siemer *et al.*, 2004). This difference in awareness may be due to the different levels of impacts, or awareness of these, between urban Scotland and the USA study sites, highlighting the differences between these study contexts (7.2.1). Impacts of deer are discussed in turn in the subsequent sections.

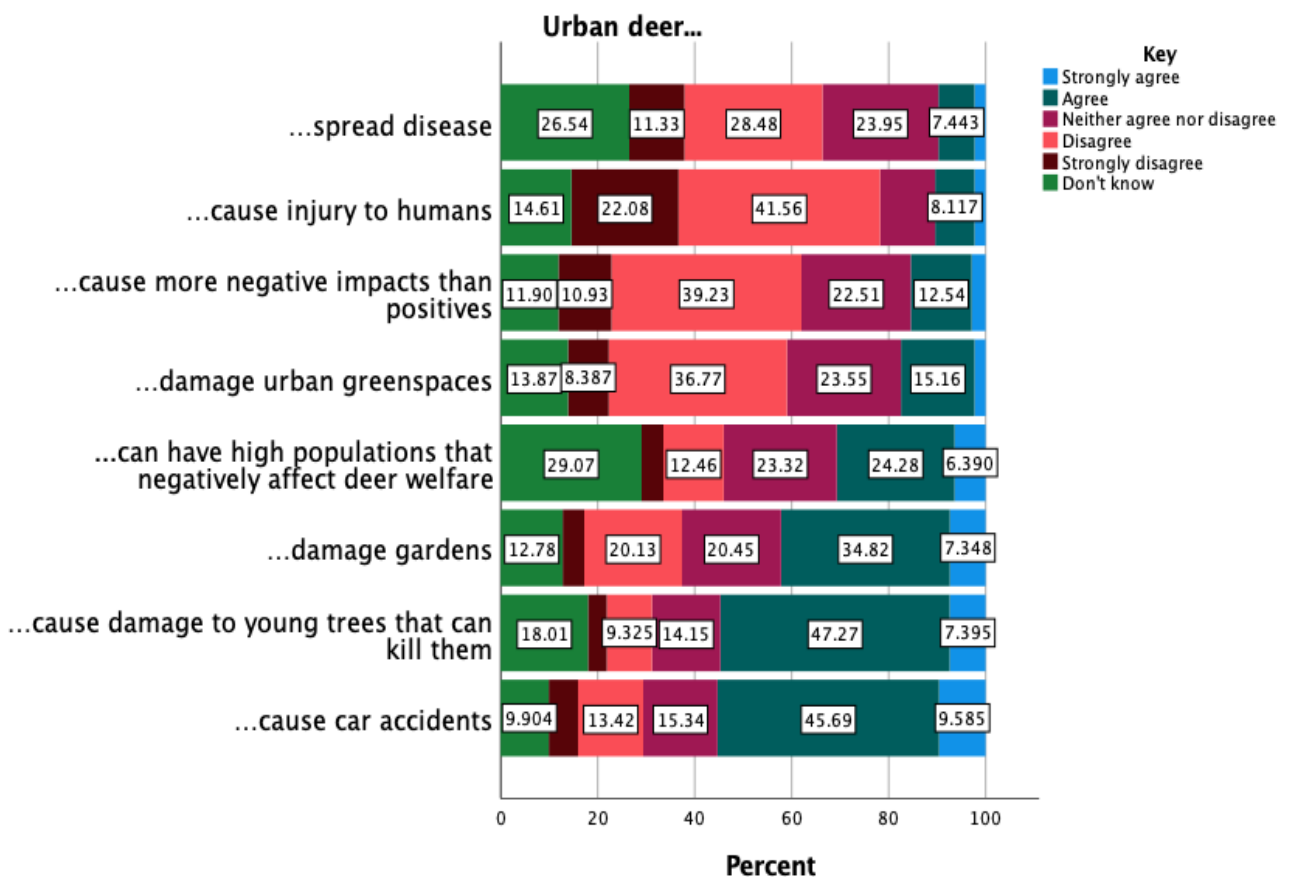


Figure 4.4: Public survey respondents' beliefs about whether urban deer cause impacts.

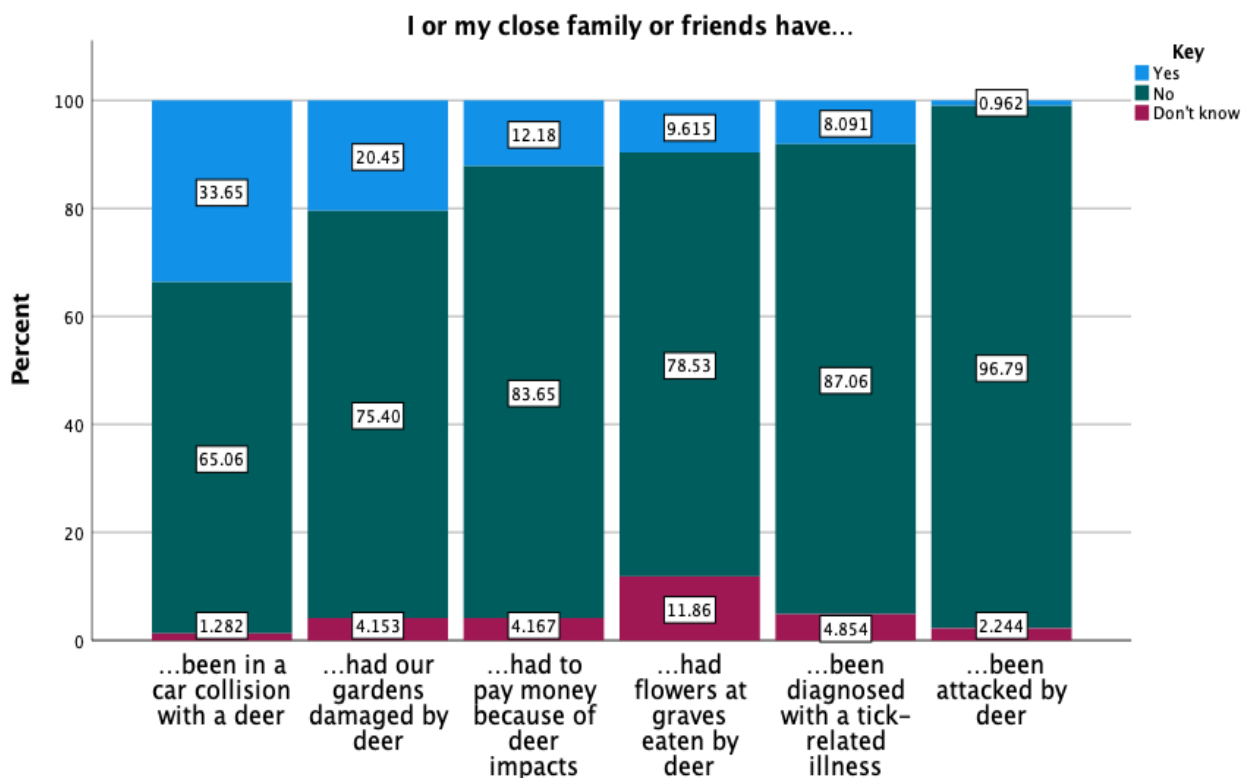


Figure 4.5: Public survey respondents' experience of deer-related impacts.

4.5.1. Impacts on the environment

Damage to greenspaces or gardens by urban deer was not recognised by most public participants (45.77%), but damage to trees was (54.67%) (Figure 4.4). Very few expert participants recognised damage by urban deer as a concern, particularly compared to woodland damage in rural areas or other urban environmental stressors (Theme A, Table 4.7). Some expert interviewees did, however, have experience of urban woodland damage and believed that it could be widespread but remains largely unrecorded (Theme B, Table 4.7). This highlights the general lack of attention paid to urban environmental impacts, suggesting that the environmental impacts of deer in urban areas are not considered either a pressing problem or a particular benefit, although this complacency is based on limited evidence (4.5.6).

Table 4.7: Data from expert interviewees on the environmental impact of urban deer.

Theme	Data and participant
A. Less of a concern than in rural areas	<p><i>“Putting it in context you tend not to associate the impact of deer in woodland in urban areas the same way as you would... Glen Feshie, where there were 4000 red deer annihilating an iconic native pinewood... the consequences of a handful of roe deer at Aberdeen, environmentally, is nothing compared with the heavy lorries and cars that are belting up and down.”</i></p> <p>- Mr E, Government Organisation</p>
B. Experience of deer damage to woodlands in urban areas	<p><i>“That first winter we had some snow and two of the sites were browsed off by deer down to the snowline very quickly and they were both sites we weren’t anticipating there would be any issues with deer on. So, deer obviously was a bigger problem than we’d anticipated.”</i></p> <p>- Mr H, Government Organisation</p> <p><i>“I think if you looked for it... you don’t have to go far around any town to find woodlands that are not doing as well as they could because of deer.”</i></p> <p>- Mr E, Government Organisation</p>
C. Damage within urban areas can be emotive	<p><i>“They do appreciate [seeing deer] up to a point and then when they start to get damage in their gardens, they’re less happy about it.”</i></p> <p>- Mr C, Non-Government Organisation</p> <p><i>“One of the oddities is regular damage in graveyards and cemeteries where resident deer... wander into the cemetery and pick up the wreaths and the bouquets and floral tributes and throw them about or eat them... people find that very upsetting if they’ve recently lost the relative and buried them</i></p>

	<p><i>and somebody's throwing the flowers around. So it may sound trivial, but actually it's so emotive that it's more important than perhaps it appears at face value."</i></p> <p>- Mr O, Academic</p>
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There was greater concern amongst expert participants about urban environmental impacts in areas to which people are emotionally attached, such as cemeteries and gardens, although these largely focussed on human reactions rather than environmental damage (Theme C, Table 4.7). Garden damage was the second most common impact of urban deer experienced by the public participants (20.45%); fewer participants had experienced deer eating flowers at graves (9.62%) (Figure 4.5). Impacts on gardens and cemeteries have previously been raised as a concern by communities in Scotland and the USA (Dandy *et al.*, 2011; Siemer, Decker and Stedman, 2016), and have been recognised in the USA as an important reason to manage urban and suburban deer (Connelly, Decker and Wear, 1987; Dougherty, Fulton and Lime, 2001; Siemer *et al.*, 2004).

4.5.2. Deer-vehicle collisions

DVCs were the public survey respondents' most recognised (55.28%) and experienced (33.65%) impact of urban deer (Figure 4.4 and Figure 4.5) and appeared to be the impact of most concern to the expert interviewees (Theme A, Table 4.8). High levels of concern about DVCs match concerns highlighted in the American deer literature (Lee and Miller, 2003; Raik, Siemer and Decker, 2004), and the high levels of attention they have received in Scotland (Langbein, 2017, 2019; Scottish Government, 2021a). Experts also discussed the dispatch of deer injured in DVCs and other incidents – a topic that rarely emerges in the literature (Theme B, Table 4.8). Interviewees mentioned being called out themselves to dispatch deer because of their role as a deer manager, whilst some mentioned the involvement of the police, SSPCA, vets or Local Authorities. There does not appear to be a clear protocol or responsibilities for who should dispatch injured deer following DVCs in urban areas of Scotland, with many different individuals (such as the police, 'appointed individuals', landowners, SSPCA, NatureScot, deer management groups) suggested in the

Best Practice Guides (Scottish Natural Heritage, no date b) (7.3.2).³¹ Although it is recommended that the police are called and lead culling operations where deer are presenting a risk to human safety, it is not clear who should undertake the dispatch, or what should happen where human safety is not at risk (Scottish Natural Heritage, no date b).

Table 4.8: Data from expert interviewees on urban DVCs.

Theme	Data and participant
<p>A. DVCs a significant impact of deer in urban areas</p>	<p><i>“I would say that the urban deer thing started with road traffic accidents.”</i></p> <p>- Mr M, Consultant</p> <p><i>“Road traffic accidents I think are the major problem that I see in either peri-urban or urban areas.”</i></p> <p>- Mr O, Academic</p> <p><i>“There's been a big increase in those [DVCs] in those urban areas.”</i></p> <p>- Mr K, Consultant</p> <p><i>“The concern obviously is that in urban areas they have the capability to do quite a lot of damage through DVCs... it's only when you've been close to or had a collision with a deer, that you start realising potentially how dangerous they can be in an urban situation.”</i></p> <p>- Mr C, Non-Government Organisation</p>
<p>B. Lack of protocol of who should dispatch injured deer</p>	<p><i>“Obviously if there's a road traffic accident and a deer is injured and still alive, we [a lowland deer group] try to put together a register for the local area for professional stalkers to go out and either deal with it or dispatch it. I don't know</i></p>

³¹ Dispatching deer has been recognised in the Best Practice Guidance as the most suitable method of dealing with injured deer (Scottish Natural Heritage, no date a).

	<p><i>what the policy is... I think they [the police] call in a vet... but a vet won't go because it's all down to cost."</i></p> <p>- Mr L, Deer Manager</p> <p><i>"They got called out to an incident where a red deer stag had been hit by a transit van. You've got the public in an urban area who themselves are traumatized by that sort of thing. You know they've just seen Bambi run over by a van. This isn't great, and even a vet if you have an accident in a rural area the vet will know what to do. In an urban area, they may not. You know how many vets have had to dispatch a large stag?"</i></p> <p>- Mr G, Academic</p>
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4.5.3. Disease and injury to humans

The potential for urban deer to spread disease and injure people were the least well-known and least experienced impacts amongst the public survey participants (Figure 4.4 and Figure 4.5). Additionally, none of the expert interviewees mentioned personal injury as a concern, contrasting with previous literature and media coverage (Hubbard and Nielsen, 2009; ITV News, 2013; Duarte *et al.*, 2015). This suggests that although human injuries do occur, they are rare and of little concern to the public or expert participants within urban Scotland.

The lack of public respondent awareness of deer-related disease transmission (9.7%) was surprising (Figure 4.4 and Figure 4.5), as it has previously been suggested that disease is one of the greatest causes of public concern related to deer (Kilpatrick and Walter, 1997; Putman *et al.*, 2014; Siemer, Decker and Stedman, 2016). However, Dandy *et al.* (2009) note that awareness and concern regarding disease transmission appears to be greater in the USA than in Scotland. Some of the expert interviewees were concerned about the lack of public awareness of deer-related (Lyme) disease transmission (Theme A, Table 4.9), as this could potentially lead to greater risks of exposure to disease in urban areas through lack of knowledge of how to avoid or remove ticks, leading to diseases being left unidentified and

untreated, which could exacerbate health risks and put further pressure on the National Health Service (NHS) (Theme B, Table 4.9) (Rizzoli *et al.*, 2014). There have been and continue to be various campaigns in the UK to spread awareness of Lyme Disease and other tick-borne illnesses, as awareness is thought to be poor (Lyme Disease UK, 2023; Tick-borne Illness Campaign Scotland, 2023). Some academics, however, thought the risks of disease were overplayed (Theme C, Table 4.9).

Table 4.9: Data from expert interviewees on disease and injury to humans from urban deer.

Theme	Data and participant
<p>A. Public lack of awareness of risks, where risk might be higher</p>	<p><i>"I just think there's a real lack of understanding on the public level about some of the risks that deer bring into urban spaces... If you've got that same level of infected ticks in a population in an urban greenspace and you have got many more people using that space in spring and summer, there's much more potential for contact with Lyme."</i></p> <p style="text-align: center;">- Ms J, Academic</p> <p><i>"If there are more deer then that [Lyme disease] might be an issue... and that'll be within communities where there's no awareness of that. And also 'cause we're advocating people recreate more in the great outdoors which brings more people into contact [with ticks]. Those people are urban people who have less knowledge of some of these things. So they won't know how to avoid ticks. They won't know what precautions to take, and they won't know what the hell to do when they do get them. When little Freddie has suddenly got ticks, they won't know what to do."</i></p> <p style="text-align: center;">- Mr G, Academic</p>
<p>B. Concern regarding the impacts of Lyme disease</p>	<p><i>"So apart from the illness to the people, which is really bad, the extra cost to hospitals from treatment. You know all these sorts of things, they'll start to kick in."</i></p>

	- Mr F, Government Organisation
C. Risks of disease from deer in urban areas is exaggerated	<p><i>“Lyme disease... is overplayed.”</i></p> <p>- Mr K, Consultant</p> <p><i>“Transference of disease, in truly urban areas, is not an issue.”</i></p> <p>- Mr O, Academic</p>

4.5.4. Deer Welfare

Expert interviewees and public survey participants were concerned about urban deer welfare (Figure 4.6 and Table 4.10). Deer getting trapped and entangled (77.05%), being attacked or poached (70.2%) and being negatively affected by humans (71.57%) were the welfare impacts of greatest concern to the public participants (Figure 4.6). Deer getting trapped or entangled was raised by a few expert participants and has previously been identified as a concern in the UK literature (Putman *et al.*, 2014; Langbein, 2017, 2019). Many expert interviewees gave examples of deer being poached or attacked, highlighting the range of deliberate acts of cruelty (e.g. where deer are deliberately targeted, harmed and even killed by humans e.g. with guns, traps, coursing with dogs, attacked with bottles) which have occurred to urban deer populations in Scotland (Theme A, Table 4.10). Although poaching has long been a concern in rural areas (UK Parliament, 1959; Pepper, Barbour and Glass, 2019) and cruelty/ poaching has been recognised in lowland and peri-urban Scotland (Dandy *et al.*, 2009; Lowland Deer Panel, 2019), deer cruelty or poaching in urban areas has received little attention in Scotland, other than by the media (Mills, 2009; Milmo, 2009; McGivern, 2019; McVey, 2021). Higher deer populations in urban areas, which are more visible to the public, have the potential to increase poaching cases (Pepper, Barbour and Glass, 2019).

Additionally, public (64.8%) and expert participants were concerned about urban deer being attacked by dogs³², alongside the effects this may have on fawn abandonment (Figure 4.6)

³² These attacks are not considered to be at the owner’s intention.

(Theme B, Table 4.10). The British Deer Society has recently voiced its concern over perceived increases in attacks on deer by dogs (British Deer Society, 2022). This has been the subject of recent media reports in Scotland (BBC News, 2021; Greenan, 2021; Hay, 2021) and it is an issue recognised in the literature (Livezey, 1990; Putman *et al.*, 2014; Langbein, 2017, 2019). Due to the significant effects that these interactions could have on deer welfare, a better understanding of the frequency and types of these acts of cruelty is needed, with measures potentially required to limit their occurrence (7.6).

Expert participants raised concerns about the impacts of food and resource constraints on deer welfare because of high urban deer densities (Theme C, Table 4.10), and the effects of diet on deer health (Theme D, Table 4.10). Mr A highlighted how deer weights in some urban areas are very low (e.g. 10-12kg, with roe deer³³ usually weighing from 10kg to 25kg when mature (British Deer Society, 2023)), suggesting they have not had a sufficient diet due to resource scarcity or competition, or have been subject to poor nutrition. Similar concerns have been raised in the literature but are under-researched (Putman *et al.*, 2014; Ciach and Fröhlich, 2019; Lowland Deer Panel, 2019; McLaughlin *et al.*, 2022). Although little has been written about deer consuming urban food sources (McLaughlin *et al.*, 2022), many species that reside in urban areas do consume human food or waste (Lowry, Lill and Wong, 2013; Soulsbury and White, 2015), with over half of the average stomach content in Swiss urban foxes found to be anthropogenic (Contesse *et al.*, 2004). A meta-analysis of wildlife health studies and urbanisation found a small negative relationship between urbanisation and wildlife health overall, suggesting urbanisation does negatively impact wildlife health (Murray *et al.*, 2019). The health of Scotland's urban deer populations may therefore need to be more fully considered. Over half of the public respondents were unsure, neutral or did not think that high deer populations could negatively affect deer welfare or were not concerned that deer could be unhealthy in urban areas, suggesting that the public either do not think this is a pressing issue or have limited knowledge on this topic (Figure 4.4 and 4.6) (7.2.2).

³³ Believed to be the most common deer species in urban areas of Scotland.

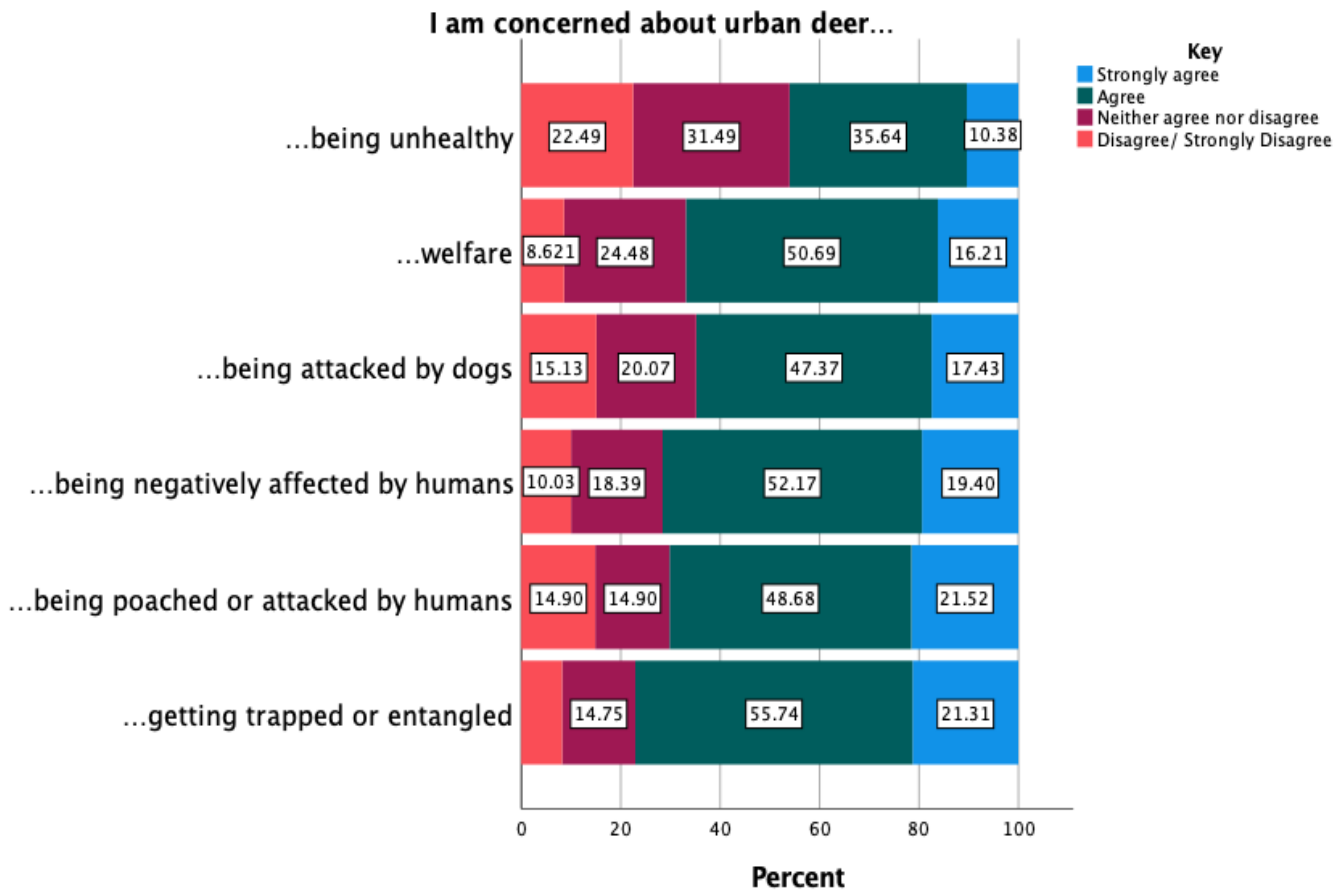


Figure 4.6: Public survey respondents' perceptions of urban deer welfare concerns.

Table 4.10: Data from expert interviewees regarding deer welfare concerns.

Theme	Data and participant
A. Poaching or acts of cruelty towards urban deer	<i>"It's generally either more organized wildlife crime, poaching and that's to do with dogs, so people with lurchers coursing dogs is a pretty big pastime in certain parts of Scotland. Or it's antisocial behaviour associated with deer, so its kids with air guns, snares, booby traps, even in nets, generally in... the shittier parts of town. There's clear links between organized crime, believe it or not, and deer poaching in Glasgow. Bits of the east end of Glasgow are well known for having big areas of greenspace which deer love, that gangs of guys who go</i>

	<p><i>out and actually bet on each other's dogs as to who's going to catch the deer first."</i></p> <ul style="list-style-type: none"> - Mr I, Government Organisation <p><i>"People were actually cutting the [deer] fence deliberately, letting the deer in, taking their dogs in and obviously the deer couldn't get anywhere. Running their dogs at the deer. And obviously that was causing a lot of suffering to the deer. Now that's the main issue that I see in the urban areas."</i></p> <ul style="list-style-type: none"> - Mr A, Government Organisation <p><i>"You also get hideous reports in the press about gangs of youths in Glasgow chasing deer into churchyards and beating them with broken bottles and crossbow bolts and all that stuff."</i></p> <ul style="list-style-type: none"> - Mr N, Non-Government Organisation
<p>B. Dogs chasing urban deer (unintentional)</p>	<p><i>"It's not malicious, they just have out of control dogs charging and then those dogs will chase deer and if they come up on a newly born roe fawn will give it a chomp or chase it. It loses its mother. So quite a significant mortality."</i></p> <ul style="list-style-type: none"> - Mr I, Government Organisation <p><i>"A lot of the problems we were having down in East Lothian along the shorefront people though it was 'Oh! There's a deer, the dogs chasing it, you know, great fun!' You know not realizing that it's probably had young lying there or if the dog touches or goes near a kid the mother will not go back to it again."</i></p> <ul style="list-style-type: none"> - Mr L, Deer Manager

<p>C. Impacts of high deer densities in urban areas</p>	<p><i>“If deer numbers build up then there’s potential welfare issues for the deer, i.e. the lack of food in some of these areas.”</i></p> <p>- Mr F, Government Organisation</p> <p><i>“We run a report on the weights of the deer, mature [roe] deer weigh in at kind of ten twelve kilos which is really really low.”</i></p> <p>- Mr A, Government Organisation</p>
<p>D. Concern over urban deer diets</p>	<p><i>“If the animals are scavenging a bit like urban foxes scavenging from dustbins, scavenging from behind the Chinese takeaway or whatever it might be. It's very probable, according to one of my veterinary colleagues that the diet they're getting is very unbalanced, is very high in starches and fats, and that can cause significant problems for the deer themselves. That can cause fatty degenerative diseases and various other associated pathologies.”</i></p> <p>- Mr O, Academic</p>

4.5.5. Balance of impacts and thresholds for management

Very few public respondents (15.43%) believed that urban deer caused more negative impacts than positives in their area, again reflecting their overall positive view of urban deer (Figure 4.4). More mixed views were present amongst the expert participants, with the balance of impacts likely to vary between locations (7.2.1) (Themes A and B, Table 4.11) (Fox and Bekoff, 2011; Furnas *et al.*, 2020). Assessing the balance of urban deer impacts, the extent to which negative impacts of deer might outweigh positive impacts, is beyond the scope of this study³⁴, but will be important for understanding where and when urban deer might need to be managed in Scotland (7.3.3 and 7.4). Experts highlighted that thresholds

³⁴ As impacts are yet to be fully researched or established, they could not be measured and thresholds are yet to exist.

could help to decide where, when and how urban deer management is required (Theme C, Table 4.11). These need to be developed to support appropriate and sustainable urban deer management in Scotland, as suggested for other areas of the UK (Dandy *et al.*, 2009; Watson *et al.*, 2009).

Table 4.11: Data from expert interviewees regarding levels of urban deer impacts and thresholds for their management.

Theme	Data and participant
A. Urban deer are not a problem that needs managing	<p><i>"Yes, we've got lots of deer in our urban areas, but a lot of them aren't a problem."</i></p> <p>- Mr I, Government Organisation</p> <p><i>"Personally, apart from road traffic accidents, I think in urban areas the negatives are pretty small and don't warrant major management intervention."</i></p> <p>- Mr O, Academic</p>
B. Urban deer are a problem in some areas and may need managing	<p><i>"Some of the effects [they] are having are undoubtedly good ones, but there is equally no doubt that they're having a damaging effect, a deleterious effect at the same time."</i></p> <p>- Mr E, Government Organisation</p> <p><i>"There are some places where it is not good to have deer or high populations, where they're just gonna cause problems either for themselves or for road traffic."</i></p> <p>- Mr I, Government Organisation</p>
C. Deciding when to manage deer/ thresholds for management	<p><i>"Do we need to get involved? Is there a solution? Is it actually a problem? Where is the public interest? Given that could be happening wholesale all over the place, at varying scales of severity. At what point is a trigger for NatureScot to actually get involved and put some resource and effort into it?"</i></p> <p>- Mr I, Government Organisation</p>

	<p><i>“If there was a management plan in place that say above a certain level of deer collisions or damage to trees or whatever, if that then kicks in, some threshold kicks in... there should be some sort of threshold and then management should happen.”</i></p> <p>- Mr K, Consultant</p>
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4.5.6. Expert recognition of gaps in data and research

Basic data on all impacts (and populations) of urban deer is limited, as is research of the nature of these impacts. This was highlighted by the expert interviewees in reference to the environmental effects of urban deer (Theme A, Table 4.12). While the environmental impacts of deer have been studied in rural areas (Gill and Beardall, 2001; Côté *et al.*, 2004; Pellerin, Huot and Côté, 2006), and some of these impacts will transfer to urban areas, it is not known specifically how deer impact smaller, fragmented urban habitats. Even where data on impacts are available, concerns were raised about their accuracy (Theme B, Table 4.12) (Langbein, 2019). Expert interviewees commented on the difficulty of establishing the extent of deer impacts as a result of limited data on this topic (Theme C, Table 4.12). The need for increased research and systematic data on urban deer impacts is discussed further in 7.2.3.

Table 4.12: Data from expert interviewees regarding gaps in data and research of Scotland’s urban deer populations.

Theme	Data and participant
A. Lack of research surrounding urban deer environmental impacts	<p><i>“I’m not sure what the kind of ecological benefits are. You know that’s not really something that has been looked at much.”</i></p> <p>- Ms J, Academic</p>

	<p><i>“Erm there will be a consequence, plant ecology, species composition and morphology. And it probably hasn't really been studied very much.”</i></p> <p>- Mr E, Government Organisation</p>
B. Concerns about data accuracy	<p><i>“They [Transport Scotland] just have to keep a log of everything they pick up off the road, and they're not really that interested in deer, they're just logging a deer or a burnt-out tyre or this and that. So they can account for it at the end, but it's not collected in a way that would, that's ideal... it's not recorded in a standard way.”</i></p> <p>- Mr K, Consultant</p>
C. Lack of clarity over how extensive urban deer impacts are	<p><i>“So yeah, it [poaching urban deer] is an issue. How big an issue it is, nobody has ever quantified I think effectively in Scotland.”</i></p> <p>- Mr O, Academic</p>

5. Exploring perceptions of urban deer management in Scotland

5.1. Introduction

This chapter explores perceptions of urban deer management in Scotland (RO2), presenting and discussing the results of the public survey and expert interviews. A full overview of the datasets used within this chapter can be found in 4.2. Discussion of key themes emerging from the two datasets focus on four research questions:

RQ4. Is there a perceived need for urban deer management?

RQ5. Is current urban deer management viewed to be sufficient?

RQ6. How are different urban deer management methods viewed?

RQ7. How is urban deer management perceived to differ from rural deer management?

5.2. Is there a perceived need for urban deer management?

5.2.1. Defining deer management

Many expert participants used the broad terms ‘management’ or ‘control’ when talking about culling deer, rather than mentioning culling explicitly, which led to confusion as to whether they were referring to all forms of potential deer management methods or solely culling (Theme A, Table 5.1). This conflation of terms was recognised by Mr M as being apparent throughout the deer management sphere (Theme B, Table 5.1), and is evident in much of the existing Scottish deer literature (Scottish Natural Heritage, 2012, 2019a; Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Hare, Daniels and Blossey, 2021; Scottish Government, 2021a; NatureScot, 2022a). This interchangeable use of language can be confusing for outside stakeholders, such as the public, as it is unclear what management method or methods are being referred to. The use of ‘management’ or ‘control’ to mean culling also suggests that other methods are not being considered, with culling seen as the only deer management method (highlighted in 5.4.3). It is therefore important that ‘management’ and ‘control’ are clearly defined and used to encompass all potential methods of managing deer (as used within this study), so it is understood that there is a range of potential deer management methods, and it is clear what method or methods are being referred to.

Table 5.1: Data from expert interviewees highlighting the use of ‘management’ or ‘control’ to mean culling deer.

Theme	Data and participant
A. Use of ‘management’ or ‘control’ when meaning only deer culling	<p><i>“For me, deer fences should only be a last resort, a management plan should be put in place first. And even with deer fences there should be a management plan in place to use lethal force on them should they get in.”</i></p> <p>- Mr D, Deer Manager</p> <p><i>“There’s a lot of Easterhouse leased to Forestry Commission... but deer control’s not even an option. You’re gonna have to</i></p>

	<p><i>fence or tube every single tree 'cause the deer pressure is so high, so it's not, it's not even giving you the option of control."</i></p> <p>- Mr A, Government Organisation</p>
B. Awareness of the need to define 'deer management'	<p><i>"Deer management requires defining, at the start of all these things, 'cause some people, well I do it, we're all guilty of doing it, if you mean shooting you should say shooting. Or you know, you should say kill. It's a euphemism that's used a lot."</i></p> <p>- Mr M, Consultant</p>

5.2.2. Perceptions of the need for deer management

The majority of public (Figure 5.1) (66.02%) and expert participants believed that urban deer should be managed, which has not previously been reported in Scotland. Expert participants highlighted that there would be adverse consequences if urban deer were not managed (Theme A, Table 5.2), including the risk of increased levels of antisocial behaviour towards deer – a link that few previous studies have identified (Holland *et al.*, 2017). The need for proactive management³⁵ was recognised by Mr K and Mr D (Theme B, Table 5.2), has been recommended in many recent deer reports (Scottish Parliament, 2017; Scottish Natural Heritage, 2019a; Pepper, Barbour and Glass, 2019), and is recognised as key to successfully reducing human-wildlife conflicts (Decker, Lauber and Siemer, 2002). However, concerns have been raised regarding the economic viability and public perceptions of such anticipatory action, particularly if deer impacts have yet to exceed public tolerance levels (Hansen and Beringer, 1997; Soulsbury and White, 2015).

³⁵Being proactive and planning for urban deer was also highlighted in reference to urban design in 4.4.2.

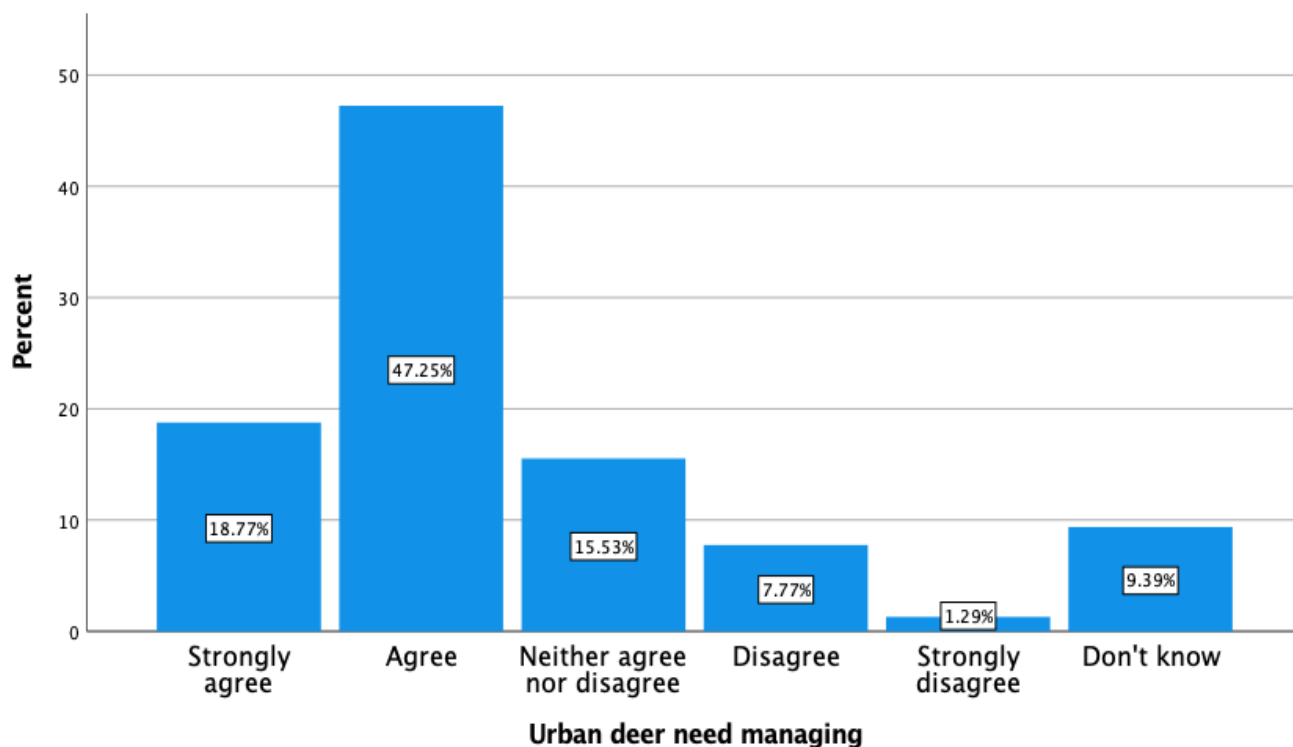


Figure 5.1: Public survey respondents’ perceptions of the need for deer management.

Table 5.2: Data from a public participant and expert interviewees regarding the need for urban deer management.

Theme	Data and participant
A. Awareness that adverse consequences may occur if urban deer are not managed	<p><i>“If we don’t have that mechanism to be able to manage populations of deer, then it gives rise to antisocial behaviour, it gives rise to disease, ticks, all this kind of stuff.”</i></p> <ul style="list-style-type: none"> - Mr A, Government Organisation <p><i>“Poaching increases significantly as deer management drops off, if they're not controlled by qualified deer managers they’re quite capably controlled by unqualified, basically, criminals.”</i></p> <ul style="list-style-type: none"> - Mr P, Consultant

<p>B. Urban deer management needs to be proactive</p>	<p><i>“It would be a good thing if we had some management in place in advance of them getting out of hand.”</i></p> <p>- Mr K, Consultant</p> <p><i>“We believe being proactive is the key to managing deer.”</i></p> <p>- Mr D, Deer Manager</p>
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5.2.3. Reasons for deer management

There does not appear to be a universal impact as the main driver of public support for urban deer management. Most impacts were only accepted as a motivator for urban deer management by a minority of public participants (Figure 5.2). However, there appears to be a preference for urban deer management because of environmental impacts or for urban deer welfare reasons (except for DVCs).³⁶ The main drivers of public motivation to manage deer in urban areas vary across the literature, from impacts on the safety of humans (Urbanek *et al.*, 2013), to impacts such as browsing on gardens (Connelly, Decker and Wear, 1987), with this range apparent in this study, and likely to vary from area to area (7.2.1).

³⁶ This was similar to the trend found regarding public concerns about deer impacts (4.5.1).

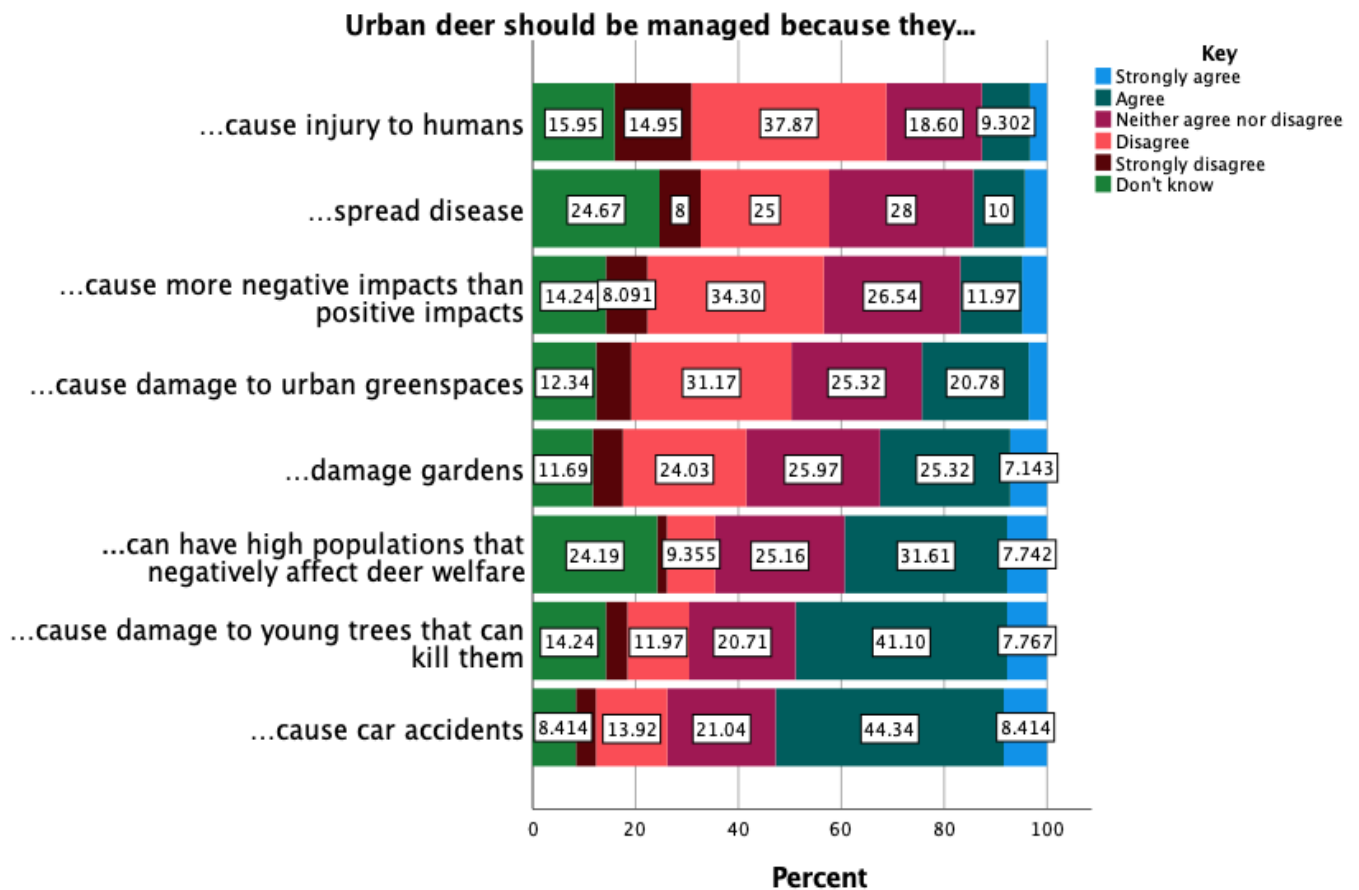


Figure 5.2: Public survey respondents' views of whether urban deer should be managed because they caused specific impacts.

The only reason for management supported by the majority of public respondents was the prevention of car accidents (52.75%) (Figure 5.2). Given that this was the most recognised and experienced impact of urban deer (4.5.2), this result was expected and reinforces previous Scottish research (Dandy *et al.*, 2009). Other impacts on human safety (disease and injury) were the least supported reasons for managing urban deer (Figure 5.2), which may be because these were recognised or experienced by few of the public participants (4.5.3). This contrasts with the existing literature, as risks to humans, particularly disease, are regarded as important reasons for managing urban deer populations in the USA (Connelly, Decker and Wear, 1987; Fulton *et al.*, 2004; Urbanek *et al.*, 2013).

Environmental impacts as motivators for deer management gathered varying levels of support from the public respondents. The high priority given to tree damage (Figure 5.2) (48.87%) contrasts with Dandy *et al.* (2009) and Ballantyne (2012), where impacts on

woodlands were not seen to be one of the most important reasons for managing peri-urban deer. Mixed views about whether damage to gardens was a motivator for management (Figure 5.2) contrasts with studies by Dougherty *et al.* (2001) and Fulton *et al.* (2004), where many respondents believed that not managing deer would be unacceptable as it would lead to increased garden damage. However, in this respect, the results were like Dandy *et al.* (2009) and Ballantyne (2012), who found that impacts on gardens were not identified as an important motivator for managing peri-urban deer in Scotland.

Overall, most public respondents did not think that deer caused more negative impacts than positives, or that most impacts provided grounds for deer management (Figure 5.2). As the majority of the public participants believed that urban deer need managing (5.2.2), it appears that support for management is not due to these individual impacts of deer but due to combinations of impacts or alternative drivers (such as concerns about deer welfare (4.5.4)).³⁷

³⁷ The public were not asked about welfare as a driver for urban deer management, except for high populations affecting deer welfare, which seemed to be poorly understood within 4.5.4.

5.3. Is current urban deer management viewed to be sufficient?

Most expert interviewees viewed urban deer management in Scotland as insufficient³⁸ (Theme A, Table 5.3), likely due to the belief that urban deer populations are growing (4.4.1) and that impacts, such as DVCs, are increasing (4.5.2). Many of the experts attributed insufficient management to NatureScot, with Mr E highlighting their longstanding focus on upland management resulting in neglect of other areas, and Mr F remarking on their lack of leadership (Theme B, Table 5.3). Both leadership and a greater urban focus have been called for by the Deer Working Group and Scottish Government (as highlighted in 2.3.1.1 (Pepper, Barbour and Glass, 2019; Scottish Government, 2021a)), and these findings reinforce these calls. However, resource and time constraints within NatureScot were recognised by the expert participants, which might affect their ability to further support and provide leadership in urban deer management (Theme C, Table 5.3). The role of NatureScot with Local Authorities, and the effects of resource constraints, are discussed further in 6.6.3.

Table 5.3: Data from expert interviewees regarding urban deer management in Scotland being insufficient.

Theme	Data and participant
A. Urban deer management practices in Scotland are insufficient	<p><i>“They’re not being managed enough, definitely not, definitely not.”</i></p> <p>- Mr F, Government Organisation</p> <p><i>“No, no no, not at all. In fact, the numbers are increasing in and around towns.”</i></p> <p>- Mr D, Deer Manager</p>
B. Blame on NatureScot for insufficient urban deer management	<p><i>“Since the Deer Act came into being in 1959, the focus [of NatureScot] has basically been on upland red deer. For whatever reason, people have just been fixated with upland red deer. We’ve basically just ignored everything else.”</i></p> <p>- Mr E, Government Organisation</p>

³⁸ Public participants were not asked for their opinions on this topic.

	<p><i>“I mean we can point the finger at councils, we can point the finger at other people to do it, but I think it's SNH [NatureScot], they're the ones that's got the legal power behind them that can force people to do it. I think they need to take a much greater lead on this... and possibly lead by example... i.e. them going into council land or something like that and doing the deer control. I'd really love to see NatureScot become more active in this area about encouraging people to do it. They have got a huge lead figure to play... They've got legislative powers that they can use [to engage with councils]. But in my opinion, they need to start to be a bit more grown up, mature and make these unpopular decisions if they're serious about managing deer in Scotland.”</i></p> <p>- Mr F, Government Organisation</p>
<p>C. Awareness of constraints on NatureScot</p>	<p><i>“I think SNH [NatureScot] are probably stretched, they're getting pulled from pillar to post between urban, rural issues, landscape issues, government reviews. They're getting probably quite a rough time of it... but I think urban is quite a big topic in itself, and some of these guys have probably only got it as an addition to their job role.”</i></p> <p>- Mr B, Non-Government Organisation</p> <p><i>“They are incredibly stretched with the staff and resources they have.”</i></p> <p>- Mr H, Government Organisation</p>

5.4. How are different deer management methods viewed?

Public survey participants were generally supportive of non-lethal methods and less supportive of culling and doing nothing to manage urban deer populations (Figures 5.3, 5.4 and 5.5), while experts were most supportive of lethal urban deer management methods. The key themes apparent regarding views of methods are discussed further in the subsequent sections.

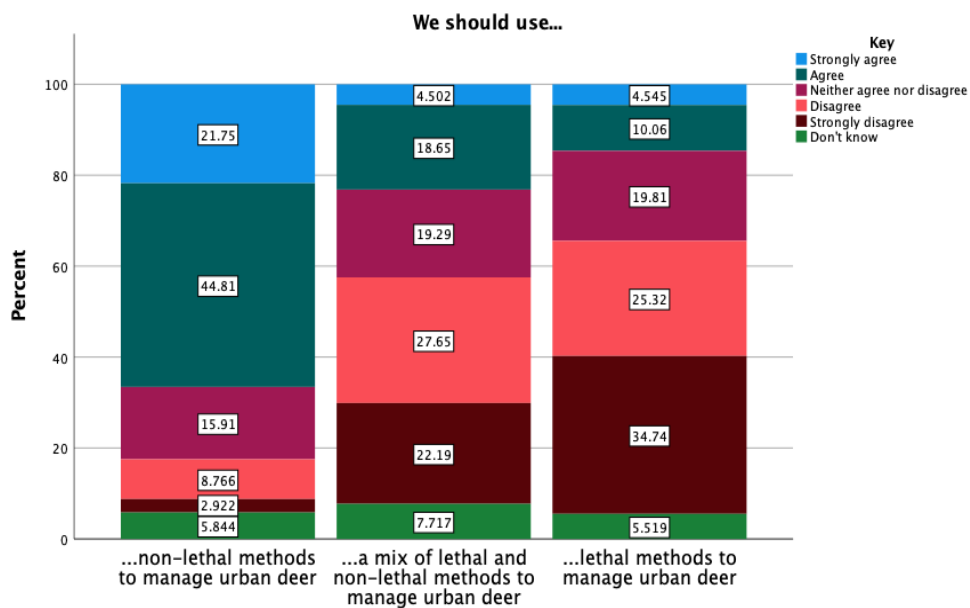


Figure 5.3: Public survey respondents' views on lethal and non-lethal management of urban deer.

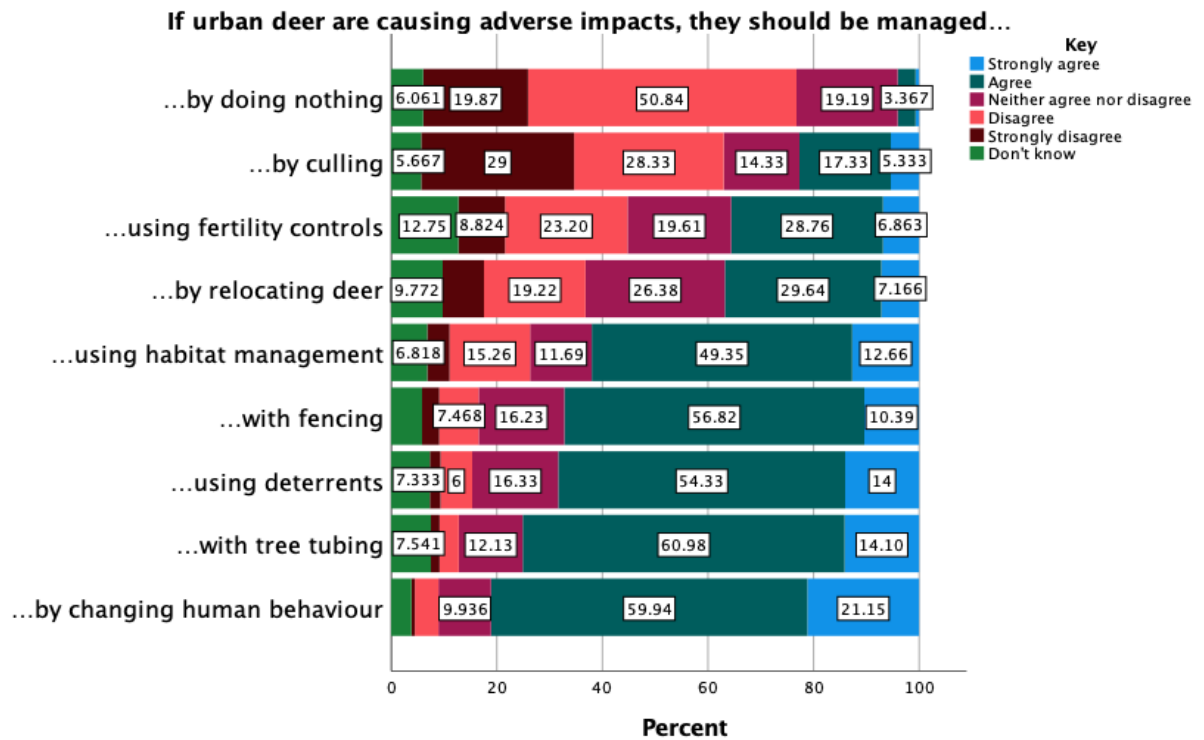


Figure 5.4: Public survey respondents' views on the use of specific methods of urban deer management.

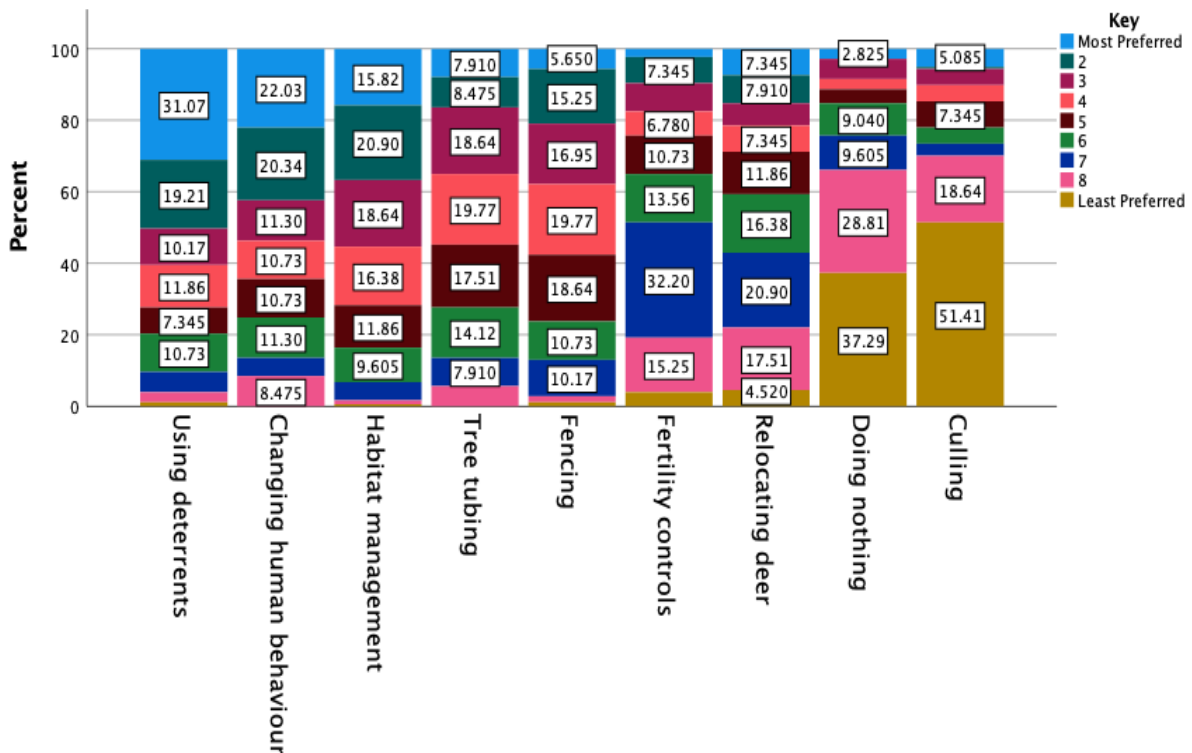


Figure 5.5: Public survey respondents' ranking of preferences for urban deer management methods.

5.4.1. Choosing not to manage urban deer is unsupported

Public respondents believed that doing nothing to manage urban deer was not a preferred management response (Figure 5.4 and Figure 5.5) (supported by only 4.04%, ranked by 37.29% of respondents as a least preferred method), confirming that deer management is perceived to be needed (5.2.2). This is in line with the findings of previous studies on deer in urban and rural areas in Scotland and the USA, and within the broader human-wildlife conflict literature (Fulton *et al.*, 2004; Dandy *et al.*, 2009, 2011; Liordos *et al.*, 2017; Whitefield *et al.*, 2021). As Whitefield (2019) highlights, the public's distaste for not managing deer may be because they feel a moral and/or ethical responsibility for deer management to take place if adverse consequences are occurring to the environment, people or the deer themselves, to minimise these negative impacts (Fraser, 2006). Dandy *et al.* (2009) state that not acting where deer are causing adverse effects or are subject to welfare concerns may contravene the Deer (Scotland) Act 1996.

5.4.2. Preference for non-lethal methods

The public respondents' preference for non-lethal methods of management (Figure 5.3, Figure 5.4 and Figure 5.5) reflects the existing Scottish deer literature³⁹ (Dandy *et al.*, 2009, 2011) and broader human-wildlife conflict studies (Liordos *et al.*, 2017). There is a clear preference amongst the public respondents for methods which alter human or deer activity (less invasive methods), rather than those that affect deer numbers (lethal, fertility controls or relocation). This preference may be due to personal values, moral responsibilities and concerns about the welfare impacts of more invasive methods, which may be perceived as inhumane or unnatural (Dandy *et al.*, 2012; Gamborg, Sandøe and Palmer, 2020; Connors and Short Gianotti, 2021).

Regarding fencing in particular, public support appeared to be lower in this study (the fifth preferred method overall) than in Dandy *et al.* (2009, 2011) and Whitefield *et al.* (2021) where it was the first preference management response. The increased urban focus of this research could explain lower support for fencing, where fences may present increased

³⁹ Comparison to USA studies is provided in 5.4.3 which focusses on lethal methods.

access issues for urban human populations and therefore be regarded less positively (Dandy *et al.*, 2009; Scottish Natural Heritage, 2016). This difference could also be explained by the higher number of management options provided for respondents to rank in this study compared to previous literature.

Expert interviewees disregarded most non-lethal methods but did accept the use of fencing. However, many experts did raise concerns about its use, including regarding it as not being effective as a sole method due to the potential for breaches, which may render them ineffective (Theme A, Table 5.4). This has also been recognised in the literature (Putman, 1997; Hedlund *et al.*, 2004; Zuberogitia *et al.*, 2014). The risk of breaches could be increased in urban areas due to higher human population densities and greater public annoyance at their access being restricted, and therefore greater risks of vandalism (Theme B, Table 5.4). The use of deer fences to facilitate acts of cruelty against deer adds a level of concern and complexity regarding fence use (Theme C, Table 5.4). This welfare impact is not recognised in the existing literature on urban deer.

Table 5.4: Data from expert interviewees on the use of fencing as an urban deer management method.

Theme	Data and participant
A. Fencing ineffective as a method alone	<p><i>“If you fence then you've still got to be ready to cull, because deer will at some point get into that fenced area. It's almost inevitable that that's gonna happen.”</i></p> <p>- Mr B, Non-Government Organisation</p>
B. Vandalism of fences a concern	<p><i>“Wherever you put a fence up, particularly where it's highly populated, it's more likely to be vandalised.”</i></p> <p>- Mr A, Government Organisation</p> <p><i>“Somebody wants to take their dog for a walk and you stick a deer fence round it, they're going to go, ‘you know what, I'll show you and they'll just cut it.”</i></p> <p>- Mr L, Deer Manager</p>

<p>C. Fences may facilitate acts of cruelty</p>	<p><i>“Cutting the fences to let deer into an area, then closing the fences up again, and then they actually use them as a kind of poaching arena i.e. chasing deer around it with running dogs. So there's been a number of incidences... through bits of Central Scotland where they've had issues like that.”</i></p> <p>- Mr I, Government Organisation</p>
<p>D. Fences displace issues, rather than getting rid of them</p>	<p><i>“In my opinion, with fencing you're just putting the problem onto somewhere else. And in an urban area that ain't obviously a good thing to do.”</i></p> <p>- Mr A, Government Organisation</p>

As Mr A highlights, fences do not actually solve deer issues, as they displace them into new areas (Theme D, Table 5.4). Consequently, although deer impacts can be reduced in specific areas of interest, their use may result in new urban environments being adversely affected, which could be problematic in urban areas as habitats are limited and fragmented, with this potentially pushing deer into areas with greater risk of impacts, such as on to roads (Shono and Smith, 2003; Dolman *et al.*, 2010; Zuberogoitia *et al.*, 2014). If fences are used within urban areas, their placement needs to be thoroughly considered, to reduce adverse effects, and as this could also affect deer pathways into urban areas – which could be seen as both a positive or negative impact. Overall, non-lethal methods were regarded poorly or disregarded by expert interviewees yet preferred by the public participants. The contrast in perceptions between the public and expert participants may cause conflict between these stakeholders, with potential ways to limit this conflict through consultation and public involvement discussed in 7.2.2.

5.4.3. Contrasting opinions of lethal methods

A similar contrast between the views of experts and the public is apparent concerning lethal management, with the former believing it is the only suitable management method (Theme A, Table 5.5) (as was also evident in the use of language highlighted in 5.2.1), and the latter ranking it as their least preferred management response (51.41% of the public ranked it as their least preferred method) (Figures 5.3, 5.4 and 5.5).

Table 5.5: Data from a public participant and expert interviewees on the use of culling as an urban deer management method.

Theme	Data and participant
<p>A. Culling is the only suitable urban deer management method</p>	<p><i>“I would say the only real control is lethal control.”</i></p> <ul style="list-style-type: none"> - Mr D, Deer Manager <p><i>“Urban dwellers are very unwilling for people to kill the deer. It's a last resort. They want to explore all the other options they've been told about like immunocontraception or translocation or whatever else it may be. These methods... not only are they unlikely to be effective, but they also have significant welfare issues associated with them.”</i></p> <ul style="list-style-type: none"> - Mr O, Academic
<p>B. Education increases support for culling</p>	<p><i>“Culling has been practised here this year. Many locals were up in arms, but people are too divorced from the realities of animal and land management these days. Education is key!”</i></p> <ul style="list-style-type: none"> - Male survey respondent, Perth <p><i>“Generally, if it's explained to people why, in my experience they kind of get it. They might not like it. They may not want to see it. But they understand why it might need to happen, so the more of that we can do, the better.”</i></p> <ul style="list-style-type: none"> - Mr I, Government Organisation

The experts’ high levels of support for culling and view of it as the only deer management method reflects the existing Scottish deer literature, with other methods given little attention (Lowland Deer Panel, 2019; Scottish Natural Heritage, 2019a; Pepper, Barbour and Glass, 2019; Hare, Daniels and Blossey, 2021; Scottish Government, 2021a). Low public support for culling reflects previous peri-urban studies in Scotland, where culling was perceived as a ‘last resort’ (Dandy *et al.*, 2009, 2011). Studies not focussed on urban or peri-urban areas within Scotland, including Hare *et al.* (2021) and Whitefield *et al.* (2021), found

much greater support for culling (62% support: 24% first preference). A link between urban location, distance from upland areas and lack of support for lethal deer management has previously been suggested in the literature (Warren, 2009; Dandy *et al.*, 2011; Pepper, Barbour and Glass, 2019), although was not identified in Whitefield *et al.* (2021). In the USA, culling has ranged from being viewed as unacceptable (Rondeau and Conrad, 2003; Raik *et al.*, 2005; Urbanek and Nielsen, 2012), to receiving high levels of support (Kilpatrick and Walter, 1997; Fulton *et al.*, 2004; Urbanek *et al.*, 2012), so it is clear that views can vary from area to area (7.2.1).

Lack of knowledge and experience of deer management (as apparent in Table 4.2 and highlighted above) have also been linked with low support for culling (Whitefield *et al.*, 2021), with education and involvement thought to increase support for lethal methods (Theme B, Table 5.5), as has been evident in studies in the USA (Connelly, Decker and Wear, 1987; Messmer *et al.*, 1997; Peterson *et al.*, 2003). The much greater support for culling found by Hare *et al.* (2021) may be due to the provision of information about culling before residents were asked about their perceptions⁴⁰, alongside the mix of rural and urban respondents. The role of education of the public to increase support for urban deer management, especially the use of lethal methods, is discussed further in 7.2.2.

5.4.3.1. Qualifications and responsibilities for culling

Strong public respondent support (79.74%) for deer managers to have deer management qualifications was found in this study (Figure 5.6) and this has previously been reported in Scotland (83%) (Hare, Daniels and Blossy, 2021). Deer management qualifications (DSC1 and DSC2) exist, but completion of these qualifications is not required to cull deer, except for authorisations for night shooting or out-of-season culling (Pepper, Barbour and Glass, 2019; Scottish Natural Heritage, 2019c). This scenario is highly unusual within Europe, with most countries requiring hunters to be qualified (Pepper, Barbour and Glass, 2019). The Deer Working Group has encouraged the Scottish Government to ensure that all people who shoot deer have a basic level of training (Pepper, Barbour and Glass, 2019), and the

⁴⁰ This was not addressed in their study.

Scottish Government has asked NatureScot to take this forward with an updated ‘fit and competent’ register of qualified deer managers (Scottish Government, 2021a).

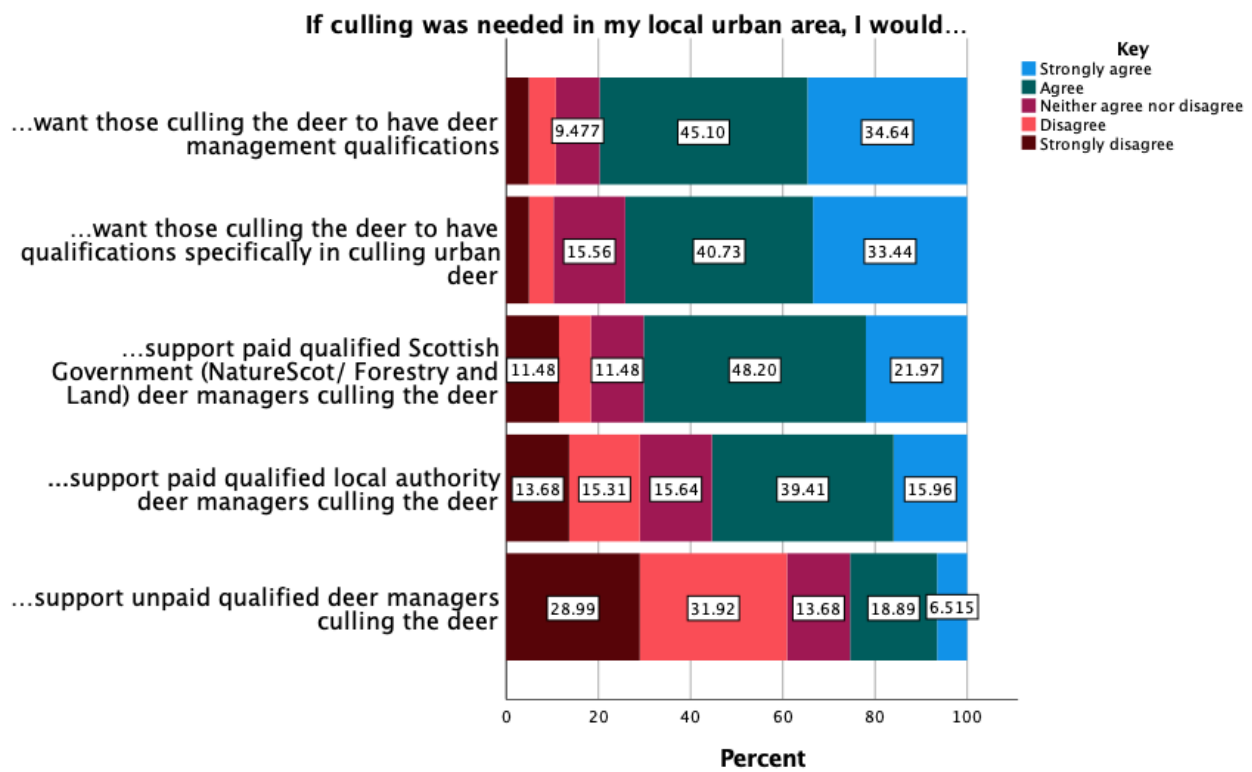


Figure 5.6: Public survey respondents’ views on deer management qualifications and who should manage urban deer.

While public respondents were also in favour of specific urban qualifications for those culling urban deer (74.17%), the expert interviewees had mixed views, with some believing that they should be introduced to ensure that deer managers can safely cull in urban areas (Theme A, Table 5.6) but others claiming that this would be unnecessary as deer management practices are already safe (Theme B, Table 5.6). Currently, urban deer management qualifications do not exist within Scotland. As there were many differences between urban and rural deer management recognised (5.5), these findings suggest that the introduction of urban specific deer management qualifications should be further considered. This leads to questioning of the Deer Working Group’s lack of recommendation to introduce urban specific deer management qualifications, despite highlighting the need for experienced and skilled marksmen (up to DSC2) to cull deer in urban areas (Pepper, Barbour and Glass, 2019).

Table 5.6: Data from expert interviewees on the introduction of urban deer management qualifications.

Theme	Data and participant
<p>A. Urban deer management training or qualifications should be introduced</p>	<p><i>“They could do an urban deer awareness course or an exam. I’ve got many friends that are recreational stalkers. Would I take them out urban stalking? No, I wouldn’t. It’s just a different level. There maybe should be criteria to meet.”</i></p> <p>- Mr L, Deer Manager</p> <p><i>“We do believe that there should be a qualification that clearly makes it acceptable to the public departments that this person is qualified to shoot deer in and around towns.”</i></p> <p>- Mr D, Deer Manager</p> <p><i>“There should be some sort of... required levels of training. The logic of that is hard to resist.”</i></p> <p>- Mr M, Consultant</p>
<p>B. Urban deer management training or qualifications unnecessary</p>	<p><i>“I don’t know if it’s specifically required. Because what issue you’re actually addressing? We know that the number of accidents involving deer management are very, very low.”</i></p> <p>- Mr C, Non-Government Organisation</p> <p><i>“It’s the same set of skills, the same set of understanding deer ecology, same set of knowing about ballistics and firearms, and it’s the same set of skills about knowing your capabilities and knowing how to do a job safely.”</i></p> <p>- Mr E, Government Organisation</p>

Similar attitudes towards different types of deer managers were apparent amongst the public participants (Figure 5.6) and by the Lowland Deer Panel (2019), where support for governmental deer managers (70.17%) was greater than Local Authorities (55.37%), and

recreational deer managers (25.4%) were the least likely to be utilised for fear of adverse public reactions. The Lowland Deer Panel (2019) suggested that established expectations and responsibilities of governmental bodies might explain greater support for NatureScot or Forestry and Land Scotland over Local Authorities. Recreational hunting⁴¹, known for its negative connotations with elitism and enjoyment in Scotland, is believed to be less supported by the public than other forms of culling (Hare *et al.*, 2021; Whitefield *et al.*, 2021). Existing academic literature has also previously linked volunteering with a perceived lack of professionalism, knowledge or experience (Ganesh and McAllum, 2012), alongside raising perceived ethical concerns about not paying volunteers for their labour (Grant-Smith and McDonald, 2018; Vercammen *et al.*, 2020). This lack of support for recreational urban deer managers contrasts with expressions from recreational stalkers, who feel their resource should be used more widely, particularly on Local Authority land (Holland *et al.*, 2017; Lowland Deer Panel, 2019). However, using employed government or Local Authority deer managers, who have deer management qualifications, ideally urban-specific, should be considered in order to gain the most public support when culling is needed.

⁴¹ Recreational hunting is associated with hunting for pleasure. This can include stalkers undertaking deer management on landowners land without payment or being allowed the carcass, but can often be transactional, with stalkers paying landowners or gillies to hunt on their land or to assist them. Some recreational hunters will be qualified (with DSC), but others will not.

5.5. How is urban deer management perceived to differ from rural deer management?

Three key challenges were highlighted by expert interviewees as contrasts between urban and rural management, presenting potential barriers to sustainable urban deer management (Table 5.7). Firstly, fragmented landholdings were mentioned (Theme A, Table 5.7) with the effects of these previously identified in the literature (Scottish Natural Heritage, 2016; Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Curtis, 2020). Fragmented landholdings (such as in dense housing areas) can result in deer not being managed to the scale of their population, or in different ways in different landholdings, which can lead to more deer moving into areas where management has taken place (e.g. lethal methods, fertility controls or relocation), rendering this management unsuccessful, or putting more pressure on areas where management has not already been undertaken (e.g. outside of fences, in areas with no deterrents or tree tubes). Cooperation between landholders is therefore important but is also challenging within urban environments with many stakeholders needing to be involved, with many of them unlikely to be engaged or knowledgeable about deer populations (Pepper, Barbour and Glass, 2019; Curtis, 2020; Valente *et al.*, 2020).

Table 5.7: Data from expert interviewees on the three main challenges associated with urban deer management.

Theme	Data and participant
<p>A. Fragmented landholdings</p>	<p><i>“The fragmented pattern of land ownership... is quite a challenge.”</i></p> <ul style="list-style-type: none"> - Ms J, Academic <p><i>“We do find that we can reduce the numbers and obviously then other ones move in from round about... so a collaborative approach is needed. It’s quite difficult in the urban areas because a lot of the surrounding land is owned in small plots.”</i></p> <ul style="list-style-type: none"> - Mr H, Government Organisation <p><i>“The scale of it [management] has got to be the scale of the deer.”</i></p> <ul style="list-style-type: none"> - Mr M, Consultant
<p>B. Presence of the public makes lethal management difficult</p>	<p><i>“There’s nervousness about shooting deer in these areas due to the number of people.”</i></p> <ul style="list-style-type: none"> - Mr F, Government Organisation <p><i>“The minute the sun got up there were people walking their dogs. And that’s one of the problems that urban deer managers or peri-urban deer managers have these days... people are running at night. People are mountain biking at night... it makes it somewhat difficult to manage these densely populated areas.”</i></p> <ul style="list-style-type: none"> - Mr C, Non-Government Organisation <p><i>“Use of high-powered rifles, close to people, in built up areas, carries high levels of risk.”</i></p>

	- Mr N, Non- Government Organisation
C. Deer managers need to have urban experiences and not base lethal urban deer management practices on rural methods	<p><i>“There's a big variation between someone who's been exposed to cull in a certain environment, and who you would want to be operating in an urban environment or peri-urban environment.... They shot 4 deer in broad daylight in front of people. One of them even filmed it and it caused a humongous issue for me for months. And it was the wrong people.”</i></p> <p>- Mr B, Non-Government Organisation</p> <p><i>“Let's just imagine somebody comes down from the Isle of Skye or Tighnabruaich or something. Their perception of managing deer is totally different to mine. And I know that 'cause I've shot in these areas, and they have a kind of gung-ho attitude that goes with the big open spaces, and nobody being around and so on right? 'cause I've brought some of the boys down here and they, straight away... they're concerned at the amount of public.”</i></p> <p>- Mr D, Deer Manager</p>

Secondly, the greater presence of the public in urban environments can present human interference, perception and safety concerns, creating an additional challenge for urban deer management, especially surrounding culling (Theme B, Table 5.7) (Urbanek *et al.*, 2012; Putman *et al.*, 2014; Lowland Deer Panel, 2019). More humans are present in urban areas, in the day and night, and using guns (or darts or traps) within any area where they are present can be potentially dangerous. Many experts highlighted the adjustments needed when culling within urban areas (Table 5.8), with many of these helping to reduce the risks associated with greater human presence. Culling at night, when human presence is lowest, is one way in which safety concerns can be reduced (Theme A, Table 5.8), which was undertaken in almost every example provided of urban culling by the expert interviewees, contrasting with the norm for deer management in Scotland (NatureScot, 2020a). The

importance of recognising differences to traditional rural methods is discussed further in 7.2.2.

Table 5.8: Data from expert interviewees on differences in the procedure of undertaking lethal urban deer management to rural deer management.

Theme	Data and participant
A. Culling takes place at night, with a night licence	<p><i>“It’s mostly all done under special authorisation for night shooting, again the sites are so well walked by people and dogs, to do the necessary work within the sort of dusk and dawn hours would be very difficult.”</i></p> <p>- Mr H, Government Organisation</p>
B. Importance of knowing the culling area extremely well	<p><i>“We’ll probably go in there and spend many hours walking the site, whether it be members of the public walking the dog, identifying hazards, identifying areas that is a safe area to shoot. When you’re in and around towns or built-up areas you have to be very, very mindful of where your backdrop are - you know, whether there’s hedges, walls, roads, access roads, just building up a complete picture.”</i></p> <p>- Mr L, Deer Manager</p>
C. Questions over suitability of firearms	<p><i>“When you get into towns, there are obviously difficulties because of the restricted type of firearms that you can use to manage deer. And it would be unusual for people to discharge a deer stalking rifle in an urban area. So we’re some way off before we have firearm capability that can be discharged in an urban area safely.”</i></p> <p>- Mr C, Non-Government Organisation</p>
D. Notifying the police ahead of culling activities	<p><i>“He always phones the police before he goes out and when he’s finished, in the hope that if someone does phone in to complain there’s somebody wandering around with a rifle, they’ll phone him first and say is that you in such and such a place and if he says yup that’s me that’s fine and they’ll go away rather than sending out an armed response unit to</i></p>

	<p><i>surround, which has happened a couple of times when the message hasn't got through to the right people."</i></p> <p>- Mr H, Government Organisation</p>
E. Importance of appearance	<p><i>"The perception of people with how you look... if I go into a forest wearing old army-type camouflage with a tabby hat, you know, the public sees me, they're gonna immediately think I'm up to no good. Whereas if I go in with corporate clothing, a clean van, you know."</i></p> <p>- Mr A, Government Organisation</p>
F. Discretion: leaving minimal evidence	<p><i>"They don't want to see you killing it. They don't want to see any signs that a deer has been dead i.e. like don't gralloch it in a high public woodland. Take the abdomen away⁴². Don't shoot it if there's snow on the ground because then there's blood, it tends to be a mass murder. Just about being discrete, stopping and thinking about it, you know, and not leaving any signs about it, not drawing any attention."</i></p> <p>- Mr F, Government Organisation</p>
G. Explaining activities to the public	<p><i>"Making sure that we're engaging with people when we see them. Because we're always seeing them *laugh*. You know, explaining to people what we do."</i></p> <p>- Mr A, Government Organisation</p>

Finally, expert interviewees highlighted that those managing urban deer need to have experience and knowledge of urban scenarios, rather than basing management practices on upland rural experience, as the context is not the same and treating it as such could result in adverse consequences (Theme C, Table 5.7). Although rural deer managers may be able to humanely cull deer within urban areas, they may not understand the additional pressures of human presence within urban environments. Urban deer management, therefore, needs to be approached from a different perspective, which is not noted in the literature, with

⁴² On the open hill or in rural woodland, the gralloch (innards) of deer are regularly left after a cull, as they are removed immediately after the deer is shot. It reduces potential contamination of the meat and provides a food source for wildlife (Scottish Natural Heritage, no date d).

different procedures used (Table 5.8) (7.2.2). Culling must take place discretely and precisely, and with a clear awareness of public access, to ensure human safety and reduce negative perceptions (Table 5.8). Some of these procedures do exist in urban-specific guidance in the existing Scottish literature (Scottish Natural Heritage, no date b; Quarrell, 2012; Forestry Commission Scotland, 2017), although these have not been previously detailed in official Scottish deer management reports or training. Although mixed opinions regarding specific qualifications for urban deer management were highlighted in section 5.4.3.1, this demonstrates why they might be necessary, as without the knowledge, skills and experience of managing deer (and people) within urban environments, unwanted negative consequences may occur.

6. Exploring the role of Local Authorities in urban deer management

6.1. Introduction

This chapter examines Local Authority views on urban deer, their impacts and management, and explores perceptions of the role of Local Authorities (RO3), as they have been identified as having the potential to play a key role within urban deer management in Scotland (Dandy *et al.*, 2009; Scottish Government, 2014; Lowland Deer Panel, 2019). This chapter also explores perceived obstacles to Local Authority involvement in urban deer management, given their limited engagement thus far (Holland *et al.*, 2017; Lowland Deer Panel, 2019). Results of the Local Authority Q-methodology study are presented and discussed, supplemented with relevant results of the local councillor and public surveys and expert interviews (section 6.5 and 6.6). This chapter presents a novel framing to the deer management debate, with Local Authority and councillor viewpoints on deer previously not studied, and Q-methodology not previously utilised for studying perceptions of deer in Scotland. Yet, these stakeholders are likely to have a key influence on how urban deer are managed. Discussion is therefore based on three research questions:

RQ8. What are Local Authorities' views regarding urban deer, impacts, and management?

RQ9: What is the perceived role of Local Authorities within urban deer management?

RQ10: What are the perceived obstacles to Local Authority involvement in urban deer management?

6.2. Overview of the datasets

6.2.1. Local Authority Q-methodology dataset

Thirty Local Authority participants representing the thirty Local Authorities which have deer in Scotland took part in the Q-methodology study (Figure 6.1). There was no clear geographical correlation between Local Authorities and their viewpoints on urban deer, so the effect of location on Local Authority responses is not mentioned further in this thesis. Most of the Local Authority participants held roles such as Countryside Ranger, Parks, Biodiversity or Ecology Officer within their Local Authority and had experience in land-based sectors (Table 6.1). Most Local Authorities had ecology employees, but half did not have employees working specifically on deer-related issues, with most not having a deer management plan or managing urban deer populations (Table 6.2). However, when asked about which methods their Local Authority used to manage deer, 27 respondents (90%) declared that they did undertake some form of deer management. These statistics may therefore not reflect the full extent of Local Authority deer management activities. This may be because of a lack of knowledge surrounding deer management (below) and highlights the importance of the term 'deer management' being defined and used clearly (as in 5.2.1).

When completing the Q-sorting process, it was clear that many of the Local Authority participants did not feel that they had much knowledge or experience regarding urban deer (Theme A, Table 6.3). This was despite the participants being selected as the most experienced person on the topic in their Local Authority. This lack of knowledge should be considered when assessing the results of this study, as not every Local Authority participant had strong opinions or knowledge of urban deer, and therefore may not have had a full understanding of the topic. This lack of knowledge and experience (as highlighted in Table 6.2 and within the existing literature (Goldberg, 2003; Holland *et al.*, 2017; Lowland Deer Panel, 2019)), suggests that many Local Authorities have not previously had to extensively deal with urban deer populations and their management. The limited engagement of Local Authorities with urban deer is discussed further in section 6.5.2.

Table 6.1: Demographic and relevant experience statistics of the Local Authority Q-methodology participants.

		Proportion of participants (%)
Job Role or Equivalent	Countryside Ranger/ Parks Officer	46.7
	Biodiversity/ Ecology Officer	33.3
	Forestry Officer	10.0
	Other - Planner/ Roads Officer/ Leisure Officer	10.0
Age	32-41	20.0
	42-51	16.7
	52-61	63.3
Gender	Male	43.3
	Female	56.7
Years working for Local Authority	0-10	16.7
	11-20	53.3
	21-30	20.0
	31+	10.0
Experience in land-based sectors	Yes	90.0
	No	10.0

Table 6.2: Proportion of Local Authorities who have various experience with deer and their management.

	Yes (%)	No (%)	Don't know (%)
Does your Local Authority have employees that work on deer issues?	43.3	50.0	6.7
Does your Local Authority have ecology employees?	73.3	26.7	0.0
Does your Local Authority have a deer management plan?	23.3	66.7	10.0
Does your Local Authority manage urban deer?	40.0	56.7	3.3
Does your Local Authority organise the dispatch of injured deer in urban areas?	36.7	26.6	36.7
Does your Local Authority remove dead deer from roads within urban areas?	80.0	0.0	20.0

Table 6.3: Data from the Local Authority participants highlighting a lack of knowledge about urban deer.

Theme	Data and participant
<p>A. Participants did not feel they had much knowledge about urban deer populations and therefore struggled to sort the statements</p>	<p><i>“I don't know how much these things are actually a problem, so I'm partially guessing for some and for some of them I'm putting them where it would be a problem if it was happening. I just don't know if it's happening. It's actually raised quite a lot of questions for me or showed me where there's maybe gaps in our knowledge.”</i></p> <p>– LA1</p> <p><i>“Yeah, I don't kind of range in the urban environment that much, so there's quite a few what I could only guess at.”</i></p> <p>– LA4</p> <p><i>“Most of my answers on that, are just about things that we don't have data on and I just wouldn't be able to say one way or another you know.”</i></p> <p>– LA9</p> <p><i>“But I think the ones I really didn't know, I've stuck in the neutral column.”</i></p> <p>– LA25</p>

6.2.2. Councillor survey dataset

The demographics of the councillor participants are consistent with those reported of councillors elected from 2017-2022 (Table 6.4) (Improvement Service, 2018). The majority of councillor participants had been in position for a limited time, between 1 and 5 years, and did not have experience in land-based sectors. All Local Authorities (with deer present) and all political parties were represented. Details about the number of councillors from each Local Authority and Political Party are presented in Appendices 16 and 17.

Table 6.4: Demographic and relevant experience statistics of the local councillor survey participants.

		Proportion of participants (%) (out of 353 councillors)
Age	18-35	5.4
	36-45	10.1
	46-55	22.3
	56-65	37.2
	66-75	22.0
	76+	3.0
Gender	Male	69.4
	Female	26.6
	Other	1.0
	Prefer Not to Say	3.0
Years as councillor	1-5	52.6
	6-10	14.5
	11-15	17.0
	16+	15.9
Experience in land-based sectors	Yes	33.0
	No	67.0

6.3. Q-methodology study results

Presented below are the results of the Q-methodology study, including the quantitative outputs and qualitative interpretation of the Factors that emerged from the analysis. The Factors are discussed in relation to the research questions, literature and other data sources in the subsequent sections of this chapter.

6.3.1. Results

A correlation matrix of the Q-sorts (each representing a single Local Authority respondent viewpoint) is presented in Appendix 18. Most Q-sorts have a relatively low positive correlation, suggesting some similarities between Local Authority respondent viewpoints, but also many differences. The highest positive correlation was between Q-sorts LA1 and LA13, with the most negatively correlated sorts LA8 and LA14, and LA10 and LA17. No correlation was found between LA4 and LA7, and LA7 and LA17.

Centroid Factor Analysis was undertaken to extract Factors from the dataset. A three-Factor solution was deemed the best solution, as explained in 3.3.2.2.3. This solution explained 46% of the variance, with 22 Q-sorts (Local Authorities) loading significantly (and not confounded) on three Factors. Once extracted, these Factors were rotated using Varimax rotation. The loadings of the Q-sorts on these rotated Factors are presented in Table 6.5 and summarised in Table 6.6.

Factor arrays were created for each Factor from the significantly loading Q-sorts (excluding confounded Factors⁴³). These are presented below as composite Q-sort Factor arrays for ease of examination of the individual Factors (Figures 6.2, 6.3 and 6.4), and as a table for ease of comparison between Factors (Table 6.7).

⁴³ The confounding and non-loading Q-sorts were used throughout the analysis and therefore shaped the Factors that were extracted. However, they are not represented in the Factor arrays and subsequent interpretation. More details about the confounding and non-loading Q-sorts are provided in Appendix 19.

Table 6.5: Loadings of the Q-sorts on the three rotated Factors. Significant loadings are shown with an * and represent significant loading of a Q-sort on the Factor at the $p < 0.01$ level. Where a Q-sort loads significantly onto two or more Factors, known as a confounding Factor, this is demonstrated with ^.

Q Sort	F1	F2	F3
LA1	0.800*	0.310	0.035
LA2	0.166	0.324	0.151
LA3	0.447*	0.230	0.304
LA4	0.377*	0.326	0.016
LA5	-0.166	0.682*	0.202
LA6	-0.127	0.180	0.722*
LA7	0.283	0.004	0.581*
LA8	0.490*	0.118	-0.084
LA9	0.637*	-0.131	0.265
LA10	0.713*	0.041	-0.044
LA11	0.235	0.773*	0.125
LA12	0.509^	0.522^	0.068
LA13	0.718*	0.125	0.287
LA14	0.032	0.100	0.536*
LA15	0.433*	0.225	0.132
LA16	0.548*	0.161	0.358
LA17	0.071	0.243	-0.014
LA18	0.162	0.169	0.539*
LA19	-0.193	0.377^	0.561^
LA20	0.346	0.471*	0.280
LA21	0.282	0.411*	0.363
LA22	0.290	0.572^	0.435^
LA23	0.521^	0.492^	0.056
LA24	0.209	0.280	0.652*
LA25	0.653*	0.188	0.214
LA26	0.128	0.620*	0.315
LA27	0.476*	0.349	0.299
LA28	0.095	0.717*	0.202
LA29	0.523^	0.153	0.525^
LA30	0.448^	0.061	0.584^

Table 6.6: A summary of the loadings of the Q-sorts.

Factor	Q-Sort numbers	Total number of Q-sorts
F1	1, 3, 4, 8, 9, 10, 13, 15, 16, 25, 27	11
F2	5, 11, 20, 21, 26, 28	6
F3	6, 7, 14, 18, 24	5
Confounded	12, 19, 22, 23, 29, 30	6
Non-Significant	2, 17	2

Composite Q sort for Factor 1

-5	-4	-3	-2	-1	0	1	2	3	4	5
14. Deer have a negative impact on the public overall in urban areas in	** ◀ 19. We should be responsible for organising the dispatch of injured deer in	16. Deer attracting visitors to areas is a concern in	** ◀ 25. We manage deer sufficiently in urban areas in our LA	** ▶ 22. NatureScot should be responsible for managing urban deer on land	27. Tree guards are an effective deer management technique in	** ▶ 48. Risk of negative media coverage stops us from managing deer	** ▶ 41. Resource constraints stop us from managing deer in urban areas	** ▶ 42. We would like more support/ guidance on deer/ deer	24. We should work with other landowners to collaboratively manage deer in	38. We would receive public objections for culling deer in urban areas in
** ◀ 21. We should be responsible for managing deer on all urban land	** ◀ 10. Deer being attacked by dogs is not a concern in urban areas in	47. Existing policies would stop us managing deer in urban areas	4. We are worried about the deer in urban areas in our LA	29. Deterrents are not an effective deer management technique in	** 1. In some urban areas that my LA owns/ manages there are too	13. Deer have a positive impact on greenspaces/ the environment overall in	** ▶ 39. Risk of public objections stops us from managing deer	5. It's a good thing to have deer in urban areas in our LA	** ▶ 31. We are reluctant to cull deer in urban areas in our LA	37. We would expect public objections to using recreational
	35. We should hide our urban deer management activities from the public	12. Deer damage to woodlands/ parklands/ gardens/ cemeteries is	** 15. Deer in urban areas in our LA cost us a significant amount of money	32. Fences are not an effective deer management technique in	3. We believe deer populations are increasing in urban areas in	43. The public vandalizing fences is a concern in urban areas in	26. Deer management is needed in some urban areas in our LA	33. Consulting local communities about urban deer management	34. Educating the public about urban deer/ deer management is	
		** ◀ 9. Deer being targeted in acts of cruelty/ poaching is not	** ◀ 7. Deer spreading Lyme disease is not a concern in urban areas in	11. Deer getting trapped/ entangled is a concern in	36. We are reluctant to manage deer in urban areas in our LA	** ▶ 44. Councillors would block deer management from happening in urban areas	18. We should be responsible for managing deer on urban land that we	2. We enjoy seeing deer in urban areas in our LA		
			28. Culling is an effective deer management technique in urban areas in	* ◀ 30. Deer warning signs are not an effective deer management	6. Deer injuring the public (not through deer-vehicle	45. Stalkers should have specific urban deer management qualifications	** ▶ 46. We are concerned about the safety of culling in urban areas in			
				23. Forestry and Land Scotland should be responsible for managing	20. We should be responsible for removing dead deer off roads in urban	8. Deer-vehicle collisions are a concern in urban areas in our LA				
					** ▶ 40. Lack of knowledge stops us managing deer in urban areas in our LA					
					17. The health/ condition of deer is not a concern in urban areas in					

Legend

- * Distinguishing statement at P< 0.05
- ** Distinguishing statement at P< 0.01
- ▶ z-Score for the statement is higher than in all other factors
- ◀ z-Score for the statement is lower than in all other factors
- Consensus Statements

Figure 6.2: A composite Factor array of Factor 1. This represents the average placing of each item within Factor 1. If sorted at -5, the statement was most disagreed with, if sorted at 5, the statement was most agreed with.

Composite Q sort for Factor 2

-5	-4	-3	-2	-1	0	1	2	3	4	5
** ◀ 15. Deer in urban areas in our LA cost us a significant amount of money	14. Deer have a negative impact on the public overall in urban areas in	23. Forestry and Land Scotland should be responsible for managing	28. Culling is an effective deer management technique in urban areas in	11. Deer getting trapped/ entangled is a concern in	36. We are reluctant to manage deer in urban areas in our LA	17. The health/ condition of deer is not a concern in urban areas in	* ▶ 6. Deer injuring the public (not through deer-vehicle	24. We should work with other landowners to collaboratively manage deer in	37. We would expect public objections to using recreational	38. We would receive public objections for culling deer in urban areas in
35. We should hide our urban deer management activities from the public	4. We are worried about the deer in urban areas in our LA	47. Existing policies would stop us managing deer in urban areas	32. Fences are not an effective deer management technique in	44. Councillors would block deer management from happening in urban areas	30. Deer warning signs are not an effective deer management	20. We should be responsible for removing dead deer off roads in urban	5. It's a good thing to have deer in urban areas in our LA	** ▶ 27. Tree guards are an effective deer management technique in	** ▶ 45. Stalkers should have specific urban deer management qualifications	** ▶ 33. Consulting local communities about urban deer management
	** ◀ 39. Risk of public objections stops us from managing deer	40. Lack of knowledge stops us managing deer in urban areas in our LA	** ◀ 8. Deer-vehicle collisions are a concern in urban areas in our LA	** ◀ 26. Deer management is needed in some urban areas in our LA	25. We manage deer sufficiently in urban areas in our LA	* ▶ 7. Deer spreading Lyme disease is not a concern in urban areas in	** ▶ 10. Deer being attacked by dogs is not a concern in urban areas in	2. We enjoy seeing deer in urban areas in our LA	34. Educating the public about urban deer/ deer management is	
		* ◀ 48. Risk of negative media coverage stops us from managing deer	16. Deer attracting visitors to areas is a concern in	** ◀ 43. The public vandalizing fences is a concern in urban areas in	29. Deterrents are not an effective deer management technique in	13. Deer have a positive impact on greenspaces/ the environment overall in	18. We should be responsible for managing deer on urban land that we	** ▶ 9. Deer being targeted in acts of cruelty/ poaching is not		
		** 22. NatureScot should be responsible for managing urban deer on land		** ◀ 1. In some urban areas that my LA owns/ manages there are too	** ▶ 12. Deer damage to woodlands/ parklands/ gardens/ cemeteries is	3. We believe deer populations are increasing in urban areas in	19. We should be responsible for organising the dispatch of injured deer in			
			** 21. We should be responsible for managing deer on all urban land		46. We are concerned about the safety of culling in urban areas in	** 31. We are reluctant to cull deer in urban areas in our LA				
					42. We would like more support/ guidance on deer/ deer					
					41. Resource constraints stop us from managing deer in urban areas					

Legend

- * Distinguishing statement at P< 0.05
- ** Distinguishing statement at P< 0.01
- ▶ z-Score for the statement is higher than in all other factors
- ◀ z-Score for the statement is lower than in all other factors
- Consensus Statements

Figure 6.3: A composite Factor array of Factor 2. This represents the average placing of each item within Factor 2. If sorted at -5, the statement was most disagreed with, if sorted at 5, the statement was most agreed with.

Composite Q sort for Factor 3

-5	-4	-3	-2	-1	0	1	2	3	4	5
12. Deer damage to woodlands/ parklands/ gardens/ cemeteries is	14. Deer have a negative impact on the public overall in urban areas in	** ▶ 35. We should hide our urban deer management activities from the public	* 48. Risk of negative media coverage stops us from managing deer	** ▶ 15. Deer in urban areas in our LA cost us a significant amount of money	29. Deterrents are not an effective deer management technique in	8. Deer-vehicle collisions are a concern in urban areas in our LA	2. We enjoy seeing deer in urban areas in our LA	** ▶ 1. In some urban areas that my LA owns/ manages there are too	** ▶ 21. We should be responsible for managing deer on all urban land	** ▶ 18. We should be responsible for managing deer on urban land that we
** ◀ 22. NatureScot should be responsible for managing urban deer on land	** ◀ 36. We are reluctant to manage deer in urban areas in our LA	** ◀ 31. We are reluctant to cull deer in urban areas in our LA	46. We are concerned about the safety of culling in urban areas in	41. Resource constraints stop us from managing deer in urban areas	27. Tree guards are an effective deer management technique in	43. The public vandalizing fences is a concern in urban areas in	3. We believe deer populations are increasing in urban areas in	26. Deer management is needed in some urban areas in our LA	34. Educating the public about urban deer/ deer management is	24. We should work with other landowners to collaboratively manage deer in
	* ◀ 47. Existing policies would stop us managing deer in urban areas	23. Forestry and Land Scotland should be responsible for managing	16. Deer attracting visitors to areas is a concern in	* 7. Deer spreading Lyme disease is not a concern in urban areas in	30. Deer warning signs are not an effective deer management	** ▶ 11. Deer getting trapped/ entangled is a concern in	20. We should be responsible for removing dead deer off roads in urban	33. Consulting local communities about urban deer management	19. We should be responsible for organising the dispatch of injured deer in	
		40. Lack of knowledge stops us managing deer in urban areas in our LA	4. We are worried about the deer in urban areas in our LA	** 10. Deer being attacked by dogs is not a concern in urban areas in	25. We manage deer sufficiently in urban areas in our LA	6. Deer injuring the public (not through deer-vehicle	** ◀ 38. We would receive public objections for culling deer in urban areas in	** ▶ 28. Culling is an effective deer management technique in urban areas in		
		44. Councillors would block deer management from happening in urban areas		** 39. Risk of public objections stops us from managing deer	42. We would like more support/ guidance on deer/ deer	* ◀ 5. It's a good thing to have deer in urban areas in our LA	** ◀ 37. We would expect public objections to using recreational			
				** 9. Deer being targeted in acts of cruelty/ poaching is not	13. Deer have a positive impact on greenspaces/ the environment overall in	45. Stalkers should have specific urban deer management qualifications				
					17. The health/ condition of deer is not a concern in urban areas in					
					32. Fences are not an effective deer management technique in					

Legend

- * Distinguishing statement at P< 0.05
- ** Distinguishing statement at P< 0.01
- ▶ z-Score for the statement is higher than in all other factors
- ◀ z-Score for the statement is lower than in all other factors
- Consensus Statements

Figure 6.4: A composite Factor array of Factor 3. This represents the average placing of each item within Factor 3. If sorted at -5, the statement was most disagreed with, if sorted at 5, the statement was most agreed with.

Table 6.7: Factor arrays. The numbers under each Factor number represent the average position that each statement was sorted to in a Q-sort grid within each Factor. If sorted at -5, this statement was most disagreed with, if sorted at 5, the statement was most agreed with. The shading of this table relates to the topic that the statements covered: grey is perceptions of urban deer; blue is perceptions of urban deer impacts; orange is perceptions of the role of their Local Authority in urban deer management; green is perceptions of urban deer management methods; yellow is perceptions of obstacles to urban deer management.

Statement		F1	F2	F3
Number	Statement			
1	In some urban areas that my LA owns/ manages there are too many deer	0	-1	3
2	We enjoy seeing deer in urban areas in our LA	3	3	2
3	We believe deer populations are increasing in urban areas in our LA	0	1	2
4	We are worried about the deer in urban areas in our LA	-2	-4	-2
5	It's a good thing to have deer in urban areas in our LA	3	2	1
6	Deer injuring the public (not through deer-vehicle collisions or disease) is not a concern in urban areas in our LA	0	2	1
7	Deer spreading Lyme disease is not a concern in urban areas in our LA	-2	1	-1
8	Deer-vehicle collisions are a concern in urban areas in our LA	1	-2	1
9	Deer being targeted in acts of cruelty/ poaching is not a concern in urban areas in our LA	-3	3	-1
10	Deer being attacked by dogs is not a concern in urban areas in our LA	-4	2	-1
11	Deer getting trapped/ entangled is a concern in urban areas in our LA	-1	-1	1
12	Deer damage to woodlands/ parklands/ gardens/ cemeteries is not a concern in urban areas in our LA	-3	0	-5
13	Deer have a positive impact on greenspaces/ the environment overall in urban areas in our LA	1	1	0
14	Deer have a negative impact on the public overall in urban areas in our LA	-5	-4	-4
15	Deer in urban areas in our LA cost us a significant amount of money	-2	-5	-1

Statement		F1	F2	F3
Number	Statement			
16	Deer attracting visitors to areas is a concern in urban areas in our LA	-3	-2	-2
17	The health/ condition of deer is not a concern in urban areas in our LA	0	1	0
18	We should be responsible for managing deer on urban land that we own in our LA	2	2	5
19	We should be responsible for organising the dispatch of injured deer in urban areas in our LA	-4	2	4
20	We should be responsible for removing dead deer off roads in urban areas in our LA	0	1	2
21	We should be responsible for managing deer on all urban land within our Local Authority area	-5	-1	4
22	NatureScot should be responsible for managing urban deer on land that we own	-1	-2	-5
23	Forestry and Land Scotland should be responsible for managing urban deer on land that we own	-1	-3	-3
24	We should work with other landowners to collaboratively manage deer in urban areas in our LA	4	3	5
25	We manage deer sufficiently in urban areas in our LA	-2	0	0
26	Deer management is needed in some urban areas in our LA	2	-1	3
27	Tree guards are an effective deer management technique in urban areas in our LA	0	3	0
28	Culling is an effective deer management technique in urban areas in our LA	-2	-2	3
29	Deterrents are not an effective deer management technique in urban areas in our LA	-1	0	0
30	Deer warning signs are not an effective deer management technique in urban areas in our LA	-1	0	0
31	We are reluctant to cull deer in urban areas in our LA	4	1	-3
32	Fences are not an effective deer management technique in urban areas in our LA	-1	-2	0
33	Consulting local communities about urban deer management is important	3	5	3

Statement		F1	F2	F3
Number	Statement			
34	Educating the public about urban deer/ deer management is important	4	4	4
35	We should hide our urban deer management activities from the public	-4	-5	-3
36	We are reluctant to manage deer in urban areas in our LA	0	0	-4
37	We would expect public objections to using recreational stalkers to cull deer in urban areas in our LA	5	4	2
38	We would receive public objections for culling deer in urban areas in our LA	5	5	2
39	Risk of public objections stops us from managing deer in urban areas in our LA	2	-4	-1
40	Lack of knowledge stops us managing deer in urban areas in our LA	0	-3	-3
41	Resource constraints stop us from managing deer in urban areas in our LA	2	0	-1
42	We would like more support/ guidance on deer/ deer management in urban areas in our LA	3	0	0
43	The public vandalizing fences is a concern in urban areas in our LA	1	-1	1
44	Councillors would block deer management from happening in urban areas in our LA	1	-1	-2
45	Stalkers should have specific urban deer management qualifications	1	4	1
46	We are concerned about the safety of culling in urban areas in our LA	2	0	-2
47	Existing policies would stop us managing deer in urban areas in our LA	-3	-3	-4
48	Risk of negative media coverage stops us from managing deer in urban areas in our LA	1	-3	-2

6.3.2. Interpretation

Three Factors – three groups of Local Authority respondents who thought about urban deer and their management in similar ways - emerged from the Q-methodology analysis. These groups are:

- 1) Factor 1: Cautious, Concerned and Constrained (eleven Local Authority participants are significantly associated with this Factor)⁴⁴
- 2) Factor 2: Unconcerned and Unnecessary (six Local Authority participants)⁴⁵
- 3) Factor 3: Responsible and Ready (five Local Authority participants)⁴⁶

Table 6.8 summarises contextual information⁴⁷ about the experience with deer of Local Authorities represented by each Factor. In the following three sub-sections, each of the Factors is summarised in turn, to provide insight into the views of the Local Authorities represented within each Factor.

Table 6.8: Contextual information about the experience of deer management of the Local Authorities that significantly loaded on each Factor.

Local Authority...	Factor 1 (% of Local Authorities that significantly loaded on this Factor)	Factor 2 (% of Local Authorities that significantly loaded on this Factor)	Factor 3 (% of Local Authorities that significantly loaded on this Factor)
...has an employee working on deer issues	36.4	33.3	100.0
...believes that they are required to manage, or consider	72.7	33.3	100.0

⁴⁴ Factor 1 has an eigenvalue of 9.15 and explains 31% of the study variance.

⁴⁵ Factor 2 has an eigenvalue of 2.66 and explains 9% of the study variance.

⁴⁶ Factor 3 has an eigenvalue of 1.77 and explains 6% of the study variance.

⁴⁷ This information was gathered in a pre-Q sorting survey.

managing, deer on their land			
...has a deer management plan	36.4	0.0	80.0
...monitors deer impacts	18.2	0.0	60.0
...manages deer	36.4	16.7	100.0
...has culled deer	27.3	0.0	80.0
...has organised the dispatch of injured deer	18.2	50.0	80.0
...has worked with NatureScot regarding urban deer issues	72.7	16.7	100.0

6.3.2.1. Factor 1: Cautious, Concerned and Constrained

The Local Authority participants represented by Factor 1 (Figure 6.2 and Table 6.7) enjoyed seeing urban deer, believing urban deer had a positive impact on the public overall. They were unsure whether urban deer populations were increasing in number, or whether there were too many urban deer in their area. However, this group highlighted concern regarding the impacts of and on urban deer, especially regarding deer damage to woodlands, parklands, gardens and cemeteries (Theme A, Table 6.9), human-induced deer welfare concerns such as attacks by dogs and acts of cruelty (Theme B, Table 6.9) and transmission of Lyme disease (Theme C, Table 6.9).

Table 6.9: Data from Local Authority participants represented by Factor 1 about urban deer and their management.

Theme	Data and participant
A. Concern about impacts in cemeteries	<p><i>"We had a complaint recently about the wreaths and the flowers that are getting placed down and then the people go back the next day to visit the graveside and half the things are already eaten. We can't be the only ones having this issue, you know?"</i></p> <p>- LA9</p>
B. Concerns about Lyme disease	<p><i>"I know that we have had a couple of complaints about Lyme disease. That people reckon they've picked up in our parks."</i></p> <p>- LA1</p>
C. Concerns about human-induced deer welfare concerns	<p><i>"We've got a lot of evidence of dogs attacking deer in our urban areas. So yeah, that's a huge concern."</i></p> <p>- LA15</p> <p><i>"We had several incidences of deer being poached on the site and actually being strung up along the fence. Really kind of horrible things like that."</i></p> <p>- LA9</p>
D. Concerns about culling	<p><i>"Being in the middle of a city, particularly a city like [redacted], which is well known for being a beautiful city, lots of people like to come and visit. Shooting urban deer wouldn't go down well... guns and city centres, you know, don't mix very well."</i></p> <p>- LA1</p>
E. Concerns about public objections	<p><i>"And I said to SNH [NatureScot] if we start killing deer... there'll be public outrage. And the members will not like it because we'll get local people coming on to us."</i></p> <p>- LA8</p>

	<p><i>"I think the recreational side of things might be unpalatable with people. I think if they were professional stalkers that would give a very different impression than people who were maybe also seeing it as a hobby."</i></p> <p>- LA25</p>
F. Constrained by a lack of resources	<p><i>"It's not that we're reluctant to manage deer. It's probably more it's about the resources, the resource and that are kind of tied, it's about having enough. It is always staff time."</i></p> <p>- LA3</p>

The Local Authority participants represented by this Factor took limited responsibility for managing urban deer, despite believing urban deer management was needed in their area. They agreed they should be responsible for managing urban deer on their own land but believed more strongly than the other Factors that they should not be responsible for managing deer on all urban land, or for dispatching injured deer. This group agreed that they should work collaboratively with other landowners to manage urban deer and were less against NatureScot or Forestry and Land Scotland managing urban deer on Local Authority land than other Factors. Respondents in this Factor believed non-lethal methods of deer management were effective in urban areas but thought culling would be ineffective.

Respondents in Factor 1 were least likely to think they were managing deer sufficiently in urban areas and were the most reluctant to cull deer, although were ambivalent about managing deer overall (Theme D, Table 6.9). Like within the other Factors, these Local Authority participants did not believe they should hide deer management from the public and believed in the importance of consulting and educating the public about urban deer and urban deer management. They perceived more barriers to successful urban deer management than other Factors. They were more likely than other Factors to state that a risk of public objections or negative media coverage would stop them from managing urban deer, and strongly believed that they would receive public objections for culling or using recreational stalkers in urban areas (Theme E, Table 4.9). They were also the Factor who were most concerned about the safety of culling in urban areas, believing stalkers should have specific urban deer management qualifications. Factor 1 participants felt constrained

by a lack of resources (Theme F, Table 4.9), to some extent a lack of knowledge, and by councillor views but not existing policies, and wanted to receive more support and guidance on urban deer management, more so than other Factors.

6.3.2.2. Factor 2: Unconcerned and Unnecessary

The Local Authority participants represented by Factor 2 (Figure 6.3 and Table 6.7) also enjoyed seeing urban deer and believed that urban deer had a positive impact on people overall. They believed that urban deer populations were increasing in their area but were least likely compared to other Factors to believe that urban deer numbers were too high in their area. They were least worried about urban deer populations and least concerned regarding impacts on the urban environment, people or the deer themselves (Theme A, Table 6.10).

Table 6.10: Data from Local Authority participants represented by Factor 2 about urban deer and their management.

Theme	Data and participant
A. Urban deer are not a concern	<p><i>"It's not an issue for the Local Authority. It's not a major issue for us."</i></p> <p>- LA26</p> <p><i>"I think generally, they're at a density where really, the deer are quite healthy."</i></p> <p>- LA21</p>
B. Do not think NatureScot or Forestry and Land Scotland should manage urban deer in their area	<p><i>"I think the landowner should be responsible really. Forestry and Land Scotland have got enough of their own land to manage."</i></p> <p>- LA11</p> <p><i>"Considering NatureScot doesn't even have enough staff to do what I believe that it should be doing, and that it has</i></p>

	<p><i>downgraded much of what it's work is. I'm getting less and less faith in what was Scottish Natural Heritage [NatureScot]."</i></p> <p>- LA5</p>
C. Importance of engaging local communities	<p><i>"I think that you shouldn't be doing any wildlife management or conservation without engaging the community. If you don't engage the community, you're always gonna get backlash, because they'll think that you're doing something you shouldn't be doing."</i></p> <p>- LA26</p>
D. Public objections would not stop them undertaking urban deer management	<p><i>"I think the council's very much of the view and the realisation that you're gonna get public objection, to certain activities, regardless of what you're doing. But I think the view of the council would be very much that if it was deemed to be a requirement, they wouldn't shy away from that."</i></p> <p>- LA28</p>

Factor 2 participants did not think that urban deer management was needed in their area, in contrast with other Factors. They took some responsibility for urban deer management, agreeing that they should be responsible for managing urban deer on their own land, but disagreed that they should be responsible for managing deer on other land within urban areas. They also believed they should be responsible for dispatching injured deer and removing dead deer from roads. Respondents in this Factor believed less strongly than others that they should work collaboratively with other landowners to manage urban deer. They did not think that NatureScot or Forestry and Land Scotland should be managing urban deer on Local Authority land (Theme B, Table 6.10). Factor 2 participants believed barrier methods of urban deer management would be effective, and that culling would be ineffective in urban areas.

Respondents represented by Factor 2 were unsure as to whether they were managing deer sufficiently within urban areas, were somewhat reluctant to cull urban deer and were ambivalent about managing urban deer overall. Like other Factors, these Local Authority

participants did not believe they should hide deer management from the public and believed strongly in the importance of consulting and educating the public about urban deer and urban deer management (Theme C, Table 6.10). They strongly believed that they would receive public objections to deer culling or using recreational stalkers, but believed more strongly than other Factors that a risk of public objections or negative media coverage would not stop them from managing urban deer (Theme D, Table 6.10). This group were ambivalent as to whether the safety of culling was a concern, but strongly believed that stalkers should have urban deer management qualifications. They did not believe that the public vandalising fences was a concern, which contrasted with other Factors. Factor 2 participants were ambivalent about whether they were constrained by a lack of resources, did not believe they were constrained by a lack of knowledge, or by councillor views or existing policies. They were ambivalent as to whether they would like more support or guidance on urban deer management.

6.3.2.3. Factor 3: Responsible and Ready

The Local Authority participants represented by Factor 3 (Figure 6.4 and Table 6.7) also enjoyed seeing urban deer and thought that deer had a positive overall effect on the public, but less so than other Factors. They believed that urban deer populations were increasing in their area and were more likely than other Factors to believe that there were too many urban deer (Theme A, Table 6.11). Factor 3 participants were not worried about urban deer populations, although impacts of urban deer were generally a concern, especially surrounding impacts on woodlands, parklands, gardens and cemeteries (more so than for other Factors) (Theme B, Table 6.11), impacts on deer and on humans.

Table 6.11: Data from Local Authority participants represented by Factor 3 about urban deer and their management. SSSI = Site of Special Scientific Interest.

Theme	Data and participant
A. Too many deer	<p><i>"Yeah, up here there's too many deer. That's why we get them culled."</i></p> <p>- LA14</p>

<p>B. Deer damage is a concern</p>	<p><i>“Deer damage. It's absolutely a concern for us. We have [retracted] SSSIs in unfavourable condition. So, you know, we have a duty to bring that into favourable condition.”</i></p> <p>- LA18</p>
<p>C. Do not think NatureScot or Forestry and Land Scotland should manage urban deer in their area</p>	<p><i>“I don't see why. If it's Local Authority, its Local Authority's responsibility, that seems straightforward to me.”</i></p> <p>- LA7</p> <p><i>“They [NatureScot] have no clout.”</i></p> <p>- LA18</p>
<p>D. Hiding deer management from the public</p>	<p><i>“I don't think we should hide them. But you maybe don't want them to be front page news.”</i></p> <p>- LA14</p>
<p>E. Risk of opposition would not affect actions</p>	<p><i>“I think possibly other Local Authorities perhaps are maybe quite reluctant because you look at what happened in Aberdeen and the backlash and it's all over the newspapers and Bambi and all this kind of stuff. We're not really coming from that place within the team. You know, that's not something that I think holds us back.”</i></p> <p>- LA18</p>
<p>F. Not constrained by resources or knowledge</p>	<p><i>“Resource constraints. Well I haven't come across that yet, but we don't pay very much for it, it's not very expensive.”</i></p> <p>- LA14</p> <p><i>“We're lucky in [retracted], we have myself and we've got a couple of tree officers covering different areas. So that knowledge kind of pulls together quite well.”</i></p> <p>- LA18</p>

Factor 3 participants thought deer management was needed in their respective urban areas. Overall, they took high responsibility for urban deer management on their own land and

other land in urban areas, contrasting with other Factors. They also believed they should be responsible for dispatching injured deer and removing dead deer from roads. This group very strongly believed that they should work collaboratively with other landowners to manage urban deer, and that NatureScot (stronger than other Factors) and Forestry and Land Scotland should not be managing urban deer on land that Local Authorities own (Theme C, Table 6.11). Factor 3 participants believed culling was an effective urban deer management method, contrasting considerably with other Factors, but were ambivalent about non-lethal methods.

Respondents in Factor 3 were unsure as to whether they were managing deer sufficiently in their urban area but were not reluctant to cull or manage urban deer, in contrast with the other Factors. Similar to the other Factors, they did not believe they should hide deer management from the public, although this belief was less strong (Theme D, Table 6.11). Respondents in Factor 3 believed strongly in the importance of consulting and educating the public. They believed that they would receive public objections to deer culling or using recreational stalkers, but this was less of a concern than amongst other Factors, and believed that a risk of public objections or negative media coverage would not stop them from managing urban deer populations (Theme E, Table 6.11). These participants were not concerned about the safety of culling in urban areas (they were less concerned than other Factors) but did believe that stalkers should have urban deer management qualifications. They felt the least constrained towards managing urban deer and were less likely than other Factors to believe they were constrained by a lack of resources (Theme F, Table 6.11) or by councillor views and did not believe existing policies or a lack of knowledge stopped them from managing urban deer. Factor 3 participants were ambivalent as to whether they would like more support or guidance on urban deer and deer management.

6.4. What are Local Authorities' views regarding urban deer, impacts and management?

Positive views of urban deer amongst all three Factors (6.3.2) largely match the perceptions of the public participants, expert interviewees (4.3.2) and existing literature on deer in Scotland (Dandy *et al.*, 2011; Whitefield, 2019; Hare, Daniels and Blossey, 2021). The fears about excessive urban deer numbers expressed by Factor 3 echo those of the expert participants, but contrast with the views of Factor 1, Factor 2 and the public (4.4.1) respondents, who were unconcerned about current urban deer numbers. A greater range of views was apparent regarding the impacts of urban deer. Factor 2 respondents showed the least concern over the impacts of urban deer, which was similar to the public participants, who did not recognise the majority of impacts (4.5). Respondents within Factors 1 and 3 were more concerned, especially surrounding Lyme disease and DVCs, which were concerns reflected in the expert interviews (4.5.2 and 4.5.3).

Views on the need for, and most appropriate means of, urban deer management differed between the Factors. Participants represented by Factors 1 and 3 believed urban deer management was needed in their areas, unlike those in Factor 2. This is a logical extension of the higher levels of concern about urban deer impacts expressed by Factors 1 and 3, whose views also appear to be in line with those of the expert interviewees and public survey participants (5.2.2). The complacent position of Factor 2 contrasts with the views expressed by the rest of the participants. Regarding lethal control, Factor 3 participants were the only Local Authority participants to believe it an effective urban deer management method, which was like the view of the expert interviewees (5.4.3). The views of Factors 1 and 2 were more similar to the public survey respondents, with preferences for non-lethal methods (5.4.2).

The differences in views between Local Authorities could be due to their differing experiences with deer and their management. Factor 3 participants had the most experience with deer, with staff working on deer, an awareness of their responsibilities, and undertook various forms of deer management (Table 6.8). The Factor 2 participants, however, had very little experience with deer or their management (Table 6.8). More

experience and knowledge of deer may be leading to greater awareness of the impacts and pressures of urban deer populations, and therefore a greater belief that management, especially lethal management methods, are needed, which is a pattern found in the literature (Siemer *et al.*, 2004; van der Wal *et al.*, 2014; Whitefield, 2019; Whitefield *et al.*, 2021). Additionally, views may differ because of variability in deer densities or impacts between the Local Authority areas. In the absence of reliable urban deer population and impact data (4.5.6), it is currently impossible to assess whether differing perceptions between the groups of Local Authority participants reflect geographical variations in urban deer impacts and/or the degree to which prior knowledge, or other factors, shapes their views. The importance of context, awareness and gaps in data and research for urban deer management are discussed in 7.2.

6.5. What is the perceived role of Local Authorities within urban deer management?

For the rest of this chapter, the Local Authority Q-methodology study results are supplemented with results from the public survey, expert interviews, and councillor survey to explore responsibilities, engagement and obstacles to urban deer management.

6.5.1. Local Authority responsibilities for managing urban deer

The public survey participants (Figure 6.5 and Figure 6.6) and expert interviewees (Table 6.12) were supportive of Local Authorities being responsible for urban deer management, including for a range of management activities. Factor 3 respondents took the greatest responsibility for managing urban deer, with respondents from Factor 1 taking the least responsibility (6.3.2).

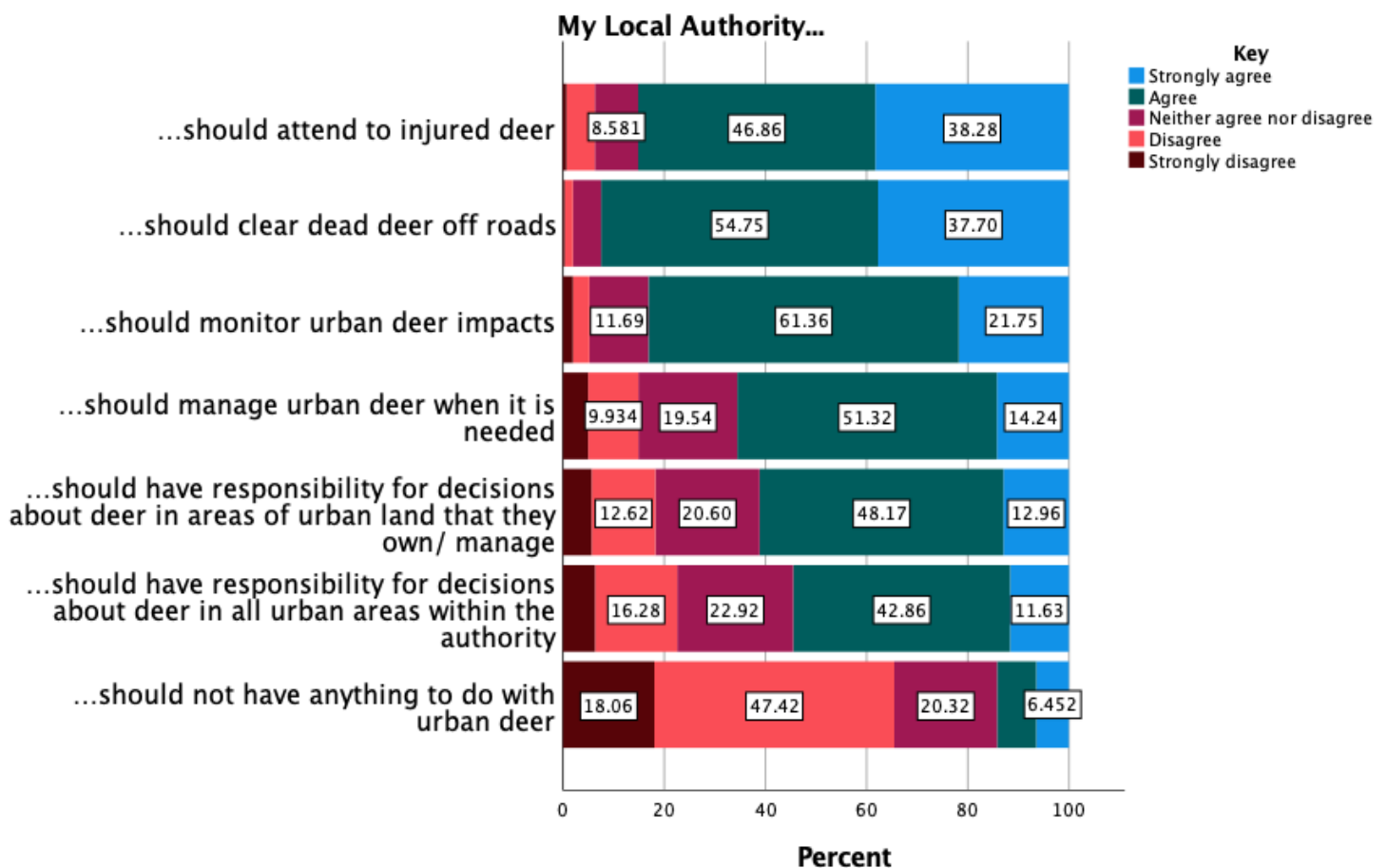


Figure 6.5: Public survey respondents' views of whether their Local Authority should manage urban deer.

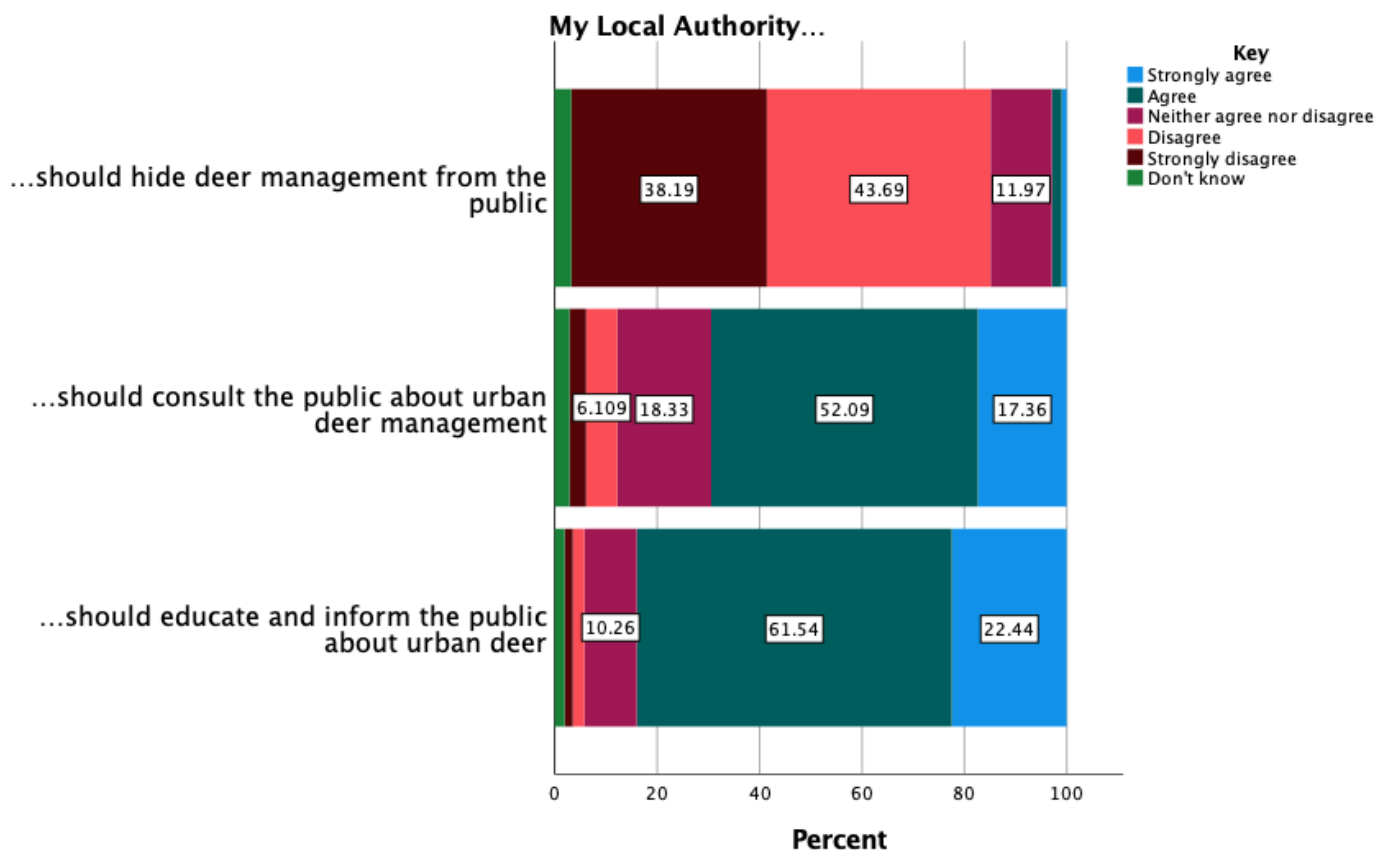


Figure 6.6: Public survey respondents' views of Local Authorities' role in informing and involving the public in urban deer management.

Table 6.12: Data from expert interviewees on the role of Local Authorities within urban deer management.

Theme	Data and participant
A. Local Authorities should be responsible for managing deer on their own land	<p><i>"They do have a legal responsibility to manage deer or consider deer management. That's in the Deer Code... they've got a specific responsibility."</i></p> <p>– Mr I, Government Organisation</p> <p><i>"It's always the landowner. So Local Authorities shouldn't be exempt from that."</i></p> <p>– Mr B, Non-Government Organisation</p>

<p>B. Local Authorities could have a role in the wider urban environment (not just on land they own)</p>	<p><i>“Maybe having a scenario where OK if you've got a population that needs managing, you can't call on the owners to actually do that management, the Local Authority should be able to go in and cull the deer.”</i></p> <p>- Ms J, Academic</p> <p><i>“The Local Authority could make it very clear that the Local Authority has got concerns, or not about the number of deer or the impacts that deer are having. So organisations like the Local Authority could in theory put a bit of pressure on the landowner.”</i></p> <p>- Mr E, Government Organisation</p> <p><i>“I think Local Authorities could provide the facility or facilitation for a deer forum within their geographic area.”</i></p> <p>- Mr P, Consultant</p>
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Public participants (Figure 6.5) (61.13%), expert interviewees (Theme A, Table 6.12) and all of the Local Authority groups believed that Local Authorities should be responsible for managing urban deer on land that they own (6.3.2). This follows the responsibilities of landowners for deer on their land outlined in the Deer Code (2.3.1) (Scottish Natural Heritage, 2012), and the range of reports that have highlighted the role of Local Authorities in urban deer management in Scotland (Dandy *et al.*, 2009; Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). The high level of responsibility recognised by Local Authorities contrasts with published reports, which stated that Local Authorities did not recognise their duty to manage deer (Scottish Parliament, 2017; Lowland Deer Panel, 2019). This may suggest that recent work by NatureScot highlighting the responsibilities of Local Authorities for deer management has been effective (NatureScot, 2022a), although considering the limited involvement of Local Authorities with urban deer management (Table 6.8), this recognition does not appear to have led to much action thus far (Scottish Natural Heritage 2019a, 2019b; Pepper, Barbour and Glass, 2019; Scottish Government, 2021a).

A broader role of Local Authorities within urban deer management was supported by the public participants (Figure 6.5 and Figure 6.6) and recognised by the expert participants (Theme B, Table 6.12), from managing deer on all urban land (supported by 54.49% of public respondents), to encouraging landowners in urban areas to participate in urban deer management, to facilitating collaborative management. This echoes the calls from the Scottish Government and Deer Working Group that Local Authorities act as an intermediate deer management level within urban areas (Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). Polarised views about Local Authorities having broader responsibility across urban areas, however, were apparent amongst the Local Authority participants (6.3.2). Open communication, consultation and education of the public about urban deer management is however desired by the Local Authority, public and local councillor (76.1%) participants in this study (Table 6.13; Figure 6.6), with the role of this discussed further in 7.2.2. Collaboration for deer management was also supported by all Local Authority groupings (6.3.2). Given the recognition of fragmented urban landscapes and the need for cooperation for urban deer management raised by the expert interviewees in 5.5, it is positive that Local Authorities are supportive of working with others to manage deer over broader urban areas than just those they own.

Table 6.13: Local councillors' views on urban deer management being undertaken with minimal public awareness.

	Yes (%)	No (%)
Do you feel urban deer management is best conducted with minimal public information and awareness?	23.9	76.1

6.5.2. Engagement of Local Authorities and the sufficiency of management

While there is strong consensus that Local Authorities do have a role to play in urban deer management, concerns were raised by the expert interviewees about how much Local Authorities have engaged with, or taken responsibility for, urban deer management thus far

(Theme A, Table 6.14). Although no Local Authority participant groupings agreed that they were reluctant to manage urban deer, participants from Factors 1 and 2 were unsure about their willingness to manage deer and indicated a reluctance to cull urban deer (6.3.2). These results do not suggest universal willingness amongst Local Authorities to undertake urban deer management. These concerns are reinforced by the low proportion of Local Authorities which have a deer management plan or undertake urban deer management (Table 6.2). The lack of engagement and reluctance of Local Authorities to manage deer has been previously recognised (Scottish Parliament, 2017; Lowland Deer Panel, 2019; Scottish Natural Heritage, 2019a), with barriers to their involvement discussed in 6.6.

Local Authorities do not appear to be managing urban deer populations sufficiently, as emphasised in the expert interviews (Theme A, Table 6.14) and by Factor 1. This echoes the view of both the Deer Working Group and the expert participants that levels of urban deer management are insufficient in Scotland (5.3), and that Local Authorities are not fulfilling their duty under the Deer Code (Pepper, Barbour and Glass, 2019). Factor 2 and 3 participants were unsure whether their Local Authority’s practices were sufficient, as were the public respondents (52.9% neither agree nor disagree or do not know) (Figure 6.7). Uncertainty may be due to the lack of engagement with urban deer management by Local Authorities (Table 6.2), and a lack of public awareness or involvement with deer, their impacts and management (Table 4.2 and 5.4.3). It could also be explained by the lack of understanding and data available about urban deer (4.5.6), which is discussed further in 7.2.3.

Table 6.14: Data from expert interviewees on the lack of sufficient management or engagement of Local Authorities within urban deer management.

Theme	Data and participant
A. Most Local Authorities have not sufficiently managed urban deer or engaged with urban deer management	<p><i>“I know some in the Central Belt are doing their part, but I think it's the exception not the rule.”</i></p> <ul style="list-style-type: none"> <li>- Mr B, Non-Government Organisation

	<p><i>“I think Local Authorities in general aren't very good at embracing the fact that they are responsible for deer management on their properties. They're not the easiest to get to acknowledge any level of responsibility for that because it's so alien to them. It's something they have no experience in at all, and it's completely a different world and so they'd rather forget about it than deal with it.”</i></p> <p>- Mr O, Academic</p> <p><i>“And there's a degree of apathy, of let's bury our head in the sand and waiting until we are provided with greater understanding over what our responsibilities are.”</i></p> <p>- Mr P, Consultant</p>
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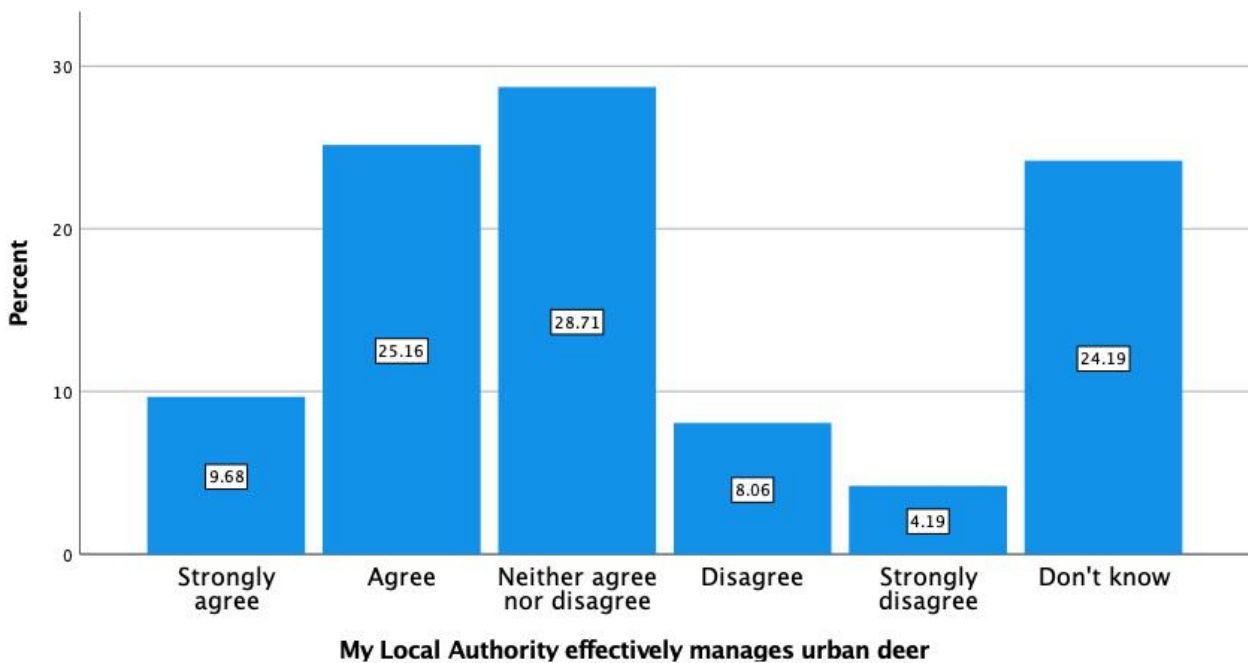


Figure 6.7: Public survey respondents' views on whether their Local Authority effectively manages urban deer.

6.6. What are the perceived obstacles to Local Authority involvement in urban deer management?

Despite broad agreement that Local Authorities should be responsible for many forms of urban deer management (6.5.1), three broad obstacles to their involvement were identified. These help to explain their limited engagement and insufficient practices thus far (6.5.2).

6.6.1. Safety

The largest group of Local Authority participants (Factor 1) were concerned about the safety of culling within urban areas (6.3.2), with this also highlighted by some expert interviewees (5.5) and is evident in the literature (Kilpatrick, LaBonte and Barclay, 2007; Watson, Putman and Green, 2009). Safety concerns are associated with the use of guns for culling in urban areas, with live ammunition presenting a potential risk to humans if not undertaken carefully (ideally where humans are not present, which is not often possible in urban areas) or without a suitable backstop. Since lethal management is often perceived to be a key urban deer management method, with experts perceiving it as the only method (5.4.3), safety concerns may affect Local Authorities' willingness to engage in lethal urban deer management practices. Additionally, all three Factors, most of the public survey respondents and many expert interviewees agreed that stalkers should have urban deer management qualifications (5.4.3.1 and 6.3.2). The current lack of urban deer management training or certification could be acting as a barrier to Local Authority involvement, with the skillset and safety of stalkers under question (Watson, Putman and Green, 2009; Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019).

6.6.2. Acceptability

Acceptability of practices to the public, local councillors and senior Local Authority decision-makers may also act as a barrier to Local Authority engagement in urban deer management, especially regarding the use of lethal methods. Only a minority of public survey participants stated they would trust their Local Authority to make the right decisions regarding urban

deer (41.67%), support their Local Authority in lethally managing deer (37.38%), or support them in using unpaid deer managers to cull deer (28.85%) (Figure 6.8). This matches wider public perceptions of lethal deer management (5.4) (Dandy *et al.*, 2009, 2011), and unpaid stalkers (5.4.3.1), and these objections were perceived by the Local Authority participants (6.3.2). Notably, Factor 1 believed that the risk of public objections and negative media coverage would stop them from managing urban deer,⁴⁸ with expert interviewees also highlighting this (Theme A, Table 6.15).

Additionally, expert interviewees raised concerns about local councillors' willingness to allow urban deer management in their area, stating that councillors might be too concerned about the views of the electorate to support urban deer management policies (Theme B, Table 6.15). These concerns are inevitable, with councillors holding their position because of an electorate whose views they have been elected to represent (Scottish Government, 2022). Decision-making within Local Authorities varies between areas, but often permission is needed from councillors before policies or actions are undertaken or funds are allocated (Marsh, 2013; Scottish Government, 2022). Deer management may therefore require local councillors to vote on its use, and even if not, actions are open to scrutiny. Councillors may be reticent to support something which can be seen as unfavourable which may affect their future electability. The Local Authorities represented by Factor 1 believed local councillors would block urban deer management from occurring; the other groups did not (6.3.2). Most councillors stated they would support their Local Authority's use of non-lethal methods (88.9%), with a minority supporting lethal management actions (40.5%) (Table 6.16). Concerns were also raised by the expert interviewees about senior Local Authority staff blocking urban deer management activities because of their own perceptions (Theme C, Table 6.15). Although no Local Authority groups thought that existing policies would stop them from managing urban deer (6.3.2), a lack of support from local councillors, senior staff, and the public for urban deer management (especially for the use of lethal methods) may reduce Local Authorities' ability to manage urban deer.

⁴⁸ The other two groups did not, but these groups either did not think urban deer management was necessary or were already managing urban deer populations.

Table 6.15: Data from expert interviewees on public outcry as a barrier to Local Authority engagement with urban deer management.

Theme	Data and participant
<p>A. Concern about public perceptions</p>	<p><i>“Their perception is Bambi killing. What’s the voters gonna think? What’s the public gonna think? Not wanting to deal with the outcry.”</i></p> <p>- Mr F, Government Organisation</p> <p><i>“The big thing for them is that their perception is if we do something, there’s going to be huge public outcry. People are gonna hate it. And we’re gonna lose votes. And you know we’re going to be on the front page of the tabloids or on social media. And things can just spiral out of control unbelievably quickly. So they’re always really nervous about anything to do with deer because of the risk of that.”</i></p> <p>- Mr I, Government Organisation</p>
<p>B. Culling urban deer may affect votes for local councillors</p>	<p><i>“You know shooting deer doesn’t get you votes *laugh*.”</i></p> <p>- Mr A, Government Organisation</p> <p><i>“I think it’s an emotive topic that could be unpopular and if it impacts their votes or position or job, and it’s a topic they’re not familiar with, then the question would be, why would I want to do something that could be very unpopular with the people?”</i></p> <p>- Mr B, Non-Government Organisation</p>
<p>C. Senior staff blocking urban deer management from occurring</p>	<p><i>“Quite often we find there’s people at my sort of level who can see the need for doing it but convincing their lords and masters above that it’s something that they need to be doing or should be being done is more difficult.”</i></p> <p>- Mr H, Government Organisation</p>

	<p>“[Redacted] Council, the perfect example where [there’s] real reluctance to get involved. To the point where I think the guy recently said that under my watch, there’s no [lethal] control happening.”</p> <p>- Mr B, Non-Government Organisation</p>
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If deer needed to be managed in my local urban area, I would support my Local Authority..

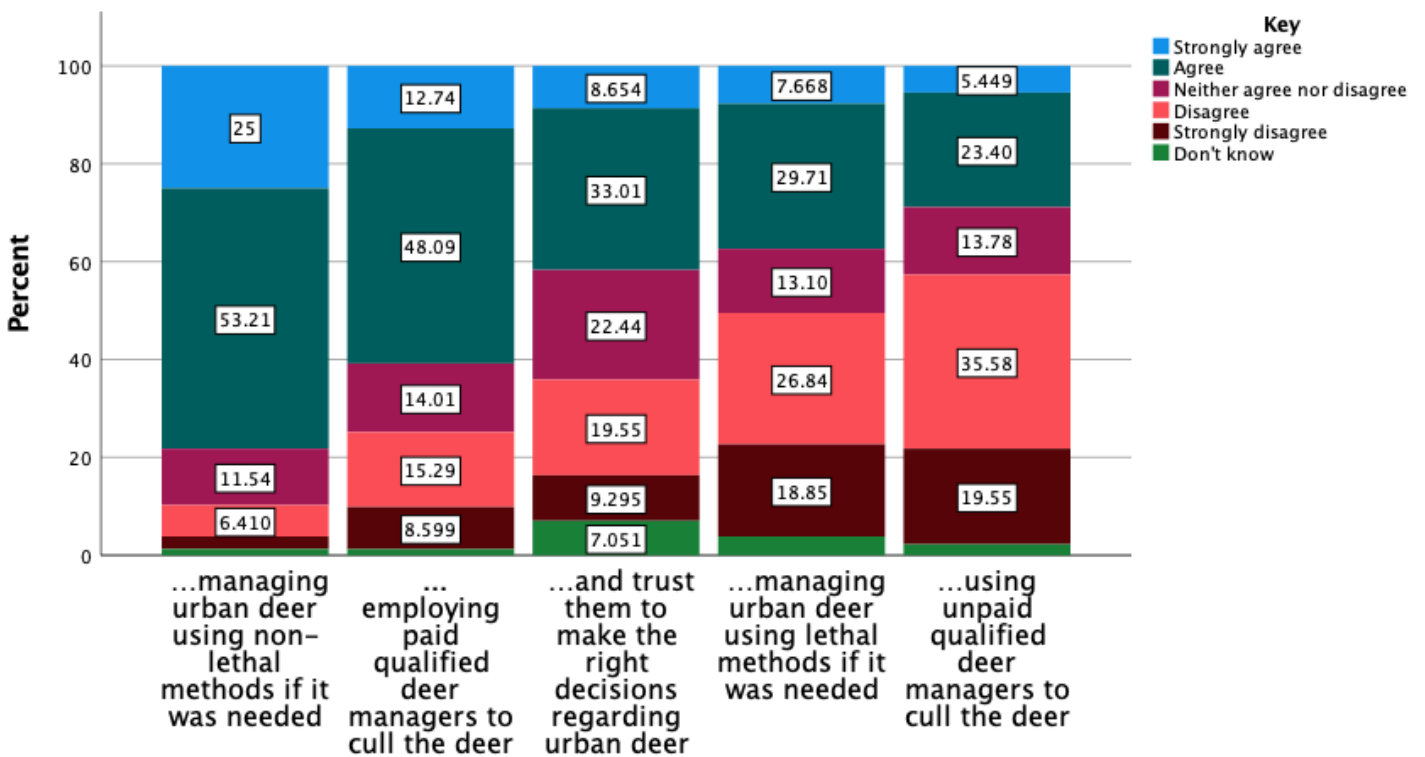


Figure 6.8: Public survey respondents' views on whether they would support their Local Authority regarding various urban deer management methods.

Table 6.16: Local councillors' views on supporting their Local Authority's use of urban deer management methods.

	Yes (%)	No (%)
If urban deer were causing adverse impacts, would you support a policy in your Local Authority to manage urban deer using non-lethal methods?	88.9	11.1
If urban deer were causing significant adverse impacts, would you support a policy in your Local Authority to manage urban deer using lethal methods?	40.5	59.5

6.6.3. Lack of experience, resources and support

Urban deer management is not part of a Local Authority's core remit. Consequently, there may be a lack of awareness or experience of their responsibilities for urban deer and a lack of structures or support for managing urban deer problems, alongside the prioritisation of limited resources to more core Local Authority responsibilities (e.g., education, social care, housing, roads) (Scottish Government, 2017b; Scottish Parliament, 2017; Scottish Natural Heritage, 2019a). These factors may result in limited engagement with urban deer management practices.

No group of Local Authorities believed that a lack of knowledge⁴⁹ was stopping them from managing urban deer, despite many participants feeling they lacked knowledge or experience on urban deer when completing this study (6.2.1). However, it was evident that Local Authorities with greater experience in urban deer management (those represented by Factor 3) were more aware of their responsibilities and were more prepared and willing to manage deer (Table 6.7 and Table 6.8). Factors 1 and 2 did not appear to have much experience, with few having staff working on deer issues or undertaking urban deer

⁴⁹ On reflection, asking whether a lack of knowledge would affect Local Authorities' ability to undertake urban deer management may not have resulted in honest opinions. People do not like to feel incapable and may also not know what knowledge they are missing.

management. A lack of expertise and experience⁵⁰ may be acting as an obstacle to Local Authority engagement with urban deer management, even if Local Authorities do not feel a lack of knowledge would affect their actions. Awareness and experience with deer and effects on deer management are discussed further in 7.2.2.

Expert interviewees were concerned about the effects of limited resources on Local Authority engagement with urban deer management (Theme A, Table 6.17), with the Factor 1 participants⁵¹ believing a lack of resources affected their practices (6.3.2). Funding cuts within Local Authorities in the UK are leading to time and resources having to be prioritised to key services, often away from environmental and biodiversity staff, and therefore resources for urban deer management are rare (Rotherham, 2015; Dick, 2019; Milne, 2021; Snell and Oxford, 2022). Consequently, asking more of Local Authorities for urban deer management, beyond their statutory duties through the Deer Code (2.5.1 and 6.5.1), could be unrealistic (Scottish Natural Heritage, 2012; Dick, 2019; Milne, 2021; Greenspace Scotland, 2022). There may be a mismatch between urban deer management goals and available resources, especially in urban areas where Local Authority spending decisions are often heavily criticised, which may limit their ability to invest in deer management (Davies and White, 2012).

Table 6.17: Data from expert interviewees on resources and support as barriers to Local Authority engagement with urban deer management.

Theme	Data and participant
A. Concern about limited resources	<p><i>“We’re seeing real cuts in the amount of resources going to ranger services across councils.”</i></p> <p>- Ms J, Academic</p> <p><i>“Local Authorities as everybody knows, have had their finances severely cut into... to the extent that they really can’t</i></p>

⁵⁰ Local Authorities were not asked how their experience or existing structures within their Local Authorities affected them managing urban deer.

⁵¹ Factor 1 participants were the one group who believed urban deer management was needed but were not undertaking it.

	<p><i>afford to do the things like picking up rubbish and managing waste. They can't do those so they aren't looking for new jobs. So, although they have a duty under the law to manage deer... they have no appetite for new tasks and so, you've got very little expertise within their officials."</i></p> <p>- Mr N, Non-Government Organisation</p> <p><i>"Everybody's really thinly spread. So when you get a thing that is really high on our agenda, but really low on a Local Authority's agenda, then they're not gonna give that the time that it needs."</i></p> <p>- Mr A, Government Organisation</p>
<p>B. NatureScot need to support Local Authorities</p>	<p><i>"I think NatureScot should be supporting them in this role. That's part of their role."</i></p> <p>- Mr F, Government Organisation</p> <p><i>"I think that probably comes back to NatureScot's role in this... they should probably provide clearer direction to the Local Authorities as to what their responsibilities are."</i></p> <p>- Mr P, Consultant</p>

A final barrier to Local Authority engagement which was identified by expert interviewees was a lack of support from NatureScot (Theme B, Table 6.17). The Local Authorities represented by Factor 1 agreed that they would like more support or guidance in managing urban deer.⁵² Given the very tight budgets which Local Authorities operate within, more time, money and support may be needed from NatureScot to help support urban deer management (Lowland Deer Panel, 2019; Scottish Natural Heritage, 2019a; Pepper, Barbour and Glass, 2019). However, NatureScot itself has a very tight budget, and with its priorities currently focussed elsewhere (5.3), more support may not be a realistic prospect. At the time this thesis was written, "a decade of austerity" was present in the UK, resulting in

⁵² The other two groups did not believe they needed more support or guidance, but these groups either did not think urban deer management was necessary or were already managing urban deer populations.

limited budgets for Local Authorities and government agencies, such as NatureScot, through reduced public spending (Elliott, 2023). Nevertheless, supporting and developing the role of Local Authorities is going to be necessary if they are to fulfil their perceived responsibilities for urban deer management.

7. What is needed to effectively manage urban deer in Scotland?

7.1. Introduction

Current urban deer management practices in Scotland are perceived to be insufficient by most experts in this study and within the existing Scottish literature (Pepper, Barbour and Glass, 2019; Scottish Government, 2021a). Consequently, to support more effective urban deer management, changes in practices are needed. Effective management includes keeping deer populations and impacts to 'acceptable' levels for the safety and wellbeing of the public, the health of the environment and the welfare of deer, while minimising stakeholder opposition against management actions. Firstly, this chapter discusses three factors that have emerged from this study which could impact the effectiveness of urban deer management in Scotland. It then proposes a policy framework for future effective urban deer management in Scotland and identifies priority areas for further research.

7.2. Factors impacting the effectiveness of urban deer management in Scotland

7.2.1. Developing context-specific management responses

Recognising and understanding the context-specific needs of urban deer management is essential to increase its effectiveness. The importance of context for urban deer management is multi-scalar, given that deer impacts, human interactions and management needs vary within and between urban areas, between rural and urban areas, and between countries.

Local contexts vary for wildlife and environmental management, with impacts and management needs affected by the local physical and social geography (Oppel *et al.*, 2018; Fattorini *et al.*, 2020; Ghisbain *et al.*, 2020; Sulis *et al.*, 2021). In this study, geographical differences in awareness and concern regarding impacts and views of and preparedness to undertake management were evident in the responses of the Local Authority and public respondents (6.3.2 and Appendices 13, 14 and 15). The varying nature of management needs across the country were also recognised by expert participants (4.5.5). Similar geographical differences are apparent in the USA, with Urbanek *et al.* (2012) recognising site-by-site differences in the suitability of management responses, contrasting levels of local deer pressures, and geographic variations in public perceptions of management methods. Contrasting views of culling and collaborative approaches to deer management have been observed in different areas of the USA (Kilpatrick and Walter, 1997; Fulton *et al.*, 2004; Raik, Siemer and Decker, 2005; Urbanek, Allen and Nielsen, 2011). Failing to recognise local differences in urban deer impacts, human perceptions and management needs, will lead to management responses which do not fully suit the local context, potentially limiting their effectiveness and risking increased stakeholder conflict.⁵³ Thorough understandings of local contexts are therefore required to support appropriate and effective urban deer management decision-making.

⁵³ For example, culling at night in an area with night-time mountain bikers may not be suitable due to increased safety risks, but this approach may be suited where night recreation is lower.

Differences also exist between urban and rural contexts for deer management. Deer management methods (e.g. culling and fencing) and principles (e.g. voluntary principle, low regulation) in Scotland are based on approaches used in rural upland settings and are not necessarily suited to urban management. Fragmented landholdings, greater safety concerns, risks of public opposition, different public perceptions of deer and impacts to rural areas, and concerns about the use of culling and fencing, are key differences between rural and urban areas. Therefore, different methods and greater regulation of urban deer management are likely to be required (outlined in 7.3). These differences are not accounted for in current deer management policies, legislation or guidance in Scotland, and so management approaches which are suited to urban contexts need to be developed. This has occurred in the USA, with the development of methods such as the use of trapping and dispatching, culling at night, fertility controls and bowhunting (Bomford and O'Brien, 1990; Cromwell, Warren and Henderson, 1999; Walker *et al.*, 2021). If urban-appropriate processes and practices are not put in place, there will be a greater chance of conflict over management decisions, risks to public safety and deer welfare, fragmented responses, or limited management. Urban-specific methods, legislation and guidance, therefore, need to be developed.

Differences between national contexts also need to be recognised to ensure that deer management meets national and local needs. Literature from the USA on urban deer and their management is uniquely well-developed, especially on methods evaluation and human perceptions and involvement, so is often drawn on to understand urban deer management in other nations (Dandy *et al.*, 2011; Duarte *et al.*, 2015; Honda *et al.*, 2018). However, it cannot be assumed that this international understanding is directly transferrable to other countries, as no two countries' deer scenarios are the same. For instance, differences exist between Scotland and the USA, with different deer populations and impacts, histories of interactions with deer, cultures around hunting, laws on management methods and differing training requirements, management responsibilities, structures and objectives (Messmer *et al.*, 1997; Dandy *et al.*, 2009, 2011; Putman, 2011; Hare, Daniels and Blossey, 2021). These differences are reflected in the contrasting views between the USA and this study regarding public perceptions of deer impacts (e.g. disease), for instance. Some management techniques are also not transferrable. For example, choosing to use

bowhunting because it is preferred in the suburban USA would be illegal in Scotland (Kilpatrick, LaBonte and Barclay, 2007). Country-specific understandings of urban deer management are therefore required.

For urban deer management in Scotland to be most effective, local understandings and responses need to be situated within the broader context of national and international deer/ wildlife/ environmental management literature, and in the context of existing Scottish environmental management structures and regulations, to ensure that management approaches are cohesive and not to the detriment of other priorities (Akasaka, Higuchi and Takamura, 2018; Jenkins, Horwitz and Arabena, 2018; Korfmacher, 2019). Although it cannot be assumed that all international, rural or local understandings are transferrable to urban deer management in every area of Scotland, the breadth of literature, policy and experience that stem from other contexts provides a valuable resource for better understanding and shaping Scotland's urban deer management. It is essential that these broader understandings and frameworks are used in conjunction with an understanding of the local geography, to develop context-specific management responses.

7.2.2. Developing stakeholder awareness to increase action and support

Limited stakeholder awareness is also likely to affect the success of urban deer management in Scotland, with higher awareness and involvement believed to generate greater understanding of deer impacts, support and understanding of management decisions, and increased action regarding deer management (Connelly, Decker and Wear, 1987; Lauber and Knuth, 2000b; Stewart, 2011; Whitefield *et al.*, 2021). Knowledge and awareness levels regarding urban deer are low amongst the (primarily rural) deer expert, Local Authority and public participants (4.2; 6.2.1). This reflects the shortage of expertise on urban deer and poor levels of environmental knowledge amongst the general public more broadly (Bebbington, 2010; Granville, 2020; Gosler and Tilling, 2022), but support for public involvement and education is high (Figure 6.6). Stakeholders in this study with higher knowledge or experience with deer were more supportive of management practices (especially lethal methods) or already acting to manage urban deer (5.4.3; 6.4 and 6.6.3). In

the USA, greater support for lethal methods and management decisions has been found where public knowledge-raising or involvement initiatives have occurred (Messmer *et al.*, 1997; Siemer *et al.*, 2004; van der Wal *et al.*, 2014). Knowledge-raising through education and involvement is not only needed amongst the public in Scotland, but also amongst those responsible for urban deer management (such as Local Authorities), to help increase their understanding of deer, awareness of their responsibilities and action. The Scottish Government (2021a) has called for education on urban deer management of the public and of Local Authorities, which could help increase the effectiveness of management actions by improving understanding.

A variety of educational and participatory methods can be utilised to increase stakeholder understanding and action in environmental management (Reed *et al.*, 2018). Engagement methods are typically thought of as a hierarchical ladder, with co-productive/ collaborative methods ranked more highly than solely educational or consultative measures (Arnstein, 1969). Recently, however, this hierarchical view has been contested, recognising that different types of participation suit different contexts and stakeholders (Reed, 2008; Reed *et al.*, 2018). Within urban deer management in Scotland, varying approaches are likely to be needed depending on the stakeholders involved (e.g. the public, Local Authorities, NatureScot) and the stages of engagement (e.g. to raise awareness before impacts appear, when management decisions are needed) to support effective practices.

Substantial gains for urban deer management, including reduced conflicts and increased action, can be made by investing in education (e.g. through informational material, presentations, training) (Green, Askins and West, 1997a; Messmer *et al.*, 1997; Lauber and Knuth, 2000b; van der Ploeg *et al.*, 2011; Le Bel *et al.*, 2011; Chase Grey, Bell and Hill, 2017). Education is needed between NatureScot and Local Authorities, and between Local Authorities and/or NatureScot and the public, to increase support, understanding and action towards effective urban deer management. Education of the public has already occurred on a small scale in Scotland. For example, the Deer on Your Doorstep campaign utilised posters to communicate about the risks of deer in urban areas, and signage around areas of high DVCs has also been used (Lowland Deer Panel, 2019; Pepper, Barbour and Glass, 2019). However, it is unclear how effective these practices have been at changing

views or actions (Hedlund *et al.*, 2004; Sullivan *et al.*, 2019). Assessments of the efficacy of educational methods are rare within human-wildlife conflict literature, but no single approach is thought to always be most effective at fostering support for management actions (Espinosa and Jacobson, 2011). However, ensuring that education provides transparency over how decisions are made, and that it is proactive, well-planned, interactive, and also tailored to the concerns, needs and values of its audience has been found to be the most effective way to use education to influence attitudes and support action in conservation (Lauber and Knuth, 2004; Jacobson, 2010; van der Ploeg *et al.*, 2011; Knackmuhs and Farmer, 2017; Ardoin, Bowers and Gaillard, 2020). Educational initiatives, designed with the above factors in mind, could prove beneficial for supporting effective urban deer management in Scotland.

Participatory approaches, which involve a range of stakeholders in decision-making (either in discussions before decisions are made, or involved in making the decision themselves), are believed to support effective deer management by co-producing mutually supported responses, thereby reducing the likelihood of public opposition and increasing trust in decision-making (Decker and Bath, 2010). Participation can also increase education and awareness of topics, helping to reduce conflict through greater knowledge and increased ownership (Larson *et al.*, 2016). In the USA, participatory approaches used in urban deer management have included town hall events, citizen science, advisory groups, community-based deer management, Citizen Task Forces⁵⁴ and public votes (Stout *et al.*, 1996; Steelman and Ascher, 1997; Decker, Raik and Siemer, 2004). In Scotland, participatory approaches could be used by Local Authorities and/or NatureScot to include the public in decision-making, or between Local Authorities and other stakeholders (e.g. NatureScot, Lowland Deer Network, other Local Authorities) to work collaboratively. Ensuring participatory approaches support open discussion, involve stakeholders early, are democratic, cost-effective and involve learning, has been shown to make them most effective at coming to supported decisions (Raik *et al.*, 2005; Chase, Decker and Lauber, 2010; Decker and Bath, 2010; Staddon, 2021). Approaches which are too time-consuming,

⁵⁴ Citizen Task Forces are where representative nominated volunteers from the local community are brought together over consecutive meetings to discuss and agree on population management objectives and regulations. They are given information to help inform their views.

led by power dynamics, and where facilitators are able to manipulate outcomes (e.g. shaping final decisions with their own beliefs, rather than ensuring outcomes reflect the views of all participants, or selecting participants with a particular viewpoint), can lead to increased conflict and greater public opposition than if processes had not occurred (Baker and Fritsch, 1997; Raik *et al.*, 2005; Decker and Bath, 2010). As with educational methods, no single participatory approach is always better than another at leading to effective management outcomes (Decker and Bath, 2010). Both educational and participatory approaches could increase stakeholder awareness of urban deer management and help to gain support for management decisions and provoke action, if selected and designed carefully.

7.2.3. Filling gaps in data and research

Reliable research and data are needed to inform urban deer management decision-making so that decisions are based on evidence, which can increase trust and lead to more appropriate and effective management (Pullin *et al.*, 2004). There is a severe lack of data and research regarding urban deer in Scotland, been evidenced throughout this thesis (2.1; 4.4; 4.5.6). This hampers decision-making as it is not possible to have a fully informed understanding of the urban deer situation within Scotland, as their numbers, locations, impacts and interactions are not fully understood (Conde *et al.*, 2019). Where research and data are not available, greater use is made of informal knowledge sources, such as decision-makers' own experiences, to inform decisions (Fazey *et al.*, 2006; McKinley *et al.*, 2017; Kadykalo, Cooke and Young, 2021). However, these evidence sources are often regarded by the public and experts as anecdotal and may lead to ill-informed management decisions which may be subject to critique and increased likelihood of stakeholder opposition (Carneiro and da-Silva-Rosa, 2011; Sutherland *et al.*, 2014; Tingley, Meiri and Chapple, 2016). Considering Local Authorities may play a bigger role in urban deer management in Scotland, and there is high support of the public being informed (6.5.1), opportunities for scrutiny of decisions may be increased compared to rural deer management. More evidence-informed urban deer management is therefore needed to support rigour of decision-making, for instance through the creation of thresholds and decision support frameworks for deciding when urban deer management is needed, like that suggested by

Dandy *et al.* (2009). This study proposes many areas for further research, detailed in section 7.4, and ways in which this research and data could be gathered are highlighted below.

Urban deer data are currently in a catch-22 in Scotland. Because of the limited evidence, it is challenging to decide whether urban deer in Scotland are sufficiently problematic to need managing, but likewise, the lack of knowledge makes it difficult to justify increased funding for data collection and research. Nevertheless, if urban deer management is to be improved, there is no doubt that more data are needed, and there are a variety of ways in which the knowledge-base could be increased. Greater levels of data collection by those responsible for managing urban deer (e.g. NatureScot and Local Authorities), alongside increased research funding (from NatureScot, the Scottish Government or other funders) would be ideal for increasing the knowledge-base. However current governmental resource constraints may make this unlikely, especially considering NatureScot's budget has decreased year on year since 2020⁵⁵, and/ or would require resources to be redistributed, perhaps from the extensive funds currently spent on counting upland red deer⁵⁶ (6.6.3) (Buechley *et al.*, 2019; Dick, 2019; Snell and Oxford, 2022). Initial attention from the Government could, however, be a catalyst for further research and funding.

Consolidating and collating existing data may also provide a useful source of evidence (Fazey *et al.*, 2013). Where the impacts of deer are recognised, there are opportunities for data to be collected. For example, deer carcasses are removed from roads after DVCs, anti-social behaviour and welfare concerns are reported, and the NHS diagnoses incidences of Lyme disease. However, at present these disparate data sources are not collated (Scottish Government, 2014). For DVC data, for instance, data sources include the SSPCA, Forestry and Land Scotland, Police Scotland, Trunk Road Operating Companies, deer experts and the public (Langbein, 2019). These data are not collected systematically, meaning that some interactions are not recorded at all or could be duplicated. A central system pooling these knowledge sources facilitated by NatureScot could provide a useful evidence base for

⁵⁵ From 2020-21, NatureScot's cash grant-in-aid was £53.741 million. This reduced to £48,809 million in 2021-22 and to £47.411 million in 2022-23. This is despite inflation and rising costs (NatureScot, 2023).

⁵⁶ These current practices have been recognised as inefficient, with studies currently taking place into replacing helicopters with drones, to reduce costs and carbon emissions (NatureScot, 2022c)

understanding frequencies and locations of impacts. This could provide greater insight as to how and where deer need to be managed, leading to more informed urban deer management decision-making. It is unknown how data on urban deer is collected in other countries.

Citizen science could also improve the knowledge base for urban deer management. Many urban environmental management, human-wildlife conflict and conservation citizen science studies have taken place across the world (Toomey and Domroese, 2013; Paul et al., 2014; Larson et al., 2016; Seifert et al., 2016; Hsing et al., 2020; MacPhail and Colla, 2020; Curtis et al., 2021). The use of citizen science has previously been recommended to NatureScot, based on its successful use for other wildlife management issues, including in conservation (Cooper *et al.*, 2007; McMorrán, Gibson-Poole and Hamilton, 2019; Ostermann-Miyashita, Pernat and König, 2021). Such projects could systematically collect data on deer sightings and impacts within urban areas, such as the citizen science project used to estimate deer presence in suburban areas of the UK reported by Rotherham and Walker (2015). Much larger volumes of data can be collected through well-designed citizen science projects, more cost-effectively than using government researchers (Conrad and Hilchey, 2011; Bonney *et al.*, 2014; Anton *et al.*, 2018). Although careful study design is needed to ensure data quality, citizen science projects could be well-suited to urban deer management and would help address gaps in data (Conrad and Hilchey, 2011; McKinley *et al.*, 2017). This has the potential to aid understanding of urban deer interactions with minimal resource, whilst providing an opportunity to educate and involve the public in urban wildlife management, in turn helping to further legitimise and support effective urban deer management decision-making.

7.3. Towards effective urban deer management in Scotland

This section presents a policy framework for urban deer management in Scotland, proposing recommendations concerning the responsibilities, legislation and guidance outlined in Chapter 2 to better reflect the requirements of urban deer management in Scotland.

7.3.1. Responsibilities

Suggested changes to the responsibilities of key stakeholders in urban deer management in Scotland are outlined below. Figure 7.1 presents a simple conceptual graphic representing the primary relationships between the proposed key stakeholders.

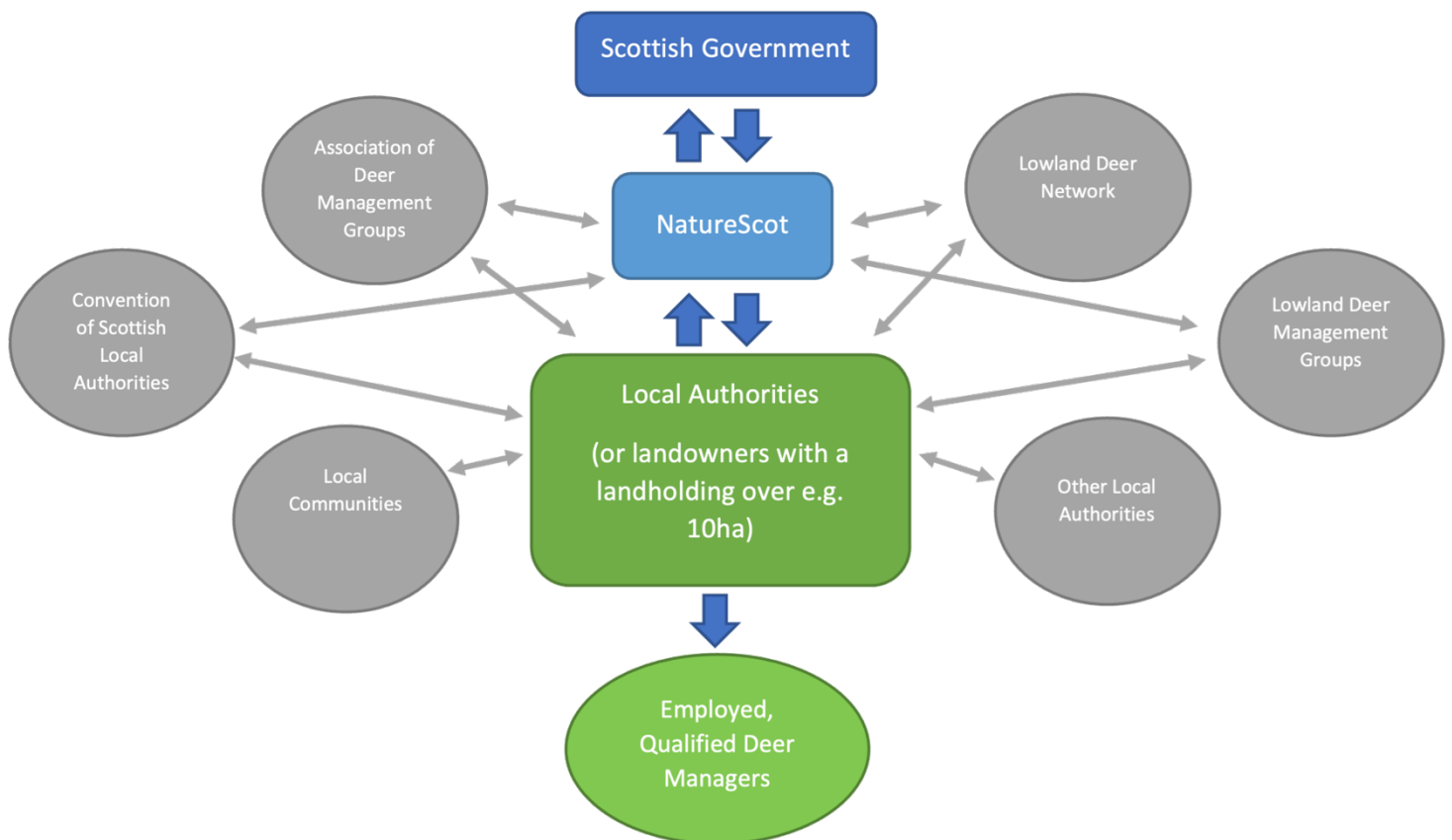


Figure 7.1: Proposed responsibilities for urban deer management in Scotland. NatureScot should retain overall responsibility for urban deer management and report to the Scottish Government. Local Authorities should be responsible for managing urban deer across urban areas, except for where landholdings are especially large (e.g. above 10ha). Employed and qualified deer managers should be used to manage deer. The grey circles represent wider stakeholders who should be involved in urban deer management through collaboration, consultation or education, with grey arrows indicating interactions between them and those responsible for management.

7.3.1.1. Scottish Government

The Scottish Government need to ensure that NatureScot dedicates appropriate resources to urban deer management according to the level of impacts and risks in each urban area. If urban deer are going to be managed effectively, the Scottish Government should increase resources to research, NatureScot and Local Authorities, to facilitate a greater understanding of urban deer populations, impacts, interactions and support effective management.

7.3.1.2. NatureScot

NatureScot should be more proactive at exercising its responsibilities for urban deer across Scotland, increasing resources dedicated to managing urban deer to reduce impacts on deer, the environment and humans, although this will be constrained by their already tight budget. Given the clear differences between the rural and urban contexts for deer management, it would be beneficial for NatureScot to put appropriate policies and guidance in place to suit these contexts and increase its support of Local Authorities (and other large landowners) to undertake urban deer management. Where Local Authorities are failing to undertake sufficient urban deer management, NatureScot must ensure this takes place using its control powers. NatureScot should be responsible for collating existing data on deer impacts from organisations which collect it (e.g. NHS, SSPCA, police), to provide a more comprehensive dataset of deer impacts across the country. It would be beneficial to develop and publish advice on how to measure urban deer populations and impacts and define how regularly data on urban deer populations and impacts in Scotland need to be collected by Local Authorities and other large landowners. NatureScot must also pay more attention to welfare impacts on deer in urban areas to quantify these effects. A register of deer managers qualified to manage deer within urban areas, managed by NatureScot and accessible to Local Authorities, would be beneficial. Finally, NatureScot should be responsible for providing national public educational resources about urban deer, to increase awareness of their impacts and management.

7.3.1.3. Local Authorities

The findings of this thesis suggest that Local Authorities should be made responsible for collecting data, monitoring and managing deer across urban areas (except where individual landholdings are above 10ha⁵⁷, for example) to tackle the current fragmented approach to urban deer management. They need to be supported by NatureScot (both financially and through advice) as otherwise they will not be able to fulfil this role due to their tight resources and lack of experience in many cases regarding urban wildlife. Local Authorities need to work with the other stakeholders represented in Figure 7.1 to provide a collaborative approach to urban deer management within their authority and across Scotland. It would be beneficial if they communicated with the public about urban deer management activities, including through consultation and education, to gain local support for management actions. Local Authorities should utilise employed, qualified deer managers to manage deer within their areas.

7.3.2. Legislation

There is a need for legislation to be updated to support effective urban deer management in Scotland, as the current Acts are outdated and rural upland focussed. The changes to the Deer Act should be undertaken in consultation with relevant deer authorities. Urban, peri-urban and rural deer populations must be defined in the Deer Act, as their populations, impacts and management needs are often different. The Deer Act should be updated to include considerations for urban deer and their management throughout, as currently they are not considered, and this could cause adverse effects if they are managed in line with the current Deer Act. This should include an awareness of the range of potential impacts on/ of urban deer, the environment and humans, and management methods which are suited to managing deer in urban environments. It must be made clear where all deer are being referred to, or just urban or rural deer populations. The updated responsibilities for urban deer management (especially greater responsibilities of NatureScot and Local Authorities, taking away responsibilities from small landowners such as householders), including a clear

⁵⁷ Areas >10ha are classed as large land areas within the Best Practice Guides (Scottish Natural Heritage, no date a) and could be a suitable size for landowner responsibility, but the size of landholding where landowners become responsible for deer in urban areas should be further considered.

and defined protocol for dispatching urban deer, need to be published in the Deer Act, so that it is simple to see who is responsible for deer and their impacts, as the current reliance on landowners does not suit the urban context. Additionally, the Deer Act should be updated to state that Deer Management Qualifications are mandatory for all people managing deer in urban area, and that these qualifications must include information on managing urban deer or the Act should support the creation of separate urban deer management qualifications. This is to ensure that those managing urban deer have the knowledge and skills to do so, as management methods currently taught in existing qualifications may not suit urban areas. The Deer Act and Firearms Act need to be updated to permit methods of deer management which are suited to urban environments (e.g. suitable firearms, culling at night, trapping and killing, fertility controls), so that urban deer can be managed using measures which are suited to the urban environment. Finally, the Firearms Act may also need to be updated, to allow deer to be culled in urban areas without special authorisation, so that special permission is not always needed to cull urban deer.

7.3.3. Guidance documents

Scotland's Wild Deer: A National Approach, the Deer Code and Best Practice Guides need to include a greater focus on urban deer management, reflecting the changes to responsibilities and legislation suggested above. Scotland's Wild Deer: A National Approach should detail clear goals for managing urban deer in Scotland, created by NatureScot and the Scottish Government. The Deer Code should either be updated by NatureScot to reflect the practicalities of urban deer management, or a new Urban Deer Code should be created. An Urban Deer Code must include a decision support framework or thresholds for managing deer in urban areas, information about education and consultation strategies, and data collection information. Best Practice Guides should include more practical information for those undertaking urban deer management, highlighting how it differs to rural environments, including a greater focus on all potentially suitable methods of deer management. Inspiration could be sought from the US for the creation of these guides, with the Association of Fish and Wildlife Agencies having produced an extensive document on managing deer in populated areas (Association of Fish and Wildlife Agencies, no date).

7.4. Further research

Based on the lessons and limitations synthesised above, this section identifies five areas for future research which could help support more effective urban deer management: urban deer populations, impacts, management, stakeholder involvement and perceptions, and interdisciplinary studies.

Firstly, more research is needed surrounding urban deer populations and their movement. No research in Scotland or elsewhere has focussed on how or why deer enter urban areas, although this study (4.4.2) and others (2.4) have provided some insights. Studies need to take place to further understand what is driving or attracting deer into urban areas, which pathways are being used and where they are residing, to establish a fuller picture of urban deer on a local and national level. As there are difficulties counting urban deer (4.4.1), research needs to be undertaken to further develop and evaluate existing (Fitzpatrick, 1998; Drake, Aquila and Huntington, 2005; Hodnett, 2005; Roberts *et al.*, 2006; NatureScot, 2022b) and new surveying methods which are appropriate to the Scottish urban context to evaluate whether urban deer populations are growing, and the need for or effectiveness of management.

Research is lacking on all impacts of urban deer, but especially regarding their environmental effects (including areas to which people have strong emotional attachments) and impacts on deer welfare. Research on other urban wildlife has noted that urban species consume human food and waste (Contesse *et al.*, 2004; Lowry, Lill and Wong, 2013; Soulsbury and White, 2015) and that urbanisation can negatively impact wildlife health (Murray *et al.*, 2019). As many concerns were raised regarding deer welfare (4.3.2; 4.5.4; 5.2.2; 5.4.2), a greater understanding of these impacts is needed. Given the debates over the relationship between Lyme disease cases and deer (Gilbert *et al.*, 2012; Putman *et al.*, 2014), and whether this is a concern in urban areas (4.5.3), more research needs to be undertaken to gain a better understanding of this relationship.

Additionally, research is needed to understand where and when urban deer management is required, and at which levels of impacts, to inform the creation of deer impact and

management thresholds (Watson *et al.*, 2009) or decision support frameworks (4.5.5) (Dandy *et al.*, 2009) suited to urban environments. Methods of urban deer management also need to be better understood. Although extensive research has been undertaken on individual methods in the USA (2.6; 5.4), this is not the case in Scotland, where methods still need to be evaluated to inform decisions in the Scottish urban context. As there is a recognised need for collaboration (6.5.1) between NatureScot, Local Authorities and other landowners within urban deer management, better understanding of how this could be facilitated within Scotland's urban areas is necessary. Additionally, with the role of Local Authorities in urban deer management recommended to increase (2.3.1.3; 6.5; 7.3), the role of electorate support and politics in their ability to undertake urban deer management needs to be understood, as this could prove to be a limiting factor on management activities.

As the need for public (and other stakeholder) awareness and involvement in urban deer management has been recognised (6.5.1; 7.2.2), a systematic study is required on the range of engagement strategies used in urban wildlife management and their effectiveness at increasing awareness and consensus-building. Additionally, although extensive research exists on how to use citizen science effectively (Cooper *et al.*, 2007; MacPhail and Colla, 2020; van Noordwijk *et al.*, 2021), research is needed to understand how this could be best utilised to support urban deer management in Scotland. Although this study has provided insight into stakeholder views of urban deer management, further research should be undertaken with a wider sample of the population and interested stakeholders to understand their views on urban deer. Additionally, studies on how these views are shaped need to be undertaken, including more in-depth studies about the effects of knowledge or information provision on support for management decisions (7.2.2).

Finally, more broadly, more interdisciplinary studies are required not only on urban deer management in Scotland but on wildlife and environmental management internationally. Integrating ecological and sociological data is necessary to fully understand the interactions between humans and the environment, especially within urban areas where these are so frequent, and on the management of these interactions (White *et al.*, 2010). Although this may present challenges associated with interweaving multiple epistemologies and

disciplines (Pricope *et al.*, 2019), rural interdisciplinary studies do exist (Dorresteijn *et al.*, 2014; Kiffner *et al.*, 2021), and their suitability for further understanding urban human-environmental interactions should not be ignored.

8. Conclusion

8.1. Introduction

As no previous research has focussed explicitly on deer in heavily built-up urban areas of Scotland, this thesis addresses significant gaps in understanding regarding public, local government and expert perceptions of urban deer and their management, alongside the role of and obstacles to the engagement of Local Authorities in Scotland. This thesis has generated new data concerning the role of Local Authorities in urban deer management, utilising a novel research method (Q-methodology), and understanding the views of a usually untapped audience in environmental research (local councillors). This new understanding will help to inform future policymaking on the subject. In doing so, this research contributes novel insights on a topic which has attracted only geographically-limited attention in the international wildlife and environmental management literature thus far.

8.2. Summary of main findings: addressing the research questions

This research strengthens existing evidence that deer are viewed positively in Scotland, with their urban presence presenting a unique opportunity to view large wildlife close to home (RQ1 and RQ8). Although there were contrasting views amongst stakeholders as to whether urban deer numbers are too high, experts recognised that urban deer populations are increasing across the country, with some populations at sufficiently high densities to require management (RQ2 and RQ8). Perceptions of deer impacts varied considerably. All stakeholders recognised the risk of DVCs and threats to animal welfare, but there was minimal public awareness of potential human health risks, and limited attention given by the experts to environmental impacts (RQ3 and RQ8). This contrasts with rural norms.

Despite uncertainties regarding deer populations and impacts, this research indicates a broad consensus that urban deer in Scotland do need to be managed, even though data on their populations is lacking (RQ4 and RQ8). Current urban deer management practices in Scotland are considered insufficient, and critical views were expressed over the limited

attention it has received hitherto by NatureScot and Local Authorities (RQ5 and RQ9). However, there is much less consensus over how urban deer should be managed. Amongst those stakeholders with the most experience of deer (such as experts and Local Authorities already managing deer), there is a clear preference for lethal management, whereas those with less experience preferred non-lethal methods (RQ6 and RQ8). Many differences between urban and rural deer management were recognised: fragmented landholdings (such as in dense housing areas) and increased public presence represent barriers to effective urban deer management. As a result, established rural methods and responsibilities are likely not suited to the urban context and urban-specific processes therefore need to be developed (RQ7).

Overall, there was a widely shared view that Local Authorities should take responsibility for urban deer management, not only on their own land but also beyond their landownership, although there was no consensus over the latter between Local Authorities (RQ9). Potential obstacles to Local Authority participation and leadership include concerns about safety, public, councillor and Local Authority decision-maker perceptions, and a lack of resources, experience and support, although again these varied in importance between Authorities (RQ10). These obstacles will need to be addressed if Local Authorities are going to be able to effectively participate in urban deer management in Scotland.

Three over-riding factors were identified as impacting the effectiveness of urban deer management in Scotland: there is a need (i) for context-specific management responses, (ii) for greater awareness, education and involvement to increase action and support for management responses, and (iii) for extensive research and data gaps to be filled. With currently no clear responsibilities, legislation, guidance, thresholds for management and limited guidance, data and research for urban deer management in Scotland, these gaps are likely to be limiting the effectiveness of management responses. This thesis presents a policy framework to support more effective urban deer management in Scotland and suggests a range of avenues for further research.

8.3. The value of Q-methodology in wildlife research

Q-methodology is well-suited to understanding detailed stakeholder perspectives on complex environmental, conservation and human-wildlife management conflicts (Rust, 2017; Zabala, Sandbrook and Mukherjee, 2018; Read, Mawaskar and Habib, 2019; Bavin *et al.*, 2020) and has the potential to be more widely applied in this context. This is the first known study to employ Q-methodology to understand perceptions of deer management. Q-methodology has proved a valuable method for understanding Local Authority viewpoints regarding urban deer as a whole. In particular, it enabled groups of Local Authorities with similar experiences and viewpoints to be identified, thus providing clearer insight into areas of consensus and contestation (Zabala, Sandbrook and Mukherjee, 2018). Knowing that groups with similar beliefs exist, and how these differ, can enable different approaches and support to be targeted to them. This should benefit urban deer management in Scotland - and human-wildlife conflicts more broadly - as a deeper understanding of groups of perspectives can enable tailoring of effective and efficient support and provide an opportunity for groups with different viewpoints to learn from others. The process itself can also enable stakeholder learning about the topic of interest, as the sorting process sets out all perspectives on a subject in a transparent manner, which can help to overcome management conflicts and increase engagement with the topic (Zabala, Sandbrook and Mukherjee, 2018; Bavin *et al.*, 2020). For these reasons, Q-methodology is a useful tool within the wildlife manager's toolbox for understanding stakeholders' often diverse and sometimes conflicting viewpoints.

8.4. Concluding remarks

This research has improved our understanding of perceptions of urban deer and their management in Scotland, including the involvement of Local Authorities, which should help to support, inform and improve future urban deer management practices and policymaking across the country. The extensive data received from Local Authorities and local councillors provides a new insight into the topic. The research has also highlighted the value of Q-methodology for understanding views on wildlife management. The findings can help policymakers to prepare proactively for growing urban deer populations before their

populations and impacts become more pressing. Urban deer populations need to be on the policy agenda if they are to be managed effectively, for the benefit of deer, the environment and people, and not simply be subsumed within existing policies for upland deer, where cultural histories and tradition have long defined the political agenda for Scottish environmental management. However, it is recognised that the policy agenda is a competitive place to be, and although urban deer may be perceived in this study to need to be managed, other political and funding priorities may limit this occurring in the future.

This research has highlighted the importance of urban wildlife research in an increasingly urbanised world. Urban wildlife are valued, and can benefit the environment and humans in urban areas. Within society-nature interactions, humans and wildlife both have a part to play, and understanding human perspectives and ecology is therefore important for informing suitable management practices and approaches. The social sciences play a key role in understanding perspectives and informing practices regarding environmental management. As humans increasingly urbanise rural landscapes, it is essential that efforts are made to understand, plan and provide legislation for urban wildlife and their management, for the health of humans, the environment and - as is often forgotten - the wild animals themselves.

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10. Appendices

Appendix 1: The main functions of Acts related to deer management in Scotland.

Table 10.1: The main functions of Acts related to deer management in Scotland.

Act	Main Functions
Deer (Scotland) Act 1959 (UK Parliament, 1959)	<ul style="list-style-type: none"> • Creates the Red Deer Commission. • Introduces control measures and close seasons. • Prohibits poaching of deer. • Introduces offences regarding unlawful taking or killing of deer.
Deer (Scotland) Act 1996 (UK Parliament, 1996)	<ul style="list-style-type: none"> • Converts the Red Deer Commission into the Deer Commission for Scotland. • Creates deer panels. • Alters close seasons. • Introduces control agreements and control schemes. • Introduces emergency measures for dealing with problematic deer. • Expands offences in relation to the killing of deer. • Introduces licenses for dealing in venison. • Includes interests in natural heritage.
Public Services Reform (Scotland) Act 2010 (Scottish Parliament, 2010)	<ul style="list-style-type: none"> • Makes the Deer Commission for Scotland part of Scottish Natural Heritage⁵⁸.
Wildlife and Natural Environment (Scotland) Act 2011 (Scottish Parliament, 2011)	<ul style="list-style-type: none"> • Includes a need to manage peri-urban and urban deer. • Includes concerns regarding public safety. • Introduces a code of practice (the Deer Code). • Alters control agreements and control schemes. • Gives permission for a register of persons competent to shoot deer to be created.

⁵⁸ Since 2020, Scottish Natural Heritage has been known as NatureScot.

	<ul style="list-style-type: none"> • Requires review of competence of those who manage deer. • Introduces action intended to prevent suffering of deer.
<p>Land Reform (Scotland) Act 2016 (Scottish Parliament, 2016)</p>	<ul style="list-style-type: none"> • Repeals the exclusion of deer forests and shootings from the valuation roll. • Introduces additional functions under deer panels. • Requires NatureScot to review the Deer Code every three years. • Introduces a requirement for deer management plans. • Requires return of number of deer culled.

Appendix 2: Details of the three main guidance documents for deer management in Scotland.

Table 10.2: Details of the three main guidance documents for deer management in Scotland.

Guidance document	Content
Best Practice Guides (2008 – Present) (Best Practice Guides, 2019)	<ul style="list-style-type: none"> • Developed by NatureScot and the wider deer sector. • 74 Best Practice Guides which are added to as new guidance develops. • Principal source of practical guidelines for deer managers. • Aim to help safeguard public safety, food safety and take account of deer welfare. • Supposed to be easily accessible to the deer sector, to improve quality of deer management.
Scotland’s Wild Deer: A National Approach (2008 and 2014) (Scottish Government, 2008)	<ul style="list-style-type: none"> • Created by the Deer Commission for Scotland and the wider deer sector. • Set out guiding principles, objectives, actions and tools for sustainable deer management. • Updated in 2014 to set a vision for the years 2015-2020. • Main priorities for 2015-2020 were around collaboration; effective deer management planning and implementation; healthy ecosystems; lowland and urban deer; economic and community development; deer welfare and stalker training. • Due to be updated.
Deer Code (2012) (Scottish Natural Heritage, 2012)	<ul style="list-style-type: none"> • Produced by NatureScot as a requirement of the Wildlife and Natural Environment (Scotland) Act 2011. • Outlines what landowners must, should and could do to manage deer sustainably.

	<ul style="list-style-type: none">• Describes when NatureScot may seek to use control agreements and control schemes.• Outlines the importance of deer management planning and collaboration.• Describes the importance of public interests.• Aimed at land managers and stalkers.• NatureScot can decide on interventions based on the Code.
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Appendix 3: Letter of ethical approval

School of Geography and Sustainable Development Ethics Committee

04 August 2022

Dear Abigail

Thank you for submitting your ethical application which was considered at the School Ethics Committee meeting on 19th August 2020.

The School of Geography and Sustainable Development Ethics Committee, acting on behalf of the University Teaching and Research Ethics Committee (UTREC), has approved this application:

Approval Code:	15067	Approved on:	3 rd September 2020	Approval Expiry:	3 rd September 2025
Project Title:	Developing Policies for Managing Deer in and Around Towns in Scotland: Understanding Perceptions to Shape Policymaking				
Researcher(s):	Abigail Whitefield				
Supervisor(s):	Dr Charles Warren and Dr Althea Davies				

The following supporting documents are also acknowledged and approved:

1. Participant Information Sheet
2. Participant Consent form
3. Questionnaire/online survey screenshots
4. Interview Questions/focus group guide

Approval is awarded for 5 years, see the approval expiry data above.

If your project has not commenced within 2 years of approval, you must submit a new and updated ethical application to your School Ethics Committee.

If you are unable to complete your research by the approval expiry date you must request an extension to the approval period. You can write to your School Ethics Committee who may grant a discretionary extension of up to 6 months. For longer extensions, or for any other changes, you must submit an ethical amendment application.

You must report any serious adverse events, or significant changes not covered by this approval, related to this study immediately to the School Ethics Committee.

Approval is given on the following conditions:

- that you conduct your research in line with:
 - the details provided in your ethical application
 - the University's [Principles of Good Research Conduct](#)
 - the conditions of any funding associated with your work
- that you obtain all applicable additional documents (see the ['additional documents' webpage](#) for guidance) before research commences.

You should retain this approval letter with your study paperwork.

Yours sincerely,

Dr Antje Brown

SEC Convener

School of Geography & sustainable Development Ethics Committee

Dr Antje Brown, Irvine Building, North Street

Telephone: 01334 463934 Email: ggethics@st-andrews.ac.uk

The University of St Andrews is a charity registered in Scotland: No SC013532

Appendix 4: Expert interview participant information sheet



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Participant Information – Expert Interviews

**Developing Policies for Managing Deer in and Around Towns in Scotland:
Understanding Perceptions to Shape Policymaking**

Abigail Whitefield

What is the study about?

I invite you to participate in a research project about deer management in and around towns in Scotland. This project aims to examine public, expert and policymaker (local authority) perceptions of deer and deer management in and around towns. This project hopes to use these perceptions to help shape local authority policymaking.

Why have I been invited to take part?

You have been invited to take part because you have expert knowledge of deer management. We want to understand more about your thoughts around the need for the management of deer in and around towns, local authority involvement in deer management in and around towns, and any perceptions, understandings and barriers to the effective management of urban deer that you can identify.

Do I have to take part?

This information sheet has been written to help you decide if you would like to take part. It is up to you and you alone whether you wish to take part. If you do decide to take part you will be free to withdraw at any time without providing a reason, and with no negative consequences.

What would I be required to do?

You will be required to complete an online interview, which is expected to last between 30 minutes and 1 hour.

Are there any risks associated with taking part?

There are no anticipated risks to you throughout the research process, however some of the data you provide may be attributable to you.

Informed consent

It is important that you are able to give your informed consent before taking part in this study and you will have the opportunity to ask any questions in relation to the research before you provide your consent.

Who is funding the research?

My research is being funded by a scholarship from the University of St Andrews.

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Compensation

There is no direct reward or compensation for taking part in this research process.

What information about me or recordings of me ('my data') will you be collecting?

I will be collecting information about your understanding, barriers to and perceptions of deer management in and around towns via paper notes and audio recordings. I will not be collecting any personal information about you.

How will my data be securely stored, who will have access to it?

Your data will be stored in a pseudonymised form, which means that your data will be edited so that you are referred to by a unique reference such as a code number or different name, and the original data will remain accessible only to the researcher and her supervisors. Your data will be stored on an online password-protected storage cloud, and only the researcher will be able to access it. There will be a 'key' document, which will link your unique reference to your real identity. The key will be kept on an online password-protected storage cloud, and only the researcher will have access to it and be able to reconnect your data to you at a later date.

Audio recordings will be taken on an encrypted device and transcribed at the earliest opportunity before being archived for future use.

How will my data be used, and in what form will it be shared further?

Your research data will be analysed as part of the research study. It will then be published in my PhD thesis and any other resulting publications.

When shared, your data will be in a pseudonymised form, which means that your data will be edited so that you are referred to by a unique reference such as a code number or different name. Your identity will be pseudonymised but could be evident from your views or position.

It is expected that the project to which this research relates will be finalised by October 2022.

When will my data be destroyed?

The data held by the researcher will be converted into an anonymous format following submission of this thesis and kept indefinitely in accordance with the safeguards detailed by law, with all un-anonymised data destroyed.

Will my participation be confidential?

Your participation will be known to the researcher and her supervisors. You will be kept pseudonymised to the readers of the thesis, but you may be identifiable because of your views or role. If you participate in a workshop at a later date, you will be identifiable to the other participants in this study.

Use of your personal data and data protection rights

The University of St Andrews (the 'Data Controller') is bound by the UK 2018 Data Protection Act and the General Data Protection Regulation (GDPR), which require a lawful basis for all processing of personal data (in this case it is the 'performance of a task carried out in the public interest' – namely, for research purposes) and an additional lawful basis for processing personal data containing special characteristics (in this case it is 'public interest research'). You have a range of rights under data protection legislation. For more information on data protection legislation and your rights visit <https://www.st-andrews.ac.uk/terms/data-protection/rights/>. For any queries, email dataprot@st-andrews.ac.uk.

You will be able to withdraw your data before October 2020. If your data is anonymised, we will not be able to withdraw it, because we will not know which data is yours.

Ethical Approvals

This research proposal has been scrutinised and subsequently granted ethical approval by the University of St Andrews Teaching and Research Ethics Committee.

What should I do if I have concerns about this study?

In the first instance, you are encouraged to raise your concerns with the researcher. However, if you do not feel comfortable doing so, then you should contact my Supervisor or School Ethics Contact (contact details below). A full outline of the procedures governed by the University Teaching and Research Ethics Committee is available at <https://www.st-andrews.ac.uk/research/integrity-ethics/humans/ethical-guidance/complaints/>.

Contact details

Researcher(s)	Abi Whitefield	Supervisor(s)	Dr Charles Warren Dr Althea Davies
	aw241@st-andrews.ac.uk	Contact	crw2@st-andrews.ac.uk ald7@st-andrews.ac.uk

Appendix 5: Consent form used for expert interviewees and Local Authority Q-methodology participants



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Consent Form

**Developing Policies for Managing Deer in and Around Towns in Scotland:
Understanding Perceptions to Shape Policymaking**

Abigail Whitefield

The University of St Andrews attaches high priority to the ethical conduct of research. We therefore ask you to consider the following points before signing this form. Your signature confirms that you are willing to participate in this study, however, signing this form does not commit you to anything you do not wish to do and you are free to withdraw your participation at any time.

Please initial box

- I understand the contents of the Participant Information Sheet (marked 'aw241_EthicsApp_')
- I have been given the opportunity to ask questions about the study and have had them answered satisfactorily.
- I understand that my participation is entirely voluntary and that I can withdraw from the study at any time without giving an explanation and with no disbenefit
- I understand who will have access to my data, how it will be stored, in what form it will be shared, and what will happen to it at the end of the study.
- I understand that I will be able to withdraw my data before April 2021, and I understand that if my data has been anonymised, it cannot be withdrawn.
- I agree to take part in the above study

Audio recordings

I understand that part of this research involves recording audio data. These will be kept securely and stored separately to any identifiable information, i.e. consent forms and questionnaires.

Audio data can be a valuable resource for future studies and therefore we ask for your additional consent to maintain this data for this purpose.

- I agree to have my audio recorded
- I agree to my audio material to be published as part of this research.
- I give permission for my audio material to be used in future studies without further consultation.

I confirm that I am willing to take part in this research

	Print name	Date	Signature
Participant			
Person taking consent			

Appendix 6: Expert interview question guide

Expert semi-structured interview question guide

Interview structure will not strictly stick to the interview guide, allowing flexibility so that conversation flows with the interviewee's knowledge, experience and interests. This may lead to additional questions being asked, although I will try and ensure all the below questions are covered.

1. What is your job title/ role? What does that involve? How long?
2. How have you been involved with deer management?
3. Have you had any involvement with deer management in and around towns?
4. If so, what has your involvement been?
5. Do you know of any deer populations within urban areas/ in and around towns?
6. Do you think it's a good or bad thing to have deer in urban areas/ in and around towns?
7. What issues, if any, are you aware of relating to deer presence in and around towns?
8. What management actions have you taken (do you know have been taken) in response to these, if any?
9. Do you know of any other examples of deer management being required in and around towns?
10. Do you think deer need to be managed in and around towns?
11. Are deer being sufficiently managed in and around towns?
12. How do you think deer should be managed in and around towns? Why (not)?
13. What methods do you think are most suited to managing deer in and around towns?
14. What methods do you think are least suited to managing deer in and around towns?
15. Who has been involved with the management of deer in and around towns?
16. Do you think that the current arrangements for managing deer in and around towns are working well?
17. In your view, which organisations, authorities and/or individuals should be responsible for managing deer in and around towns?
18. Why do you think those people should be involved with the management of deer in and around towns?
19. What should the role of local authorities be in the management of deer in and around towns?
20. Do you think local authorities should be responsible for the management of deer in and around towns?
21. What challenges do you perceive to management of deer in and around towns?
22. How do you think the public might respond to deer management in and around towns?
23. How might the public response affect local authority involvement in decisions about deer management?
24. What challenges do you perceive to local authority management of deer in and around towns? Do you think the public might be a barrier?
25. Do you have any other thoughts about the management of deer in and around towns?

Appendix 7: Local Authority Q-methodology list of items

Q-methodology Items

1. In some urban areas that my LA owns/ manages there are too many deer
2. We enjoy seeing deer in urban areas in our LA
3. We believe deer populations are increasing in urban areas in our LA
4. We are worried about the deer in urban areas in our LA
5. It's a good thing to have deer in urban areas in our LA
6. Deer injuring the public is not a concern in urban areas in our LA
7. Deer spreading Lyme disease is not a concern in urban areas in our LA
8. Deer-vehicle collisions are a concern in urban areas in our LA
9. Deer being targeted in acts of cruelty/ poaching is not a concern in urban areas in our LA
10. Deer being attacked by dogs is not a concern in urban areas in our LA
11. Deer getting trapped/ entangled is a concern in urban areas in our LA
12. Deer damage to woodlands/ parklands/ gardens/ cemeteries is not a concern in urban areas in our LA
13. Deer have a positive impact on greenspaces/ the environment overall in urban areas in our LA
14. Deer have a negative impact on the public overall in urban areas in our LA
15. Deer in urban areas in our LA cost us a significant amount of money
16. Deer attracting visitors to areas is a concern in urban areas in our LA
17. The health/ condition of deer is not a concern in urban areas in our LA
18. We should be responsible for managing deer on urban land that we own in our LA
19. We should be responsible for organising the dispatch of injured deer in urban areas in our LA
20. We should be responsible for removing dead deer off roads in urban areas in our LA
21. We should be responsible for managing deer on all urban land within our local authority area
22. NatureScot should be responsible for managing urban deer on land that we own
23. Forestry and Land Scotland should be responsible for managing urban deer on land that we own
24. We should work with other landowners to collaboratively manage deer in urban areas in our LA
25. We manage deer sufficiently in urban areas in our LA
26. Deer management is needed in some urban areas in our LA
27. Tree guards are an effective deer management technique in urban areas in our LA
28. Culling is an effective deer management technique in urban areas in our LA
29. Deterrents are not an effective deer management technique in urban areas in our LA
30. Deer warning signs are not an effective deer management technique in urban areas in our LA
31. We are reluctant to cull deer in urban areas in our LA
32. Fences are not an effective deer management technique in urban areas in our LA
33. Consulting local communities about urban deer management is important
34. Educating the public about urban deer/ deer management is important
35. We should hide our urban deer management activities from the public
36. We are reluctant to manage deer in urban areas in our LA
37. We would expect public objections to using recreational stalkers to cull deer in urban areas in our LA
38. We would receive public objections for culling deer in urban areas in our LA
39. Risk of public objections stops us from managing deer in urban areas in our LA

40. Lack of knowledge stops us managing deer in urban areas in our LA
41. Resource constraints stop us from managing deer in urban areas in our LA
42. We would like more support/ guidance on deer/ deer management in urban areas in our LA
43. The public vandalizing fences is a concern in urban areas in our LA
44. Councillors would block deer management from happening in urban areas in our LA
45. Stalkers should have specific urban deer management qualifications
46. We are concerned about the safety of culling in urban areas in our LA
47. Existing policies would stop us managing deer in urban areas in our LA
48. Risk of negative media coverage stops us from managing deer in urban areas in our LA

Appendix 8: Local Authority participant information sheet



University of
St Andrews

Participant Information – Local Authorities: Interviews and Q-Sort

**Developing Policies for Managing Deer in and Around Towns in Scotland:
Understanding Perceptions to Shape Policymaking**

Abigail Whitefield

What is the study about?

We invite you to participate in a research project about deer management in and around towns in Scotland. This project aims to examine public, expert and policymaker (local authority) perceptions of deer and deer management in and around towns. This project hopes to use these perceptions to help shape local authority policymaking for deer management in and around towns.

Why have I been invited to take part?

You have been invited to take part because you are a local authority representative whose job title is related to deer management. We want to understand more about your thoughts around the need for the management of deer in and around towns, local authority involvement in deer management in and around towns, and any perceptions, understandings and barriers to deer management in and around towns that you can identify.

Do I have to take part?

This information sheet has been written to help you decide if you would like to take part. It is up to you and you alone whether you wish to take part. If you do decide to take part you will be free to withdraw at any time without providing a reason, and with no negative consequences. As this research process involves multiple stages, it would be helpful to us if you were able to inform us as to how much of the research process you are able to take part in in advance.

What would I be required to do?

You will be required to complete a survey and Q-sorting process (around one hour), which involves sorting statements into a set distribution as to those you most agree with to those you least disagree with. After the Q-sorting process, a short interview will take place. Throughout the whole process, the researcher will be on a video call with you.

Are there any risks associated with taking part?

There should not be any risks to you throughout the research process. Some of the data you provide may be attributable to you.

Informed consent

It is important that you are able to give your informed consent before taking part in this study and you will have the opportunity to ask any questions in relation to the research before you provide your consent.

Who is funding the research?

My research is being funded by a scholarship from the University of St Andrews.

Compensation

There is no direct reward or compensation for taking part in this research process.

What information about me or recordings of me ('my data') will you be collecting?

I will be collecting information about your understanding, barriers to and perceptions of deer management in and around towns in Scotland via paper notes, an application called QMethodSoftware and audio recordings. I will not be collecting any personal information about you.

How will my data be securely stored, who will have access to it?

Your data will be stored in a pseudonymised form, which means that your data will be edited so that you are referred to by a unique reference such as a code number or different name, and the original data will remain accessible only to the researcher and her supervisors. Your data will be stored on an online password-protected storage cloud, and only the researcher will be able to access it. There will be a 'key' document, which will link your unique reference to your real identity. The key will be kept on an online password-protected storage cloud, and only the researcher will have access to it and be able to reconnect your data to you at a later date.

Audio recordings will be taken on an encrypted device and transcribed at the earliest opportunity before being archived for future use.

How will my data be used, and in what form will it be shared further?

Your research data will be analysed as part of the research study. It will then be published in my PhD thesis and any other resulting publications.

When shared, your data will be in a pseudonymised form, which means that your data will be edited so that you are referred to by a unique reference such as a code number or different name. Your identity will be pseudonymised but could be evident from your views or position.

It is expected that the project to which this research relates will be finalised by December 2022.

When will my data be destroyed?

The data held by the researcher will be converted into an anonymous format following submission of this thesis and kept indefinitely in accordance with the safeguards detailed by law, with all un-anonymised data destroyed.

Will my participation be confidential?

Your participation will be known to the researcher and her supervisors. You will be kept pseudonymised to the readers of the thesis but you may be identifiable because of your views or role. If you participate in a workshop at a later date, you will be identifiable to the other participants in this study.

Use of your personal data and data protection rights

The University of St Andrews (the 'Data Controller') is bound by the UK 2018 Data Protection Act and the General Data Protection Regulation (GDPR), which require a lawful basis for all processing of personal data (in this case it is the 'performance of a task carried out in the public interest' – namely, for research purposes) and an additional lawful basis for processing personal data containing special characteristics (in this case it is 'public interest research'). You have a range of rights under data protection legislation. For more information on data protection legislation and your rights visit <https://www.st-andrews.ac.uk/terms/data-protection/rights/>. For any queries, email dataprot@st-andrews.ac.uk.

You will be able to withdraw your data before April 2021. If your data is anonymised, we will not be able to withdraw it, because we will not know which data is yours.

Ethical Approvals

This research proposal has been scrutinised and subsequently granted ethical approval by the University of St Andrews Teaching and Research Ethics Committee.

What should I do if I have concerns about this study?

In the first instance, you are encouraged to raise your concerns with the researcher. However, if you do not feel comfortable doing so, then you should contact my Supervisor or School Ethics Contact (contact details below). A full outline of the procedures governed by the University Teaching and Research Ethics Committee is available at <https://www.st-andrews.ac.uk/research/integrity-ethics/humans/ethical-guidance/complaints/>.

Contact details

Researcher(s)	Abi Whitefield	Supervisor(s)	Dr Charles Warren Dr Althea Davies
	aw241@st-andrews.ac.uk	Contact	crw2@st-andrews.ac.uk ald7@st-andrews.ac.uk

Appendix 9: Local Authority Q-methodology pre-sort survey

1. What is your job title? *

2. What does your job role involve? *

3. How many years have you worked for your local authority? *

4. Does your local authority have employees that work on deer issues? *

- Yes
- No
- Don't know

5. Does your local authority have an ecology employee? *

- Yes
- No
- Don't know

6. Are there deer in urban areas within your local authority? *

- Yes
- No
- Don't know

7. Are there deer present in urban areas of land that your local authority owns? *

- Yes
- No
- Don't know

8. Which species of deer are present in urban areas of your local authority? *

- Red
- Roe
- Sika
- Fallow
- Chinese Water Deer
- Muntjac
- Other
- None
- Don't know

9. What activities do you consider to be methods of urban 'deer management'? *

10. Are local authorities required to manage (or consider managing) deer on the land that they own? *

- Yes
- No
- Don't know

11. Does your local authority have a deer management plan? *

- Yes
- No
- Don't know

12. Does your local authority monitor urban deer impacts? *

- Yes
- No
- Don't know

13. Select the impacts which occur as a result of urban deer in your local authority *

- None
- Deer-vehicle collisions
- Poaching/ anti-social behaviour towards deer
- Public complaints about deer
- Public worries about deer
- Direct injury to the public (not through deer-vehicle collisions)
- Spread of diseases (such as Lyme disease)
- Deer unintentionally attacked by dogs
- Deer getting trapped/ entangled
- Deer damage to woodlands/ parklands/ cemeteries/ gardens
- Deer attract visitors to our area
- Health or condition of the deer is poor
- Don't know
- People enjoy seeing the deer

14. Does your local authority manage urban deer? (Managing includes the use of lethal and/ or non-lethal methods) *

- Yes
 - No
 - Don't know
-

15. Select the deer management methods that are utilised by your local authority in urban areas *

- Culling
- Fencing
- Deer tubes around trees
- Deer warning signs
- Deterrents
- Habitat management
- Contraception
- Other
- None
- Don't know

16. If your local authority culls urban deer, who does this? *

- Council employees
- Contractors
- Recreational stalkers (unpaid)
- Recreational stalkers (paid)
- Forestry and Land Scotland
- NatureScot
- N/A
- Other

Neighbouring landowners

Don't know

16.5. If you selected 'other' to the previous question, please elaborate

17. If your local authority culls urban deer, does the venison enter the human food chain? *

Yes

No

Don't know

N/A

18. Does a lack of larders restrict your local authority's urban culling activities? *

Yes

No

Don't know

N/A

19. Does your local authority organise the dispatch of injured deer in urban areas? *

- Yes
- No
- Don't know

20. Does your local authority remove dead deer from roads within urban areas? *

- Yes
- No
- Don't know

21. Has your local authority received public backlash for culling urban deer? *

- Yes
- No
- Don't know
- N/A

22. Has your local authority worked with NatureScot (SNH) regarding urban deer issues? *

- Yes, thoroughly
- Yes, to some extent
- Not at all
- Don't know

23. Have councillors stopped culling from happening within urban areas of your local authority? *

- Yes
- Maybe
- No
- Don't know
- N/A

24. Are the public told about your local authority's urban deer management activities/ is information easily publicly available? *

- Yes
- No
- Don't know
- N/A

24.5. If you selected 'no' to the previous question, please explain why

25. What is your age? *

26. What gender do you identify as? *

- Female
- Male
- Other
- Prefer not to say

27. Do you have experience within land-based or environmental sectors?
(E.g. land management/ farming/ game management/ horticulture/
conservation etc) *

- Yes
- No
- Maybe

Participant Information

What is the study about?

We invite you to participate in a research project about urban deer and urban deer management in Scotland. This project aims to examine public, expert, local authority employee and councillor perceptions of urban deer and deer management. We will use your responses to assess the role of local authorities in urban deer management.

What is urban?

Urban areas are defined as being villages, towns, or cities that have a population of at least 3000 people. Within these, all areas are considered urban, including urban greenspaces. For this study, areas of the urban fringe (immediately on the edge of an urban area, with an urban area immediately on at least one side) are also considered.

Why have I been invited to take part?

You have been invited to take part because you are a councillor within a local authority in Scotland. We want to understand more about your perceptions of urban deer and deer management policies.

Do I have to take part?

This information sheet has been written to help you decide if you would like to take part. It is up to you and you alone whether you wish to take part. If you do decide to take part you will be free to withdraw at any time without providing a reason, and with no negative consequences.

What would I be required to do?

You will be required to complete a short survey about your perceptions of urban deer and deer management.

Are there any risks associated with taking part?

There should not be any risks to you throughout the research process.

Informed consent

It is important that you are able to give your informed consent before taking part in this study and you will have the opportunity to ask any questions in relation to the research before you provide your consent. Implied consent will be assumed by participating in this

survey.

Who is funding the research?

My research is being funded by a scholarship from the University of St Andrews.

Compensation

There is no direct reward or compensation for taking part in this research process.

What information about me or recordings of me ('my data') will you be collecting?

I will be collecting information about your perceptions of urban deer and deer management in Scotland via an online survey. I will be collecting some demographic information about you to help situate your perceptions.

How will my data be securely stored, who will have access to it?

Your data will be stored in an anonymised form. Your data will be stored on an online password-protected storage cloud, and only the researcher will be able to access it.

How will my data be used, and in what form will it be shared further?

Your research data will be analysed as part of the research study. It will then be published in my thesis and any other resulting potential publications. If shared (published and/or placed in a database accessible by others), your data will be in an anonymised form. It is expected that the project to which this research relates will be finalised by December 2022.

When will my data be destroyed?

The data will be kept indefinitely in accordance with the safeguards detailed by law.

Will my participation be confidential?

Yes. The researcher and supervisors may be able to identify you from demographic information gathered, but you will be kept confidential.

Use of your personal data and data protection rights

The University of St Andrews (the 'Data Controller') is bound by the UK 2018 Data Protection Act and the General Data Protection Regulation (GDPR), which require a lawful basis for all processing of personal data (in this case it is the 'performance of a task carried out in the public interest' – namely, for research purposes) and an additional lawful basis for processing personal data containing special characteristics (in this case it is 'public interest research'). You have a range of rights under data protection legislation. For more information on data protection legislation and your rights visit <https://www.st-andrews.ac.uk/terms/data-protection/rights/>. For any queries, email dataprot@st-andrews.ac.uk. Your data will be anonymised, so we will not be able to withdraw it, because we will not know which data is yours.

Ethical Approvals

This research proposal has been scrutinised and subsequently granted ethical approval by the University of St Andrews Teaching and Research Ethics Committee.

What should I do if I have concerns about this study?

In the first instance, you are encouraged to raise your concerns with the researcher. However, if you do not feel comfortable doing so, then you should contact my Supervisors. A full outline of the procedures governed by the University Teaching and Research Ethics Committee is available at <https://www.st-andrews.ac.uk/research/integrity->

ethics/humans/ethical-guidance/complaints/.

Contact details

Researcher	Abi Whitefield	Supervisors	Dr Charles Warren Dr Althea Davies
	aw241@st-andrews.ac.uk		crw2@st-andrews.ac.uk ald7@st-andrews.ac.uk

Which local authority are you a councillor within?

Which political party do you represent within your council?

- Scottish Conservatives and Unionist
- Scottish National Party
- Scottish Labour
- Scottish Green Party
- Scottish Liberal Democrats
- Independent/ No Party
- Other

How many years have you been a councillor for?

Does the area you are councillor for cover urban or urban fringe areas? (*Urban areas*

are defined as being villages/ towns/ cities that have a population of at least 3000 people. Within these, all areas are considered urban, including urban greenspaces. For this study, areas of the urban fringe (immediately on the edge of an urban area, surrounded by urban areas on most sides) are also considered).

- Yes
 No

Are there deer in urban or urban fringe areas of the ward you are councillor for?

- Yes
 No
 Don't know

Are you aware of deer causing/ having impacts in urban or urban fringe areas of the ward you are councillor for?

- Yes
 No
 Don't know

Please select the issues you are aware of within urban or urban fringe areas of the ward you are councillor for

- Poaching/ anti-social behaviour towards deer Deer getting trapped/ entangled
 Deer-vehicle collisions Deer damage to woodlands/ parklands/ cemeteries/ gardens
 Public concerns about deer Health or condition of the deer is poor
 Direct injury to the public (except deer-vehicle collisions) by deer Other
 Spread of diseases (such as Lyme disease) by deer None
 Deer attacked or chased by dogs

Who made you aware of these issues?

- The public Personal experience

- Employees in my local authority
- Other
- Other councillors within my local authority
- Unsure
- Friends and family

The following methods have been utilized to control the impacts of rural deer in Scotland and urban deer in the United States of America: fencing, tree tubing, relocation, deterrents, fertility controls, habitat management, raising public awareness, deer warning signs. **If urban deer were causing adverse impacts, would you support a policy within your local authority to manage them using some or all of these non-lethal methods?**

- Yes
- No
- Don't know

Based on existing experience of managing rural deer in Scotland and urban deer in the United States of America, lethal control is shown to be the most effective and humane method for managing harmful deer impacts. **If urban deer were causing significant adverse impacts, would you support a policy within your local authority to manage them using lethal methods?**

- Yes
- No
- Don't know

Would concern about public perceptions affect your decision to support deer management, using non-lethal methods?

- Yes
- No
- Don't know

Would concern about public perceptions affect your decision to support deer management, using lethal methods?

- Yes

- No
 Don't know

Do you feel urban deer management is best conducted with minimal public information and awareness?

- Yes
 No
 Don't know

Please feel free to leave any additional comments here

What gender do you identify as?

- Male
 Female
 Other
 Prefer not to say

What is your age?

Do you have any experience (whether work/ voluntary/ casual) within land-based or environmental sectors? (e.g. land management/ farming/ game management/ horticulture/ conservation etc). If yes, please specify.

- Yes

- No



Don't know

Survey Powered By [Qualtrics](#)

Appendix 11: Public survey⁵⁹



University of
St Andrews



Survey on deer living in urban areas in Scotland

Dear Torry/ Ferryhill Ward Aberdeen Resident,

My name is Abi Whitefield and I am a PhD student at the University of St Andrews. As part of my PhD, I am conducting a public survey on opinions of deer living in urban areas of Scotland. This survey is being funded by Forestry and Land Scotland, the Scottish Alliance for Geoscience, Environment and Society and the University of St Andrews. I would love you to participate.

The aim of my research is to help improve decisions regarding deer living in urban areas of Scotland, as deer numbers are thought to be increasing in many areas across the country, including expanding into urban areas.

This survey seeks views on urban deer from residents in three urban areas of Scotland: Aberdeen, Glasgow and Perth. Your opinions on the topic could help inform decisions on urban deer across Scotland. This is a rare opportunity to have your voice heard on this topic.

The survey will ask about your opinions of urban deer and deer management in Scotland. You don't have to know anything specific about the topic. It should take around 10-20 minutes to complete the survey. **Your responses will be kept completely confidential.** You must be aged 18 or over to complete the survey.

I would be grateful if you could complete my survey (attached) and return it using the pre-paid envelope. Alternatively, you could complete the survey at tinyurl.com/urbandeersurvey or access it using the QR code below.

As a thank you for participating, if you include your details on the final page of the survey, you will be entered into a draw to **win a £50 voucher** to spend at a retailer of your choice. These details will be kept separate from the survey responses to ensure confidentiality.

To be included in the research and in the voucher draw, the deadline for returning your survey is the **31st July 2021**.

I can be contacted on aw241@st-andrews.ac.uk if you have any questions. If you would like to hear about the results of this study, please include your contact details where asked.

Thank you for your time. I look forward to receiving your survey response.

With best wishes,

Abi



The University of St Andrews is a charity registered in Scotland, No: SC013532

⁵⁹ The cover sheets of the surveys were personalised to the city, with this example distributed in Aberdeen.



University of
St Andrews

Participant Information

Managing Urban Deer in Scotland: Understanding Perceptions to Shape Policymaking

What is the study about?

I invite you to participate in a research project about urban deer and urban deer management in Scotland. This project aims to examine public, expert and policymaker (local authority) perceptions of urban deer and deer management. This project will use these perceptions to help shape policymaking.

Why have I been invited to take part?

You have been invited to take part because you live within one of three study areas.

Do I have to take part and what would I be required to do?

This information sheet has been written to help you decide if you would like to take part. It is entirely your choice whether you wish to take part. If you do decide to take part you will be free to withdraw at any time. You will be asked to complete a short survey about your perceptions of urban deer and deer management and the involvement of local authorities.

Informed consent

It is important that you are able to give your informed consent before taking part in this study. Please feel free to email us any questions in relation to the research before you provide your consent. **Consent is implied by completion and return of the survey.**

Who is funding the research?

My PhD is being funded by a scholarship from the University of St Andrews and this survey is being funded by Forestry and Land Scotland and the Scottish Alliance for Geoscience, Environment and Society.

Will I be reimbursed for my participation?

You will be able to enter a draw for a £50 voucher and to receive the results of this study.

What information about me or recordings of me ('my data') will you be collecting?

I will be collecting information about your understanding and perceptions of urban deer and deer management in Scotland via a postal or online survey. I will be collecting some demographic information about you to help contextualise your perceptions.

How will my data be securely stored, who will have access to it? How will my data be used, and in what form will it be shared further?

Your data will be stored in an anonymised form on an online password-protected storage cloud and only the researcher will be able to access it. Physical copies of your survey will be

destroyed after the PhD thesis is completed. Your response will be analysed as part of the research study. It will then be published in my thesis and any other resulting publications. Any data that are shared in publications or by archiving in a social science database will be in an anonymised format. It is expected that my PhD will be finalised by December 2022.

When will my data be destroyed? Will my participation be confidential?

The data will be kept indefinitely in accordance with the safeguards detailed by law. Your participation will only be known to the researcher who will not be able to identify you.

Use of your personal data and data protection rights

The University of St Andrews (the 'Data Controller') is bound by the UK 2018 Data Protection Act and the General Data Protection Regulation (GDPR), which require a lawful basis for all processing of personal data (in this case it is the 'performance of a task carried out in the public interest' – namely, for research purposes) and an additional lawful basis for processing personal data containing special characteristics (in this case it is 'public interest research'). You have a range of rights under data protection legislation. For more information on data protection legislation and your rights visit <https://www.st-andrews.ac.uk/terms/data-protection/rights/>. For any queries, email dataprot@st-andrews.ac.uk.

Ethical Approvals

This research proposal has been scrutinised and subsequently granted ethical approval by the University of St Andrews Teaching and Research Ethics Committee.

What should I do if I have concerns about this study?

In the first instance, you are encouraged to raise your concerns with the researcher. However, if you do not feel comfortable doing so, then you should contact their Supervisor. A full outline of the procedures governed by the University Teaching and Research Ethics Committee is available at <https://www.st-andrews.ac.uk/research/integrity-ethics/humans/ethical-guidance/complaints/>.

Contact details

Researcher	Abi Whitefield	Supervisors	Dr Charles Warren Dr Althea Davies
	aw241@st-andrews.ac.uk	Contact	crw2@st-andrews.ac.uk ald7@st-andrews.ac.uk

Definitions:

Urban – any area with over 3000 residents, including areas on the immediate edge of urban areas (at least one side of the area is next to urban land)

Urban deer – deer living in urban areas, or immediately on the edge of urban areas

Urban greenspaces – any green area such as parks, woodlands, cemeteries or golf courses

Deer management – any method of human control of deer populations or impacts, spanning lethal and non-lethal methods. Lethal methods involve a trained deer manager killing deer. Non-lethal methods involve any approach that does not kill deer

Deer manager – a person who is qualified to shoot deer (has a Deer Management Qualification) and is on the Fit and Competent register of deer managers

Wild deer – deer that are free to roam where they like (e.g. not fenced in a park or farmed)

Survey:

1. Knowledge of deer

Please answer these questions to the best of your ability, from your existing knowledge. It does not matter if you're unsure of your answers.

1.1. How much do you think you know about deer in Scotland?

- A lot Quite a lot A little Very little Nothing Don't know

1.2. How much do you think you know about urban deer in Scotland?

- A lot Quite a lot A little Very little Nothing Don't know

1.3. Please try to identify the following species of deer:



a)
.....



b)
.....



c)
.....



d)
.....

1.4. Which species of deer are present in the wild in Scotland? (Tick all that apply)

- Reindeer Roe Red Muntjac Chinese water
 Sika Fallow Elk White-tailed

1.5. Which species of deer are native to Scotland? (Tick all that apply)

- Reindeer Roe Red Muntjac Chinese water
 Sika Fallow Elk White-tailed

1.6. Which government organisation has overall responsibility for Scotland's deer?

.....

2. Your perceptions of deer

2.1. Please mark one box in each row, that reflects your opinion of wild deer:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
Deer should be present in urban areas						
I like/ would like seeing deer in urban areas						
Deer are beautiful creatures						
Seeing deer in urban areas makes me/ would make me feel worried						
Deer in urban areas are a nuisance						
Deer are important symbols of Scottish culture						

2.2. Please mark one box in each row, that reflects your **opinion of wild deer**:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
Seeing deer in urban areas shows that local nature is healthy						
Seeing deer in urban areas helps improve my wellbeing						
Seeing deer in urban areas makes me feel connected to nature						
Seeing deer in urban areas encourages me to visit local greenspaces more often						
Seeing deer in urban areas makes me worried about human safety due to deer						
Seeing deer in urban areas makes me worried about their environmental impacts						

3. Your perceptions and experience of urban deer populations

3.1. Please mark one box in each row, that reflects **where you have seen urban wild deer in your local urban area**:

<i>I have seen wild deer in my local urban area...</i>	Yes	No	Don't know
...in urban greenspaces			
...in urban brownfield/ development sites			
...on urban roads			
...in my garden/ other gardens			
...on the edge of urban areas			
...in other urban areas not mentioned			

3.2. **How frequently do you see deer in your local urban area?**

Daily Weekly Monthly Less than monthly Never Don't know

3.3. Please mark one box in each row, that reflects your **opinion of urban wild deer populations in your local urban area:**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
I would like to see deer more frequently in my local urban area						
Urban deer populations have increased in my area						
Deer have always lived in my area						
There are too many urban deer in my area						

4. Your perceptions of deer impacts

4.1. Please mark one box in each row, that reflects your **opinion about the impacts of urban wild deer in your local urban area:**

Urban deer...	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...cause more negative impacts than positives						
...cause car accidents						
...damage gardens						
...spread disease						
...damage urban greenspaces						
...cause injury to humans						
...cause damage to young trees that can kill them						
...can have high populations that negatively affect deer welfare						

4.2. Please mark one box in each row, that reflects your **experience of wild deer impacts:**

I or my close family or friends have...	Yes	No	Don't know
...had our gardens damaged by deer			
...had flowers at graves eaten by deer			
...been diagnosed with a tick-related illness			
...been in a car collision with a deer			
...had to pay money because of deer impacts			
...been attacked by deer			

4.3. Please mark one box in each row, that reflects your **opinion of impacts on urban wild deer in your local urban area:**

<i>I am concerned about urban deer...</i>	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...being attacked by dogs						
...getting trapped or entangled						
...being poached or attacked by humans						
...welfare						
...being unhealthy						
...being negatively affected by humans						

5. Your perceptions of deer management

5.1. Please mark one box in each row, that reflects your **opinion of urban wild deer management in Scotland:**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
Urban deer need managing						
We should use non-lethal methods to manage urban deer						
We should use lethal methods to manage urban deer						
We should use a mix of lethal and non-lethal methods to manage urban deer						
Woodlands and other habitats should be protected from urban deer						
We should try to stop urban deer from going onto roads						

5.2. Please mark one box in each row, that reflects your **opinion of urban wild deer management in response to impacts in Scotland:**

<i>Urban deer should be managed because they...</i>	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...cause more negative impacts than positives						
...cause car accidents						
...damage gardens						
...spread disease						
...cause damage to urban greenspaces						
...cause injury to humans						
...cause damage to young trees that can kill them						
...can have high populations that negatively affect deer welfare						

5.3. Please mark one box in each row, that reflects your **opinion of urban wild deer management methods in response to impacts in Scotland:**

<i>If urban deer are causing adverse impacts, they should be managed...</i>	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...using deterrents (noises/ smells/ tastes)						
...by changing human behaviour (reducing feeding of deer; deer warning signs; raising awareness etc)						
...by doing nothing						
...by culling (shooting deer)						
...using fertility controls (contraception/ sterilization)						
...using habitat management (removing trees near roads/ creating overpasses etc)						
...with fencing						
...with tree tubing						
...by relocating deer						

5.4. Please rank these **wild urban deer management methods for use in your local urban area, if deer were having adverse impacts: 1=most preferred; 9=least preferred:**

	Rank (1 to 9)
Using deterrents	
Changing human behaviour	
Doing nothing	
Culling	
Fertility controls	
Habitat management	
Fencing	
Tree tubing	
Relocating deer	

5.5. Please mark one box in each row, that reflects your **opinion of culling within your local urban area:**

<i>If culling was needed in my local urban area, I would...</i>	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...support unpaid qualified deer managers culling the deer						
...support paid qualified local authority deer managers culling the deer						
...support paid qualified Scottish Government (NatureScot / Forestry and Land) deer managers culling the deer						
...want those culling the deer to have deer management qualifications						
...want those culling the deer to have qualifications specifically in culling urban deer						
...like the venison from the deer to be available to the public for free						
...like the venison from the deer to be available to the public to buy						

6. Your perceptions of the role of local authorities in urban deer management

6.1. Please mark one box in each row, that reflects your **opinion of the role of your local authority/ council**:

<i>My local authority/ council...</i>	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...should have responsibility for decisions about deer in all urban areas within the authority						
...should have responsibility for decisions about deer in areas of urban land that they own/ manage						
...should manage urban deer when it is needed						
...should monitor urban deer impacts						
...should clear dead deer off roads						
...should attend to injured deer						

6.2. Please mark one box in each row, that reflects your **opinion**:

<i>My local authority/ council...</i>	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...should not have anything to do with urban deer						
...should educate and inform the public about urban deer						
...should consult the public about urban deer management						
...should hide deer management from the public						
...effectively manages urban deer						

6.3. Please mark one box in each row, that reflects whether you would **support your local authority's/ council's actions:**

<i>If deer needed to be managed in my local urban area, I would support my local authority/ council...</i>	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
...using unpaid qualified deer managers to cull the deer						
...employing paid qualified deer managers to cull deer						
...managing urban deer using non-lethal methods if it was needed						
...managing urban deer using lethal methods if it was needed						
...and trust them to make the right decisions regarding urban deer						

7. **Any comments:**

.....

.....

.....

.....

.....

.....

8. **Some information about you (you will be kept anonymous):**

8.1. Which town or city do you live in?

.....

8.2. What is your age?

- 18-25
 26-35
 36-45
 46-55
 56-65
 66-75
 76-85
 86+

8.3. What gender do you identify as?

Female Male Other Prefer not to say

8.4. What is your highest level of qualification?

- Level 1: No qualifications, standard grades or equivalent
- Level 2: Higher, advanced higher or equivalent
- Level 3: HNC, HND, SVQ level 5 or equivalent
- Level 4: Undergraduate or postgraduate degree, professional qualification (e.g. for teaching, nursing, accounting) or equivalent

8.5. Have you ever lived in a rural area (somewhere with a population under 3000)?

Yes No Other.....

8.6. How often do you use local greenspaces (e.g. parks/ woodlands)?

Daily Weekly Monthly Less than monthly Never Don't know

8.7. Do you or have you ever had any involvement with deer management or deer culling?

Yes No Other.....

8.8. Do you have any experience (whether work/ education/ voluntary/ casual) within land-based or environmental sectors (e.g. land management/ farming/ game management/ horticulture/ conservation etc)?

Yes No Other.....

8.9. Do you think that controlling wildlife populations is needed to protect the environment?

Yes Maybe No Other.....

You have reached the end of the survey! If you would like to enter the draw for a £50 voucher for a place of your choice, please complete the form below.

Please return this survey to Abi Whitefield in the return envelope included as soon as possible, but by the 31st July at the latest.

If you have any questions, please get in touch. Thank you for your participation.

The data you provide on this page will be stored separately from your survey responses.

If you would like to enter the draw for a £50 voucher of your choice, please leave your details below:

Name:.....


Email address:.....

If you would like to hear the results of this study, please tick here:



Thank you!

Appendix 12: Public survey reminder postcard



Scotland's Urban Deer Survey

Scotland's Urban Deer Survey




Hello!

A few days ago you should have received a letter asking you to complete a survey about deer that live in urban areas of Scotland. Thank you so much if you have already completed this survey. If you haven't already done so, it would be great if you could return the completed survey as soon as possible, as I would love to hear your views on the topic.


To complete the survey, please feel free to use the postal survey and pre-paid return envelope I sent to you, or alternatively you can access it using the QR code or at tinyurl.com/urbandeersurvey. **You have one week left to give us your views.** Once you have completed the survey, you will have the opportunity to win a £50 voucher for a retailer of your choice!

Thank you so much for participating and helping to inform decision-making about urban deer! If you have any questions, please feel free to contact me at aw241est-andrews.ac.uk.


Best wishes,
Abi Whitefield, PhD Student at the University of St Andrews



University of St Andrews | FOUNDED 1413



Forestry and Land Scotland
Coilltearachd agus Fearann Alba



SAGES
Scottish Alliance for Geoscience, Environment and Society

Appendix 13: Comparison of public participant perceptions of urban deer by cities of residence

Associations were tested with Chi-square unless marked with an * which denotes testing with Fisher's Exact testing (e.g. 0.000*) (3.3.3.4). Significant associations were found between respondents' city of residence and the following:

- age of respondent (p=0.000)
- experience in land-based sectors (p=0.028)
- participants having lived in rural areas (p=<0.001)
- frequency of use of greenspaces is also strongly associated (p=0.015)
- whether respondents believed that deer should be present in urban areas (p=0.028)
- whether urban deer were perceived as a nuisance (p=0.038)
- whether seeing urban deer encouraged more frequent use of urban greenspaces (p=0.036)
- whether respondents wanted to see urban deer more frequently (p=0.006)
- whether deer had always lived in their area (p=0.000)
- whether they believed urban deer damaged urban greenspaces (p=0.021)
- whether they believed urban deer damaged young trees (p=0.002)
- whether they believed urban deer damaged gardens (p=0.000)
- whether they believed urban deer caused car accidents (p=0.046)
- whether they or their friends or family had experienced garden damage (p=0.000*)
- whether they or their friends or family had experienced DVCs (p=0.012*)
- whether they were concerned about deer welfare (p=<0.001)
- whether they were concerned about deer being negatively affected by humans (p=0.042)

The Perth sample consisted of an older age demographic than respondents from the other cities (Table 10.3). Participants in Glasgow were least likely to have experience in land-based

sectors or to have lived in rural areas and used urban greenspaces least often (Table 10.4). Generally, survey respondents from Glasgow were more positive about urban deer, wanting to see them more regularly, whereas respondents from Perth were more negative (Table 10.5). Respondents from Perth were more likely to agree that deer caused the impacts of deer mentioned above and to have experienced these impacts (Table 10.6 and 10.7). Residents of Glasgow appear to be most concerned about deer welfare (Table 10.8).

Table 10.3: Demographic statistics of the public survey respondents by city of residence.

		Aberdeen	Glasgow	Perth
Number of participants		80	78	160
Age (%)	18-35	20.3	11.6	4.4
	36-55	34.1	33.8	22.8
	56-75	36.7	49.4	51.9
	76+	8.9	5.2	20.9
Gender (%)	Male	52.6	51.9	56.3
	Female	47.4	48.1	43.8
Highest educational attainment level (%) (census data is for over 16s)	No qualifications or Level 1: Standard Grades or equivalent	13.0	22.4	15.9
	Level 2: Higher Grades or equivalent	9.1	10.5	11.5
	Level 3: HNC, HND or equivalent	23.4	18.4	13.4
	Level 4: Undergraduate or postgraduate degree or professional qualification	54.5	48.7	59.2

Table 10.4: Statistics regarding environmental involvement of the public survey participants, by city of residence.

	Do you or have you had any involvement with deer management or deer culling?		Do you have any experience within land-based or environmental sectors?		Have you ever lived in a rural area?		How often do you use local greenspaces?			
	Yes	No	Yes	No	Yes	No	Daily	Weekly	Monthly	Less than monthly
Perth (%)	8.0	92.0	22.3	77.7	50.6	49.4	49.4	33.1	7.1	10.4
Glasgow (%)	2.6	97.4	11.7	88.3	26.0	74.0	24.7	42.9	15.5	16.9
Aberdeen (%)	5.2	94.8	29.1	70.9	51.3	48.7	35.0	38.8	13.7	12.5

Table 10.5: Results for statements on perceptions of urban deer which were perceived significantly different between the public survey respondents in different cities of residence.

Statement	City	Strongly Agree (%)	Agree (%)	Neither Agree Nor Disagree (%)	Disagree (%)	Strongly Disagree (%)	Don't know (%)
Deer should be present in urban areas	Perth	7.9	31.1	31.8	19.9	9.3	N/A
	Glasgow	15.6	42.9	19.5	19.5	2.5	N/A
	Aberdeen	9.3	22.7	40.0	17.3	10.7	N/A
Deer in urban areas are a nuisance	Perth	6.9	16.7	31.9	31.3	13.2	N/A
	Glasgow	1.3	8.0	25.3	38.7	26.7	N/A
	Aberdeen	1.4	16.2	27.0	31.1	24.3	N/A
	Perth	8.6	27.6	36.2	24.3	3.3	N/A
	Glasgow	17.1	30.3	34.2	18.4	0.0	N/A

Seeing deer in urban areas encourages me to visit local greenspaces more often	Aberdeen	15.6	40.3	27.3	11.6	5.2	N/A
I would like to see deer more frequently in my local urban area	Perth	7.0	25.3	40.5	14.5	10.8	1.9
	Glasgow	19.7	35.5	23.7	17.2	3.9	0.0
	Aberdeen	13.7	25.0	27.5	26.2	6.3	1.3
Deer have always lived in my area	Perth	15.6	51.9	5.6	5.0	1.9	20.0
	Glasgow	10.4	31.1	15.6	16.9	1.3	24.7
	Aberdeen	6.2	32.5	11.3	15.0	7.5	27.5

Table 10.6: Results for statements on perceptions of urban deer population impacts which were perceived significantly different between the public survey respondents in different cities of residence.

Statement	City	Strongly Agree (%)	Agree (%)	Neither Agree Nor Disagree (%)	Disagree (%)	Strongly Disagree (%)	Don't know (%)
Urban deer... ...damage urban greenspaces	Perth	2.6	20.6	26.5	31.6	4.5	14.2
	Glasgow	1.3	5.2	16.9	45.4	14.3	16.9
	Aberdeen	2.5	14.1	24.3	38.5	10.3	10.3
...cause damage to young trees that can kill them	Perth	10.9	53.2	10.9	5.2	1.9	17.9
	Glasgow	3.9	31.6	18.4	15.8	5.3	25.0
	Aberdeen	3.8	50.6	16.5	11.4	6.3	11.4
...damage gardens	Perth	10.3	46.8	17.3	14.7	0.0	10.9
	Glasgow	3.9	18.2	18.2	29.9	13.0	16.9
	Aberdeen	5.0	27.5	28.7	21.3	5.0	12.5
...cause car accidents	Perth	10.3	53.8	12.8	10.9	2.6	9.6
	Glasgow	9.1	29.9	19.5	16.9	11.6	13.0
	Aberdeen	8.8	45.0	16.2	15.0	7.5	7.5

Table 10.7: Results for statements on experience of urban deer population impacts which were significantly different between the public survey respondents' cities of residence.

Statement	City	Yes (%)	No (%)	Don't Know (%)
I or my close family or friends have...				
...had our gardens damaged by deer	Perth	33.5	62.7	3.8
	Glasgow	1.3	93.5	5.2
	Aberdeen	12.8	83.4	3.8
...been in a car collision with a deer	Perth	38.3	61.1	0.6
	Glasgow	19.5	79.2	1.3
	Aberdeen	38.5	59.0	2.5

Table 10.8: Results for statements on perceptions of urban deer welfare which were perceived significantly different between the public survey respondents in different cities of residence.

Statement	City	Strongly Agree (%)	Agree (%)	Neither Agree Nor Disagree/ Don't Know (%)	Disagree/ Strongly Disagree (%)
I am concerned about urban deer...					
...welfare	Perth	11.8	43.8	35.4	9.0
	Glasgow	18.3	64.8	12.7	4.2
	Aberdeen	22.7	50.7	14.6	12.0
...being negatively affected by humans	Perth	16.9	48.0	23.0	12.1
	Glasgow	18.1	66.7	8.3	6.9
	Aberdeen	25.3	46.8	19.0	8.9

Appendix 14: Comparison of public participant perceptions of urban deer management by cities of residence

Associations were tested with Chi-square unless marked with an * which denotes testing with Fisher's Exact testing (e.g. 0.000*) (3.3.3.4). Significant associations were found between respondents' city of residence and the following:

- whether urban deer need to be managed because of the effect of high deer populations on deer welfare ($p=0.016$)
- whether urban deer need to be managed because they cause car accidents ($p=0.048$)
- whether urban deer need to be managed because they damage trees ($p<0.001$)
- whether urban deer need to be managed because they damage gardens ($p=0.001$)
- whether urban deer need to be managed because they damage urban greenspaces ($p<0.001$)
- whether we should use lethal methods to manage urban deer ($p=0.002^*$)
- whether we should use a mix of lethal and non-lethal methods to manage urban deer ($p<0.001$)
- whether urban deer should be managed with tree tubes ($p=0.002^*$)
- whether urban deer should be managed with fencing ($p=0.017^*$)
- whether urban deer should be managed with fertility controls ($p=0.044$)
- whether urban deer should be managed with culling ($p=0.002^*$)
- preference ranking of fencing ($p=0.003^*$)
- support for the use of paid qualified Local Authority deer managers ($p<0.001$)
- support for the use of unpaid qualified deer managers ($p=0.002$)

Residents of Perth were overall most likely to agree that urban deer should be managed because of the impacts highlighted in Table 10.9, and most likely to support the use of the deer management methods highlighted in Tables 10.10 and 10.11 and deer managers presented in Table 10.12.

Table 10.9: Results for statements on perceptions of reasons for urban deer management which were perceived significantly different between the public survey respondents in different cities of residence.

Urban deer should be managed because they...	City	Strongly Agree (%)	Agree (%)	Neither Agree Nor Disagree (%)	Disagree (%)	Strongly Disagree (%)	Don't know (%)
...can have high populations that negatively affect deer welfare	Perth	10.3	38.1	21.9	5.2	0.0	24.5
	Glasgow	3.9	21.1	30.3	14.5	3.9	26.3
	Aberdeen	6.3	29.1	26.6	12.7	3.8	21.5
...cause car accidents	Perth	8.4	51.0	18.1	11.5	1.3	9.7
	Glasgow	5.3	36.8	21.1	18.4	6.6	11.8
	Aberdeen	11.5	38.5	26.9	14.1	6.4	2.6
...cause damage to young trees that can kill them	Perth	10.9	48.7	14.1	9.6	1.3	15.4
	Glasgow	5.3	23.7	30.2	15.8	6.6	18.4
	Aberdeen	3.9	42.9	24.7	13.0	7.7	7.8
...damage gardens	Perth	9.7	31.8	26.0	19.6	1.9	11.0
	Glasgow	3.9	11.8	21.2	35.5	10.5	17.1
	Aberdeen	5.1	25.6	30.8	21.8	9.0	7.7
...cause damage to urban greenspaces	Perth	5.2	27.9	22.7	29.2	3.3	11.7
	Glasgow	1.3	8.0	20.0	41.3	10.7	18.7
	Aberdeen	2.5	19.0	35.4	25.3	10.1	7.6

Table 10.10: Results for statements on perceptions of urban deer management methods which were perceived significantly different between the public survey respondents in different cities of residence.

	City	Strongly Agree (%)	Agree (%)	Neither Agree Nor Disagree (%)	Disagree (%)	Strongly Disagree (%)	Don't know (%)
We should use...							
...lethal methods to manage urban deer	Perth	5.8	14.3	24.0	24.7	24.7	6.5
	Glasgow	2.7	5.3	8.0	33.3	46.7	4.0
	Aberdeen	3.8	6.3	22.8	19.0	43.0	5.1
...a mix of lethal and non-lethal methods to manage urban deer	Perth	4.5	26.7	22.1	23.6	13.4	9.6
	Glasgow	2.7	5.4	10.9	35.1	40.5	5.4
	Aberdeen	6.3	15.0	21.3	28.7	22.5	6.2
If urban deer are causing adverse impacts, they should be managed...							
...with tree tubing	Perth	18.1	65.2	6.5	3.1	0.0	7.1
	Glasgow	6.7	54.1	21.5	4.1	1.4	12.2
	Aberdeen	13.2	59.2	14.5	3.9	5.3	3.9
...with fencing	Perth	14.1	60.9	12.2	7.7	1.3	3.8
	Glasgow	5.3	56.6	17.1	6.6	2.6	11.8
	Aberdeen	7.9	48.7	23.7	7.9	7.9	3.9
...using fertility controls	Perth	7.1	33.5	16.7	19.4	5.2	18.1
	Glasgow	6.8	23.3	20.6	26.0	13.7	9.6
	Aberdeen	6.4	24.4	24.4	28.2	11.5	5.1
...by culling	Perth	6.8	25.0	16.9	23.0	20.9	7.4
	Glasgow	6.6	7.9	7.9	34.2	39.5	3.9
	Aberdeen	1.3	11.8	15.9	32.9	34.2	3.9

Table 10.11: Results for the ranking of fencing as an urban deer management method which was perceived significantly different between the public survey respondents in different cities of residence.

Ranking of preferences for urban deer management methods... ..fencing									
	1 - Most preferred	2	3	4	5	6	7	8	9 – Least preferred
Perth	4.9	25.9	12.4	18.5	14.8	11.2	8.6	2.5	1.2
Glasgow	8.3	8.3	18.8	22.9	27.1	12.5	0.0	2.1	0.0
Aberdeen	4.2	4.2	22.9	18.8	16.6	8.3	22.9	0.0	2.1

Table 10.12: Results for statements on perceptions of who should cull urban deer which were perceived significantly different between the public survey respondents in different cities of residence.

If culling was needed in my local urban area, I would...	City	Strongly Agree (%)	Agree (%)	Neither Agree Nor Disagree or Don't Know (%)	Disagree (%)	Strongly Disagree (%)
...support paid qualified Local Authority deer managers culling the deer	Perth	16.2	52.6	11.7	11.0	8.5
	Glasgow	16.2	20.3	21.6	21.6	20.3
	Aberdeen	15.2	31.6	17.7	17.8	17.7
...support unpaid qualified deer managers culling the deer	Perth	4.5	28.4	12.9	31.0	23.2
	Glasgow	10.5	6.6	17.1	27.6	38.2
	Aberdeen	6.6	11.8	11.8	38.2	31.6

Appendix 15: Comparison of public participant perceptions of Local Authority involvement in urban deer management by cities of residence

Associations were tested with Chi-square unless marked with an * which denotes testing with Fisher's Exact testing (e.g. 0.000*) (3.3.3.4). Significant associations were found between respondents' city of residence and the following:

- I would support my Local Authority/ council employing paid qualified deer managers to cull the deer (0.017)
- I would support my Local Authority/ council using unpaid qualified deer managers to cull the deer (<0.001*)

Residents of Glasgow were the least likely to agree with the use of paid or unpaid deer managers to cull deer.

Table 10.13: Results for statements on perceptions of support for Local Authorities using different deer managers which were perceived significantly different between the public survey respondents in different cities of residence.

If deer needed to be managed in my local urban area, I would support my Local Authority/ council...	City	Strongly Agree (%)	Agree (%)	Neither Agree Nor Disagree (%)	Disagree (%)	Strongly Disagree (%)	Don't Know (%)
...employing paid qualified deer managers to cull the deer	Perth	12.0	57.0	13.9	10.8	4.4	1.9
	Glasgow	14.3	32.5	13.0	23.4	15.6	1.3
	Aberdeen	12.7	45.6	15.2	16.4	10.1	0.0
...using unpaid qualified deer managers to cull the deer	Perth	5.1	32.6	15.9	29.3	14.6	2.5
	Glasgow	6.6	7.9	11.8	39.5	32.9	1.3
	Aberdeen	5.1	20.3	11.4	44.3	16.5	2.4

Appendix 16: Number of local councillors from each Local Authority in Scotland that participated in this study

Table 10.14: Number of local councillor participants per Local Authority.

Local Authority	Number of participants (total = 353 councillors)
Aberdeen City	21
Aberdeenshire	21
Angus	9
Argyll and Bute	10
Clackmannanshire	7
Comhairle nan Eilean Saar	7
Dumfries and Galloway	20
Dundee	12
East Ayrshire	8
East Dunbartonshire	10
East Lothian	5
East Renfrewshire	6
Edinburgh	20
Falkirk	6
Fife	33
Glasgow	16
Highland	18
Inverclyde	14
Midlothian	1
Moray	7
North Ayrshire	9
North Lanarkshire	9
Perth and Kinross	16
Renfrewshire	11
Scottish Borders	5
South Ayrshire	10
South Lanarkshire	19
Stirling	6
West Dunbartonshire	5
West Lothian	12

Appendix 17: Number of local councillors from each political party that participated in this study

Table 10.15: Percentage of local councillor participants per political party.

Political party	Percentage of participants (%)
Scottish Conservatives and Unionists	22.5
Scottish National Party	37.3
Scottish Labour	16.0
Scottish Green Party	2.6
Scottish Liberal Democrats	9.1
Independent/ No Party	11.7
Other	0.8

Appendix 18: Q-methodology correlation matrix

Table 10.16: Q-methodology correlation matrix. Correlations range from 100 (completely positive) to -100 (completely negative), with 0 indicating no correlation.

	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA8	LA9	LA10	LA11	LA12	LA13	LA14	LA15	LA16	LA17	LA18	LA19	LA20	LA21	LA22	LA23	LA24	LA25	LA26	LA27	LA28	LA29	LA30
LA1	100	30	43	26	12	3	23	46	53	48	48	64	72	2	38	52	14	13	-8	38	42	41	70	30	57	31	46	29	44	44
LA2	30	100	10	18	15	17	4	10	28	13	40	45	13	16	7	22	7	15	10	17	30	26	12	31	32	26	19	39	21	10
LA3	43	10	100	30	10	28	41	28	31	20	36	36	44	28	28	36	15	19	8	29	25	41	47	44	35	31	54	21	44	33
LA4	26	18	30	100	4	13	0	37	8	48	28	39	18	9	30	38	7	29	13	17	27	38	28	21	11	31	42	17	42	9
LA5	12	15	10	4	100	33	27	7	-13	-13	47	29	0	15	9	2	27	15	40	39	24	41	30	30	-5	44	21	50	3	26
LA6	3	17	28	13	33	100	36	-5	5	-10	25	11	9	36	-3	20	1	56	58	17	20	43	4	54	-4	31	19	24	42	26
LA7	23	4	41	0	27	36	100	14	36	4	31	27	43	36	25	25	0	40	23	24	21	18	23	39	39	33	29	22	34	54
LA8	46	10	28	37	7	-5	14	100	46	28	22	37	22	-18	13	18	-3	10	-9	13	7	1	42	15	20	26	13	24	29	16
LA9	53	28	31	8	-13	5	36	46	100	40	14	49	42	16	13	46	-10	23	-15	18	15	9	25	33	50	15	22	13	49	52
LA10	48	13	20	48	-13	-10	4	28	40	100	18	37	48	-1	28	47	-18	27	-8	22	37	21	20	-3	57	20	48	19	34	33

	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA8	LA9	LA10	LA11	LA12	LA13	LA14	LA15	LA16	LA17	LA18	LA19	LA20	LA21	LA22	LA23	LA24	LA25	LA26	LA27	LA28	LA29	LA30
LA11	48	40	36	28	47	25	31	22	14	18	100	60	34	23	27	19	28	12	25	38	44	54	53	40	40	65	46	52	25	13
LA12	64	45	36	39	29	11	27	37	49	37	60	100	39	6	36	29	10	17	3	46	31	47	55	35	34	35	32	37	50	34
LA13	72	13	44	18	0	9	43	22	42	48	34	39	100	23	43	59	12	23	7	37	50	45	51	29	72	21	58	17	47	52
LA14	2	16	28	9	15	36	36	-18	16	-1	23	6	23	100	16	20	-5	22	25	13	38	29	14	48	29	29	21	24	26	28
LA15	38	7	28	30	9	-3	25	13	13	28	27	36	43	16	100	22	23	8	11	48	23	37	49	29	47	1	29	24	39	35
LA16	52	22	36	38	2	20	25	18	46	47	19	29	59	20	22	100	26	38	19	34	46	37	29	29	48	32	48	26	47	57
LA17	14	7	15	7	27	1	0	-3	-10	-18	28	10	12	-5	23	26	100	-5	9	28	0	22	23	14	7	16	22	2	5	1
LA18	13	15	19	29	15	56	40	10	23	27	12	17	23	22	8	38	-5	100	38	29	34	39	6	38	20	38	34	37	49	37
LA19	-8	10	8	13	40	58	23	-9	-15	-8	25	3	7	25	11	19	9	38	100	35	47	49	7	45	4	26	18	29	31	27
LA20	38	17	29	17	39	17	24	13	18	22	38	46	37	13	48	34	28	29	35	100	39	62	43	43	37	31	48	44	52	47
LA21	42	30	25	27	24	20	21	7	15	37	44	31	50	38	23	46	0	34	47	39	100	52	33	24	44	36	38	53	33	28
LA22	41	26	41	38	41	43	18	1	9	21	54	47	45	29	37	37	22	39	49	62	52	100	49	53	37	42	52	47	60	42
LA23	70	12	47	28	30	4	23	42	25	20	53	55	51	14	49	29	23	6	7	43	33	49	100	40	43	40	36	40	38	35
LA24	30	31	44	21	30	54	39	15	33	-3	40	35	29	48	29	29	14	38	45	43	24	53	40	100	23	41	24	24	60	51
LA25	57	32	35	11	-5	-4	39	20	50	57	40	34	72	29	47	48	7	20	4	37	44	37	43	23	100	23	62	23	41	45
LA26	31	26	31	31	44	31	33	26	15	20	65	35	21	29	1	32	16	38	26	31	36	42	40	41	23	100	43	65	25	24

	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA8	LA9	LA 10	LA 11	LA 12	LA 13	LA 14	LA 15	LA 16	LA 17	LA 18	LA 19	LA 20	LA 21	LA 22	LA 23	LA 24	LA 25	LA 26	LA 27	LA 28	LA 29	LA 30
LA 27	46	19	54	42	21	19	29	13	22	48	46	32	58	21	29	48	22	34	18	48	38	52	36	24	62	43	100	28	38	33
LA 28	29	39	21	17	50	24	22	24	13	19	52	37	17	24	24	26	2	37	29	44	53	47	40	24	23	65	28	100	15	31
LA 29	44	21	44	42	3	42	34	29	49	34	25	50	47	26	39	47	5	49	31	52	33	60	38	60	41	25	38	15	100	56
LA 30	44	10	33	9	26	26	54	16	52	33	13	34	52	28	35	57	1	37	27	47	28	42	35	51	45	24	33	31	56	100

Appendix 19: Confounded and non-loading Q-sorts

The confounded and non-loading Q-sorts, although not represented by the Factors, were used throughout the analysis and therefore helped to shape the Factors that have been extracted alongside the loading sorts. The six confounded sorts demonstrate a mix of viewpoints/ Factors, with loadings on multiple Factors. Two Q-sorts loaded on Factors 1 and 2 (LA12 and LA23), two loaded on Factors 1 and 3 (LA29 and LA30) and two loaded on Factors 2 and 3 (LA19 and LA22). These viewpoints were not so different in themselves from the 3 Factors, or related enough to other confounding Q-sorts, so they did not form their own Factor. They can be considered as Q-sorts that are represented by a mix of two Factors.

The two non-loading Q-sorts are dissimilar to the viewpoints demonstrated in the Factors, and therefore are not represented by them. They are also dissimilar to each other. The unloaded sorts were Q-sorts LA2 and LA17. The lack of correlation between these sorts and other sorts is obvious in the correlation matrix (Appendix 18). LA17 has a maximum correlation of 28 with any of the other sorts. Although LA2 had a maximum correlation of 45, with sort LA12 (a confounded sort), the overall correlations between LA2 and other Q-sorts were low compared to correlations between other Q-sorts.

When considering these two Local Authorities with the contextual experience of watching them complete the Q-sorting process, there were some clear differences in their experiences than to the other Local Authorities. Neither LA2 nor LA17 appeared to focus on urban deer whilst they were completing the Q-sort. They were both from very rural environments and appeared to have interests largely focussing on rural deer or on forestry. LA17 was unsure that they had sorted everything to represent their opinions and some of their statement positions conflicted with each other. LA2 on the other hand, appeared very knowledgeable about forestry, and of the impacts of deer but did not appear to focus on urban environments, and specifically confused a lowland rural area for urban. This contextual information may help explain why these two participants had very different perspectives to the other participants – they appeared to both be knowledgeable about deer but struggled to focus on deer within urban areas. This appeared to contrast to the

other participants, who were more able to focus on urban deer, even if they may have had less knowledge of deer in general.