Sustento del uso justo de Materiales Protegidos

derechos de autor para fines educativos

UCI
Universidad para la Cooperación Internacional

UCI

Sustento del uso justo de materiales protegidos por derechos de autor para fines educativos

El siguiente material ha sido reproducido, con fines estrictamente didácticos e ilustrativos de los temas en cuestión, se utilizan en el campus virtual de la Universidad para la Cooperación Internacional – UCI – para ser usados exclusivamente para la función docente y el estudio privado de los estudiantes pertenecientes a los programas académicos.

La UCI desea dejar constancia de su estricto respeto a las legislaciones relacionadas con la propiedad intelectual. Todo material digital disponible para un curso y sus estudiantes tiene fines educativos y de investigación. No media en el uso de estos materiales fines de lucro, se entiende como casos especiales para fines educativos a distancia y en lugares donde no atenta contra la normal explotación de la obra y no afecta los intereses legítimos de ningún actor.

La UCI hace un USO JUSTO del material, sustentado en las excepciones a las leyes de derechos de autor establecidas en las siguientes normativas:

a- Legislación costarricense: Ley sobre Derechos de Autor y Derechos Conexos, No.6683 de 14 de octubre de 1982 - artículo 73, la Ley sobre Procedimientos de Observancia de los Derechos de Propiedad Intelectual, No. 8039 – artículo 58, permiten el copiado parcial de obras para la ilustración educativa.
b- Legislación Mexicana; Ley Federal de Derechos de Autor; artículo 147.
c- Legislación de Estados Unidos de América: En referencia al uso justo, menciona: "está consagrado en el artículo 106 de la ley de derecho de autor de los Estados Unidos (U.S,Copyright - Act) y establece un uso libre y gratuito de las obras para fines de crítica, comentarios y noticias, reportajes y docencia (lo que incluye la realización de copias para su uso en clase)."
d- Legislación Canadiense: Ley de derechos de autor C-11– Referidos a Excepciones para Educación a Distancia.
e- OMPI: En el marco de la legislación internacional, según la Organización Mundial de Propiedad Intelectual lo previsto por los tratados internacionales sobre esta materia. El artículo 10(2) del Convenio de Berna, permite a los países miembros establecer limitaciones o excepciones respecto a la posibilidad de utilizar lícitamente las obras literarias o artísticas a título de ilustración de la enseñanza, por medio de publicaciones, emisiones de radio o grabaciones sonoras o visuales.

Además y por indicación de la UCI, los estudiantes del campus virtual tienen el deber de cumplir con lo que establezca la legislación correspondiente en materia de derechos de autor, en su país de residencia.

Finalmente, reiteramos que en UCI no lucramos con las obras de terceros, somos estrictos con respecto al plagio, y no restringimos de ninguna manera el que nuestros estudiantes, académicos e investigadores accedan comercialmente o adquieran los documentos disponibles en el mercado editorial, sea directamente los documentos, o por medio de bases de datos científicas, pagando ellos mismos los costos asociados a dichos accesos.

Human-wildlife interactions in urban areas: a review of conflicts, benefits and opportunities

Carl D. Soulsbury[1] and Piran C.L. White[2]

[1]School of Life Sciences, Joseph Banks Laboratories, University of Lincoln, Lincoln, LN2 2LG, UK: csoulsbury@lincoln.ac.uk

[2]Environment Department, University of York, York, YO10 5DD, UK

Abstract

Wildlife has existed in urban areas since records began. However, the discipline of urban ecology is relatively new and one that is undergoing rapid growth. All wildlife in urban areas will interact with humans to some degree. With rates of urbanisation increasing globally, there is a pressing need to understand the type and nature of human-wildlife interactions within urban environments, to help manage, mitigate or even promote these interactions. Much research attention has focussed on the core topic of human-wildlife conflict. This inherent bias in the literature is probably driven by the ease with which can be quantified and assessed. Human-wildlife conflicts in terms of disease transmission, physical attack and property damage are important topics to understand, but conversely the benefits of human interactions with wildlife are equally important, becoming increasingly recognised although harder to quantify and generalise. Wildlife may contribute to the provision of ecosystem services in urban areas, and some recent work has shown how interactions with wildlife can provide a range of benefits to health and wellbeing. More research is needed to improve understanding in this area, requiring wildlife biologists to work with other disciplines including economics, public health, sociology, ethics, psychology and planning. There will always be a need to control wildlife populations in certain urban situations to reduce human-wildlife conflict. However, in an increasingly urbanised and resource-constrained world, we need to learn how to manage the risks from wildlife in new ways, and to understand how to maximise the diverse benefits that living with wildlife can bring.

Keywords: human-wildlife benefit, human-wildlife conflict, urbanisation, biodiversity, health and wellbeing, infectious disease, wildlife-vehicle collisions, interdisciplinary.

Introduction: the urban environment and urban wildlife

Urban areas are made up of a complex habitat mosaic containing a mix of buildings, streets, and green space (Forman and Godron 1986; Mazerolle and Villard 1999). The urban matrix is not homogenous; it may contain a mix of high- and low-density building clusters, small to large green spaces containing intensively managed parkland through to natural habitat remnants, or linear structures such as rivers, roads, and railway tracks. This mingling of habitats, along with their size and extent, give each urban area its own unique habitat mosaic (Werner 2011).

At the same time, urban habitats across the world exhibit some common ecological characteristics even in very different biogeographic locations (Savard *et al.* 2000; Groffman *et al.* 2014). The impact of urbanisation on the environment is substantial and can result in substantial changes to ecosystem structure and processes (Grimm *et al*. 2008). Existing natural habitat is either lost or fragmented and new habitats are created, whilst physico-chemical properties such as hydrology, soil geochemistry (DeKimpe and Morel 2000), nutrient cycling and temperature (Taha 1997) can be altered. In addition, there are novel pressures on the ecosystem such as light pollution (Longcore and Rich 2004), noise pollution (Francis *et al.* 2009) and invasive species (e.g. Blair 1996), which include new or a lack of predators (Crooks and Sóule 1999) and disease (Lafferty and Kuris 2005) . Combined, these effects make urban areas challenging environments for wildlife to survive in and have profound impacts at all levels for the plant and animal communities that live there (Marzluff 2001; McKinney 2002, 2008; Miller and Hobbs 2002).

Wildlife has existed in urban areas for as long as humans have lived in settlements. For example, there are records of scavenging birds and mammals entering urban areas to forage during ancient Egyptian times (Dixon 1989). The first formal studies on urban ecology did not occur until the late 1600s with basic descriptions of plant diversity (Sukopp 1998). As a discipline, urban wildlife research did not really being till the late 1960s and early 1970s (Magle 2012). Since that time it has undergone rapid growth (Adams 2005; Gehrt 2010;

Magle *et al.* 2012), though in general this still represents a small proportion of published research output on wildlife (Magle *et al.* 2012). With urbanisation increasing globally, both in terms of the total urban area covered and the rate of the process (Ramhalo and Hobbs 2012), there is a real research need to look at the ecology of urban wildlife and in particular, theirrelationship with humans.

Wildlife of urban areas

There is a general trend for biotic diversity in urban areas to decline (McKinney 2006; Groffman *et al.* 2014) and across the urban-rural gradient, this decline tends to increase as habitats become more and more urbanized (McKinney 2002). Though the biotic diversity decreases, urban areas still typically retain the biogeographic fauna and flora of the local area (Aronson *et al*. 2014; La Sorte *et al*. 2014). Patterns of biotic diversity can vary with urban intensity, with some studies reporting higher species richness at intermediate urban intensity (McKinney 2008). Some of this increased diversity is caused by an increasing number of invasive species (Blair 1996; Shochat *et al.* 2010; Dolan *et al.* 2011; Wang 2011). Evidence from a range of taxa show that urbanisation leads to the loss of species that have specialist diets (e.g. birds: White *et al.* 2005; Devictor *et al.* 2007; Evans *et al*. 2011), breeding locations (Devictor *et al.* 2007; Fattorini 2011) or habitat requirements (Ordeñana *et al.* 2010). Species that do well in urban areas also tend to have narrower ranges of body sizes, i.e. few very small or very large species (Niemelä *et al.* 2002; Van Der Ree and McCarthy 2005; Batemen and Fleming 2012). At the same time, there is considerable diversity in how wildlife uses the urban environment. Landscape usage by wildlife follows a continuum of "contact", ranging from use that is concentrated outside the urban area but occasionally includes the urban fringe, to use that spans the entirety of the urban space (Riley *et al.* 2010a). How wildlife species use urban areas, and the ways in which they utilise the resources available, has profound impacts on human-wildlife interactions.

Several studies have tried to categorize urban wildlife in different ways, often trying to capture some ecological criteria usually based on the status and sustainability of the population. The commonest categorisation uses the terms of urban “exploiters”, “adapters” or “avoiders” (McKinney 2006). In birds, determinants of species as “urban exploiters” or “urban adapters” included diet, degree of sociality, sedentariness, preferred nesting sites and personality (Kark *et al.* 2007; Croci *et al.* 2008; Evans *et al*. 2011; Meffert and Dzoick 2013; Vine and Lil 2015). Other studies have used the term “residency” or “transiency” as another defining characteristic. “Resident” urban carnivorous mammals tended to be smaller and have more generalist diets than “transient” species (Iossa *et al.* 2010). Whether this is important is open to conjecture, but terms such as “exploiter” and “adapter” have the ability to shape perceptions about the wildlife they label (e.g. Hoon Song 2000) and at the same time may obscure the ecological mechanisms that may be impacting urban biodiversity (Fischer *et al.* 2015). Recent attempts to clarify the terminology have suggested the terms “avoiders”, “utilizers” and “dwellers”, with the emphasis on the terms fitting into a gradient of responses to urbanization (Fischer *et al.* 2015). Though an undoubted improvement, it is important to consider that categorisation may have its limitations; there can be strong temporal and spatial in the responsiveness of wildlife to urban areas, including accompanying shifts in human behaviour/perception. Hence categorization as a tool, may in fact be counterproductive as it could obscure important inter-species variability in ecology.

Human-wildlife interactions

At some point in their lives, animals living in urban areas will interact with humans, due to the high density of human population in these areas. These interactions vary on a continuum from positive and neutral through to negative, vary in intensity from minor to severe, and vary in frequency from rare to common. Negative interactions, more correctly termed *human-wildlife conflict,* emphasize the conscious antagonism between wildlife and humans (Graham *et al.* 2005). Interestingly there is no alternative term to describe positive human-wildlife interactions, probably reflecting the significant bias towards negative interactions in the literature (Peterson *et al.* 2010).

Human wildlife interactions are not random. Human–wildlife interactions typically occur in a non-linear fashion along a gradient of development, with higher concentrations of interactions occurring in the intermediate levels of development, namely the ex-urban and suburban landscape, often in the vicinity of natural patches of habitat or green spaces (Krestner *et al.* 2008; Lukasik and Alexander 2011; Merkl *et al.* 2011; Poessel *et al.* 2013; Teixeira *et al*. 2015). At the same time, the species involved in conflict tend to be non-random. They tend to have broad dietary requirements, which contribute to them being able to live at high population densities (Iossa *et al*. 2010; Charles and Linklater 2013). Interactions can have a strong seasonal component, occurring during critical parts of the animal's lifecycle e.g. nesting or denning (Jones and Thomas 1999; Lukasik and Alexander 2011).

The human participants in interactions are important, since outcomes are dependent on the socio-economic and political context (Mascia *et al.* 2003) and a 'conflict' in one context may not be considered as such in another. Indeed, many conflicts are more about social and cultural values than they are about actual impacts (McIntyre *et al.* 2008). Understanding how individuals and communities respond to wildlife and the impacts it has is therefore a key part of understanding and dealing with potential human-wildlife conflict situations in urban areas. Factors including gender, ethnicity, wealth, education and experience may all affect values and attitudes (Dietz *et al.* 2002; Dickman 2010) and therefore determine the likelihood that a species or its impact are viewed positively or negatively in a particular situation (Bjerke and Østdahl 2004**;** Treves 2007). At the same time humans may be motivated to directly engage in interactions, and so human participants can vary from being active through to indirect, passive or reluctant participants. This further increases the complexity of human-wildlife interactions.

Recent years have seen an increase in human-wildlife conflict in urban areas (Kistler *et al.* 2009; Davison *et al.* 2010). Some of this is due to increasing urban human populations and the encroachment of urban areas into the surrounding countryside, particularly in Africa and Asia (Ditchkoff *et al.* 2006), as well as increases in urban green spaces and spread of residential areas in western countries (Kabisch and Haase 2013). Human-wildlife conflicts are caused where the movement and activities of wildlife, such as associated with foraging or reproduction, have an adverse impact on human interests, whether in a primary way, such as through aggression or nuisance behaviour, or in a secondary way, such as through the spread of parasites or infectious disease. In the following sections, we will explore some of these major areas of conflict in the context of urban wildlife.

Human-wildlife conflict: Aggression, injury and death

The most direct impact of wildlife on humans is that of direct attacks. Attacks by wildlife on humans can be broadly categorised as predatory, territorial or defensive (Conover 2001). In urban areas, predatory attacks are rare due to the general absence of large predators. Nevertheless, they do occur, and in some less developed countries, large predators use some urban areas e.g. spotted hyenas *Crocuta crocuta* (Abey *et al.* 2011), occasionally causing injuries and even fatalities. Overall, though, fatalities or serious injury from urban wildlife are very rare (Mayer 2013). It is more common for human-wildlife conflict to arise from some sort of territorial or defensive aggression by wildlife, with no or only minor injuries to humans taking place. Attacks can occur when individuals are protecting young (e.g. raptors: Parker 1999; Australian magpies *Cracticus tibicen*: Jones and Thomas 1999, masked lapwings *Vanellus miles*: Lees *et al.* 2013) or over food (e.g. long-tailed macques *Macaca fascicularis*: Sha *et al.* 2011; marmosets *Callithrix penicillata*: Goulart *et al.* 2010). For some species, attacks on humans are a very small but growing problem (e.g. wild pigs *Sus* spp.: Mayer 2013; coyote *Canis latrans*: Timm *et al.* 2004), usually associated with increasing populations of these species. Even though attacks by wildlife on humans are rare, the consequences of attacks on the attitudes and perception of urban wildlife can be dramatically negative (Cassidy and Mills 2012), and a significant proportion of people still fear attack by urban wildlife (18.5% respondents feared bobcats *Lynx rufus*; Harrison 1998; 15% respondents feared red foxes *Vulpes vulpes* could injure people: König 2008).

There is often a significant perceived threat of urban wildlife attack on domestic pets (Harrison 1998; König 2008; Spacapan 2013). Depending on the species, some threats can be serious e.g. coyote predation of cats (Grubbs and Krausman 2009; Alexander and Quinn 2011); dietary analysis indicates that the frequency of cats in coyote scats varies depending on location (1-13%), indicating a strong spatial component to risk (MacCracken, 1982; Quinn, 1997; Morey *et al*., 2007). For other species, risks of attack on pets seem to be more minor or absent (Cooke *et al*. 2006; Riley *et al*. 2010b). Urban foxes, which are commonly perceived to kill pets, only do so at a very low rate. Diet analysis shows that pets (including hens, cats, dogs, rabbits and cattle) made up 4.5% of the gut volume of foxes in Zürich (Contesse *et al*. 2004) and 2.4% of the content of fox scats in Bristol, UK (Ansell 2004); scat analysis does not differentiate between killed or scavenged prey. Surveys have also shown that relatively few pets are actually killed, with 8% of householders losing chickens, rabbits or guinea pigs and 0.7% losing a cat (Harris 1981). Even so, pet- urban wildlife interactions are not random. They often occur at night (Grubbs and Krausman 2009) and during certain seasons (e.g. denning season: Lukasik and Alexander 2011). Hence, appropriate management of pets would certainly reduce the risk of conflict in a number of situations.

At the same time, urban areas are important sources of mortality for wildlife. It is beyond the scope of this review to detail all possible human-wildlife interactions in this context, but it is important to acknowledge that sources of mortality in and deriving from urban areas such as disease (see ***Human-wildlife conflict: Disease***), roads (Forman and Alexander 2008) and bird strike of windows (Loss *et al*. 2014) may have significant impact on urban wildlife populations. It is not only direct anthropogenic sources of mortality that are important. The global impact of domestic cat predation on wildlife in urban areas is also widely recognised (Loss *et al*. 2013); It is clear that managing and conserving urban wildlife requires greater consideration for such negative effects of mortality on the populations' future viability.

Human-wildlife conflict: nuisance and property damage

Surveys in urban areas in the Europe and the USA have revealed that from 20% to over 60% of respondents report having had a wildlife-related problem at some time (Conover 1997; Messmer *et al.* 1999; Bjerke and Østdahl 2004). Most of these problems are minor and by comparison, respondents usually report more problems with neighbours' cats and dogs, than with wildlife (Bjerke and Østdahl 2004). However, the relatively high frequency of reported problems is reflected in a general perception that urban wildlife is a nuisance (Table 1). This can be linked to individual's past experience of damage or conflict (Bjerke *et al.* 2003) or a more general "perception" that the species is a problem e.g. snakes (Butler *et al.* 2005). Quite often there is a discord between perceived problem and actual problem (Dickman 2010).

Damage caused by wildlife can sometimes be substantial. In the UK, subsidence damage to property or infrastructure caused by badgers digging setts is an increasing problem (Harris and Skinner 2002; Davison *et al.* 2011). Although badgers are protected by law in England under the Protection of Badgers Act 1992, there is provision to allow actions under licence that would normally be prohibited by the Act. Thus, where badgers are causing damage to property, licences can be granted to allow their removal. Licence applications related to badger damage problems in England increased from 1581 in 1994-1995 to 2614 in 2002-2004, with the proportion of these in urban areas in the three worst-affected regions increasing from an average of 19% in 1994-1996 to 36% in 2002-2004 (Delahay *et al.* 2009).

Wildlife may also inflict damage and potentially serious injury through their involvement in road vehicle collisions (Rowden *et al*. 2008; Found and Boyce 2011; Rea 2012). In urban and peri-urban areas, larger typically herbivorous species such as deer (several species), moose *Alces alces*, macropods (*Macropus* spp*., Wallabia* spp*.)* and camels (*Camelus dromedaries*) can pose a significant hazard for road vehicle collisions (Rowden *et al*. 2008). Deer-vehicle collisions are increasing in many countries (Seiler 2005; Langbein 2007; Ng *et al.* 2008; Found and Boyce 2011). For example, in Iowa, deer-vehicle collisions account for 13% of all crashes reported (Gkritza *et al.* 2014). This is a trend that is likely to continue as urban areas spread, deer become more common within them, and traffic levels increase. Increases in wildlife-vehicle collisions in urban areas may sometimes be an unintended consequence of other policy initiatives such as enhancing green infrastructure (Benedict and MacMahon 2006; Tzoulas *et al.* 2007; Baycan-Levent and Nijkamp 2009).

Nevertheless, most damage or problems caused by urban wildlife are minor. Depending on the species, it can include damage to landscaping such as lawns or fences (Harris 1985; FitzGibbon and Jones 2006; Urbanek *et al.*, 2011), loss of crops (Harris 1985) or low-level damage to cars or property (Herr *et al.* 2009). In some areas, bin-raiding (Harris, 1985; Clark, 1994; Belant 1997; McKinney 2011), fouling and noise (Geronzel and Saloman 1995; Belant 1997; Cleargeau *et al.* 2001; FitzGibbon and Jones 2006; Phillips *et al.* 2007) are commonly reported problems with urban wildlife, especially from species living in colonies or that have semi-permanent den sites. Some of these are associated with a defacing of buildings and sites and loss of aesthetic value, not necessarily damage (Coluccy *et al*. 2001). Whilst clearly most forms of damage caused by urban wildlife are minor, at the local or individual level they can be very distressing. However, with appropriate education and/or mitigation, many of these conflicts can be reduced or negated.

Human-wildlife conflict: Disease

Approximately 60% of diseases causing pathogenic illness in humans originate in animals (Bengis *et al.* 2004). The emergence or re-emergence of zoonotic and vector-borne diseases pose considerable risks to public health, the environment and the economy across the globe (Daszak *et al.* 2000; Bengis *et al.* 2004). Vector-borne diseases in particular may flourish with rapid urbanization (Vora 2008). Expanding cities can encroach upon neighbouring environments, thereby increasing exposure to some vectors and nonhuman hosts of vector-borne diseases, especially in countries with a wide range of background diseases, such as developing countries in tropical regions. Urbanization also tends to lead to a greater density of people as well as domestic and peridomestic animals, creating conditions that can propagate, rather than reduce, disease transmission (Enserink 2008; Alirtol *et al*. 2011). In particular, urban areas in developing countries may often have multiple conditions that allow certain vector-borne disease to persist in urban environments (De Silva and Marshall 2012). Though typically thought of as a developing country health issue, vector-borne diseases are an important problem even within developed countries (Nash *et al*. 2001; WHO 2007). The control of vector-borne diseases in urban areas is a critical issue; ongoing and new strategies need to be developed to effectively tackle this current and emerging health problem.

In a similar way to vector-borne disease, zoonotic diseases are also of considerable importance in urban settings (Mackenstedt *et al*. 2015). Though urban areas frequently reduce the number of species of wildlife (McKinney 2006), those species that do live in urban areas often do so at higher densities than they do in rural areas. Combined with high densities of humans and domestic and companion animals, there is considerable opportunity for diseases to transmit from wildlife to humans or from wildlife to pets (Bradley and Altizer 2007; Mackenstedt *et al*. 2015). Urban wildlife provides an important conduit for diseases to enter the human population, and sometimes may act as a reservoir to enable diseases to persist in urban areas e.g. rabies (Favoretto *et al.* 2013). Direct transmission of a disease from wildlife to humans may be relatively rare, but pets are often important parts of the disease cycle, and can act as a transmission link between wildlife and humans (Deplazes *et al.* 2011). The risk posed by zoonotic disease is often reflected in people's attitudes towards wildlife (König 2008).

The increasing policy emphasis of the benefits of green infrastructure for health and wellbeing (Tzoulas *et al.* 2007; Lee and Maheswaran, 2011) may have consequences for the spread and prevalence of wildlife disease in urban areas in the future. Some diseases have lower prevalence currently in urban areas. For example, *Echinococcus* prevalence in foxes in a Swiss study was 52% in rural areas compared with 31% in urban areas (Fischer *et al.* 2005). It has been hypothesized that this difference may be linked with flexibility in fox feeding behaviour via changes in levels of predation on intermediate rodent hosts (Hegglin *et al.* 2007). However, with an increase in urban-greening, and particularly the establishment of rural-urban corridors, more urban-rural fringe habitats will be created, which pose a high disease hazard (Deplazes *et al.* 2004). Thus, whilst policy initiatives on urban greening have clear benefits to human health and wellbeing in terms of alleviating chronic disease and stress (Tzoulas *et al.* 2007), the presence of more green infrastructure in urban areas may also have adverse consequences in relation to enhancing transmission opportunities for a range of zoonotic and vector-borne disease (Hamer *et al*. 2012; Santiago-Alcaron *et al*. 2014).

In some situations, rather than being a sink for diseases found predominantly in rural areas, urban areas themselves serve as sources of disease to wildlife populations in the surrounding areas. For example, sea otter *Enhydra lutris* populations in California have been infected with *Toxoplasma gondii* and *Sarcocystis neurona* from land-based run-off from urban areas (Miller *et al.* 2010; Shapiro *et al.* 2012). Similarly, feral or free-ranging dogs *Canis familiaris* and cats *Felis catus* (Acosta-Jamett, *et al.* 2011; Hughes and Macdonald 2013) and even humans can directly or indirectly transmit diseases to wildlife (Carver *et al.* 2012). Disease, both wildlife to human and human to wildlife, remains one of the most pressing types of human-wildlife conflict. Given the significant financial cost disease can entail and the threat to human, companion animal and wildlife populations, there is a continued need to study zoonotic diseases in an urban setting (Bradley and Altizer 2007).

Human wildlife conflict: economic costs

Estimates of costs of urban wildlife conflict are rarely properly calculated, often because most human-wildlife conflict is minor. It is also difficult to properly assess the “hidden” costs of human-wildlife conflict such as diminished psychosocial wellbeing, disruption of livelihoods and food insecurity (see Barua *et al.* 2013). However, a proper estimation of costs of damage and urban wildlife control is needed to understand the costs and benefits of alternative management strategies (White *et al.* 2003). There are only a few estimates of urban wildlife damage: for example, urban stone marten *Martes foina* damage to cars is estimated to cost ~€1.6 millon per annum across all of Switzerland (Kistler *et al.* 2013). It was estimated that trapping nuisance animals (skunk, coyote, and raccoon) in Chicago in 1999 cost around $1 million (Gehrt 2004). Where badgers in some parts of the UK are causing damage to property, the cost of repairing damage and removing badgers may run into thousands of pounds. For example, the cost of excluding badgers from a modest sized sett (four to six holes) costs £5,000–£10,000 for proofing and remedial work to buildings (Davison *et al.* 2011). However, if there is more extensive damage to infrastructure, such as canals, the costs of remediation may exceptionally run into hundreds of thousands of pounds. Such reactive and targeted control is much more common than systematic control because of the prohibitive costs. The systematic, proactive control of wildlife in urban areas is generally not carried out due to cost. For example, urban foxes used to be controlled in London, but this was abandoned because it was uneconomical (Harris 1985).

The greatest economic costs associated with urban wildlife are probably related to wildlife diseases. The economic cost of vector-borne diseases in substantial, and globally amounts to billions of US dollars per annum (World Malaria Report 2009). Costs can include direct treatment; *Echinococcus multilocualris* has been estimated to cost €182,594 (€144,818–€231,448) to treat each case (Torgerson *et al.* 2008) or costs can include loss of opportunity through sickness (Walsh 1984). Wildlife disease are also costly to control and to prevent. For example, prevention of vector-borne diseases relies heavily on vector control which can be expensive (Mills 1993). Similarly the costs of trap-translocation (Beringer *et al.* 2002) or trap-vaccination of wildlife can be very high (Rosatte *et al.* 1992; Daszak *et al.* 2001). Large-scale baiting strategies can be costly, especially if conducted over a number of years (Rosatte *et al.* 2007; Hegglin and Deplazes 2013). White *et al.* (2003) calculated the costs of trapping urban red foxes in Britain and estimated that the benefits only outweighed the costs at unfeasibly high fox densities. However, should a zoonotic disease enter the fox population, this would drastically alter the outcome of the cost-benefit analysis (White *et al.* 2003).

Overall, it is very hard to understand the true costs of human-wildlife conflict in urban areas. Most people coexists with wildlife and conflict, where it occurs is minor and relatively difficult to cost. So far, an extrapolation study suggests that urban wildlife costs in excess of US$8.6 billion in damage and cost of control across the USA (Conover 2001). By comparison, expenditure in relation to wildlife benefits is an order of magnitude higher. For example, expenditure on wildlife watching approaches US$55 billion and US$90 billion is spent on hunting and fishing (US Fisheries and Wildlife Service 2012). More specifically, US$7 billion is spent on wildlife food (mainly birds) and bird boxes (US Fisheries and Wildlife Service 2012). Clearly, the economic costs of human-wildlife conflict can be large, especially in certain situations, but in comparison to expenditure on benefits associated with wildlife, the costs are relatively small.

Human-wildlife benefits

Urban wildlife can provide a range of positive values to humans, including opportunities for physical utility, and health, recreational, scientific, ecological and historical values (Conover 2001). Depending on the philosophical viewpoint, urban wildlife may also have intrinsic, or existence, value. Many of these are benefits are difficult to quantify (though see Dallimer *et al.* 2014), because many of the outcomes are often intangible, but their impact may be considerable.

In an increasingly urban society, there is recognition that humans are becoming more remote from the natural environment. Increasing mental health problems are associated with increased urban living. Mental ill-health is a considerable drain on society and the economy, accounting for approximately 14% of the global burden of disease (Prince *et al.* 2007) and its economic impact globally has been estimated as equivalent to 3-4% of total GDP (WHO, 2004) and there is increasing evidence that nature can provide benefits in terms of mental health and wellbeing (Maller *et al.* 2006; Tzoulas *et al.* 2007). However, public health policy tends to concentrate on lifestyle change at an individual level, and the potential transformative capacity of natural environments in enhancing population health remains a neglected and relatively untapped area (Maller *et al.* 2006).

In urban areas in particular, there has been a traditionally greater focus on the less tangible benefits of wildlife, such as recreation or wellbeing value, compared with monetary value. The benefits of urban wildlife are generally much harder to quantify in comparison to human-wildlife conflicts, and research is this area has consequently been limited. The potential role of urban wildlife in promoting mental wellbeing may be one area in which the value of urban wildlife is very significant, and where more research is needed to understand beneficial outcomes as a function of wildlife properties and ecological processes.

Human-wildlife benefits: keystone species and ecosystem

In faunally-impoverished urban areas, the loss of keystone species or ecosystem engineers can have a disproportionately large effect on ecosystem processes, because there is unlikely to be any compensation by other species. As in more natural ecosystems, species in urban areas can play a keystone role though different mechanisms. These can include top-down control through predation or regulation of other species through competition. For example, the loss of coyotes from urban ecosystem caused avifaunal declines by removing suppression of smaller mesopredator populations (Crooks,and Soulé 1999). Similarly, the decline in vulture populations in India has led to dramatic increases in feral dog populations in urban and rural areas (Markandya *et al.* 2008). This has increased the prevalence and risk of rabies transmission to humans, and higher dog densities also increase competition and predation on wildlife (Markandya *et al.* 2008; Vanak and Gompper 2009). Less commonly, ecosystem engineers can also provide important habitat modifications that increase biodiversity. For example, species such as black-tailed prairie dogs and great spotted woodpeckers (*Dendrocopos major*) can increase diversity through burrowing and cavity nest building (Kotaka and Matsuoka 2002; Magle *et al.* 2008).

It may be argued that keystone species do not directly benefit humans themselves, but this is a somewhat short-sighted view. Urban biodiversity has considerable aesthetic value to humans. Therefore, species that act to increase or maintain biodiversity in urban areas may be of considerable indirect value to humans.

Human-wildlife benefits: provisioning regulating and supporting ecosystem services

Ecosystem services are the benefits provided by ecosystems that contribute to making human life both possible and worth living. Ecosystem services comprise provisioning services (e.g. food, fresh water), regulating services (e.g. flood protection), cultural services (e.g., tourism, cultural heritage), and supporting services (e.g. nutrient cycles; UK NEA 2011; Ford-Thompson *et al.* 2014). In urban areas, most of these services tend to relate to urban green spaces and the benefits that these provide, such as flood regulation, carbon sequestration and recreation, rather than the value of urban wildlife (Bolund and Hunhammar 1999; Tratalos *et al.* 2007). However, many parts of the world do rely on urban wildlife for some form of ecosystem service. Historically, many animals have used urban waste as food sources (Dixon 1989; O'Connor 2000). Such was their importance in this role, some species such as red kites *Milvus milvus* and ravens *Corvus corax* were afforded protection (Gurney 1921). Many animals have a similar role today. Rubbish dumps or other waste facilities are still important feeding sites for many species, though often these are regarded as pests (Baxter and Allan 2006). However, some animals have crucial roles in waste disposal, e.g. spotted hyenas (Abay *et al.* 2011) and predatory/scavenging birds (Pomeroy 1972; Markandya *et al.* 2008), especially in developing countries.

Many urban animals act as important predators of pest species. This was first recognised in newspapers as far back as 1884, where songbirds were encouraged into gardens to consume insect pests (Vuorisalo *et al.* 2001). Recent evidence suggest this role is still important (Orros and Fellowes 2012). Many of the commoner urban wildlife species have omnivorous diets that include pest insects. For example, skunks (*Mephitis* spp.) in urban areas eat a range of important garden insect pests (Rosatte *et al.* 2010) and some cities within Italy have begun to use artificial bat roosts to encourage predation of invasive tiger mosquitos *Aedes albopictus* (The Independent 2010). Predatory birds and snakes too contribute effectively to rodent control (Meyer 2008), though human tolerance of snakes in urban areas tends to be low.

Overall, the role of urban wildlife as providers of, or contributors to, ecosystem services has received relatively little recognition. Some animal groups, such as pollinators, probably contribute substantially to ecosystem services in urban areas (Matteson and Langellotto 2009; Bates *et al*. 2011), but the topic as a whole is in need of more thorough research.

Human-wildlife benefits: cultural ecosystem service

Urban areas, and particularly urban green spaces have long been recognised as providing important cultural and recreational ecosystem services (Bolund and Hunhammar 1999). In contrast, there has been much less study on the cultural and recreational value of wildlife in urban areas. The purely aesthetic value of wildlife in urban areas has long been recognised, (Vuorisalo, *et al.* 2001), and we now know that urban residents can gain considerable enjoyment from encounters from urban wildlife (Dandy *et al* 2011) or from sharing the local environment with a species (Dandy *et al.* 2009; Morse *et al.* 2011; Hedblom *et al*. 2014). This is reflected in attitudes surveys, which consistently report a high proportion of respondents having positive attitudes to certain types of wildlife (Table 1). Within this, there are often both species-specific and locational differences in attitudes (Clucas and Marzluff 2012). These often link back to cultural perceptions (Clucas and Marzluff 2012), socioeconomic or demographic factors (Bjerke and Østdahl 2004) or the presence/absence of perceived risk (e.g. disease risk: Peterson *et al*. 2006). The real exception tends to arthropods, which tend to be more unpopular (Bjerke and Østdahl 2004; Table 1), though this varies widely with type of arthropod and the location (indoors/outdoors; Hahn and Ascenro 1991; Bjerke and Østdahl 2004). In general, there is real enjoyment in seeing urban wildlife (Bjerke and Østdahl 2004; Goddard *et al.* 2013), even for those species that can potentially cause damage or pose a threat (Table 1).

Of all positive human-wildlife interactions, globally the commonest is feeding of garden birds (Jones and Reynolds 2007; Goddard *et al.* 2013). The reasons that people feed wildlife are often extremely complex (Jones and Reynolds 2007; Jones 2011). Many people simply derive pleasure from doing so (Clergeau *et al.* 2001; Howard and Jones 2004; Miller 2005), whereas others also couch the practice within conservation-based themes

(Howard and Jones 2004; Jones and Reynolds 2007). Evidence certainly shows the considerable value placed on these interactions (Clucas *et al*. 2014).

More generally, there is a growing body of evidence that both the presence and viewing of urban wildlife are beneficial for mental health and bring psychological benefits (Maller *et al.* 2006; Fuller et al. 2007; Luck et al. 2011; Dallimer *et al*. 2012). There is often a link, albeit not a straightforward one, between preferences, well-being and species richness (Dallimer *et al*. 2012; Shwartz *et al*. 2014). Such evidence suggests that conserving and enhancing biodiversity in urban areas has knock-on health benefits. Linked to this, there has been a real growth in the concept of "wildlife gardening" in recent years. As well as potentially being beneficial to wildlife (Gaston *et al*. 2005), wildlife gardening also provides health and psychological benefits to people (Catanzaro and Ekanem 2004; Van den Berg and Custers 2011; Curtin and Fox 2014). It often again links back to "seeing" wildlife and the motivation to be involved in conservation (Goddard *et al.* 2013). Evidence suggests that these interactions can increase the value and appreciation of the urban landscape (Hedblom *et al*. 2014). Though often hard to define and quantify, the presence of wildlife in urban areas gives people an opportunity to connect locally and directly with nature. In an increasingly urbanised society, this may be the sole direct contact with nature that people have. It is clear that there are considerable benefits from these interactions, yet we are only now starting to recognise their full value. In the longer term, it is important to better understand the mechanisms involved and hence the actions that can be taken to enhance this important relationship. In particular, one of the areas in which there is considerable scope to improve our understanding is the role of urban wildlife and urban biodiversity in general, in the promotion of mental health and its greater role as a recreational and cultural ecosystem service.

A complex web of interactions: the future research priorities

It is clear that urban wildlife has both positive and negative interactions with people. Historically, much research emphasis has been placed on the conflicts between urban residents and wildlife, whereas there is now growing recognition of the benefits wildlife can bring. There is an important role for wildlife agencies and non-governmental organisations in promoting education about urban wildlife and its risks. It is important that differing and sometimes contradictory messages are avoided and the real risks and how to avoid or mitigate them are presented to the public (Gompper 2002; König 2008). Better education has an important role in preventing hysteria and ill-informed management decisions when an attack occurs. At the same time, education has an important role in increasing the "value" placed on urban wildlife (Caula *et al*. 2009). However, behavioural change requires more than education alone, and it is also important that the benefits of living with wildlife are apparent to people at the individual level, so that there is a cultural shift from considering urban wildlife as a problem to a situation in which wildlife are viewed as an integral part of the urban ecosystem.

In conclusion, research priorities need to focus much less on human-wildlife conflict in urban areas and accept that urban wildlife is part of the urban ecosystem. Eradication of wildlife species from urban areas is extremely expensive and not feasible in the vast majority of cases. Some management of problem species will always be necessary, but research also needs to consider the human-wildlife relationship in a more holistic way. We need to improve education around the risks, including damage and infectious disease, but we also need to identify ways of maximising the significant benefits, both physical and mental, that human-wildlife interactions can bring. In particular, increasing the accessibility of natural greenspaces and promotion of interactions as a form of nature-based therapy may bring considerable future benefits (Maller *et al*. 2006; Tzoulas *et al*. 2007; Keniger *et al*. 2013; Lovell *et al*. 2014). At the same time, there is critical need to develop improved conceptual frameworks to understand human-wildlife interactions (e.g. Morzillo *et al*. 2014), and this will require researchers in wildlife ecology working more closely and actively with researchers from other disciplines including economics, public health, sociology, ethics, psychology and planning. It is only through such an integrative approach that we can advance our understanding of how to live successfully alongside wildlife in an increasingly urbanised world.

Acknowledgements

We are grateful to two anonymous reviewers for their comments, which helped to improve the manuscript. PCLW acknowledges the support of the Economic & Social Research Council (ESRC) through a Transformative Research grant on the Health of Populations and Ecosystems (ES/L003015/1).

References

Abay, G.Y., Bauer, H., Gebrehiwot, K. and Deckers, J. (2011). Peri-urban spotted hyena (*Crocuta crocuta*) in northern Ethiopia: diet, abundance and economic impact. European *Journal of Wildlife Research* **57**, 759–765.

Acosta-Jamett, G., Chalmers, W. S. K., Cunningham, A. A., Cleaveland, S., Handel, I. G., and Bronsvoort, B. M. (2011). Urban domestic dog populations as a source of canine distemper virus for wild carnivores in the Coquimbo region of Chile. *Veterinary Microbiology* **152**, 247-257.

Adams, L.W. (2005). Urban wildlife ecology and conservation: a brief history of the discipline. *Urban Ecosystems* **8**, 139-156.

Alexander, S.M., and Quinn, M. S. (2011). Coyote (*Canis latrans*) interactions with humans and pets reported in the Canadian print media (1995–2010). *Human Dimensions of Wildlife* **16**, 345-359.

Alirol, E., Getaz, L., Stoll, B., Chappuis, F., and Loutan, L. (2011). Urbanisation and infectious diseases in a globalised world. *The Lancet Infectious Diseases* **11**, 131-141.

Ansell, R.J. (2004). *The spatial organization of a red fox (Vulpes vulpes) population in relation to food resources.* PhD thesis, University of Brisol.

Aronson, M.F. *et al*. (2014). A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. *Proceedings of the Royal Society B: Biological Sciences* **281**, 20133330.

Barua, M., Bhagwat, S. A., and Jadhav, S. (2013). The hidden dimensions of human–wildlife conflict: Health impacts, opportunity and transaction costs. *Biological Conservation* **157**, 309-316.

Baxter, A. T., and Allan, J. R. (2006). Use of raptors to reduce scavenging bird numbers at landfill sites. *Wildlife Society Bulletin* **34**, 1162-1168.

Baycan-Levent, T., and Nijkamp, P. (2009). Planning and management of urban green spaces in Europe: Comparative analysis. *Journal of Urban Planning and Development* **135**, 1-12.

Belant, J. L. (1997). Gulls in urban environments: landscape-level management to reduce conflict. *Landscape and Urban Planning* **38**, 245-258.

Benedict, M. A., and McMahon, E. T. (2006). 'Green infrastructure: linking landscapes and communities'. (Island Press, New York).

Bengis, R. G., Leighton, F. A., Fischer, J. R., Artois, M., Morner, T., and Tate, C. M. (2004). The role of wildlife in emerging and re-emerging zoonoses. *Revue Scientifique et Technique-Office International des Epizooties* **23**, 497-512.

Bengis, R. G., Leighton, F. A., Fischer, J. R., Artois, M., Morner, T., and Tate, C. M. (2004). The role of wildlife in emerging and re-emerging zoonoses. *Revue Scientifique et Technique-Office International des Epizooties* **23**, 497-512.

Beringer, J., Hansen, L. P., Demand, J. A., Sartwell, J., Wallendorf, M., and Mange, R. (2002). Efficacy of translocation to control urban deer in Missouri: costs, efficiency, and outcome. *Wildlife Society Bulletin* **30**, 767-774.

Bjerke, T., and Østdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoos* **17**, 109-129.

Bjerke, T., Østdahl, T., and Kleiven, J. (2003). Attitudes and activities related to urban wildlife: Pet owners and non-owners. *Anthrozoos* **16**, 252-262.

Bjurlin, C. D., and Cypher, B. L. (2005). Encounter frequency with the urbanized San Joaquin kit fox correlates with public beliefs and attitudes toward the species. *Endangered Species Update* **22**, 107-115.

Blair, R. B. (1996). Land use and avian species diversity along an urban gradient. *Ecological Applications* **6**, 506-519.

Bolund, P. and Hunhammar, S. (1999). Ecosystem services in urban areas. *Ecological Economics* **29**, 293-301

Bradley, C. A., and Altizer, S. (2007). Urbanization and the ecology of wildlife diseases. *Trends in Ecology and Evolution* **22**, 95-102.

Butler, H., Malone, B., and Clemann, N. (2005). The effects of translocation on the spatial ecology of tiger snakes (*Notechis scutatus*) in a suburban landscape. *Wildlife Research* , 165-171.

Byrne, D. N., Carpenter, E. H., Thoms, E. M., and Cotty, S. T. (1984). Public attitudes toward urban arthropods. *Bulletin of the ESA* **30**, 40-44.

Carver, S., Scorza, A. V., Bevins, S. N., Riley, S. P., Crooks, K. R., VandeWoude, S., and Lappin, M. R. (2012). Zoonotic parasites of bobcats around human landscapes. *Journal of Clinical Microbiology* **50**, 3080-3083.

Cassidy, A., and Mills, B. (2012). “Fox Tots Attack Shock”: Urban Foxes, Mass Media and Boundary-Breaching. *Environmental Communication* **6**, 494-511.

Catanzaro, C.and Ekanem, E. (2004). Home gardeners value stress reduction and interaction with nature. *Acta Horticulturae* **639**, 269–275.

Caula, S., Hvenegaard, G. T., and Marty, P. (2009). The influence of bird information, attitudes, and demographics on public preferences toward urban green spaces: The case of Montpellier, France. *Urban Forestry and Urban Greening* **8**, 117-128.

Charles, K. E. (2013). *Urban human-wildlife conflict: North Island kākā (Nestor meridionalis septentrionalis) in Wellington City*. MSc thesis, Victoria University of Wellington.

Charles, K. E., and Linklater, W. L. (2013). Dietary breadth as a predictor of potential native avian–human conflict in urban landscapes. *Wildlife Research* **40**, 482-489.

Clergeau, P., Mennechez, G., Sauvage, A. and Lemoine, A. (2001). Human perception and appreciation of birds: a motivation for wildlife conservation in urban environments of France. In 'Avian ecology and conservation in an urbanizing world', (Eds. J. Marzluff, R. Bowman and R. Donnelly, R , pp. 69-88. (Springer, USA).

Clucas, B., and Marzluff, J. M. (2012). Attitudes and actions toward birds in urban areas: Human cultural differences influence bird behavior. *The Auk* **129**, 8-16.

Clucas, B., Rabotyagov, S., and Marzluff, J. M. (2014). How much is that birdie in my backyard? A cross-continental economic valuation of native urban songbirds. *Urban Ecosystems*, Online early.

Coluccy, J. M., Drobney, R. D., Graber, D. A., Sheriff, S. L., and Witter, D. J. (2001). Attitudes of central Missouri residents toward local giant Canada geese and management alternatives. *Wildlife Society Bulletin* **29**, 116-123.

Conover, M. R. (1997). Wildlife management by metropolitan residents in the United States: practices, perceptions, costs, and values. *Wildlife Society Bulletin* **25**, 306–311.

Conover, M. R. (2001). 'Resolving human-wildlife conflicts: the science of wildlife damage management.' (CRC Press, Florida).

Contesse, P., Hegglin, D., Gloor, S., Bontadina, F., and Deplazes, P. (2004). The diet of urban foxes (*Vulpes vulpes*) and the availability of anthropogenic food in the city of Zurich, Switzerland. *Mammalian Biology* **69**, 81-95.

Cooke, R., Wallis, R., Hogan, F., White, J., and Webster, A. (2006). The diet of powerful owls (*Ninox strenua*) and prey availability in a continuum of habitats from disturbed urban fringe to protected forest environments in south-eastern Australia. *Wildlife Research* **33**, 199-206.

Cornicelli, L., Woolf, A., and Roseberry, J. L. (1993). Residential attitudes and perceptions toward a suburban deer population in southern Illinois. *Transactions of the Illinois State Academy of Science* **86**, 23-32.

Croci, S., Butet, A. and Clergeau, P. (2008) Does urbanization filter birds on the basis of their biological traits. *Condor* **110**, 223-24

Crooks, K. R., and Soulé, M. E. (1999). Mesopredator release and avifaunal extinctions in a fragmented system. *Nature* **400**, 563-566.

Curtin, S., and Fox, D. (2014). Human dimensions of wildlife gardening: its development, controversies and psychological benefits. In 'Horticulture: Plants for People and Places, Volume 3', (Eds. G.R. Dixon and D.E. Aldous), pp. 1025-1046, (Springer Netherlands).

Dallimer, M. *et al*. (2012). Biodiversity and the feel-good factor: understanding associations between self-reported human well-being and species richness. *BioScience* **62**, 47-55.

Dallimer, M. *et al*. (2014). Quantifying preferences for the natural world using monetary and nonmonetary assessments of value. *Conservation Biology* **28**, 404-413.

Dandy, N., Ballantyne, S., Moseley, D., Gill, R., and Quine, C. (2009). 'The management of roe deer in peri-urban Scotland'. (Forest Research, Farnham).

Dandy, N., Ballantyne, S., Moseley, D., Gill, R., Peace, A., and Quine, C. (2011). Preferences for wildlife management methods among the peri-urban public in Scotland. *European Journal of Wildlife Research* **57**, 1213-1221.

Daszak, P., Cunningham, A. A., and Hyatt, A. D. (2000) Emerging infectious diseases of wildlife--threats to biodiversity and human health. *Science* **287**, 443-449.

Davison, J., Roper, T. J., Wilson, C. J., Heydon, M. J., and Delahay, R. J. (2011). Assessing spatiotemporal associations in the occurrence of badger–human conflict in England. *European Journal of Wildlife Research* **57**, 67-76.

De Kimpe, C. R., and Morel, J. L. (2000). Urban soil management: a growing concern. *Soil Science* **165**, 31-40.

Delahay, R. J., Davison, J., Poole, D. W., Matthews, A. J., Wilson, C. J., Heydon, M. J., and Roper, T. J. (2009). Managing conflict between humans and wildlife: trends in licensed operations to resolve problems with badgers *Meles meles* in England. *Mammal Review* **39**, 53-66.

Deplazes, P., Hegglin, D., Gloor, S., and Romig, T. (2004). Wilderness in the city: the urbanization of *Echinococcus multilocularis*. *Trends in Parasitology* **20**, 77-84.

Deplazes, P., van Knapen, F., Schweiger, A., and Overgaauw, P. A. (2011). Role of pet dogs and cats in the transmission of helminthic zoonoses in Europe, with a focus on echinococcosis and toxocarosis. *Veterinary Parasitology*, **182**, 41-53.

Devictor, V., Julliard, R., Couvet, D., Lee, A., and Jiguet, F. (2007). Functional homogenization effect of urbanization on bird communities. *Conservation Biology* **21**, 741-751.

Dickman, A. J. (2010). Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Animal Conservation* **13**, 458-466.

Dietz, T., Kalof, L., and Stern, P. C. (2002). Gender, values, and environmentalism. *Social Science Quarterly* **83**, 353-364.

Ditchkoff, S. S., Saalfeld, S. T., and Gibson, C. J. (2006). Animal behavior in urban ecosystems: modifications due to human-induced stress. *Urban Ecosystems* **9**, 5-12.

Dixon, D. M. (1989). A note on some scavengers of ancient Egypt. *World Archaeology* **21**, 193-197.

Dolan, R. W., Moore, M. E., and Stephens, J. D. (2011). Documenting effects of urbanization on flora using herbarium records. *Journal of Ecology* **99**, 1055-1062.

Dowle, M., and Deane, E. M. (2009). Attitudes to native bandicoots in an urban environment. *European Journal of Wildlife Research* **55**, 45-52.

Enserink, M. (2008), Entomology. A mosquito goes global. *Science* **320**, 864–866.

Evans, K. L., Chamberlain, D. E., Hatchwell, B. J., Gregory, R. D., and Gaston, K. J. (2011). What makes an urban bird? *Global Change Biology* **17**, 32-44.

Fattorini, S. (2011). Insect extinction by urbanization: a long term study in Rome. *Biological Conservation* **144**, 370-375.

Favoretto, S. R., de Mattos, C. C., de Mattos, C. A., Campos, A. C. A., Sacramento, D. R. V., and Durigon, E. L. (2013). The emergence of wildlife species as a source of human rabies infection in Brazil. *Epidemiology and Infection* **141**, 1552-1561

Fischer, C., Reperant, L. A., Weber, J. M., Hegglin, D., and Deplazes, P. (2005). *Echinococcus multilocularis* infections of rural, residential and urban foxes (*Vulpes vulpes*) in the canton of Geneva, Switzerland. *Parasite* **12**, 339-346.

Fischer, J. D., Schneider, S. C., Ahlers, A. A., and Miller, J. R. (2015). Categorizing wildlife responses to urbanization and conservation implications of terminology. *Conservation Biology*.

FitzGibbon, S. I., and Jones, D. N. (2006). A community-based wildlife survey: the knowledge and attitudes of residents of suburban Brisbane, with a focus on bandicoots. *Wildlife Research* **33**, 233-241.

Ford-Thompson, A., Hutchinson, J., Graham H. and White P.C.L. 2014, Health of Populations and Ecosystems Glossary of Terms [online] www.york.ac.uk/healthsciences/research/public-health/projects/hope/glossary. Accessed 17/10/2014.

Forman, R. T. T., and Godron, M. (1986). Landscape Ecology. 619p. New York, Chichester.

Forman, R. T., and Alexander, L. E. (1998). Roads and their major ecological effects. *Annual Review of Ecology and Systematics* **29**, 207-23.

Found, R., and Boyce, M. S. (2011). Predicting deer–vehicle collisions in an urban area. *Journal of Environmental Management* **92**, 2486-2493.

Francis, C. D., Ortega, C. P., and Cruz, A. (2009). Noise pollution changes avian communities and species interactions. *Current Biology 19*, 1415-1419.

Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., and Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters* **3**, 390-394.

Gaston, K. J., Smith, R. M., Thompson, K., and Warren, P. H. (2005). Urban domestic gardens (II): experimental tests of methods for increasing biodiversity. *Biodiversity and Conservation*, **14**, 395-413.

Gehrt, S. D. 2004. Ecology and management of striped skunks, raccoons, and coyotes in urban landscapes. In ‘People and predators: from conflict to conservation’, (Eds. N. Fascione, A. Delach, and M. Smith), pp. 81–104, (Island Press, Washington, D.C.).

Gkritza, K., Souleyrette, R. R., Baird, M. J. *et al.* (2014) Empirical Bayes approach for estimating urban deer-vehicle crashes using police and maintenance records. *Journal of Transportation Engineering* **140**, article 04013002.

Goddard, M. A., Dougill, A. J., and Benton, T. G. (2013). Why garden for wildlife? Social and ecological drivers, motivations and barriers for biodiversity management in residential landscapes. *Ecological Economics* **86**, 258-273.

Gompper, M. E. (2002). Top carnivores in the suburbs? ecological and conservation issues raised by colonization of north-eastern North America by coyotes The expansion of the coyote's geographical range may broadly influence community structure, and rising coyote densities in the suburbs may alter how the general public views wildlife. *Bioscience* **52**, 185-190.

Gorenzel, W. P., and Salmon, T. P. (1995). Characteristics of American Crow urban roosts in California. *Journal of Wildlife Management*, **59**, 638-645.

Goulart, V. D., Teixeira, C. P., and Young, R. J. (2010). Analysis of callouts made in relation to wild urban marmosets (*Callithrix penicillata*) and their implications for urban species management. *European Journal of Wildlife Research***56**, 641-649.

Graham, K., Beckerman A.P., and Thirgood S. (2005) Human predator-prey conflicts: ecological correlates, prey losses and patterns of management. *Biological Conservation* **122**, 159–171.

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., and Briggs, J. M. (2008) Global change and the ecology of cities. S*cience* **319**, 756-760.

Groffman, P. M., Cavender-Bares, J., Bettez, N. D., Morgan Grove, J. Hall, S. J., Heffernan, J. B., Hobbie, S. E. *et al.* (2014) Ecological homogenization of urban USA. *Frontiers in Ecology and the Environment* **12**, 74-81.

Grubbs, S.E. and Krausman, P.R. (2009) Observations of coyote-cat interactions. *Journal of Wildlife Management* **73**, 683–685.

Gurney, J.H. (1921). 'Early annals of ornithology'. (London: Witherby).

Hahn, J. D. and Ascerno, M. E. (1991). Public attitudes toward urban arthropods in Minnesota. *American Entomologist* **37**, 179-185.

Hamer, S. A., *et al*. (2012). Wild birds and urban ecology of ticks and tick-borne pathogens, Chicago, Illinois, USA, 2005–2010. *Emerging Infectious Diseases* **18**, 1589.

Harris, S. (1981). The food of suburban foxes (*Vulpes vulpes*), with special reference to London. *Mammal Review* **11**,151-68.

Harris, S. (1985). Humane control of foxes. In 'Humane control of land mammals and birds', (Ed. D. Britt), pp 63-74, (UFAW, Potters Bar).

Harris, S. and Skinner, P. (2002). 'The badger sett at Lustrell's Crescent/Winton Avenue, Saltdean, Sussex'. Unpublished report to Elliot Morley MP.

Harrison, R. L. (1998). Bobcats in residential areas: distribution and homeowner attitudes. *Southwestern Naturalist* **43,** 469-475.

Hedblom, M., Heyman, E., Antonsson, H., and Gunnarsson, B. (2014). Bird song diversity influences young people's appreciation of urban landscapes. *Urban Forestry and Urban Greening* **13**, 469-474.

Hegglin, D., and Deplazes, P. (2013). Control of *Echinococcus multilocularis*: Strategies, feasibility and cost–benefit analyses. *International Journal for Parasitology* **43**, 327-337.

Hegglin, D., Bontadina, F., Contesse, P., Gloor, S., and Deplazes, P. (2007). Plasticity of predation behaviour as a putative driving force for parasite life-cycle dynamics: the case of urban foxes and *Echinococcus multilocularis* tapeworm. *Functional Ecology* **21**, 552-560.

Herr, J., Schley, L., and Roper, T.J. (2009). Stone martens (*Martes foina*) and cars: investigation of a common human-wildlife conflict. *European Journal Wildlife Research* **55**, 471–477.

Hofer, S., Gloor, S., Müller, U., Mathis, A., Hegglin, D. and Deplazes, P. (2000). High prevalence of *Echinococcus multilocularis* in urban red foxes (*Vulpes vulpes*) and voles (*Arvicola terrestris*) in the city of Zürich . *Parasitology* **120**, 135-42.

Hoon Song, S. (2000). The Great Pigeon Massacre in a deindustralizing American region. In: 'Natural enemies: people–wildlife conflicts in anthropological perspective' (Ed J. Knight), pp 212–228, (London: Routledge).

Howard, P. and Jones, D. N. (2004). A qualitative study of wildlife feeding in south-east Queensland. In 'Urban wildlife: more than meets the eye.' (Eds S.K. Burger and D. Lunney), pp. 55–62, (R. Zool. Soc, NSW, Sydney).

Hughes, J., and Macdonald, D. W. (2013). A review of the interactions between free-roaming domestic dogs and wildlife. *Biological Conservation* **157,** 341-351.

Iossa, G., Soulsbury, C. D., Baker, P. J., and Harris, S. (2010). A taxonomic analysis of urban carnivore ecology. In 'Urban carnivores: ecology, conflict, and conservation', (Eds. S.D. Gehrt, S.P.D. Riley and B.L. Cypher), pp. 173-180, (The Johns Hopkins University Press, Baltimore).

Johnston, J.F. (2001). Synanthropic birds of North America. In 'Avian ecology and conservation in an urbanising world ', (Eds. J. Mazluff, R. Bowman and R. Donnelly), pp 49-68, (Kluwer Academic Publishers, Norwell, USA).

Jones, D. (2011). An appetite for connection: why we need to understand the effect and value of feeding wild birds. *Emu* **111**, 1-7.

Jones, D. N., and Reynolds, J. S. (2008). Feeding birds in our towns and cities: a global research opportunity. *Journal of Avian Biology* **39**, 265-271.

Jones, D. N., and Thomas, L. K. (1999). Attacks on humans by Australian magpies: management of an extreme suburban human-wildlife conflict. *Wildlife Society Bulletin* **27**, 473-478.

Kabisch, N. and Haase, D. (2013). Green spaces of European cities revisited for 1990–2006. *Landscape and Urban Planning* **110**, 113-122.

Kark, S., Iwaniuk, A., Schalimtzek, A. and Banker, E. (2007). Living in the city: can anyone become an 'urban exploiter'? *Journal of Biogeography* **34**, 638–651.

Keniger, L. E., Gaston, K. J., Irvine, K. N. and Fuller, R. A. (2013). What are the benefits of interacting with nature? *International Journal of Environmental Research and Public Health* **10**, 913-935.

Kistler, C., Hegglin, D., von Wattenwyl, K. and Bontadina, F. (2013). Is electric fencing an efficient and animal-friendly tool to prevent stone martens from entering buildings? *European Journal of Wildlife Research* **59**, 905-909.

König, A. (2008). Fears, attitudes and opinions of suburban residents with regards to their urban foxes. *European Journal of Wildlife Research* **54**, 101-109.

Kotaka, N., and Matsuoka, S. (2002). Secondary users of great spotted woodpecker (*Dendrocopos major*) nest cavities in urban and suburban forests in Sapporo City, northern Japan. *Ornithological Science* **1**, 117-122.

Kotulski, Y., and König, A. (2008). Conflicts, crises and challenges: wild boar in the Berlin city–a social empirical and statistical survey. *Natura Croatica* **17**, 233-246.

Kretser, H. E., Sullivan, P. J., and Knuth, B. A. (2008). Housing density as an indicator of spatial patterns of reported human–wildlife interactions in Northern New York. *Landscape and Urban Planning* **84**, 282-292.

La Sorte, F. A., Aronson, M. F. J., Williams, N. S. G., Celesti-Grapow, L., Cilliers, S., Clarkson, B. D., Dolan, R. W., Hipp, A., Klotz, S., Kühn, I., Pyšek, P., Siebert, S. and Winter, M. (2014), Beta diversity of urban floras among European and non-European cities. *Global Ecology and Biogeography*, **23**, 769–779.

Lafferty, K. D. and Kuris, A. M. (2005) Parasitism and environmental disturbances. In 'Parasitism and ecosystems', (Eds. F. Thomas, F. Renaud, and J.F. Guégan), pp. 113-123m (New York: Oxford University Press).

Langbein, J. (2007). 'National deer-vehicle collisions project: England 2003–2005. Final report to the Highways Agency.' (The Deer Initiative, Wrexham, UK).

Lawrence, S. E., and Krausman, P. R. (2011). Reactions of the public to urban coyotes (*Canis latrans*). *Southwestern Naturalist* **56**, 404-409.

Lee, A. C. K., and Maheswaran, R. (2011). The health benefits of urban green spaces: a review of the evidence. *Journal of Public Health* **33**, 212-222.

Lees, D., Sherman, C. D., Maguire, G. S., Dann, P., Cardilini, A., and Weston, M. A. (2013). Swooping in the suburbs; Parental defence of an abundant aggressive urban bird against humans. *Animals* **3**, 754-766.

Longcore, T., and Rich, C. (2004). Ecological light pollution. *Frontiers in Ecology and the Environment* **2**, 191-198.

Loss, S. R., Will, T., Loss, S. S., and Marra, P.P. (2014). Bird-building collisions in the United States: Estimates of annual mortality and species vulnerability. *The Condor*, **116**, 8-23.

Loss, S.R., Will, T., and Marra, P.P. (2013). The impact of free-ranging domestic cats on wildlife of the United States. *Nature Communications*, *4*, 1396.

Lovell, R., Wheeler, B. W., Higgins, S. L., Irvine, K. N. and Depledge, M. H. (2014). A systematic review of the health and well-being benefits of biodiverse environments. *Journal of Toxicology and Environmental Health, Part B* **17**, 1-20.

Luck, G.W., Davidson, P., Boxall, D., and Smallbone, L. (2011). Relations between urban bird and plant communities and human well-being and connection to nature. *Conservation Biology*, **25**, 816-826.

Lukasik, V. M., and Alexander, S. M. (2011). Human–coyote interactions in Calgary, Alberta. *Human Dimensions of Wildlife* **16**, 114-127.

MacCracken, J. G. (1982). Coyote foods in a southern California suburb. *Wildlife Society Bulletin* **10**, 280–281.

Mackenstedt, U., Jenkins, D., and Romig, T. (2015). The role of wildlife in the transmission of parasitic zoonoses in peri-urban and urban areas. *International Journal for Parasitology: Parasites and Wildlife* **4**, 71-79.

Magle, S. B., Hunt, V. M., Vernon, M., and Crooks, K. R. (2012). Urban wildlife research: past, present, and future. *Biological Conservation* **155**, 23-32.

Magle, S. B., Theobald, D. M., and Crooks, K. R. (2009). A comparison of metrics predicting landscape connectivity for a highly interactive species along an urban gradient in Colorado, USA. *Landscape Ecology* **24**, 267-280.

Maller, C., Townsend, M., Pryor, A., Brown, P., and St Leger, L. (2006). Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International* **21**, 45-54.

Markandya, A., Taylor, T., Longo, A., Murty, M. N., Murty, S., and Dhavala, K. (2008). Counting the cost of vulture decline—An appraisal of the human health and other benefits of vultures in India. *Ecological Economics* **67**, 194-204.

Marzluff, J. M. (2001) Worldwide urbanization and its effects on birds. In 'Avian ecology and conservation in an urbanising world ', (Eds. J. Mazluff, R. Bowman and R. Donnelly), pp 19-38, (Kluwer Academic Publishers, Norwell, USA).

Mascia, M. B., Brosius, J. P., Dobson, T. A., Forbes, B. C., Horowitz, L., McKean, M. A., and Turner, N. J. (2003). Conservation and the social sciences. *Conservation Biology* **17**, 649-650.

Matteson, K.C. and Langellotto, G.A. (2009). Bumblebee abundance in New York City community gardens: implications for urban agriculture. *Cities and the Environment* **2**, 5.

Mayer, J.J. (2013). Wild pig attacks on humans. *Proceedings of the 15th Wildlife Damage Management Conference*. (Eds. J. B. Armstrong and G. R. Gallagher), paper 151.

Mazerolle, M. J., and Villard, M. (1999). Patch characteristics and landscape context as predictors of species presence and abundance: a review. *Ecoscience* **6**, 117-124.

McDonald, A. M. H., Rea, R. V., and Hesse, G. (2012). Perceptions of moose-human conflicts in an urban environment. *Alces* **48**, 123-130.

McIntyre, N., Moore, J., and Yuan, M. (2008). A place-based, values-centered approach to managing recreation on Canadian crown lands. *Society and Natural Resources* **21**, 657-670.

McKinney, M. L. (2002) Urbanization, biodiversity, and conservation. *BioScience* **52**, 883–890

McKinney, M. L. (2006). Urbanization as a major cause of biotic homogenization. *Biological Conservation* **127**, 247-260.

McKinney, M. L. (2008). Effects of urbanization on species richness: a review of plants and animals. *Urban Ecosystems* **11**, 161-176.

McKinney, T. (2011), The effects of provisioning and crop-raiding on the diet and foraging activities of human-commensal white-faced capuchins (*Cebus capucinus*). *American Journal of Primatology* **73**, 439–448.

Meffert, P. J., and Dziock, F. (2013). The influence of urbanisation on diversity and trait composition of birds. *Landscape Ecology*, **28**, 943-957.

Merkle, J. A., Krausman, P. R., Decesare, N. J. and Jonkel, J. J. (2011), Predicting spatial distribution of human–black bear interactions in urban areas. *Journal of Wildlife Management* **75**, 1121–1127.

Messmer, T. A., Brunson, M. W., Reiter, D., and Hewitt, D. G. (1999). United States public attitudes regarding predators and their management to enhance avian recruitment. *Wildlife Society Bulletin* **27**, 75-85.

Meyer, S. (2008). 'The barn owl as a control agent for rat populations in semi-urban habitats' (MSc thesis, University of the Witwatersrand).

Miller, J. R. and Hobbs, R. J. (2002) Conservation where people live and work. *Conservation Biology* **16**, 330–337.

Miller, J. R.. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution* **20**, 430–434.

Miller, M. A., Byrne, B. A., Jang, S. S., Dodd, E. M., Dorfmeier, E., Harris, M. D. *et al*. (2010). Enteric bacterial pathogen detection in southern sea otters (*Enhydra lutris nereis*) is associated with coastal urbanization and freshwater runoff. *Veterinary Research* **41**, 1-13.

Mills, A. (1993). The economics of vector control strategies for controlling tropical diseases. *The American Journal of Tropical Medicine and Hygiene* **50,** 151-159.

Morey, P. S., Gese, E. M., and Gehrt, S. (2007). Spatial and temporal variation in the diet of coyotes in the Chicago metropolitan area. *American Midland Naturalist*, **158**, 147-161.

Morse, L. K., Powell, R. L., and Sutton, P. C. (2012). Scampering in the city: Examining attitudes toward black-tailed prairie dogs in Denver, Colorado. *Applied Geography* **35**, 414-421.

Nash, D. *et al*. (2001). The outbreak of West Nile virus infection in the New York City area in 1999. *New England Journal of Medicine*, **344**, 1807-1814.

Ng, J. W., Nielson, C., and St Clair, C. C. (2008). Landscape and traffic factors influencing deer-vehicle collisions in an urban enviroment. *Human-Wildlife Conflicts* **2**, 34-47.

Niemelä, J., Kotze, D. J., Venn, S., Penev, L., Stoyanov, I., Spence, J., *et al*. (2002). Carabid beetle assemblages (Coleoptera, Carabidae) across urban-rural gradients: an international comparison. *Landscape Ecology* **17**, 387-401.

O'Connor, T.P. (2000) Human refuse as a major ecological factor in medieval urban vertebrate communities. In 'Human Ecodynamics. Symposia of the Association for Environmental Archaeology', (Eds. G. Bailey, R. Charles, and N. Winder), pp. 15-20, (Oxbow Books , Oxford).

Ordeñana, M. A., Crooks, K. R., Boydston, E. E., Fisher, R. N., Lyren, L. M., *et al.* (2010). Effects of urbanization on carnivore species distribution and richness. *Journal of Mammalogy* **91**, 1322-1331.

Parker, J. W. (1999). Raptor attacks on people. *Journal of Raptor Research* **33**, 63-66.

Peterson, M. N., Birckhead, J. L., Leong, K., Peterson, M. J., and Peterson, T. R. (2010). Rearticulating the myth of human–wildlife conflict. *Conservation Letters* **3**, 74-82

Peterson, M. N., Mertig, A. G., and Liu, J. (2006). Effects of zoonotic disease attributes on public attitudes towards wildlife management. *Journal of Wildlife Management* **70**, 1746-1753.

Phillips, P., Hauser, P., and Letnic, M. (2007). Displacement of black flying-foxes *Pteropus alecto* from Batchelor, Northern Territory. *Australian Zoologist* **34**, 119-124.

Poessel, S. A., Breck, S. W., Teel, T. L., Shwiff, S., Crooks, K. R. and Angeloni, L. (2013), Patterns of human–coyote conflicts in the Denver Metropolitan Area. *Journal of Wildlife Management* **77**, 297–305.

Pomeroy, D. E. (1975), Birds as scavengers of refuse in Uganda. *Ibis* **117**, 69–81.

Prince, M., Patel, V., Saxena, S., Maj, M., Maselko, J., Phillips, M. R., and Rahman, A. (2007). No health without mental health. *Lancet* **370**, 859-877.

Quinn, T. (1997). Coyote (*Canis latrans*) food habits in three urban habitat types of western Washington. *Northwest Science* **71**, 1–5

Ramalho, C. E., and Hobbs, R. J. (2012). Time for a change: dynamic urban ecology. *Trends in Ecology and Evolution* **27**, 179-188.

Rea, R. V. (2012). Road Safety implications of moose inhabiting an urban-rural interface. *Urban Habitats* **7**, 8pp.

Riley, S.P.D., Boydston, E. E., Crooks, K. R., and Lyren, L. M. (2010b).Bobcats (*Lynx rufus*). In 'Urban carnivores: ecology, conflict, and conservation', (Eds. S.D. Gehrt, S.P.D. Riley and B.L. Cypher), pp. 121-140, (The Johns Hopkins University Press, Baltimore).

Riley, S.P.D., Gehrt, S.D. and Cypher, B.L. (2010a). Urban carnivores: Final perspectives and future directions. In 'Urban carnivores: ecology, conflict, and conservation', (Eds. S.D. Gehrt, S.P.D. Riley and B.L. Cypher), pp. 223-232, (The Johns Hopkins University Press, Baltimore).

Rosatte, R. C., Power, M. J., Donovan, D., Davies, J. C., Allan, M., Bachmann, P., *et al*. (2007). Elimination of arctic variant rabies in red foxes, metropolitan Toronto. *Emerging Infectious Diseases* **13**, 25-27.

Rosatte, R. C., Power, M. J., Machines, C. D., and Campbell, J. B. (1992). Trap-vaccinate-release and oral vaccination for rabies control in urban skunks, raccoons and foxes. *Journal of Wildlife Diseases* **28**, 562-571.

Rosatte, R., Sobey, K., Dragoo, J. W., and Gehrt, S. D. (2010). Striped skunks and allies (*Mephitis* spp.). In 'Urban carnivores: ecology, conflict, and conservation', (Eds. S.D.

Gehrt, S.P.D. Riley and B.L. Cypher), pp. 97-106, (The Johns Hopkins University Press, Baltimore).

Russell, T. C., Bowman, B. R., Herbert, C. A., and Kohen, J. L. (2011). Suburban attitudes towards the common brushtail possum *Trichosurus vulpecula* and the common ringtail possum *Pseudocheirus peregrinus* in the northern suburbs of Sydney. *Australian Zoologist*, **35**, 888-894.

Santiago-Alarcon, D., Havelka, P., Pineda, E., Segelbacher, G., and Schaeffer, H. (2013). Urban forests as hubs for novel zoonosis: blood meal analysis, seasonal variation in Culicoides (Diptera: Ceratopogonidae) vectors, and avian haemosporidians. *Parasitology*, **140**, 1799-1810.

Savard, J. P. L., Clergeau, P., and Mennechez, G. (2000). Biodiversity concepts and urban ecosystems. *Landscape and Urban Planning* **48**, 131-142.

Seiler, A. (2005). Predicting locations of moose–vehicle collisions in Sweden. *Journal of Applied Ecology*, 42, 371-382.

Sha, J. C. M., Gumert, M. D., Lee, B. P.Y.-H., Jones-Engel, L., Chan, S. and Fuentes, A. (2009), Macaque–human interactions and the societal perceptions of macaques in Singapore. *American Journal of Primatology*, **71**, 825–839.

Shapiro, K., Miller, M., and Mazet, J. (2012). Temporal association between land-based runoff events and California sea otter (*Enhydra lutris nereis*) protozoal mortalities. *Journal of Wildlife Diseases* **48**, 394-404.

Shochat, E., Lerman, S. B., Anderies, J. M., Warren, P. S., Faeth, S. H., and Nilon, C. H. (2010). Invasion, competition, and biodiversity loss in urban ecosystems. *BioScience* **60**, 199-208.

Shwartz, A., Turbé, A., Simon, L., and Julliard, R. (2014). Enhancing urban biodiversity and its influence on city-dwellers: An experiment. *Biological Conservation* **171**, 82-90.

Spacapan, M. (2013). Modeling perceived risk from coyotes among Chicago residents. MSc thesis, University of Illinois at Urbana-Champaign.

Sukopp, H. (1998) ‘Urban ecology—scientific and practical aspects.’ (Springer Berlin Heidelberg).

Taha, H. (1997). Urban climates and heat islands: albedo, evapotranspiration, and anthropogenic heat. *Energy and Buildings* **25**, 99-103.

Teixeira, B., Hirsch, A., Goulart, V., Passos, L., Teixeira, C., James, P and Young, R. (2015). Good neighbours: Distribution of black tufted marmoset (*Callithrix penicillata*) in an urban environment. *Wildlife Research*

The Independent (2010) Italians recruit bats to take sting out of summer [http://www.independent.co.uk/news/world/europe/italians-recruit-bats-to-take-sting-out-of-summer-2006124.html] accessed 29th January 2015

Timm, R. M., Baker, R. O., Bennett, J. R., and Coolahan, C. C. (2004). Coyote attacks: an increasing suburban problem. *Proceedings Vertebrate Pest Conference* **21**, 47–57.

Torgerson, P. R., Schweiger, A., Deplazes, P., Pohar, M., Reichen, J., Ammann, R. W. *et al.* (2008). Alveolar echinococcosis: from a deadly disease to a well-controlled infection. Relative survival and economic analysis in Switzerland over the last 35 years. *Journal of Hepatology* **49**, 72-77.

Tratalos, J., Fuller, R. A., Warren, P. H., Davies, R. G., and Gaston, K. J. (2007). Urban form, biodiversity potential and ecosystem services. *Landscape and Urban Planning* **83**, 308-317.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., and James, P. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landscape and Urban Planning* **81**, 167-178.

UK NEA (UK National Ecosystem Assessment) (2011). ‘The UK National Ecosystem Assessment Technical Report.’ (Cambridge: UNEP-WCMC).

Urbanek, R. E., Allen, K. R., and Nielsen, C. K. (2011). Urban and suburban deer management by state wildlife-conservation agencies. *Wildlife Society Bulletin* **35**, 310-315.

US Fisheries and Wildlife Service (2012) U.S. Fish and Wildlife Service 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation National Overview.[http://www.doi.gov/news/pressreleases/upload/fws-national-preliminary-report-2011.pdf]

Van den Berg, A.E. and Custers, M.H.G. (2011) Gardening promotes neuroendocrine and affective restoration from stress. *Journal of Health Psychology*, 16, 3–11

Van der Ree, R., and McCarthy, M. A. (2005). Inferring persistence of indigenous mammals in response to urbanisation. *Animal Conservation* **8**, 309-319.

Vanak, A. T., and Gompper, M. E. (2009). Dogs *Canis familiaris* as carnivores: their role and function in intraguild competition. *Mammal Review* **39**, 265-283.

Vora, N. (2008). Impact of anthropogenic environmental alterations on vector-borne diseases. *The Medscape Journal of Medicine*, **10**, 238.

Vuorisalo, T., Lahtinen, R., and Laaksonen, H. (2001). Urban biodiversity in local newspapers: a historical perspective. *Biodiversity and Conservation* **10**, 1739-1756.

Walsh, J. A. (1984). Estimating the burden of illness in the tropics. In 'Tropical and Geographical Medicine', (Eds. K.S. Warren and A.A.F. Mahmoud), pp. 1073–1085 (New York: McGraw-Hill Book Co)

Wang, H. F, López-Pujol, J., Meyerson, L. A., Qiu, J–X., Wang, X-K. and Ouyang, Z-Y (2011). Biological invasions in rapidly urbanizing areas: a case study of Beijing, China. *Biodiversity and Conservation* **20**, 2483-2509.

Werner, P. (2011). The ecology of urban areas and their functions for species diversity. *Landscape and Ecological Engineering* **7**, 231-240.

White, J. G., Antos, M. J., Fitzsimons, J. A., and Palmer, G. C. (2005). Non-uniform bird assemblages in urban environments: the influence of streetscape vegetation. *Landscape and Urban Planning* **71**, 123-135.

White, L. A., and Gehrt, S. D. (2009). Coyote attacks on humans in the United States and Canada. *Human Dimensions of Wildlife* **14**, 419-43.

White, P.C.L., Baker, P.J., Smart, J.C.R., Harris, S. and Saunders, G. (2003). Control of foxes in urban areas: modelling the benefits and costs. "Symposium on Urban

Wildlife, Third International Wildlife Management Congress". (Christchurch, New Zealand).

Whiting, A. E., Miller, K. K., and Temby, I. (2010). Community attitudes toward possums in metropolitan Melbourne. *Victorian Naturalis* **127**, 4-10.

World Health Organisation (2002) Urbanization: an increasing risk factor for leishmaniasis. *Weekly Epidemiological Record* **77**, 365–372.

World Health Organisation (2004). Promoting mental health: concepts, emerging evidence, practice: a report from the World Health Organisation, Department of Mental Health and Substance Abuse; in collaboration with the Victorian Health Promotion Foundation and the University of Melbourne. Geneva, Switzerland.

World Malaria Report (2009) World Health Organization: Geneva, Switzerland. [http://www.who.int/malaria/world_malaria_report_2009/en/] accessed 31/1/15

Table 1: Positive and negative attitudes for different species in urban areas and for seeing urban wildlife in general.

Species	**Positive attitudes and enjoyment in seeing wildlife (%)**	**Considered a nuisance (%)**	**References**
Moose *Alces alces*	92%		McDonald *et al.* 2012
Coyote *Canis latrans*	33-52%	28-29%	Lawrence and Krausman 2011; Spacapan 2013
Long-nosed bandicoots *Perameles nasuta*	55	28%	Dowle and Deane 2009
Brown bandicoots *Isoodon macrourus*	85%		FitzGibbon and Jones 2006
Black-tailed prairie dogs *Cynomys ludovicianus*	40%		Morse *et al.* 2011
Possums *Pseudocheirus peregrinus* and *Trichosurus vulpecula*	63.1%	32%	Whiting *et al*. 2010
Kaka *Nestor meridionalis*	61.8%		Charles 2012
Red fox *Vulpes vulpes*	60-36%		Harris 1985; König 2008

Eurasian badger *Meles meles*	66%		Harris and Skinner 2002
White-tailed deer *Odocoileus virginianus*	46%		Cornicelli *et al.* 1993
Wild boar *Sus scrofa*	77%	59%	Kotulski and Konig 2008
Kit fox *Vulpes macrotis*	~20-50%		Bjurlin and Cypher 2005
Bobcat *Lynx rufus*	86.2%		Harrison 1998
Urban birds	61-72%	0%	Cleargeau *et al.* 2001
Arthropods	6-69.2%	88-85.9 (indoor arthropods)	Byrne *et al.* 1984; Hahn and Ascero 1991