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A tale of two cities: Coexisting with coyotes in an urban environment

A thesis submitted in partial fulfilment of the requirements for the
Degree of Master of International Nature Conservation

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by Elizabeth E. Elliot-Hogg

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Abstract of a thesis submitted in partial fulfilment of the
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by

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The global spread of urban development and concomitant reduction in wilderness areas can both pressure and entice wild animals to adapt to the urban environment. As wildlife moves into metropolitan areas, however, they come into contact with residents who have become increasingly disconnected from natural environments and have little to no experience in dealing with wild animals. While many large carnivores actively avoid urban areas, North America's coyote (*Canis latrans*) has proved remarkably adept at utilizing the highly altered habitat of the modern city. Yet while the coyote's behavioural adaptations to urban areas have been relatively well researched, fewer studies have focused on human-coyote interactions in cities and suburbs. Given that human attitudes, fears, knowledge and resulting behaviours often underpin human-wildlife conflicts, the following study investigates and compares the human aspects of coyote conflict in two cities with large populations of both people and coyotes: Chicago and Los Angeles. Data were collected via email surveys sent to residents of Cook and Los Angeles Counties. The survey instrument included questions on residents' opinions, fears, knowledge, personal experiences with urban coyotes and behaviours affecting them. The general goal of the study was to investigate the potential for human-coyote coexistence in urban environments. The following research revealed great variation in attitudes towards coyotes, with animal lovers being as much a part of the problem as those with a paralyzing fear of wildlife. Consequently, finding acceptable solutions may pose a real challenge to urban wildlife managers and reconciliation ecologists.

Keywords: coyote, *Canis latrans*, human-wildlife conflict, attitudes towards wildlife, reconciliation ecology, urban wildlife, Chicago, Los Angeles

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Chapter 1: Introduction

For the first time in human history, there are more people living in cities than in rural areas across the globe (Gehrt, Riley & Cypher, 2010). Thirty per cent of the United States population is currently living in cities and 50 per cent in suburbs (Hobbs & Stoops, 2002). Urban development is a lasting type of habitat change that often eliminates the large majority of native flora and fauna (McKinney, 2006). Czech, Krausman and Devers (2000) found that urbanization was more geographically widespread in the mainland United States, and threatened more species, than any other human activity. This spread of urban development and concomitant reduction in wilderness areas can both pressure and entice wild animals to adapt to the urban habitat (Bateman & Fleming, 2012).

As wildlife moves into metropolitan areas, however, it comes into contact with residents who have become increasingly disconnected from the non-urban environment and have little to no experience with or knowledge of how to coexist with wild animals. Consequently, city and suburban residents are inadvertently attracting wildlife through the provision of food in the form of garbage, spills from bird feeders, pet food, fruits and vegetable gardens, and failing to frighten bold animals away.

Many large carnivore species, such as the grey wolf (*Canis lupus*) or spotted hyena (*Crocuta crocuta*), actively avoid urban areas, rapidly retreating in the face of urban spread (Bateman & Fleming, 2012) but one relatively large carnivore that has proved remarkably successful in adapting to urban development is the coyote (*Canis latrans*).

Originally found in the deserts and prairies of central North America, over the past two centuries coyotes have greatly extended their geographical range and can now be found in every state in the continental United States as well as much of Canada (Shivik, 2010). The adaptable, omnivorous canid has become established in many metropolitan areas across the United States, where it represents the largest carnivore (12-15 kg) living in such proximity to people. The urban coyote has modified its behaviour in order to avoid humans, shifting its activity to night time, and preferring large fragments of natural habitat where human activity is lower and cover is abundant (White & Gehrt, 2009). Despite these adaptations, conflict with the coyote's human neighbours does occur, and reports of coyote attacks on people and their pets have been recorded (White & Gehrt, 2009; Baker & Timm, 1998; Timm & Baker, 2007; and Alexander & Quinn, 2011).

Two urban centres supporting large populations of both humans and coyotes are Chicago, Illinois, and Los Angeles, California. Cook County, which is associated with the greater Chicago metropolitan area, is the second most populous county in the United States after Los Angeles County (U.S. Census Bureau,

2009). While currently the risk of coyote attacks on people is quite small, a trend has been noted by Timm et al. (2004) of increasing numbers of attacks on humans in California, and the Cook County Coyote Project (n.d.) has documented an increase in the numbers of pet attacks in Chicago. It is possible that Los Angeles County, which most likely has been living with coyotes since the beginning of its human development, is predictive of Cook County's future human-coyote interactions.

Human attitudes, fears, knowledge and resulting behaviours are often at the root of human-wildlife conflicts. It is therefore vital that wildlife managers identify human behaviours that are attracting coyotes to metropolitan areas and allowing this potentially dangerous carnivore to habituate to human presence. The goal of this thesis is to investigate the potential for human-coyote coexistence in metropolitan areas. Throughout this paper, *coexistence* denotes a way of living that enables both people and coyotes to inhabit an urban space without fear of coyote attacks on people or pets and without the assumption that these animals are a dangerous threat to be immediately hunted down and destroyed. Coyote experts agree that habituation in coyotes, or becoming used to human presence and realising humans pose no threat, can potentially lead to coyote attacks on people (Fox, Papouchis, Hirsch, & Lamont, 2005; Timm & Baker, 2007; White & Gehrt, 2009, Schmidt & Timm, 2007). *Coexistence* in this paper does not mean deliberately attracting wildlife closer to people or treating wild animals as domestic pets. Quite the opposite, in the case of large carnivores, the safety of people and their companion animals may depend on encouraging avoidance behaviours in these predators. I believe it is a better solution for all parties involved to chase a coyote away with a stick than to be forced later to destroy an animal that has bitten a toddler. For a further discussion of habituation, see chapter 2.9.1. *Attitudes and perceptions of carnivores*.

With this overarching goal in mind, the general aim of my research was to identify, compare and contrast the opinions and attitudes of Cook and Los Angeles County residents towards urban wildlife generally, and coyotes more specifically. The research had three objectives:

- > To gain a better understanding of Los Angeles and Cook County residents' awareness and knowledge of coyotes (their presence, behaviour and biology) and appropriate responses to encounters with them;
- > To investigate human actions and behaviours that can influence coyote behaviour and increase the risk of conflict;
- > To determine public preferences for urban coyote management.

In order to fulfil these objectives, I first undertook a review of the literature on urban biodiversity conservation, wildlife management in urban areas, and the ecology and behaviour of urban coyotes

(Chapter 2). The purpose of this chapter was to set the stage for the human-coyote coexistence conundrum by looking at the role cities play in biodiversity conservation, the effect of urbanization on people and large carnivores, and coyote adaptations to the metropolitan environment. The second half of the chapter is devoted to an investigation of the literature on human attitudes and perceptions of carnivores and how these can influence human behaviour. The review of the literature is followed by a presentation of the study area in Chapter 3. The methodology is detailed in Chapter 4 and the results presented in Chapter 5. The discussion of the research results in Chapter 6 addresses each of the original research objectives in terms of the study's findings and relates them back to debates outlined in the literature review. The conclusions in Chapter 7 explore implications of the study's findings for reconciliation ecologists interested in promoting peaceful human-carnivore coexistence, and for wildlife managers in urban North American cities facing the challenge of urban coyote management.

Chapter 2: Review of the literature

Given the goal of this study to investigate the relationship between humans and coyotes in an urban setting, the following review of the literature explores various aspects of the human-coyote problem, including the role of cities in native biodiversity conservation, the effect of cities on large carnivores, and coyote adaptations to the urban environment.

2.1. The role of cities in conserving biodiversity: effects of urbanization

For the first time in human history, there are more people living in cities than in rural areas across the globe (Gehrt, Riley, & Cypher, 2010). As of 2008, more than half the world's population (over 3 billion people) can be found in urban areas (UNFPA, 2007). This world-wide spread of urbanization raises new challenges for conservation biologists, as urban development produces some of the greatest local extinction rates and frequently eliminates the large majority of native species (McKinney, 2002). Not only is urbanization typically a lasting type of habitat loss, it also tends to replace native species with widespread non-natives, thus reducing the biological uniqueness of local ecosystems (McKinney, 2002). Czech et al. (2000) found that urbanization threatened more species and was more geographically widespread in the mainland United States than any other human activity.

Cities can be defined as concentrated centres of anthropogenic production, consumption, and waste disposal that result in dramatic environmental changes, such as built structures, impervious surfaces, fragmentation of natural vegetation, and altered temperatures, as well as noise, air and light pollution, (Grimm, Faeth, Golubiewski, Redman, Wu, Bai & Briggs, 2008). Urban areas are often defined in terms of population size and density – the U.S. Census Bureau defines “urban” as an area with more than 2,500 people (> 620 individuals/km²). McIntyre, Knowles-Yáñez and Hope (2000) argue that the one feature that distinguishes an urban environment unambiguously from surrounding areas is the level of energy use. Ecologists and conservationists see the traditional city as a habitat “constructed almost exclusively to meet the relatively narrow demands of just one species, *Homo sapiens*” (McKinney, 2006).

While nature reserves comprise less than 5 per cent of the surface of the Earth and are unlikely to increase substantially (J. R. Miller, 2005), the growth rate of urban land use continues to accelerate (McKinney, 2002). Habitat alteration and fragmentation from urbanization is drastic, widespread and typically long-lasting. Urbanization results in habitat loss for many specialist species but it also creates new habitats for some, often generalist, species (Adams, 2005). Examples of generalist species adept at colonizing human-dominated landscapes include the rock dove (*Columbia livia*), house mouse (*Mus musculus*) and feral house cats (*Felis catus*) (McKinney, 2006). As these same urban-adaptable species

colonize the expanding cities of every continent, global biodiversity will decrease as local, indigenous, or specialized species lose their habitats or are out-competed and preyed upon by invasive exotics (McKinney, 2006).

2.2. Separation of people from nature

As the fraction of the human population living in or near urban areas continues to increase, more and more people are only coming into contact with nature¹ in an urban setting. Ecologist Raymond Dasmann, who helped shape the modern environmental movement, drew attention to the fact that generations of humans are growing up in cities with no roots in the land and little experience of wilderness (Dasmann, 1966). While urban residents often claim to value biological diversity, the majority of the general public cannot identify whether a species is local or exotic (McKinney, 2002). Two dramatic examples of urban residents' disconnect from and ignorance of their natural environment were described by Miller (2005), who pointed out that most Americans can identify hundreds of corporate logos but fewer than ten native plant species (Hawkin, 1993), and that teenagers in Los Angeles are more likely to correctly identify an automatic weapon by its report than a bird by its call (Nabhan & Trimble, 1994).

For the average city dweller, conservation is often something that happens in distant areas of natural beauty that have experienced little to no human disturbance – in national parks, nature reserves or rainforests. According to Orr (2002), the tendency to focus on distant lands and species that most people will never see is unlikely to foster genuine appreciation of local biodiversity and of native, endemic, and perhaps less charismatic, species. If the majority of the world's population is living in a concrete world far removed from the intricacy and wonder of biological diversity, with little to no knowledge of or personal interaction with the natural environment, the job of the conservation biologist in convincing the general public of the importance of nature conservation will be that much more difficult. According to lepidopterist Robert Pyle, collective ignorance ultimately leads to collective indifference (Pyle, 2002).

2.3. Reconciliation ecology and goals for urban biodiversity conservation

“Reconciliation ecology” is a concept that evolved in an effort to respond to this problem of spreading urbanization, resulting habitat fragmentation and loss, and the growing disconnect between people and the natural environment. It was first articulated by Michael Rosenzweig (2003), who identified a need for “inventing, establishing and maintaining new habitats to conserve biodiversity in the same places where people live, work and play” (Rosenzweig, 2003, p. 7). Reconciliation ecology focuses on designing urban areas that are ecologically valuable, despite not being “wild” or “pristine,” and provide

¹ While the definition of the terms “nature” and “natural” may be controversial, they are used colloquially in this paper to denote areas less affected by human activity.

habitats for native wildlife, as well as humans. This concept further promotes finding ways for civilisation and wildlife to coexist in areas highly modified by human activity. Given the unique challenges and perhaps also opportunities characteristic of the urban landscape, the goals of reconciliation ecologists will differ from traditional approaches to conservation.

Nevertheless, the general motivations are fairly similar and, as discussed by Dearborn & Kark (2008), may include:

1. Understanding and facilitation of species' responses to environmental change

This goal recognizes that natural populations will need to adjust to urbanization, whether by evolutionary adaptation or phenotypic plasticity, and supports research into which species are best adapting to changes resulting from urbanization, as well as which species' characteristics are allowing this adaptation.

2. Providing ecosystem services

A few examples of ecosystem services include the reduction in heating and cooling costs of buildings by vegetated rooftops, the ability of small wetlands to buffer against flooding, and free pest control provided by carnivore species such as foxes and coyotes which prey upon rats and mice.

3. Improving human well-being

A study in Sheffield, England, found that the psychological benefits of exposure to urban green space increases with species richness, as measured by the diversity of plants, birds, and butterflies (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007). Human physical health can also be improved by such ecosystem services as reduction in air pollution (Dearborn & Kark, 2010).

Similarly, Curtin (2010) emphasizes the psychological and emotional benefits of nature. Her study of tourists' reactions to wildlife encounters highlights the restorative effects of nature and wildlife on human well-being. Curtin concludes that experiences and interactions with the natural world may be fundamental to human health and happiness and stresses the importance of urban green spaces in improving quality of life.

4. Connecting people with nature and providing environmental education

As ever more people are growing up in cities, urban areas provide an opportunity to teach environmental processes and conservation to large groups of people (Dearborn & Kark, 2010). Studies have shown that children need personal experience with nature and biodiversity to become passionate about its protection

(Chawla, 1999), yet are spending less time outside and more time in front of the television (J. R. Miller, 2005).

The potential of ecologically-designed green spaces in urban areas for education and reconnecting people with nature is vast. However, if one of the goals of urban biodiversity conservation is reconnecting people with nature, wildlife managers will need to be prepared to resolve potential conflicts between people and wildlife, as “nature” in cities cannot be limited to birds and butterflies in specifically designated spaces.

2.4. Carnivores in urban areas

While the general public may have quite a high appreciation of wildlife in their gardens when the animal in question is a ruby-throated hummingbird (*Archilochus colubris*) or a European hedgehog (*Erinaceus europaeus*) (P. J. Baker & Harris, 2007; Mankin, Warner, & Anderson, 1999; C. A. Miller, Campbell, Yeagle, & Colligan, 2001), they may feel less accommodating towards large carnivores, such as a coyote or mountain lion (*Puma concolor*) (Kellert, 1985). Due to their large size and predatory nature, throughout human history carnivores have come into conflict with people over habitat, space and prey requirements (Karanth & Chellam, 2009). Consequently, large carnivores such as grey wolves (*Canis lupus*), African wild dogs (*Lycaon pictus*), grizzly bears (*Ursus arctos*) or leopards (*Panthera pardus*) have been among the most persecuted of the world’s mammals (Clark, Curlee, & Reading, 1996). The result of this persecution has been the elimination of many large carnivores from human-dominated landscapes.

While cities present a challenging environment for the majority of the world’s carnivores, due in part to human intolerance of their presence (Bateman & Fleming, 2012), human population growth and the resulting increase in urbanized land and concomitant reduction in availability of wilderness areas may either pressure or entice animals to utilize urban habitats. A trend of increasing numbers of carnivores using urban areas has been documented in recent years (Bateman & Fleming, 2012), with examples including a 15-fold increase in the numbers of nuisance coyotes (*Canis latrans*) removed annually from the Chicago metropolitan area in the 1990s (Gehrt, 2011), or the 10-fold increase in complaints about black bears (*Ursus americanus*) in urban Nevada (Beckman & Lackey, 2008).

Urban areas in developed countries often encompass private residential gardens and patches of natural or semi-natural habitat (e.g. woodlands, scrub, golf courses, parks, road verges, railway embankments, churchyards, cemeteries and waterways) that provide food and cover for a range of mammalian species (P. J. Baker & Harris, 2007). Urban habitat features championed by reconciliation ecology, such as

greenbelts, wildlife corridors or planting of native species, attract and provide refuge not only for the hedgehog but for the red fox (*Vulpes vulpes*) and coyote as well. These “green zones” have been found to play an important role in supporting significant numbers of carnivores (Bateman & Fleming, 2012).

Cities may further attract animals due to reliable, non-seasonal sources of food and water (P. J. Baker & Harris, 2007; Bateman & Fleming, 2012). Urban residents are inadvertently attracting wildlife closer to human settlements through the provision of food in the form of garbage, compost piles, spillage from bird feeders, pet food and fruit or vegetable gardens (Bateman & Fleming, 2012; Don Carlos, Bright, Teel, & Vaske, 2009). In a study of red foxes in Zürich, Switzerland, 85 per cent of surveyed households unintentionally provided food for foxes through garbage bins, compost piles, garden fruit or food left out for pets or birds (Contesse, Hegglin, Gloor, Bontadina, & Deplazes, 2004). Both wolves and bears have been documented foraging on garbage dumps near towns (Blanchard, 1987; Boitani, 1992; L. L. Rogers, Kuehn, Erickson, Harger, Verme & Ozoga, 1976; Voigt, Kolenosky, & Pimlott, 1976). Households in urban areas of developed countries may also put out food specifically for urban carnivores, such as badgers and foxes (Bateman & Fleming, 2012; Harris, 1984).

Provision of reliable, highly nutritional food sources, whether intentionally or unintentionally, may be the first step in habituating wildlife to the presence of humans. Feeding has been linked to carnivore attacks on humans in the case of grey wolves (Mader, 2007), dingoes (Thompson, Shirreffs, & McPhail, 2003), and coyotes (Fox, Papouchis, Hirsch, & Lamont, 2005; Timm & Baker, 2007; White & Gehrt, 2009).

While urban carnivores may be valued and even enticed into urban areas by the animal/nature loving sector of society (P. J. Baker & Harris, 2007), their presence often results in conflicts due to potential disease transmission to humans and companion animals, damage to houses and gardens, or direct attacks on people or pets (Bateman & Fleming, 2012). Wildlife feeding is not the only human behaviour that has encouraged dangerous habituation in carnivores. Urban residents, disconnected as they are from nature, have little knowledge of predator behaviour and prefer to avoid acting aggressively when they come into contact with large carnivores, believing that this will prevent the animal from attacking (Bateman & Fleming, 2012). The opposite, however, is true for wolves (Geist, 2007), mountain lions (Beier, 1991) and coyotes (Schmidt & Timm, 2007). Shouting and throwing objects serves to scare the animal away and prevent it from losing its fear of humans.

The majority of large carnivores that have managed to utilize urban areas, such as brown bears, black bears and spotted hyenas (Beckmann & Lackey, 2008; Kaczensky, Knauer, Krze, Jonozovic, Adamic & Gossow, 2003; Patterson, Kasiki, Selempo, & Kays, 2004), do so by moving in and out of the urban

matrix. One relatively large carnivore that has managed to adapt to the urban environment, so as to be capable of spending the entirety of its life in human-dominated areas, is the coyote. Bateman and Fleming (2012) believe the coyote to be one of the most directly dangerous carnivores to humans due to its size (10-16 kg) and ability to live in extremely close association with urban areas. Thus the coyote has emerged as one of the most controversial carnivore species in North American metropolitan areas.

2.5. The rise of the urban coyote



Figure 1. Three coyotes on a road in New Mexico. Photo by Judy Paulson, Project Coyote 2013.

Although originally found primarily in central North America, over the past two centuries coyotes have greatly expanded their geographical range, taking over many areas formerly inhabited by wolves, as European settlement and expansion altered landscape structure and carnivore community composition (Gompper, 2002) (Fig. 2). Coyotes can now be found in every state in the continental United States (Feldhamer, Thompson, & Chapman, 2003).

As omnivorous feeders and opportunistic predators, coyotes have proven particularly successful at adapting to urban and suburban environments and have become established in many metropolitan areas across the United States and Canada (Fig. 1), where they represent the largest carnivore living in such proximity to humans (White & Gehrt, 2009). Bekoff and Gese (2003) reported that their “plasticity in behaviour, social ecology, and diet allows coyotes to not only exploit, but to thrive, in almost all environments modified by humans” (Feldhamer et al., 2003). As the appearance of coyotes in urban environments is a relatively recent phenomenon (Gehrt, 2011), extensive research of urban coyotes’ ecology, population biology, activity patterns and diet is needed for wildlife managers to determine the potential threat coyotes pose to humans and domestic animals, as well as the management techniques needed to minimize human-coyote conflict.

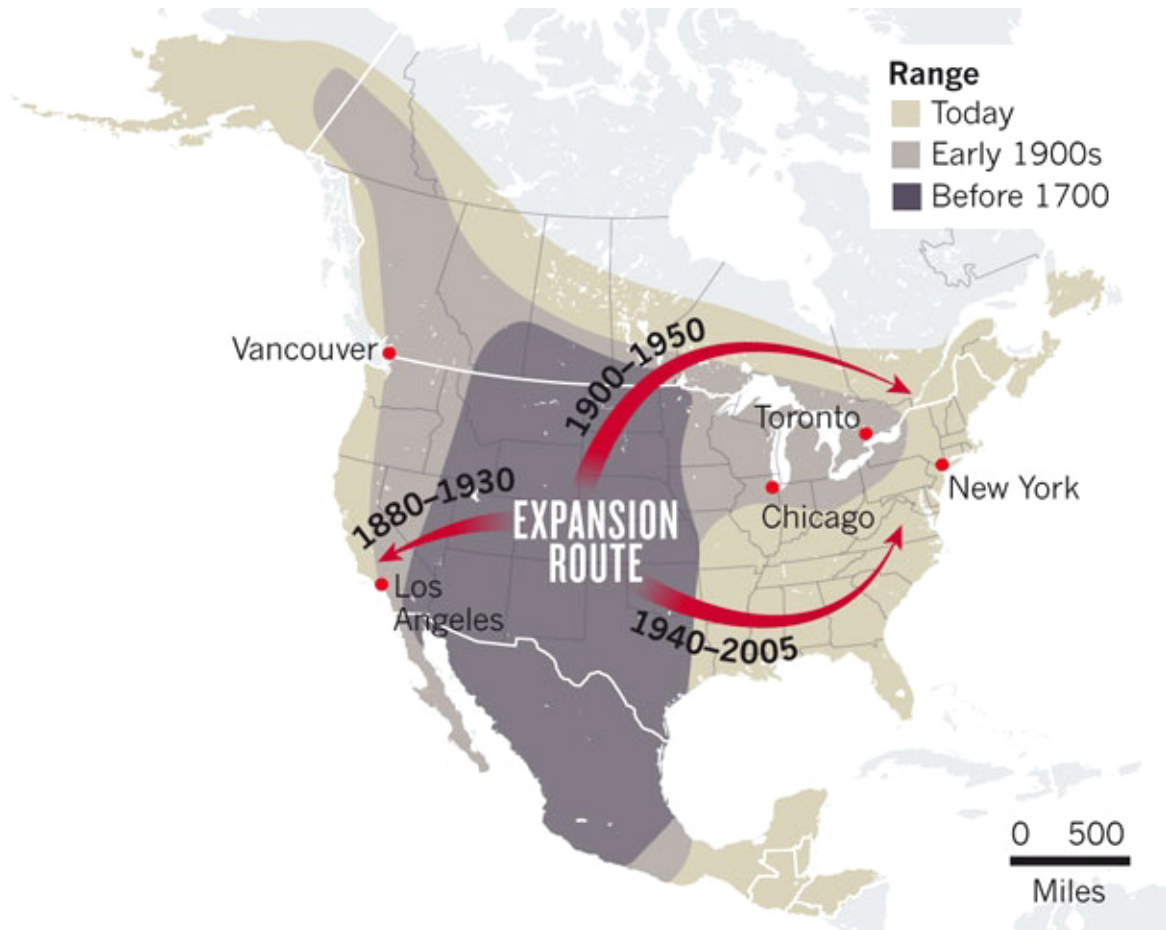


Figure 2. Progression of coyote range expansion in North America and Mexico. Map via the Cook County Coyote Project.

The question arises whether urban growth can be rendered compatible with the conservation of local carnivores. Currently, the coyote, abundant throughout its North American range and increasing in distribution, is far from being endangered. Present abundance, however, is no protection against future extinction, as was illustrated by the disappearance in the early 20th century of the passenger pigeon (*Ectopistes migratorius*) which, in the 19th century, was one of the most abundant birds in the world (BirdLife International, 2012). Consequently, if conservation biologists and wildlife managers fail to promote ways of coexisting with this versatile carnivore, coyotes may begin to disappear from urban areas and, as these continue to expand, from its native prairies in the American mid-west.

2.6. Adapting to city life: Is the urban coyote a synanthropic species?

A synanthropic species, as defined by Gade (2010), is one that has developed an affinity for or reliance on human interventions in the landscape. The question arises of how dependent the urban coyote is on human activities and resources for its survival in cities and suburbs. This is an important question, as

the answer will indicate whether the peaceful coexistence of humans and coyotes is an attainable goal for wildlife managers. If the urban coyote is evolving to rely heavily on human food sources, such as pets or garbage, or is an animal that easily loses its fear of humans, learning to conduct its daily activities in plain sight of people with little attempt at avoidance, conflicts between coyotes and humans are likely to escalate. The following literature review investigates the animal's interactions with people and attempts to answer the question of how urban coyotes are using human-dominated landscapes.

2.6.1. Urban coyote diet

Dietary studies of urban and suburban coyotes have revealed that, although the coyote's diet shifts, depending on the season and the animal's environment, it is consistently dominated by small rodents and lagomorphs (Fedriani, Fuller, & Sauvajot, 2001; Grigione, Burman, Clavio, Harper, Manning & Sarno, 2011; MacCracken, 1982; Morey, Gese, & Gehrt, 2007).

A dietary study by Fedriani et al. (2001) was carried out in the Santa Monica Mountains of California, which lie to the north of the Los Angeles metropolitan area. Three study sites were chosen, characterised by varying levels of human activity. For all the study sites, rodents were most commonly found in feces (37-47 per cent occurrence), followed by lagomorphs (9-18 per cent) and wild fruit (3-23 per cent). Similar results were obtained by Morey et al. in their study of coyotes in the Chicago metropolitan area, where dominant food items included small rodents (42 per cent occurrence), fruit (23 per cent), white-tailed deer (*Odocoileus virginianus*) (22 per cent), and Eastern cottontail (*Sylvilagus floridanus*) (18 per cent).

A study conducted in Pinellas County, Florida (Grigione et al., 2011), compared the diets of coyotes from suburban and wildland habitats across seasons. The researchers found that in the wildland habitat, vegetative matter (96 per cent), *Insecta* (53 per cent), and *Rodentia* (45 per cent) were recovered most often, as opposed to berries (56 per cent) and *Lagomorpha* (32 per cent) in the suburban habitat. Anthropogenic waste was recovered over twice as often from coyote fecal samples collected in the suburban habitat. Although suburban coyotes in Pinellas County continued to rely primarily on lagomorphs and berries for their diet, they were also increasing their use of anthropogenic food as it became more available in their habitat. Thus, the Florida study supports previous research revealing that urban and suburban coyotes, just like their wildland counterparts, are adaptable and opportunistic omnivores whose diet depends on what is most available as well as desirable in their habitat. Coyotes use anthropogenic foods when these are easily accessible but continue to prefer items such as rodents, lagomorphs and vegetative matter.

These studies revealed increasing frequencies of human-related foods in the diets of coyotes with habitats in greater proximity to residential areas. For example, in the most developed area of the California study (Fedriani et al., 2001), anthropogenic food items (which the authors defined as trash, livestock and domestic fruit) comprised between 14 and 25 per cent of all items in the coyote scats, depending on the season. Human-related foods found in the Chicago metropolitan area study (Morey et al., 2007) occurred in 2 per cent of scats analysed and included fast food wrappers, pieces of rubber, candy wrappers, plastic, string, aluminium foil and dog food. The use of human-associated food items in the Chicago study was much lower than that found in the California study, revealing that the Chicago coyotes continued to rely primarily on prey and vegetation even though they had access to refuse and pet food (Gehrt et al., 2010). Human-coyote conflicts in the Chicago metropolitan area are rare, which may be linked to the low levels of anthropogenic food items found in their diet. Although human-related food made up 25-30 per cent of coyote food item occurrence in the Southern California diet studies (Fedriani et al., 2001), the most common anthropogenic item was domestic fruit (Gehrt et al., 2010).

Easy, year-round access to food in cities and suburbs may attract coyotes to venture closer to human residential areas. Intentional or unintentional feeding of coyotes by people may further encourage these adaptable canids to lose their fear of humans and associate them with food, resulting in escalating levels of conflict between people and coyotes. Timm et al. (2004) suggested that the use of anthropogenic food by coyotes may be a precursor or contributor to coyote attacks on people and pets (Timm & Baker, 2007).

The threat of coyote predation on pets is a major contributor to human-coyote conflict. Domestic cat or dog remains, however, are consistently found in low frequencies in dietary studies (Fedriani et al., 2001; MacCracken, 1982; Morey et al., 2007). In California, domestic cat was only found in trace amounts for scats collected across all study sites, apart from the most developed area where domestic cat was found to make up 1 per cent of food items in coyote feces during the wet season (Fedriani et al., 2001). In the Chicago area, domestic cat remains were found in 1 per cent of coyote scats (Morey et al., 2007), suggesting that urban coyotes are not relying on pets for food. This data is supported by the relatively low number of reported coyote attacks on pets in the Chicago area (see section 2.8. "Threats coyotes pose to humans and pets"), with 6-14 reported attacks per year.

An important conclusion to be drawn from this review of diet studies is that urban coyotes are not currently dependent on human-associated food items, including pets, for their survival. Coyotes are flexible omnivores and will utilize food items that are abundant in their environment, and this flexibility protects them from dependence on any one food source. Thus, the conflict that occurs between people

and coyotes as a result of pet attacks and deaths might be mitigated by responsible pet ownership. Pets that are properly supervised are less likely to fall prey to coyotes. Thus, if residents are aware of coyote presence in their neighbourhood, they could refrain from letting their cats roam free or leaving their small dogs outside unattended.

2.6.2. Home range

Studies have revealed a trend for mean home range estimates from urban coyote populations to be smaller than for rural populations (Gehrt 2007, Bekoff & Gese 2003). Gehrt (2007) surveyed nine studies which reported annual home range estimates for resident coyotes from eight urbanized areas (Table 1).

Table 1. Annual home range sizes (km²) from radiotelemetry studies of coyotes in urban areas. Sample sizes include total number of radiocollared coyotes (N) in the study, and sample size (n) for home range estimates. Adapted from Gehrt, 2007.

METRO AREA	N	HOME RANGE SIZE (N)	SOURCE
Tucson, AZ	19	13 (13)	Grinder & Krausman 2001 a,b
Lincoln, NE	1	7 (1)	Andelt & Mahan 1980
Lower Fraser Valley, BC	13	11 (13)	Atkinson & Shackleton 1991
Los Angeles, CA	86	5 (40)	Riley et al. 2003
Albany, NY	21	7 (17)	Bogan 2004
Cape Cod, MA	11	30 (5)	Way et al. 2002
Los Angeles, CA	13	3 (13)	Tigas et al. 2002
Chicago, IL	150	5 (109)	Gehrt et al. 2009

After excluding the mean for Cape Cod as an outlier, the urban home range across studies had a grand mean of 7.3 km², compared to a grand mean of 17.5 km² for resident coyotes in rural areas (Bekoff & Gese, 2003). Two studies further found a positive relationship between home range size and amount of developed property (Gehrt, Anchor, & White, 2009; Riley, Sauvajot, Fuller, York, Kamradt, Bromley & Wayne, 2003), suggesting either that developed areas do not provide enough suitable habitat for hunting, or that coyotes shun highly developed areas within their home range in an effort to avoid people. Apart from resident coyotes, which belong to a social group and defend their territory (McClennen, Wigglesworth, Anderson, & Wachob, 2001), urban coyote populations also consist of solitary,

nonterritorial transients whose home ranges have been found to be larger than those of resident coyotes (Gehrt et al., 2009).

Gehrt et al. (2009) further analysed coyotes' preference for land-use types in the heavily urbanized landscape of the Chicago metropolitan area. The authors concluded that coyote home ranges largely comprised areas protected from development and in many cases home ranges were found almost completely within large fragments of natural habitat. However, the authors noted great individual variation, with some coyotes maintaining territories in areas of little or no natural habitat, and even utilizing areas within the inner core of the city of Chicago. Similar results were obtained by Riley et al. (2003) who concluded that although coyotes utilized developed areas, they were mainly associated with natural areas. Gehrt et al. (2009) found no evidence suggesting that coyotes were attracted to human-associated areas within the animal's home range.

These studies suggest that although coyotes are capable of living in large cities with high human densities, they prefer to avoid people by using semi-natural areas that provide cover and abundant hiding places, such as urban parks, cemeteries, or golf courses. The animal's natural wariness of humans should be encouraged, for example through "hazing." Hazing, also known as "fear conditioning," is a wildlife control technique whereby humans who encounter coyotes respond in a way that makes the animal uncomfortable or fearful of close human presence. Hazing might include yelling, waving arms, throwing projectiles or spraying the coyote with a hose or water gun. The goal of hazing is to discourage coyotes from adapting and becoming habituated to human presence, and to reinforce the animal's natural wariness of people. Because the coyote is naturally shy and skittish around people, hazing, i.e. human behaviour, can be used successfully to shape coyote behaviour (The Humane Society of the United States, n.d.; Project Coyote, n.d.; Stanley Park Ecology Society, n.d.).

These studies further bring to our attention the fact that the environmental features encouraged by reconciliation ecology can also provide attractive, resource-rich habitat for urban carnivores such as the coyote. Thus, if indeed we wish to live in cities that still contain some of the beauty and diversity of surrounding local ecosystems, we will need to learn how best to live with the wildlife that these types of areas attract, in a way that takes into account both human safety and the conservation of native species.

2.6.3. Nocturnal activity

Whereas coyotes in the wild are mainly active throughout the day and evening, urban coyotes appear to have shifted their activity to nighttime in order to avoid humans (Grinder & Krausman, 2001; McClennen et al., 2001; Riley et al., 2003). Shargo (1988) found that Los Angeles coyotes were foraging in residential areas at night, returning to adjacent chapparal to rest in the daytime. Gehrt (2007) cautions

that given the consistency of this behaviour across studies in urban areas, exceptions to the urban coyote's nocturnal pattern could be a good indicator of habituation to people, which in turn may lead to conflict.

The urban coyote is able to thrive in human-dominated areas by shifting its activity pattern to avoid times of high human activity, primarily utilizing areas that provide sufficient cover and focusing its activity on habitat fragments protected from development. The picture of the urban coyote that emerges from this review is of a highly adaptable animal that is capable of living in areas of high human activity thanks to its ability to avoid people, both spatially and temporally. The coyote is capable of exploiting and thriving in landscapes heavily altered by human activity. They are not, however, dependent on human activities or food sources and have altered their behaviour in order to avoid interactions with people. With a better understanding of people's actions and activities, this avoidance behaviour can and perhaps should be encouraged, particularly if there are benefits deriving from coyote presence in urban areas.

2.7. Ecological role of coyotes: Can their presence benefit the urban system?

As a result of the eradication of the grey wolf (*Canis lupus*) by humans from much of its former range, the coyote was released from competitive pressure with the wolf, allowing the smaller canid to spread beyond the Midwest and western North America (Gompper, 2002). In ecosystems such as Yellowstone where wolves have been reintroduced, coyotes can be defined as mesopredators, or omnivorous, mammalian predators between 1 and 15 kg in body weight, as defined by Buskirk (1999). In areas where wolves and other large predators have disappeared, however, coyotes have taken over the role of apex predator (Gompper, 2002), controlling smaller medium-sized predators such as grey foxes, domestic cats and opossums (Crooks, Riley, Gehrt, Gosselink & Van Deelen, 2010). Yet some biologists argue that coyotes can only partially mimic the role of wolves in their influence on ecosystem function, which has distorted ecological relationships over large geographic areas and temporal scales (Biggins, Harlow, Harlow, Miller, & Ripple, 2012).

Fox populations have been shown to be limited by coyotes, both through predation and overlapping prey use (Nelson, Cypher, Bjurlin, & Creel, 2007), with coyotes being identified as the primary source of mortality for kit foxes (*Vulpes macrotis*), swift foxes (*Vulpes velox*) and potentially so for red foxes (*Vulpes vulpes*) and grey foxes (*Urocyon cinereoargenteus*) (Gehrt & Prange, 2007). Competitive exclusion of foxes from coyote territory has been shown to benefit ground-nesting ducks in the Prairie Pothole Region of North and South Dakota by reducing nest depredation by foxes (Sovada, Sargeant, & Grier, 1995). The authors further speculate that coyotes may have a deleterious effect on Canada goose

(*Branta canadensis*) nests, for although the Canada goose may be able to defend its nest from foxes, it would be susceptible to predation by the larger coyote. This hypothesis was confirmed in a Master's thesis study by Brown (2007), where coyotes were found to be the primary predator of Canada goose nests in the Chicago metropolitan area, responsible for over 75 per cent of depredated nests. Given that Canada geese have become overabundant in urban areas in the United States, resulting in lethal culls being implemented by the U.S. Department of Agriculture (Board of Park Commissioners, 2001), nest predation by coyotes can be viewed as providing free pest control.

In a study of coastal southern California, the decline of the coyote was predicted to result in the ecological release of native and exotic mesopredators, including striped skunks, raccoons, grey foxes, domestic cats and opossums (Crooks & Soule, 1999). Increased predation by these smaller mammalian predators would in turn lead to higher mortality and local extinction rates of scrub-breeding birds. The results of the study supported the authors' hypothesis, with the decline of coyotes resulting in greater numbers of mesopredators that prey heavily on birds and other small vertebrates. The authors suggested, however, that it was the top-down effect of coyotes on cats that likely had the strongest positive impact on the diversity and abundance of scrub breeding birds.

These findings are supported by a study in Lux Arbor Reserve in southwest Michigan, where coyotes were believed to increase song sparrow nest success by preying on, or otherwise influencing, the abundance of raccoons and other mesopredators (C. M. Rogers & Caro, 1998). Interestingly, in two studies of the impact of coyotes on skunks and raccoons in north-eastern Illinois, Gehrt and Prange (2007) failed to document any raccoon or skunk mortalities as a result of coyote predation and further found little evidence of either raccoons or skunks avoiding coyote habitat. The authors caution that relationships between mesopredators, especially omnivores, may be more complex than a simple linear hierarchy based on body size.

A study in western Texas investigated the effects of removing coyotes on populations of rodents, lagomorphs, raptors and mammalian mesopredators, which included badgers, bobcats, striped skunks and grey foxes (Henke & Bryant, 1999). The results revealed an increase in mesopredator populations, and decrease in rodent richness and diversity on sites where coyotes were removed. Coyotes had no discernable effect on cottontail density, though they did have a regulatory effect on jackrabbits.

In rural areas, coyotes have been shown to be important predators of deer fawns, accounting for 79 per cent of early fawn mortality in a study of mule deer (*Odocoileus hemionus*) and white-tailed deer (*O. virginianus*) in Colorado (Whittaker & Lindzey, 1999). Coyotes were also found to be the primary

predators of fawns in two parks in the Chicago metropolitan area, with predation rates of 20-80 per cent (Gehrt & Riley, 2010).

Thus, as the top predator capable of living in urban systems, coyotes have the potential of playing an important role in controlling populations of some abundant urban “pest” species, such as Canada geese and white-tailed deer. According to Willowbrook Wildlife Center naturalist Jack McRae, “any ecosystem is going to be healthier if there are predators involved. And coyotes are the biggest predators we have now” (Jack McRae, personal communication, 2013). This view was supported by Max McGraw Wildlife Foundation researcher Heidi Garbe, “wildlife managers will spend a lot of resources trying to regulate certain wildlife populations, but in having a coyote population, we have a natural predator that is helping to control overabundant species” (Heidi Garbe, personal communication, 2013).

Further studies are needed to investigate the impact coyotes have on rats and mice in urban areas. Coyotes may further have a positive effect on the diversity and abundance of songbirds through their control of mesopredators such as grey foxes, domestic cats and possums. While urban residents may appreciate the coyote’s positive impact on songbird abundance, the majority of cat owners are likely to resent the coyote’s ability to effectively control populations of free-ranging domestic cats. However, keeping cats indoors is a simple solution for preventing coyote killing of companion animals.

2.8. Threats coyotes pose to humans and pets

2.8.1. Coyote attacks on people and pets

While most human-coyote encounters are merely sightings (Fox, 2006), attacks on people or their pets in cities and suburbs do occur. With an average of 3.5 attacks on people per year since 1960 (White & Gehrt, 2009), compared to an estimated 4.7 million dog bites occurring in the US each year (Centres for Disease Control, 2003), coyote attacks on people are quite rare. The majority of reported urban coyote attacks on humans have taken place in California (Fig. 3).

White and Gehrt (2009) conducted a study of coyote attacks on humans in the United States and Canada. They investigated 142 reported attack incidents

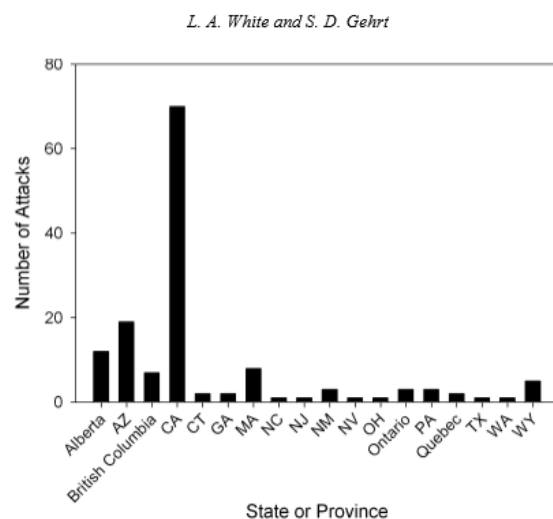


Figure 3. Geographic distribution of coyote attacks on humans (n=142) in the United States and Canada, during 1960-2006. From White and Gehrt (2009).

which resulted in 159 victims bitten by coyotes between 1960 and 2006. Attacks were documented in 14 U.S. states and four Canadian provinces. The study reported that most attacks occurred in the western United States, with 49 per cent of attacks in California and 13 per cent in Arizona. Gehrt and his research team (Cook County Coyote Project, n.d.), found no records of coyote attacks on people within the Chicago metropolitan area, or even within the state of Illinois.

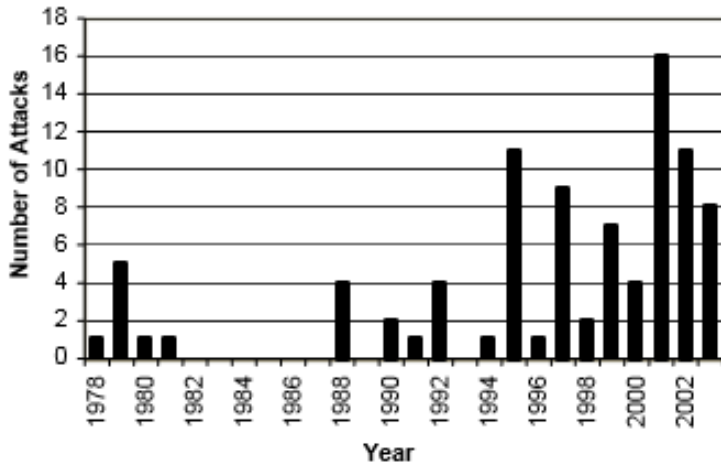


Figure 4. Number of coyote attacks on people and pets in California, from 1978-2003. From Timm et al. (2004).

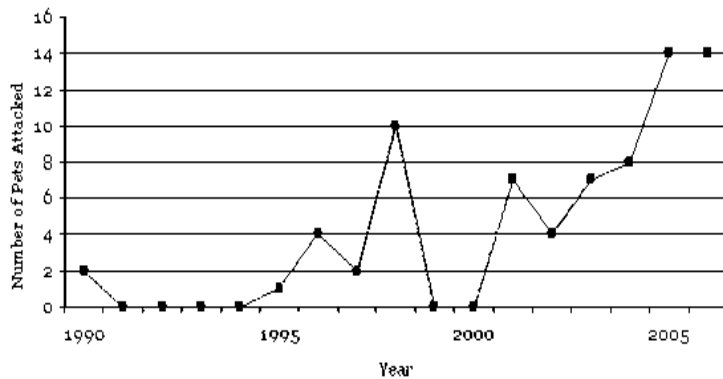


Figure 5. Coyote attacks on domestic pets in the Chicago metropolitan area. From the Cook County Coyote Project, n.d.

To date, two people have been reported killed by coyotes. The first incident took place in Glendale, Los Angeles County, California in 1981, when 3-year old Kelly Keen was attacked while playing in her driveway. The child died of the wounds sustained in the attack (Timm et al., 2004). More recently, in 2009, 19-year old Taylor Mitchell was attacked and killed by a pack of coyotes while hiking alone in Cape Breton Highlands National Park in Nova Scotia, Canada (Cook County Coyote Project, n.d.).

Timm et al. (2004) described an alarming increase in coyote attacks on adults, children and pets in California (Fig. 4) and suggested that as coyotes become habituated to humans, they lose their fear of them and begin to regard small children as prey. In his report on the urban coyote problem in Los Angeles County, Howell (1982, p. 21) describes the suburban edge as a coyote paradise:

Affluent residential properties now extend into more than 100 lineal miles of mountain ranges spread out over many pockets of native brush and canyons where coyotes feel very comfortably at home, refusing to retreat as have most other predators. Coyotes have discovered the human environment here to be ideal, providing them with abundant food choices such as readily available household garbage, pet foods, small pets, vegetable gardens, water and vast assortments of other leftovers conveniently accessible day or night.

These landscapes further support an abundance of rodents and rabbits (Timm et al. 2004), which continue to form the basis of the urban coyote's diet.

While the Chicago metropolitan area has also recently been populated by a growing number of coyotes (Gehrt, 2004), there have not been any verified attacks on humans within Cook County, which is associated with the Chicago metropolitan area in Illinois (Gehrt et al., 2010). Homeowners in the Chicago area, however, have ranked coyotes as the wildlife species posing the most severe threat to human health and safety (C. A. Miller et al., 2001). While they reported no bites to people, the Cook County Coyote Project (n.d.) did find an increase in pet attacks, from 0-2 reported attacks per year in 1990 to 6-14 per year in 2004 (Fig. 5).

Previous research on coyote attacks on humans (R. O. Baker & Timm, 1998) has attempted to identify a predictable sequence of observed changes in coyote behaviour that would indicate dangerous levels of coyote habituation and an increasing risk of attacks on humans. This sequence included an increase in sightings of coyotes in streets and yards during the day, instances of coyotes chasing or taking unattended pets, coyotes attacking pets on leashes or with their owners, and coyotes being observed around children's play areas. Gehrt and Riley (2010), however, criticize Baker and Timm's (1998) interpretation of their results as being inconsistent and based on inaccurate information concerning the ecology and behaviour of urban coyotes.

White and Gehrt (2009) attempted to identify patterns in the details of coyote attacks and determine victim demographics. The researchers classified coyote attacks on 159 victims into five behavioural categories: predatory, investigative ("testing" victims as possible prey sources), pet-related, defensive (when the coyote is cornered or defending pups and/or a den) and rabid. The study found that victims of predatory attacks were primarily children and the researchers hypothesize that if coyotes become overly habituated to humans, they may begin to see small children as potential prey. An early study by Lehner (1976) suggested that coyotes may be stimulated to attack by escape behaviour, such as children running during play.

All studies on human-coyote conflicts have pointed to people providing food for coyotes either intentionally (leaving out food specifically for coyotes) or unintentionally (leaving food in the yard for pets or other wildlife such as birds and squirrels) as possible causes of coyote habituation, which in turn can lead to attacks on humans and pets (e.g. White & Gehrt 2009; Fox 2006; Baker & Timm 1998; Timm et al. 2004). Gehrt and his colleagues (Cook County Coyote Project, n.d.) commented that in almost a third of reported attack cases, coyotes were being fed, intentionally or accidentally and, after

contacting wildlife officials from areas of coyote attacks, they further believe that feeding of wildlife occurred at other attack sites but was not documented.

The public does not necessarily make the connection between feeding of wildlife and coyote attacks and researchers recommend the implementation of educational programs, especially in areas that report coyote sightings, as a pre-emptive strike against potential coyote attacks (White & Gehrt 2009; Fox 2006; Timm et al. 2004). Such programs should encourage residents to keep their dogs on leashes, their cats inside, and their yards free of pet food or other items attractive to coyotes. Educational programs should further describe how people ought to react when approached by a coyote – waving arms, yelling and throwing objects at the coyote may help re-instil the animal’s natural fear of humans (Gehrt, 2006). Timm et al. (2004) believe, however, that in some cases where coyotes have become nuisances, trapping and shooting are the best methods of preventing potential attacks. Fox (2006) notes that if coyotes in a particular area have not become nuisances and continue to avoid humans, it is best to leave them alone. Removing them would result in new coyotes claiming the vacated territory and these coyotes may be bolder or more aggressive, potentially leading to conflict with their human neighbours.

2.8.2. Diseases associated with coyotes

The health risk posed by coyotes to humans and domestic pets is not restricted to coyote attacks. Although coyote-strain rabies has currently only been found in Mexico and south Texas, coyotes can be infected with rabies from other species such as raccoons (Gehrt & Riley, 2010). To date, however, attacks on humans by rabid coyotes remain infrequent, with 10 recorded cases, in which the coyote was captured and tested positive for rabies (White & Gehrt, 2009).

Coyotes also serve as hosts for the mite *Sarcoptes scabiei* which causes sarcoptic mange in canids and can be spread to domestic dogs. Coyotes infected with mange are not aggressive but will approach houses and people in daylight in search of food and cover, and thus are more likely to be observed and reported as a “threat” by the public (Cook County Coyote Project, n.d.).

Coyotes can carry the dog tapeworm *Echinococcus granulosus*, which can cause hydatid cyst disease in humans, and canine heartworm which can spread to dogs through mosquito vectors (Timm et al. 2004). In a study of 85 radio-collared coyotes in Cook County, researchers found that the rate of heartworm

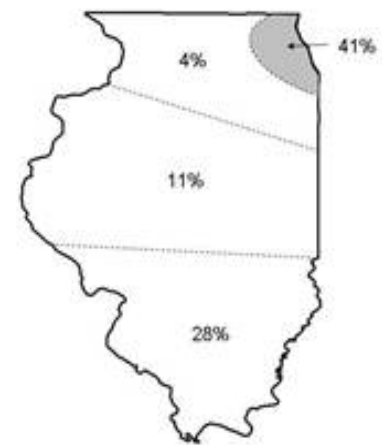


Figure 6. Prevalence of heartworm infection in rural coyotes across southern, central, and northern Illinois (from Nelson et al., 2003) and in urban coyotes in Cook County (from the Cook County Coyote Project, n.d.).

infection among coyotes in Cook County was approximately 10 times greater than for coyotes from rural areas in northern Illinois (Fig. 6).

Coyotes are also a potential source of canine parvovirus infection for domestic dogs (Gese et al., 1997). Urban coyotes may further be exposed to both canine adenovirus, which causes infectious canine hepatitis, and canine distemper. While canine hepatitis can spread between canids (including domestic dogs), an infected coyote cannot transmit the virus to humans. Canine distemper also is not known to be transmissible to humans. It can, however, affect unvaccinated pets (Merck Veterinary Manual, 2006).

2.9. Human dimensions of coyote management

Coyotes and their ability to adapt to the urban environment are only one aspect of this particular human-wildlife problem. Just as important, though much more difficult to investigate and predict, are human attitudes towards coyotes and resulting human behaviours affecting America's song dog.

As cities continue to grow and expand and nature reserves continue to shrink, no wildlife manager will be able to focus solely on the biological and ecological aspect of wildlife management, especially given the fact that the human dimensions of wildlife conflict are often the most difficult and frustrating to understand and manage (Decker & Chase, 1997; Manfredi, Decker, & Duda, 1998). Reflecting on conservation efforts, Mascia et al. (2003) went so far as to assert that social aspects are often the determining factor of a conservation intervention's success or failure. Given that the greatest increase in human-wildlife conflicts appears to be taking place in urban and suburban environments (Decker & Chase, 1997), wildlife managers in these areas require information on how people regard wildlife, how their attitudes influence their behaviours affecting wildlife, and how to incorporate this knowledge into education programs and management strategies that will decrease the number and severity of human-wildlife conflicts. In recognition of the fact that many wildlife conflicts stem from the behaviour of people, human dimensions research attempts to identify ways to influence human thought and behaviour affecting wildlife (Manfredi, Decker, et al., 1998). Such research seeks to identify what people think and do regarding wildlife, specifically large carnivores in this case, understand the reasons for their attitudes and behaviour, then incorporates these findings into education programs and wildlife management techniques (Decker & Lipscomb, 1991).

The first section of the literature review was concerned with exploring coyote behavioural adaptations to the urban environment. The following section explores human attitudes, perceptions, and knowledge of carnivores and how these may potentially affect human behaviour and wildlife management preferences.

2.9.1. Attitudes and perceptions of carnivores

In examining attitudes towards wolves, grizzly bears (*Ursus arctos horribilis*) and mountain lions in North America, Kellert, Black, Rush & Bath (1996) defined various human attitudes as a consequence of four interacting variables:

1. People possess basic values toward animals and nature which will affect their perceptions of individual species.
2. The physical appearance and behavioural characteristics of an animal will influence people's attitudes towards them.
3. People's knowledge and understanding of an animal can influence their attitudes.
4. Exposure to and interactions with the given animal species can affect people's perception of them.

With regards to the first point, coyotes, along with wolves and rattlesnakes, have traditionally been viewed by European settlers of North America as intrinsically worthless animals (Kellert et al., 1996). The coyote has been held responsible for considerable losses to livestock producers (Kellert, 1985) and coyote killing contests continue to be held in efforts to exterminate the "pest."

Kluckhohn and Strodtbeck (1961) concluded that domination is the most prevalent value orientation in North America. People holding a domination, or "wildlife use" value orientation (Manfredo & Dayer, 2004), believe animals are important only in terms of their usefulness to people, and support such activities as hunting and fishing. North American views of wildlife seem to be shifting, however, and Manfredo et al. (1998) propose that attitudes towards carnivores are becoming more protectionist, as opposed to utilitarian. In highly urbanized metropolitan areas, residents are more likely to value wildlife in much the same way they value pets and people (Mankin et al., 1999). Value orientations may therefore be shifting from wildlife use to wildlife protection, with proponents of wildlife protection believing that animals possess intrinsic value (irrespective of their usefulness to people) and rights similar to those of human beings (Manfredo & Dayer, 2004).

Thus, in contrast to the traditional approach of extermination and control, the desire to protect predators is becoming a dominant attitude in American society (Schmidt & Timm, 2007). Mech (1995) reflects on the effect of this shift in perceptions on wolf conservation, describing how our traditional image of the vile, dangerous wolf is being replaced by a new mythology of the noble, unjustly persecuted wolf (Mech, 1995).

Some wildlife managers believe that large carnivores' fear and avoidance of humans is a learnt behaviour, resulting from years of persecution, hunting and trapping (McCullough, 1982; Schmidt & Timm, 2007). In the case of black bears, McCullough (1982) suggested that hunting resulted in selective removal of aggressive individuals and in survivors, the learnt behaviour of avoiding humans. Hunting and trapping of large carnivores, however, are no longer supported by those holding protectionist views of wildlife. Mech (1995) recognized that the same cultural shift that allowed for wolf recovery in the United States also fostered an extreme degree of wolf protectionism, with those who enthusiastically support wolf recovery opposing any form of wolf control. The protectionist approach to carnivores, coupled with the general public's limited knowledge of wildlife ecology and behaviour, has resulted in potentially dangerous animals such as bears, wolves and coyotes becoming habituated to human presence.

Geist (2007) defines habituation as an animal's "decreased responsiveness to humans due to repeated contact (...). Unfortunately, habituated animals, those who have developed a psychological patience with our presence, are potentially much more dangerous than non-habituated, or 'wild' animals, because habituation is a state of unconsummated interest on the part of the animal, expressing itself as tolerance of and even an attraction to humans" (Geist, 2007). Some members of the public are providing wild carnivores with food rewards (in the form of garbage, compost piles or even direct feeding) for bold behaviour and few are punishing habituation, whether it be by throwing objects and otherwise hazing, or the traditional methods of hunting and trapping. Habituated carnivores can become dangerous, and thus the human attitudes and behaviours allowing habituation need to be understood and targeted by wildlife co-existence campaigns.

Despite the recent shift towards carnivore protection, attitudes toward wildlife remain ambivalent. On the one hand, people enjoy seeing wildlife in their neighbourhoods and perceive this as giving them a higher quality of life. On the other hand, they are afraid of some of the consequences of living with their wild animal neighbours (König, 2008). This suggests the need for an investigation of factors that have frequently been found to influence people's perceptions and attitudes towards carnivores, with a particular focus on how these factors may influence attitudes towards urban coyotes, including the effect of personal experience on attitudes.

2.9.2. Effect of personal experience on attitudes

In support of the point made by Kellert et al. (1996) that exposure to an animal affects human perceptions (see section 2.9.1. "Attitudes and perceptions of carnivores," above), a study of public attitudes toward the endangered San Joaquin kit fox in California found that respondents' exposure to and appreciation

of foxes were directly related. Those who had more personal experience with foxes held more positive attitudes towards their conservation (Bjurlin & Cypher, 2005). With regards to the larger coyote, the effects of exposure to the animal and public perceptions would be more difficult to predict. While seeing or hearing a coyote may be a positive experience for some residents, it could be a negative one for others. Fox (2006) stated that with coyotes, sightings are enough for some residents to report human-coyote conflict. The effects of encounters or interactions with coyotes are partially dependent on the person's pre-conceived ideas and beliefs about the animal, as well as the coyote's appearance and behaviour during the encounter. Residents may have no strong opinion about coyotes until their own pet is attacked, injured or killed, or until someone in their neighbourhood is bitten (Schmidt & Timm, 2007). As negative encounters with wildlife are likely to result in negative attitudes, a potential way forward, if these animals are to continue to live in close proximity to humans, is for wildlife managers to work proactively to prevent conflicts between urban and suburban residents and coyotes.

2.9.3. Fear

Fear has been found to be one of the main factors influencing people's attitudes towards predators (Hook & Robinson, 1982). Research on attitudes towards three large carnivores in Slovakia (Wechselberger, Rigg & Beřková, 2005) found that fear played a key role in influencing the opinions of hunters, shepherds, farmers, foresters and tourists. Hunziker, Egli & Wallner (2001) found that families with small children had lower acceptance of predators and the younger the children were, the lower the acceptance. It is reasonable to hypothesize that people with small children or pets, which are more susceptible to coyote attacks than adults due to the smaller size of the carnivore, will be more afraid of coyotes and less supportive of the animal's presence in cities and suburbs.

The National Canine Research Council describes domestic dog bite-related fatalities as exceedingly rare. In 2012 in the United States, 34 people died of dog bites within a human population of over 310 million and a canine population estimated at over 70 million (National Canine Research Council, n.d.). Coyote-bite related fatalities have only occurred twice in recorded history. An estimated 4.7 million dog bites occur in the US each year (Centres for Disease Control, 2003), compared to the 159 victims bitten by coyotes over a 46 year period in the US and Canada (White & Gehrt, 2009). Considering how closely associated coyotes have become with urban and suburban areas, the number of coyote attacks on humans is surprisingly low. However, devastating events, even when extremely rare, can have a disproportionate effect on people's fear and risk perceptions (Dickman, 2010).

2.9.4. Knowledge

Kellert et al. (1996) believe that people's knowledge and understanding of a particular species could influence their attitudes toward the animal. Thus it is possible for stakeholders' beliefs to change as they gain knowledge and experience with a given species (Decker & Chase, 1997). However, Kellert et al. (1996) also noted that people often use newly gained knowledge to reinforce and rationalize attitudes they already held. This view is supported by Meadow, Reading, Phillips, Mehringer & Miller (2005), who concluded that when attitudes or values are strongly held, new information is selectively received, interpreted and remembered, serving only to reinforce the individual's previously held position.

Attitude studies have found that the preferred method for managing problem wildlife is increased public education (Mankin et al., 1999; Reiter, Brunson, & Schmidt, 1999). In a study of attitudes and perceptions of the Illinois public regarding using and managing wildlife, Mankin et al. found that a high percentage of respondents believed that wildlife added value to their lives and that conservation education should be a priority, with 97 per cent agreeing on the importance of wildlife and conservation education in schools. The same study concluded, however, that increased urbanization continues to distance citizens from natural environments and few people receive accurate, in-depth, ecological information on living with wildlife.

A study conducted by Draheim et al. (2013) on attitudes of college undergraduates towards coyotes in the Washington D.C. metropolitan area found that the majority of respondents lacked basic knowledge of coyote ecology and behaviour. Among respondents, 59.4 per cent believed coyotes were obligate carnivores, eating only meat, 57.8 per cent believed the average weight of an adult male coyote was 45 kg, and 70.2 per cent of respondents thought coyotes were in danger of becoming extinct. A similar lack of knowledge was found by Kristine Webber in her 1997 Master's thesis on public perceptions of urban coyotes in the Greater Vancouver Regional District (GVRD). Only 25 per cent of respondents correctly identified the average weight of a coyote (between 9-14 kg). Moreover, GVRD respondents were poorly informed about coyote diseases that can affect people and their pets.

City residents' lack of knowledge concerning coyotes is often revealed in their actions and behaviour. Lawrence and Krausman (2011) conducted a survey on public reactions to urban coyotes in Tucson, Arizona. The survey was originally conducted in 1992, then repeated in 2007 and responses were compared between years. The authors found that the majority of residents felt quite comfortable around coyotes and did not harass or scare away animals that appeared to be equally comfortable around humans. Coyote sightings had increased from 1992 to 2007, and coyotes were so habituated to people

that they were approaching dogs on leashes. Only residents who viewed coyotes as a nuisance harassed them.

As mentioned earlier, feeding coyotes, whether intentionally or unintentionally, is a major contributor to human-coyote conflict (Fox, 2006). Easily accessible food will attract coyotes to people's yards, which will lead to more interactions with people. When residents fail to harass increasingly bold animals, coyotes will lose their natural fear of people, which in turn can lead to attacks on pets, children or even adults. The urban coyote's current behavioural adaptations result in it avoiding human interaction, both temporally by shifting its activity to night time, and spatially by hunting and foraging in areas that provide cover. Human behaviours, such as feeding and failing to scare away coyotes, are allowing the animal to develop new behavioural responses to people. If human habitats are rich in resources such as food and water and humans themselves are discovered to pose no threat, coyotes will be able to revert to crepuscular (dawn and evening) or diurnal foraging and use urban/suburban areas even at the height of human activity.

2.9.5. Urban wildlife management preferences

Previous studies have noted that people are less supportive of lethal wildlife control methods, and opposition is greater from those who have grown up in cities or suburbs (Draheim et al., 2013; Mankin et al., 1999; Reiter et al., 1999). Kellert (1979) and Arthur et al. (1979) found that the majority of respondents disapproved of indiscriminate trapping and killing of coyotes but would support management strategies that selectively targeted the coyotes causing the problems.

The challenge of managing large predators in an urban setting is well illustrated by the efforts of the Colorado Division of Wildlife, coping with mountain lions in Denver, Colorado (Manfredo, Zinn, Sikorowski, & Jones, 1998). On the one hand, the public expect the agency to ensure their safety from mountain lion attacks in the Denver metropolitan and foothills area. On the other hand, when the agency takes steps to discourage lions from entering urban and suburban areas through hazing or destroying problem animals, certain members of the public raise strong opposition. The study by Manfredo, Zinn, et al. (1998) of public acceptance of mountain lion management in Denver revealed that the majority of respondents rated hazing as unacceptable in all situations.

Capturing and relocating is often the public's preferred management method for animals that are causing problems but have not killed a person (Manfredo, Zinn, et al., 1998; Reiter et al., 1999). It is often the case, however, that suitable habitat for the animal, whether it be a mountain lion or coyote, is already occupied and so the relocated animal will be chased out of the already-claimed territory, or killed. Relocated coyotes further tend to try to return to their original territory and are often killed while

crossing roads (Gehrt et al. 2010). Finally, the relocated animals are usually bold individuals who have lost their fear of humans and have started coming too close to people or taking pets. By capturing and relocating them, wildlife managers are simply moving this problem to someone else's neighbourhood.

2.9.6. Pet ownership

Pet owners are important stakeholders in coyote management programs, as urban coyotes will take cats and small dogs, as well as other small pets such as rabbits or chickens, and may attack larger dogs (Fig. 7). Furthermore, dog owners are more likely to come across coyotes while walking their pets in the early morning or late evening, and coyotes seem to show more interest in dogs than humans (Krausman & Lawrence, 2011).

On the one hand, pet owners are more likely to be animal lovers, and pet ownership has been correlated with positive attitudes towards urban wildlife (Draheim, Patterson, Rockwood, Guagnano, & Parsons, 2013). Draheim et al. (2013) found that respondents who did not own pets were more likely to be afraid of coyotes, while more pet owners supported the existence of coyotes in the study area. The authors further reported that both pet owners and non-pet owners agreed that the former were partially responsible for keeping their pets safe from coyotes, with the majority of respondents agreeing that coyotes should not be blamed for killing pets left outside unattended. On the other hand, because coyotes do attack and kill pets, owners are more likely to be concerned about the potential threat these canids pose to their pets.



Figure 7. Coyote-dog fight. Photo via petpawsppectives.wordpress.com

Chapter 3: Study Areas

By expanding their range into urban environments, coyotes are more frequently coming into contact with people who have had no previous experience in dealing with wild carnivores. Los Angeles and Cook Counties represent two such highly urbanized areas. They are the two most populous counties in the United States. Los Angeles County leads with a population of 9,962,789 and a human density of 534 people/km² (U.S. Census Bureau 2012). Cook County follows with a population of 5,231,351 and the much higher human density of 5,602 people/km² (U.S. Census Bureau 2012). Both these counties are currently living with relatively large numbers of urban coyotes (see Fig. 8 and Fig. 9).

In Cook County's urban centre of Chicago, Illinois, wildlife biologists of the Cook County Coyote Project, led by Stanley Gehrt, have radio-collared over 250 urban coyotes as of 2008 (Cook County Coyote Project, n.d.). Biologists further postulate that between 1,000 and 2,000 coyotes may be living in Cook County alone (Gehrt, 2011; Forest Preserve District of Cook County, n.d.). The project is the largest and longest running study of urban coyotes in the world. Another long-term study is being conducted in the Los Angeles metropolitan area, which is home to an estimated 5,000 urban coyotes (Ryan, 1997), and where 110 coyotes were captured and radio-collared as of 2006 (Gehrt et al., 2010).



Figure 8. Coyote with Los Angeles City in the background. Photo by Christoph Steinhard.

The two counties differ, however, in the extent to which residents have been affected by coyote presence. California is the state with the highest number of reported coyote attacks on people, with 70 attack incidents, or 49 per cent of documented coyote attacks (White & Gehrt, 2009). One of the two recorded human deaths caused by coyotes occurred in Glendale, Los Angeles County, in 1981. Timm et al. (2004) reported an increase in attacks on humans in California from 1978-2003.

In contrast, Cook County has no confirmed record of coyote attacks on humans, though Gehrt and his colleagues from the Cook County Coyote Project have documented an increasing number of attacks on pets, and there have been purported attacks on people. It is possible that Cook County represents a metropolitan area that has only recently begun to be affected by urban coyotes, in contrast to Los Angeles County, which may have been home to coyotes throughout its history of human development (Gill, 1970). Problem behaviours of coyotes in suburban and urban areas of southern California began to be noted as early as the late 1930s/early 1940s (Gill, 1970).

Researchers believe that coyotes originally colonized the Cook County region sometime after 1700 from the western deserts and prairies. During the 19th century, they disappeared from the area, mainly due to habitat loss. By the late 20th century they had returned, and their population rose dramatically in the 1980s as they occupied the Chicago region landscape. Since then, the coyote population is believed to have remained relatively stable, currently estimated to be in the low thousands in Cook County (Forest Preserve District of Cook County, n.d.).



Figure 9. Coyote running down State Street in downtown Chicago. Photo via video from WGN-TV.

The relationship between humans and coyotes in the Los Angeles metropolitan area may be representative of the Chicago metropolitan area's future with these adaptable canids. An investigation of Los Angeles and Chicago residents' attitudes, opinions, knowledge and behaviours could potentially identify which human actions result in a high risk of attracting coyotes. This could prove a useful foundation for proactive educational campaigns, which should take place before rates of conflict increase and strong negative attitudes towards coyotes are formed.

3.1. Los Angeles County, California

Los Angeles County (Fig. 10) covers 10,507.58 km² of south-western California (U.S. Census Bureau, 2012). The county borders 110 km of coast on the Pacific Ocean and encompasses the Santa Monica and San Gabriel Mountain ranges. The county also includes two offshore islands, Santa Catalina and San Clemente. Highly represented habitats include urban/suburban/residential, chaparral, coastal sage scrub, oak forest and grasslands (Fedriani et al. 2001). The climate is Mediterranean with mild rainy winters, high temperatures at Los Angeles International Airport of 18.6 °C, and hot dry summers, with an average August high of 24.8 °C (National Oceanic and Atmospheric Administration, n.d.).

There are 88 incorporated cities in LA County, the most populous being Los Angeles. As of 2012, the county is estimated to have a population of 9,962,789, making it the most populous county in the United States, followed by Cook County, IL (U.S. Census Bureau, 2012).

Some mammals native to the LA County region, and of particular importance to studies of coyotes, include the raccoon (*Procyon lotor*), opossum (*Didelphis marsupialis*), grey fox (*Urocyon cinereoargenteus*), eastern fox squirrel (*Sciurus niger*), Botta's pocket gopher (*Thomomys bottae*), desert cottontail (*Sylvilagus audubonii*) and black-tailed jackrabbit (*Lepus californicus*). Non-native mammals include the house cat (*Felis domesticus*) and domestic dog (*Canis familiaris*) (Dines, n.d.).

There are an estimated 5,000 coyotes living within the county of Los Angeles (Ryan, 1997).

3.2. Cook County, Illinois

Cook County (Fig. 11) is located in north-eastern Illinois and has a land area of 2,447.54 km² and a population of 5,231,351 (U.S. Census Bureau, 2012). Cook County is a mainly urban area, with 130 municipalities, the largest being the City of Chicago. The county is bordered on the east by Lake Michigan.

The climate is temperate continental, with cold winters and warm, humid summers. In July, Cook County averages daytime highs of 29°C, and in January, highs of – 0.6°C.

Natural areas include savannahs, woodlands, grasslands and wetlands (Gehrt et al. 2009). Forest preserves, which are patchworks of natural areas protected from urban development, make up 11 per cent of the land area of Cook County (Forest Preserve District of Cook County, n.d.).

Some native fauna likely to interact with coyotes include white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*), raccoon, voles (*Microtus* spp.), white-footed mice (*Peromyscus* spp.), beaver (*Castor canadensis*), opossum, eastern cottontail (*Sylvilagus floridanus*) and muskrat (*Ondatra zibethica*). Non-native fauna include the house cat, domestic dog and ring-necked pheasant (*Phasianus colchicus*) (Morey et al. 2007).

Estimates of coyote numbers living within Cook County range from just over 1,000 (Cook County Forest Preserve, n.d.) to over 2,000 (Gehrt, 2011).

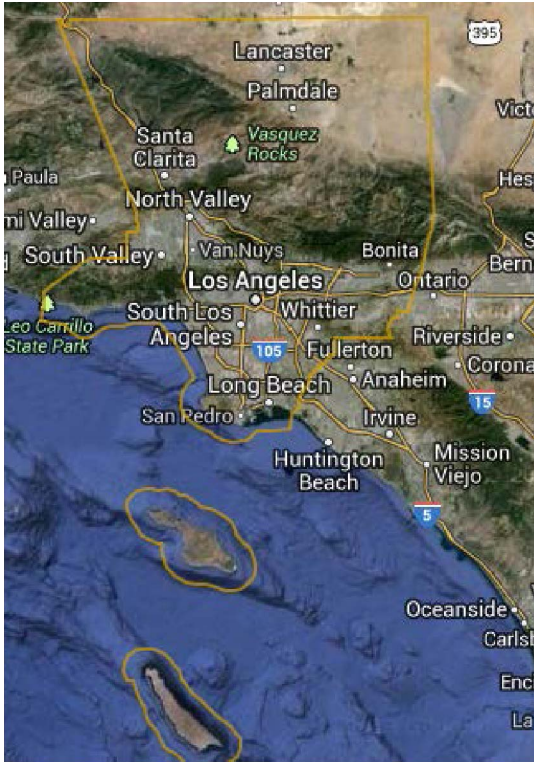


Figure 10. Left: satellite image of Los Angeles County, outlined in gold (map via Google Maps). Right: map of California counties, Los Angeles County highlighted in red (map via mapsof.net).

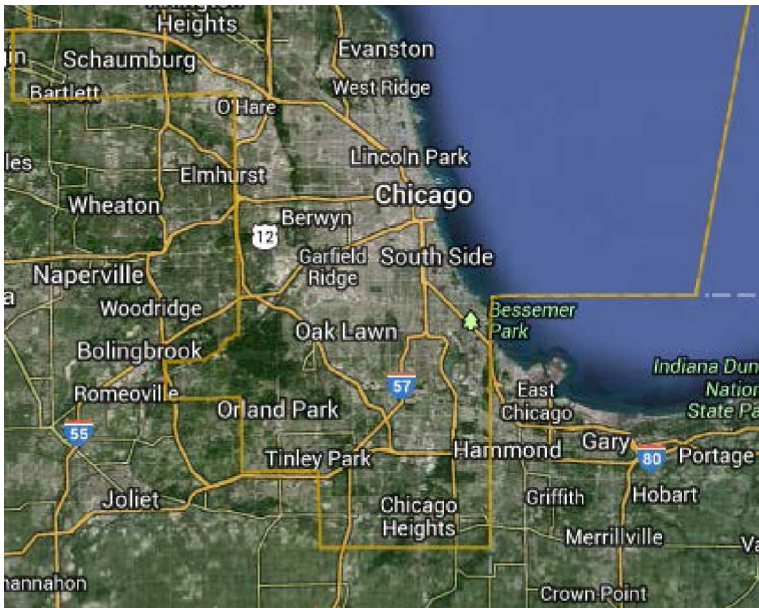


Figure 11. Left: satellite image of Cook County, outlined in gold (map via Google Maps). Right: map of Illinois counties, Cook County highlighted in red (map via FamilySearch.org).

Chapter 4: Methodology

4.1. Research objectives

The urban coyotes of Chicago and Los Angeles have been relatively well studied in the past decade in terms of their adaptations to urban living, diet, home range and interactions with other urban wildlife species (Fedriani et al., 2001; Grigione et al., 2011; MacCracken, 1982; Morey et al., 2007; Gehrt 2007, Bekoff & Gese 2003; Brown, 2007; Crooks & Soule, 1999; Rogers & Caro, 1998; Henke & Bryant, 1999; Whittaker & Lindzey, 1999; Gehrt & Riley, 2010). The social aspect of the human-coyote equation has received less attention in the form of scientific research. Given its complexity and importance for human-coyote coexistence, the following study investigates the attitudes and knowledge of residents of Chicago and Los Angeles concerning urban coyotes, and the behaviours residents engage in that attract coyotes to the urban environment. The following research objectives (originally presented in Chapter 1: *Introduction*, on page 2) were developed for this study:

1. Gain a better understanding of Los Angeles and Cook County residents' awareness and knowledge of coyotes (their presence, behaviour and biology) and appropriate responses to encounters with them;
2. Investigate human actions and behaviours that can influence coyote behaviour and increase the risk of conflict;
3. Determine public preferences for urban coyote management.

4.2. Choice of quantitative survey as research instrument

Given that one purpose of this study was to summarize urban residents' attitudes towards and knowledge of coyotes, so as to aid wildlife managers in their decisions concerning coyote management and resident education programs, I needed a research method that would allow me to generalise my findings from the sample population to the whole population of interest, in this case, urban residents of the Los Angeles and Chicago metropolitan areas and possibly further, to all United States urbanites. This study was further concerned with investigating relationships between variables, such as respondent knowledge and attitude, or the relationship between human actions or behaviours and numbers of interactions with coyotes. In order to obtain my research objectives, I needed to be able to collect a large amount of quantifiable data in a short period of time in a cost-effective manner. Quantifiable data further allowed this study to compare and contrast results from the two counties. Given that the study was concerned with causality (or relationships between variables), generalization (the ability to generalize the findings beyond the sampled population) and statistical comparisons between samples, the quantitative research method was chosen as optimal for obtaining the desired information.

4.3. Data collection

The study targeted adult (18 years or older) residents of Cook County, Illinois, and Los Angeles County, California.

To investigate their experience with problem coyotes and resulting residents' complaints, in-depth, semi-structured interviews were conducted with four wildlife managers from the following organizations: Max McGraw Wildlife Foundation, Willowbrook Wildlife Centre, and Wolf Park (interview questions can be found in Appendix 1).

Based on these interviews, as well as previous studies of residents' attitudes and opinions towards wildlife and coyotes (Draheim et al., 2013; Kellert, 1985; Kellert et al., 1996; König, 2008; Krausman & Lawrence, 2011; Webber, 1997), a web-based survey was developed. The questionnaire was designed using SurveyMonkey and administered by a survey research firm, Survey Sampling Inc., Fairfield, Connecticut. The survey instrument can be found in Appendix 2. The survey was distributed April 26th, 2013 and closed three days later on April 29th, when the desired number of responses (300 per county) was obtained or exceeded.

Completed email surveys were received from 307 residents of Cook County, IL and 300 residents of Los Angeles County, CA, for a total of 607 completed surveys. The survey consisted of the following sections:

1. Residents' attitudes and fears concerning urban wildlife and coyotes
2. Personal experience with coyotes in their county
3. Knowledge concerning coyote ecology, biology and behaviour and risks they pose to humans and pets, and the sources of residents' knowledge
4. Preferred urban coyote management techniques
5. Residents' behaviour toward coyotes or actions they are engaged in that may be attracting coyotes to their property or neighbourhood
6. Socio-demographic information (e.g. age, sex, race/ethnicity, education, income, place of residence, number of children, number and type of pets)

Out of a total of 60 survey questions, 15 concerned attitudes, opinions and fears and were measured on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." Because this section of the survey was intended to measure attitudes, not knowledge, an "I do not know" option was not included.

Point 3 on the scale was defined as “neutral.” The lack of a “neutral” option would force respondents to have an opinion on all the Likert scale questions. I wanted to give respondents the opportunity to indicate that they did not have an opinion concerning a specific statement. All questions concerning residents’ knowledge were in the form of multiple choice responses which sometimes included an “I do not know” option. There were only two open-ended questions, one asking residents to list the places they had seen coyotes in their county, and one asking them to list the one place where they saw coyotes most often. Eight multiple-choice questions provided an “other” option where respondents could give their own suggested answer and elaborate on their opinion. Open boxes were also provided for the question concerning diseases carried by coyotes in which respondents were asked to list these diseases.

The survey was prefaced by a cover letter explaining the study (included with the questionnaire in Appendix 2).

The survey data were downloaded from the survey website (surveymonkey.com) and coded in Excel. The data was used to create several indices for further analysis (see below).

Chi-square tests for independence, Cronbach’s alpha, and independent samples t-tests were carried out using SPSS for Windows, version 20.0. R version 3.0.1. (R Core Team, 2013) was used to run a general linear model and multinomial logistic regression. Significance was set at $p < 0.05$.

4.3.1. Attitudes towards coyotes and urban wildlife

A “Coyote Attitude” index was created based on respondents’ answers to 10 Likert scale questions (Q3). These questions included whether respondents wanted to see coyotes in their neighbourhood, whether they feared coyotes, whether coyotes were a nuisance or an important part of nature, whether the animal should not be tolerated near people or whether we should learn to live with them in cities and suburbs. The index was found to be internally reliable (Cronbach’s Alpha = 0.800). An independent samples t-test was conducted to compare “Coyote Attitude” scores between counties.

Chi-square tests for independence were run to compare where residents would like to see coyotes (Q19) by county, where the options were: around my home/in my yard or garden, in neighbourhood parks and green spaces, in forest preserves, in the suburbs, in the zoo, and I don’t want to see coyotes. An “other” option was also provided where respondents could write in their own answer.

A “Nature Attitude” index was created based on 3 Likert scale questions – whether residents enjoyed seeing wildlife in their neighbourhood, and whether they believed it was important to maintain a diversity of native animals in cities and suburbs. The index was created on the basis of previous studies investigating people’s attitudes towards wildlife (Draheim et al., 2013; Kellert, 1985; Kellert et al., 1996;

König, 2008; Krausman & Lawrence, 2011; Webber, 1997). An attempt was made to find studies concerned with coyotes or similar animals, such as urban foxes. The “Nature Attitude” index was found to be internally reliable (Cronbach’s Alpha = 0.870). An independent samples t-test was conducted to compare “Nature Attitude” scores between counties.

A multinomial logistic regression was run to investigate which factors influence fear. The responses to the 5-point Likert scale statement “I am afraid of coyotes” was condensed into three categories – agree, neutral and disagree. The factors included in the model were: “Knowledge of Coyote Ecology/Biology,” “Knowledge of Appropriate Response to Coyotes,” “Nature Attitudes” and “Frequency of Sightings.” For the analysis, the interaction between “County” and each factor was originally included in the model. These interactions were insignificant and so were removed from the final model.

4.3.2. Knowledge of coyotes

A “Knowledge of Coyote Ecology/Biology” index was created based on respondents’ answers to three questions – when urban coyotes are most active (Q15), what urban coyotes mainly eat (Q16), and where coyotes can be found (their geographic distribution, Q18). One point was awarded for the correct answer – urban coyotes are most active at night, they mainly eat small rodents, and they can be found only in North America. Zero points were given for the wrong answer or the response “I don’t know.”

A “Knowledge of Appropriate Response to Coyotes” index was also created. For the question on how they should behave if approached by coyotes (Q14), respondents could choose one or more of 7 responses or write in their own answer. Their answers to this question were scored as shown in Table 2 (the last two responses were written in by respondents). Negative points were given to responses that showed no knowledge of coyote behaviour and would most likely result in the coyotes attacking the person encountered. Zero points were given if the human behaviour would not necessarily result in a coyote attack but was not optimal for teaching coyotes to avoid people. Zero points were also given if respondents admitted to not knowing how to react. One point was given for answers that would keep urban coyotes wary of humans.

Table 2. Scores given for responses to the question of how to react when approached by a coyote (Q14).

Responses for what to do if approached by a coyote	Score
Hold out my hand and approach it	-1
Wave my arms and shout	1
Walk away	1

Run away	-1
Throw something at it	1
Remain still and quiet	0
I don't know	0
Make myself look bigger	1
Attack it	-1

The two knowledge indices were combined to give an overall “Knowledge” index which combined knowledge of coyote ecology with how to react if approached by a coyote. The maximum number of points that could be obtained was 7, and the minimum was -3. An independent samples t-test was conducted to compare “Knowledge” scores between counties.

A chi-square test for independence was run to compare knowledge of how to react if approached by a coyote by county.

4.3.3. Predictors of risk factors

For the purpose of this study, risk factors were defined as activities that residents engage in that attract coyotes to their properties. The risk factors tested for in the survey included leaving pets outside unattended, leaving food outside for strays, wildlife or pets, walking dogs off-leash, and having uncovered compost piles, vegetable gardens or fruit trees.

A “Risk Factor” index was created based on respondents’ answers to seven questions which included whether they walked their dogs off-leash, left pets outside unattended, left food outside for animals, had uncovered compost piles, bird feeders, vegetable gardens or fruit trees. Behaviours or situations that attract coyotes to human properties were given a score of -1, and lack of these behaviours/situations was given a score of 1. The lowest possible score was -9 and the highest possible score was 7. Thus low scores indicated a high risk of encountering/attracting coyotes and high scores indicated lower risk of attracting coyotes.

To investigate which potential explanatory variables predicted high risk factors, a general linear model (GLM) was run using R version 3.0.1. (R Core Team, 2013). The “Risk Factor” index was entered as the dependent variable and the following were entered as potential independent, or predictor, variables: “County” (Los Angeles or Cook), “Knowledge of Coyote Ecology/Biology,” “Knowledge of Appropriate Response to Coyotes,” “Nature Attitudes” and “Coyote Attitudes.” In the initial model, interactions between all indices and the county were also entered into the equation in order to test

whether the relationship between any given index and the “Risk Factor” index differed by county. Interactions that were not significant were removed from the final model.

A chi-square test for independence was run to investigate the relationship between leaving pets outside unattended (Q28) and losing pets to coyotes (Q30). A chi-square test for independence was also run to compare risk factors and residents’ belief that they had lost pets to coyotes between counties.

4.3.4. Predictors of coyote sightings

A multinomial logistic regression was run to test whether the frequency of coyote sightings was influenced by county or risk factors. Frequency of sightings was made up of three groups defined by respondents’ answers to Q9: “What best describes how often you see coyotes in your county?” with the responses “daily,” “weekly” and “monthly” categorized as frequent sightings, and “once a year” or “only saw coyote(s) once” categorized as infrequent sightings. The third group was made up of residents who had not seen a coyote in their county in the last 12 months – these were categorized as extremely rare sightings, or lack of sighting. For the analysis, “County”, “Risk Factor” index, and their interaction were initially included in the model; the interaction was not significant, so it was removed from the final model.

4.3.5. Preferred management method

A multinomial logistic regression was run to investigate which factors (“Frequency of Sightings,” “Knowledge of Coyote Ecology/Biology,” “Knowledge of Appropriate Response to Coyotes,” “Nature Attitudes” and “Coyote Attitudes”) influence residents’ preferred management techniques. The initial model included the interactions between each factor and “County”. Apart from frequency of coyote sightings, the interactions with “County” were not significant, and so were removed from the final model.

Chapter 5: Results

5.1. Characteristics of residents

The majority of respondents (55 per cent for Cook, N = 303, and 45 per cent for Los Angeles County, N = 304) were white. The next largest racial group of respondents from Cook County were Black/African Americans (24 per cent), followed by Hispanics (13 per cent). For Los Angeles, the second largest racial group of respondents was Hispanic (25 per cent), followed by Asian (14 per cent) and Black/African American (12 per cent) (Table 3).

Respondents were generally evenly distributed across age groups, with a slight majority being between 21-30 years old (23 per cent of all respondents from both counties). The small number of respondents under 20 was due to the fact that only residents over 18 were eligible to take the survey.

Fifty-six per cent of all respondents from both Cook and LA counties (from now on referred to as CC and LAC) had completed a college degree, while 27 per cent had only a high school degree, and 2 per cent had less than high school. Twenty per cent of all respondents either had children under the age of six, or children under the age of six visiting regularly. Approximately 62 per cent of the total population from both counties combined owned pets.

Table 3. Cook and Los Angeles County respondents by race as compared to data from the U.S. Census Bureau.

	American Indian or Alaska Native	Asian	Black or African American	Native Hawaiian or other Pacific Islander	Hispanic or Latino	White, not Hispanic or Latino	Total
Cook County Survey Data	1.4 % 4	6.1 % 18	24.3 % 72	1.4 % 4	12.8 % 38	56.4 % 167	296
Cook County U.S. Census Data	0.8 %	6.7 %	24.8 %	0.1 %	24.6 %	43.4 %	5,231,351
LA County Survey Data	4.5 % 13	14.4 % 42	12.7 % 37	0.3 % 1	25.4 % 74	47.1 % 137	291
LA County U.S. Census Data	1.5 %	14.5 %	9.3 %	0.4 %	48.2 %	27.3 %	9,962,789

5.2. Attitudes towards urban coyotes and wildlife

The majority of Cook County residents (66 per cent, N = 303) do not want to see coyotes in their neighbourhood (Table 4). Fifty-one per cent, however, agree that they enjoy seeing wildlife in their neighbourhood (Table 4). Forty-six per cent believe it is important to maintain a diversity of native

animals in cities and 60 per cent agree to this statement for suburbs. Thirty-eight per cent of respondents thought Cook County residents should learn to live with coyotes while 32 per cent disagreed with this statement. Twenty-three per cent agreed that coyotes were nuisances in Cook County and 40 per cent thought coyotes should not be tolerated close to people. Forty-three per cent believed coyotes were an important part of nature in Cook County, with 51 per cent agreeing coyotes control populations of pests, such as mice and rats. Forty-three per cent agreed they were afraid of coyotes, with 49 per cent saying coyotes are dangerous to adults, 78 per cent believed they were dangerous to small children, and 82 per cent agreed they were dangerous to pets. Fifty-four per cent agreed feeding coyotes should be illegal.

As in Cook County, the majority (61 per cent, N = 301) of Los Angeles County respondents did not want to see coyotes in their neighbourhood, though 51 per cent agreed they enjoyed seeing wildlife in their neighbourhoods. Forty-nine per cent thought it was important to maintain a diversity of wildlife in urban areas and slightly more (51 per cent) agreed with this statement for suburban areas. Forty-four per cent thought residents should learn to live with urban coyotes, with 23 per cent disagreeing with this statement (Table 4). Fifty-six per cent believed coyotes were an important part of nature in their counties and 56 per cent agreed the animal helped control pest populations such as mice and rats. Forty-eight per cent said they were afraid of coyotes, with 46 per cent believing they were dangerous to adults, 76 per cent that they are dangerous to children, and 86 per cent that they are dangerous to pets.

Table 4. Attitudes of Cook County and Los Angeles County respondents towards urban coyotes.

	County	Agree	Neutral	Disagree
I would like to see coyotes in my neighbourhood	Cook	16.8 % 51	17.5 % 53	65.7 % 199
	LA	17.6 % 53	20.9 % 63	61.5 % 185
We should learn to live with coyotes in my county	Cook	38.5 % 116	29.2 % 88	32.2 % 97
	LA	44.4 % 132	32.0 % 95	23.6 % 70
Coyotes are an important part of nature in my county	Cook	42.8 % 128	35.1 % 105	22.1 % 66
	LA	56.0 % 167	27.9 % 83	16.1 % 48

I am afraid of coyotes	Cook	43.1 % 129	25.1 % 75	31.8 % 95
	LA	48.0 % 144	20.3 % 61	31.7 % 95
Coyotes should not be tolerated close to people	Cook	39.8 % 121	33.2 % 101	27.0 % 82
	LA	37.2 % 110	33.2 % 101	28.0 % 85
Coyotes are a nuisance in my county	Cook	23.4 % 71	40.3 % 122	36.3 % 110
	LA	22.3 % 67	33.0 % 99	44.7 % 134

The “Coyote Attitude” index (Cronbach’s Alpha = 0.800) had a minimum possible and actual score of 10, and a maximum possible and actual score of 50, with low scores indicating negative attitudes towards coyotes. The index had a mean of 26.85 (SD = 7.17, SE = 0.41) for Cook County and 27.85 (SD = 6.71, SE = 0.39) for Los Angeles County (Fig. 12). The means of the Coyote Attitude index did not differ significantly between the two counties ($t = -1.76$, $df = 605$, $p = 0.078$). This finding is contrary to what we expected, given the higher number of reported incidents of coyote-human conflict in LAC.

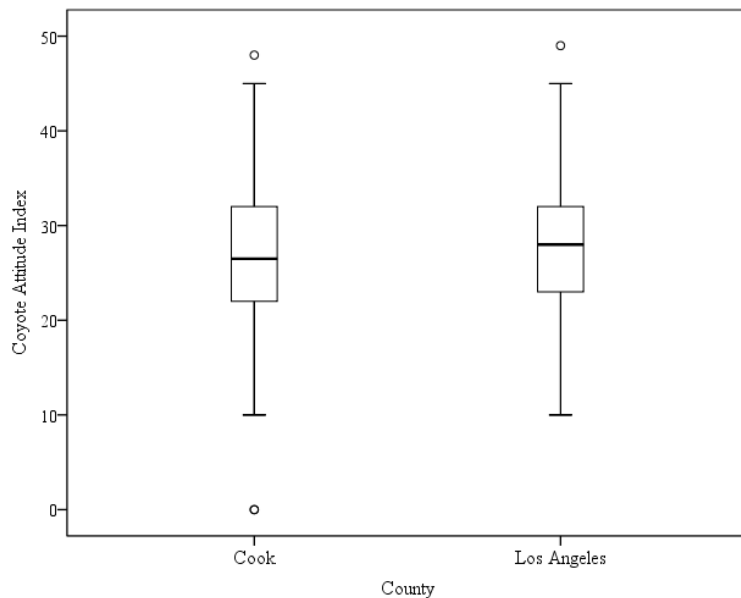


Figure 12. Boxplot of “Coyote Attitude” index by county.

Table 5. Attitudes of Cook County and Los Angeles County respondents towards urban wildlife.

	County	Agree	Neutral	Disagree
I enjoy seeing wildlife in my neighbourhood	Cook	51.3 % 156	19.7 % 60	28.9 % 88
	LA	51.5 % 154	19.4 % 58	29.1 % 87
It is important to maintain a diversity of native animals in cities	Cook	45.7 % 138	26.2 % 79	28.1 % 85
	LA	49.2 % 148	26.9 % 81	23.9 % 72
It is important to maintain a diversity of native animals in suburbs	Cook	58.0 % 174	21.7 % 65	20.3 % 61
	LA	51.7 % 155	28.0 % 84	20.3 % 61

The “Nature Attitudes” index (Cronbach’s Alpha = 0.870) had a minimum possible and actual score of 3 and a maximum possible and actual score of 15, with lower scores indicating a negative attitude towards urban wildlife. The index had a mean of 9.77 (SD = 3.39, SE = 0.19) for Cook County and 9.89 (SD = 3.24, SE = 0.19) for Los Angeles County (Fig. 13). The means of the Nature Attitude index did not differ significantly between the two counties ($t = -0.45$, $df = 605$, $p = 0.650$).

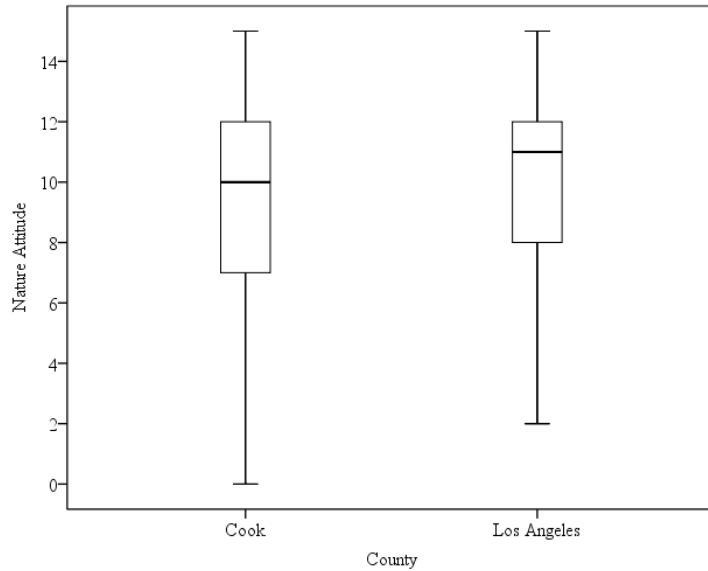


Figure 13. Boxplot of “Nature Attitude” index by county.

A significant relationship was found between fear and “Nature Attitude” ($\chi^2 = 15.1804$, $df = 2$, $p = 0.0005$). As “Nature Attitude” scores increase, fear scores decrease (Table 6). Thus, as attitudes towards urban wildlife become more positive, people are less fearful of urban coyotes.

Table 6. The mean and standard error of “Nature Attitude” index scores for the three categories of the statement “I am afraid of coyotes.”

Nature Attitude Scores	I am afraid of coyotes		
	Disagree	Neutral	Agree
Mean	10.80	10.07	9.16
Standard Error	0.24	0.22	0.21

A significant relationship was also found between fear and “Frequency of Sightings” ($\chi^2 = 11.0244$, $df = 4$, $p = 0.0262909$). People who never see coyotes tended to be more afraid of them – 51.4 per cent of respondents who never see coyotes agreed they were afraid of them, while 32.6 per cent of those who saw coyotes frequently agreed they were afraid of them.

5.3. Awareness of and personal experience with coyotes

The majority of residents from Cook and LA Counties (77 per cent of all respondents from both counties combined) were aware that coyotes were present in their county, with 23 per cent of respondents saying they were unaware of coyote presence (72 residents from CC and 67 from LAC). When asked how they knew of coyote presence, LAC residents most frequently reported having seen them (30 per cent of LAC

respondents), while CC residents were more likely to cite television as their source of knowledge (30 per cent of CC respondents). Significantly more LAC respondents claimed to have seen coyotes than CC respondents ($\chi^2 = 4.265$, $df = 1$, $p < 0.05$).

When asked about the coyote’s reaction to their presence, the majority of responses from both counties could be classified as appropriate coyote responses to human presence. Positive coyote responses (walking or running away) are defined as those that will not result in conflicts with humans, and made up 47 per cent of interactions reported by respondents from both counties. Neutral coyote reactions (watching people, not noticing the resident) made up 46 per cent of selected responses. Eight per cent of coyote-human interactions reported by respondents from both counties could be defined as negative, with the coyote snarling or growling at the person, following or physically attacking the respondent or their pet. Two pet attack incidents were reported for LAC, and one respondent from CC selected the “physically attacked me” response.

Significantly more LAC residents believed they had lost pets to coyotes ($\chi^2 = 12.892$, $df = 1$, $p < 0.001$), with 18 per cent ($n = 36$) of LAC respondents claiming they had lost a pet compared to 6 per cent ($n = 11$) of CC respondents. In Cook County, the main victims of coyote attacks reported by respondents were small dogs, while in Los Angeles County, cats were most often reported as being lost to coyotes (Fig. 14).

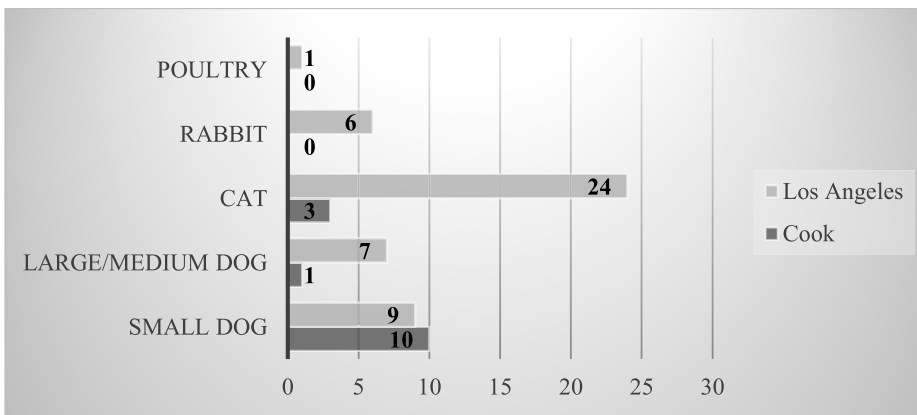


Figure 14. Frequency count of type of pet residents believed they had lost to coyotes.

5.4. Knowledge of coyotes

The maximum number of points gained by respondents in the “Knowledge” index was 5 and the minimum was -1, where the maximum possible was 7 and the minimum possible was -3. Sixty-three per cent of CC residents and 66 per cent of LAC residents scored between 1 and 2 points (Fig. 15). The index had a mean of 1.36 (SD = 1.06, SE = 0.06) for Cook County and 1.51 (SD = 1.10, SE = 0.06) for

Los Angeles County (Fig. 16). The means of the “Knowledge” index did not differ significantly between the two counties ($t = -1.74$, $df = 605$, $p = 0.083$).

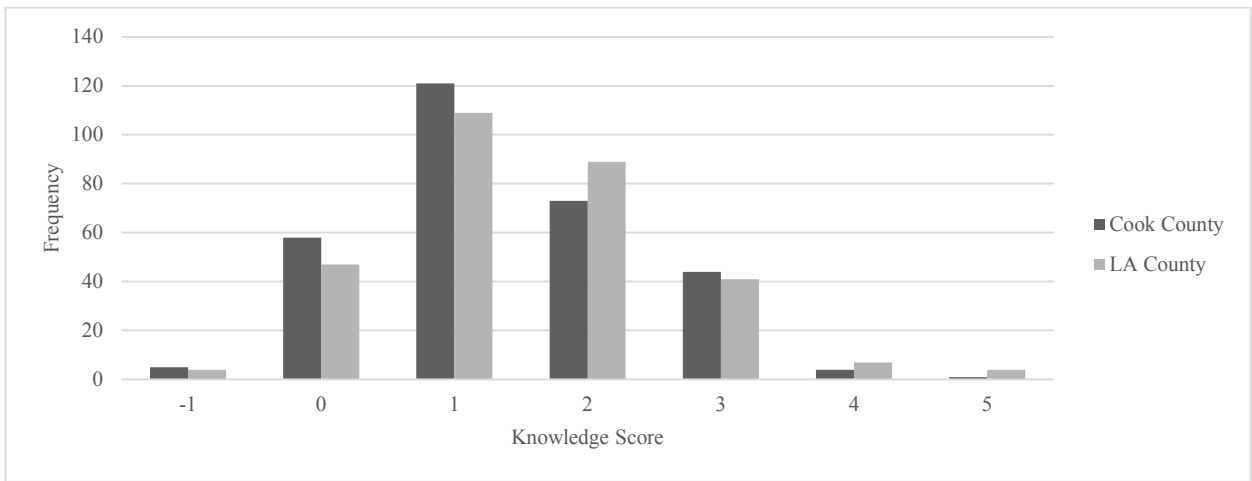


Figure 15. Frequency count for knowledge scores obtained by residents of Cook and Los Angeles counties.

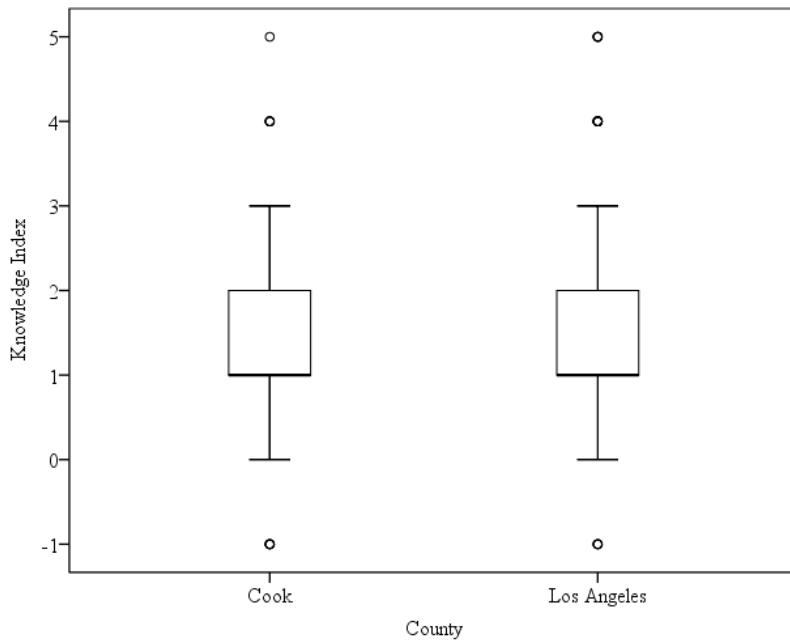


Figure 16. Boxplot of the “Knowledge” index by county.

The responses to the three coyote biology/ecology questions (Tables 7, 8 and 9) revealed that the majority of residents believed urban coyotes were most active at night (53.4 per cent – this was the correct response). They admitted to not knowing what coyotes mainly eat (45.0 per cent) and they did not know where coyotes can be found (43.2 per cent). After the “I don’t know” option, the most frequently chosen response was “all over the world” (29.9 per cent).

Table 7. Responses to Q15. “When are urban coyotes most active?” (the correct answer is shaded):

County	In the daytime	At night	In the morning and evening	All the time	Total
Cook	8.0 % 24	50.2 % 151	27.2 % 82	14.6 % 44	301
Los Angeles	6.3 % 19	56.7 % 170	25 % 75	12 % 36	300

Table 8. Responses to Q16. “Coyotes in your county are mainly eating” (the correct answer is shaded):

County	Small rodents	Garbage	Raccoon	Small pets	I don’t know	Total
Cook	28.2 % 86	11.5 % 35	4.3 % 13	8.9 % 27	47.2 % 144	305
Los Angeles	28.6 % 86	13.6 % 41	2.7 % 8	12.3 % 37	42.9 % 129	301

Table 9. Responses to Q18. “Coyotes can be found” (the correct answer is shaded):

County	All over the world	Only in North and South America	Only in North America	Only in my county	I don’t know	Total
Cook	31.8 % 97	10.5 % 32	16.1 % 49	0.3 % 1	41.3 % 126	305
Los Angeles	27.9 % 84	11.3 % 34	15.3 % 46	0.3 % 1	45.2 % 136	301

While the majority of respondents knew not to run away from a coyote or hold out their hand and approach it (Table 10), they were also not likely to wave their arms and shout or throw something at the coyote. The majority believed they should remain still and quiet and walk away, or simply admitted to not knowing how to react. Significantly more LAC respondents chose the “wave my arms and shout” response ($\chi^2 = 17.339$, $df = 1$, $p < 0.001$).

Residents who believed that urban coyotes were a nuisance were more likely to say they would harass a coyote they encountered by throwing something at it ($\chi^2 = 19.672$, $df = 2$, $p < 0.001$).

Table 10. Responses to the question: “If approached by a coyote I should:”

	Hold out my hand and approach it	Wave my arms and shout	Walk away	Run away	Throw something at it	Remain still and quiet	I don't know	Total Respondents
Cook County	3 % 8	12 % 36	37 % 114	9 % 26	4 % 12	42 % 128	29 % 88	305
Los Angeles County	3 % 9	26 % 76	33 % 99	9 % 27	4 % 11	34 % 100	24 % 72	297
Total Respondents	17	112	213	53	23	228	160	602

Forty-four per cent (N = 297) of CC and 48 per cent (N = 295) of LAC respondents believed coyotes carried diseases they could pass on to humans. Of these respondents, only 43 per cent from Cook County and 55 per cent from Los Angeles County attempted to list the diseases. Of those who did list diseases, 74 per cent from Cook County and 77 per cent from Los Angeles County wrote “rabies.” This disease can be transmitted from coyotes to humans. This rarely happens, however, and only ten cases have been recorded. Two respondents from CC listed distemper, one listed canine hepatitis and one listed Lyme disease. Two LAC respondents listed Lyme disease. Rodents, not coyotes, are the major carriers of Lyme disease, and both distemper and canine hepatitis can affect domestic dogs but not humans.

The “other” category further included such responses as bacteria, ticks, tularaemia, worms, salmonella and plague. Coyotes are not the main carriers of tularaemia and plague, and there have been no recorded cases of coyotes transmitting these diseases to humans (Gese et al., 1997).

Fifty-two per cent (N = 298) of Cook County respondents and 57 per cent from Los Angeles County (N = 296) believed coyotes carried diseases they could pass on to pets. Of those who attempted to list these diseases, 70 per cent from CC and 72 per cent from LAC listed rabies. Three respondents from CC listed mange, one listed Lyme disease, heartworm and canine hepatitis. Two LAC respondents listed distemper, and one listed heartworm and parvovirus. The “other” category also included ticks, fleas, tularaemia, worms, viruses and salmonella.

5.5. Human behaviours attracting coyotes to urban environments

Twenty-five per cent of all respondents walk their dogs off-leash and approximately 42 per cent leave their pets outside unattended. Residents who left pets outside unattended were more likely to report having lost a pet to a coyote ($\chi^2 = 22.774$, $df = 1$, $p < 0.001$). Of those who left their pets outside

unattended, 74 per cent (34) believed they had lost a pet to a coyote. Respondents were simply asked whether they believed they had lost a pet to a coyote, so this category would include missing pets that owners may have assumed were taken by coyotes, whether or not there was any direct evidence to support this assumption.

Further, approximately 25 per cent leave food outside either for pets, wildlife or strays. Cook County residents are slightly less likely to leave food outside than their LAC counterparts ($\chi^2 = 4.330$, $df = 1$, $p < 0.05$). Ten per cent of all residents (combined from both counties) have uncovered compost piles in their yard, 39 per cent have vegetable gardens and 39 per cent grow fruit trees. Significantly more LAC residents have fruit trees growing in their yards or gardens ($\chi^2 = 64.785$, $df = 1$, $p < 0.001$).

5.6. Factors contributing to higher risk behaviours and situations

For the “Risk Factor” index, the lowest possible score was -9 and the highest possible score was 7. The lowest score obtained was -8 and the highest obtained was 7. A low score corresponds to higher risk of attracting coyotes (Fig. 17).

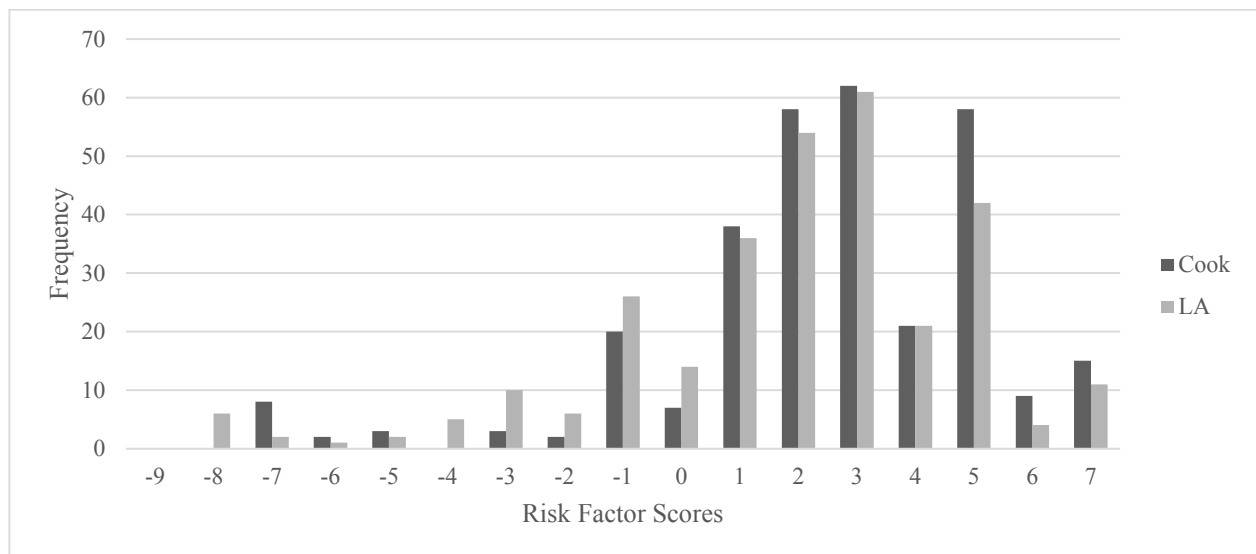


Figure 17. Frequency count for “Risk Factor” index scores obtained by respondents from Cook and LA counties.

GLM analysis revealed a significant positive correlation between the “Knowledge of Appropriate Responses to Coyotes” index and the “Risk Factor” index ($t = 2.161$, $p = 0.03109$), suggesting that respondents with greater knowledge of how to respond to a coyote encounter had fewer risk factors. Moreover, there was a significant negative correlation between the “Nature Attitude” index and “Risk Factor” index ($t = -3.306$, $p = 0.00100$), suggesting that residents with more positive views of nature and urban wildlife had riskier behaviours that could lead to potentially dangerous situations. LAC respondents were found to have significantly lower “Risk Factor” scores ($t = 2.183$, $p = 0.02940$) and

thus more risky behaviours/situations. However, there was a significant interaction between “County” and “Coyote Attitude” ($t = -2.949, p = 0.00331$), suggesting that the effect of residents’ attitudes towards coyotes on their risk behaviours/situations differed significantly between the two counties. In Cook County, attitudes towards coyotes had no effect on the “Risk Factor” index, while in Los Angeles County, as “Coyote Attitude” scores increased, “Risk Factor” scores decreased (Fig. 18).

No significant correlation was found between “Risk Factor” and “Knowledge of Coyote Ecology/Biology” or “Coyote Attitude.”

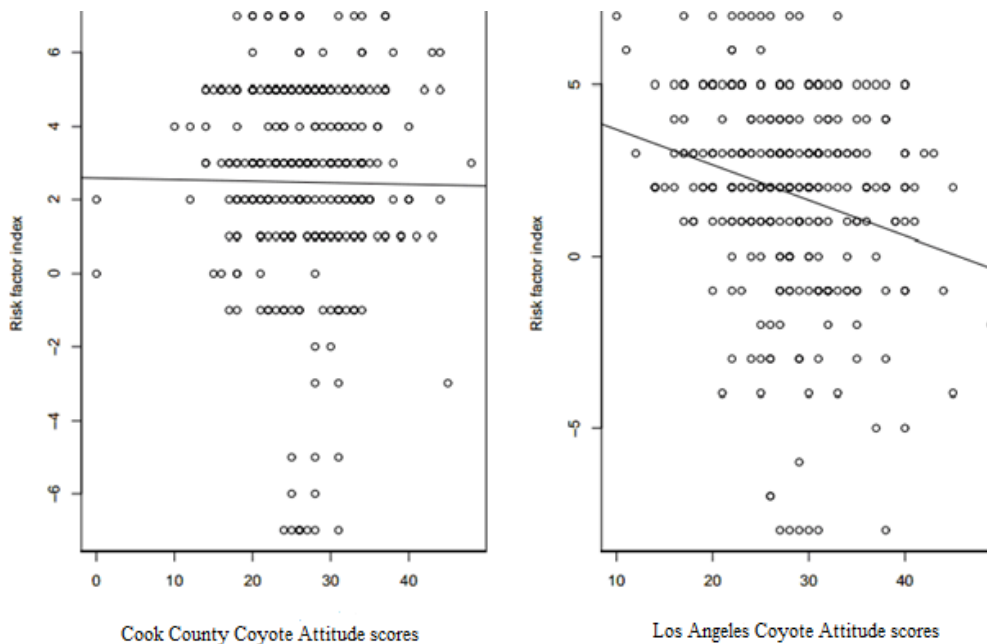


Figure 18. Relationship between “Coyote Attitude” scores and “Risk Factor” index for Cook and LA counties.

5.7. The correlation between risk factors and frequency of coyote sightings

A significant relationship was found between “Frequency of Sightings” and the “Risk Factor” index ($\chi^2 = 25.3725, df = 2, p = 3.093e-06$) (Table 11). “Risk Factor” index scores were lowest for respondents who reported seeing coyotes frequently ($\bar{x} = 1.06 \pm SE 0.33$), suggesting that more risky behaviours/situations correspond with a higher likelihood of frequent coyote sightings (Fig. 19).

Table 11. Mean and standard deviation of “Risk Factor” index scores for the three categories of sighting frequency.

“Risk Factor” Index Scores	Frequent Sightings	Infrequent Sightings	Very Rare/No Sightings
Mean	1.06	2.17	2.59
Standard Error	0.33	0.24	0.13

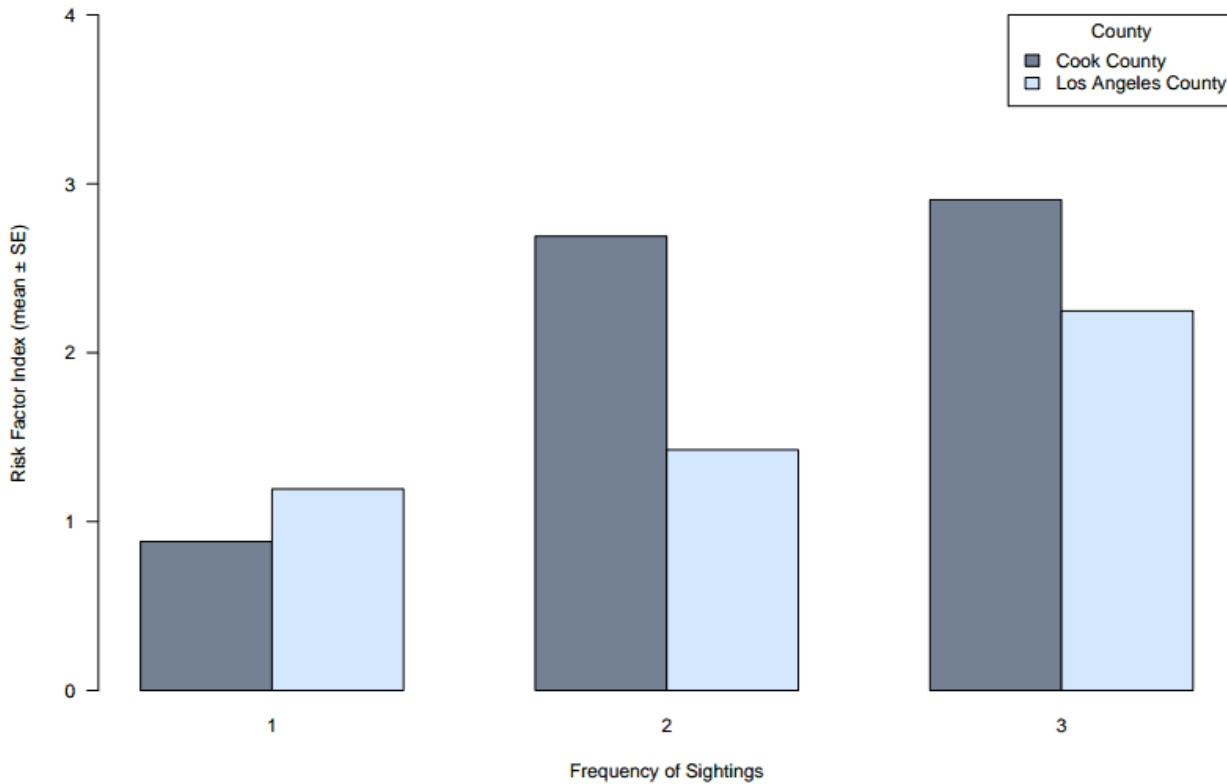


Figure 19. Mean and standard error of the “Risk Factor” index for three categories of sighting frequencies

There is a trend suggesting LAC residents see coyotes more frequently than CC residents ($\chi^2 = 5.9767$, $df = 2$, $p = 0.05037$).

5.8. Management preferences

When asked where they would like to see coyotes, the most popular response was “in forest preserves” (64 per cent of respondents from both counties combined, $N = 595$), followed by “in the zoo” (43 per cent of all respondents). Approximately 16 per cent of all respondents did not want to see coyotes at all (Table 12).

The preferred method for managing problem coyotes was public education to avoid human-coyote conflicts, with 55 per cent of all respondents in favour. Thirty-seven per cent further supported relocation of problem coyotes. Only 4 per cent supported euthanizing problem coyotes, and 4 per cent also supported using poison, traps and hunting to manage coyote populations. Residents of both counties believed that the most acceptable reason for humanely destroying a coyote is when human safety is threatened, with 58 per cent of the total population choosing this response. Euthanizing a diseased or

injured coyote was seen as acceptable by 56 per cent of residents from both counties. Seventeen per cent of respondents believed it is never acceptable to euthanize problem coyotes.

Table 12. Responses to Q19. “Where would you like to see coyotes”? Multiple choices possible.

County	Around my home/in my yard or garden	In neighbourhood parks and green spaces	In forest preserves	In the suburbs	In the zoo	I don't want to see coyotes	Total
Cook	5.0 % 15	10.6 % 32	56.5 % 170	8.3 % 25	48.2 % 145	17.6 % 53	440
Los Angeles	6.1 % 18	18.0 % 53	71.1 % 209	10.2 % 30	37.8 % 111	14.0 % 41	462

Sixty per cent of respondents from both counties believed coyote populations in their county should remain the same and 33 per cent were in favour of reducing their county's coyote population. Seventy-two per cent of respondents said they would support a law banning the feeding of coyotes, with 28 per cent saying they would be against such a law.

The “Coyote Attitude” and “Nature Attitude” indices were found to be significantly related to preferred management methods ($\chi^2 = 20.8067$, $df = 3$, $p < 0.001$ for “Coyote Attitudes” and $\chi^2 = 17.9565$, $df = 3$, $p < 0.001$ for “Nature Attitudes”). Residents with more positive attitudes towards coyotes or wildlife in general preferred public education as a management option (Table 13).

Table 13. Means and standard deviation of “Coyote Attitude” and “Nature Attitude” scores for the four wildlife management options.

		Public education	Relocate problem coyote	Euthanize problem coyote	Poison/trap/hunt coyotes
Coyote Attitude Scores	Mean	29.1	25.5	26.1	23.0
	SD	0.37	0.43	1.19	1.69
Nature Attitude Scores	Mean	10.6	9.19	9.50	6.63
	SD	0.17	0.22	0.52	0.72

5.9. Summary of results

Respondents were more likely to agree with the statement that diversity of native plants and animals should be maintained in suburbs (54.8 per cent) than in cities (47.4 per cent). While the majority of respondents enjoy seeing wildlife in their neighbourhood (51.4 per cent), there is very little acceptance of coyote presence (17.2 per cent). Attitudes towards coyotes, however, were not found to be strongly negative, with about half the sampled population agreeing that coyotes are an important part of nature and that urban residents should learn to live with them. Attitudes were not strongly positive either, with over a third believing coyotes should not be tolerated close to people. Furthermore, almost half of respondents were afraid of coyotes and a large majority saw the animal as dangerous to pets and small children.

The majority of respondents are aware of coyote presence in their county (77 per cent), with more LAC respondents knowing of coyote presence through sightings, and the majority of CC respondents through watching television. A trend was noted for more LAC respondents to have seen coyotes in their county.

The majority of reported coyote encounters resulted in no harm to people or their pets. However, a minority of respondents had experienced pet loss to coyotes, with cat losses more commonly reported by LAC residents, and CC residents most often reporting the loss of a small dog.

Knowledge of both coyote biology and how to react to a coyote encounter was extremely low, and residents from both counties were engaging in a number of behaviours that attract coyotes, such as leaving pets outside unattended (42 per cent) and leaving food outside for animals (25 per cent). However, respondents who knew how to react to a coyote encounter were also less likely to engage in high risk behaviours.

People with positive views of urban wildlife tended to have higher risk factor scores, and the more risky behaviours respondents engaged in, the higher the likelihood of their seeing coyotes ($\chi^2 = 25.3725$, $df = 2$, $p = 3.093e-06$).

The majority of respondents believed coyotes belong in forest reserves (64 per cent) or in zoos (43 per cent), and the preferred management strategy was public education. A large majority (72 per cent) would support a law banning the feeding of coyotes.

Chapter 6: Discussion

As the highly adaptable coyote continues to expand its range into urban areas across North America, the animal will increasingly come into contact with urban and suburban residents who have had limited experience with wildlife and lack adequate knowledge of how to coexist with potentially dangerous carnivores. Los Angeles and Chicago represent urban centres with large human populations, high human densities, and growing numbers of coyotes. Although America's song dog has modified its behaviour in an attempt to avoid people in urban areas (Fox et al., 2005; Gehrt et al., 2009; Gehrt et al., 2010), human-coyote conflicts are reported to be on the rise, especially in California (R. O. Baker & Timm, 1998). Los Angeles County may have been living with coyotes throughout its history of human development, in contrast to Cook County, where the coyote returned toward the end of the 20th century. It is therefore possible that Los Angeles County is predictive of Cook County's future of human-coyote interactions. Although there is evidence that coyotes are adapting their behaviour to take advantage of the opportunities urban environments present, human behaviour is a key element underpinning peaceful coexistence between species. It is therefore imperative that wildlife managers understand the public's attitudes towards, and knowledge of, this urban wild dog, in order to develop appropriate proactive educational programs and management strategies. The objectives of this study were to identify the opinions and attitudes of Cook and Los Angeles County residents towards coyotes, investigate residents' awareness and knowledge of the animal, as well as their knowledge of how to behave in an encounter with the wild dog. The questionnaire further investigated what actions and behaviours residents engaged in that can attract coyotes to urban neighbourhoods, increasing the potential for conflict. Finally, the public's management preferences for urban coyotes were analysed. In this chapter, I address each of these research objectives by assessing the results of my study in terms of key findings and debates outlined in the literature review.

6.1. Attitudes towards urban coyotes and wildlife

A review of the literature revealed that coyotes, much like grey wolves, have traditionally been viewed as intrinsically worthless animals (Kellert et al., 1996). Urban residents' attitudes towards carnivores, however, appear to be shifting from utilitarian to protectionist (Manfredo, Decker, et al., 1998; Mech, 1995; Schmidt & Timm, 2007), with urbanites often valuing wildlife in much the same way they value pets and people (Mankin et al., 1999). Despite this shift, attitudes towards wildlife in urban areas remain ambivalent, with most residents enjoying the sight of wildlife in their neighbourhoods and seeing this as giving them a higher quality of life (P. J. Baker & Harris, 2007; Loker & Decker, 1998), while at the same time fearing the consequences of living with their wild neighbours (König, 2008).

Since no significant difference in attitudes was found between the two counties, they will be discussed as one sample. My results are consistent with this literature, with the majority of respondents claiming to enjoy seeing wildlife in their neighbourhood (51.4 per cent) and believing that maintaining a diversity of native plants and animals in cities is important (47.4 per cent). More residents supported this same statement in reference to suburbs (54.8 per cent). These results support previous findings that indicate urban residents enjoy seeing wildlife in their gardens (P. J. Baker & Harris, 2007; König, 2008) and believe wildlife adds value to their lives (Mankin et al., 1999). My survey results further suggest that there is a tendency for people to see suburbs, where there is less development and fewer people compared to cities, as places where native wildlife should be maintained.

This survey did not investigate people's opinions concerning specific wild animals other than the coyote, but what is evident is that although about half of respondents agreed they appreciated the presence of wildlife in their neighbourhoods, this number dropped to 17.2 per cent when asked if they would like to see *coyotes* in their neighbourhood. Coyotes are thus not one of the native animals people had in mind when agreeing to the need to maintain a diversity of native plants and animals in urban or suburban areas. The majority of respondents agreed that coyotes are an important part of nature in their county (49.4 per cent) and further believed their county should learn to live with coyotes (41.5 per cent). However, over a third agreed that coyotes should not be tolerated close to people (38.5 per cent). Over a fifth thought that coyotes were a nuisance in their county (22.9 per cent) and 45.6 per cent of respondents were afraid of them. These results suggest that people have highly ambiguous, polarized attitudes towards the coyote. As an abstract concept, the coyote is viewed relatively positively (e.g., as an important part of nature) but the actual animal is not welcome so close as the respondents' own neighbourhoods.

The large proportion of people holding either positive or neutral attitudes, combined with the relatively small percentage of people who see coyotes as nuisances in their county, should be encouraging for wildlife managers. These results suggest that to date, coyotes in Cook and Los Angeles counties have not had a profound, negative impact on their human neighbours. This finding is in keeping with research of the coyote's behavioural adaptations to urban environments (Fox et al., 2005; Gehrt et al., 2009; Gehrt et al., 2010; Morey et al., 2007), suggesting that, at this point in time, the animal is successfully avoiding negative interactions with humans in Chicago and Los Angeles, thanks to its shift to nocturnal activity and preference for natural areas, which provide cover from human activity.

As with other large carnivores, such as brown bears, wolves and lynx (*Lynx lynx*) (Wechselberger et al., 2005), fear appeared to play an important role in shaping people's attitudes towards coyotes.

Respondents who saw coyotes more frequently, however, tended to be less afraid of them. This may have been because coyotes are smaller than people who have not seen them before often expect (Draheim et al., 2013; Webber, 1997), or it could simply be that those who have seen coyotes without any negative interaction become less fearful of the animal. Further studies would be needed to investigate what specific attributes of coyotes make them more or less frightening to urban/suburban residents.

Most respondents believed that coyotes are dangerous to pets (83.7 per cent) and small children (77.2 per cent), with fewer expressing concern for adults (47.7 per cent). On one level, this trend reflects the reality, with attacks on pets occurring more frequently than those on children or adults. For example, there is an average of six attacks on pets per year in the Chicago metropolitan area, based on data from the years 1990-2007 (Cook County Coyote Project, n.d.), and to date, no reported attacks on people. While White and Gehrt (2009) found the number of reported coyote attacks in the US and Canada to be nearly equal between children and adults, child victims were more prevalent in predatory attacks. Furthermore, toddlers and the elderly are more susceptible to injury or death than healthy adults following attack by a canid (Alexander & Quinn, 2011). However, given the extremely small number of coyote attacks on people, with an average of 3.5 attacks per year since 1960 (White & Gehrt, 2009), compared to an estimated 4.7 million dog bites occurring in the United States each year (Centres for Disease Control, 2003), respondents appear to have a hugely exaggerated perception of the danger posed by coyotes in urban areas. According to Newton, MA, animal control officer Ralph Torres, people have a higher chance of winning the lottery than of getting attacked by coyotes (Allen, 2013).

6.2. Awareness of and personal experience with coyotes

In the case of some wild carnivores, such as the San Joaquin kit fox, attitudes towards the animal can improve with increased exposure to it (Bjurlin & Cypher, 2005), though it is also clear that people's experiences can vary. For example, howling is classified by some members of the public as 'coyote conflict' (Fox, 2006), while others may enjoy the sound.

While the majority of respondents are aware of coyote presence in their county (77 per cent), given the large numbers of coyotes present and the length of time these animals have been around, it is slightly surprising that 23 per cent of respondents did not know they were living with coyotes. Los Angeles County's residents were more likely to know about coyote presence from personal experience, i.e. sightings. Cook County residents were more likely to know about the animal's presence through television news reports. There is a trend for more LA respondents to have seen coyotes in their county, suggesting that there are either more coyotes in Los Angeles than Cook County, or that the LAC coyotes

are less fearful of humans and are more active during daylight hours and thus more easily spotted. A third possibility is that LAC residents are spending more time outdoors, which may be a result of the difference in climate between California and Illinois. The substantially lower population density in LAC may also be a contributing factor, possibly resulting in a higher proportion of LAC residents living near natural or semi-developed areas frequented by coyotes. Further studies would be needed to investigate the effect of these various factors.

In my study, of the 237 reported encounters with coyotes, in 27 cases the animal's behaviour suggested habituation in the wild canid. In these instances, the animal either followed the respondent, snarled and growled at them, or attacked and bit a person or pet. However, coyotes guarding dens will "escort" potential threats away from their territory. Thus not all following behaviour is necessarily a manifestation of coyote habituation. Similarly, a coyote that feels cornered will snarl and growl, expressing not aggression but fear and the desire to escape. Thus it is difficult to say what coyote behaviours are caused by loss of fear of people. Nevertheless, it is evident that the majority of reported encounters or sightings of coyotes resulted in no threat to the respondent, with most coyotes running or walking away (47 per cent of encounters) or the animal simply being sighted from a distance (46 per cent).

More LAC than CC respondents believed they had lost pets to coyotes. In LAC, the most commonly lost pet were cats (n = 24), followed by small dogs (n = 9). In CC, the majority who reported pet losses claimed to have lost a small dog (n = 10).

It is possible that the largest number is for cats in LAC because cats are often allowed to roam free out of doors and in California's climate, pets can be let outside all year round. On the other hand, it may be that there are simply more cats in LAC than CC. More LAC residents reported having "one or more cats" (31.6 per cent, compared to 25.3 per cent for CC). However, this difference was not found to be statistically significant. Furthermore, the survey did not ask for the specific number of cats owned. Another possibility is that there may be more coyotes in LAC than CC. It is worth bearing in mind, however, as noted by the Cook County Coyote Project (n.d.), that cat attacks are often more difficult to substantiate than dog attacks, and owners of missing cats may simply assume their pet was taken by a coyote.

These findings suggest that there may be more potential for human-coyote conflict in LAC, due to the higher number of pets believed to be taken by coyotes. Given these results, it is surprising that the attitudes of CC and LAC residents do not currently differ at a statistically significant level. A further implication of these findings is that wildlife managers in LAC should find ways to target pet owner, and

especially cat-owner, behaviours, given the effects these can have in attracting coyotes to urbanized areas.

Overall, the number of pets attacked by coyotes in urban areas appears to be relatively low. My study found 18% of Los Angeles County residents and 6% of Cook County residents believed their pets had been attacked by coyotes. It is furthermore highly likely that the perceived frequency of pet, and especially cat, attacks is exaggerated, with owners assuming missing pets to have been lost to coyotes. Nevertheless, infrequent pet attacks, coupled with sensationalized media coverage, are enough to brand the coyote as an unwanted, dangerous urban neighbour.

6.3. Knowledge of coyotes

Respondent knowledge of coyote biology and how to react to a coyote encounter is extremely poor, with the majority of respondents scoring between one and two points out of a possible total score of seven. Similar findings of lack of knowledge of coyote ecology and behaviour were reported by Draheim et al. (2013) for Northern Virginia and Webber (1997) for British Columbia. These results also support the more general findings that urban residents are becoming increasingly distanced from nature, with little knowledge of how to live with wildlife (Mankin et al., 1999; J. R. Miller, 2005). When asked where coyotes can be found, apart from the “I don’t know” response (43.2 per cent), most people chose “all over the world” (29.9 per cent). The majority of respondents do not know that the coyote is a North American native. Thus when agreeing that native animals should be maintained in cities, they are likely not taking America’s wild song dog into account.

Given that knowledge of coyote biology and ecology was not correlated with whether or not people engaged in risky behaviours, the primary goal of information packets should be to list what people should and should not do in relation to coyotes, as opposed to beginning with descriptions of coyotes, their behaviour or habitat requirements.

Perhaps more important than general knowledge of where coyotes can be found is the practical knowledge of how to react to an encounter with a wild canid. When crossing paths with a coyote, wildlife managers encourage people to make themselves look as big and threatening as possible, wave their arms, shout, or throw objects at the animal. This behaviour should scare the coyote away and encourage the animal to fear and avoid people. The majority of respondents from both counties, however, believed they should remain still and quiet (37.9 per cent). While this reaction is not as bad as running away (which could trigger the coyote’s stalk and attack response; this option was chosen by 8.8 per cent), or holding out one’s hand and approaching the animal (which, if the coyote does not run away, will almost certainly result in a bite; response chosen by 2.8 per cent), remaining still and quiet may allow coyotes

to lose their fear of people, as they learn that human presence poses no threat. To date, education campaigns and news reports on coyote attacks cannot have been successful in encouraging people to act aggressively towards coyotes. Statistically significantly more LAC respondents knew to wave their arms and shout – this suggests that either Los Angeles has had greater success in getting the message across that coyotes need to be scared away, or perhaps LAC residents receive more information on dealing with other large carnivores, such as lynx or mountain lions, for which similar frightening techniques are encouraged by wildlife agencies (Beier, 1991).

Residents with more negative views of coyotes, those that see the animal as a “nuisance,” were more likely to harass an encountered coyote by throwing objects at it. This same finding was documented in Tucson, Arizona, where the majority of respondents did not harass coyotes and only those who saw the animal as a nuisance would try and scare it away (Krausman & Lawrence, 2011). In a sense, this is encouraging – those who do not like coyotes are quite willing to harass them and those that like coyotes can be targeted by education programs and convinced that scaring coyotes is what will keep them alive. Ethologist Marc Bekoff, who has studied coyotes for 42 years, sees this dilemma as a choice: “Do we want coyotes shot because they are tolerant of us, or are we willing to throw a tennis ball at them?” (Marshall, n.d.).

About half of those surveyed believed coyotes carry diseases they can pass on to people and pets. Few respondents were able to name any disease other than rabies. Coyote-strain rabies is restricted to southern Texas, and rabid coyote attacks on humans account for less than 8 per cent of all reported cases, or 10 rabid attack incidents in recorded history (Gehrt et al., 2010). Given how rare incidents of coyote-transmitted rabies are, this aspect of coyote ecology could be targeted by education programs to reduce the perceived risk posed by the wild canid.

6.4. Human behaviours attracting coyotes to urban environments

Wildlife may be attracted to human settlements due to the abundance of reliable, non-seasonal sources of food and water in cities and suburbs (P. J. Baker & Harris, 2007; Bateman & Fleming, 2012). City dwellers unintentionally provide plentiful food resources in the form of garbage, compost piles, spillage from bird feeders, pet food, unattended pets, fallen fruit and vegetable gardens (Bateman & Fleming, 2012; Don Carlos et al., 2009). Some households intentionally put out food for wild carnivores, such as badgers and foxes in Britain (Harris, 1984).

Of the various human behaviours that can attract coyotes to the urban environment, the one most people engaged in (42 per cent) was leaving their pets outside unattended. Given that 74 per cent of respondents who left pets outside believed they had lost a pet to a coyote, this behaviour should be targeted by

education programs, as losing a pet is likely to foster negative attitudes towards coyotes.² Responsible pet ownership in areas of coyote presence needs to be emphasized. This could be done with the help of veterinary clinics, pet shops or dog obedience schools, as these institutions are already involved in pet owner education and will often send out monthly informational emails to their clients.

Many researchers believe feeding of wild carnivores to be the first step in habituation (Fox, 2006; Mader, 2007; Thompson et al., 2003; White & Gehrt, 2009). Twenty-five per cent of people surveyed were leaving food outside for pets, strays and wildlife. A larger percentage (39 per cent) of respondents is likely to be feeding coyotes inadvertently, since they had vegetable gardens and orchards which can provide food for the omnivorous coyote. Fruit trees were much more prevalent in LAC than CC, most probably due to the difference in climate. Gardening clubs and supply stores could be encouraged to provide information concerning which vegetables or fruits are most attractive to coyotes, as well as stressing the need to clean up all fallen fruit.

6.5. Factors contributing to higher risk behaviours and situations

People who knew how to react to an encounter with a coyote (e.g. by throwing objects or shouting) were also less likely to engage in behaviours that attract these wild dogs, such as leaving food outside or having free-ranging cats. This could be because these people have been targeted by some form of coyote-human coexistence education, such as a pamphlet or flier from wildlife management facilities. These pamphlets often include information on how to behave when confronted by a coyote, as well as what human behaviours will attract the animal to an urban/suburban yard. If this is the case, then increasing the number of people receiving these pamphlets could decrease the number engaging in “high risk” behaviours. Since knowledge of coyote biology and ecology was not correlated with risk factors, it appears that people will not necessarily make the connection between coyote behaviour, human behaviour and resulting conflict. Thus, it is more productive for information packets to directly present facts on which human behaviours to avoid since they attract coyotes, as opposed to general facts about coyote ecology.

Respondents with more positive views of urban wildlife tended to have higher risk factor scores ($t = -3.306$, $p = 0.00100$). People who enjoy wildlife are more likely to be the people with bird feeders in their yards, lush gardens, compost piles, and pets. Los Angeles County residents with positive attitudes

² Anecdotal evidence of pet owner influence was provided by naturalist Jack MacRae of the Willowbrook Wildlife Center in Glen Ellyn, who recounted a story of one small dog, left in a yard unattended, being taken by a coyote, which resulted in the mayor declaring “war” on the city’s coyotes. Five were removed, which MacRae likened to removing five buckets of water from Lake Michigan and declaring that the lake’s water level had thereby been decreased.

towards coyotes had higher risk factor scores while in Cook County, attitudes towards coyotes did not influence risk factor scores. Given their more positive attitudes towards wildlife, what needs to change is not their attitudes towards wild animals but their knowledge of the consequences of their behaviour. It is easier to provide someone with such information than to change their attitudes (Kellert et al., 1996; Meadow et al., 2005). My research highlighted important connections between risky behaviours and positive attitudes towards wildlife, suggesting that targeting animal and nature lovers over the more general population may allow wildlife agencies to limit their expenditure of time and money, while still obtaining the desired results.

This study found that the more risky behaviours respondents engaged in, the higher the likelihood of their seeing coyotes ($\chi^2 = 25.3725$, $df = 2$, $p = 3.093e-06$). Thus, human behaviours such as leaving out food, owning bird feeders, vegetable gardens or fruit trees do indeed attract coyotes, resulting in more frequent sightings and potential interactions.

6.6. Urban coyote management preferences

While the majority of respondents did not want to see coyotes in their own neighbourhood, 64 per cent did want to see them limited to forest reserves. Forty-three per cent, however, only wanted to see them in zoos, and 16 per cent did not want to see them at all. There is a sense amongst respondents that coyotes belong “in forest preserves,” somewhere “wild,” “natural,” and far from people. This was an open-ended section of the survey and a number of residents wrote in their own answers, which included “in nature,” “national parks,” “in the mountain areas” or “in their natural habitat, far from people.” As previous studies have shown, urban residents do not generally have strongly negative attitudes towards predators (Manfredo, Zinn, et al., 1998; Mankin et al., 1999) though this may be because they do not expect to have them living in their neighbourhoods. They want predators to live at a safe distance, in “natural areas, far from people,” or safely behind the bars of a zoo. There is also a small percentage of urban respondents who are very strongly opposed to coyotes in general, with one Cook County resident complaining, “It’s sick, some people think they [coyotes] are cute, they put these vicious animals before concerns for human safety [...] Coyotes belong in the zoo behind bars like all dangerous wild animals.”

Such extreme cases aside, previous studies have found that as a consequence of protectionist attitudes, many people who have grown up in urban and suburban areas are less supportive of lethal wildlife control methods (Draheim et al., 2013; Mankin et al., 1999), instead preferring public education and relocation of the problem animal (Manfredo, Zinn, et al., 1998; Reiter et al., 1999). When lethal control is necessary to ensure human safety, urban residents prefer selectively targeting and removing the

problem animal, as opposed to indiscriminate trapping and killing of the species in general (Kellert, 1980).

This study confirmed these findings. The preferred method for managing wildlife problems was public education, and lethal management had very little support. Only when the coyote posed a threat to human safety, or was itself diseased or injured, did the majority of respondents support lethal control. Residents with more positive attitudes towards urban wildlife in general, as well as coyotes in particular, were more likely to support non-lethal control options, such as public education and relocation of problem animals. These preferences reflect the trend noted in previous studies for Americans, especially urban residents, to adopt a protectionist attitude towards wildlife, valuing them in a way similar to the way they value pets (Mankin et al., 1999; Mech, 1995; Schmidt & Timm, 2007). The results further indicate that the general public does not realize that relocating an animal will most likely result in its death (Gehrt, 2010). As relocation is costly and ineffective, this knowledge gap should be targeted by education materials.

While the majority of respondents (72 per cent) said they would support a law banning the feeding of coyotes, all it takes is the remaining 28 per cent feeding coyotes to attract them to urban neighbourhoods. It would be interesting to investigate further whether the 28 per cent that would not support a coyote feeding ban are against it because they want to feed coyotes or because they resent on principle any restrictions on their “constitutional” rights. Schmidt and Timm (2007) believed that neighbourhood peer pressure would work better than enacting anti-feeding ordinances, since the implementation of these bans would always be a low priority for law enforcement personnel. For peer pressure to work, however, the majority of urban and suburban residents would need to be made aware that feeding coyotes could lead to increased negative interactions between coyotes, people and their pets.

Chapter 7: Conclusions

The objectives of this study were to gain a better understanding of Los Angeles and Cook County residents' attitudes, awareness and knowledge of urban coyotes and explore how residents respond to encounters with coyotes. The study highlighted the inconsistency in residents' attitudes towards living with wildlife, with appreciation of wild animals declining when the creature in question was the relatively large, predatory coyote. My research revealed great variation in attitudes towards coyotes, with animal lovers being as much a part of the problem as those with a paralyzing fear of wildlife. Consequently, finding acceptable solutions may pose a real challenge to urban wildlife managers and reconciliation ecologists.

Another objective of this study was to investigate human actions and behaviours that may increase the likelihood of coyote-human conflict. The results revealed that human behaviours, such as leaving out food, owning bird feeders, vegetable gardens or fruit trees, do indeed attract coyotes, resulting in more frequent sightings and potential interactions. The two high-risk behaviours residents most frequently engaged in were leaving pets outside unattended (42 per cent) and leaving food outside (25 per cent).

The final goal of this study was to establish public preferences for urban coyote management. Given that the vast majority of residents preferred public education as a management tool rather than euthanasia or relocation, the findings of this study pinpoint important knowledge gaps for wildlife managers and reconciliation ecologists to target.

7.1. Carnivores in the city: Implications for reconciliation ecologists and further research

Rosenzweig's (2003) concept of reconciliation ecology evolved from his conviction that conservation of native biodiversity within natural area reserves on its own is unlikely to preserve viable populations of the vast majority of the world's species. According to Western (2001, p. 5462), the global network of protected areas is too small to avert a "rash of extinctions." With the global spread of urbanization and fragmentation of natural areas, urban green spaces may represent important refuges for native flora and fauna (Goddard, Dougill & Benton, 2009). Given that towns and cities are now home to about 80 per cent of the human population (UNFPA, 2007), urban green spaces offer further conservation benefits by providing opportunities for people to interact with nature and so, perhaps, encourage interest in nature conservation issues (Goddard et al., 2009). However, since reconciliation ecology "seeks techniques to give many species back their geographical ranges without taking away ours" (Rosenzweig, 2003, p.

201), reconciliation ecologists will have to develop strategies to promote peaceful coexistence between city dwellers and large predators.

The majority of Los Angeles and Chicago respondents appear to be supportive of the ideals of the “ecological city” as defined by reconciliation ecology, believing in the importance of maintaining a diversity of native plants and animals in cities and suburbs. A major challenge, however, is extending the principles of reconciliation ecology beyond butterflies and birds to potentially dangerous carnivores, such as coyotes in North America, foxes in England, or dingoes in Australia. Though the majority of urbanites surveyed in this study agree that the coyote is an important part of nature, the animal is not welcome too close to people. The wild dog is believed to belong in “natural”, “wild” areas, far from people, or behind the bars of a zoo.

The differences in values and attitudes urban residents hold toward wildlife will give rise to many variations on the human-carnivore coexistence ideal (Whittaker & Knight, 1998). Urban wildlife managers across the globe are faced with the challenge of what Thompson, Shirreffs and McPhail (2006, p. 46) describe as “walking the management tightrope between keeping wildlife wild and people safe.” Restoration ecologists and wildlife managers need to develop research collaboration on living in urbanized areas with unpredictable, potentially dangerous carnivores, such as coyotes, bears, wolves, hyenas, dingoes and mountain lions. This collaboration should evaluate urbanites’ attitudes and knowledge of wildlife, and develop and compare effective education campaigns for coexisting with large urban carnivores. In their investigation of dingo management on Fraser Island in Queensland, Australia, Burns, MacBeth and Moore (2011) concluded that education programs were needed that recognize the intrinsic value of wildlife and develop a sense of moral obligation toward wildlife interactions. Collaborative research should further investigate which human actions affect urban wildlife behaviour, and develop strategies to mitigate potential negative impacts of urban carnivores on human wellbeing.

7.2. Coyote neighbours: Implications for urban wildlife managers

To date, the urban coyotes of Los Angeles and Cook counties do not appear to have had a profound, negative impact on their human neighbours and the vast majority of coyote sightings and encounters reported in this study posed no threat to human safety. This finding suggests there is still time to encourage and promote peaceful human-coyote coexistence before strong, negative opinions are formed as a result of tragic human-coyote encounters.

Although the majority of respondents’ attitudes towards coyotes were either positive or neutral, positive attitudes towards wildlife and nature do not imply knowledge of how to coexist with wild animals in

such a way as to prevent conflict. Nature *lovers* should not be assumed to have particularly good *knowledge* of wildlife and, indeed, may comprise a subset of the population most suitable for targeted information about coyote management. This study revealed that knowledge of coyote ecology, behaviour and how to react to a coyote encounter was extremely poor, irrespective of the respondents' attitude toward wildlife in general or coyotes in particular. This lack of knowledge once more highlights the separation of urban and suburban residents from nature and suggests that peaceful coexistence with potentially dangerous animals will require careful, targeted education. Urban and suburban residents must learn not only to value wildlife but also to respect the characteristics of large carnivores that can render them dangerous to humans. Coyotes are wild predators and cannot be treated like domestic dogs.

Given the financial limitations of education campaigns, my findings suggest it would be more cost-effective to target animal and nature lovers with wildlife coexistence programs. Gardeners, bird watchers, pet owners and other nature enthusiasts are more likely to be the people with lush, productive gardens, compost piles, bird feeders, pets, and feeding stations for wildlife or strays. Targets for education should include the practice of leaving pets outside unattended, leaving food out for pets, strays and wildlife, and the abundance of fruits and vegetables in urban/suburban yards and gardens.

The results of this study further indicate that the majority of respondents, especially those who did not view coyotes as a nuisance, are unwilling to harass the animals. This should be a major goal for education, as residents are obviously unaware of the consequences of their actions. Positive attitudes towards coyotes may be more detrimental in this case to peaceful coexistence than negative attitudes, as well-meaning but ignorant residents may be enticing the coyote into urban/suburban yards with food rewards and further encouraging habituation in the animal by failing to harass bold individuals. There is no need to change attitudes, only to provide information on the long-term consequences of feeding and failing to scare away coyotes.

Instead of relying primarily on wildlife management agencies to distribute educational material, human-coyote coexistence could be promoted more effectively through the collaboration of an expanded range of partners. To minimize human-coyote conflict in the form of pet attacks and deaths, education programs could promote responsible pet ownership, for example via veterinary clinics, humane societies, pet supply stores or dog obedience schools. Other examples of groups wildlife managers could work with include gardening clubs, bird watching groups, and zoological societies. The results of this study, as well as previous research, suggest cats and small dogs may be more at risk than large dogs, and pet owners should be made aware of coyote presence in their area and encouraged to keep their cats indoors, especially at night. Similarly, small dogs should never be left in yards unattended.

The study recorded a trend for more Los Angeles County respondents to have seen coyotes in their county and to believe that they had had a pet taken by a coyote. Whatever the causes, whether it be larger numbers of coyotes or greater habituation on the part of the wild dog, these findings suggest LAC may be in more pressing need of education programs targeting changes in human behaviours. Furthermore, in the case of both counties, it may be more productive for information packets to directly present facts explaining which human behaviours attract coyotes, as opposed to general facts about coyote ecology.

The coyote is an intelligent, intriguingly adaptable wild dog that has roamed the prairies of North America for millions of years. While persecution by European settlers decimated the grey wolf population, the coyote's behavioural and ecological flexibility allowed the animal to thrive under intense persecution. With the continuing spread of urbanization, all large predators will face the challenge of coexisting with humans, or else they will disappear with the advance of human development. While reconciliation ecology offers an attractive alternative to the traditional concept of the city as a human-dominated landscape, devoid of green spaces and native flora and fauna, to succeed it will require intensive education of the public on how to coexist with wildlife, from the troublesome raccoon to the potentially dangerous coyote. Human attitudes, knowledge and resulting behaviours are often at the root of human-wildlife conflicts. Identifying and modifying these human behaviours should be the first step in any urban wildlife management plan.

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Appendix 1: Semi-structured interview questions

1. Could you describe the work you do as it relates to coyotes?
2. Have you noticed an increase/decrease/no change in human/coyote encounters over the past 5 years?
3. Does [Max McGraw Wildlife Foundation/Forest Preserve District of Cook County] have an education program on how to deal with urban coyotes? (details of the education program)
4. What characteristics of coyotes do you think allow them to adapt to urban/suburban environments?
5. What management options are there for urban coyotes? How do you choose amongst them?
6. Do you get a lot of complaints about nuisance coyotes? (approx. how many per week/month)
7. Are there particular areas/neighbourhoods that call in the majority of the complaints? (names of areas/neighbourhoods)
8. What specifically are the nuisance coyotes doing? (is just sighting a coyote reported, are they taking food, destroying property, approaching pets/humans)
9. How do you deal with nuisance coyotes?
10. To date, no serious attacks on people have been documented in the Midwest (including Chicago). However, attacks on people and pets have occurred more frequently in the southwestern US. Why do you think more coyote attacks on people and pets have happened in the SW compared to the Midwest?
11. How would you advise a person to react when approached by a coyote?
12. What can city/suburban residents do to minimize encounters with coyotes?
13. Do you think coyotes pose a serious threat to human/pet health and safety?
14. Do you think human/coyote coexistence in cities/suburbs is possible? If so, what would it require on the part of residents?
15. What agency is primarily responsible for dealing with problem coyotes?
16. Are there any benefits of having coyote population living in cities/suburbs?

17. In your opinion, is co-existence with coyotes desirable? Why should we try to live peacefully with them instead of simply eradicating them?
18. Is there anything you would like to add about urban coyotes and peoples' relationship with them that has not been covered in the questions I've already asked?

Appendix 2: Email survey questions

April 14th, 2013

Dear Participant:

My name is Elizabeth Elliot and I am a graduate student at Lincoln University, New Zealand. For my Master's thesis, I am examining and comparing the attitudes and knowledge of Cook County, IL and Los Angeles County, CA residents with regards to coyotes living in these cities. As a resident of Cook County or Los Angeles County, I would like to invite you to participate in this research study by completing the following survey.

The aim of the project is to investigate your opinions, attitudes, fears and knowledge of coyotes living in the city of Chicago and Los Angeles in order to assist wildlife managers in identifying the public's educational needs. A further goal is to identify coyote management techniques acceptable to the public.

The following questionnaire will require approximately 10 minutes to complete. In order to ensure that all information will remain confidential, please do not include your name.

If you choose to participate in this project, please try to complete and return the survey within the next 7 days. The questionnaire is anonymous, and your participation in this project is voluntary. You may withdraw your participation, including withdrawal of any information you have provided, before the completion of the study on October 1st, 2013. If you complete the questionnaire, however, it will be understood that you have consented to participate in the project and consent to publication of the results of the project with the understanding that anonymity will be preserved. This project has been reviewed and approved by Lincoln University's Human Ethics Committee. However, the Committee only approved indicative survey questions – they were not presented with the final survey instrument.

In the performance of the tasks and application of the procedures, there is the risk of emotional stress if you have experienced the loss of a pet due to coyote attacks. If you do experience such stress, please do not feel obligated to finish the survey. Below is the contact information for a grief counsellor specializing in pet loss:

Arryn Hawthorne-Jader, AM, LCSW, EMDR Certified Therapist
2656 West Montrose Avenue, Suite 112
Chicago, Illinois 60618
Phone: (773) 852-3642
Email: ArrynHJader@gmail.com

Thank you for taking the time to help me in my educational endeavours. The results of the survey will provide useful information to wildlife managers on how best to manage the coyote population in Chicago and Los Angeles in a way that is acceptable to these cities' residents.

If you require additional information, would like a summary copy of this study or have questions, please contact me at the number or email listed below.

Sincerely,

Elizabeth Elliot

Phone: 312 835 5092

Email: Elizabeth.elliott-hogg@lincolnuni.ac.nz

1. Which county are you from:

- Cook County, IL
- Los Angeles County, CA

2. What neighborhood are you from?

3. For each statement listed, please check the box that best indicates how much you agree or disagree with each statement on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Please check only one box per statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would like to see coyotes in my neighborhood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy seeing wildlife in my neighborhood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important to maintain a diversity of native animals in cities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important to maintain a diversity of native animals in suburbs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are dangerous to adults	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are dangerous to small children	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are dangerous to pets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am afraid of coyotes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We should learn to live with coyotes in my county	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are a nuisance in my county	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes should not be tolerated close to people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes help control populations of pests (e.g. rats, mice) in my county	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are an important part of nature in my county	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeding coyotes should be illegal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feeding all wildlife should be illegal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Are you aware that there are coyotes living in your county?

- Yes
- No

**5. If you answered yes to Question 4, how did you know there are coyotes in your county?
(check all boxes that apply)**

- TV
- Internet
- Newspaper
- I've seen them
- Word of mouth
- I didn't know

Other (please specify)

6. Have you seen coyote(s) in your county in the past 12 months?

- Yes
- No

7. Please list all the places you've seen coyotes in your county (please be as specific as possible, e.g. closest intersection/street name):

8. Please name the one place where you have most often seen coyotes:

9. What best describes how often you see coyotes in your county?

- Daily
- Weekly
- Monthly
- Once a year
- Only saw coyote(s) once

10. What time of year do you mostly see coyotes?

- Summer
- Fall
- Winter
- Spring
- All year round

11. What time of day do you mostly see coyotes?

- In the morning
- During daylight hours
- At dusk
- At night
- At all hours

12. What best describes the coyote's reaction to your presence? (check all boxes that apply)

- Snarled/growled at me
- Ran away
- Walked away
- Watched me
- Followed me
- Didn't notice me
- Physically attacked me
- Physically attacked my pet

Other (please specify)

13. If you have ever been approached or followed by a coyote in your county, what activity were you engaged in when this happened? (check all boxes that apply)

- Jogging/walking with a dog
- Jogging/walking alone
- Biking with a dog
- Biking alone
- Relaxing in a yard/park
- I've never been approached/followed by a coyote in my county

Other (please specify)

14. If approached by a coyote, I should: (check all that apply)

- Hold out my hand and approach it
- Wave my arms and shout
- Walk away
- Run away
- Throw something at it
- Remain still and quiet
- I don't know

Other (please specify)

15. When are urban/suburban coyotes most active?

- In the daytime
- At night
- In the morning and evening
- All the time

16. Coyotes in your county are mainly eating:

- Small rodents
- Garbage
- Raccoon
- Small pets
- I don't know

17. Coyote numbers in your county are:

- Increasing
- Decreasing
- Staying the same

There are
no coyotes
in my
county

I don't know

18. Coyotes can be found:

- All over the world
- Only in North and South America
- Only in North America
- Only in my county
- I don't know

Where would you like to see coyotes? (check all that apply)

- Around my home/in my yard or garden
- In neighborhood parks and green spaces
- In forest preserves
- In the suburbs
- In the zoo
- I don't want to see coyotes
- Other (please specify)

19. Do coyotes carry any diseases they can pass on to people?

- Yes
- No

If yes, please list the diseases

20. Do coyotes carry any diseases they can pass on to pets?

- Yes
- No

If yes, please list the diseases

21. What is the best method for managing problem coyotes?

- Public education to avoid human-coyote conflicts
- Relocate problem coyote
- Euthanize problem coyote
- Poison, trap or hunt coyotes

22. When is it acceptable to humanely destroy a coyote? (check all that apply)

- When human safety is threatened
- When pet safety is threatened

- When the animal is diseased or injured
- When the coyote is causing property damage
- It is never acceptable

24. Coyote populations in your county:

- Should remain the same
- Should be increased
- Should be decreased

25. Would you support a law that makes feeding coyotes illegal?

- Yes
- No

26. Do you have any pets? (check all that apply)

- No
- I have one or more cats
- I have one or more small dogs
- I have one or more large/medium-sized dogs

Other (please specify)

27. If you own dogs, do you ever walk them off-leash?

- Yes
- No
- I don't own dogs

28. Do you ever leave your pets outside unattended?

- Yes
- No

29. What best describes how often you leave your pet(s) outside unattended?

- Once or twice a year
- 1-3 months a year
- 3-6 months a year
- 6-9 months a year
- All year around

Other (please specify)

30. Do you believe you have lost a pet to a coyote?

- Yes
- No

31. What kind of pet do you believe you lost to a coyote? (check all that apply)

- small dog
- large/medium dog
- cat
- rabbit
- poultry

Other (please specify)

32. Does anyone in your household ever leave food outside for: (check all that apply)

- Pets
- Strays
- Wildlife
- Our household doesn't leave food outside

33. Approximately how often do you engage in outdoor activities?

- Less than one month year
- 1-3 months a year
- 3-6 months a year
- 6-9 months a year
- 9-12 months a year

34. Do you have children under the age of 6, or children under the age of 6 visiting regularly?

- Yes
- No

35. Do you have a bird feeder?

- Yes
- No

36. Do you have a yard or garden?

- Yes
- No

37. Do you have an uncovered compost pile in your yard?

- Yes
- No

38. Do you have a vegetable garden?

- Yes
- No

39. Do you grow fruit trees in your yard/garden?

- Yes
- No

Now, to help classify your answers and to make statistical comparisons, would you mind answering the following questions:

40. To which age group do you belong?

- Under 20
- 21-30
- 31-40
- 41-50
- 51-60
- 60+

41. Please indicate your gender:

- Female
- Male

42. Please indicate the highest level of education you have completed:

- Less than high school
- High school
- College
- Graduate program

43. Are you Hispanic or Latino?

- Yes
- No

44. Which of the following would you say is your race? (check all that apply)

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or other Pacific Islander
- White

45. What is your total household income?

- Less than \$10,000
- \$10,000 - 39,999
- \$40,000 - 69,999
- \$70,000 - 99,999
- \$100,000 and more