Chapter 2

Urban Wildlife Management: A Square Peg?

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Abstract −This chapter makes the case for the rising significance of urban wildlife and identifies some of the particular challenges associated with that rise. Urban wildlife management introduces a range of ethical and scientific concerns that are either neglected or not well-met by the conventional paradigm associated with the North American Model of Wildlife Conservation. We call for a new and/or revised wildlife conservation praxis that incorporates the social, cultural and technical insights of urban wildlife management, and make the case for its transformative potential.

Introduction

In recent years, the moral and practical dimensions of urban wildlife management, a globally emerging concern (Lunney and Burgin 2004; Heltai 2013), have raised a central challenge to the broader fields of wildlife protection, welfare and conservation, and especially to the traditional wildlife management framework in the United States. The presence of wildlife in urban contexts involves different social, cultural and technical considerations and, to an ever-increasing degree, calls for new approaches that contest longstanding perspectives and practices on both ethical and scientific grounds. Rising attention to the social and psychological benefits of human-wildlife coexistence in urban centers, the embrace of nonlethal tools and strategies of management, a growing recognition of the impact the built environment has on wildlife and the apparent inadequacy of current regulatory frameworks and entities for addressing urban wildlife concerns have all played their part. A new and revised paradigm for wildlife management is needed, one that takes deeper account of the insights and demands of the urban contexts in which most people most often encounter wildlife. With its underlying philosophy and more nuanced approaches, urban wildlife management promises to transform American wildlife management overall, with substantial benefits for humans and animals alike. But it is not going to be easy.

Urban wildlife management in the United States (to which we restrict our discussion because we know that context best, and because there are numerous and significant differences in the way wild animals in cities are managed elsewhere) largely stems from a discipline of wildlife management that arose in response to concerns about the overexploitation of wild animals important to recreational hunting and trapping interests (Adams 2005, 2014). Urban wildlife management itself was first introduced as one element of that broader discipline at a symposium held at the 32nd North American Fish and Wildlife Conference (Scheffey 1967). There, Stuart Davey of the Bureau of Outdoor Recreation argued that the low priority given to urban wildlife by state and federal agencies was a matter of fiscal history and policy, and that wildlife managers should work with planners, landscape architects and others to preserve all species, not just game animals. Davey asserted that the agenda was not, but should be, geared to increasing "desirable" populations of wildlife in cities (Davey 1967).

In the same forum, Forest Stearns spoke as an ecologist to note that cities were increasingly becoming recognized as ecosystems in their own right and that the plant and animal (nonhuman) communities in them created conditions pertinent to the quality of human life (Stearns 1967). Both Davey and Sterns raised what has become a pervasive and dominant theme about urbanites and nature: that city dwellers are remote from the natural world and do not well understand or appreciate it. Stearns (1970) returned to chair a symposium entitled *Urban Ecology Today* for the prestigious American Association for the Advancement of Science (AAAS) conference, sponsored jointly by the Ecological Society of America (ESA) and The Wildlife Society (TWS).

These developments were paralleled by the beginning of urban ecology as a field of its own in the 1970s, organized around the idea that urban ecosystems were as legitimate and relevant as classically recognized "natural" systems (McDonnell 2011). Studies in this nascent field (Magle *et al.* 2012; Collins *et al.* 2021) tended to focus on specific taxa, such as insects (Frankie and Ehler 1978), birds (Emlen 1974), amphibians (Orser and Shure 1972) and mammals (Schinner and Cauley 1974). These represented the era's interest in the study of wildlife in cities, soon to be followed by a more holistic approach that addressed the ecology of cities (Pickett *et al.* 1997; Byrne 2022).

At about the same time, another form of urban wildlife management was expanding from "awkward beginnings" (Brabrand 1993) where individuals coming largely from a heritage and/or commercial fur trapping background provided control services for "nuisance" wildlife such as northern raccoons (*Procyon lotor*) and grey squirrels (*Sciurus carolinensis*) in urban and suburban neighborhoods. This led to the growth of commercial services focusing on other species, the rise of trade organizations and franchise entities as well as mergers with the larger pest control industry that had been largely focused on control of insect pests and commensal rodents (rats and mice).

Humans now have a dominant influence on all the earth's ecosystems (Vitousek *et al.* 1997), and nowhere is this more evident than in cities (Pickett *et al.* 1997). Managing urban wildlife engages a human social dimension as much and sometimes more than biological or ecological dimensions (Hadidian 2009; Luther 2018). Among the significant concepts in thinking about cities as ecosystems is the idea that natural systems and even wildlife hold intrinsic value and are deserving of moral consideration (Wolch *et al.* 1995; Lynn 1998).

The existing paradigm for wildlife management in the United States, embodied in a state and federal agency structure that historically emphasized wildlife as a sustainable resource and renewable commodity (Riley *et al.* 2002), does not fit well with an agenda for urban wildlife. The reasons for this were already known and outlined in the 1967 symposium. Yet, as Adams (2003) put it more than 3 decades later, an infrastructure for urban wildlife was still missing. Hampered by a culture whose interests and priorities lie elsewhere, urban wildlife is something of trying to fit a square peg in a round hole.

This chapter provides background for the evolution of urban wildlife management in the United States, addresses what we mean by "urban wildlife," describes 3 main approaches to urban wildlife management, identifies some of the diverse parties who manage wildlife in cities, and specifies some of the ways in which management occurs. We raise the question of whether an ethic is needed for urban wildlife, and how that need is being addressed. Finally, we describe some scenarios under which urban wildlife management might be reconsidered going forward.

Defining urban wildlife

To us, and perhaps to most ecologists as well, urban wildlife should encompass all forms of Animalia, even if some are considered marginal or unimportant to advancing knowledge about urban ecosystems or capturing the public's attention and admiration. The detritivores that live in the organic material accumulated on the ledges of skyscrapers share a niche with the peregrine falcons (*Falco peregrinus*) perched nearby, but they are likely to attract little to no attention next to the charismatic birds. Charisma matters in cities (Cohn 2005). Red-tailed hawks (*Buteo jamaicensis*) warrant popular books (Winn 1999)

while soil nematodes might never be mentioned outside of science journals. But both are wildlife, and the nematodes are arguably as or more important to the ecology of the city as the hawks.

For the conservationist, an emphasis on rarity is important and focuses both time and attention on certain individual species. On the other hand, non-native species do not belong and become the frequent subject of special efforts to manage their numbers (Adams 2016). Domestic animals – our pets – are not considered wildlife even when feral (Palmer 2003a,b), although their presence may still prompt demands for management or even be required by a regulatory authority. If cats (*Felis catus*), have a major impact on birds in cities, as some argue (Loss *et al.* 2013), then the fact that they are found there and spend time outdoors makes them an urban wildlife management issue.

Wild animals in cities are at times socially constructed, and embedded in the cultural discords or conflicts that can emerge between people (Goedeke and Herda-Rapp 2005). Pigeons (*Columba livia*), for example, are a non-native species often loved and heavily supplemented by humans who do not see or acknowledge that others vilify them as "dirty birds" and "rats with wings" (Blechman 2006; Jerolmack 2008). Pigeons and other urban wildlife can be metaphors, too, standing for what it is about cities that people most dislike. All of this leads us to believe we should question the normative framing of wildlife as "out of place" in cities and move toward a holistic perspective (Egerer and Bucholtz 2021) that recognizes humans and wildlife as integrated elements within urban ecosystems.

Approaches to managing urban wildlife

We use management here in the sense that it comprises the "manipulation, use, treatment or control (of things or persons)" (OED 1971). This may connote more than administrative acts such as decision-making, or events, such as a planned population restoration. Wild animals in cities can be managed intentionally, as when Canada geese (*Branta canadensis*) deemed to be problems on a golf course are rounded up when in molt and killed, or unintentionally as when development destroys habitat for songbirds. The unintentional management of urban wildlife may go unnoticed, happening without much thought or awareness of the consequences. Ad hoc control actions by individuals employing inappropriate and sometimes illegal chemicals and other products (Conover 1997) are a concern as well.

Intentional management, on the other hand, comes with established conceptual and theoretical frameworks. We briefly describe below 3 of those frameworks (the conservation approach, the ecological approach and the "pest" control approach) and their relation to urban wildlife management, conceding that to an increasing degree that there is dynamic engagement between these and other approaches and that they continue to inform, borrow from and reshape one another. Our view, notwithstanding, is that this classification continues to have considerable explanatory power.

The conservation approach

One form of urban wildlife management in the United States derives from the concepts developed to regulate access and take of valued wildlife that had historically been overexploited (Adams 2005, 2014). Market and unregulated hunting produced drastic declines in the mid-19th century and a reaction which saw the development of regulatory reforms that helped launch a period of population recovery beginning in the 1890s (McCance *et al.* 2017). Leopold (1933) is credited with codifying these reforms in his theory of game management, although he was preceded and followed by others advocating broadly for wildlife conservation (e.g., Hornaday 1914). State and federal wildlife and fish agencies became the primary stewards of wild animals as a public trust that was to be managed by expert authority (wildlife biologists) who would establish a "sufficiency of biology" to achieve sustainable populations through regulated take by hunting, trapping and fishing (Riley *et al.* 2002).

In 1937, the passage of the Pittman-Robertson Act (PR) created a tax on firearms and ammunition that solidified the influence of consumptive users over wildlife management decisions (Langenau 1982). Among the uses for the funds generated was the acquisition of lands that were managed to augment game animal numbers, with a collateral benefit of producing an umbrella under which nongame species were

conserved as well. This created an antecedent of sorts to the contemporary field of conservation biology (Young 2000). In 1950, the Dingell-Johnson Act provided for fisheries what Pittman-Robertson had done for terrestrial wildlife by creating a tax on fishing equipment. Together, the acts ensured that sporting interests had an "outsized" influence (Casellas Connor and Rea 2022) on wildlife management. A utilitarian philosophy of "wise use" thus came to represent the dominant model for wildlife management (Gill 1996).

Challenges to that model began to surface with the rise of the environmental movement in the 1960s and 1970s, leading to a "fundamental philosophical shift" (Decker *et al.* 1996) that forced examination of exactly what interests were involved in wildlife management (Jacobson *et al.* 2022). The value orientation of the urban public weighed heavily in the shift (Manfredo *et al.* 2003; Teel and Manfredo 2009), leading to calls to incorporate and embrace a wider community of interest or stakeholders (Decker and Chase 1997). Kellert (1984) had surveyed those interests and found relatively higher scores for urbanites on humanistic (indicating a primary interest and affection for individual animals, particularly pets) and moralistic (concern for the right or wrong treatment of all animals) scales, while rural Americans scored more highly on the utilitarian (primary concern for the practical and material value of animals) scale.

> The continuing influence of consumptive use thinking within state agencies was conspicuously evident in an incident that occurred the spring of 2023 in New Jersey, one of the most urbanized states in the country. There, the New Jersey Department of Environmental Protection's (NJDEP) fish and wildlife division authorized the razing of wetlands in the Glassboro Wildlife Management Area, a 930-ha reserve between Philadelphia and Atlantic city, to create an 8.5-ha meadowland to encourage American woodcock (*Scolopax minor*) occupancy (Wu 2023). The project involved the clear-cutting and bulldozing of a forested wetland to promote a bird popular with upland game hunters in apparent violation of a state wetlands protection act. The clearing involved the destruction of habitat for at least 2 bird species deemed threatened or endangered in the state, the barred owl (*Strix varia*) and the red-shouldered hawk (*Buteo lineatus*). As a regulatory agency, the NJDEP faced the ironic situation of being responsible for imposing a substantial fine upon itself.

Geist (2006) and others (Organ *et al.* 2012; Mahoney 2019) rearticulated the role of hunting and trapping in wildlife management as The North American Model (NAM) of Wildlife Conservation, visualized as resting on 7 "pillars," that provide for specific policies and value orientations based on wildlife as a renewable resource. The NAM does not fit particularly well with urban wildlife conservation, especially with 2 pillars — the democracy of hunting and wildlife used only for a legitimate, nonfrivolous purpose — centering on commodification of wild animals in a way that has little relevance to wild animals in cities. Increasingly, too, the Pittman-Robertson Act as a funding model has been criticized as being out of touch with contemporary realities in wildlife management (Peterson and Nelson 2017; Serfass *et al.* 2018; Bruskotter *et al.* 2022), and it is seen by some as being in a 'precarious position' (Duda *et al.* 2022). This weakened status comes partly as a result of shifting societal interests and priorities. For example, today fewer Americans value wildlife only as a resource while placing more interest in wildlife welfare, while the NAM frequently lacks the holistic vision necessary to address modern conservation challenges even as other sources of funding are coming into play (McCance *et al.* 2017).

The principal organization in the United States for wildlife professionals is The Wildlife Society, defining professionals as managers, scientists, technicians and planners who manage, conserve and study wildlife populations and habitats. Its position statement on urban wildlife management notes that it represents "a logical and needed expansion of traditional professional wildlife management" (TWS 2020) and encourages public and private natural resource organizations to allocate personnel and fiscal resources toward relevant research and planning. To date, the record for such allocations remains poor (Lyons and Leedy 1984; Adams *et al.* 1987; Adams 2003) with only a fraction of states reporting staff dedicated to urban wildlife programs, and well below 10% of their wildlife-related budgets allocated to urban research, management,

and the prevention of human-wildlife conflict prevention. The reasonable conclusion is that little attention is paid at the agency level to urban and suburban wildlife (DeStefano and DeGraaf 2003).

The ecological approach

As a field, urban ecology can be traced to the 1940s, although like urban wildlife it is largely recognized as coming into its own only in the 1970s (McDonnell 2011). This field is multidisciplinary, embracing not only ecology but planning, architecture, geography, economics, political science, engineering, sociology, social work, anthropology, psychology and health sciences as well, with a strong affiliation to landscape ecology (McIntyre *et al.* 2000; Alberti 2009). Its research focus on areas such as patch dynamics and habitat mosaics (Forman 1995), wildlife corridors (Adams and Dove 1989), urban-rural gradients (Blair 1996) and novel ecosystems (Hobbs *et al.* 2009) has a broad relevance to the management of urban wildlife and their habitats. Urban ecology further acknowledges the critical interface between humans and the natural environment through concepts such as coupled humans and natural systems (CHANS) which emphasizes the ways in which human and natural systems connect and interact (Strohbach *et al.* 2014).

Researchers using a prepositional framework delineating ecology *in* and *of* cities (Pickett *et al.* 1997) contrasted the study of individual species *in* cities and an emerging body of research addressed the ecology *of* cities more holistically. Additional development of this framework leads to qualifying research on ecology *for* cities, such as restoring and conserving biodiversity and ecosystems services, and most recently ecology *with* cities, to address the socio-ecological dynamic of nonhumans and humans in urbanizing environments (Byrne 2022). Urbanizing environments are increasingly recognized for their potential in biodiversity conservation (Muller and Werner 2010), and as areas ripe for study and development of principles in restoration (Young 2000), reconciliation (Francis and Lorimer 2011), and conciliation (Carroll 2011) ecology to establish practical connections to urban planning and development. The biophilic cities movement contributes to this vision (Beatley 2010), and biophilic design concepts align with traditional architecture in cities to help transform grey infrastructure into green infrastructure (Kellert *et al.* 2008).

An important research focus is reflected in the near exponential growth of studies that connect urban biodiversity and greenspace to human health (Hartig *et al.* 2014; Hartig and Kahn 2016; Marselle *et al.* 2021). Wild animals are important, even central, in establishing people's connections to the natural world, as perhaps nowhere better reflected than in the statistics that show wildlife watching to be the dominant form of outdoor recreation practiced by Americans (USFWS 2016). Still, preferences may be fixed on only a select set of favored species, since many Americans also have highly negative attitudes about wild animals (Kellert 1984, 1993). This brings us to a 3rd approach to urban wildlife management.

The "pest" control approach

The term "pest" is a human construct (Braysher *et al.* 2012) that occurs pervasively in both public and scientific discourse having both technical as well as moral meaning (Fine and Christoforides 1991). It carries a pejorative connotation that is broadly applied to many animals who come into conflict with humans, are viewed as overabundant, or are non-native (Fine and Christoforides 1991). As a business model established in Europe and imported to the U.S. in the mid-19th century, "pest" control initially was focused on insects deemed injurious to human interests in cities and on farms (Snetsinger 1983). Indeed, as recently as the 1980s, the history of urban pest management was being written without any mention of vertebrates (Flint and Bosch 1981). When commensal rodents and other imported vertebrate species began to become problematic in cities, the industry added their control to its portfolio, both by providing extermination services as well as by marketing traps, poisons and other control paraphernalia to homeowners.

A large-scale, federally sponsored effort at pest control began in the 1880s when the Section of Economic Ornithology and Mammalogy (now, USDA-Wildlife Services) was created to focus on controlling rodent and predator damage, primarily in the West (Robinson 2005). Wildlife Services today has a visible role in managing urban wildlife, deploying its agents to lethally control locally "overabundant" white-tailed deer

(*Odocoileus virginianus*) and Canada geese, administering a national rabies management program, and helping to implement Bird Aircraft Strike Hazard (BASH) plans (Dolbeer *et al.* 2000). Most of the wildlife control that takes place in cities, however, falls to private practitioners.

> The April-May 1996 volume of the trade journal "Animal Damage Control" includes advice on alternatives for nuisance animal disposal where the writer notes that because of the "antis" (those holding anti-trapping sentiments) he preferred to remain vague with homeowners when asked about what will happen with trapped animals. Advising others to essentially avoid discussion about killing, he recommended simply telling clients that any animal trapped will be "relocated," knowing, undoubtedly, that the state mandates euthanasia for most species if not released on site. The method of dispatch recommended is described as "suffocation" achieved by placing animals in used 25-gallon chlorine barrels and replacing the airtight cover so that it was just "a matter of time" before the air ran out (Cea 1996).

Private "nuisance" wildlife control operators became established in cities during the 1980s and 1990s (Braband 1993). Since then, Nuisance Wildlife Control Operators (NWCOs), who frequently come from a background in recreational trapping, have increasingly affiliated and merged into the larger commercial pest control industry (Vantassel and Gropper 2016). These providers work in urban and suburban communities and engage primarily in the removal of wild animals from in and around homes (Drake 2014). Control services for other species, such as white-tailed deer, Canada geese, coyotes (*Canis latrans*) and North American beaver (*Castor canadensis*) may be provided by NWCOs but tend to present broader technical and social challenges that may require attention from consulting specialists (DeNicola *et al.* 1997; Lisle 2003). There are inherent ethical concerns when for-profit businesses or enterprises provide services to homeowners they may or may not have needed and without transparency in advising those homeowners about the fate of trapped animals (Hadidian 2015).

At its beginnings in the 1880s, vertebrate pest control (now more often, wildlife damage management) was essentially ungrounded in science as we know it today. Its purpose was maximum reduction in wild animals thought to be injurious to human interests. This approach has become increasingly subject to scrutiny under precepts based in science (Hone 2007; Hone *et al.* 2018) and via focused exploration of the welfare consequences of control actions (Littin *et al.* 2004; Littin and Mellor 2005). In its general practice and approach, urban pest control largely operates outside the field of applied ecology and receives little oversight or regulatory enforcement (Barnes 1997; Hadidian *et al.* 2001). The need for reform is urgent, even if only in adopting management strategies grounded in principles such as Integrated Pest Management (IPM) (Ehler 2006) to lower threats to wildlife (Serieys *et al.* 2015). More comprehensive reform is needed but it may be much longer in coming.

Who manages urban wildlife?

Wild animals in cities are continually being affected by human actions. Some direct actions might include those taken to address conflicts, to protect valued species, or to provide enjoyment through viewing opportunities. Less direct actions might include the mowing of turf, planting of trees or preservation of green and blue spaces that provide wildlife habitat. Management actions can be paradoxical and ironic, as for example when the developers of a golf course create lush turf that attracts Canada geese only to turn to culling and nest destruction when these birds defecate on that same turf. The attitudes, values and perceptions of the urban public have much to do with how urban wildlife is managed, and these appear to be dynamic and malleable (Patterson *et al.* 2003; Perry *et al.* 2020). For Lindsey and Adams (2006), urbanites they surveyed appeared to exist in an "intellectual and experiential vacuum."

A significant amount of urban wildlife management is undertaken by individual home and property owners. Conover (1997) surveyed 100 of the largest metropolitan areas in the United States and found that 69% of individual respondents were actively involved in managing wildlife in and around their homes in

the prior year. Miller *et al.* (2001) likewise reported that 71% of homeowners surveyed in the Chicago metropolitan region attempted their own solutions, nearly a third of them using household chemicals. It is not clear what motivates citizens who take such actions. Urbanites may be highly driven by preferences favoring certain species, such as songbirds, and dislike or fear of others such as commensal rodents, stinging insects and snakes (Daag 1970; Kellert 1984; Zinn and Miller 2003), but the majority may be neutral toward wild animals and not know or care about their presence. Still, urbanites can hold highly negative attitudes towards certain species, such as snakes (Bateman *et al.* 2021), and their response to wildlife will vary broadly, based on a complex set of factors (Zinn and Miller 2003). What little is known about how individuals relate to wild animals in cities suggests that the polarization between preferred and disliked species is dynamic. Bats, for example, have undergone a significant transition from being disliked to liked (Tuttle 1988; George *et al.* 2016).

All too often, the individuals whose activities influence (manage, to us) urban wildlife may not even know or care that they do so. The homeowner who leaves trash accessible to raccoons or plants a garden that attracts deer is unlikely to think of these actions as management, but to the extent that they influence the health, safety, ecology or behaviour of wild animals, they are.

In most states, private property owners can typically control nuisance wildlife on their land by any legal means, including trapping and translocation or euthanasia, although some states may require that property owners obtain a permit to do so. Live-trapping and translocation of animals such as squirrels and raccoons by private individuals is unquestionably quite common, and questionably humane, as the consequences of translocating wild animals may be problematic (Craven *et al.* 1998; Adams *et al.* 2004).

Also heavily engaged in management of urban wildlife are businesses that either provide direct control or by their nature perform work that has implications for wild animals. Commercial pest management businesses may perform wildlife services, with nuisance wildlife control operators (NWCOs) doing so exclusively (Vantassel and Gropper 2016). Landscaping firms, chimney sweeps, home improvement contractors, arborists and others engage in management with impacts and consequences that are to a great extent undetermined and unassessed. One exception is Bluett *et al.* (2003), which reports on 9 yrs (1992-2000) of data from nuisance wildlife control activities in Illinois. There, a total of 428,003 wild animals of 6 terrestrial species were trapped, a majority (180,324) being northern raccoons, of which slightly more than 127,000 were killed. How such removals affect species at the population level or what ecological consequences such removals have remains largely undocumented.

State wildlife agencies typically hold regulatory authority for urban wildlife (the territories being notable exceptions) and are variously engaged and involved in urban wildlife management, education and extension services. The first states to create urban wildlife programs were Kansas, Tennessee and Missouri in 1978; by 1983, 6 states had programs, with only 3 reporting research as part of their activities, dedicating only 8% of staff time and 5% of budget to this activity (Lyons and Leedy 1985). Adams (2003) surveyed state wildlife agencies and found fewer than 1% of staff biologists with an urban wildlife portfolio.

At the federal level, land management agencies such as the National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS) often assign specialists to deal with urban wildlife at properties located in or adjacent to cities. FWS has an Urban Conservation Program that works to improve access to wildlife refuges within 40 km of major urban centers and highlights the 7 flagship refuges actually located in cities. As noted, Wildlife Services will contract with different agencies and others to provide services for control of wildlife on a variety of urban lands.

Animal care and control agencies, local humane societies, homeowner's associations (HOAs), municipal wildlife, parks and health departments, schools and universities, may all perform or contract for services in wildlife management. A full accounting of all the entities involved, and the extent of their engagement, remains to be made. A growing number of wildlife rehabilitation facilities are located in cities and comprise an important resource not only by providing direct care for injured and orphaned wild animals, but as well by serving as a public interface in conflict resolution advisement and educational outreach.

How is urban wildlife managed?

Urbanites interact directly and indirectly with wild animals, actively managing for some species and against others (Conover 1997). This interaction-management scale falls along a conflict-to-coexistence continuum (Soulsbury and White 2015; Nyhus 2016). Human-wildlife conflict has been well-articulated in the literature (Madden and McQuinn 2014), while human-wildlife coexistence has only recently come into its own as a way of framing human-wildlife relationships; it is preferred by some as it takes the emphasis off wild animals as antagonists (Peterson *et al.* 2010; Pooley 2021). Coexistence may also align more closely with the values of the urban public, given urbanites' tendency to view wild animals less for their instrumental and utilitarian worth than their intrinsic, aesthetic and ecological value (Dubois and Harshaw 2013).

A vast range of anthropic activities can influence the behaviour and abundance of wild animals in cities and thus qualify as "management" in the sense of having population-level and perhaps even evolutionary consequences (Johnson and Munshi-South 2017). Poor garbage control and sanitary practices by a restaurant can leave abundant food available to rats, leading to rapid population spikes and spurring need and demand for management to control and reverse such growth. Common practices such as bird-feeding and lawn mowing are arguably forms of management in their own way, since they directly support populations of preferred species and/or indirectly create or deny habitat to others.

Direct or interventional urban wildlife management involves the use of many of the same tools and techniques employed for wildlife management in other contexts, although lethal practices are likely to be more limited than in rural settings. One exception is the mass poisoning of commensal rodents, affecting not only those species directly but leading to secondary poisoning and mortality of nontarget species as well (Serieys *et al.* 2015). Avicides are also used, primarily to poison pigeons, but at times gulls, blackbirds and crows (McLean and Khan 2013).

Trapping is highly contested by animal welfare and rights groups (Pacelle 1998) while staunchly defended by interest holders who argue for its overall role in society (Vantassel 2007) as well as its specific utility in situational contexts (Proulx 2022). Traps of many sorts are used in urban wildlife control, including box and cage traps, a variety of steel-jawed leghold traps, "enclosed" foothold traps, foot and body snares, and killing traps, including Conibear-type body crushing traps, neck snares, and drowning sets for animals such as beaver. Best Management Practices (AFWA undated) exist for trapping in many forms and contexts, but to date none have been issued for urban wildlife (Stevens and Proulx 2022).

A popular mode of wildlife control employed by individuals, private wildlife control companies and the occasional municipal agency involves trapping and translocation of smaller animals such as raccoons, skunks and squirrels (Craven *et al.* 1998). While this activity often requires a permit from a state wildlife agency, the box traps used for this purpose can be readily purchased through hardware stores and chain supercenters making it highly likely that many homeowners trap without being aware of any permitting requirements. Homeowners are also generally unaware of seasonal birthing times of the small mammals that may utilize their homes to raise young, and when they take trapping actions in response to an intrusion, they capture adults, unknowingly leaving dependent young behind. Trapping and killing of problem animals is often controversial, but more commonly practiced by commercial businesses than trapping and translocation or release on site (Bluett *et al.* 2003). Release on site requires taking steps to prevent the animal from immediately returning to the entry point to gain access and shifting the approach to focus on structural issues related to deficiencies in design, maintenance or construction that allowed animal(s) access in the first place.

These companies may lack permitted access to or training in the use of euthanasia drugs, which may account for their use of inappropriate euthanasia techniques at times (Julien *et al.* 2010). The use of unstudied, untested and unapproved chemicals in wildlife euthanasia is especially problematic, as exemplified by the use of acetone (methyl ketone) to kill skunks via thoracic injection or drowning as used by both private individuals and some commercial businesses (Ludders *et al.* 1999; Hadidian 2015). The debate over lethal control is complex, beginning with the question of whether it is needed or required in the

first place and continuing on through acceptable methods for a given situation and then to an evaluation of consequences and adjustments if necessary and if a particular program is expected to be ongoing (Sharp and Saunders 2011; Dubois *et al.* 2017).

Standards do exist for euthanasia of animals in zoos, companion animals, and wildlife in various settings (Baer 2006; AVMA 2020). Euthanasia of wild animals presents additional concerns, such as the stress experienced just from being in the presence of humans, not to mention being handled, transported or held. This raises the question of whether it is more humane to dispatch animals in the field using an inferior technique or to handle and transport them to a controlled setting where chemical euthanasia can be provided.

State wildlife agencies typically seek to promote hunting as a means of population control where this is not a threat to public safety, notwithstanding that hunting in such contexts often faces stiff public opposition (Stewart 2011; Fulton *et al.* 2004). Culling is a lethal practice which usually engages specialists with firearm training to target deer (DeNicola *et al.* 1997). Canada geese are rounded up when in the annual molt and either dispatched on site using carbon dioxide chambers or transported to poultry facilities and killed in the same way commercially processed birds are (Smith *et al.* 1999; Gerritzen *et al.* 2013). These are perhaps the most commonly controlled species in the U. S., but many others may be targeted in and around cities, such as roosting crows, gulls at landfills, pigeons in city parks and multiple species of burrowing rodents. The full range of species that are lethally controlled in cities has yet to be surveyed.

There are many nonlethal tools and strategies advocated for use in urban wildlife control, ranging from the nonlethal tools of tolerance, understanding and the modification of human practices (Dubois *et al.* 2017) to a wide range of aversive conditioning approaches using repellents and frightening devices, as well as techniques of physical exclusion (Conover and Conover 2022). Nonlethal strategies can easily fail if animals are highly motivated, allowed to habituate to aversive stimuli, or can overcome physical barriers. Monitoring and repeated response, if necessary, are especially important when employing nonlethal strategies. It is important to recognize that nonlethal tools and practices can have adverse welfare consequences for wild animals (Sharp and Saunders 2011) and should be carefully evaluated.

Gates *et al.* (2006) and Griffin *et al.* (2008) described an evict-exclude-reunite strategy for both mammals and birds that displaces problem-causing animals while allowing for family units (typically females with dependent offspring) to remain together. This means that displaced animals can remain in an established home range where sources of food and other resources are known, including alternative den sites. With birds, relocation typically means renesting with chicks placed in an alternative nest close and within line of sight to the one from which they have been removed. This approach is not without critics, with some arguing this is just shifting a problem-causing animal onto another homeowner (O'Donnell and DeNicola 2006). When openings on structures present opportunities for denning or nesting, it is not clear if the animals' experience plays any role; further research is needed to clarify the conditions under which this might happen and the extent to which it occurs.

Conflicts with urban wildlife occur at different levels (individual, community and municipal) at different intensities (short and long term), in different contexts (homes, businesses, municipal facilities such as airports and golf courses, wetlands and riparian zones) and for different reasons (overabundance, ecological damage, property damage, injured/sick; habituated and/or food conditioned, unreasonable fear and lack of understanding, among others). Conflicts can be visualized as events (e.g., squirrels digging up a tulip bed) or processes (e.g., deer browsing that alters the vegetative composition of a woodlot), and sometimes both. Conflicts have spatial and temporal distributions, and their timing, periodicity, sequencing, and intensity are factors influencing their nature and expression as well as their control, stabilization or resolution (Hadidian 2015). Their impacts can be imagined or perceived or range from trivial to severe, and problem-causing animals themselves may be rare, common, protected or unprotected.

Conflicts aside, there are substantial benefits to having wild animals in cities. These range from providing for personal enjoyment to contributing to the public well-being. A preference by urbanites for some species as opposed to others has long been documented in surveys (Daag 1970; Kellert 1984; Zinn and Miller 2003), with birdwatching being a highly preferred activity (USFWS 2016). Beyond the fulfilment and satisfaction that many urbanites derive from such activities, wild animals are an important component of

the broader concept of "urban nature" (Mace 2014; Luther 2018) that includes both the biodiversity (Marselle *et al.* 2021) and greenspace (Hartig *et al.* 2014) increasingly tied to the physical and mental well-being of human residents. While it remains to be seen exactly what prescriptions need to be written to produce desired effects (Wolch *et al.* 2014), wild animals will surely be included as this field rapidly grows.

Is an ethic needed for urban wildlife?

In the not-too-distant future, technology will allow for the elimination of entire species, producing a wildlife management option with profound moral seriousness (Bouyer *et al.* 2018). Many of the problem-causing species in cities, such as the brown rat (*Rattus norvegicus*) or any of a variety of cockroaches (*Blattodea* spp.) could be targeted for elimination under strongly argued justification, especially if local eradications did not threaten species extinctions. If for no other reason, then, the onrush of technological change provides a strong argument for an ethic for urban wildlife. But there are other reasons as well. For one, an ethic could simply be justified under the age-old Socratic doctrine that invites us to explore the "right" way to live (Hadidian *et al.* 2006). For another, an ethic can help create an "environment of care" (Lunney and Burgin 2004) that might translate broadly into support for the conservation of natural resources everywhere (Dunn *et al.* 2006). Then, for some, an ethic might be justified simply by the argument that wild animals have intrinsic value and ought to be treated with greater moral consideration (Singer 1997; Lynn 1998).

Relative to the 3 approaches to urban wildlife management discussed here, we will generalize about their ethical perspectives to say, first, that the traditional approach is strongly anthropocentric while, second, the ecological approach is strongly biocentric, with each richly steeped in ethical frameworks of their own. Pest management, perhaps because of its traditional focus on insects, or because it is generally practiced as a commercial business, has arguably a weaker moral framework than the other approaches. With growing concern over insect conservation (Hallmann *et al.* 2017), however, an ethic may be needed there as well. Lockwood (1987) calls for at least a minimum ethic, arguing that we should refrain from killing or harming insects when they are causing us only trivial harm and when the costs to our welfare of doing so are trivial as well. Samways (1990) adds to this a minimum ethic for the preservation of genetic diversity, aligning with contemporary conservation concerns.

The need for an ethic is also evident in relation to urban wildlife damage management, the field of practice aimed at control or mitigation of unwanted effects and outcomes tied to the presence of wildlife in urbanized areas. Decision-making in wildlife damage management, its parent field, has typically focused on economy, efficacy, selectivity and safety as first order concerns (Conover and Conover 2022), placing less emphasis on animal welfare even though a call to make it a first-order decision rule was raised many years ago (Schmidt 1989). Both anthropocentric and biocentric orientations have in the past subordinated and still frequently subordinate the welfare of individuals to that for populations and species, especially when dealing with "pests" or common species of little or no conservation concern, typically the case for most urban species. Still, agreed-upon principles for the ethical control of wildlife have been published as an international panel's consensus approach (Dubois *et al.* 2017), "best practices" for wildlife damage management advanced (Braysher *et al.* 1996, 2012), decision-making steps proposed as guidance (Marks 1999; Littin *et al.* 2004; Hadidian 2015) and a matrix created to weigh welfare impact by wildlife control activities (Sharp and Saunders 2011; Beausoleil *et al.* 2022; Proulx *et al.* 2022). These all provide ample frameworks to address the welfare of wild animals at any level and for all species.

Scholarship surrounding the ethics of urban wildlife has generally sought to explore human-wildlife relationships and the place of wild animals in the city. Lynn (1998) addresses this place in a geographical context, arguing for a site-based and situational approach that remaps the "moral landscape." Wolch *et al.* (1995) "foreground an urban theory that takes nonhumans seriously." These scholars tacitly acknowledge that wild animals have a place and belong in cities, should be given weight, but generally are not. For Palmer (2003a), this lack of consideration revolves around disparities of power, bringing us full circle with the issue of anthropocentrism and its assertion in cities, the most human-dominated of environments. Wolch and others would reconceptualize the city within the larger concept of zoopolis (Wolch 1998;

Kymlicka and Donaldson 2013). They define zoopolis as an urban environmental ethic that thoroughly reconceptualizes the daily social, cultural, political and technical practices of urban life when it comes to animals, i.e., not only animal regulation and control activities but landscaping, development, planning, design, transportation and infrastructure decisions, energy and resource use, and more— in short, any and all practices that affect animals and nature within the urban context. In a related vein, Fraser (2019) argues for even broader consideration of the unintended harm occurring to animals from perils associated with the built environment and the human activities taking place within it. For her part, Palmer (2003a) addresses questions about the duty of care we owe to animals in the city, one that is fairly clear with pets (but less so when they become feral) and much less clear with respect to wild animals. Palmer also distinguishes between the causal responsibility we owe to our pets and the moral responsibility we owe to other nonhumans with whom we share space (Palmer 2003b). Michelfelder (2003) extends the argument for the community of nonhumans in cities whose presence contributes to a sense of place, a segue into the ethics of development and planning, a considerable area of its own (Campbell and Marshall 1999). Michelfelder (2018) proposes a framework for urban wildlife ethics in which people and animals are seen in a "robust sense of belonging together". Rather than consigning wild animals to liminality, these approaches place humans within the context of the biotic communities of domestic animals and wildlife, embracing a substantially different frame of reference than that taken in traditional wildlife management or even in the ecological approach.

With respect to pest control, these perspectives have prompted a focus on coexistence based on more nuanced insights into the behaviour and ecology of wild animals in cities. Nieuwland and Meijboom (2021), for example, argue that rats are a "moral litmus test" for philosophers (and others, we would add) who must address the means by which these animals are managed against the knowledge that they engage in complex social behaviors, including social cooperation, and express complex emotions. These are all qualities that demand a reassessment of the humaneness of the poisons, glue boards and other devices used to control them even when the need for control is incontestable (Mason and Littin 2003).

An ethic for urban wildlife management should include consideration of the habitat that supports wild animals, with a wealth of material to draw from there. Leopold's (1949) articulation of a land ethic established the basis for habitat in an ethical context, while Beatley (1991, 1994) argues that the social allocation of land is fundamentally a matter of ethics. Dorney (1989) articulated an "ethical triad" for urban ecologists that consisted of reverence for life, reverence for land, and reverence for diversity. If as Lynn (1998) suggests, ethics can represent a "blizzard of concepts," it clearly would be snowing hard in the cities.

The future of urban wildlife management

Accepting that there is a need for 'infrastructure' in urban wildlife management, as Adams (2003) argues, we ought to begin exploring what form that might take. State fish and wildlife agencies have and will retain a major role in urban wildlife management if for no other reason than the fact of their statutory and regulatory authority over wild animals. As advocates and supporters of a conservation model, state agencies are likely to prioritize the monitoring of threatened and endangered species, provide the public with educational and outreach materials (mostly web-based), and engage with urban and suburban communities in the management of specific species of interest, such as bear and deer. They may face strong opposition from the public and from interest groups, often mounted in the form of challenges such as ballot initiatives (Pacelle 1998). These experiences will inevitably reinforce feelings that adversarial groups are committed to modifying or reducing agencies' role and authority. How the states respond to such challenges as well as to the need to better engage the urban public will obviously be central to the future of urban wildlife management.

Federal agencies will play an obvious role in urban wildlife management when their lands fall within or near urban boundaries and management programs must be coordinated with other interest holders. This role extends to educational outreach as well, to which most agencies are committed and have devoted resources. The U.S. Fish and Wildlife Service's Urban Conservation Program is one example of federal

engagement (USFWS 2023). Both state and federal agencies are likely to enthusiastically support and adopt noncontroversial programs, such as the creation of backyard habitats and native pollinator gardens. Dealing with more controversial topics is likely to remain more difficult for them even as they move to create better ways to engage others in discussion of their management concepts (Decker *et al.* 2005).

There are more than 3,500 animal care and control facilities in the United States (Rowan and Kartal 2018) whose activities can include providing euthanasia services for animals trapped and surrendered by private landowners, responding to concerns about wildlife around (or in) the home, dealing with wild animals found injured or dead on roads, responding to potentially rabid wildlife, and/or working with wildlife rehabilitators to transport injured or orphaned wildlife to their care centers. While a majority of wildlife rehabilitation activities are still home-based, the field continues to develop and increasingly, there are numbers of highly trained and professional staff working out of larger and better equipped headquarters (Bernat 2023). These organizations can provide not only direct services that are highly meaningful to individuals seeking care for injured or orphaned animals, but they are also a source of significant educational and outreach resources to help resolve human-wildlife conflicts.

Both animal care and control and wildlife rehabilitation organizations have in a few cases begun to provide direct and hands-on services for local communities similar to those provided by commercial wildlife control service providers. A role for these agencies in urban wildlife management seems logical since it would largely entail the extension of their community-based animal-related services and incorporate an animal welfare ethic above and beyond the economic model that commercial wildlife businesses are built upon (Hadidian 2015; Stevens and Proulx 2022).

The pest management industry will be most likely to change through economic incentive and seems unlikely to reform its business model anytime soon. If it does, such change will probably come first in response to continuing scrutiny and public concern over the use of rodenticides and their impact on valued wildlife species (Stone *et al.* 1999; Serieys *et al.* 2015). Competing mandates are involved here, with environmental protection and public health and safety agencies both working under a remit to serve the public. Progress on the industry side may come with increasing adoption of IPM strategies that make it possible to reduce pesticide and rodenticide use but still achieve desired levels of control (Witmer 2007) and a clear commitment to "continual improvement" (Fitzner 2002).

Dorney (1989) described criteria for small environmental management firms seeking to establish consulting services to advise urban planners, including the need for a wildlife specialist within the multidisciplinary staff cohort working in such contexts. Community and homeowners' associations (HOAs) are important and in the future may be key parties in discussions of urban wildlife management. If it is true that all (or at least, most) development is local (Hess *et al.* 2014), then the same might be said for management. Community associations in the United States have grown from 10,000 associations with approximately 2.1 million residents in the 1970s to an estimated 358,000 associations with over 74 million residents (CAI 2021). Decisions made by HOAs, their associated management companies, and community boards can literally be the difference between establishing a meadow or surrendering acreage to housing.

Larger nonprofit organizations can also play a significant role in urban wildlife management, whether at a local city level as when wildlife rehabilitators work with animal control officers (or when the agencies themselves add wildlife response and care programs) to rescue and rehabilitate injured and orphaned wildlife, or where programs such as the National Wildlife Federation's Garden for Wildlife™ and Certified Wildlife Habitat® programs subscribe thousands of individual properties throughout the country. Luther (2018) argues that an "institutional evolution" is taking place in which a new conservation rhetoric is emerging via the "people and nature" constructs that better fit the socioecological complexity of cities and their conservation concerns.

A consensus approach to urban wildlife management is unlikely to emerge soon, given the many different private and public interests involved and the complex practical as well as moral issues that urban wildlife management must address. This does not mean that meaningful frameworks cannot be advanced, however, as has been the case with conflict management (Soulsbury and White 2015), land use (Beatley 1991), and elsewhere.

Summary and conclusions

We have used a broad brush to describe what we mean by urban wildlife management, choosing to visualize it expansively as taking place in planned and unplanned contexts. Moving a box turtle (*Terrapene* spp.) out of the road is unplanned management, while culling deer in a neighborhood park is typically highly planned. Both involve interactions with wild animals that are consequential, both for the individuals involved and for their biotic community. Humans are members of the biotic community also and the consequences extend to them as well. The dominating presence of humans in cities means that wildlife management is dictated by human ideology and the institutions and organizations that people create.

Traditional wildlife managers may show little interest in wildlife in cities, either because as 'wildlifers' at heart they are trying to escape the city rather than improve it (Gilbert and Dodds 2001) or because the existing fiscal mechanisms mean that resources simply cannot be allocated for urban-focused work. An ecological approach to managing urban wildlife works well in many respects, especially as it focuses on the human side of management and the need for engagement (Davies *et al.* 2004). However, urban ecologists may be more focused on "big picture" issues, such as biodiversity conservation and climate change, and have not yet established any framework for dealing with routine and ordinary human-wildlife interactions, either as positive or negative events. Applied ecology (Hone 2007; Hone *et al.* 2018) may offer a direct and much needed bridge in this regard, providing a counterweight to the commercial pest control model that neither seeks to address conservation needs nor advance understanding of human-wildlife relationships.

It has often been argued that cities separate people from nature (Turner *et al.* 2004) and that urbanites as a result have a less realistic understanding of the natural world. This is highly consequential, if it be the case, because cities overwhelmingly represent the demographic majority (Golding and Winkler 2020) that will shape the policies and practices of wildlife management in the future. If one goal shared by most interest holders is to better connect the urban public with wildlife, some realities will need to be addressed. One is that cities do comprise novel ecosystems that will require significant modification of conservation norms (Hobbs *et al.* 2009). There will be no urban grey wolf (*Canis lupus*) packs or American bison (*Bison bison*) herds in cities. The values and attitudes of the urban public will dictate what species are preferred and favored (probably birds and butterflies in the near term) and some species will be at best tolerated (raccoons and squirrels) while others may be completely suppressed and controlled using whatever means are available (rats, for example). The conservation community and the general public will have to accept and establish a rules-based approach aligned with this reality. Even so, the conservation and management of urban wildlife will be a low priority in urban planning and development. Most urbanites will prioritize the more immediate and tangible challenges of urban living – public education, transportation, housing, and jobs, for example – when discussions about resource allocation, growth and development take place. The nexus of greenspace, wildlife, and human health and well-being is not on their radar yet, nor has it been integrated into and justified under the "one explicit model" (McHarg 1969) of the world – economics.

It is not entirely clear what the future trajectory of human-wildlife interactions will be in our cities, and given their complexity and dynamic nature, it may never be. Moreover, the history of human-wildlife involvement in cities has barely begun to be written. New species of wild animals will continue to colonize cities and present new challenges as well as opportunities. Today's urbanites are emerging from a period of unfamiliarity with wild animals as neighbours into increasingly normalized interactions and relationships. Urban wildlife management is one small part of a broad reorientation of science, policy and practice emerging from the environmental revolution of the 1970s. It is not surprising that it is inchoate and conflicted by competing policies and practices. It exists almost as an afterthought in contemporary American culture, largely because the wild animals living in cities are an afterthought themselves. Yet they are part of an "urban nature" that we know to be beneficial, and perhaps essential to the well-being of people and other species in our cities. Realizing how to maximize that benefit is the principal challenge for urban wildlife managers heading into the future.

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