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Human–Wildlife Interactions and Coexistence in an Urban Desert Environment

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Abstract: Negative interactions between people and wildlife pose a significant challenge to their coexistence. Past research on human–wildlife interactions has largely focused on conflicts involving carnivores in rural areas. Additional research is needed in urban areas to examine the full array of negative and positive interactions between people and wildlife. In this study, we have conducted interviews in the desert metropolis of Phoenix, Arizona (USA), to explore residents' everyday interactions with wildlife where they live. Our multifaceted approach examines interactions involving physical contact and observational experiences, as well as associated attitudinal and behavioral responses and actions toward wildlife. Overall, the qualitative analysis of residents' narratives identified two distinct groups: people who are indifferent toward wildlife where they live, and those who appreciate and steward wildlife. Instead of revealing conflicts and negative interactions toward wildlife, our findings underscore the positive interactions that can foster human wellbeing in urban areas. The holistic approach presented herein can advance knowledge and the management of coexistence, which involves not only managing conflicts but also tolerance, acceptance, and stewardship. Understanding diverse human–wildlife interactions and managing coexistence can advance both wildlife conservation and human wellbeing in cities.

Keywords: urban ecology; human–wildlife coexistence; nature conservation

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1. Introduction

Conflicts between people and wildlife present a critical challenge to preserving wildlife and managing human-dominated landscapes for the wellbeing of both human and non-human species [1]. Conflicts involving wildlife attacks on people, domesticated animals, and property have been the focal point of significant research on human–wildlife interactions (HWIs) [2–6]. Although important, scholars have recently argued that the focus on conflicts limits the exploration of solutions, and thus, research requires a reframing to incorporate positive interactions [1,4,5]. As a result, an emerging framework for understanding a range of HWIs and how to manage them has developed around the idea of coexistence, which has been defined as a dynamic, sustainable state in which people and wildlife co-adapt to shared landscapes [2,5].

Coexistence entails governing HWIs to protect wildlife while managing tolerable levels of risks and the social legitimacy of management decisions [2,5]. Coexistence is not the opposite of conflict, but rather, it entails managing negative interactions in ways that society will tolerate [1,7]. As such, coexistence requires that people accept at least some level of conflict with wildlife [4,5,8]. On the more positive side of HWIs, coexistence involves more active acceptance and even the stewardship of wildlife, wherein people appreciate and even support the conservation of wildlife where they live [7,8]. Given the diverse array of potential positive and negative interactions with wildlife, managing HWIs for coexistence requires understanding the contexts in which conflicts, tolerance, acceptance,

and stewardship occur [5]. While the precise meaning of these concepts remains unclear, scholars agree that residents' experiences with wildlife interact with their attitudes and behaviors toward them to determine the extent to which negative and positive interactions occur, thereby affecting the potential for coexistence [5,8].

To date, HWI research has also largely focused on conflicts in rural areas involving carnivores and large mammals [1–3,6]. Far fewer studies have focused on human interactions with a range of wildlife [4]. Additional research on diverse HWIs is needed in cities [6,9], especially considering that the range of positive, negative, and neutral interactions in urban regions is poorly understood [10]. In this paper, we examine human–wildlife interactions in the desert metropolis of Phoenix, Arizona, in southwestern United States. Specifically focusing on HWIs in residential settings, we conducted interviews to document the types of wildlife that residents have observed where they live, coupled with any associated physical interactions (e.g., conflicts), attitudinal responses (i.e., positive, negative, or neutral), and behavioral activities that affect coexistence.

By evaluating multidimensional responses to everyday interactions with wildlife, researchers can identify common situations that involve the targeted management of HWIs to distinct people or contexts. For instance, negative responses involving acute, physical interactions and human behaviors that harm wildlife require strategies that prevent and avoid harm or nuisances. Yet, in urban areas, where physical harm to people from wildlife is less common, as our data demonstrate, managing human tolerance of nuisances and mitigating fears might be more needed, given less benign interactions in rural areas. Additionally, more positive HWIs involve seeing and enjoying wildlife in urban environments, thereby potentially leading to positive outcomes for human wellbeing as well as stewardship. Overall, both our approach to evaluating multifaceted urban HWIs and the empirical evidence we present advance the understanding of diverse conditions for coexistence while demonstrating the need to tailor management to specific situations.

1.1. Urban Human–Wildlife Interactions and Conservation

Before detailing our research methods, we further explain urban HWIs and our approach to examining multifaceted HWIs for coexistence and conservation. HWIs in urban regions involve less acute conflicts than in rural areas because large carnivores are less prevalent and people's livelihoods are less impacted [9]. The threats from urban wildlife often involve attacks on pets, as well as personal anxiety and nuisances associated with encroachment on and damage to property [11]. Stray cats and dogs are another concern in urban areas, as they may negatively impact both people and wildlife through attacks, disturbances to wildlife populations, and transmission of diseases [4,12–14]. An increasing threat in urbanizing areas is zoonosis since wildlife can spread diseases to both people and domestic animals [9,15–17]. The rise of the One Health framework acknowledges the threat of vector-borne diseases and underscores how the interconnections between people, animals, plants, and the environment significantly impact human health, especially in urbanizing regions, where increasing contact between people and animals can spread diseases such as rabies, the West Nile virus, and the coronavirus [16,18,19].

The positive impacts of human–wildlife interactions in urban and other locations may include material and non-material benefits, with the latter including positive effects on psychological wellbeing [1,5]. Connections with nature in cities, including wildlife, can improve wellbeing, yet the specific effects of HWIs on human wellbeing are not fully understood [10,20,21]. Nevertheless, connections with urban nature can have restorative effects that reduce stress and provide mental relief [22,23]. Spiritual health outcomes also result from interacting with nature, including a sense of transcendence and connectedness with other living beings [24,25]. Not only can connections with urban nature improve human wellbeing, they also lead to positive feedback by spurring conservation actions such as gardening for wildlife and feeding birds [16,26–30]. Furthermore, in urban areas, residential yards have been shown to provide critical habitats for birds, bees, and other pollinators, which can lead to positive feedback loops for both people and wildlife [31–34].

Overall, both the severity and frequency of HWI interactions and impacts vary greatly in urban areas, given the mixture of land uses and cover types in cities [10]. Depending on the spatial configuration of landscape features, the clustering of HWIs may occur in urban regions where, for example, parks and open spaces, as well as low-density housing, provide habitats for wildlife. Beyond the interactions people have with wildlife in different locations, diverse values and worldviews among urban residents also affect their responses to encounters with wildlife [35,36]. Given a shift in wildlife values in the U.S.—specifically toward more mutualistic worldviews emphasizing the protection of wildlife and a willingness to coexist with them—in contrast to the more traditional utilitarian worldviews emphasizing the benefits of wildlife to people [37,38], urban environments are likely to experience a wider array of HWIs, potentially including more positive responses that garner appreciation and stewardship. As a whole, both heterogeneous landscapes and residents in urban regions can result in varied responses to wildlife.

1.2. Multifaceted HWIs in the Context of Coexistence

The co-occurrence of people and wildlife depends on environmental conditions (e.g., availability of habitats) well as the behavioral traits of wildlife (e.g., daily and seasonal movements) [10]. Such conditions determine the frequency with which HWIs occur, as well as the potential for physical contact between wildlife and people or their property to cause conflict. Since acute conflicts are relatively rare in urban areas, other forms of interactions are important to consider in understanding the full array of HWIs and associated outcomes [9,11]. Specifically, sightings of birds or smaller wildlife are more likely in urban areas than physical conflicts involving large carnivores. Research has shown, for example, that seeing or hearing birds can enhance nature appreciation, but this may depend on how common or rare the birds are, and the responses are likely to vary based on the specific calls, colors, or other traits of the species encountered [39,40]. In general, the nature and extent of wildlife observations, whether they are seen, heard, or otherwise sensed, are important to consider in urban settings, as are people's subjective responses to them.

Since people's values, perceptions, and affective responses to wildlife influence whether encounters with wildlife are evaluated positively or negatively [5,35], people's subjective views of wildlife must be considered alongside physical and observational interactions. Beyond utilitarian versus protectionist values, emotional responses (e.g., awe versus fear) and perceived risks (e.g., whether wildlife pose a threat) significantly affect attitudinal evaluations (i.e., positive and negative judgments) toward wildlife [36,41–43]. As a whole, the impacts of HWIs are filtered through individuals' subjective views and experiences, which tend to be context-specific [3,35,44]. Accordingly, people in similar situations with wildlife may respond differently, thereby determining the extent of the conflict or mere tolerance of wildlife or more active appreciation and stewardship.

Lastly, behavioral actions and responses toward wildlife should be considered distinct from attitudes since they affect the nature of interactions and outcomes, including stewardship as well as actions that potentially harm wildlife [10,43]. Both people's attitudes and behaviors will distinguish between tolerance and acceptance since tolerance implies inaction (i.e., not harming wildlife) in the face of dislike or other negative evaluations of interactions [3,7,44]. Meanwhile, acceptance of wildlife has been positioned as more positive than tolerance and seems to embody more positive attitudes involving appreciation [7,8]. As such, acceptance is an intermediary of tolerance and stewardship, wherein the former involves relatively negative attitudes and the latter involves actions undertaken to benefit wildlife.

2. Materials and Methods

To better understand varying levels of coexistence in urban environments, we analyze interviews to qualitatively examine physical, observational, attitudinal, and behavioral interactions with wildlife. In this section, we first describe the study area of metropolitan Phoenix, Arizona, followed by our data collection analytical approach.

2.1. The Study Area

The study area of metropolitan Phoenix is situated in the Sonoran Desert of central Arizona, which is a semi-arid biome that receives approximately seven inches of precipitation annually [45]. As one of the fastest-growing urban areas in the U.S., the region's population is approximately five million people. Historically, urban development has occurred on former agricultural land, yet in recent decades, development has been encroaching on desert lands [46]. As residential communities abut desert lands, human–wildlife encounters have increased. Moreover, residents who live near desert preserves, both within the urbanized environment and along the fringe, also tend to encounter a greater diversity of birds and other wildlife, ranking from snakes to mammals [40,47]. Iconic desert species in the region include the cactus wren, roadrunner, Gambel's quail, and Anna's hummingbird, in addition to collared peccaries (also known as javelina), antelope jackrabbits, gila monsters, and western diamondback rattlesnakes. While many wildlife species in the metropolitan area of Phoenix tend to live in desert preserves, away from highly urbanized environments, residents throughout the Valley commonly encounter coyotes, cottontail rabbits, scorpions, and a variety of lizards and birds.

2.2. Data Collection and Sample

In the winter to spring of 2020, our team conducted semi-structured interviews that primarily included open-ended questions about residents' experiences with wildlife in the region and beyond. The protocol started by asking participants to explain where they grew up and the range of places they have lived, followed by asking about their childhood experiences with wildlife. We then asked them to describe their current residence in the metro Phoenix area and any wildlife they have encountered or seen in and around their neighborhood. We further asked participants to explain how they felt about those experiences. We asked additional questions, for example, about memorable or concerning experiences with wildlife broadly. However, given the goal of understanding everyday HWIs where people live, the analysis herein focuses solely on participants' narratives about their wildlife experiences where they currently live in the Phoenix area. In order to capture participants' own perceptions, we did not define wildlife for the participants, although, as described below, some participants inquired about what we meant by "wildlife".

The interview protocol was implemented as a part of a student research training program, wherein five students (one PhD student and four undergraduates) interviewed four or five people each for a total of 24 interviews. Due to the student training and exploratory nature of this research, as well as people quarantining during the early days of the COVID-19 pandemic, we opted for a convenience-based approach, wherein students interviewed friends, peers, and/or family members, primarily via Zoom. For all interviews, we used the recording feature in Zoom to develop preliminary transcripts, which were then edited for clarity and imported into Dedoose software for content analysis. Four interviews were conducted in Spanish and then translated into English. All transcripts were anonymized, and the procedures were approved through our university's Institutional Review Board.

Given our convenience-based sample, research participants included several college-aged adults. The average age of participants was 28 years, with a minimum age of 20 and a maximum age of 55. About half (57%) of the participants lived in single-family homes, while the others lived in multi-family dwellings such as apartments or condos. The participants lived in varied locations in the metro area, including relatively urbanized areas of central Tempe and Phoenix, suburban areas such as Mesa or Glendale, and fringe neighborhoods near desert preserves. Some participants referenced living in multiple locations in the Valley, for example, at their own residence and 'at home' with their parents. Our sample was fairly split by gender, with one non-binary participant who also identified as female. One-quarter of our participants were Hispanic, while three-fourths were White (see Table 1 for details). Although our sample is limited demographically and we cannot generalize our results to the broader population of Phoenix, our results are informative, nonetheless.

Table 1. Demographics of interview participants.

Age (Mean)	**28 Years (Range 20–55)**	
Gender [1]	Male	50%
	Female	54%
	Non-binary	4%
Race [2]	White	75%
	Latinx/Hispanic	25%
	Asian	8%
	Black	4%
	Indigenous	4%
Residential settings	Single family	57%
	Apartments	43%

Notes: [1] One participant identified as both female and non-binary. [2] Percentages do not add up to 100% due to mixed race/ethnicity participants, e.g., people identifying as White Hispanic.

2.3. Qualitative Analysis

For this manuscript, the primary investigator conducted the coding after iterative coding with the student team for broader research and training purposes. The analytical approach presented herein was relatively simple and focused on coding only the portion of the interview transcripts wherein participants described the wildlife they had encountered around where they live in the Phoenix region. The sections of text ranged from approximately 50 to 500 words. As presented below, the specific wildlife mentioned were first coded to document which types of wildlife were mentioned by participants (Table 2). In a few cases, participants also mentioned wildlife in other houses they have lived; in one case, this was another home in the Valley where the person had recently lived, and in two other cases, the encounters mentioned were from college students who also spend time in the parents' home in the region. Their references are included in the analysis.

Table 2. Interviewees' mentions of different wildlife encountered around their homes in the greater Phoenix area of Arizona (n = 24).

Wildlife Specified	**Sum**	**% of Sample**	**Wildlife Specified**	**Sum**	**% of Sample**
BIRDS	19	79.20%	INSECTS and ARACHNIDS	10	41.70%
Birds (general)	16	66.70%	Scorpions	5	20.80%
Pigeons	8	33.30%	Bugs or Insects (general)	4	16.70%
Hummingbirds	4	16.70%	Spiders or Arachnids (general)	3	12.50%
Doves (Mourning)	2	8.30%	Bees	2	8.30%
Falcons (Peregrine)	2	8.30%	Butterflies	1	4.20%
Hawk (Harris)	2	8.30%	Ladybugs	1	4.20%
Quail	2	8.30%	Cockroaches	1	4.20%
Owls	2	8.30%	Flies/Maggots	1	4.20%
Lovebirds	1	4.20%	Crickets	1	4.20%
Crows	1	4.20%	REPTILES and AMPHIBIANS	8	33.30%
Finches	1	4.20%	Lizards	5	20.80%
Ducks	1	4.20%	Rattlesnake	3	12.50%
MAMMALS	11	45.80%	Snakes (general)	2	8.30%
Coyote *	8	33.30%	Gopher snake	1	4.20%
Rabbits (Cottontails)	5	20.80%	Frogs	1	4.20%
Javelina	2	8.30%	OTHERS	8	33.30%
Squirrels	2	8.30%	Stray Cats	5	20.80%
Foxes	1	4.20%	Roadkill	1	4.20%
Mountain Lion	1	4.20%	Fish	1	4.20%
(continued on right side)			Snails	1	4.20%

Notes: The frequencies presented are for general or specific references to particular types of wildlife by type. * One mention of wolves was included as a coyote since wolves do not inhabit the region and we assumed the person meant coyotes, which are common in the study area.

Second, for each interviewee, we coded their narrative comments for references to physical interactions with wildlife involving bodily contact between people and an animal or its excrements. These references could involve instances in which wildlife would bite, attack, or otherwise physically harm or defecate on people or their property, in addition to people physically touching wildlife. Second, the nature of the observational interactions was documented, including visual sightings as well as auditory encounters in which people heard wildlife. Third, we recorded attitudinal interactions as people's evaluative responses involving positive or negative terminology to describe their encounters with wildlife; for example, positive attitudes were expressed as people liking or enjoying the encounters, whereas negative attitudes were expressed with terms indicating fear or disgust. Meanwhile, people who make comments such as "I don't really think about wildlife" or "I don't really care" were coded as disinterested or apathetic about encounters. Lastly, behavioral interactions with wildlife were recorded when people described actions they had taken to attract or provide resources (e.g., food) for wildlife, as well as actions taken to deter, avoid, or harm wildlife. We also documented behavioral intentions when people mentioned plans or ideas that conveyed an intention to act in a certain way in the future.

In the results section below, we report descriptive trends in the wildlife encountered in diverse ways, involving physical, observational, attitudinal, and behavioral interactions, both in terms of the quantitative extent to which they were mentioned and, more importantly, the qualitatively ways in which the HWIs were described by the research participants. Based largely on individuals' attitudinal responses to wildlife they have encountered at home, we identified two general groups of people—those who were generally positive about HWIs where they live and those who were indifferent or apathetic. In each group, we also describe mixed responses, including negative reactions to particular wildlife that reflect the potential for conflict, as well as positive responses that reflect appreciation and stewardship behaviors.

While reporting our findings, we provide exemplary or demonstrative quotes to document the trends in HWIs. The quotes included below are verbatim wording, with some deletions for colloquial expressions or words such as "um" and "like", as well as repetitive or extraneous wording (represented with ellipses). Bracketed phrases are used to clarify statements taken out of their discursive context. In all but one instance describing a husband and wife's differential responses to a particular HWI, we use they pronouns for simplicity since gender is not the focus of this research.

3. Results

We now describe the wildlife encountered in residential neighborhoods, followed by how our research participants interacted with and responded to them.

3.1. Wildlife Encountered in Residential Areas

When we initially asked our research participants about the wildlife they encountered where they live in metro Phoenix, about one-fifth asked for clarification about what we meant by wildlife. Meanwhile, about one-third immediately responded with comments such as "none" or "not much". Yet all participants eventually mentioned at least one type of wildlife encountered around their home or neighborhood. The maximum number of wildlife mentioned was ten, with an average of roughly four types of wildlife mentioned across participants.

Interviewees most commonly mentioned birds they encountered where they live, with 79% of participants referring to birds generally or to specific types of birds. Pigeons (33% of participants) and hummingbirds (17%) were the two specific birds referenced most often (see Table 2 for details). Nearly half (46%) of our interviewees mentioned mammals; coyotes were most often mentioned (33% of participants), followed by rabbits (21%). Nearly the same number of participants (42%) referred to encounters with scorpions, insects, or spiders where they live; while 21% mentioned scorpions, the next most frequent references were to "bugs" or "insects" generally, followed by "spiders", or by one person, "arach-

nids". Reptiles and amphibians were least often mentioned (one-third of our participants); specifically, lizards were mentioned by one-fifth of participants and rattlesnakes or snakes were mentioned by others. Additional references to specific wildlife were made by one or two people in our sample, while one-fifth of participants mentioned "stray cats" (Table 2).

3.2. Different Types of HWI

3.2.1. Physical Interactions with Wildlife

Only five (21%) interviewees mentioned some sort of physical contact with wildlife they encountered where they live, with references including picking up the occasional stray cat, stepping on a lizard, hitting a rattlesnake with a car, and catching scorpions to take them outside, in addition to one person expressing their annoyance with pigeons pooping on their balcony. While the individual who stepped on the lizards simply reported the interaction with no emotive or evaluative response, the person who hit the rattlesnake expressed sadness and regret. Specifically: "I have seen some snakes, and I've seen rattlesnake out in the wash . . . I actually accidentally hit one with my car when I was learning to drive. I still am really sad about it to this day. I'm sorry. It is one of my biggest regrets . . . I choose to think that it was fine and slid away and healed". The person who reported physical interactions with scorpions said: "Seeing a scorpion in the house [is] kind of inconvenient, but I still like them. I just catch them and take them outside".

While no participants reported physical attacks or harm to people, pets, or property, some people did report being stung by scorpions in other contexts (i.e., not where they currently live), and others expressed a fear of wildlife (as described below). A couple of instances of physical interactions between the wildlife observed by participants are also detailed below, both of which involved birds of prey hunting pigeons.

3.2.2. Observations of Wildlife

All 24 of our interviewees reported seeing wildlife where they lived, as reported above and in Table 2. One-quarter of our research participants also mentioned hearing wildlife around their homes, especially birds and coyotes, as well as one person each for rattlesnakes and a mountain lion. One resident said they hear birds more than they see them, and another mentioned hearing wolves (sic) at night. While those two auditory reports were matter-of-fact, the quotes below demonstrate people's differential responses to hearing wildlife near their homes.

> "I definitely can hear different kinds of bird calls and bird noises outside my window. . . I love being able to hear birds, and sometimes open my window just to be able to hear the birds, particularly right when the pandemic started; I started opening my window, and it was nice that I could hear the birds without the sound of the nearby major road".

> "I've heard mountain lions in the area, but haven't directly seen one. [It's] kind of like screaming. They're very, very distinctive, and you can hear them from very like far distances. Hearing a mountain lion is cool. Kind of unsettling but cool".

> "Sometimes I hear the noise of the rattle. [Encounters like this] make me feel good. But. . . I feel pity. Sometimes it makes me feel that we are invaders. Because we are invading where they live".

The last quote above is from a resident who lives near a desert mountain preserve and has described various interactions with wildlife such as rattlesnakes and lizards, as well as many birds, including owls. With regard to encountering wildlife overall, they stated: "[These animals] are a part of us. They make me feel good. It's a part. . . of my life". In the next section, we further detail residents' emotional and other evaluative responses to wildlife where they live.

3.2.3. Attitudinal Responses to Wildlife

Participants' descriptions of wildlife encounters around their homes ranged from negative to indifferent to positive. Negative attitudes mostly referred to insects and scorpions. For instance, scorpions were described as "inconvenient", "not fun", or "never pleasant", and residents also described being "scared" of bees and snakes. Residents with positive sentiments about wildlife tended to use words such as "like" or "love", "nice" or "enjoy" in relation to birds, mammals, or wildlife as a whole. Overall, while half of the interviewees tended toward positive views toward various wildlife, the other half were relatively indifferent or apathetic about the wildlife they encounter where they live. Compared to the interviewees who expressed relatively positive HWIs, the indifferent group reported fewer wildlife sightings, ranging from 1 to 5 kinds of wildlife with an average of 2.9, compared to 3–10 with an average of 5.2. While the indifferent group more commonly referenced birds, especially pigeons, as well as rabbits, the positive group tended to mention a greater variety of birds and wildlife, including hummingbirds, in addition to snakes and lizards. Both groups included people with mixed views, as detailed below.

The Residents Who Were Relatively Indifferent about Wildlife

About half of our research participants can be characterized as indifferent or apathetic, as they tended to mention wildlife they have seen or heard without a positive or negative response. Additionally, these individuals made comments such as, "I don't really care" or "I don't really think much of them". Seven of the twelve (58%) interviewees designated as indifferent initially reported "no wildlife" or "not much" where they lived, often saying that they live in an apartment complex. Others said: "[there are] not really any wildlife other than…" "birds", "bugs", or "stray cats". A few indifferent residents made negative comments about scorpions or insects such as flies. When prompted further, other participants expressed mixed sentiments, such as, "I'm scared of bees. But it's nice seeing butterflies and some of the birds. Some can be annoying. Doves and pigeons are annoying". Another example from a relatively indifferent resident who expressed mixed sentiments toward different wildlife is as follows:

> "Well, there's always a lot of birds in my backyard; my parents feed them. We get these bird seeds from Costco and my parents put them out there…[they] have told me [about] some hawks flying around above our house. There were a couple of occasions where we saw rabbits down the road, but it's very infrequent…For the most part, I don't really care. I mean, whenever we see…a wild rabbit around, that brings me joy. I like seeing that. But whenever my mom tells me there's a hawk flying around above our house, that kind of scares me because we also have a small dog, and my [pet] rabbit sometimes goes outside in our backyard and runs around. So, [it] kind of gets me a little scared that it might attack them and do something".

Two participants classified as indifferent went on to say the following about coyotes. The first one initially said there was no wildlife around their apartment complex but then mentioned the following observation of a coyote in her parent's neighborhood: "This summer, I was walking by and I saw a coyote; that was pretty cool. It was pretty far away, so I wasn't I wasn't too bothered. If it started running at me, that would be a different story". The second person simply said, "There [are] coyotes here, but they're animals that are very fearful of humans, and they move away at the sight of you".

Another indifferent resident was the wife of another interviewee who commented on falcons hunting pigeons around their home. The husband described the following:

> "We've been seeing the Peregrine falcons hunt from our palm tree. I should say they kill [pigeons] from our palm tree, [which] includes coming out in the morning and seeing pigeon feathers all over the car and then finding two [pigeon wings] nicely and neatly set by each other, severed from the body. …It's pretty crazy".

While the entertained husband refers to these interactions as "the killing fields", his wife said: "he enjoys that, but really, it's just not enjoyable. It's really gross". The husband says, "I love raptors. I love all Arizona wildlife, so being able to see them in action in the city is great. I'm glad to know they're well fed". The husband, who was relatively positive about wildlife where they lived, also enthusiastically commented about:

> "...a dozen groups of [rosy faced] lovebirds live in these overgrown palm trees...adjacent to us...When the fronds lay down around the tree...it becomes a great bird habitat. So right here in our neighborhood we see a lot of lovebirds, which is interesting".

The second incident of wildlife-to-wildlife interactions observed by a participant involved a Harris Hawk who, "eats pigeons on the power pole in front of the house"; specifically:

> "[the hawk] haunts the pigeons. Then I go out to my car and it yells at me. It's kind of fun. It's terrifying [interviewee makes the sound of the hawk], but I say hello to it [laughter]".

The same participant also mentioned seeing various birds, including hummingbirds and quail, as well as cottontail rabbits and coyotes, adding: "they make me feel happy. I'm always happy to see them. I say hello".

The Residents Who Were Comparatively Positive about Wildlife

The two participants who were entertained by raptors hunting pigeons outside their homes were among the second group of twelve participants who were relatively positive toward wildlife. Although overall positive about encountering wildlife where they live, one-quarter expressed very specific negative sentiments: two specifically said scorpions were "inconvenient" and "not fun" in the house; one was fearful of "all serpents", including gopher snakes that "don't bite"; and the last one was the resident who mentioned pooping pigeons on the balcony, who said, "I like the birds...if [they're] not pooping everywhere". The following is a quote indicating an appreciation of wildlife, with the specific exception of a scorpion inside their home.

> "I think in the neighborhood, it's really just been lizards [which] are everywhere. I found a scorpion in my home once; that was not fun. I have a lot of hummingbirds because I put up a hummingbird feeder. Some other types of birds, and then there's a park pretty close to my neighborhood which has a lake, so there are fish there and ducks and some other birds...I love [seeing wildlife] because it kind of reminds me of home, because I saw animals so frequently there. I like being in a city, but I definitely like to still see wildlife in nature, greenery and all of that".

The remaining participants were unequivocally positive about the wildlife they encountered where they live. For some, interactions with wildlife represent spiritual experiences that bring out personal philosophies about living with nature, as shown by the quote above about local wildlife being "a part of me and my life". A couple of other examples follow:

> "I have mostly seen the famous rattlesnake. For me, it is harmless. [People] have always told me that it is very poisonous, that you have to be careful. And yes, I am careful. But it is very peaceful. That snake can be there quietly and as long as you don't bother it, it won't even make that sound. I also encounter coyotes. We exchange looks. I would like to understand the language of the coyote. I would like to dialogue with the coyote. We see each other, the coyote and I. It gives me great joy when the coyote stops and looks at me".

> "There [are] male and female crows, purple face finches, hummingbirds, species I don't know. There are...mourning doves, and some other things that I don't recognize in my bird book. We have some scorpions around here in terms of

> insects (sic), crickets, and things like that, but we don't see a lot. And some spiders, but we don't really see a lot, at least inside the house…I enjoy it. I think it's humbling…I wake up in the morning and it makes me feel grounded". (Note: the sic reference indicates an incorrect reference to scorpions as insects since scorpions are taxonomically related to spiders as a form of arachnid).

In summary, the positive responses to wildlife range from simple enjoyment or appreciation to spiritual feelings of humility and connectedness. As seen in the next section, people with positive sentiments often expressed behavioral intentions or actions aimed at stewardship.

3.2.4. Behavioral Actions toward Wildlife

Nine participants (39%) reported behavioral acts or intentions toward wildlife that reflect appreciating or caring for wildlife through various means. A few already mentioned include the individual who talks to wildlife (i.e., says hello), the one who catches scorpions inside the home to take them outside (i.e., as opposed to killing them), and the one who sometimes picks up stray cats. The most common behavior mentioned by five (21%) of participants was feeding or attracting birds. A couple of unique quotes include the following, which indicate the intent to safeguard or avoid harming wildlife.

> "…There's also a rabbit that comes through my backyard periodically. I would really like to build some kind of like enclosure for it to keep it safe, because my dog likes to chase after it but that's another very positive experience that I have. Whenever I see the rabbit it makes me happy. I like to see it. I think it's cute".

> "[We see bunnies] and my mom likes to feed [birds]…Sometimes I get excited, but I also don't want to go outside because I'm scared that I'm going to scare them away".

Regarding people who feed birds, one quote indicates caution regarding how the appreciation of wildlife can be associated with feeding birds and outdoor cats in the same vicinity.

> "I put water and food out for the cats that live around here, especially in the summer…I have a bird bath out and a bird block and hummingbird feeder and tomato and bell pepper plants. I'm starting to see a lot of bees come in the yard. The birds are now [coming around]; it takes them a while because they're skeptical, but they bathe in the bird bath and drink in it, and the bird block is about half gone now…. [We have an] immense amount of cats, because for whatever reason, better or worse, the owners just kind of started housing them and then there's shade here, so they start to gravitate. Every once in a while, you can pick them up so that's kind of nifty. They kind of leave you alone. [But there are] lots of birds. Lots of hummingbirds, which is awesome. We just got some plants that actually that they like to feed on, so we get to watch them and I find a lot of peace and serenity from just watching them buzz around".

In the discussion that follows, we address situations in which people attract birds that raise related concerns (e.g., about cats preying on birds or predatory birds preying on pets). We also discuss the significance of our findings and the importance of examining ordinary interactions with urban wildlife in diverse residential settings.

4. Discussion

In this paper, we have documented everyday interactions with a wide variety of wildlife where people live in the desert metropolis of Phoenix, Arizona. We believe studies like this complement previous research that has more commonly focused on interactions between people and particular species, especially those involving conflict with carnivores in rural areas [2,6]. While we recognize our small, convenience-based sample limits the ability

to advance knowledge through generalizations, the approach and results offer important insights into understanding and managing diverse HWIs and coexistence in urban regions.

4.1. Understanding and Targeting Distinct and Positive HWIs

Our research revealed two broad types of responses to everyday urban wildlife in the study region of metropolitan Phoenix, Arizona—residents who are largely indifferent and somewhat negative about wildlife and those who generally enjoy interacting with wildlife where they live. This suggests that for many urban residents, their regular interactions with wildlife may be more mundane or positive than conflictual or negative. While these results are not groundbreaking, they underscore how everyday interactions with wildlife in urban areas warrant attention to diverse experiences with different types of wildlife. Accordingly, human–wildlife coexistence across metropolitan regions may be less about managing conflicts and acute physical interactions and more about dealing with annoyances and minimizing harm, especially to pets [9].

We found that even simple interactions with common wildlife in urban areas, such as birds, lizards, and coyotes, can bring about joy and other positive responses that enhance the wellbeing of urban residents. For example, urban residents in our study reportedly benefited from enjoyable interactions with wildlife, including feelings of calmness and connectedness. These experiences signal the potential for positive mental and spiritual health outcomes [24,25]. Since the spiritual and other non-materials effects of HWIs have been understudied [25], we recommend additional research to better understand the contexts in which these effects occur and may be linked to positive outcomes on human health [24]. This seems especially worthwhile since past research has focused on the health outcomes associated with vegetation, parks, and greenspaces [48–50] or captive animals rather than free-roaming "wildlife" [51,52]. Overall, documenting positive HWI and associated outcomes for human wellbeing could help shift wildlife management toward managing an array of interactions and outcomes, including those aimed at stewardship.

Given distinct responses to wildlife among different urban populations, conservation outreach should be targeted to groups of people who hold different values and emotions as well as attitudinal and behavioral responses [42,53]. Even within our limited sample, we identified two distinct groups of residents. For the relatively negative group, communications could be aimed at preventing or avoiding unwanted interactions. In doing so, conservationists and wildlife managers should acknowledge emotions (such as fear) and validate concerns while reinforcing a sense of control in managing HWIs [42,53]. For the positive residents that enjoy wildlife, outreach could focus more on stewardship and habitat provisioning, for example, through wildlife gardening [26,27,29,30]. As a whole, media and other outreach methods can foster coexistence by detailing strategies to prevent and manage conflicts, fears, and nuisances, in addition to offering specific recommendations for effectively protecting wildlife and providing habitats [54].

4.2. Evaluating Threats to Human and Wildlife Health

One concern largely absent from respondents' statements about wildlife where they live was the perceived risks of zoonotic diseases. While increased tolerance of wildlife can benefit the conservation and promotion of urban wildlife communities, close interactions with wildlife can also serve as a pathway for the spread of diseases [15,17,55]. In urban settings, understanding how these interactions may lead to negative health consequences is central to the application of the One Health framework [18,56,57]. To assess the health implications of HWIs, future studies may need to explicitly ask about perceptions and behaviors relating to the threat and spread of diseases. Moreover, to evaluate the potential for disease spread between urban wildlife populations and residents, incorporating people's behaviors (e.g., feeding animals) into geospatial models—along with heterogenous landscape features—can create maps to identify places of interactions (e.g., near habitat areas) that may create or mitigate future health concerns for both people and wildlife [56,57].

Urban wildlife may be especially susceptible to diseases if residents perceive them positively and take action to interact with wildlife by feeding them. Supplemental food introduced to wildlife (e.g., bird feeders, outdoor food for cats or dogs) can introduce diseases to populations and can also promote the spread of disease by clustering wildlife [58,59]. Behaviors such as feeding birds can also cause problems for wildlife if they are drawn to areas with high populations of predators, such as stray cats [12,60]. Specifically, one of our participants commented about attracting birds with feeders and bird baths into an apartment complex with several stray cats. Such situations may create ecological traps, wherein the attention to wildlife may ultimately harm them. Given the potential for unintended consequences from well-intentioned human behaviors, the feeding of urban wildlife is a critical challenge to coexistence and, therefore, should be the focus of future HWI research.

4.3. Managing HWIs for Coexistence

To underscore conservation and management insights from our findings, a few additional points are noteworthy. First, certain species that are relatively common and tend to be appreciated—such as coyote, cottontail rabbits, and a variety of birds, including hummingbirds and quail, in the study region of Phoenix—might be the most effective conservation mascots [61,62] in the pursuit of wildlife acceptance and stewardship. While iconic species in the Sonoran Desert include the charismatic roadrunner and protected species such as cactus wren, these types of wildlife are less often encountered, and thus, conservation efforts might be more productively focused on the wildlife that a wide range of people tend to experience in their ordinary lives.

Second, local wildlife that people fear due to potential stings, bites, or attacks (e.g., on pets)—for example, scorpions, snakes, and coyotes in our study—should be targets for conservation campaigns aimed at fostering tolerance and avoiding conflict. In doing so, detailing specific information and behavioral tips on how to deter unwanted wildlife and avoid harm is crucial [54]. Such outreach should also be tailored to encountering specific wildlife in different situations since attitudinal and behavioral responses to wildlife can be highly context-specific [5,25].

Lastly, although species such as bees and butterflies were not frequently mentioned by our interviewees, they should nevertheless be central to urban conservation and coexistence since neighborhood and urban environments can provide viable habitats for these species [32,33]. To advance urban wildlife conservation broadly, framing public outreach and strategies to an array of positive and negative interactions could help to manage varying levels and types of coexistence by minimizing specific risks and nuisances and increasing tolerance, appreciation, and stewardship through a sense of control and appreciation [10,53].

5. Conclusions

This study offers a rare evaluation of residents' encounters with and responses to diverse wildlife in urban residential settings, specifically in metropolitan Phoenix, Arizona. Our study found that urban HWIs are not as acutely negative as the well-researched conflicts in rural areas. Rather, we identified two distinct groups of residents: those who are relatively indifferent about local wildlife and those who enjoy and benefit from everyday interactions with wildlife where they live. The positive outcomes associated with urban wildlife, including common birds, lizards, and coyotes, encompass mental and spiritual health benefits such as feelings of peace and connectedness. Meanwhile, the only negative experiences we identified were mild nuisances (e.g., birds pooping on patios), inconveniences (e.g., having to deal with scorpions in homes), and fears about attacks on pets (e.g., from birds of prey). Overall, given differentiated human interactions with and responses to urban wildlife, evaluating HWIs along the coexistence continuum—from conflicts and passive tolerance to more active acceptance, appreciation, and stewardship—is useful for characterizing diverse situations and targeting management strategies to them.

Our approach to examining physical, observational, attitudinal, and behavioral interactions between people and wildlife can inform diverse contexts of coexistence in urban areas. Identifying the extent of physical and observational encounters is helpful for knowing which types of interactions are occurring; moreover, evaluating attitudinal and behavioral responses is crucial since individuals may respond differently to similar situations. By documenting the extent of different types of urban HWIs and responses to them, wildlife managers and conservationists can tailor strategies to different contexts. Where conflict is high or tolerance is low, strategies to deter, avoid, and remove wildlife from residential settings may be most effective for managing coexistence. In contrast, where acceptance and appreciation are high, stewardship may be possible through habitat provisioning or other actions beneficial to wildlife and the people who enjoy them.

To conclude, specific management approaches with detailed strategies should be tailored to different contexts in which people want to deter unwanted wildlife and avoid harm, in contrast to those in which people want to steward and appreciate wildlife. Additionally, promoting and managing positive, everyday experiences with urban wildlife can foster conservation through wildlife gardening and habitat provisioning, which can lead to positive impacts on both people and wildlife. However, feeding birds and other wildlife should be further examined and managed to avoid harm to wildlife and the potential spread of zoonotic diseases. As a whole, the pursuit of coexistence in urban areas involves managing multifaceted and distinct human–wildlife interactions within and across diverse cities, regions, and nations.

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