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Citizen science as a tool to increase residents' tolerance towards urban wildlife: a case study of raccoon dogs in shanghai

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With the increase in the number of urban wildlife, some residents feel anxious and fearful due to the presence of wildlife in urban communities, even when there is no direct physical conflict between them. This research aims to analyze the role of citizen science in increasing residents' tolerance towards urban wildlife. This research takes the communities with the highest raccoon dog density in Shanghai as the research sites. Forty respondents were selected from local community by systematic sampling. Information was collected through semi-structured interviews and participatory observation. This research used NVivo 12 for thematic analyses. The research found that residents who did not participate in citizen science tended to take crisis observation. They regard raccoon dogs as dangerous wildlife and strictly monitor their behavior to prevent them from causing harm to humans. Residents who are engaging in citizen science tend to take scientific observations. They rationally and objectively record raccoon dogs' behavior, numbers, and distribution. Based on the experience of scientific observation, residents who had participated in citizen science anthropomorphically observed raccoon dogs in their daily lives and established an emotional bond with them. This research found that citizen science enhances residents' tolerance towards urban wildlife by producing knowledge and perceiving animal selfhood. In conclusion, this research reveals the complex relationship between residents and wildlife in urban communities by incorporating animals into sociological analysis.

KEYWORDS

citizen science, urban wildlife, urban ecology, residents-wildlife relationship, raccoon dogs

1 Introduction

As urban ecology is restored, more and more wildlife is returning to the cities and becoming urban citizens. This "in-town" wildlife is gradually adapting to the urban environment and becoming new neighbors in urban communities. Wildlife that has adapted to and thrived in urban environments is defined as "urban wildlife." (Adams, 2009) (Basak et al., 2022) For example, *Nyctereutes procyonoides*, also called the raccoon dog, mainly lives in mountains, forests, wasteland grasslands near rivers, and bushes (Mulder, 2012) (Duscher et al., 2017). The raccoon dog was once on the verge of extinction in some parts of China due to environmental pollution and urban expansion (Diao et al., 2022). The raccoon dog has been classified as a second-level protected wildlife in the 2021 Chinese National List of Key Protected Wildlife. Fortunately, as Shanghai's ecology is

restored, the raccoon dog population in Shanghai is growing. At the end of 2020, raccoon dogs were found in at least 147 communities. The raccoon dog population in Shanghai is estimated to be over 2,000 (Zhao et al., 2024).

The raccoon dog is docile and does not actively attack residents. However, residents have a low tolerance towards them. In the past 5 years, residents' complaints about raccoon dogs have increased 32 times (Diao et al., 2022). Of the hundreds of complaints, only one was confirmed to be a raccoon dog attack on a resident. Most of the complaints were that residents became fearful after seeing raccoon dogs (Zhao et al., 2024) (Xuanyu and Xiaoyu, 2023). This means that conflicts between residents and raccoon dogs are not as much of a direct threat to the lives of residents from large wildlife such as wild boars and wolves but cause residents to feel anxious and fearful (Mech, 2017) (Komi and Nygren, 2023). Thus, managing raccoon dogs may be more related to providing education and reducing mental stress among residents. This requires incorporating the human dimension into animal conservation and focusing on the interaction between residents and raccoon dogs.

Unlike wildlife living in the wilderness, Donaldson (2011) define urban wildlife living in neighborhoods as liminal animals and endow them with resident identity. They point out that liminal animals have similar rights and moral status to urban residents (Donaldson and Kymlicka, 2011). This emphasizes that urban wildlife lives at the interface between the artificial and natural environments. They are neither fully part of the wild nor fully integrated into human society. Resident identity hints at the possibility of their coexistence with humans. To increase residents' tolerance towards raccoon dogs, the Shanghai government has implemented a citizen science project, "The Raccoon Dog Census," in collaboration with social organizations and universities since 2019. The project is conducted annually and involves recruiting residents to understand the comprehensive distribution of raccoon dogs in Shanghai. This citizen science project provides timely information about raccoon dogs to provide a scientific basis for management measures. It also enhances residents' understanding of raccoon dogs and reduces their fear (Zhao et al., 2024) (Xuanyu and Xiaoyu, 2023). Therefore, this research selects resident-raccoon dog coexistence as a case study to analyze citizen science on improving residents' tolerance towards urban wildlife.

1.1 Citizen science and resident-urban wildlife relationships

As researchers have deepened their understanding of Resident-urban wildlife relationships, the research focus has shifted from conflict to coexistence (Wierucka et al., 2023) (Fletcher and Toncheva, 2021) (Bhatia et al., 2020). Conflict refers to negative interactions between residents and urban wildlife, such as destroying urban landscapes and threats to residents' lives (Schell et al., 2021) (Baker and Timm, 2017). However, there are also positive interactions between residents and urban wildlife (Chavez et al., 2023) (Basak et al., 2022). For example, residents establish an emotional bond with nature by observing wildlife (Ballantyne et al., 2011). In addition, residents and urban wildlife influence each other. While urban wildlife impacts the lives of residents, residents also affect the lives and activities of urban wildlife (Pătru-Stupariu et al., 2020). Based on these considerations, the researcher opposes the conflict analysis framework and advocates a focus on human-wildlife coexistence (Fletcher and Toncheva, 2021).

Turning from a conflict to a coexistence perspective requires that researchers put Resident-urban wildlife relationships in the context of a complex social-ecological system (Drake et al., 2021). On the one hand, it is necessary to focus on the social, economic, political, and cultural influences on Resident-urban wildlife relationships (Fiorini et al., 2011) (Piana et al., 2024). On the other hand, people's encounters and experiences with wildlife add to the complexity of resident-urban wildlife relationships (Dandy et al., 2012) (Puri et al., 2024). Frank (2016) transcends the binary division between coexistence and conflict and proposes the concept of tolerance, which refers to the varying degrees of acceptance that residents have towards wildlife living in areas close to human communities (Frank, 2016).

Tolerance means that residents should learn to live with their new neighbors. As Frank points out, the way people interact with wildlife in urban communities is different from wildlife living in uninhabited wilderness (Frank, 2016). For wildlife living in the wilderness, people need to recognize their sovereignty over their habitats and minimize interference with them (Donaldson and Kymlicka, 2011). For living with urban wildlife, it is essential to establish appropriate social norms for interactions between residents and urban wildlife to facilitate the formation of multi-species cities (Donaldson and Kymlicka, 2011) (Dandy et al., 2011).

How can we increase residents' tolerance towards urban wildlife? Some researchers have advocated the implementation of citizen science to improve residents' awareness of wildlife and to encourage residents to participate in the protection and management of urban wildlife (Phillips et al., 2019). Citizen science refers to the public's participation in scientific research in various ways, including data collection, theory validation, and knowledge spreading (Crain et al., 2014). Research on citizen science's role focuses on ecological and social effects (Bíl et al., 2020) (Phillips et al., 2019). The environmental effect refers to the positive impact of citizen science on biodiversity conservation, pollution control, environmental risk monitoring. (Chandler et al., 2017). The social impact refers to citizen science promoting the popularization and practice of ecological conservation and sustainable development (Phillips et al., 2021a).

What is the relationship between citizen science and residents' tolerance towards urban wildlife? Some researchers found that residents who participated in citizen science were able to learn about scientific observation methods, gain a deeper understanding of urban wildlife and their habitats, and increase their awareness and action for urban wildlife conservation (Haklay et al., 2018) (Fritz et al., 2017). Scientific observation refers to residents participating as Citizen Scientists who can objectively observe wildlife, including changes in the number of species, their distributional ranges, and physiological activities (Zapponi et al., 2017). Observing wildlife can enrich residents' natural experiences, develop their emotional bond with wildlife, and promote their tolerance towards wildlife (Ganzevoort and van den Born, 2019) (Markowitz et al., 2013) (Wilkins et al., 2019). Ganzevoort (2019) focused on residents' subjective experiences when observing animals. He points out that observers experience tremendous emotional responses when discovering new species. Even if no new species are found, observing

wildlife allows participants to learn about biodiversity and wildlife knowledge and gain an unforgettable experience (Ganzevoort and van den Born, 2019). Hobbs et al. implemented the Hedgehog Project, which brought together researchers and volunteers to track the movements of hedgehogs. By researching the subjective experiences of the volunteers, Hobbs et al. (2016) found that participation in the Hedgehog Project effectively enhanced the volunteers' connection with nature and wildlife and encouraged them to observe and record wildlife more in their daily lives (Hobbs and White, 2016).

Most researchers have only verified that scientific observation in citizen science facilitates the coexistence between residents and urban wildlife, but have yet to analyze the different dimensions of observation in further depth. People's wildlife observations usually involve emotions, perceptions, and attitudes (Thiele, 1903) (Fleming et al., 1963). They also ignore various types of observations other than scientific observations, such as daily observations in daily life (Harden and Harden, 2013) (Williams, 2005). These observations complement scientific observations and add to residents' multidimensional understanding of urban wildlife.

1.2 Symbolic interactionism and wildlife observation

Symbolic interactionism has been used only to explain the process of symbolic communication in human societies, focusing on how people construct and communicate meaning through symbols (Carter and Fuller, 2015). Some symbolic interactionists believe that interaction exists only between actors who have self-awareness. Therefore, animals do not have self-awareness and should not be considered by sociological research (Mead, 1934). Until the beginning of the 21st century, some researchers broke the traditional boundaries between human and non-human animals in sociological research and began to emphasize that non-human animals have a profound impact on human society (Carter and Charles, 2018). Researchers have rethought the concept of selfhood, unbound the selfhood from language ability, and suggested that the animal's selfhood can be understood through gestures and body postures (Irvine, 2004). This indicates that by observing wildlife, people can understand the behavioral patterns of these animals. This not only reveals the role of wildlife in human society but also deepens the understanding of human-wildlife relationships, thereby pushing the boundaries of sociological research into the non-human realm.

Wildlife observation refers to residents observing and recording the behavior and habits of wildlife to understand their behavioral patterns better (Edwards et al., 2022) (Edwards et al., 2021) (Waetjen and Shilling, 2017). Marvin (2005) points out that humans observe animals in various ways and for different purposes. These differing methods of observation and perception not only imply distinct relationships between humans and animals but also generate these relationships (Marvin, 2005).

From an interactionist perspective, observation can be used as a form of interaction to facilitate the understanding of animal selfhood (Irvine, 2011). Zhang noted that humans and non-human animals can follow a certain logic of visual communication to break through the original species boundaries between them (Zhang, 2020). Observation is one of the ways to generate encounter value. Encounter value refers to various species constantly shaping each other's selfhood and behavior in the process of encounter (Haraway, 2008). By observing urban wildlife near their living areas, residents feel closer to nature and identify more with the ecological and aesthetic value of wildlife (Basak et al., 2022). Teel (2022) further argued that wildlife observation can alleviate residents-urban wildlife conflict. Observing wildlife allows people to reflect on their relationship with wildlife and change their negative attitudes towards wildlife (Teel et al., 2022).

Wildlife observation can be divided into multiple dimensions. Some researchers have pointed out that observation, as an interaction strategy between actors, consists mainly of understanding, emotions, attitudes, and actions (Heath, 1980) (Wang, 2021) (Eberbach and Crowley, 2009). In this research, "action" is subdivided into "naming" and "interaction" to facilitate empirical analyses. Residents' urban wildlife observations have five dimensions: understanding, attitude, emotion, naming, and interaction. The specific meanings of the five dimensions are shown in Figure 1. In the following section, these five dimensions will be used to analyze differences in the way residents observe animals and thus explore how citizen science can increase residents' tolerance towards urban wildlife.

2 Methods

2.1 Research area

Since 2019, the Shanghai Forestry Department, Fudan University, and the Shan Shui Conservation Centre have conducted a citizen science project called "The Raccoon Dog Census." The main components of this citizen science project were: firstly, recruiting residents to participate in a community ecological survey, which calculated the average density of raccoon dogs in Shanghai—secondly, installing more than 200 infrared cameras in major parks to record information on raccoon dogs' activity and provide data support for monitoring urban biodiversity in Shanghai. Thirdly, conducting popular science campaigns to raise residents' awareness of raccoon dog conservation. This citizen science project was listed in the "Global Case for Biodiversity Conservation" at the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity (COP15).

In order to gain a deeper understanding of the interaction between residents and raccoon dogs, this research chose the two communities with the highest raccoon dog population densities as the research area. According to Figure 2, Communities Milannuoguidu and Yushanghai are located in the southwestern part of Shanghai; both are close to the city park (Sheshan National Forest Park) and have rich ecological resources. Use the letter M for Community Milannuoguidu. Use the letter Yfor Community Yushanghai. The density of raccoon dog populations in communities M and Y was much higher than in other areas, with four and five raccoon dogs per hectare, respectively (Zhao et al., 2022) (Diao et al., 2022). This implies that residents in these two communities are more likely to encounter raccoon dogs. Therefore, these two communities were selected as research sites for this research to gain insight into the coexistence between high-

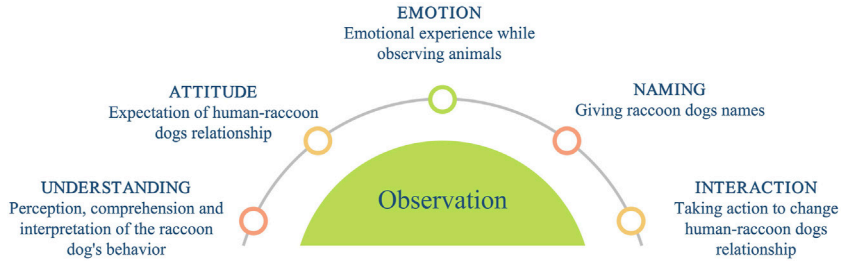

FIGURE 1
Five dimensions of observation.

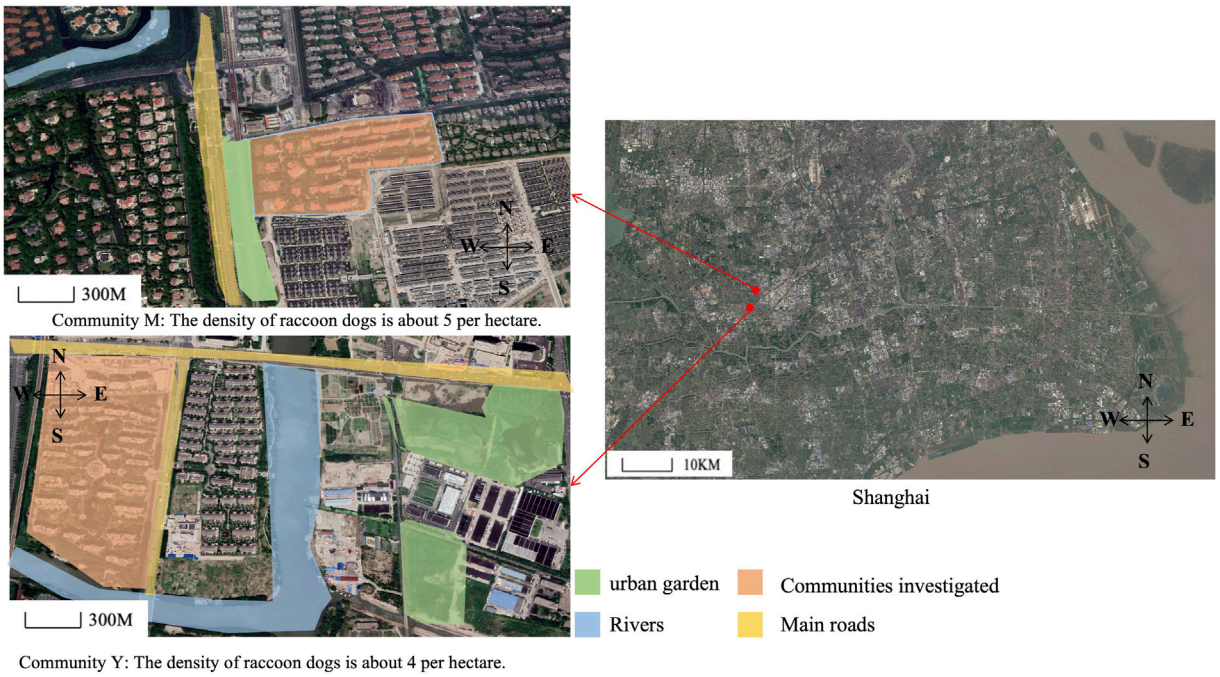

FIGURE 2
Map of communities M and Y.

density raccoon dog populations and residents, as well as the conflicts and challenges that may arise.

2.2 Respondents

A systematic sampling method was used to select 20 residents as respondents from each of Community M and Community Y, ensuring that the samples were both representative and comparable. Initially, we numbered the dwellings in Community M and Y. Then, a dwelling was selected at regular intervals according to a predetermined order. For each selected dwelling, the head of the household was invited to participate in the interview. If the head of household was absent or could not be contacted, the next dwelling was selected as a replacement sample.

The data saturation method was used to determine the number of respondents. The data saturation method means that the number of respondents is continuously increased until the information provided by the respondents begins to be repeated (Islam and Aldaihani, 2022). Based on this method, a total of 40 respondents were selected for this research. All respondents signed an informed consent form. The head of the household was selected due to their comprehensive understanding of the household's activities and interactions, which ensured more accurate and insightful data. The basic information of the 40 respondents can be found in Table 1. Despite the small sample size, we ensured that the sample provided sufficient information based on the inductive thematic saturation approach proposed by Saunders et al. (2018) (Saunders et al., 2018).

To highlight the impact of citizen science on residents' perceptions and behaviors, we divided the respondents into three groups based on whether they participated in citizen science or not. The first group consisted of 21 residents who did not participate in citizen science, and the second group consisted of nine residents who were participating in citizen science. The third group consists of 10 residents who participated in citizen science activities last year.

TABLE 1 The basic information of respondents.

The basic information		Number	Percentage (%)
Age	18–30	13	32.5
	30–45	11	27.5
	46–60	9	22.5
	60+	7	17.5
Gender	Female	22	55.0
	Male	18	45.0
Participation in Citizen Science Projects	Not Participated	21	52.5
	Currently Participating	9	22.5
	Participation completed and project closed	10	25.0

Having completed the project, their experience has led them to adopt different approaches to observing raccoon dogs compared to those who have not participated in such activities.

Participant observation and semi-structured interviews were used to collect data. We first went into the community and conducted participatory observation for 2 months. During this period, observations and recordings were made of residents' reactions when confronted with raccoon dogs. The observations were categorized into raccoon dogs' activities, residents' actions, and raccoon dogs' responses. This categorization provides a comprehensive analysis of human-animal coexistence in urban settings. The observation recording table is organized into three main sections: raccoon dogs' activity characteristics, residents' actions toward raccoon dogs and raccoon dogs' reactions to residents' actions.

Secondly, we adopted a tracking interview method for respondents. The tracking interview method was used to reconnect with respondents after some time to collect data on their changes over a long period (Euser et al., 2009). We chose two time points: July 2022 and July 2023. In July 2022, the researcher interviewed the respondents. The second group of respondents participated in citizen science 'The Raccoon Dog Census.' This project ended in August 2022. In August 2023, we re-contacted respondents to collect their feedback 1 year after the end of the citizen science project.

All interviews lasted between 60 and 100 min. The interview is structured around five key areas: Interactions with Raccoon Dogs: Questions focus on the types and frequency of interactions residents have with raccoon dogs. Emotions: Questions explore residents' emotional responses to raccoon dogs. Attitudes: This section investigates residents' overall attitudes towards the presence of raccoon dogs in their community. Actions: Questions address the specific actions residents take when they encounter raccoon dogs, such as feeding, shooing away. Future Expectations: This section gathers residents' expectations and suggestions for future community actions or policy changes regarding raccoon dogs. Specific interview questions can be found in Appendix 1.

2.3 Data analysis

Thematic analysis is a standard qualitative method used to identify and explore themes and patterns in textual data, providing substantial evidence for theoretical analyses (Clarke and Braun, 2017) (Braun and Clarke, 2012). This research uses thematic analysis to identify the most salient themes and their significance and further explores the different ways of observation and their impact on human-raccoon dog relationships.

NVivo is a professional qualitative research analysis tool that helps researchers to conduct thematic analyses (Dhakal and Vivo, 2022). NVivo has been widely used in the field of wildlife conservation. For example, Cong (2014) utilized NVivo to analyze wildlife tourism experiences with endangered species, specifically encounters with giant pandas in Chengdu, China, demonstrating its effectiveness in managing and coding qualitative data to uncover key themes and insights (Cong et al., 2014). Similarly, Moshier (2019) employed NVivo in their network analysis of a stakeholder community combatting illegal wildlife trade, showcasing its ability to handle complex qualitative data and enhance the transparency and rigor of the analysis (Moshier et al., 2019).

The steps for NVivo to conduct thematic analysis are: Based on previous literature, we identified five main nodes for our analysis: "Understanding," "Attitude," "Emotion," "Naming," and "Interaction." Secondly, we performed automated text coding to categorize the data into the appropriate nodes by NVivo. Each parent node includes multiple dimensions representing different aspects of the main theme. Specific information on text encoding and nodes can be found in Table 2. The number following the code indicates the number of responses for that code. Since a text may contain rich meanings, it can respond to multiple codes simultaneously (Edhlund and McDougall, 2018). Thus, each code's total number of occurrences may be more than 40.

To illustrate the differences in observation methods among three distinct groups, we will use R software to analyze the results of thematic analysis. Through correlation analysis, we will examine the differences in performance across various dimensions of observation for each group.

3 Results

The results of the thematic analysis and correlation analysis are summarized in Table 3. The Chi-square test results indicated significant differences in observation methods across the three

TABLE 2 Nodes and code information of thematic analysis.

Node	Node definitions	Code	Code definitions	Cases
Understanding	This dimension refers to the knowledge and comprehension that individuals have about wildlife	Violence	Treating the normal biological behavior of raccoon dogs as violence	"It is dangerous and very violent."
		Timidity	Animals are very timid by nature	"They are very timid and do not actively attack people."
		Naughtiness	Animals are very naughty when they are playing	"They are very naughty. They chase you for the purpose of playing with you, not attacking"
		Anthropomorphically	Attributing human characteristics or behaviors to wildlife	"They share experiences through gatherings."
Attitude	This dimension encompasses the beliefs, perceptions, and predispositions individuals hold towards wildlife	Repulsion	Raccoon dogs should not live in the city	"They should be driven out of the city."
		Accept conditionally	Under certain conditions, raccoon dogs can live in specific spaces in the city	"They can live in the city as long as they do not interfere with our lives."
		Coexistence	People and raccoon dogs can share any urban space	"I'd like to share the public space of the community with raccoons."
Emotion	This dimension involves the emotional responses and feelings that wildlife evokes in individuals	Negative	Negative emotions such as fear, hatred, and rejection	"We hate raccoons very much!"
		Neutrality	Remain objective, rational and avoid emotional stress	"Both raccoons and humans are in the ecosystem and neither can be abandoned"
		Positive	Positive emotions such as affection and excitement	"We are very fond of raccoons and would love to welcome them to live in our city."
Naming	This dimension relates to the linguistic and categorical aspects of identifying and labeling wildlife	Beasts	The raccoon is seen as a beast that destroys urban ecology	"They are beasts full of danger."
		Number	Numbering of wildlife. Refers to the population or quantity of wildlife	"To analyze the distribution of raccoons, we marked each raccoon with a number"
		Affectionate names	Nicknames or terms of endearment given to wildlife	"They are the stars of our neighborhood."
Interaction	This dimension involves the nature and quality of interactions between individuals and wildlife	Avoid	Avoiding encounters with raccoon dogs	"If there are raccoons on one road, we will change the road."
		Relocation	Removing raccoon dogs from the city to the wilderness	"Control raccoons in a certain space and do not allow them to go beyond the demarcated boundaries"
		Non-intervention	Raccoon dogs are allowed to live in the city, and they are asked to keep a distance from the residents	"Keep your distance from raccoons based on the principle of 'no fear, no feeding, no contact."
		Restrain one's own behavior	Controlling or modifying human actions to avoid negatively impacting wildlife	"Don't interfere with raccoon's life to satisfy your curiosity."
		Care	Rescuing and caring for injured raccoon dogs	"Sending injured raccoons to wildlife rescue centers"

groups, with Pearson Chi-square values being significant ($p < 0.05$). The results show that different groups of respondents have various tendencies in the five dimensions of observation. The following section presents the results of the different groups of respondents.

3.1 Residents who did not participate in citizen science

According to the results of Category 1A and 1B in Table 1, there was little change in the experience of respondents who did not participate in citizen science observing raccoon dogs. They tended to regard raccoon dogs as the cause of the ecological crisis. The expected behavior of raccoon dogs, such as feeding and movement, is coded as hostile violence by respondents (86%). This further exacerbated residents' conflicts with raccoon dogs and caused negative feelings (90%), Such as fear, hatred, and anger. As the negative feelings accumulate, raccoon dogs are labeled as beasts and vermin. These labels imply respondents' perception of the raccoon dog's character and behavior. For example, "beast" highlights the raccoon dog's wild, dangerous, and uncontrollable wild nature.

Under the influence of negative emotions, most respondents began to repel raccoon dogs (86%). Respondents see raccoon dogs as

TABLE 3 Results of thematic analysis and correlation analysis.

	COUNT N[P][a]			Correlation Analysis		
	Respondents who did not participate in citizen science	Respondents who are participating in citizen science	Respondents who have completed citizen science	chi-square value	Pearson correlation coefficient	P-value
Understanding						
Violence	18[0.86]	1[0.11]	0[0]	26.12	-0.76	<0.001
Timidity	2[0.10]	7[0.78]	7[0.70]	17.23	0.57	0.009
Naughtiness	0[0]	2[0.22]	8[0.80]	23.17	0.74	0.040
Anthropomorphically	0[0]	1[0.11]	9[0.90]	30.45	0.81	0.034
Attitude						
Repulsion	18[0.86]	1[0.11]	0[0]	26.12	-0.75	<0.001
Accept conditionally	0[0]	7[0.78]	3[0.30]	20.51	0.39	0.044
Coexistence	0[0]	5[0.56]	9[0.90]	26.27	0.81	<0.001
Emotion						
Negative	19[0.90]	1[0.11]	0[0]	20.21	-0.81	0.026
Neutrality	2[0.10]	8[0.89]	3[0.30]	18.13	0.29	<0.001
Positive	0[0]	0[0]	7[0.70]	25.45	0.70	<0.001
Naming						
Beasts	19[0.90]	0[0]	0[0]	32.74	-0.82	0.005
Number	1[0.05]	8[0.89]	2[0.20]	22.74	0.27	<0.001
Affectionate names	0[0]	3[0.33]	9[0.90]	26.19	0.80	0.003
Interaction						
Avoid	19[0.90]	0[0]	0[0]	32.74	-0.83	0.049
Relocation	18[0.86]	2[0.22]	0[0]	23.49	-0.75	<0.001
Non-intervention	0[0]	9[1.00]	4[0.40]	29.06	0.48	0.012
Restrain one's own behavior	0[0]	7[0.77]	7[0.70]	23.93	0.68	0.041
Care	0[0]	3[0.33]	9[0.90]	26.19	0.80	<0.001

[a]In N [P], N is the number of respondents who chose the code. P represents the percentage of respondents who chose the code in the corresponding subgroups.

wildlife that "invade" the city and advocate sending them to the wilderness away from the city. They aimed to increase the spatial distance to avoid encounters between the residents and raccoon dogs. This idea deprives raccoon dogs of the right to live in urban spaces and precludes raccoon dogs from sharing urban areas with residents.

In interactive practice, some respondents have taken the initiative to avoid raccoon dogs (90%). Some other residents have contacted the news media, hoping to draw the government's attention to relocate the raccoon dog (86%). This means that respondents who did not participate in citizen science tended to increase their distance from raccoon dogs to create a safe and comfortable living environment without them.

3.2 Respondents who are participating in citizen science

To increase residents' tolerance of raccoon dogs, the "Raccoon Dog Census" citizen science invites residents to participate in the scientific study of monitoring raccoon dogs. This citizen science Project aims to make a comprehensive and objective observation of the raccoon dog's behavior by installing monitoring equipment and trackers, collecting feces, and examining its geographical distribution.

By observing the distribution of raccoon dogs, respondents found that raccoon dogs are not violent but rather timid (78%). They have observed that raccoon dog attacks are partly due to the naughty nature of young raccoon dogs, not malicious attacks (22%).

Since scientific observation requires the production of accurate and valid numerical records, they always keep objective and rational to avoid excessive emotional involvement (89%). They use numbers to name the raccoon dog (89%). Numerical naming ensures the objectivity of observation and avoids excessive emotional involvement.

By scientific observation, respondents found that the cause of the conflict between residents and raccoon dogs is people's wrong behaviors, such as feeding and chasing them. Therefore, they advocate planning the space for residents and raccoon dogs to avoid frequent encounters with each other. They advocate restraint in their behavior without feeding or touching raccoon dogs (100%). Based on this understanding, respondents accepted raccoon dogs conditionally (78%).

3.3 Respondents who have completed a citizen science project

The experience of participating in citizen science has enabled respondents to develop the habit of observing raccoon dogs in their daily lives and to establish a positive emotional bond with them. The results show that respondents who have participated in citizen science interpret the raccoon dog group behavior anthropomorphically (90%). Through anthropomorphism in daily observation, they demonstrated a solid willingness to coexist with raccoon dogs (90%).

Regarding emotion, they show positive feelings for raccoon dogs (70%). Based on their affection for raccoon dogs, these residents call raccoon dogs by affectionate names (90%), such as "little guy" and "little star." These names convey the friendly to raccoon dogs and promote positive interactions between residents and raccoon dogs. For example, they will restrain themselves from interfering with raccoon dogs' activities (70%) and care for injured raccoon dogs (90%).

4 Discussion

4.1 Differences in various observation types

Each type of observation has five dimensions: understanding, attitude, emotion, naming, and interaction. Respondents who did not participate in citizen science tend to regard raccoon dogs as dangerous wildlife, constantly observing their behavior. constantly observing their behavior through a lens of caution and apprehension. This perspective is reflected in their preference for codes like 'Violence' (86%) and 'Repulsion,' (86%), indicating a significant level of fear and discomfort. Their emphasis on 'Negative emotion' (90%) and 'Beasts' (90%), suggests that they view raccoon dogs more as threats or nuisances rather than as part of the urban ecosystem.

Moreover, their inclination towards 'Avoid' (90%) and 'Relocation' (86%) codes indicates a desire to minimize contact with the raccoon dogs, either by staying away from areas where the animals are present or by supporting measures to relocate them. This avoidance strategy underscores their discomfort and preference for separation from the wildlife they perceive as hazardous. Based on this, this study defines their method of observing raccoon dogs as "crisis observation," which refers to the way they observe these animals with heightened vigilance and concern. They tend to view raccoon dogs as dangerous wildlife, posing potential threats to humans and the environment. Crisis observation reflects the observers' anxiety and preventive mindset, prioritizing how to avoid contact with raccoon dogs and minimize their potential impact on the community. This perspective is rooted not only in concerns for personal safety but also in considerations of ecological balance and public health. For example, Michael (2022) found that community residents' fear of potential disease vectors often drives them to take extreme preventive measures, thereby exacerbating human-wildlife conflicts (Mahero et al., 2022).

Respondents who participated in citizen science tend to systematically and objectively observed, recorded, and analyzed the raccoon dog populations, distribution, and biological habits. This research defines this type of observation as "scientific observation." They rationalize the activities of raccoon dogs without fear. They focus more on the objectivity and accuracy of their observations. They also try to apply their observations to scientific research or conservation practices. This perspective is reflected in their preference for codes like 'Timidity' (78%), 'Accept conditionally' (78%), ' Neutrality' (89%), 'Non-intervention' (100%), and 'Restrain one's own behavior' (77%). The 'Timidity code indicates that respondents prefer to observe from a distance without disturbing the animals, demonstrating respect for their space and minimizing potential risks. The 'Accept Conditionally' code indicates that respondents are willing to tolerate the presence of raccoon dogs under specific conditions. The 'Neutrality' code represents an unbiased and objective stance towards raccoon dogs. Respondents highlights the importance of impartial observation and study, free from preconceived notions or emotional biases. The 'Non-intervention' and 'Restrain one's own behavior' code highlights a preference for minimal human interference in the lives of raccoon dogs. Respondents believe that raccoon dogs should be allowed to live and behave naturally without human intervention unless absolutely necessary.

Scientific observation as defined in this study aligns with findings from previous research on citizen science practices. For instance, Brown (2019) emphasize that citizen scientists often contribute to biodiversity monitoring by collecting high-quality data that can be used for ecological research and conservation efforts (Brown and Williams, 2019). By engaging in scientific observation, citizen scientists help fill these gaps, providing essential information that can inform policy decisions and conservation strategies (McKinley et al., 2017).

Respondents who had participated in citizen science are more likely to prefer codes 'Naughtiness' (80%), 'Anthropomorphically' (90%), 'Coexistence' (90%), 'Positive' (70%), 'Affectionate names' (90%), 'Non-intervention' (100%), 'Care' (90%). These codes reflect a more empathetic and integrative approach to observing and interacting with raccoon dogs, indicating a deeper sense of connection and understanding between humans and wildlife. They observed and understood raccoon dogs' behavior through anthropomorphism and developed positive emotions. For example, the residents noticed that several raccoon dogs often gather at night to play and frolic in the park. They chase and nip at each other, appearing to be quite joyful. Observing this scene, the residents felt

TABLE 4 Residents' various observations of wildlife.

Types of observations	Definitions	Characteristics
Crisis Observation	Observations made in response to a perceived or actual threat or emergency involving wildlife	• Triggered by unusual or dangerous situations
		• Often urgent and reactionary
		• Focus on immediate impact and mitigation efforts
Scientific Observation	Systematic and methodical observation of wildlife aimed at gathering empirical data and understanding ecological processes	• Use of scientific methods and tools
		• Objective and data-driven
		• Focus on species behavior, population dynamics, and ecological impact
Anthropomorphic Observation	Attributing human characteristics, emotions, and intentions to wildlife, often based on personal feelings and cultural narratives	• Subjective and based on personal interpretation
		• Emotional and imaginative
		• Influenced by cultural stories and personal experiences

that these raccoon dogs resembled a group of children at play. They would laugh and say, "Look, these little guys are having a party again!" They even created dialogues and storylines for the raccoon dogs, saying things like, "This one must be their 'leader,' guiding everyone in their play, while that lively one is probably the 'troublemaker.'" It can be seen that anthropomorphic observations are more focused on individual subjective feelings and emotional experiences than scientific observations.

Anthropomorphic observations often lead to the development of affectionate feelings and a sense of kinship with the observed animals (Weik von Mossner, 2018). This approach can enhance the observer's interest and involvement in wildlife conservation effort. The example of residents watching raccoon dogs play in the park illustrates this well. By interpreting the raccoon dogs' playful interactions as similar to children's games, residents not only find joy in the observation but also develop a protective and caring attitude towards the animals. They see the raccoon dogs as individuals with personalities and social structures, which humanizes them and strengthens the bond between humans and wildlife.

Based on the analysis results, this research divides observation into three categories: scientific, crisis and anthropomorphic observation (Table 4). Crisis observation refers to a method of observing wildlife through a lens of heightened vigilance and concern, often stemming from perceived threats or nuisances posed by the animals. Their observations are driven by anxiety and a desire to minimize contact with the animals. This perspective often leads to support for measures aimed at reducing raccoon dog populations or relocating them away from human habitats. Scientific observation is characterized by systematic, objective, and data-driven approaches. Respondents who engage in scientific observation tend to focus on the accuracy and reliability of their observations, often aiming to contribute to scientific research or conservation efforts. For example, citizen scientists meticulously document the raccoon dogs' activities, utilizing rigorous methodologies to record their findings, which can then be used to inform ecological studies and conservation strategies. Anthropomorphic observation involves attributing human traits, emotions, and behaviors to raccoon dogs, leading to empathetic and integrative interactions. They assign human characteristics or emotions to wildlife in their observations to get a closer feel of the wildlife's state of life and emotional expression. This approach encourages a compassionate attitude and a willingness to coexist with the wildlife.

4.2 The positive role of citizen science in resident-urban wildlife relationships

The results of the analyses indicate that participants could not only take scientific observations to interact rationally and objectively with raccoon dogs during their participation in the citizen science Project. They could also continue to observe raccoon dogs in an anthropomorphic way after the project and establish a positive emotional bond with them. This indicates that there are two paths for the positive effect of citizen science on Resident-urban wildlife relationships: knowledge production and animal selfhood interpretation.

Knowledge production is when participants in citizen science share their scientific observation data and work together to analyze and interpret them, thereby generating new scientific knowledge (Alvarado et al., 2020) (Giardullo, 2023) (Phillips et al., 2021b). This process of knowledge production not only promotes public participation in scientific research and the propagation of scientific Knowledge but also helps participants improve their rational knowledge of wildlife and ecology (Vallabh et al., 2016) (López et al., 2020). As found in this research, Knowledge gained in citizen science could be used to change reality by directing residents' actions. Based on the Knowledge produced by scientific observation, people have acquired the concept of "no fear, no feeding, no touch." In addition, the data collected from the scientific observation was incorporated into the data platform and made available to all participants and related organizations to help people make decisions. This allows the public to be invited to discuss the issue of resident-wildlife conflict and to have their voices heard. This will ensure the solutions are backed by scientific Knowledge and public support. Based on the Knowledge generated by

scientific observations, participants acquired the principle of "no fear, no feed, no touch." In addition, the data collected from the scientific observations were incorporated into a data platform that was made available to all participants to help people make decisions. This will ensure that solutions are supported by scientific Knowledge and residents.

Animal selfhood interpretation means changing attitudes towards wildlife by integrating animal selfhood into cultural relationships in an anthropomorphic way (Irvine, 2004). Some researchers have previously criticized anthropomorphism as an anthropocentric perspective on animals, which makes people's view of animals full of emotion and uncertainty (Weitzenfeld and Joy, 2014). Critical anthropomorphism can be developed if anthropomorphism is viewed from an interactive perspective (Karlsson, 2012). Critical anthropomorphism means using cognitive, intuitive, emotional, and detailed behavioral explanations to represent animal selfhood based on considering the differences between species (Burghardt, 2016). This perspective enables a deeper understanding of the behavior and psychology of animals, thus promoting better protection and respect for their living space and rights.

Irvine divides animal selfhood into four levels: agency, coherence, affectivity, and self-history (Irene, 2008). Agency means that animals are self-aware of their actions (Špinka, 2019). Respondents recognize that raccoon dogs have social and educational actions in addition to predatory actions. Coherence means that animals have relatively fixed self-boundaries that ensure the stability of behavior in different times and spaces (Budd, 1993) (Libby and Eibach, 2011), as respondents use names to express the uniformity of animal selfhood. They call raccoon dogs "little guys" and "little stars" to show that raccoon dogs have a friendly figuration. Affectivity refers to the ability of animals to experience and express different types of emotions. Markowitz found that building an emotional bond with wildlife by understanding their emotions increases the acceptance of multi-species cities (Markowitz et al., 2013). Respondents appreciate the raccoon dog's maternal love in their behavior of protecting their offspring. Self-history refers to the continuity of animal selfhood (Irvine, 2004). Past actions and emotions are integrated into selfhood and preserved in a relatively stable relationship between humans and non-human animals. As The respondents gave raccoon dogs the identity of neighbors based on their experience of living harmoniously with raccoon dogs. In short, Haraway refers to this human-wildlife interaction that mutually shapes selfhoods and behaviors as "encounter value." When residents encounter urban wildlife in the community, the " encounter value" is reflected in residents building close relationships with urban wildlife by observing them.

It is worth noting that despite the small sample size of this research, we aimed to explore new areas and provide initial insights for future research. Prospectively, more extensive quantitative investigations will be conducted to analyze data from larger samples and provide more robust causal explanations. Quantitative analyses based on large samples are expected to improve the reliability and generalizability of the findings.

5 Conclusion

In the 1980s, the "posthuman" trend re-examined and reinterpreted the relationship between human and non-human animals based on questioning anthropocentrism and humanism. Non-human animals began to enter the field of sociological research. From an interactionist perspective, the observation towards animals can be seen as a form of interaction. This research found that observation towards raccoon dogs can be used to communicate and promote understanding of them. This can help residents find a balance between interfering with raccoon dogs' activities and leaving them alone.

This research first classified observations into five dimensions: understanding, emotion, attitude, and actions. This research classified the respondents' observations towards raccoon dogs into three categories based on their different manifestations of five dimensions: crisis observations, scientific observations, and anthropomorphic observations. Crisis observation refers to residents viewing the presence of urban wildlife as a sign of threat or insecurity and strictly monitoring their behavior to prevent them from causing harm to humans. Citizen science facilitates the development of scientific and anthropomorphic observations. In participating in citizen science, residents rationally and objectively record raccoon dog populations, distribution, and behavior and improve their scientific understanding and knowledge of the raccoon dog, i.e., "scientific observation." At the end of the citizen science, residents can give human characteristics or emotions to urban wildlife, thus getting a closer feel of the urban wildlife's lifestyles and emotional expression, i.e., "anthropomorphic observation."

This research further found that citizen science can increase residents' tolerance towards urban wildlife in terms of both knowledge production and animal selfhood interpretation. On the one hand, residents participating in citizen science can gain scientific knowledge about urban wildlife. This scientific knowledge helps increase residents' awareness of the urban ecosystem and enhances their understanding of and respect for urban wildlife. On the other hand, residents could continue their observations and recordings in their daily lives after the citizen science project was over and put more personal concepts and emotions into anthropomorphic interpretations of the urban wildlife's behaviors. They understood the selfhood of urban wildlife they were observing and facilitated the formation of a positive emotional bond with urban wildlife.

In conclusion, this research views observation as a form of interaction, including resident-urban wildlife interactions in sociological research. This helps researchers analyze the influence of urban wildlife on society, reflect on existing sociological concepts, and improve their understanding of humans.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethical review of School of public administration, Hohai University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

HL: Conceptualization, Formal Analysis, Methodology, Investigation, Writing–original draft, Project administration, Supervision, Writing–review and editing. DW: Software, Validation, Visualization, Writing–original draft, Writing–review and editing. JG: Resources, Supervision, Writing–review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fenvs.2024.1395829/full#supplementary-material

References

Adams, C. E. (2009). *Urban wildlife management[M]*. Boca Raton: CRC Press.

Alvarado, C. M. M., Rendon, A. Z., and Pérez, A. S. V. (2020). Integrating public participation in knowledge generation processes: evidence from citizen science initiatives in Mexico. *Environ. Sci. and Policy* 114, 230–241. doi:10.1016/j.envsci.2020.08.007

Baker, R. O., and Timm, R. M. (2017). Coyote attacks on humans, 1970-2015: implications for reducing the risks. *Human–Wildlife Interact.* 11 (2), 3. doi:10.26077/jy37-s271

Ballantyne, R., Packer, J., and Sutherland, L. A. (2011). Visitors' memories of wildlife tourism: implications for the design of powerful interpretive experiences. *Tour. Manag.* 32 (4), 770–779. doi:10.1016/j.tourman.2010.06.012

Basak, S. M., Hossain, M. S., O'Mahony, D. T., Okarma, H., Widera, E., and Wierzbowska, I. A. (2022). Public perceptions and attitudes toward urban wildlife encounters–A decade of change. *Sci. total Environ.* 834, 155603. doi:10.1016/j.scitotenv.2022.155603

Bhatia, S., Redpath, S. M., Suryawanshi, K., and Mishra, C. (2020). Beyond conflict: exploring the spectrum of human–wildlife interactions and their underlying mechanisms. *Oryx* 54 (5), 621–628. doi:10.1017/s003060531800159x

Bíl, M., Heigl, F., Janoška, Z., Vercayie, D., and Perkins, S. E. (2020). Benefits and challenges of collaborating with volunteers: examples from national wildlife roadkill reporting systems in europe. *J. Nat. Conservation* 54, 125798. doi:10.1016/j.jnc.2020.125798

Braun, V., and Clarke, V. (2012) "Thematic analysis," in *APA handbook of research methods in psychology, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological.* Editors H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D Rindskopf, and K. J. Sher (American Psychological Association), 57–71. doi:10.1037/13620-004

Brown, E. D., and Williams, B. K. (2019). The potential for citizen science to produce reliable and useful information in ecology. *Conserv. Biol.* 33 (3), 561–569. doi:10.1111/cobi.13223

Budd, K. W. (1993). Self-coherence: theoretical considerations of a new concept. *Archives Psychiatric Nurs.* 7 (6), 361–368. doi:10.1016/0883-9417(93)90055-2

Burghardt, G. (2016). Mediating claims through critical anthropomorphism. *Anim. Sentience* 1 (3), 17. doi:10.51291/2377-7478.1063

Carter, B., and Charles, N. (2018). The animal challenge to sociology. *Eur. J. Soc. Theory* 21 (1), 79–97. doi:10.1177/1368431016681305

Carter, M. J., and Fuller, C. (2015). Symbolic interactionism. *Sociopedia. isa* 1 (1), 1–17. doi:10.1177/205684601561

Chandler, M., See, L., Copas, K., Bonde, A. M., López, B. C., Danielsen, F., et al. (2017). Contribution of citizen science towards international biodiversity monitoring. *Biol. Conserv.* 213, 280–294. doi:10.1016/j.biocon.2016.09.004

Chavez, J. B. R., Larson, K. L., Guerrero, J. M., and Clark, J. A. (2023). Evaluating how varied human-wildlife interactions affect physical, mental, social, and spiritual health. *SSM-Qualitative Res. Health* 4, 100302. doi:10.1016/j.ssmqr.2023.100302

Clarke, V., and Braun, V. (2017). Thematic analysis. *J. Posit. Psychol.* 12 (3), 297–298. doi:10.1080/17439760.2016.1262613

Cong, L., Wu, B., Morrison, A. M., Shu, H., and Wang, M. (2014). Analysis of wildlife tourism experiences with endangered species: an exploratory study of encounters with giant pandas in Chengdu, China. *Tour. Manag.* 40, 300–310. doi:10.1016/j.tourman.2013.07.005

Crain, R., Cooper, C., and Dickinson, J. L. (2014). Citizen science: a tool for integrating studies of human and natural systems. *Annu. Rev. Environ. Resour.* 39, 641–665. doi:10.1146/annurev-environ-030713-154609

Dandy, N., Ballantyne, S., Moseley, D., Gill, R., Peace, A., and Quine, C. (2011). Preferences for wildlife management methods among the peri-urban public in Scotland. *Eur. J. Wildl. Res.* 57, 1213–1221. doi:10.1007/s10344-011-0534-x

Dandy, N., Ballantyne, S., Moseley, D., Gill, R., Quine, C., and Van Der Wal, R. (2012). Exploring beliefs behind support for and opposition to wildlife management methods: a qualitative study. *Eur. J. Wildl. Res.* 58, 695–706. doi:10.1007/s10344-012-0619-1

Dhakal, K., and Vivo, N. (2022). NVivo. *J. Med. Libr. Assoc. JMLA* 110 (2), 270–272. doi:10.5195/jmla.2022.1271

Diao, Y., Zhao, Q., Weng, Y., Huang, Z., Wu, Y., Gu, B., et al. (2022). Predicting current and future species distribution of the raccoon dog (*Nyctereutes procyonoides*) in

Shanghai, China. *Landsc. Urban Plan.* 228, 104581. doi:10.1016/j.landurbplan.2022.104581

Donaldson, S., and Kymlicka, W. (2011). *Zoopolis: a political theory of animal rights [M]*. USA: Oxford University Press.

Drake, D., Dubay, S., and Allen, M. L. (2021). Evaluating human–coyote encounters in an urban landscape using citizen science. *J. Urban Ecol.* 7 (1), juaa032. doi:10.1093/jue/juaa032

Duscher, T., Hodžić, A., Glawischnig, W., and Duscher, G. G. (2017). The raccoon dog (*Nyctereutes procyonoides*) and the raccoon (*Procyon lotor*)—their role and impact of maintaining and transmitting zoonotic diseases in Austria, Central Europe. *Parasitol. Res.* 116, 1411–1416. doi:10.1007/s00436-017-5405-2

Eberbach, C., and Crowley, K. (2009). From everyday to scientific observation: how children learn to observe the biologist's world. *Rev. Educ. Res.* 79 (1), 39–68. doi:10.3102/0034654308325899

Edhlund, B., and McDougall, A. (2018). *NVivo 12 essentials[M]*. Morrisville: Lulu. com.

Edwards, T., Jones, C. B., and Corcoran, P. (2022). Identifying wildlife observations on twitter. *Ecol. Inf.* 67, 101500. doi:10.1016/j.ecoinf.2021.101500

Edwards, T., Jones, C. B., Perkins, S. E., and Corcoran, P. (2021). Passive citizen science: the role of social media in wildlife observations. *Plos one* 16 (8), e0255416. doi:10.1371/journal.pone.0255416

Euser, A. M., Zoccali, C., Jager, K. J., and Dekker, F. W. (2009). Cohort studies: prospective versus retrospective. *Nephron Clin. Pract.* 113 (3), c214–c217. doi:10.1159/000235241

Fiorini, S., Yearley, S., and Dandy, N. (2011). Wild deer, multivalence, and institutional adaptation: the deer management group in britain. *Hum. Organ.* 70 (2), 179–188. doi:10.17730/humo.70.2.0107055588r8861h

Fleming, P. C., Goldner, M., and Glass, D. G. (1963). Observations on the nature, distribution, and significance of cephalosporinaae. *Lancet* 281, 1399–1401. doi:10.1016/s0140-6736(63)92051-8

Fletcher, R., and Toncheva, S. (2021). The political economy of human-wildlife conflict and coexistence. *Biol. Conserv.* 260, 109216. doi:10.1016/j.biocon.2021.109216

Frank, B. (2016). Human–wildlife conflicts and the need to include tolerance and coexistence: an introductory comment. *Soc. and Nat. Resour.* 29 (6), 738–743. doi:10.1080/08941920.2015.1103388

Fritz, S., Fonte, C. C., and See, L. (2017). The role of citizen science in earth observation. *Remote Sens.* 9 (4), 357. doi:10.3390/rs9040357

Ganzevoort, W., and van den Born, R. (2019). The thrill of discovery: significant nature experiences among biodiversity citizen scientists. *Ecopsychology* 11 (1), 22–32. doi:10.1089/eco.2018.0062

Giardullo, P. (2023). Non-experts' participation in processes of scientific knowledge creation: the case of Citizen science. *Sociol. Compass* 17 (9), e13100. doi:10.1111/soc4.13100

Haklay, M., Mazumdar, S., and Wardlaw, J. (2018). Citizen science for observing and understanding the earth. *Earth observation open Sci. innovation*, 69–88. doi:10.1007/978-3-319-65633-5_4

Haraway, D. (2008). *When species meet*. Minnesota: University of Minnesota Press, 5–14.

Harden, A., and Harden, A. (2013) "Observing and imagining animal behaviour," in *Animals in the classical world: ethical perspectives from Greek and roman texts*, 87–102.

Heath, T. (1980). Observation, perception and education. *Eur. J. Sci. Educ.* 2 (2), 155–160. doi:10.1080/0140528800020206

Hobbs, S. J., and White, P. C. L. (2016). Achieving positive social outcomes through participatory urban wildlife conservation projects. *Wildl. Res.* 42 (7), 607–617. doi:10.1071/wr14184

Irene, G. Coherence means that animals have relatively fixed self-boundaries that ensure the stability of behavior in different times and space, 2008, 2: 205–219.

Irvine, L. (2004). A model of animal selfhood: expanding interactionist possibilities. *Symb. Interact.* 27 (1), 3–21. doi:10.1525/si.2004.27.1.3

Irvine, L. . (2011). A model of animal selfhood: expanding interactionist possibilities. *Symb. Interact.* 27 (1), 3–21. doi:10.1525/si.2004.27.1.3

Islam, M. A., and Aldaihani, F. M. F. (2022). Justification for adopting qualitative research method, research approaches, sampling strategy, sample size, interview method, saturation, and data analysis. *J. Int. Bus. Manag.* 5 (1), 01–11. doi:10.37227/JIBM-2021-09-1494

Karlsson, F. (2012). Critical anthropomorphism and animal ethics. *J. Agric. Environ. Ethics* 25, 707–720. doi:10.1007/s10806-011-9349-8

Komi, S., and Nygren, A. (2023). Bad wolves? Political ecology of responsibility and more-than-human perspectives in human–wildlife interactions. *Soc. and Nat. Resour.* 36 (10), 1238–1256. doi:10.1080/08941920.2023.2209789

Libby, L. K., and Eibach, R. P. (2011). Self-enhancement or self-coherence? Why people shift visual perspective in mental images of the personal past and future. *Personality Soc. Psychol. Bull.* 37 (5), 714–726. doi:10.1177/0146167211400207

López, M. P., Soekijad, M., Berends, H., and Huysman, M. (2020). A knowledge perspective on quality in complex citizen science. *Citiz. Sci. Theory and Pract.* 5 (1). doi:10.5334/cstp.250

Mahero, M. W., Pelican, K. M., Waila, J. M., Namusisi, S., Rwego, I. B., Kajura, C., et al. (2022). "There are many fevers": communities' perception and management of Febrile illness and its relationship with human animal interactions in South-Western Uganda. *PLoS neglected Trop. Dis.* 16 (2), e0010125. doi:10.1371/journal.pntd.0010125

Markowitz, E. M., Slovic, P., Västfjäll, D., and Hodges, S. D. (2013). Compassion fade and the challenge of environmental conservation. *Judgm. Decis. Mak.* 8 (4), 397–406. doi:10.1017/s193029750000526x

Marvin, G. (2005). Guest editor's introduction: seeing, looking, watching, observing nonhuman animals. *Soc. and Animals* 13 (1), 1–12. doi:10.1163/1568530053966689

McKinley, D. C., Miller-Rushing, A. J., Ballard, H. L., Bonney, R., Brown, H., Cook-Patton, S. C., et al. (2017). Citizen science can improve conservation science, natural resource management, and environmental protection. *Biol. Conserv.* 208, 15–28. doi:10.1016/j.biocon.2016.05.015

Mead, M. (1934). *Self and society*. Chicago: University of Chicago Press.

Mech, L. D. (2017). Where can wolves live and how can we live with them? *Biol. Conserv.* 210, 310–317. doi:10.1016/j.biocon.2017.04.029

Moshier, A., Steadman, J., and Roberts, D. L. (2019). Network analysis of a stakeholder community combatting illegal wildlife trade. *Conserv. Biol.* 33 (6), 1307–1317. doi:10.1111/cobi.13336

Mulder, J. L. (2012). A review of the ecology of the raccoon dog (*Nyctereutes procyonoides*) in Europe. *Lutra* 55 (2), 101–127.

Pătru-Stupariu, I., Nita, A., Mustățea, M., Huzui-Stoiculescu, A., and Fürst, C. (2020). Using social network methodological approach to better understand human–wildlife interactions. *Land Use Policy* 99, 105009. doi:10.1016/j.landusepol.2020.105009

Phillips, T. B., Bailey, R. L., Martin, V., Faulkner-Grant, H., and Bonter, D. N. (2021a). The role of citizen science in management of invasive avian species: what people think, know, and do. *J. Environ. Manag.* 280, 111709. doi:10.1016/j.jenvman.2020.111709

Phillips, T. B., Ballard, H. L., Lewenstein, B. V., and Bonney, R. (2019). Engagement in science through citizen science: moving beyond data collection. *Sci. Educ.* 103 (3), 665–690. doi:10.1002/sce.21501

Phillips, T. B., Parker, A., Bowser, A., and Haklay, M. (2021b) "Publicly generated data: the role of citizen science for knowledge production, action, and public engagement," in *Closing the knowledge-implementation gap in conservation science: interdisciplinary evidence transfer across sectors and spatiotemporal scales*, 83–107. doi:10.1007/978-3-030-81085-6_4

Piana, P., Brocada, L., Hearn, R., and Mangano, S. (2024). Urban rewilding: human-wildlife relations in genoa, NW Italy. *Cities* 144, 104660. doi:10.1016/j.cities.2023.104660

Puri, M., Goode, K. O., Johannsen, K. L., and Pienaar, E. F. (2024). Engaging urban residents in the appropriate actions to mitigate human–wildlife conflicts. *Conservation Sci. Pract.* 6 (2), e13074. doi:10.1111/csp2.13074

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., et al. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Qual. and quantity* 52, 1893–1907. doi:10.1007/s11135-017-0574-8

Schell, C. J., Stanton, L. A., Young, J. K., Angeloni, L. M., Lambert, J. E., Breck, S. W., et al. (2021). The evolutionary consequences of human–wildlife conflict in cities. *Evol. Appl.* 14 (1), 178–197. doi:10.1111/eva.13131

Špinka, M. (2019). Animal agency, animal awareness and animal welfare. *Anim. Welf.* 28 (1), 11–20. doi:10.7120/09627286.28.1.011

Teel, T. L., Adams, M., Carlos, A. W. D., Bonnell, M. A., Breck, S. W., et al. (2022). A mixed-methods social psychology application evaluating the role of citizen science in mitigating human-wildlife conflict. *Soc. and Animals* 31, 645–668. doi:10.1163/15685306-bja10067

Thiele, T. N. (1903). *Theory of observations*. [M]. London; Copenhagen printed.

Vallabh, P., Lotz-Sisitka, H., O'Donoghue, R., and Schudel, I. (2016). Mapping epistemic cultures and learning potential of participants in citizen science projects. *Conserv. Biol.* 30 (3), 540–549. doi:10.1111/cobi.12701

Waetjen, D. P., and Shilling, F. M. (2017). Large extent volunteer roadkill and wildlife observation systems as sources of reliable data. *Front. Ecol. Evol.* 5, 89. doi:10.3389/fevo.2017.00089

Wang, W. (2021). The gaze: as dialogue and action - and the rise and fall of photojournalism. *Journalist* 6, 65–83.

Weik von Mossner, A. (2018). Engaging animals in wildlife documentaries: from anthropomorphism to trans-species empathy. *Cognitive Theory Documentary Film*, 163–179. doi:10.1007/978-3-319-90332-3_10

Weitzenfeld, A., and Joy, M. (2014). An overview of anthropocentrism, humanism, and speciesism in critical animal theory. *Counterpoints* 448, 3–27.

Wierucka, K., Hatten, C. E. R., Murphy, D., Allcock, J. A., Andersson, A. A., Bojan, J. W., et al. (2023). Human-wildlife interactions in urban Asia. *Glob. Ecol. Conservation* 46, e02596. doi:10.1016/j.gecco.2023.e02596

Wilkins, E. J., Cole, N. M., Miller, H. M., Schuster, R. M., Dayer, A. A., Duberstein, J. N., et al. (2019). Rural-urban differences in hunting and birdwatching attitudes and participation intent. *Hum. Dimensions Wildl.* 24 (6), 530–547. doi:10.1080/10871209.2019.1661046

Williams, E. H. (2005). *The nature handbook: a guide to observing the great outdoors [M]*. Oxford University Press.

Xuanyu, Y., and Xiaoyu, Z. (2023). A multi-species ethnographic perspective on urban human-wildlife relationships—a comparative study of stray cats and wild raccoon dogs in Shanghai city. *Acad. J. Humanit. and Soc. Sci.* 6 (4). doi:10.25236/AJHSS.2023.060414

Zapponi, L., Cini, A., Bardiani, M., Hardersen, S., Maura, M., Maurizi, E., et al. (2017). Citizen science data as an efficient tool for mapping protected saproxylic beetles. *Biol. Conserv.* 2017, 139–145. doi:10.1016/j.biocon.2016.04.035

Zhang, H. Q. (2020). Gazing at animals: reconstructing "nature" in the context of the Anthropocene. *Learn. Explor.* 6, 159–166.

Zhao, Q., Diao, Y., Weng, Y., Huang, Z., Gu, B., Wu, Y., et al. (2022). Predicting future distributions and dispersal pathways for precautionary management of human-raccoon dog conflicts in metropolitan landscapes. *Environ. Res. Lett.* 17 (10), 104036. doi:10.1088/1748-9326/ac9491

Zhao, Q., Wang, Y., Wu, L., Feng, Y., Li, Y., Zhang, Z., et al. (2024). A path to human-raccoon dog harmony: identifying factors influencing the tolerance of urban residents in Shanghai towards a neglected species. *People Nat.* 6, 1277–1287. doi:10.1002/pan3.10636