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RESEARCH ARTICLE

The frequent five: Insights from interviews with urban wildlife professionals in Germany

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Abstract

1. Wildlife in cities divides people, with some animals bringing positive benefits and others causing conflict, for example due to property damage.
2. Urban wildlife professionals from municipal administration, nature conservation, and hunting associations have a crucial role in shaping human-wildlife relationships in cities and fostering conflict-free coexistence. While many studies on urban wildlife have focused on the views of citizens, few have investigated the perspectives of experts to date. To address this knowledge gap, we interviewed 36 urban wildlife professionals giving guidance in the context of urban wildlife management, either in one of the four largest German cities by population (Berlin, Hamburg, Munich and Cologne) or at the national level.
3. Red foxes, wild boars, raccoons, stone martens and Eurasian beavers were the five mammal species most frequently highlighted in interviews to cause human-wildlife conflicts. The interviewees saw wild boars and raccoons as the most controversial urban wild mammals but emphasized the need to create refuges for beavers and better inform the public about foxes.
4. Management in terms of public outreach, urban planning and population control, as well as establishing official contact points and stricter fines of activities violating regulations were highlighted as important elements of a toolkit to manage urban wildlife conflicts.

KEYWORDS
Castor fibre, expert interviews, human-wildlife interactions, *Martes foina*, *Procyon lotor*, *Sus scrofa*, urban wildlife conflicts, *Vulpes vulpes*

1 | INTRODUCTION

'Wild animals are mostly nice and beautiful as long as they leave you alone' (anonymous expert N_2 interviewed for this study).

1.1 | Wildlife in urban areas

Rapid urban growth (UN, 2018) and increasing land conversion by infrastructure and agriculture are continuing to reduce natural habitats for a large number of wildlife (Adams, 2005). Simultaneously, ecological conditions in urban areas bring benefits to wildlife (Birnie-Gauvin et al., 2016). The species that successfully adapt to urban areas often exhibit distinct behaviour, movement patterns, reproduction rates, dietary habits and survival rates compared to their counterparts in natural habitats (Ritzel & Gallo, 2020; Schell et al., 2021). As a consequence, these species can take advantage of the urban environment with the term 'urban wildlife' referring to those that have established populations in urban areas (Magle et al., 2012). Wild animals can be classified as 'urban avoiders', those rarely found in urban areas; 'urban utilizers', which can range from sporadic use of urban resources to breeding in developed areas; and 'urban dwellers', species ranging from populations existing in both natural and urban environments to those entirely reliant on settled areas (Fischer et al., 2015). Several mammalian species are known as urban dwellers or utilizers, for example, red foxes (*Vulpes vulpes*; Morton et al., 2023) and raccoons (*Procyon lotor*; Jernelöv, 2017). Wild mammals have successfully adapted to urban environments (Santini et al., 2019) and are notably prominent in discussions regarding human-wildlife conflicts (Basak et al., 2022; Perry et al., 2020). Indeed, conflicts with mammals arise predominantly with individuals, such as white-tailed deer (*Odocoileus virginianus*) and coyotes (*Canis latrans*), as opposed to non-mammalian taxa like sparrows (*Passeridae*) and ants (*Formicidae*), where conflicts typically involve groups of these organisms (Schell et al., 2021). Urban wild mammals are generally less studied than birds (Magle et al., 2012) but hold significant importance, as their behaviour often serves as early indicators of potential conflicts (McDonnell & Hahs, 2015; Ritzel & Gallo, 2020). Research on urban wild mammals spans a diverse range, including studies on smaller mammals such as hamsters (*Cricetus cricetus*) in Vienna (Flamand et al., 2019) and hedgehogs (*Erinaceus europaeus*) in Zurich (Taucher et al., 2020), carnivores such as red foxes in Bristol (Padovani et al., 2021), wild boars (*Sus scrofa*) in Barcelona (Castillo-Contreras et al., 2018, 2021) and potentially dangerous brown bears (*Ursus arctos*) in Romania (Cimpoca & Voiculescu, 2022). Consequently, human-wild mammal interactions in urban areas present multifaceted challenges (Gallo et al., 2017; McCleery, 2010), but remain poorly understood in terms of the resulting benefits and conflicts, underscoring the need for further research.

1.2 | Impacts of wild mammals in urban areas

During the COVID-19 pandemic, when decreased human activity temporarily improved the quality of urban habitats for certain species (Coman et al., 2022; Vardi et al., 2021), wildlife in urban areas felt more present for humans (Murray et al., 2023; Zellmer et al., 2020). The presence of urban wildlife yields a spectrum of positive and negative interactions. On the positive end of this spectrum, urban wildlife can provide natural pest control (Nardi et al., 2020) or citizens actively seek out wild animals in their environment and enjoy observing them (Basak et al., 2022; Rupprecht, 2017). The presence of wildlife in urban areas can engage citizens in biodiversity conservation (Soga & Gaston, 2016), as urban environments are where many individuals form their ethical views on wildlife and express concern for conserving nature (Lunney & Burgin, 2004). Thus, urban wildlife can restore the connection between humans and nature (Snep & Clergeau, 2020) and play an important role for ecosystem services, human wellbeing and health (Soulsbury & White, 2015). On the other hand, urban animals can damage private or public property, and cause health and safety concerns (e.g. injuries to humans, perceived threats to safety; Basak et al., 2022; Soulsbury & White, 2015). Some citizens consider urban animals as 'pests' or 'vermin' that should remain in their 'natural' habitat (Hadidian, 2015; Lindsey & Adams, 2006). Negative experiences could potentially exacerbate a disconnect from nature, fostering biophobia characterized by irrational fears and aversion responses toward specific wild species (Soga et al., 2023; Soga & Gaston, 2022). Generally, perceptions of urban wildlife range from positive, that is, they are welcome in urban environments, to negative (Perry et al., 2020). Given this divide, citizens would require objective and evidence-based guidance to transition from viewing wildlife as problematic to seeing their presence as neutral. Such a transition needs proper management on how to address conflicts and, ideally, engage in wildlife conservation.

1.3 | Urban wildlife management

Urban wildlife management focuses on the interactions between wildlife, habitats and humans (Decker et al., 2012), and limiting negative wildlife impacts to humans (Adams, 2016; Reidinger, 2022). Methods of wildlife management include raising awareness (Peerenboom et al., 2020), hunting and trapping animals (Decker et al., 2012; Loker et al., 1999) and urban planning (Houston et al., 2017). Concerning awareness, it has been argued that a shift is needed from seeing urban animals as a problem toward appreciating them as being part of the urban ecosystem (Soulsbury & White, 2015). Here, a way of reducing conflicts is to engage with citizens' views, as, paradoxically, wildlife management is often more about managing people than managing wildlife itself (Davies et al., 2004). Regarding hunting and trapping, the so-called 'city hunters' have a special authority to remove

wildlife from residential areas, something normally prohibited in cities to avoid casualties (Peerenboom et al., 2020). However, studies show that the public favours hunting only as a last resort when other management methods fail (Dandy et al., 2011). Voices have been raised to consider wildlife in urban planning (Shingne & Reese, 2022), as part of the urban fabric (Michelfelder, 2003; Palmer, 2003). Conflicts can be avoided by multispecies approaches within urban planning (Houston et al., 2017) inducing wildlife needs (Apfelbeck et al., 2020). Examples on a larger scale involve integrating wildlife into new buildings (*Animal Aided Design* by Weisser & Hauck, 2017) and creating intentionally wild spaces (Jakoby et al., 2019; Nassauer, 1995), with smaller-scale planning actions including wildlife-friendly gardening and garden connectivity (e.g. Gazzard et al., 2021), and strategies to prevent wildlife intrusion into houses (Kistler et al., 2013). Although the possibilities of management actions are broad and diverse, often people need professional advice on how to cope with wildlife and their impacts.

Urban areas often lack clear centralized points of contact for guidance on questions related to human-wildlife interactions (Messmer, 2000; Peerenboom et al., 2020). As a result, residents seek guidance from a diverse array of sources, including emergency hotline services (Pop et al., 2023), councils (Baker et al., 2020), animal welfare services (Reese & Ye, 2017), conservation organizations (Messmer, 2000, 2009) and hunting associations (von Essen & Redmalm, 2023). Such urban wildlife professionals are equipped with a comprehensive understanding of the range of issues citizens encounter with urban wildlife. Their opinions have significant value in managing and fostering improved relationships between people and wildlife for sustainable coexistence in cities.

1.4 | Research questions

Although research on urban wildlife has rapidly expanded since the 1990s (Magle et al., 2012), there has been a notable absence of studies examining the insights of professional views on wildlife and their management in urban areas. Investigating expert views, e.g. with interviews, have been used for wildlife management in wilderness areas (e.g. Marshall et al., 2007), while in urban areas they have so far concentrated on ecosystem services (e.g. Kabisch, 2015) or only particular wildlife species (Lee et al., 2021 on rats, Snep et al., 2016 on birds). To address this gap, we interviewed urban wildlife professionals from nature conservation, administration and hunting associations to gain valuable insights into their views of urban wild mammals, the associated impacts and perceived urgency of management strategies. The interviews were used to investigate the main question: How do urban wildlife professionals perceive the benefits and challenges stemming from urban human-wildlife interactions, and what associated management strategies do they recommend in order to address them? Connected to this overarching question, we addressed the following specific research questions: (1) Which urban mammalian species are of focal concern for urban wildlife professionals? (2) What are the impacts—positive and negative—seen by professionals, and are there certain mammals connected to certain impacts? (3) What management strategies do urban wildlife professionals recommend and which mammal species are connected with these?

This study's conceptual framework is rooted in human-wildlife interactions, a research field that examines the intricate relationships between humans and wildlife (Frank & Anthony, 2021; Pătru-Stupariu et al., 2020). Following the approach of Lischka et al. (2018) to integrate the social-ecological systems theory (Redman et al., 2004), we acknowledge the complex dynamics of these interactions and categorize them as perceived benefits, such as ecosystem services and aesthetic value, and challenges, such as human-wildlife conflicts (Basak et al., 2022; Rupprecht, 2017). Using this framework, we aim to elucidate experts' perspectives on human-wildlife interactions and the importance of specific management strategies. Our study highlights the importance of understanding experts' perceptions to achieve dynamic human-wildlife coexistence (König et al., 2020). Therefore, based on expert knowledge and statements, we explored management strategies to promote human-wildlife coexistence in urban areas. We examined German cities and potentially occurring wild mammals (Table A1) as a case study to inspect human-wildlife interactions and management actions. Our insights will be consolidated into a toolkit tailored for cities facing similar challenges.

2 | MATERIALS AND METHODS

2.1 | Study area

Interviews were carried out with professionals in Germany. These professionals were from one of the four largest German cities (Berlin, Hamburg, Munich, and Cologne; Figure A1) or worked for an organization with a nationwide perspective. Berlin is Germany's largest city with 3.7 million inhabitants, followed by Hamburg (1.9 million), Munich (1.5 million) and Cologne (1.1 million; Statista, 2021). Hamburg has the highest proportion of urban green spaces (UGS, 71.4%), followed by Berlin (59.0%), Cologne (58.4%) and Munich (49.9%, Statista, 2016).

2.2 | Qualitative methodology

Our study adopts a qualitative approach, using semi-structured interviews (Adams, 2015; Bogner et al., 2005) to gather in-depth insights from experts. Rooted in the interpretivist paradigm, this methodological framework involves coding interview data using Mayring's (2015) qualitative content analysis method. This approach aims to delve into the subjective experiences and insights of experts, exploring their perspectives on urban wildlife management.

2.3 | Expert selection

For our study, we engaged with urban wildlife professionals, individuals with specialized knowledge and experience in managing human-wildlife interactions within urban settings. We defined urban wildlife professionals as experts who regularly interact with people in their cities or nationwide and provide advice on wildlife matters, ranging from damages to simple inquiries. These professionals have a comprehensive understanding of the city and gain insights into the problems and benefits related to urban wildlife through direct communication with the public. They share ideas on what actions need to be taken to mitigate human-wildlife conflicts. To identify suitable interview candidates, we adopted a systematic approach, utilizing targeted Google searches employing specific wildlife-related keywords, such as 'Wildtiere Berlin', for each city and across Germany. This method mirrored the typical process that citizens employ when seeking guidance regarding wildlife-related concerns. In each city and at the national level, efforts were made to find comparable interviewees across various categories. For example, if a nature conservation agency in Berlin was interviewed, similar institutions were sought in other cities and nationwide. Contact was initiated with a total of 71 identified individuals. Ultimately, 36 people agreed to participate in the interviews.

Upon consenting to participate, the experts self-assessed their level of expertise, confirming their proficiency in their respective domains. The interview cohort comprised urban wildlife professionals of diverse backgrounds, including municipal administration, such as green space administrators for urban parks, forests or cemeteries ($n=8$); nature conservation NGOs ($n=15$); hunting- or forest-related societies ($n=10$); and private experts, such as independent wildlife educators ($n=4$). The interviews were classified into five sets according to their respective regions: Berlin, Hamburg, Munich, Cologne and nationwide (Table 1).

2.4 | Ethics statement

There were no institutional requirements for ethical clearance. However, the survey was carried out in accordance with the General Data Protection Regulation (GDPR; https://gdpr-info.eu/) of the European Union. A consent form was provided to interview participants ensuring their anonymity, information about the general purpose of the study, data that will be collected, contact and that there would be no disadvantages for participants if they resign from the study at any stage.

2.5 | Semi-structured interviews

We conducted semi-structured expert interviews following Bogner et al. (2005), with a mix of closed and open questions, the latter being how- or why-questions (Adams, 2015). Interviews were conducted following ethical guidelines, guaranteeing participant anonymity, informed consent, and the freedom to withdraw from the study without repercussions (see Research Ethics). The interview guideline contained seven questions asked in order following the main themes (Table A2). If experts were imprecise (e.g. 'Wildlife needs to be reduced'), additional refinement questions were asked. This method allowed us to engage with one interviewee at a time and to focus on urban species that the interviewee chose to talk about. The interviews were recorded with an Olympus WS-852 digital voice recorder between September and December 2020 (Table 1; Table A3). Interviews, all conducted by the same interviewer, were set up as expert-to-quasi-expert dialogues, enabling discussions with technical terminology (Pfadenhauer, 2005). The average interview had a length of 41:08 min (min 24:24 min, max 65:11 min), thus mostly within the anticipated time frame of 1 h (Adams, 2015). Interviews were transcribed with F4 (www.audiotranskription.de) and then anonymized and assigned to the city (B = Berlin, H = Hamburg, C = Cologne, M = Munich) or as nationwide (N). Quotes from experts are with the corresponding letter and number (e.g. B_1 for the first Berlin expert). Included quotes are in the original language (German) and translation (English) in Appendix Table A4.

2.6 | Coding and analysis

The interviews were coded after Mayring's (2015) qualitative content analysis using MAXQDA Version 22.2.1 (https://www.maxqda.com). We used inductive coding, that is codes were developed

TABLE 1 Interview by region and expert group.

Interview sets	Administration	Nature conservation	Hunting/forest	Private experts	Total
B—Berlin	2	3	2	2	8
H—Hamburg	1	3	1	0	5
M—Munich	2	2	3	0	7
C—Cologne	2	2	3	1	8
N—Nationwide	1	5	1	1	8
Total	8	15	10	4	36

Note: The regions were divided into experts from Berlin, Hamburg, Munich, Cologne and nationwide experts. The expert groups were classified into administration, nature conservation, hunting or forest organizations, and private experts.

bottom-up. To address our three research questions, we coded and sorted statements on urban wildlife into three themes: (1) focal species, (2) impacts of urban wildlife and (3) management of urban wildlife. Impacts were divided into positive and negative impacts (Tables A5 and A6), and management into environmental education, urban planning and wildlife population control. Each mammal species mentioned in an interview was identified and coded. Figure 1 shows the code tree and an example of coding a statement by an expert interviewed. The interview quote 'Raccoons and martens cause devastation in gardens, and here we need to teach people not to attract those with food' was coded with 'raccoon', 'marten', 'damage in private properties' and 'education about consequences of feeding'. Codes were sorted into the code categories: 'raccoon' into 'focal species', 'damage to private properties' into 'negative impacts' and so on. Results are given as total percentage (e.g. 'raccoon' was found in 30 of all 36 interviews resulting in 83%) and percentage per set (e.g. 'raccoon' was found in eight out of eight interviews from the Berlin set, resulting in 100%). In addition, positive and negative examples of impacts of urban wildlife, as well as statements about management, were classified and given in percentage for all interviews and for each of the five sets. If the coding overlapped within one sentence, the percentage of overlap between categories was calculated through the MAXQDA code relations browser (for example, the overlap of 'raccoon' and 'damage to private properties' was found in 13 of 36 interviews, thus 36% of the interviews). The figures include focal species that were mentioned by more than 10% of the

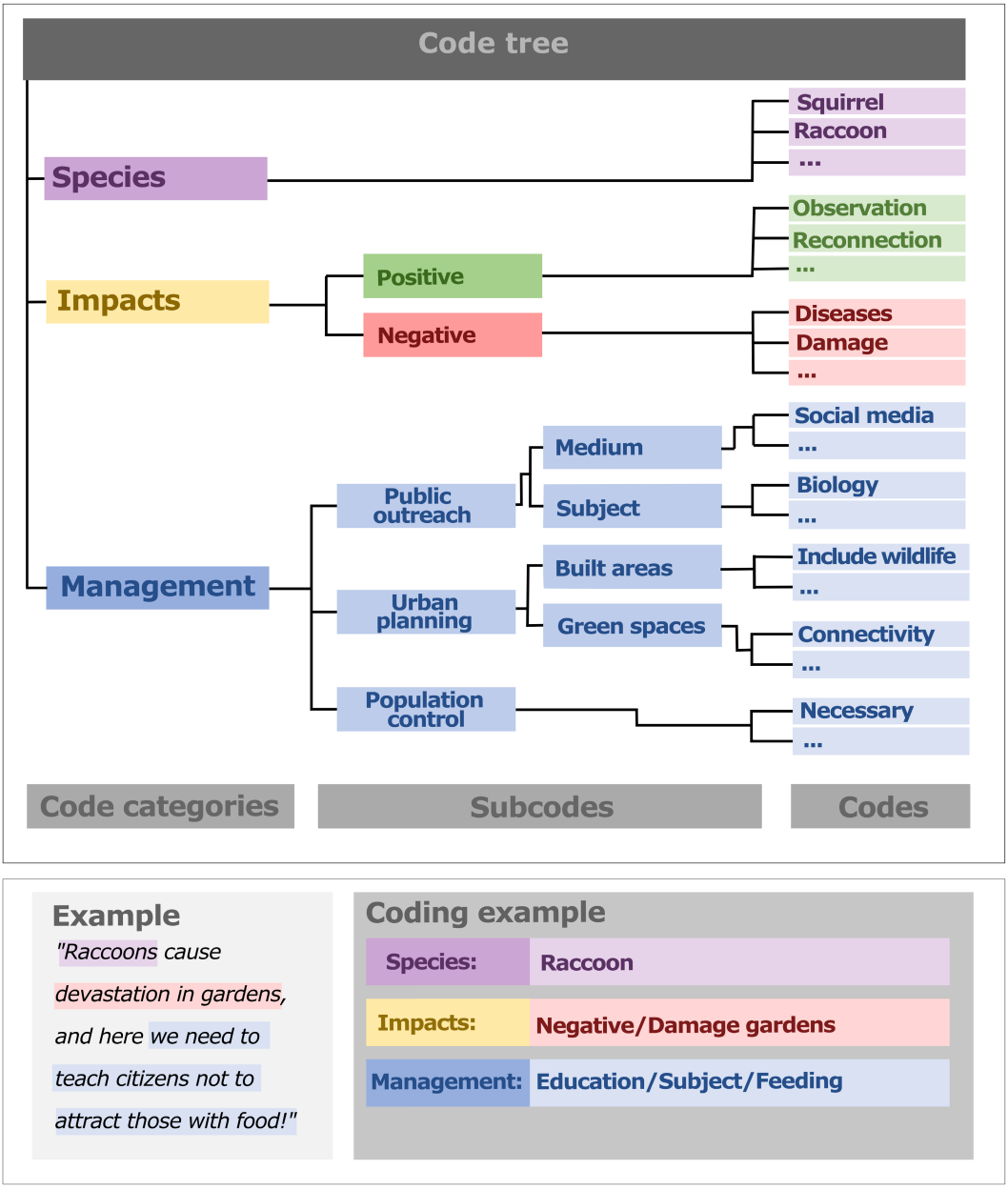

FIGURE 1 Code tree and example coding. Code categories species (purple), impacts (yellow) and management (blue) with subcodes and codes. The dots (...) indicate that similar codes follow. The example (grey) shows an interview quote and coding of sentence fragments.

interview partners with respect to a negative or positive impact or management actions. Silhouettes used in the figures are from http://phylopic.org.

3 | RESULTS

3.1 | Focal species

We found a variety of wild mammals mentioned by the interviewed experts: All 36 experts mentioned foxes (100%), followed by 34 interviewees mentioning wild boars (92%), 31 martens (86%) and 30 raccoons (83%). Wolves (39%), hedgehogs (39%) and coypus (25%) were mentioned less frequently (Figure A2). Per interviewee, each mammal was classified according to whether it was associated with solely positive impacts, solely negative impacts, both, no impacts (e.g. just within a list) or not mentioned at all (Figure 2). While foxes were generally connected to negative impacts or both (negative and positive impacts), experts associated wild boars, martens and raccoons mostly with negative impacts. No expert named raccoons in connection with positive influences. While beavers were related to positive and negative impacts, mice were mostly mentioned without reflecting on their impacts. Similarly, hares, wolves and hedgehogs were merely just listed, while squirrels—if mentioned—were connected to positive impacts by most interviewees.

All Berlin experts mentioned wild boars, and other experts added that Berlin is notorious for wild boars, for example 'We don't have it as bad with the wild boars as in Berlin' (H_4) or 'we have the wild boars but not like in Berlin, because there they are in the city center' (H_2). Raccoons were spoken of least in Cologne and Munich, with the notion that 'Kassel is the raccoon capital in Germany' ($N_{2,4}$). Rabbits were listed by almost all Cologne experts (e.g. C_4: 'Cologne used to be the wild rabbit capital of Germany'). Beavers were mentioned least in Cologne. Wolves were voiced by all Hamburg experts, but with the constraint that 'the wolf won't settle in Hamburg, although it is sometimes in the tabloids' (H_2). At the national level, foxes, wild boars, marten and raccoons marked the most discussed focal species.

3.2 | Impacts of urban wildlife

Mentioned urban wildlife impacts were identified and grouped into eight categories each for positive and negative impacts (Tables A5 and A6). Positive categories were: observation of wildlife, livability of cities, consideration (learning to be compassionate and understanding), biodiversity, reconnection to nature, intrinsic value of nature, reduction of vermin and ecosystem services. Negative categories were damage to private properties, diseases, fear, injury, harassment, damage to public spaces, impacts on other species and conflicts for pets (see Table A7 for listings per set; Table A8 for listings per mammal).

Positive impacts of wildlife focused mainly on the joy of observing wildlife (97%), followed by wildlife increasing the livability of cities (50%), wildlife teaching us consideration for others (50%), biodiversity (44%; e.g. N_4: 'By now, everyone is aware that biodiversity is in danger—worldwide. [...] I think, the return of wild animals to the city [... is] a little sign of hope.') and the possibility of reconnecting with nature (42%, e.g. H_1: 'We have become quite alienated and removed from nature. Now nature is actually following us, exactly where we do not expect it' or B_6: 'Through the fact that wildlife comes to urban areas, conquers new habitats or reconquers old ones, we suddenly have some conflicts again, which are very important for us [...], because they show us how we deal with nature, with wild habitats and their inhabitants').

Most positive impacts were related to wildlife in general rather than certain species, with a few exceptions: Wildlife observation was connected to squirrels, wild boars, foxes, beavers, rabbits, hares, hedgehogs, deer and wolves. Pest control (31%) was mainly connected to foxes (e.g. N_4: 'foxes [...] are opponents of mice, rats and also rabbits.') and the contribution of ecosystem services (28%) was attributed to beavers (e.g. B_2: 'beavers create new habitats as natural regulators') and wild boars (e.g. B_5: 'wild boars dig up the in the soil and from the seed bank in the soil then other plants germinate.') At the city level, wildlife observation was the only positive impact present by more than half of the five interview sets.

Negative impacts overshadow positive ones (Figure 3), where all eight negative impact categories occurred in at least 39% of the interviews. Most experts mentioned damage to private properties (94%), followed by diseases (83%), fear (75%) and risk of injury (75%).

Negative impacts—contrary to positive ones—were always related to a particular species. This was the case for wild boars for seven of the eight negative impact categories, foxes for five impact categories, and raccoons and beavers for four impact categories. Regarding wild boars, N_2 expressed that 'people [were] crying in their formerly well-kept front garden, which looks as if a tank had driven through' (N_2). Foxes were disproportionally associated with diseases (67%), namely tapeworms (*Echinococcus multilocularis*), rabies and mange. However, experts stated that 'Foxes have always been known to transmit rabies. Although this has now come to a standstill here, it is still very, very deeply rooted in people's minds' (C4) and that 'rabies is long gone, and fox tapeworm is also a fairytale' (H1). Wild boars and beavers were associated with general injuries, and martens with damage to cars, potentially resulting in accidents. More specifically, wild boars were connected to direct attacks on humans (e.g. B_4: 'A wild boar is big and has the potential to injure people') and beavers with the risk of injuries caused by tree gnawing (e.g. M_2: 'Where a beaver gnaws on trees in order to then fell them, this poses a risk'). Martens, also referred to as 'car martens' (N_2) are associated with car damage that can lead to accidents (e.g. M_7: 'Martens cause damage to vehicles or wiring systems with short circuits and brake failures'). Regarding the negative impacts on other species, beavers

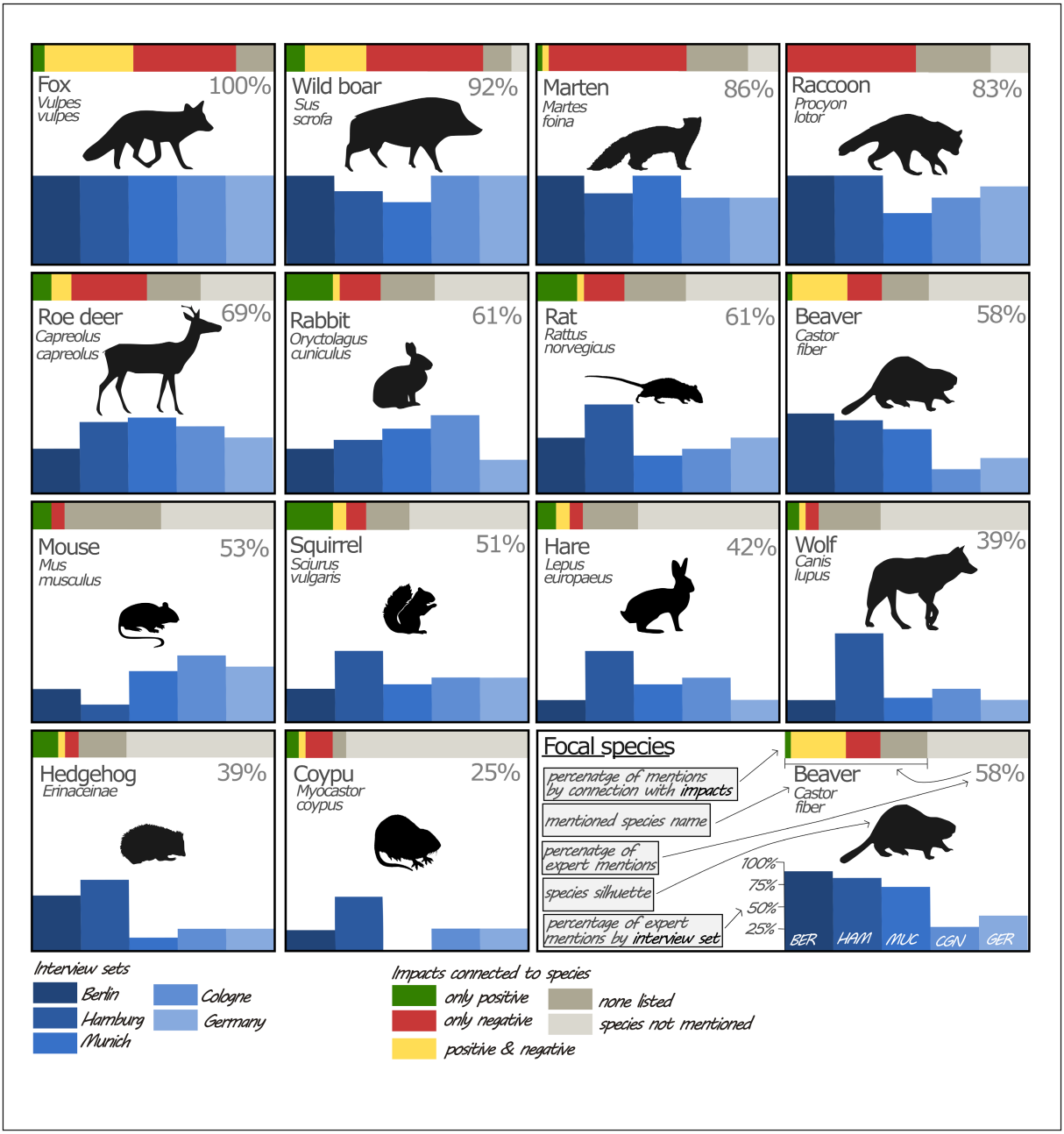

FIGURE 2 Mammals mentioned in the interviews, displayed as shown in the bottom right as an example. Each panel shows the percentage of interviews in which an animal was mentioned: On the upper right as a percentage value for all 36 interviews together (e.g. 58% for the beaver), and on the bottom for each of the cities (BER = Berlin, HAM = Hamburg, MUC = Munich, CGN = Cologne) and nationwide (GER). The type of impact (i.e. whether and animal was associated with positive, mixed or negative impacts) is shown on the top of each panel.

were described as felling trees, raccoons were associated with the loss of native animals such as amphibians ($B_{2,7}$, M_2) and coypus with the destruction of habitat through reed browsing (N_2). At the city level, all Berlin experts noted diseases, damage to private property, fear and injury, whereas in Hamburg the focus was on fear and the impact on other species. In Munich, damage to private and public spaces was mentioned most frequently. For Cologne, no negative impact was listed by all experts, but damage to private and public places was highlighted by 88% of the interviewees.

3.3 | Management methods

Almost all experts saw public outreach, urban planning and population control as important measures to shape human-wildlife coexistence in urban areas. In addition to these three, additional recommendations emerged during the interviews: advice and networks, as well as restrictions and fines.

Public outreach was highlighted by 97% of the interviewees and classified into the two subcodes 'medium' (e.g. tours and

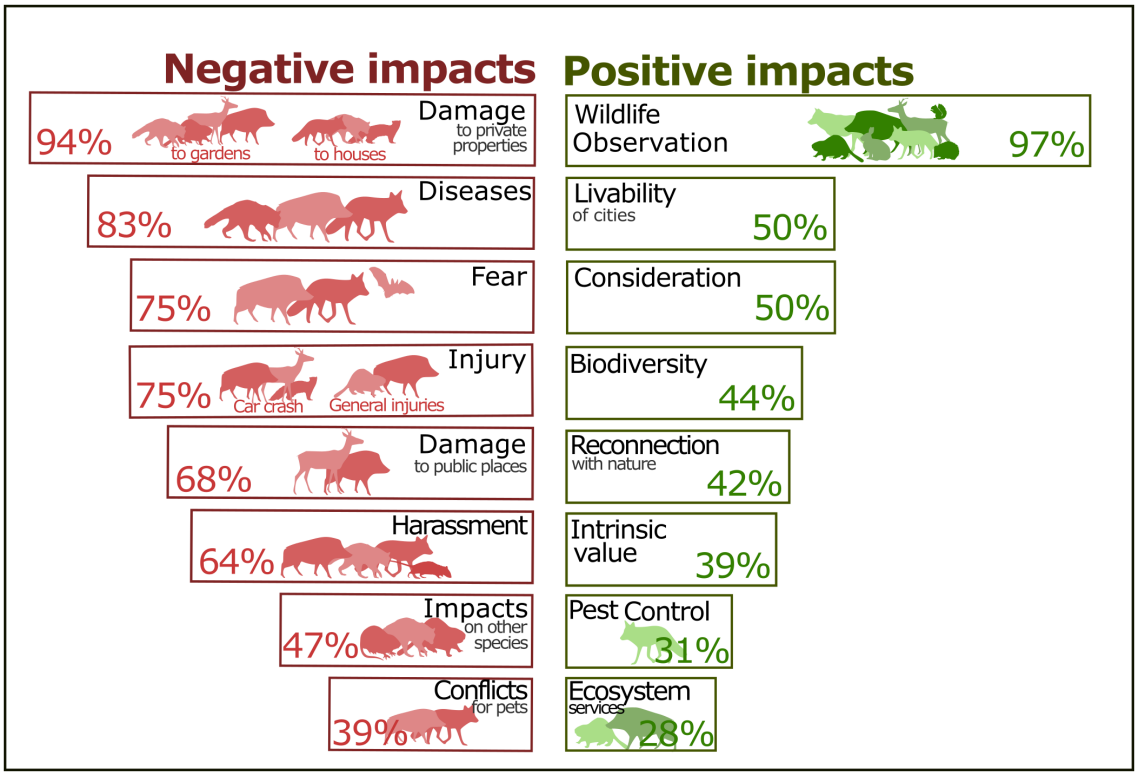

FIGURE 3 Impacts of urban wildlife as stated by urban wildlife professionals interviewed, grouped into the eight most frequently mentioned negative and positive categories. The width of each box shows the percentage of interviews that mention an impact, and animal silhouettes indicate that the particular animal was associated with that impact by more than 10% of the interviewees; if empty, the impact was in the interview only associated with wildlife in general rather than a particular species.

talks) and 'topic' (e.g. behaviour toward wildlife) (Figure 4). Five codes were identified corresponding to different media sources: 42% of the interviews saw a need to integrate education about wildlife into school curricula, followed by nature tours and talks (33%), social media (28%), participatory activities (25%), and major events and festivals (22%). While foxes were related to the inclusion of school curricula, tours and talks were highlighted by interviewees regarding beavers. Regarding the topics, seven distinct themes were identified: Biology and behaviour of wildlife were accentuated most by interviewees (72%), followed by behaviour of humans toward wildlife (53%), consequences of (un)intentional feeding (47%), measures in urban green spaces (UGS; 42%) and the ability to cope with wildlife impacts (36%). Wild boars were predominantly associated with topics related to biology, human behaviour and feeding consequences. Measures in UGS were primarily related to beavers, while assistance with coping with wildlife impacts was attributed to martens and raccoons. Regarding interview sets, the topic of wildlife biology was most frequently discussed in Berlin, Hamburg and Cologne, whereas experts in Munich focused on measures in UGS (Table A9).

Urban planning was addressed by 94% of the interviewees and sorted into 'built areas' and 'green spaces' (Figure 4; Table A9). For built areas, the integration of wildlife into building projects was mentioned most (39%, e.g. AAD), followed by (wildlife-friendly) green infrastructure (33%, e.g. green roofs or facade greening) and exclusion of wildlife (33%). Concerning wildlife exclusion, interviewees saw a need to design houses and building quarters in a way that keeps wildlife out, in particular raccoons, wild boars and martens; experts from Cologne frequently mentioned this type of management measure (63%; Table A10). Although most of the interviewees, who mentioned the inclusion of wildlife, were nationwide experts (75%), the inclusion of greening was mainly highlighted by Hamburg experts (60%). For UGS, interviewees saw a need to enhance (86%), connect (33%), protect (22%) and/or characterize (22%) them. Here, 'enhancement' included calls for better infrastructure (e.g. signs, wildlife-safe trash cans), along with a push for more natural and diverse designs. The characterization of UGS included outlining areas to be wildlife-inclusive (e.g. adding undergrowth/bushes as retreat) or exclusive (e.g. not giving spaces to hide). For the enhancement of greenspaces, wild boars, foxes and beavers were highlighted most (Table A11).

References toward population control were found in 94% of interviews. We categorized interviewees according to their view of whether control through hunting is necessary and which species they highlighted as suitable targets (Figure 4). In total, 36% of the interviewees highlighted the need to manage species through hunting, where the removal of 'colonizers' (C5) was emphasized (e.g. N3: 'We need to specifically hunt down the individuals who have obviously rehashed or adopted these traditions of moving into cities') as well as hunting in the city outskirts, urban forests and cemeteries.

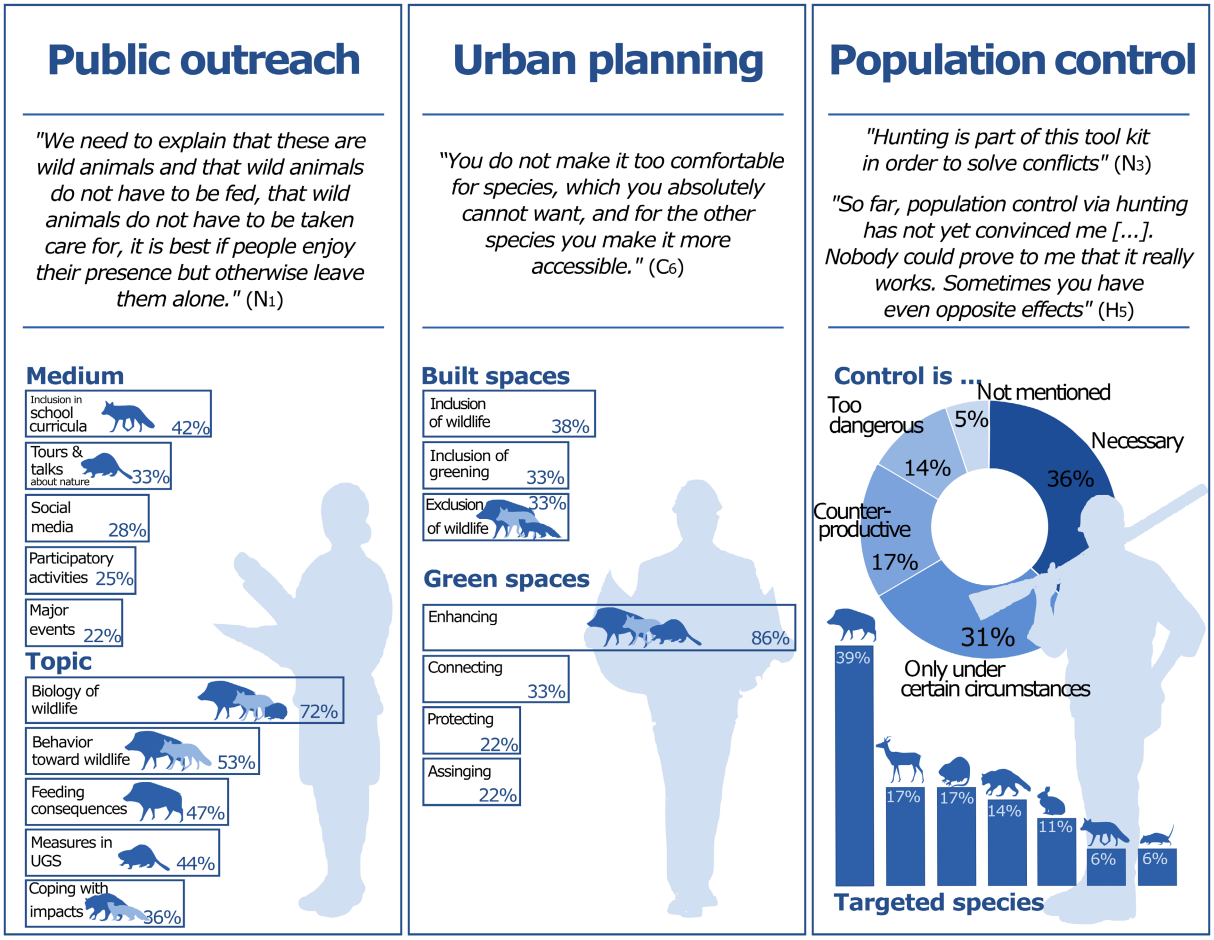

FIGURE 4 Examples of quotes by the interviewed urban wildlife professionals on management methods focusing on: Public outreach (environmental education and awareness raising), urban planning and population control. The figure shows all measures that were mentioned in more than 10% of the interviews within the three management categories.

Furthermore, 31% of the interviewees saw a need for hunting only in certain circumstances, such as wounded or sick animals or 'problem animals' (expression used by 14%) and articulated the importance of city hunters (e.g. B_7: 'City hunters are there to protect the citizens from danger'). Additionally, 17% saw population control through hunting as counterproductive. Interviewees focused on specific species to be controlled via hunting: wild boars were mentioned most frequently (39%), followed by deer (17%), coypus (17%), raccoons (14%), rabbits (11%), foxes (6%) and rats (6%). Regarding raccoons hunting, B_4 added: 'there are too many people who find raccoons cute.' Hunting for wild boars (8%), raccoons (6%), beavers (3%), and coypus (3%) was deemed counterproductive, with anticipated population sizes remaining unchanged or potentially increasing after culling.

In addition, interviewees added 'advice and networks' (72%) and 'fines and restrictions' (67%). Regarding advice and networks, 58% saw a need for official advice points to help citizens engage with urban wildlife (e.g. B_2: 'I think there must be contact points where citizens with their concerns can find competent advice'). Furthermore, 36% of the interviewees recommended a citywide network of all stakeholders or a round table; 22% stressed the importance of a wildlife representative, referring to Berlin (e.g. C_8: 'It stands and falls with the person, [...]. And we need people like that [Berlin's wildlife representative] to carry that forward adequately'). Concerning fines and restrictions, 44% highlighted rules and regulations for pets due to their effect on wildlife (e.g. recommend dog bans for protected UGS or fining owners of unleashed dogs in UGS more rigorously). Furthermore, 36% of interviewees highlighted stricter controls of rules in UGS, for example remaining paths, or increasing surveillance. Fines for illegal feeding were highlighted in 33% of the interviewees (e.g. B_8: 'animals, which live in cities, are not allowed to be fed, so that these won't lose their last shyness').

4 | DISCUSSION

The interviews aimed to understand how urban wildlife professionals perceive and navigate human-wildlife interactions in urban environments. Our study had three main objectives: Regarding Objective 1, we found that five species mostly concerned the interview partners, wild boar, red fox, marten, beaver and raccoon; regarding Objective 2, our study highlights the prevalence of negative impacts associated

with urban wildlife, although positive aspects were also noted; and regarding Objective 3, we explore a toolkit to mitigate conflicts and promote coexistence with urban wildlife.

4.1 | The *frequent five* and their management

Although interviews were carried out without prompting names of particular species, a set of *frequent five* played a key role and were the major concern among urban wildlife professionals: wild boar, red fox, marten, beaver and raccoon (Figure 5). While it was expected that species involved in human-wildlife conflicts would be the most frequently discussed, two unexpected findings emerged: First, we were surprised that bats were not mentioned more frequently, due to the discussion about the origin of SARS-CoV-2 (Zhou et al., 2020) which fell into the time of the interviews. Second, it was unexpected to observe such a pronounced contrast between these five species and hedgehogs and squirrels, which are perceived positively by the general public (Basak et al., 2022). These animals have the potential to serve as positive examples for connecting humans with wildlife.

Urban foxes, mentioned in all interviews, are not exclusive to Germany. They have predominantly been associated with urban environments in the United Kingdom (Scott et al., 2014) and Switzerland (Wandeler et al., 2003), and they have been found in many other urban areas from North America (Soulsbury et al., 2010) to Asia (Tsukada et al., 2000) and Australia (Gil-Fernandez et al., 2020). Foxes are frequently represented in newspapers as nuisance wildlife, despite their general positive perception (Stewart & Cole, 2015). The connection of foxes and diseases might be linked to the exacerbation of existing concerns due to increased knowledge of fox-transmitted diseases (Kimmig et al., 2020; König, 2008) and perceptions of foxes as bold (Padovani et al., 2021). Although Germany has been free of terrestrial rabies since the beginning of the 2000s (Müller et al., 2005), citizens still connect foxes with this disease (Kimmig et al., 2020). Public outreach is crucial to convey the message that '[r]abies is long gone' (H_1). If anything, the successful eradication of rabies could have led to an increase of fox populations and potentially elevated rates of tapeworm infections (Schneider et al., 2023; Schweiger et al., 2007). Although the tapeworm is prevalent in many European countries (Oksanen et al., 2016), it is primarily transmitted through human contact with fox faeces (Soulsbury et al., 2010), a risk that can be cost-effectively mitigated with worm baits (König, 2008) and practicing hand washing after outdoor activities (Peerenboom et al., 2020). However, despite their central role in interviews and studies in European cities, they hold a minor

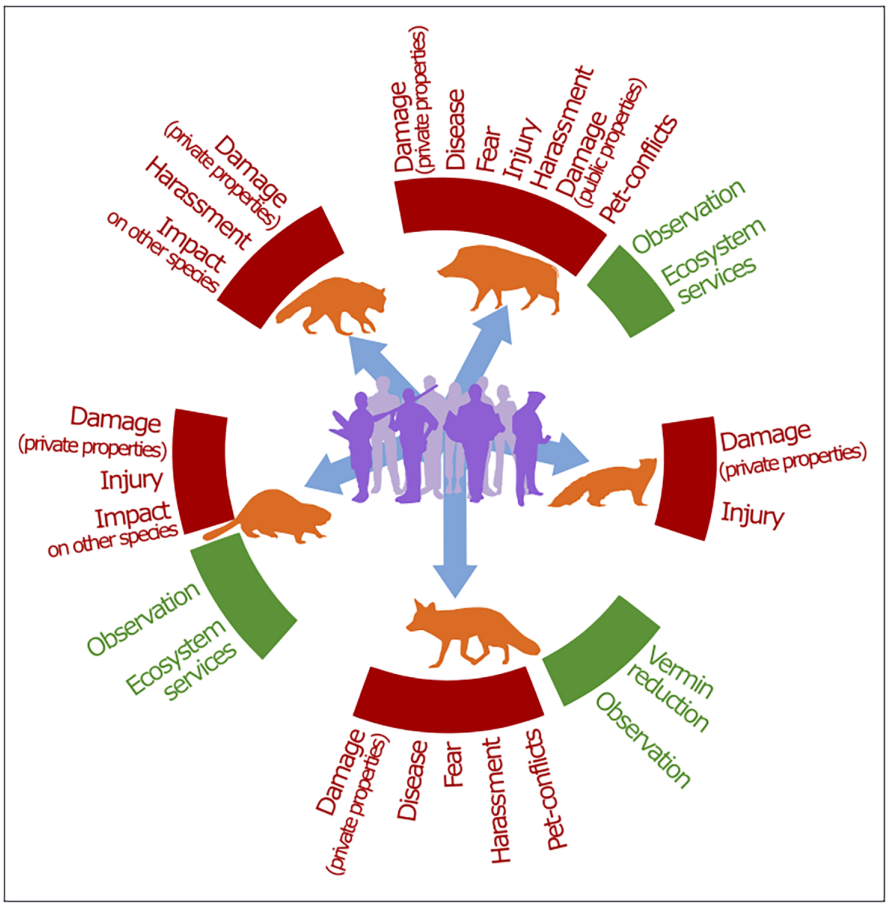

FIGURE 5 The frequent five: Wild boars, martens, foxes, beavers and raccoons. Negative (red) and positive (green) impacts related to mammal species (orange) and their management (blue arrows) by urban wildlife professionals (purple).

position in the US where coyotes dominate (Nardi et al., 2020), as well as in Australia and Asia where snakes are regarded the most dangerous wildlife (Rupprecht, 2017).

Wild boars were the species connected with the most negative impacts (Figures 2 and 3). The connection of diseases and wild boar is related to the African swine flu, which is a core research regarding wild boar (Sauter-Louis et al., 2021). The connection between wild boars and Berlin specifically has been strengthened via media headlines in recent years: In 2020, a wild boar nicknamed 'Elsa' made international headlines by stealing a laptop and being chased by a nudist at Teufelssee (NYP, 2020), and in 2023, a wild boar mistaken for a lion sparked a large-scale police search in the southwest of the city (The Guardian, 2023). Berlin is recognized for its wild boar challenges and has been a key area of study (Kotulski & König, 2008; Stillfried et al., 2017); however other cities, such as Houston, Hong Kong, Barcelona and Rome deal with similar issues (Fulgione & Buglione, 2022). Barcelona, in particular, has been researched regarding urban wild boar dynamics (e.g. Castillo-Contreras et al., 2018, 2021; Hagemann et al., 2022). Reducing periurban wild boar populations is often advocated as a solution to mitigate conflicts, as recommended by both research (González-Crespo et al., 2018; Stillfried et al., 2017) and interviewees (e.g. H_2: 'Wild boars have no enemies, so humans must intervene'). However, the effectiveness of wild boar hunting to mitigate conflicts is controversial (Massei et al., 2015). Implementing fertility control measures in areas where hunting is logistically challenging, such as urban environments, could serve as a viable solution to mitigate conflicts without resorting to lethal control (Massei & Cowan, 2014). However, a different approach without invasive interference is that 'you do not make it too comfortable for species, which you absolutely cannot want' (C_5) in accordance with the recommendation by Castillo-Contreras et al. (2018) to decrease the attractiveness of urban areas that act as inviting corridors. Further, unleashed dogs are seen as the catalyst of wild boar conflicts (e.g. N_7 '[People] go into the forest with [their] dog—especially when wild boars are leading piglets—and let it run around'). Evidence shows that unleashed dogs negatively impact wildlife in woodlands (Beasley et al., 2023; Hughes & Macdonald, 2013), especially for wild boars (Stillfried et al., 2017). To minimize conflicts, ensuring dogs are leashed could decrease the probability of conflict initiation (Dhanjal-Adams, 2017).

Raccoons were associated with a large number of negative impacts (Figure 3). Native to North America, raccoons are invasive in Europe (Hohmann & Bartussek, 2018; Jeschke et al., 2022). While Berlin is the city of wild boars, 'Kassel is the raccoon capital in Germany' ($N_{2,4}$). Close to Kassel, a medium-sized city in the centre of Germany, raccoons were released in the 1930s (Fischer et al., 2016). While all interviewees from Berlin and Hamburg mentioned raccoons, this was not the case for Cologne and Munich, where raccoons are not yet so abundant (Fischer et al., 2016). The raccoons were not associated with positive effects (Figure 2) and were emphasized as causing damage to private properties and impacts on other species. While their impact on other species opens a new discussion of the effects of invasive species on native ecosystems (Jernelöv, 2017), it can be stated that non-native raccoons are also noted by experts as bringing negative consequences within urban ecosystems. The small number of interviewees proposing to hunt raccoons as a management measure (Figure 4) reflects the need for other measures, as 'there are way too many raccoons for that [hunting]' (B4) and 'there [are] too many people who find raccoons cute', underlining by Jarić et al.'s (2020) point of the consequences of the charisma of invasive species. Management measures recommended by the interviewees included sealing off entries to houses or locked trash cans reflecting findings of targeted raccoon interviews (Moesch et al., 2024). Exploring diverse approaches to raccoon conflict management, including observing management methods in their native habitats in North America (e.g. Gehrt, 2012; Rosatte, 2000) and in areas where they are newly spreading, such as Italy (Mazzamuto et al., 2020), could help mitigate conflicts effectively. The increasing presence of invasive raccoons in German cities foreshadows potential developments in other European urban areas, based on their initial proliferation in Germany (Jernelöv, 2017) and the projected expansion into additional European urban environments (Fischer et al., 2016). The recent introduction of raccoons into European cities underscores the urgent need for comprehensive management strategies specifically targeting this invasive species.

Martens were by most of the interviewees linked to car and house damage and were even considered 'car martens' (M_1, N_2). The damage to cars by martens was highlighted by most interviewees (39%), and of the 50 million cars registered in Germany, about 0.4% are damaged annually by martens (Statista, 2019, 2022). C_8 sees the 'ignorance and unawareness, that a stone marten does not eat the engines of cars' as a common perception that needs to be changed. Although there is evidence that martens damage cars (Statista, 2019, 2022), not every car visited by martens is damaged (Herr et al., 2009), and measures to scare off martens exist, for example cable sleeves (Langwieder et al., 2000). Despite the broad geographic range of martens (Harrison et al., 2004), their investigation in urban areas (e.g. Capon et al., 2021) and the first recording of martens damaging cars in the 1970s (Lachat, 1991), the conflict of martens and car damage is rarely addressed in the scientific literature (e.g. Herr et al., 2009; Tóth et al., 2009). In other studies, marten-car associations have been notably absent (Peeva & Raichev, 2016). More research is warranted to determine whether this behaviour represents an isolated occurrence among martens in central European areas, and to devise strategies to mitigate this conflict.

Eurasian beavers were named in fewer interviews than the other *frequent fives*, but were frequently mentioned in the context of impacts and management (Figures 3 and 4). Although initially surprising, the frequent mention of this mammal by numerous experts is consistent with its recent establishment as an urban inhabitant. Beavers are native to Europe and had almost completely disappeared due to overhunting, but protection and European reintroduction campaigns have seen their populations recover (Halley et al., 2021). Beavers were linked to both positive and negative impacts in our interviews (Figure 2). The negative impacts listed were damages to private properties (here, gardens), impacts on other species and risk

of injury, all resulting from trees being gnawed on. This can be regulated by enhancing green spaces with wire fences on trees, which was highlighted by almost all Munich experts. As Munich is the biggest city in Bavaria, the state with the highest number of beavers (Zahner et al., 2021), other European cities where beavers begin to reside can take Munich's wire protection as an example to reduce beaver impacts. Scientific publications have found many benefits of beavers on ecosystems (Wright et al., 2002), which have also been highlighted by the media (Kaphegyi et al., 2015). The positive effects of beavers on observation and ecosystem services were highlighted in our interviews (e.g. C_3:'beavers [...] play a major role in shaping ecosystems'). Eurasian beavers have been investigated as urban species in Slovakia (Pachinger & Hulik, 1999) and Poland (Ciach et al., 2023) and have just started to build stable populations in European countries with high urbanization rates like England, Spain and Italy (Wróbel, 2020). Therefore, the lack of comprehensive research on urban beavers in resurgent regions highlights the need for further ecological investigation in urban areas.

4.2 | More examples of negative than positive impacts of urban wildlife

Negative impacts were more frequently highlighted in the interviews than positive ones (Figure 3). Additionally, the negative impacts included more measurable values (e.g. private property damage can be measured in money), while positive impacts were rather immaterial (e.g. livability of cities is hard to quantify). However, previous studies underline the health benefits of human-wildlife interactions in urban areas (Chavez et al., 2023; Mumaw et al., 2017) as well as the important role of wildlife as ambassadors for reconnecting people with nature (Perry et al., 2020; Soga & Gaston, 2016). Negative impacts were mainly attributed to certain species (e.g. damage to public places by wild boars or diseases to foxes), while positive impacts were related to wildlife in general (e.g. B_6: 'wildlife comes to urban areas [and] they show us how we deal with nature.'). This reflects Lunney & Moon's (2008, p. 52) view of 'a paradox in our relationship with wildlife—we want to be both close and distant'.

4.3 | Toolkit for coexistence with urban wildlife

Several tools to improve human-wildlife coexistence were highlighted in our interviews. First, public outreach, including environmental education and awareness raising, was seen as a key point to reduce conflicts, showing citizens 'what an animal is and how to deal with it' (N_7) and 'how they tick' (B_1). This aligns with Messmer's (2000) view that a broader understanding of wildlife behaviour is needed to avoid conflicts (e.g. C_8 'The problem is the lack of knowledge'; B_8 'I can only accept something and also tolerate and protect it, if I know it.'). Knowledge and attitude are believed to be connected (Pohl, 2003), as the natural historian David Attenborough underlined: 'No one will protect what they don't care about; and no one will care about what they have never experienced' (Williams, 2013). Species knowledge in schools has declined (Gerl et al., 2018), which could result in seeing species as pests and not as an opportunity to connect with nature (Soulsbury & White, 2015). Therefore, education about species is essential to reduce conflicts, and an effective approach is to participate in conservation initiatives, such as wildlife gardening or biological recording (Hobbs & White, 2016).

A second key tool is urban planning, especially to attract certain species while deterring others by the design of spaces. Although architects consider integrating wildlife into new buildings (Jakoby et al., 2019) and animal-aided design (Hauck et al., 2021; Weisser & Hauck, 2017) was mentioned in the interviews, this has not yet been a priority. Similarly, to Apfelbeck et al. (2020) and Houston et al. (2017), the interviewees stated that to promote wildlife in cities, existing UGS need to be enhanced, new habitat created and animals explicitly included in urban planning. A good example is Berlin's *Gleisdreieck*, which embraces urban wilderness (Kowarik et al., 2019) and showcases a deliberate blend of natural disorder within organized structures (Nassauer, 1995). This park is understood as an example of designing urban areas and wild spaces simultaneously, overcoming the separation of urbanity and wildlife (Metta & Olivetti, 2021). If future urban planning incorporates wildlife within its development, not only will wildlife have suitable habitat, but humans can use diverse UGS as refuge.

Third, controlling urban wildlife is another important 'part of this construction kit to solve conflicts' (N_3) and should be used mainly as a last resort (Dandy et al., 2011). Here, mainly wild boar, deer, coypus, raccoons and rabbits were highlighted in the interviews as targets for hunting, with cemeteries, city outskirts and urban forests identified as areas recommended for population control. Although hunting is restricted in cities, a third of all interviewees saw a necessity to use this management measure (Figure A3). Similarly to Dandy et al.'s (2011) findings that lethal management is accepted if other measures fail, N_3 stated: 'hunting down the individuals who have obviously rehashed or adopted these traditions of moving into the cities' can be seen as a last resort. However, the removal of specific individuals (e.g. a wolf that harmed a human) receives more public support (Whittaker et al., 2006).

Fourth, several interviewees found it crucial to have official contact points for wildlife-related questions. Of the four German cities, only Berlin has such contact points: a NABU hotline and an employed designated wildlife representative. Without receiving valid and objective information from contact points, prejudices and misconceptions about wildlife can be enhanced by print (Lunney & Moon, 2008) and social media (Lenzi et al., 2020). For example, though not urban wildlife, wolves were cited to stress that 'the wolf won't settle in [cities] at some point, although it is sometimes in the tabloids'. Similar to contact points are networks, which were highlighted by interviewees as well as by Magle et al. (2019). It was planned to establish such a 'round table for discussion' (C_7) in Berlin, but that failed because professionals were reluctant to join: they

feared an overflow of questions from the public and uneven division of tasks (S. Kimmig & S. Kiefer, personal communication 2022). Giving this task to a neutral player could help shape a better structure and make such round tables successful.

Fifth, restrictions and fines for citizens. Fines for inappropriate behaviour, including feeding wildlife, were highlighted as a potential tool in the interviews. There seems to be a vast gap between announcements of penalties for feeding wildlife and actually fining such behaviour. According to the German hunting law (BJagdG §28(5)), the prohibition of feeding wildlife is a state matter. However, only ducks, geese, swans, pigeons, and wild boars are listed in this regard (https://www.bussgeldkatalog.org/tiere-fuettern). Interviewee B_7 stated that this law is not executed accordingly: 'there are also penalties for this, but it is not carried out consistently' C_2 highlights the prohibitions listed in BJagdG §28(5), but sees that '[y]ou can only appeal to people's common sense.' However, the behavioural effect of penalties in general is seen as limited (Coca-Vila, 2022). Although humans often connect with nature through wildlife feeding (Cox & Gaston, 2018; Soga & Gaston, 2020), this approach presents both advantages and disadvantages. Benefits include enhanced enjoyment of wildlife, improved mental health and increased engagement with nature. However, it can also lead to human-wildlife conflict if undesirable species are attracted, increased risk of predation from both natural predators and domestic pets, and potential issues such as dependency, poor nutrition and changes in blood chemistry for wildlife (Shutt & Lees, 2021). In terms of potentially dangerous wildlife, we follow the recommendation by Dubois and Fraser (2013) and see a need to strengthen public outreach and help people better understand the consequences of punishable actions like wildlife feeding.

The different tools highlighted by experts seem immensely useful. However, a clear structure and sustainable strategies for the coexistence of urban wildlife is currently lacking in Germany and most other countries.

4.4 | Limitations

The methodological framework employed in this study exhibited limitations that warrant careful consideration. First, while our goal was to have comparable interview partners from similar organizations, this was not always possible. For example, because conservation NGOs have different jurisdictions (NGOs in Berlin and Hamburg are acting for a federal state, while those in Munich and Cologne act for the municipality), their tasks and staff are organized differently. Second, more experts in nature conservation (15) were interviewed than in hunting (10) and administration (8), because cities in Germany have relatively few administrative experts and more organizations focusing on nature conservation than hunting. Our results did not support the assumption that conservation NGOs would put species in a rather positive light. Third, experts currently based in a given city could have been influenced by their time spent in another city or could be interested in certain species. Such personal biases or interests of interviewees are generally hard to avoid. We have no indication that they systematically affected our results. To mitigate the resulting biases in the study's findings on focal species, their impacts and suggested management, researchers could expand the study to include a larger set of cities to ascertain which professionals are primarily responsible for conservation efforts in various regions.

5 | CONCLUSIONS

We found that while positive aspects of urban mammals were attributed to wildlife in general, negative aspects were related to certain species. The *frequent five* were particularly highlighted by experts: foxes, wild boars, martens, raccoons and beavers. Based on the results of our interviews, a toolkit of urban wildlife management emerged consisting of public outreach, including environmental education and awareness raising; integration of wildlife into urban planning and governance; contact points providing advice to citizens; stricter enforcement of rules; and hunting as a last resort. An important next step will be to use these tools to develop clear and coherent management plans for urban wildlife in cities and to test their effectiveness.

AUTHOR CONTRIBUTIONS

Simon S. Moesch, Jonathan M. Jeschke, Tanja M. Straka, Stefanie Kramer-Schadt and Dagmar Haase conceived the study. Expert interviews were recorded, transcribed and analysed by Simon S. Moesch. All authors provided valuable input to the development of the final manuscript and have given approval for publication.

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The authors declare no competing interests.

DATA AVAILABILITY STATEMENT

The interview data used in this article cannot be made publicly available due to privacy protection considerations.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Figure A1. Maps of German cities above one million inhabitants: Berlin, Hamburg, Munich, and Cologne.

Figure A2. Mammals mentioned by interview partners.

Figure A3. Mentioning of hunting as necessary management measure per interview set.

Table A1. Selected mammals potentially occurring in a German city.

Table A2. Questions asked during the interviews (original German phrasing and English translations).

Table A4. Example quotes in German with English translations and codes.

Table A5. Positive impact categories.

Table A6. Negative impact categories.

Table A7. How the different types of impact were mentioned in all interviews and per set, in total numbers and percent.

Table A8. How the different types of impact were connected to the different mammal species in the interviews, in total numbers and percent.

Table A9. Ideas regarding urban and urban greenspace planning (UGS, Urban green spaces).

Table A10. Management measures mentioned in all interviews and per set, in total numbers and percent.

Table A11. How the management measures were connected to the different mammal species, in total numbers and percent.

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