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RESEARCH PAPER

Welcome for thee, but not for me: How demographic parameters and nature experience affect how close to home people accept animals

Fabio S.T. Sweet *, Wolfgang W. Weisser

Terrestrial Ecology Research Group, School of Life Sciences Weihenstephan, Technical University of Munich, Freising, Germany

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ABSTRACT

Animals are a constant presence in urban environments. While there is a handful of studies that have addressed which urban animals people like, there is little knowledge on where in cities people accept animals in relation to their homes. A preceding study by the authors indicated that Munich residents' preferred proximity to animals is influenced by their attitudes towards these animals. Here, we go a step further and analyse how human demographic parameters and experience with animals influence people's decision on where to place animals.

We used data on demographics, experiences, and attitudes to test how these factors influence how close to their home people accepted different animals – in the form of the closest relational scale chosen for the animals. A multigroup structural equation model with attitudes towards the animals as a mediator and the animals as grouping variables was used to disentangle the effects of different variables for placement, and to compare different animals. Variable selection and path constraint were done using PiecewiseSEM, and final estimates were produced with Lavaan.

We found that different demographics and experiences are associated with accepting animals closer to home or further away. People who liked animals more, had higher levels of education, stated that they enjoy spending time in nature more, or help animals in their environment, generally accepted most animals closer to their home. In contrast, people who live in a house instead of an apartment generally wanted most animals further away from home.

Our results emphasise that people have a differentiated view of animals that is influenced by both internal and external factors. Taking this into account can help identify reasons for the acceptance or rejection of an animal in urban environments, help guide urban conservation projects, and mediate human-wildlife conflicts.

Introduction

The majority of the global population now lives in cities (United Nations, Department of Economic & Social Affairs, Population Division, 2019) and we need to prepare our cities for the future, as it is imperative to design our cities in a healthier, just, and more sustainable manner. This leads to a movement towards healthier and more biodiverse cities, and as an ambitious step towards this, the *Sustainable Urban Resilience for the next Generation (SURGe)* initiative was launched at the *2022 Conference of the Parties of the UNFCCC* with the objective to '… enhance and accelerate local and urban climate action…' (COP27, 2022).

With this in mind, urban inhabitants' attitudes towards and perception of nature in their cities will become increasingly relevant. Urban greening has the potential to improve the lives of people living in cities (Sandifer et al., 2015), but without their approval, the longevity and odds of success of these projects are strongly diminished. Additionally, in order to create more biodiverse and resilient cities, not only plants but also animals will be integral to their design (Apfelbeck et al., 2020). It is thus important to consider what the people in cities think about these elements, and how they experience the nature around them.

While increasing numbers of studies investigate why people like or dislike nature or certain aspects of nature, many studies still often lack specificity. With respect to animals in cities, studies on attitudes towards 'wildlife' (that includes animals) or 'animals' are relatively common, however, what *kind* of nature or *which* animals are being considered is also of importance. People have very differing views of different animals in their cities (Sweet et al., 2023, 2024). As a consequence, the question 'Do you like animals' might elicit a positive response, while the question of whether people like specific animals might elicit very different responses (e.g., Bjerke & Østdahl, 2004; Rupprecht, 2017; Schmack et al.,

* Corresponding author.
E-mail address: Fabio.sweet@tum.de (F.S.T. Sweet).

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2024; Sweet et al., 2023, 2024). For example, animals considered to be pests, such as rats, generally elicit negative responses, while organisms such as squirrels elicit positive responses (Sweet et al., 2024) . Thus, when people are simply asked about "animals", their answer will depend on what animals they have in their mind. In addition, attitudes toward animals have been shown to be influenced by gender (e.g., Bjerke et al., 1998; Kellert & Berry, 1987; Muslim et al., 2018; Ngo et al., 2022), age group (e.g., Kellert, 1985; Muslim et al., 2018; Ngo et al., 2022), experience with nature (e.g., Hosaka et al., 2017; Moesch et al., 2024; Muslim et al., 2018; Ngo et al., 2022), and cultural background (e.g., Kellert, 1993; Muslim et al., 2018; Ngo et al., 2022; Rupprecht, 2017). In a notable recent study, Moesch et al. (2024) investigated more in-depth how different socio-demographic factors affect preferences toward animals, in this case mammals, but studies of the sort are still relatively rare. These studies, however, generally indicate that people's demographics and experiences with nature can affect their attitudes toward and willingness to coexist with animals in a variety of ways.

In a preceding study (Sweet et al., 2024), we conducted a survey to investigate where in the city people in Munich wanted animals to be in relation to their homes, and how that related to how much they liked them. Our results indicated that people rather placed animals further away than close to their home. Additionally, the preferred locations differed per animal, and people placed animals closer to home if they liked them more.

Here, we extend that study to investigate how self-reported experiences with nature, as well as a number of demographic parameters, affect where people would like animals to occur. Instead of considering in which area people want the animals to be, here, we look at how demography (e.g., gender, and age), experience with nature (e.g., whether they had seen an animal in their neighbourhood), and the interaction of these parameters with attitudes, affect how far from their home people want animals to be. The specific question that we addressed was as follows: how do demography and experiences with nature – via attitude as a mediator – affect the closest relational scale where people would place the animals? We expected that the demographics of the participants and their experiences with nature would affect both the attitudes toward specific animals and the closest relational scale where they would place the animal. Because findings in previous studies indicated that different participant demographics and experiences with nature can have different effects on attitudes and willingness to coexist with animals, we expected the same to be the case in this study, while showing differences between animal species. Considering the findings in Sweet et al., 2024, we also expected that attitudes toward the animals would mediate the effect of demographics and experiences on the closest relational scale where people place the animals.

Methods

Survey

This study uses unexplored data from the same survey used in Sweet et al., 2024. Shortly, a structured survey was conducted from 14.06.2021 to 11.07.2021 in Munich, Germany, with questions regarding people's attitudes towards animals, general demographics of participants, and experiences with regard to wildlife in their city. Flyers in which the goal of the survey was briefly described (Sweet et al., 2024, APPENDIX) were distributed to residencies around 40 squares in Munich, and the residents could participate in the survey through an online questionnaire linked in the flyer through a web-address and QR-code. The survey was conducted in German. The questionnaire was composed as described in Sweet et al., 2024 [Questionnaires], and the demographics of respondents were recorded and compared to the general population of Munich (Sweet et al., 2024).

In this study, we focus on the same animals as Sweet et al., 2024, since this study is based on the same survey. We selected 32 animal 'species' that are known to most people because they are common in German cities, and based on familiarity and attitude responses from prior research (Sweet et al., 2023). Because taxa are not equally distinguishable for non-experts due to similarity or small size, the taxonomic level varied across the named animals, from species (e.g. squirrel) to order (e.g., dragonfly). For the sake of consistency and conciseness, however, these will still be referred to as "species". The species groups included nine arthropods (wasp, spider, ladybug, firefly, dragonfly, cricket, cockroach, bumblebee, ant), eight birds (woodpecker, tit, stork, owl, duck, crow, common kestrel, city pigeon), three reptiles/ amphibians (snake, lizard, frog), 10 mammals (squirrel, rat, rabbit, mouse, mole, marten, housecat, hedgehog, fox, beaver), and two gastropods (snail, slug).

The questionnaire had four main types of questions that are relevant to this study (*Appendix_Questionnaire*): [1] basic and relevant demographics, [2] questions on the participants' general relationship and experiences with regard to nature and animals, [3] questions on the attitude towards a number of different animals on a five-point Likert scale, [4] questions on where the respondents wanted different animals to occur, along a relational proximity gradient. All variables used in the analysis are listed in Table 1.

An example of one of these questions was whether people had a "balcony", "garden", and/or "allotment garden", in which we left the strict definition of either to the discretion of the survey participant. Generally, the garden in this sense and the balcony are attached to the house where people live, whereas allotments are separate from the main residence.

Here, we focused on the closest accepted relational scale. The relational scale was defined in Sweet et al. (2024) as a proximity scaling method based on place attachment and values, rather than only physical distance. In this relational scale, the closest level is the "Homezone", which includes people's homes, garden, and balcony. The second level is the "Neighbourhood scale", which includes the people's neighbourhood and the city park. The third level was the "City-wide" scale, which included all the built-up area in the city and the surroundings of the city. Additionally, people could indicate "Nowhere", which was here treated as the fourth and furthest away scale, if they did not want an animal to be present anywhere, including outside of the city. We decided on the closest accepted relational scale because the preceding study found that if people accepted an animal close by, they would also generally accept the animals further away.

Analysis

About structural equation models (SEMs)

We used Structural Equation Models (SEM) to analyse the data and to be able to consider both the direct and indirect effects of demography and experiences on the closest scale people place the animals at, with their attitudes towards them as a mediator (*Appendix 1*). More specifically, in this study, these take the form of mediation analyses. SEMs use a "system of linked regression-style equations to capture complex and dynamic relationships within a web of observed and unobserved variables" (Gunzler et al., 2013: p. 390). In the language of linear models, SEMs are similar to interconnected regressions, in which a response variable in one model could also be a dependent variable in another – such a variable would be the mediator in mediation analyses. With the relatively recent development of multigroup analyses in piecewiseSEM (Douma & Shipley, 2021; Lefcheck, 2016), it has become feasible to conduct such analyses on many groups (in our case, read: animals) instead of only a few.

There are multiple ways to construct SEMs. In this study, the final SEM was constructed using both *piecewiseSEM* and *Lavaan* (Rosseel, 2012), because of both their strengths: for multigroup analyses, such as done with the animals in this study, piecewiseSEM automatically tests and constrains paths within the global (across-group) model. Constrained paths are paths in the model in which there is no significant

Table 1
List of variables used in the final analysis, after variable selection using piecewiseSEM. Variable names, definitions, and grouping are shown, as well as what the original answers were and how they were re-scaled to be used in the SEMs.

Variable	Variable definition	Grouping	Original answers	Scaling
Mediator				
Attitude	Self-reported liking of the animal in question	–	Not at all; Neutral; A lot	1–5
Endogenous variable				
Placement	Scale closest to home where people place the animal in question	–	Homezone; Neighbourhood scale; City-wide scale; Nowhere	1–4
Grouping variable				
Animal	Animal	–	Names of animals	–
Exogenous variables| Participant characteristics				
Age	Age of participant at time of survey participation	Demographics	**Number**,[1]	0–1
Gender	Self-reported gender at time of survey participation		Female; Male	0–1
Typeofhousing	Whether the participant lives in an apartment or house at time of survey participation		Apartment; House	0–1
Garden	Having a garden at time of survey participation		No; Yes	0–1
Allotment garden	Having an allotment garden at time of survey participation		No; Yes	0–1
Education	Highest level of education enjoyed at time of survey participation		None; High School; Mid-level; Abitur (A-levels); Finished apprenticeship; Finished studies	0–1
Seen	Whether the participant has seen the animal in question in their neighbourhood	Nature experiences	No; Yes	0–1
Number seen	Number of unique animal species from the survey seen by participant in their neighbourhood		0–32	0–1
Want more	Whether the participant wants more animals in their neighbourhood		No; Yes	0–1
Helps wildlife	Whether the participants help wildlife in their neighbourhood		No; Yes	0–1
Enjoyment nature	How much the participant enjoys spending time in nature		Not at all; Neutral; A lot	0–1
Bad experiences	Whether the participant had a bad experience with animals in the past		No; Yes	0–1
Pets	Whether the participant has a pet		No; Yes	0–1

[1] Age of participant in years at the time of survey administration.

difference in estimate between the different groups of the multigroup analysis, and thus, the estimate for that path is kept constant across groups. The opposite of those are unconstrained paths, where the estimates are allowed to vary across groups. Doing this would be a long manual task in Lavaan. On the other side, Lavaan has the benefit that estimates from individual paths in the SEM, as well as direct (*Appendix 1: c*), indirect (*Appendix 1: a*b*), and total effects (*Appendix 1: a*b + c*), can more easily be extracted from Lavaan.

Data preparation

The mean attitude score for each animal was calculated. Variables that were on an increasing scale (e.g., how much they enjoy spending time in nature: not at all - a lot) were coded as ordinal variables and scaled from 0 to 1; age was divided by 100 to scale the values between 0 and 1; the number of animals of the questionnaire that people had seen in their neighbourhood was scaled from 0-1 by dividing the number of animals from the survey they had seen in their neighbourhood by the maximum number of animals from the survey that people could indicate having seen in their neighbourhood, namely 32; and questions with binary responses were coded as 0 and 1. Attitude values and relational scales were coded as ordinal variables but not scaled from 0 to 1, as they are the response variables of the main exogenous variables (participant characteristics).

At the end of the survey period, 305 people had completed the questionnaire. Of these 305 people, 126 identified as male, 175 identified as female, and 4 identified differently. Because the sample size of participants who identified differently was too low for statistical analyses, we did not include these participants in the final analysis, setting our final sample size to 301 participants. Variables considered before backward variable selection and the number of people with corresponding characteristics can be found in *Appendix 2 and Appendix 3,* respectively.

SEM analysis

A multigroup PiecewiseSEM (Douma & Shipley, 2021; Lefcheck, 2016) analysis was run with the closest relational scale where people would accept the animal as the response variable, attitude values toward the animal as a mediator, and the animals as the grouping variable (*Appendix 1*). PiecewiseSEM constrained paths across the animals (as the grouping variable) based on ANOVA's; if a certain characteristic of the participants did not significantly differ in effect on the attitude value or placement between animals, the respective path was constrained to a global model, i.e. there was a fixed estimate for the path across all animals. Constrained paths that did not significantly affect the attitude value or placement of the animal were removed from the analyses through backward selection, and the model with no more non-significant constrained paths was kept for further analysis. This was also the model with the lowest AIC value. The backward selection procedure resulted in the directed acyclic graph (DAG) outlined in Fig. 1, and characteristics kept in the analysis were grouped into 'demographics', 'experience', and 'attitude' (Table 1). In order to obtain the

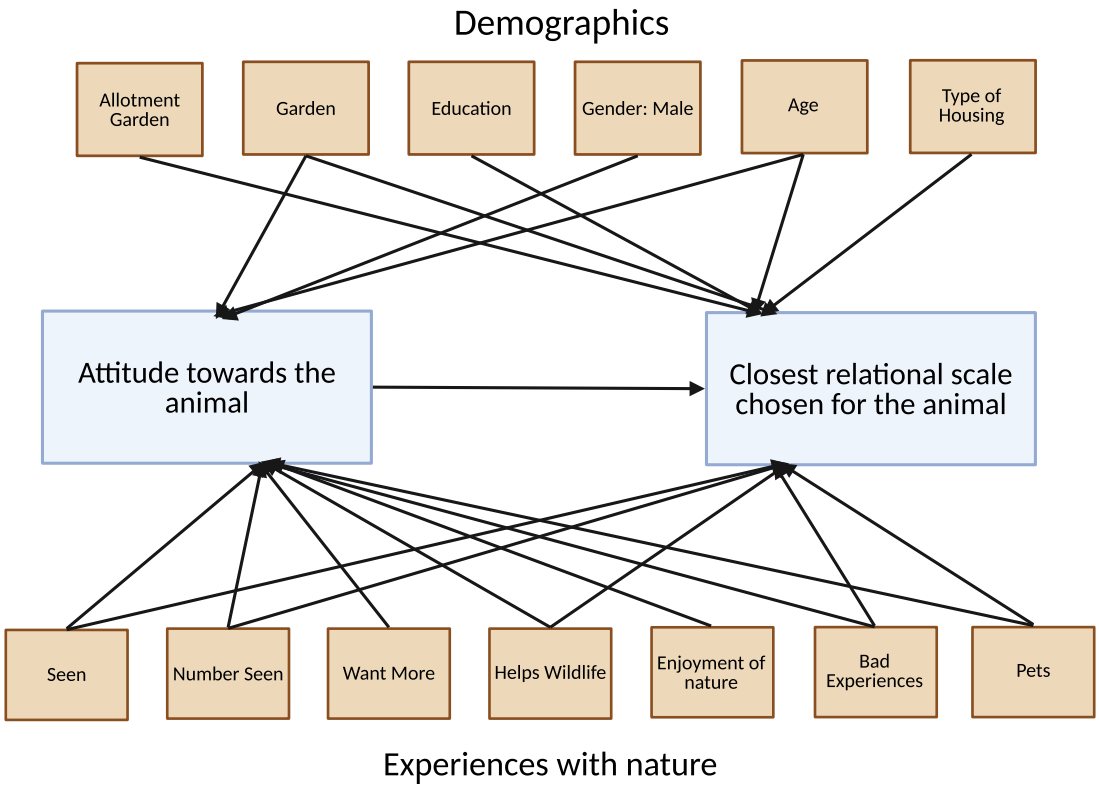

Fig. 1. Directed Acyclic Graph (DAG) resulting from the backward selection of variables in the SEM with PiecewiseSEM. This DAG was used for further analysis. Image created in BioRender. Sweet (2025) https://BioRender.com/z87a297.

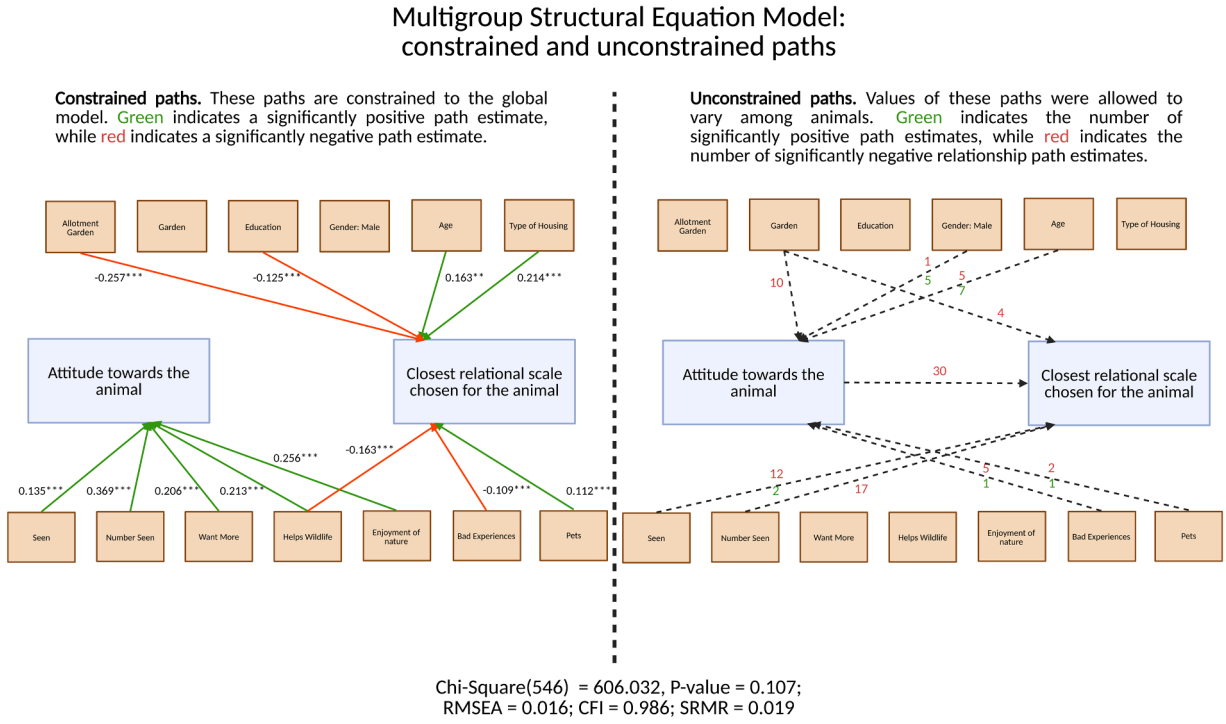

Fig. 2. Multigroup structural equation model used for analyses. Model selection was executed by backward variable selection using PiecewiseSEM. The model was then run with Lavaan for the final estimates. Left: constrained paths and estimated effects of variables with constrained paths on the values of either the attitudes toward the animals or the closest relational scale chosen for the animals. Right: unconstrained paths and number of animals for which there was a significant positive or negative estimate. Image created in BioRender. Sweet (2025) https://BioRender.com/x89c739.

direct and indirect effect of the participants' characteristics on how close to home people wanted these animals to be, the model was rewritten in Lavaan (Rosseel, 2012), since PiecewiseSEM lacked the functionality to extract direct and indirect effects of predictors on the response variable at the time of writing.

Significant direct, indirect, and total effects of participants' characteristics on the closest relational scale that people place an animal were visualized using ggplot (Wickham, 2016). One-sample *t*-tests were used to compare the predictor estimates across animals, i.e. using the total effect ($a^*b + c$) estimates of participants' characteristics on placement as data points, to test for directionality of predictors.

The overall fit of the models was determined with the Chi-Square, RMSEA, CFI, and SRMR.

Results

Model diagnostics indicated a good model fit with Chi-Square ($\chi^2(546) = 606.032$, $p = 0.107$), RMSEA (0.016), CFI (0.986), and SRMR (0.019) (Fig. 2). R-square values of the sub-models for attitudes toward the animals and the closest relational scale chosen for the animals can be found in *Appendix 4*. When reporting the effects of participant characteristics on the closest scale that people place animals, the total effects are discussed in the main text of this manuscript, and direct and indirect effects are presented in *Appendix 5*.

Paths with consistent values across animals (constrained paths)

Twelve paths were constrained to the global model, i.e., their estimates were consistent across all the animals in this study (Fig. 2*: left)*.

With regard to demographics, participants who did allotment gardening or had finished a higher level of education placed the animals closer to their homes, while older participants and participants who lived in a house instead of an apartment placed the animals further away from their homes.

With regard to experiences with nature, participants who had bad experiences with animals in the past placed the animals in the survey closer to their homes, while people with pets placed them further away from their homes. Participants who indicated that they help wildlife in their neighbourhood both placed animals closer to their homes and had a more positive attitude towards the animals in the survey. Finally, participants who had seen specific animals in their neighbourhood, who had seen more animals in their neighbourhood, who indicated that they wanted more animals in their neighbourhood, and who enjoyed time in nature more had more positive attitudes toward the animals in this survey.

Paths with animal-specific values (unconstrained paths)

Nine paths were left unconstrained to the global model, i.e., free to fluctuate in value between animals (Fig. 2*: right)*. This indicates that the paths have a significant effect for at least one of the animals.

With regard to demographics, the only unconstrained path leading into the closest relational scale where people placed the animal was having a garden, while having a garden, gender, and age could affect attitudes toward the animals.

With regard to experiences with nature, the unconstrained paths leading into the closest relational scale where people placed the animals were having seen specific animals and how many of the animals participants had seen, while having had bad experiences with animals and having pets could affect attitudes toward the animals.

The path from attitudes toward the animals to the closest relational scale where people placed the animals was also not constrained to the global model.

The effect of demographics on the placement of animals: constrained and unconstrained paths

All three characteristics where the total effect was constrained to the global model, i.e., the total effect did not significantly differ between the animals, were demographic characteristics (Fig. 3 *and* Fig. 4). The reason for this is that these were not mediated by attitudes toward the animals: the paths leading into the indirect effects were non-significant and constrained to the global model, and thus removed from the SEM. These characteristics were 1) Allotment garden, 2) Education, and 3) Type of housing. People who had an allotment garden and people who had finished a higher education level placed animals closer to their home, while people whose type of housing was a house rather than an apartment placed animals further away.

The total effect of the other three demographic characteristics varied between animals (unconstrained paths). Variables with unconstrained paths can both positively and negatively affect preferred proximity of specific animals to people's homes. Because of that, we chose for a [#+|#±|#-] approach in reporting the result, where [#+] indicates the number of animals for which a variable significantly leads to people wanting them closer to their homes, [#-] indicates the number of animals for which a variable significantly leads to people wanting them further from their homes, and [#±] indicates the number of animals for which the variable had no significant effect. For example, since having a

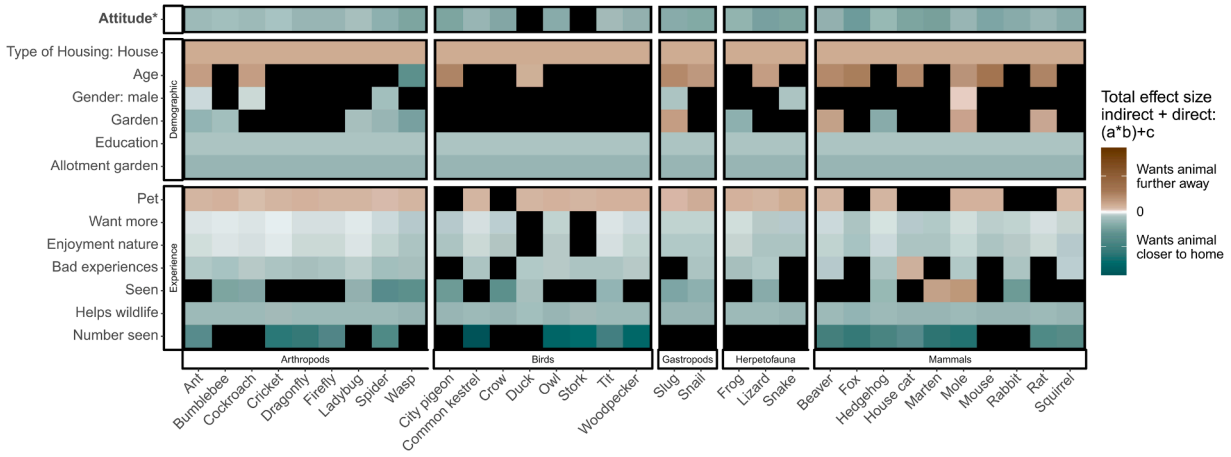

Fig. 3. Total effect of the model predictors on the closest scale that people choose for the animals. Animals are on the x-axis, and the predictors are on the y-axis. Green tiles indicate that the predictor on the x-axis is associated with people choosing a closer scale for the animals on the y-axis, while brown tiles indicate that they are associated with people choosing a further scale for the animals on the y-axis. Black tiles indicate no significant effect with $p < 0.05$. For direct and indirect effects of participant characteristics on how close people place the animals, see Appendix 5.

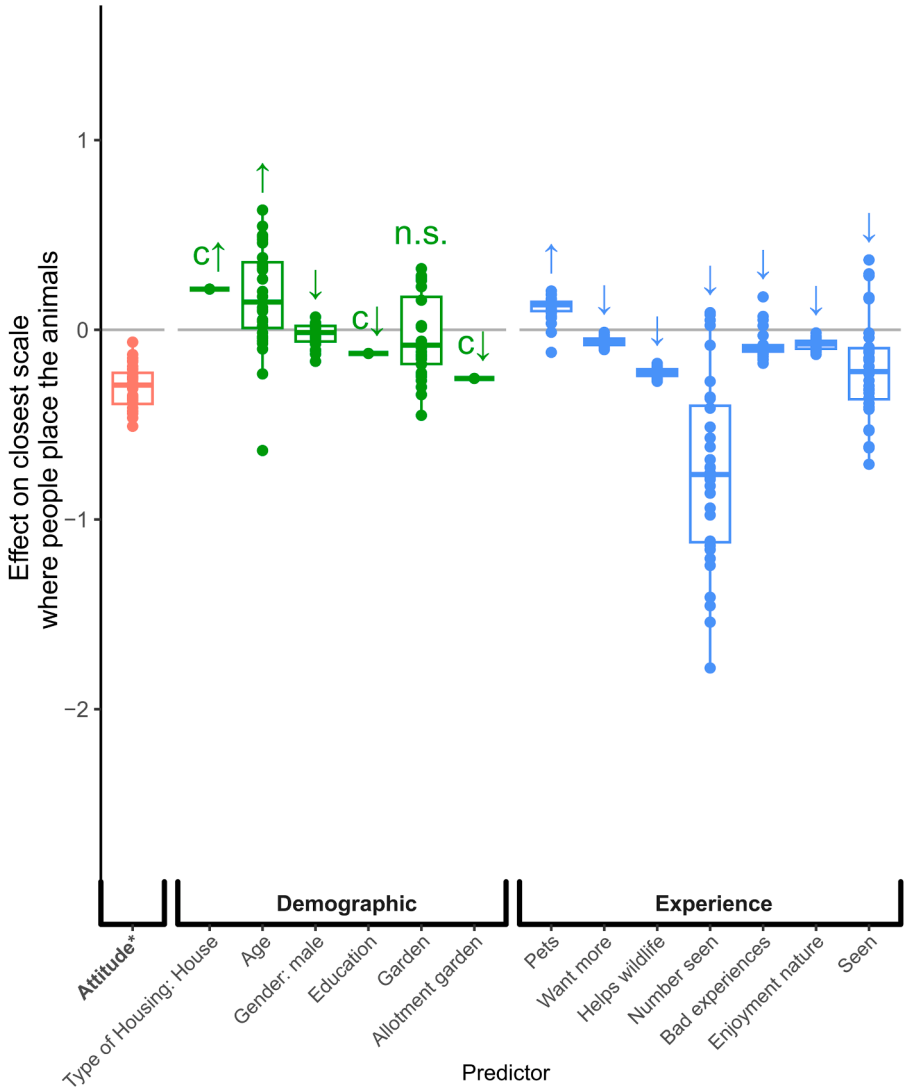

Fig. 4. Boxplots of mean estimated total effects of attitudes, demographics, and nature experiences on the closest scale that people place the animals on. The red boxplot relates to attitudes toward the animals, the green boxplots relate to demographics, and the blue boxplots relate to participants' nature experiences. Each point is the estimated mean effect for an animal. Arrows pointing upwards indicate that people with that characteristic tend to place the animals further away, and arrows pointing downwards indicate that people with that characteristic tend to place the animals closer to their home, based on one-sample *t*-tests of the SEM against 'no general effect', $\mu = 0$, $p < 0.05$. Predictors with 'c' indicate constant values, i.e., estimates that were constrained to the global model in the structural equation model.

garden caused people to want 7 of the animals significantly closer to their homes, 4 animals significantly further away, and did not significantly affect the preferred proximity for 19 of the animals, the notation is [7+|19±|4-]. We use this notation in the following sections.

For most animals, Garden [7+|19±|4-], Gender (Male) [5+|26±|1-], and Age [1+|18±|13-] did not significantly influence the placement distance, and when they did, it could be both positive and negative, dependent on the animal. When the effects of these characteristics were considered across species, i.e., the averages of the total effects for each animal, however, a higher Age was associated with placing the animals further away, while identifying as male was associated with placing the animals closer to home, and having a garden did not significantly skew towards either direction.

The effect of experiences with nature on the placement of animals: unconstrained paths

The total effect of all experiences with nature varied between animals (unconstrained paths, Fig. 3 and Fig. 4). Having pets [0+|7±|25-] caused people to want most animals further away from their homes. Conversely, factors associated with wanting animals closer to home were wanting more animals in the neighbourhood [30+|2±|0-], greater enjoyment of nature [30+|2±|0-], bad experiences with animals [23+|8±|1-], helping wildlife in the neighbourhood [32+|0±|0-], and a higher number of the animals seen in the neighbourhood [18+|14±|0-]. For the majority of animals in this study, having seen that specific animal in the neighbourhood [14+|16±|2-] did not significantly influence how close or far away people wanted this animal. However, for those animals where having seen the specific animal in the neighbourhood had a significant effect on how close to home people wanted them, it mostly caused people to want the animals closer to their homes. There are two notable exceptions, where having seen the animals caused people to want them further away: martens, and moles. In addition, even though for most species in this study, having seen that specific species in the neighbourhood did not significantly affect how close or far away people wanted it to be, across species, i.e., when the averages of the total effect for each were considered together, having seen the specific animal in the neighbourhood was associated with placing it closer to home.

Discussion

In this study, we found that different characteristics of people, including their experience with nature, affected how close people want animals to be to their houses, dependent on the animals. For some variables, such as the housing that people lived in, education, and having an allotment garden, the effect of this variable was constant, meaning it did not differ significantly among animals. For example, people who lived in a house instead of an apartment preferred to have animals further away from their homes, and people who enjoyed a higher level of education or that have an allotment garden preferred animals closer to their homes. In the case of the other variables, the effect of participants' characteristics was dependent on the animal in question, both positively and negatively. For example, people with a garden preferred wasps closer by, and slugs further away from their homes, than people without a garden.

Demographics

In this study, demographic characteristics had a number of consequences for participants' preferred proximity to the different animals. Similar to Ngo et al.'s 2022 study in Singapore, we found that higher formal education was positively associated with tolerance of wildlife. However, we did not find the strong differences in how much people of different genders liked different (groups of) animals that Ngo et al. did. We rather found that overall, in Munich there were very few differences in how much people of different genders liked the animals. This corresponds with rather small differences in the proximity that participants of different genders wanted for the animals, conversely to what Muslim et al. 2018 found.

Preceding research has indicated various different patterns related to age. Some studies have found that age is positively associated with attitudes toward animals, but not for so-called 'unfavourable' animals, i.e., animals that are generally disliked and for whom willingness to coexist is low (Kellert, 1985; Muslim et al., 2018); others find that the effect is dependent on the animal (groups) in question (Moesch et al., 2024; Ngo et al., 2022). In our study, the effect of increasing age on attitudes toward animals in Munich varied per animal. How close to their homes people placed the animals was a mix of a generally negative direct effect of age for all animals and the varying attitudes toward the animals functioning as modifiers, which leads to per-animal differences in how close to home people placed the animals (see *Appendix 5*). I.e., the results indicate that the effect of age on willingness to coexist with different animals is dependent on the animal. For example, while the direct effect of age on the placement of wasps and foxes was to place both a bit further away, the indirect effect through attitudes leads to the total effect of placing wasps closer to home, and foxes even further away.

Although the type of housing was not considered as a factor in other studies investigating willingness to coexist with animals, we found this variable to be relevant in our study. In our study, we found that people who lived in a house preferred animals further away than people who lived in an apartment. The type of dwelling that people inhabit in Munich relates to factors like place in the city, household income, and available space, as 'houses (Haus)' are commonly more expensive and provide more space than 'apartments (Wohnung)'. Living in a house or apartment can, in that sense, be seen as a proxy for wealth disparities. On top of that, houses often come with an attached garden, and with that an increased potential for human-wildlife conflict.

In our study, having a garden was mostly not significantly associated with placing animals closer or further away. Only for a smaller number of animals, having a garden was associated with placing them closer (i.e., ants, bumblebees, ladybugs, spiders, wasps, frogs, and hedgehogs) or further away (i.e., slugs, beavers, moles, and rats). However, participating in allotment gardening was universally associated with placing the animals closer to home. It is important to note, however, that only five participants indicated having an allotment garden. Similarly to the mammals in Moesch et al., 2024, known garden pests such as martens and rats were preferred further away, while better-liked animals like hedgehogs were preferred closer to home if people had a garden. In addition, slugs, also a known pest (Brace et al., 2020), were placed further away, while ants, bumblebees, ladybugs, spiders, and wasps, i.e., common garden arthropods, were preferred closer to home by people who had a garden. These findings indicate that private gardens can be a source of potential conflict, but that they could also be a place where appreciation for wildlife, especially arthropods, could be fostered, and participating in allotment gardening could lead to more biophilic attitudes.

Experience with nature

All of the experiences with nature included in our questionnaire led people to want animals closer to home, with the exception of having pets. This coincides with the idea that people who have more nature experiences tend to be more biophilic (e.g., Hosaka et al., 2017; Soga et al., 2016). Having experiences with nature could make people less aversive to sharing space with wildlife (e.g., partially in Ngo et al., 2022), however Muslim et al., 2018 found only an indirect effect through attitudes towards animals, not a direct effect as we found with some of the characteristics. Characteristics related to some form of biophilia, such as helping local wildlife, enjoying time in nature more, and wanting more animals in the neighbourhood, were associated with, on average, wanting the animals closer to home, indicating that biophilic behaviour is also associated with a higher acceptance of sharing spaces with the animals.

The finding that people with pets generally prefer wildlife to be further away could relate to perceived potential dangers for the pet (e.g., King & Tsigaris, 2024; Sponarski et al., 2018), bringing into consideration the different societal positions between domestic and wild animals. While it has been reported that children with pets had a more positive attitude toward wildlife (Bjerke et al., 2003; Prokop & Tunnicliffe, 2010), we mostly found no effect of that, or in two cases, even an inverse effect. While there are some studies on the effect of owning a pet on attitudes toward animals, little research has been done yet on pet-owners' willingness to coexist with (non-predatory) wildlife. The finding in this study that owning a pet generally leads to wanting wildlife to be further away – largely independent of their attitudes toward the animals – indicates that there could be other factors at play, such as the abovementioned concern for the well-being of their pets, that more strongly affect willingness to coexist with wildlife than purely attitudes.

We also found that people who had negative experiences with animals were often willing to place animals closer to their homes than people who have not had negative experiences with animals, with the notable exception of housecats. This is partially because of the nature of the question, wherein we asked whether people have had negative experiences with 'animals', not with 'wildlife'. Participants could voluntarily indicate which animals they have had negative experiences with in a separate open field, and many indicated that they had negative experiences with cats and dogs – generally other people's pets – and not that often with wildlife.

Finally, having seen a certain animal in the neighbourhood and having seen more different species of animals in the neighbourhood were associated with wanting the animals on a closer relational scale, indicating that certain forms of direct experiences with wildlife can be associated with accepting animals closer to home. This went both through an indirect effect through attitudes, similar to Muslim et al., 2018, and in the case of part of the animals in the questionnaire, also through a direct effect on the closest relational scale that participants placed the animals on. Notable negative exceptions were martens and moles, commonly associated with damage to cars (Herr et al., 2009) and damage to farms and gardens, respectively (Baker et al., 2016).

The importance of considering different animals

Questions about general attitudes about 'animals' or clusters of animals in broad groups are important and useful in their own right, as exemplified by how socio-demographics can affect willingness to coexist with clusters of favourably or unfavourably judged animals (Muslim et al., 2018; Ngo et al., 2022). We argue, however, that it is also important to distinguish between different animal species and consider attitudes toward them individually. Animals differ from each other in form and behaviour, and, as a consequence, human relationships with, experiences with, and attitudes towards different animals can differ. The specific factors affecting attitudes toward these animals are lost when they are not considered individually. Examples of this are how negative experiences with animals in Munich lead to specifically housecats being wanted further away because they are, together with dogs, the main source of negative experiences in cities; or how the only two animals that were wanted significantly further away if they were seen in the neighbourhood were martens and moles because they conflict with the car- and order-dominance of Bavaria; or how people with gardens specifically want the classical garden damagers further away and beneficial arthropods closer to home.

Not all wildlife is viewed equally, and there are myriad reasons for that. Being aware of these preferences for or dislikes of certain animals, with their own characteristics, given that inhabitants have certain characteristics, can bring us closer to successfully mitigating or solving human-wildlife conflicts that occur because of mismatches between human and animal characteristics. For example, the different effects on willingness to coexist with animals between having a garden attached to your building or an allotment garden suggest that the reasons for views of animals in these (physically) similar environments are different, potentially because of their difference in location, function, and meaning. Future research could try to investigate qualitatively what these differences in function and meaning are, and how they affect the differences in views on the animals. Additionally, since an increase in the number of animals seen in the neighbourhood was strongly associated with being placed closer to participants' homes for many animals, an argument can be made that making people more aware of biodiversity in the home neighbourhood can lead to a greater willingness to coexist with animals.

Caveats

In the question relating to whether people had a pet, they could indicate having any combination of a preset of pets presented, and if their pet was not in that list, they could add it in an open text field. We did not ask whether participants had outside or indoor pets, and although with some companion animals such as horses it's fair to assume that they are outside pets, we cannot know in how much, for example, people with cats let their cats roam outside, or whether people with Guinea pigs have an outside enclosure for their pets. Participants could indicate what kind of pets they have, but in the current analysis, we did not consider what kind of specific pets participants had, to not overcomplicate the current analysis and to not make assumptions about how the pets presented were kept.

The participant characteristics used in this study are not an exhaustive list of potential variables that affect animal placement by people in the city of Munich. It would be worth investigating in more detail what other variables affect the attitudes towards, and placement of animals in a city. Our study was conducted in a city, and it may be possible that in another region where the urban and social structures are different and where the relationships between people and animals are different, different preferences could be found – although there also seems to be some overlap with preceding literature. However, this study does indicate that with the different characteristics of participants, considering the specific animals instead of broad groupings or 'animals' or 'wildlife' as a broad term leads to more fine-grained insights into conditions for coexistence with wildlife in cities, and it is likely that this pattern would carry over to other study areas.

Conclusion

It is important to consider the views and diversity of inhabitants in a city when considering actions to promote wildlife in urban environments. Urban inhabitants have many different backgrounds and experiences with nature, which can influence how they view certain animals and their willingness to coexist with different animals. This study indicated the value of considering how these personal characteristics affect people's views on coexisting with different animals, and how varied the responses are when considering a wide variety of animals. Some characteristics, such as living in a house and not an apartment, are in this study consistently associated with wanting the animals further away from their homes, while conversely, characteristics like a higher finished education level are consistently associated with wanting the animals closer to home, and for experiences like having seen the animal in their neighbourhood, it depends on the animal in question whether they want it closer or further away from their home.

Human preferences for and against particular species will continue to shape urban areas. Knowledge on how these preferences for and against different animals are related to their acceptance in cities could be a valuable tool in the process of making cities more sustainable and biodiverse. A further step into this direction would be to associate the reasons for people's view on coexisting with animals on specific animal traits and bridge the gap between social characteristics and ecological traits of animals in cities. This way, we will not only have an insight into which animals people want to coexist with in their neighbourhoods, but also why, and what animal traits are associated with those views.

Institutional review board statement

Ethical approval was waived for this study by Ethikkommission der Technischen Universität München, code 2022–593-S-KH KH, on 17 November 2022.

Informed consent statement

To be able to participate with the survey, participants were required to sign an informed consent form at the beginning of the questionnaire.

Data

Data is available for import via:
Data: https://www.soscisurvey.de/Mensch_und_Tier/?act=IMi5eCZjVX4cyzkNtHRkbM40
R script: https://www.soscisurvey.de/Mensch_und_Tier/?act=IMi5eCZjVX4cyzkNtHRkbM40&rScrip

CRediT authorship contribution statement

Fabio S.T. Sweet: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Wolfgang W. Weisser:** Writing – original draft, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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References

Apfelbeck, B., Snep, R. P. H., Hauck, T. E., Ferguson, J., Holy, M., Jakoby, C., Scott MacIvor, J., Schär, L., Taylor, M., & Weisser, W. W. (2020). Designing wildlife-inclusive cities that support human-animal co-existence. *Landscape and Urban Planning, 200*, Article 103817. https://doi.org/10.1016/j.landurbplan.2020.103817

Baker, S. E., Ellwood, S. A., Johnson, P. J., & Macdonald, D. W. (2016). Moles and mole control on British farms, amenities and gardens after Strychnine withdrawal. *Animals, 6*(6). https://doi.org/10.3390/ani6060039. Article 6.

Bjerke, T., Ødegårdstuen, T. S., & Kaltenborn, B. P. (1998). Attitudes toward animals among Norwegian adolescents. *Anthrozoos, 11*(2), 79–86. https://doi.org/10.2752/089279398787000742

Bjerke, T., & Østdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoos, 17*(2), 109–129. https://doi.org/10.2752/089279304786991783

Bjerke, T., Østdahl, T., & Kleiven, J. (2003). Attitudes and activities related to urban wildlife: Pet owners and non-owners. *Anthrozoös, 16*(3), 252–262. https://doi.org/10.2752/089279303786992125

Brace, L. C., Gange, A. C., & Clover, G. R. G. (2020). What are the predominant pests and diseases afflicting gardens in the UK? *Urban Forestry & Urban Greening, 52*, Article 126706. https://doi.org/10.1016/j.ufug.2020.126706

COP27. (2022). *COP27 Presidency Sustainable Urban Resilience for the next generation (SURGe)* (p. 6). UN-Habitat and facilitated by ICLEI.

Douma, J. C., & Shipley, B. (2021). A multigroup extension to piecewise path analysis. *Ecosphere, 12*(5), Article e03502. https://doi.org/10.1002/ecs2.3502

Gunzler, D., Chen, T., Wu, P., & Zhang, H. (2013). Introduction to mediation analysis with structural equation modeling. *Shanghai Archives of Psychiatry, 25*(6), 390–394. https://doi.org/10.3969/j.issn.1002-0829.2013.06.009

Herr, J., Schley, L., & Roper, T. J. (2009). Stone martens (Martes foina) and cars: Investigation of a common human–wildlife conflict. *European Journal of Wildlife Research, 55*(5), 471–477. https://doi.org/10.1007/s10344-009-0263-6

Hosaka, T., Sugimoto, K., & Numata, S. (2017). Childhood experience of nature influences the willingness to coexist with biodiversity in cities. *Palgrave Communications, 3*(1), 1–8. https://doi.org/10.1057/palcomms.2017.71

Kellert, S. R. (1985). Attitudes toward animals: Age-related development among children. *Journal of Environmental Education, 16*(3), 29–39. https://doi.org/10.1080/00958964.1985.9942709

Kellert, S. R. (1993). Attitudes, knowledge, and behavior toward wildlife among the industrial superpowers: United States, Japan, and Germany. *Journal of Social Issues, 49*(1), 53–69. https://doi.org/10.1111/j.1540-4560.1993.tb00908.x

Kellert, S. R., & Berry, J. K. (1987). Attitudes, knowledge, and behaviors toward wildlife as affected by gender. *Wiley Wildlife Society, 15*(3), 363–371.

King, D. S., & Tsigaris, P. (2024). Risk perceptions about outdoor pet cats in a small City in the interior of British Columbia. *Pets Behaviour Science, 16*, 21–44. https://doi.org/10.21071/pbs.vi16.16724

Lefcheck, J. S. (2016). piecewiseSEM: Piecewise structural equation modelling in r for ecology, evolution, and systematics. *Methods in Ecology and Evolution, 7*(5), 573–579. https://doi.org/10.1111/2041-210X.12512

Moesch, S. S., Straka, T. M., Jeschke, J. M., Haase, D., & Kramer-Schadt, S. (2024). The good, the bad, and the unseen: Wild mammal encounters influence wildlife preferences of residents across socio-demographic gradients. *Ecology and Society, 29*(3). https://doi.org/10.5751/ES-15211-290306

Muslim, H. F. M., Tetsuro, H., Shinya, N., & Yahya, N. A. (2018). Nature experience promotes preference for and willingness to coexist with wild animals among urban and suburban residents in Malaysia. *Ecological Processes, 7*(18), 1–12. https://doi.org/10.1186/s13717-018-0127-7

Ngo, K. M., Hosaka, T., & Numata, S. (2022). Attitudes and preferences of wildlife and their relationship with childhood nature experience amongst residents in a tropical urban city. *Urban Ecosystems, 25*(6), 1939–1948. https://doi.org/10.1007/s11252-022-01280-1

Prokop, P., & Tunnicliffe, S. D. (2010). Effects of having pets at home on children's attitudes toward popular and unpopular animals. *Anthrozoos, 23*(1), 21–35. https://doi.org/10.2752/175303710X12627079939107

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*, 1–36. https://doi.org/10.18637/jss.v048.i02

Rupprecht, C. D. D. (2017). Ready for more-than-human? Measuring urban residents' willingness to coexist with animals. *Fennia, 195*(2), 142–160. https://doi.org/10.11143/fennia.64182

Sandifer, P. A., Sutton-Grier, A. E., & Ward, B. P. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem Services, 12*, 1–15. https://doi.org/10.1016/j.ecoser.2014.12.007

Schmack, J. M., Egerer, M., Karlebowski, S., Neumann, A. E., & Sturm, U. (2024). Overlooked and misunderstood: How urban community gardeners perceive social wasps and their ecosystem functions. *Journal of Insect Conservation*, 283–289. https://doi.org/10.1007/s10841-024-00548-5

Soga, M., Gaston, K. J., Yamaura, Y., Kurisu, K., & Hanaki, K. (2016). Both direct and vicarious experiences of nature affect children's willingness to conserve biodiversity. *International Journal of Environmental Research and Public Health, 13*(6), 529. https://doi.org/10.3390/ijerph13060529

Sponarski, C. C., Miller, C., & Vaske, J. J. (2018). Perceived risks and coyote management in an urban setting. *Journal of Urban Ecology, 4*(1). https://doi.org/10.1093/jue/juy025. juy025.

Sweet, F. (2025). Figure 1. Created in BioRender. https://BioRender.com/z87a297.

Sweet, F. (2025). Figure 2. Created in BioRender. https://BioRender.com/x89c739.

Sweet, F. S. T., Mimet, A., Shumon, M. N. U., Schirra, L. P., Schäffler, J., Haubitz, S. C., Noack, P., Hauck, T. E., & Weisser, W. W. (2024). There is a place for every animal, but not in my back yard: A survey on attitudes towards urban animals and where people want them to live. *Journal of Urban Ecology, 10*(1). https://doi.org/10.1093/jue/juae006. juae006.

Sweet, F. S. T., Noack, P., Hauck, T. E., & Weisser, W. W. (2023). The relationship between knowing and liking for 91 urban animal species among students. *Animals, 13*(3), 488. https://doi.org/10.3390/ani13030488

United Nations, Department of Economic and Social Affairs, Population Division. (2019). *World Urbanization Prospects 2018: Highlights* (No. (ST/ESA/SER.A/421)). United Nations. https://population.un.org/wup/Publications/Files/WUP2018-Highlights.pdf.

Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. New York: Springer-verlag. http://ggplot2.org.