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Attitudes and preferences of wildlife and their relationship with childhood nature experience amongst residents in a tropical urban city

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Abstract
How people relate to biodiversity and whether they are supportive of conservation programs and policies has implications on global and local biodiversity conservation efforts. Nature experiences in childhood has been shown to be strongly correlated to positive attitudes towards nature and wildlife in adulthood. In this study, we examined wildlife experience, attitudes and willingness to coexist with 26 vertebrates and invertebrates amongst residents in a highly urbanized tropical city, Singapore. A total of 1004 respondents were surveyed and their childhood nature experience and various socioeconomic variables were obtained. The animals were grouped by their likeability and preferred habitat from the respondents' answers. Three main groups of animals were discerned – unfavorable animals, mammals, and favorable animals. Singapore residents generally had high direct experiences of animals that are common in urban settings, for both favorable and unfavorable animals, such as butterflies, dragonflies, crows and bees, but low direct experiences of forest-dependent wildlife. Animals that were well-liked and acceptable near homes include the common urban ones and some forest-dependent ones, while animals that were disliked included stinging insects (bees and hornets) and reptiles (snakes and water monitors). Structured equation modelling showed that both childhood nature experience and wildlife experience had strong effects on wildlife likeability and habitat preference. The apparent mismatch between greening policies and people's willingness to coexist with wildlife may be problematic as urban development further encroaches on forest habitats, and this study highlights the importance of preserving forest habitats so that young children and adults have opportunities to be exposed to them.

Keywords Coexistence · Habitat preference · Singapore · Urban wildlife

Introduction

As cities worldwide move towards greening and sustainability, more green areas are set aside for public welfare and social needs (Anguelovski et al. 2018). With increasing green spaces and wildlife reserves in numerous cities (Anguelovski et al. 2018; Jim and Chen 2003; Li et al. 2005), urban wildlife is expected to increase in abundance and diversity, including both 'desirable' and pest or undesirable species. Peoples' feelings and attitudes towards wildlife affects their willingness to coexist with them, and may contribute to or deter larger biodiversity conservation goals (Castillo-Huitrón et al. 2020; Frank 2016).

The need for biodiversity conservation has not been more urgent. Worldwide, biodiversity has been greatly reduced in the past five decades due to habitat losses and degradation (Butchart et al. 2010), and this reduction is continuing in the face of climate change (Trisos et al. 2020). Changes in biodiversity can have negative impacts on ecosystems (Cardinale et al. 2012), human health, food production, and water supply, with high monetary costs (Chapin et al. 2000). These changes affect ecosystem processes, leading to further changes in species composition and vulnerability to invasion by exotic species (Chapin et al. 2000).

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Cities can be places for biodiversity conservation with proper planning (Aronson et al. 2017; Kowarik 2011), but more importantly they are important places to teach and spread the idea of biodiversity conservation, and why it matters to humans.

The willingness to coexist with wildlife is an important step towards a meaningful and effective urban greening plan. If cities are aiming to be greener, and if being greener means attracting a greater diversity and abundance of wildlife (Strohbach et al. 2013), then residents need to learn and accept that outdoor green space do not belong to humans alone, but a space to be shared with a variety of plants and animals, even if they are not affectively favored (Crespin and Simonetti 2019).

Children's contact with nature has been shown to affect their willingness to conserve biodiversity (Zhang et al. 2014; Soga et al. 2016b), and these attitudes are very likely to be carried on to adult life in the form of environmental activism (Hsu 2009; Li and Chen 2015). Formative experiences in nature and conservation issues are not necessarily restricted to the childhood period too (Reibelt et al. 2017). These studies suggest that positive nature experiences in childhood are significantly associated with caring action for the environment in adulthood, and demonstrate the necessity of first-hand experience and discoveries in fostering environmental action (Chawla and Derr 2012).

Singapore is an island located almost in the middle of the Sundaland biodiversity hotspot (Myers et al. 2000) and has been regarded as a worst-case scenario of biodiversity loss for the Southeast Asian region (Sodhi et al. 2004). However, the Singapore government has stepped up efforts to enhance both roadside and park greenery in the city over the last decade, with the current One Million Trees movement that aims to plant a million trees all over the city over ten years (National Parks Board 2022). These initiatives will put people in closer proximity to nature and may enhance existing wildlife habitats and corridors.

Although Singapore is a highly urbanized island city, human-wildlife interactions are very common. Several studies have been done on human-macaque (Long-tailed Macaque, *Macaca fascicularis*) conflicts in Singapore (Sha et al. 2009; Yeo and Neo 2010), because they were amongst the first mammal species to be considered problematic since the 1990s. These conflicts were attributed to human-induced causes (Sha et al. 2009), but government-led culling of the macaques nevertheless occurred when complaints increased (Feng 2013). Since then, other animals are being increasingly perceived as problematic too, such as the wild boar (*Sus scrofa*; Goh and Toh 2018), the reticulated python (*Malayopython reticulatus*; Tan 2019), and the Smooth-coated Otter (*Lutrogale perspicillata*; Low and Chua 2022).

Negative perceptions and fear of wildlife have been attributed to a lack of exposure and knowledge about them. This is especially true for urban residents, since their likelihood of growing up in more natural environments is lower (Mohamad Muslim et al. 2017). Low childhood nature experience was found to be strongly correlated to negative attitudes and low tolerance for problem-causing wildlife amongst urban residents in Singapore (Ngo et al. 2019). The desired treatment of these wildlife also depended on the taxa – more people preferred the extermination of invertebrates near their homes if these animals were known to have caused serious injury, compared to macaques (Ngo et al. 2019). Complaints and requests for removals were also made if wildlife were sighted at urban infrastructure away from nature areas, such as within drainage canals, even if the wildlife has not done any damage (Liu 2018).

In this paper, we sought to assess the wildlife attitudes and preferences of Singapore residents. Specifically, we asked: 1. Which kinds of broad animal groups did Singapore residents know, like and were willing to coexist with, and 2. Whether their attitudes towards different kinds of wildlife were influenced by their childhood nature experience, wildlife experience and socioeconomic factors.

Methods

Study site

Our study site was Singapore, a densely-populated, highly urban and developed island country in Southeast Asia (Singapore Department of Statistics 2019). Wilderness in the form of rubber plantations and secondary forests were widespread in the country from the 1850s to 1960s (Corlett 1991). From the 1970s, large-scale forest-clearance began for residential and industrial development. The only officially-protected forests before independence in 1965 were the water catchment areas in central Singapore (Corlett 1997). Biodiversity losses from forest conversion and habitat fragmentation have been well-documented (Chan and Davison 2019). Currently, forested areas are concentrated in the central part of Singapore where they act as water catchments, while the urban areas are filled with planted greenery.

Questionnaire

We designed an online questionnaire that covered the exposure, attitudes and willingness to coexist with a series of different wildlife taxa that can be found in Singapore. We recruited 1004 respondents living in Singapore aged 18–69 years using an Internet research company (Macromill, Inc.) in 2016. The gender ratio was even (502 male and female respondents), and 82% of the respondents spent their childhood (age ≤ 12) in Singapore. The

highest education level, ethnicity, and childhood nature experience of each respondent was recorded (Ngo et al. 2019; Supplementary Information).

In addition, we asked respondents about their knowledge, attitudes and habitat preferences of 26 animals. These animals ranged from common urban ones, such as sparrows, crows, and butterflies, to exclusively forest animals like flying lemurs (*Galeopterus variegatus*), shrews, and flying squirrels. Wildlife experience was scored on a scale of 1 to 5 with 1 being "do not know", 2 "only know by name", 3 "have watched photo or video", 4 "have watched in the zoo, insectarium etc." and 5 "have watched in the wild". Wildlife likeability was scored on a scale of 1 (dislike) to 5 (like), with 3 as a neutral point. Wildlife habitat preferences, or desirable place for wildlife to live, which we used as a measure of coexistence, was scored on a scale of 1 to 4 with 1 being "nowhere", 2 "forests and parks apart from your house", 3 "green spaces near your home", and 4 "anywhere including your home garden or veranda". Both wildlife likeability and habitat preference scores for each respondent were averaged across the 26 animals.

Childhood nature experience was the average score from two questions – the frequency of green space use and the frequency of participation in nature-related activities in their childhood (age ≤ 12). Green spaces included forests, parks, farms/plantations, and rivers/beaches, while nature-related activities included insect-catching, collecting flowers and fruits, bird-watching, tree-climbing, fishing and swimming in rivers/oceans. The two questions had a 5-point scale, ranging from 1 (never; no experience) to 5 (very often; almost everyday), with 3 being sometimes (about once a month). Further details on the questionnaire can be found in Supplementary Information.

Data analysis

We removed six respondents whose answers were 'do not know' for all 26 animals, because their likeability and habitat preference scores were also empty. The six were all male respondents. The Cronbach's alpha for the childhood nature experience questions was 0.91, that for wildlife experience (0.95), likeability (0.95) and habitat preference scores (0.94), which were all higher than the recommended 0.8 reliability (Lance et al. 2006).

We used wildlife likeability and habitat preferences to see how the 26 animals were viewed favorably or unfavorably, and used factor analysis to group animals based on likeability and habitat preference scores. The number of groups was determined by parallel analysis and the Velicer minimum average partial (MAP; Fig. S1). We also used linear regression to examine the relationship between wildlife likeability and habitat preference of the 26 animals. We performed structured equation modeling (SEM) to analyze the relationships between wildlife likeability and habitat preference as response variables, wildlife experience as a mediator, and childhood nature experience and sociodemographic factors as explanatory variables. The sociodemographic factors were gender, age, education, and ethnicity (Fig. 1). SEM fitness was checked using the χ^2 goodness-of-fit statistic, the p-value, the comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Differences in childhood nature experience, wildlife experience, likeability, and habitat preferences between gender (t-test), education levels (ANOVA), ethnicity (ANOVA) and age (linear regression) were plotted and presented in Figs. S2–S5.

We used R 4.0.3 (R Core Team 2020), the psych (v2.0.9; Revelle 2020) and tidyverse (v1.3.0; Wickham et al. 2019) packages for analyses and graphics.

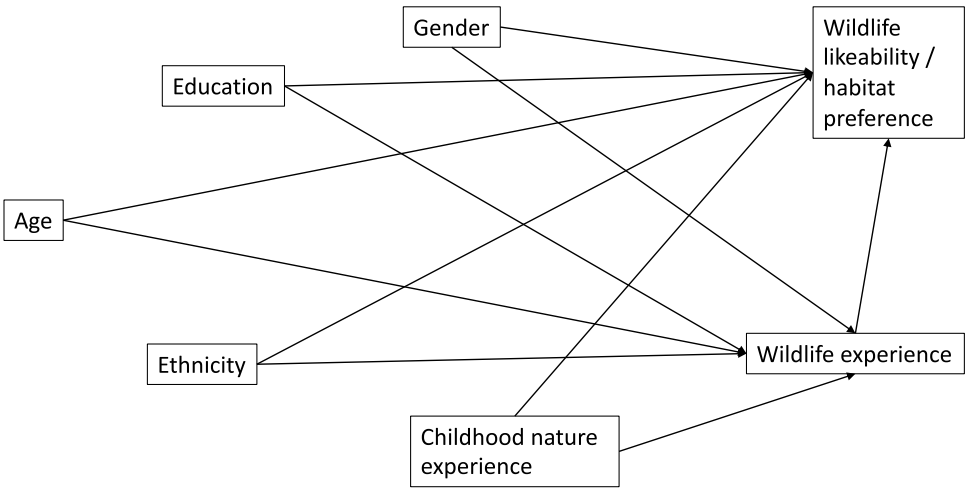

Fig. 1 Model of the hypothesized relationships between wildlife likeability and wildlife habitat preference with childhood nature experience, wildlife experience, and various sociodemographic factors

Results

Amongst the 26 animals, small ones that can be found in urban habitats, such as butterfly, dragonfly, and sparrow, had the most direct observations by respondents (Fig. 2). Forest animals such as flying lemur and shrew were the least encountered animals. Wildlife likeability and habitat preference amongst the 26 animals were significantly correlated ($R^2 = 0.278$, $F(1,24) = 10.6$, $p = 0.003$; Fig. 3).

The optimum number of factors was three (Fig. S1), so three groups of animals were identified from the factor loadings of the likeability scores – favorable animals, mammals, and unfavorable animals (Fig. 3; Table 1). Animals were assigned one of the three groups if their factor loading exceeded 0.45 for that group. The nine favorable animals included common and small urban animals such as butterflies, dragonflies, and sparrows. This group had the highest likeability and habitat preference scores. The mammal group had 7 of the 8 mammals in the questionnaire (squirrel was in the favorable animal group). Although likeability scores for this group was intermediate, they were all preferred in forests far away from homes (Fig. 3). The unfavorable animal group had 10 animals, with six invertebrates, three herptiles (snake, water monitor, frog) and one bird (crow). Of the six invertebrates, only two were commonly perceived as causing harm to humans (hornet and bee). The moth, beetle, cricket, frog and cicada were on the higher end of both likeability and habitat preference scores within this group, and they were also the ones that most respondents had direct observations of. Forest-dependent animals were found in all three groups, although most of the mammals in the questionnaire were forest-dependent.

Childhood nature experience had significant positive effects on both wildlife likeability and habitat preference across all three animal groups (Fig. 4). Wildlife experience (knowledge) had strong mediating effects on wildlife likeability, especially for mammals and favorable animals. Only childhood nature experience and education level had significant effects on wildlife experience. Wildlife experience was the strongest predictor of wildlife habitat preferences for unfavorable and favorable animals but was not significant for mammals (Fig. 4).

Education level had significant positive effects on wildlife experience, likeability and habitat preference for all animals

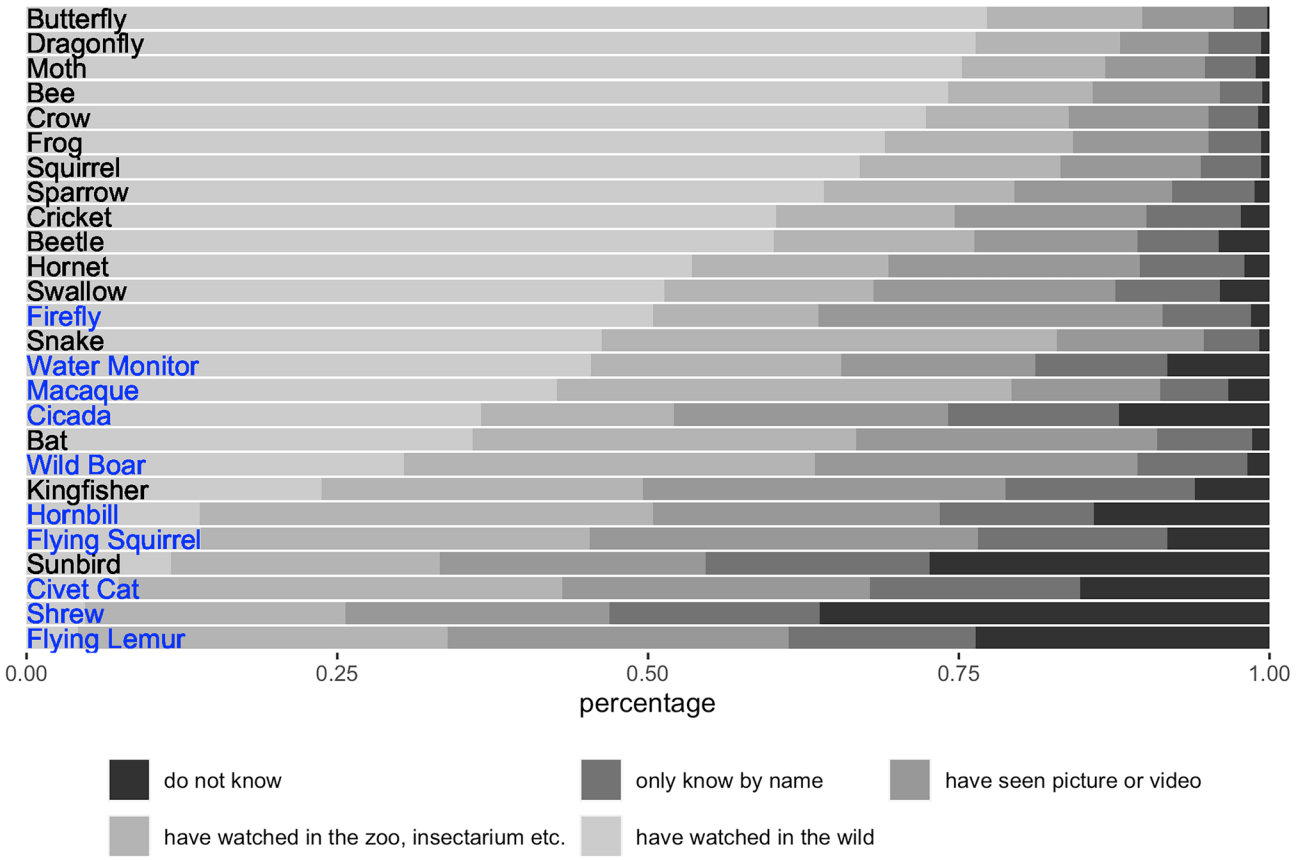

Fig. 2 Respondents' knowledge / familiarity (wildlife experience) of each animal. Animals in blue font are forest-dependent, while animals in black font include both urban or forest species

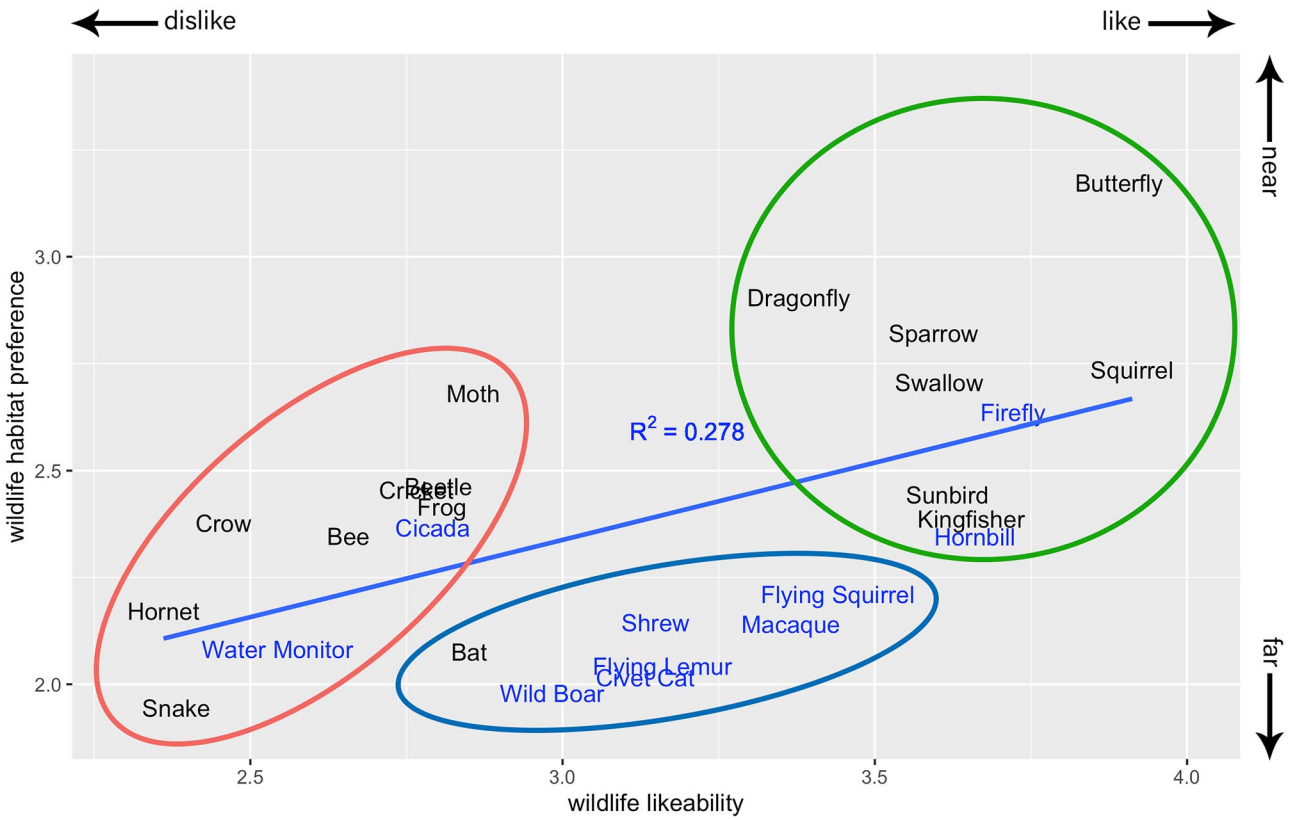

Fig. 3 Wildlife likeability and habitat preference scores of the 26 animals. Circles represent the three main groups of animals identified by factor analysis: unfavorable animals (red ellipse), mammals except squirrel (blue ellipse), and favorable animals (green ellipse). The blue line represents the best fit model for the linear regression between wildlife likeability and habitat preference ($p = 0.003$). Animals in blue font are forest-dependent, while animals in black font include both urban and forest species

groups, except for likeability of mammals (Fig. 4). Gender had significant effects only on the wildlife likeability of unfavorable animals and mammals, and the habitat preference of mammals (Fig. 4). Males and those with higher education levels tended to have higher likeability and habitat preference scores (Figs. S2 and S3). Ethnicity had significant effects on both likeability and habitat preferences of all animals groups, except for habitat preference of mammals. Interestingly the Chinese and Malays had the lowest likeability scores, followed by Indians and other races (Fig. S4). Age was not a significant factor in the SEMs of unfavorable animals, but was significantly negatively correlated to wildlife likeability and habitat preference of mammals, and significantly positively correlated to wildlife likeability and habitat preference of favorable animals (Fig. S5).

Discussion

Childhood nature experience was found to be low amongst Singapore residents in a previous study, and this was attributed to low levels of nature consciousness when respondents were growing up (Ngo et al. 2019). Singapore residents were generally willing to coexist with wildlife that are common in the urban landscape and are small in size, such as butterfly, dragonfly and sparrow. These findings were similar to surveys done in Japan, Malaysia and Norway, where small and common animals had the highest coexistence scores (Bjerke and Østdahl 2004; Hosaka et al. 2017; Mohamad Muslim et al. 2018). However, unfavorable wildlife, and larger mammals, even if well-liked, were preferred away from homes.

The strong effect of childhood nature experience on wildlife attitudes was similar to results from other cities (e.g. Hosaka et al. 2017; Mohamad Muslim et al. 2018; Soga et al. 2016a). The effect of childhood nature experience on wildlife likeability and habitat preference via wildlife experience was sometimes even stronger than the direct effects. This shows that having direct experiences with wildlife species, like seeing them with one's own eyes, compared to watching them on a documentary or reading about them, was more effective in fostering better attitudes towards wildlife. However, other studies have shown that childhood nature experience was not always necessary in forming closer connections with nature in adulthood if they have plenty

Table 1 Factor loadings (≥0.45) for each animal and grouping of animals based on likeability scores

	Factor1	Factor2	Factor3
Mammals			
Flying Lemur			0.773
Civet Cat			0.770
Shrew			0.732
Bat			0.730
Flying Squirrel			0.660
Wild Boar			0.622
Macaque			0.507
Favorable animals			
Kingfisher		0.833	
Hornbill		0.758	
Sunbird		0.756	
Squirrel		0.716	
Butterfly		0.681	
Swallow		0.666	
Sparrow		0.606	
Dragonfly	0.491	0.571	
Firefly		0.555	
Unfavorable animals			
Cricket	0.847		
Cicada	0.823		
Beetle	0.790		
Water Monitor	0.702		
Hornet	0.648		
Frog	0.625		
Bee	0.619		
Moth	0.584		
Snake	0.526		
Crow	0.473		

of exposure to nature regularly in adulthood (van den Berg et al. 2016).

Although most of our respondents had first-hand experience with common urban animals (seen the animal physically), forest-dependent animals, mostly mammals, such as flying lemurs and shrews, were unknown or known only by name by over 25% of the respondents. Low levels of wildlife knowledge are not unique to this study (e.g. Bebbington 2005; Miller and McGee 2000). Studies have shown that wildlife knowledge and interest in children can be enhanced by regular exposure to them, coupled with opportunities to study them in more detail (Lindemann-Matthies 2005). Even adults with regular exposure to nature in cities can have increased commitment to biodiversity conservation (Prévot et al. 2018). Elementary science education in Singapore in the 1990s and before (when most of the survey respondents would have been studying) were fact-based (Lee 2018). Despite this, there was very little to connect textbook knowledge with the environment. Teaching facts alone does not necessarily result in more positive attitudes towards wildlife (Prokop et al. 2009). With the current emphasis on evidence-based reasoning and knowledge application in science education (Lee 2018), there is even less motivation for students to learn about species around them if they do not appear in school examinations. School field trips to nature reserves also usually involve large groups (pers. obs.), which are not conducive to watching wildlife.

Besides childhood nature experience, education level was the only other significant correlate of wildlife experience. We found that higher formal education level correlated with higher likeability and tolerance of wildlife. This concurs with findings from Kaltenborn et al. (2006) and Røskaft et al. (2003), while Thornton and Quinn (2009) found no such relation. Randler et al. (2007) also found that education level and age were significant predictors of animal knowledge. A majority (57.2%) of respondents had a degree, while 10.8% had a postgraduate degree. Interestingly, we found that respondents with the lowest education level (primary school) had the highest median childhood nature experience and wildlife experience (Fig. S3), which points to a more complex relationship between education level and wildlife attitudes. A survey on Singapore undergraduates found that biology majors did not fare much better than non-biology majors when asked about their environmental knowledge and understanding of ecosystems (Tan 2015). Future studies could include a question on subject of specialization for respondents with degrees to examine if the subject of study had any influence on wildlife attitudes.

Wanting large and undesirable animals away from homes could be a manifestation of the not-in-my-backyard (NIMBY) syndrome. It is a prevalent attitude, which started as a resistance to social and environmental facilities deemed necessary but undesirable near residents of high-value housing estates (Teo 2018; Wei 2014). It has rarely been described for wildlife (but see Welbergen and Eby 2016), although NIMBY attitudes have been highlighted in Singapore previously over social facilities (Seow 2017; Yong 2020). In the case of wildlife, fear of zoonotic diseases, fear of injury, noise, and interference with daily life are some of the reasons people may want wildlife far from their homes, but without exterminating them (Ngo et al. 2019). For example, non-biting midge (*Polypedilum nubifer* and *Tanytarsus oscillans*) outbreaks have been known to occur in Singapore since the 1970s (Cranston et al. 2013), but their swarming behavior has been considered problematic even though they are harmless to humans (Ang 2019). There has also been numerous cases of macaques and wild boar in Singapore showing aggression to and injuring people in urban settings (e.g. Ang 2020; Yang 2017).

The unfavorable animal group included harmless animals like moths and cicadas, and also animals presumed to cause

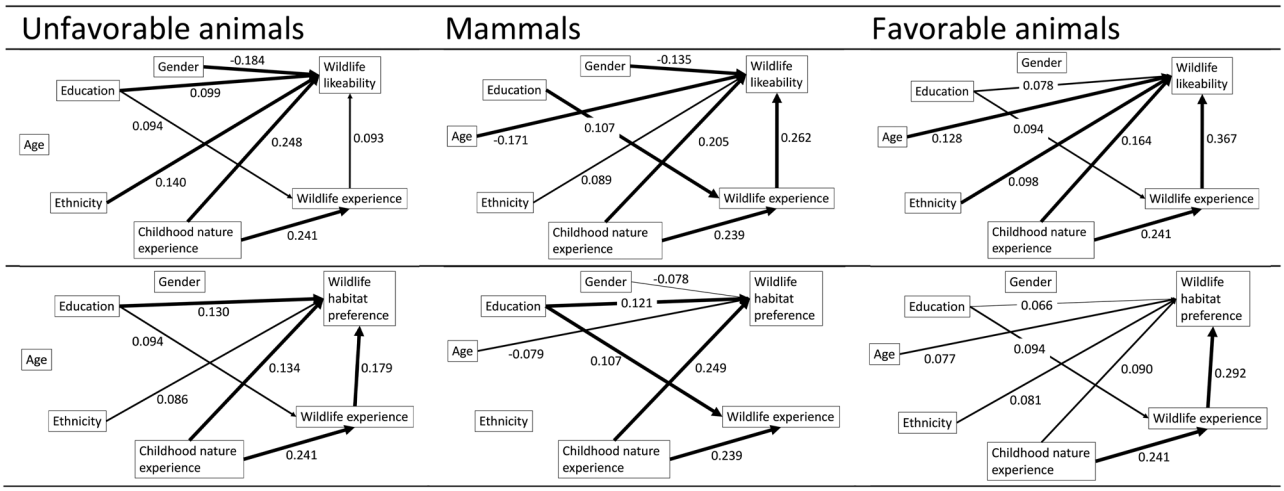

Fig. 4 Path coefficients of the SEM for wildlife likeability and wildlife habitat preference for the three main groups of animals, after removing non-significant paths. Arrow thickness represents significant levels in increasing order: $p < 0.05$, $p < 0.01$ and $p < 0.001$

harm such as bees, hornets and reptiles (snakes, water monitors). This is similar to other studies on attitudes towards these animals (e.g. Almeida et al. 2014; Kellert 1993), and they are likely driven by fear and disgust (Castillo-Huitrón et al. 2020; Polák et al. 2020). The fear of snakes by primates has been attributed to evolution (Isbell 2006) and were considered innate in humans (Menzies and Clarke 1995; Poulton and Menzies 2002). However, social constructs acquired later in life, like myths (Prokop et al. 2009), can also induce fear even if there had been no prior interactions with the wildlife species. A survey done across seven different countries found that although disgust-relevant animals were similar across all cultures, fear ratings differed between countries for fear-irrelevant, fear-relevant, and disgust-relevant animals (Davey et al. 1998), a sign that most of these fears were learnt from cultural settings. Formal education that involves interacting with unfavorable wildlife species in a controlled environment can reduce fears and improve perceptions (Pinheiro et al. 2016). The fact that tolerance levels are relatively higher for certain members of the unfavourable group, such as moths and crickets, points to an opportunity in using these species as an opening to promote coexistence with the larger and less desirable animals of this group. The strong effect of prior wildlife experience on habitat preference also highlights the importance of early exposure to different types of wildlife.

We found strong differences in wildlife likeability between gender, which was within expectations, especially for the unfavorable animals. Similar to this study, others have shown that females tended to have lower likeability towards wildlife (Kaltenborn et al. 2006; Kellert and Berry 1987), or higher affinity for 'lovable animals' and lower affinity for 'fear-relevant animals' (Schlegel and Rupf 2010). This was despite no significant differences in wildlife experience between males and females. This does not necessarily imply that females were not interested in wildlife conservation, but might reflect greater fear of the dangers that wildlife could bring (Kong et al. 1997; Thornton and Quinn 2009). Singaporean females may see themselves more as nurturers in terms of tending to nature and teaching children about nature, instead of having the need or ability to dominate nature (Kong et al. 1997). However, it may be useful to note we found no significant effect of gender on overall habitat preferences, reflecting similar preferences between males and females.

Ethnicity had a significant effect on wildlife likeability and habitat preference, similar to a Malaysian study (Mohamad Muslim et al. 2018). However, although Singapore and Malaysia share similar ethnicities, Malaysia has a Malay majority, while Singapore has an ethnic Chinese majority. Consequently, 84% of respondents from this study were Chinese, which was higher than the national average of 74.3% (Singapore Department of Statistics 2020). Contrary to findings from Mohamad Muslim et al. (2018), the Malay respondents in our study had the lowest mean scores for childhood nature experience, wildlife experience and habitat preferences, compared to other ethnicities (Fig. S4). It is unclear if this could be due to the small proportion of Malays (5.2%) who answered the questionnaire, compared to the national proportion of 13.5% (Singapore Department of Statistics 2020).

We found that age had little effect on wildlife likeability and habitat preferences in general (Table 1; Fig. S5). This is contrary to findings from Bjerke and Østdahl (2004), Hosaka et al. 2017, and Mohamad Muslim et al. (2018), but were similar to Kaltenborn et al. (2006). In a previous study with the same survey respondents, likeability and tolerance was

found to decrease with age, but that was only for three species of problem-causing wildlife (Ngo et al. 2019). The weak effect of age may be because Singapore had become highly urbanized by the 1970s (MND 2019), where people in their 40 s and below would have been born, so these generations may have had little exposure to nature when growing up. Prior to this, most of Singapore's population were concentrated in the then built-up and crowded areas (Neville 1969; Ngo et al. 2019), and people in their 50 s and above may have had grown up with little exposure to nature even though there were more forests before the 1970s.

The preferred landscape in Singapore is manicured landscapes like parks and gardens (Drillet et al. 2020; Khew et al. 2014), which harbor lower biodiversity than natural habitats such as forests (Chong et al. 2014). Most of the mammals and some unfavorable animals surveyed are found in forests. The preference for manicured landscapes was despite a general tendency towards nature conservation (Khew et al. 2014). This could lead to a positive feedback cycle where children are mostly exposed to manicured landscapes, reinforcing their preference in adulthood, and paving the way for more manicured landscapes in the future and reducing habitats for more endangered species. To reduce this tendency, there is a need have 'wilder' habitats nearer residential areas, scattered across the island instead of a few large nature reserves far away from most homes.

The COVID-19 pandemic over the last two years has upended lives and lifestyles globally. In Singapore, there has been a sudden surge in membership of local outdoor groups on social media platforms, such as hiking, cycling, and nature photography groups. Parks and nature reserves became overcrowded because the lockdowns meant that these were the only places that people could visit for relaxation or exercise. Demand for park space has never been higher in Singapore since independence (Ng 2021). However, it remains to be seen if this general heightened awareness of local green spaces translates into greater appreciation of nature and wildlife amongst children. Home-based learning in the first few months of the pandemic has greatly disrupted students' learning, and even after they return to school, outdoor unstructured play had been largely prohibited for over a year. The hope is that students regain more freedom to play after social distancing rules are relaxed.

The recent slogan change for Singapore to be a 'City in Nature' from the previous 'City in a Garden' requires its citizens to learn to coexist with wildlife around them (Lee 2017), including the unfavorable animals. Besides policy, effective biodiversity conservation requires widespread support from citizens living in biodiversity hotspots to also be supportive of conservation measures. Isolated and one-time measures that control only the wildlife population tend not to be sustainable and the same issues often recur once the measures cease. A whole-of-society effort, from government to civil groups to individuals, is required for true human-wildlife coexistence in Singapore.

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Declarations

Conflicts of interest The authors have no conflicts of interest to declare that are relevant to the content of this article.

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