Chapter 6
New Directions in Urban Avian Ecology: Reciprocal Connections between Birds and Humans in Cities

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6.1 Introduction

Ask any urban person what type of animal they see on a daily basis and the response will likely be “birds”. Whether it is their increased mobility due to flight compared to other animals, or a particular ability to adapt to changes in the environment, certain species of birds live in relatively high densities in human-dominated landscapes. Indeed, some species apparently thrive in urban habitats. The connection between birds and human settlements is not a recent one. For example, the house sparrow (*Passer domesticus*) is estimated to have begun its commensal relationship with humans between 400,000 and 10,000 years ago in the Middle East (Anderson 2006). Despite this ancient connection between people and birds the reciprocal nature of our interactions is just beginning to be investigated (e.g. Marzluff and Angell 2005).

The study of avian ecology in urban areas has steadily grown in the last decade (see Fig. 6.1), but the vast majority of this research documents the hazards of humans to birds. We affect ecosystem dynamics by changing land cover, producing waste, using resources, and changing communities of fauna and flora (Marzluff 2001; Liu et al. 2007). The major factors negatively affecting bird species are habitat alteration (loss, fragmentation, small patch sizes, vegetation changes) and introduced/exotic species (predators and competitors; Chace and Walsh 2006). These factors, however, are mostly indirect. Humans can also have direct negative effects on birds, such as disturbance (Evans et al. 2009; Fernandez-Juricic et al. 2003;

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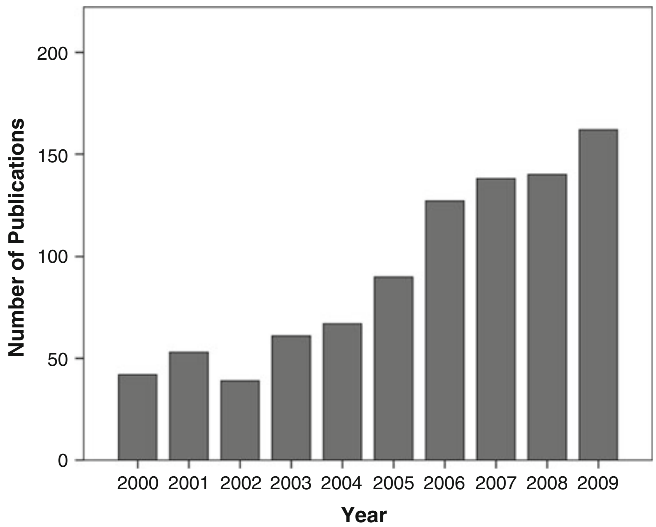

Fig. 6.1 Number of publications by year found when searching "urban and birds" and "urban and avian" on Web of Science

Möller 2008; Schlesinger et al. 2008). Humans may unintentionally negatively affect birds in urban areas simply by passing by a nest or walking in a foraging area (Fernandez-Juricic et al. 2003; Campbell 2006; Möller 2008). Human visitation to parks and other natural areas can disturb birds' foraging, breeding, and nesting behaviour (Chace and Walsh 2006).

The effects of humans on birds, while profound (Marzluff 2001, 2005; Chace and Walsh 2006; Robb et al. 2008; Chamberlain et al. 2009; Evans et al. 2009), is not only negative. A positive influence on birds is the supplementary resources provided to them by people. Our plantings, buildings, structures, and birdhouses provide novel nesting sites. Our direct (bird feeders) and indirect supplementary foods (e.g. garbage) can profoundly affect birds. In fact, up to 43% of households in the United States and 75% in the United Kingdom feed birds (Robb et al. 2008), and 48% of urban households in the UK provide food for birds (Evans et al. 2009). The effect of supplementary feeding on birds in urban areas has the potential to be substantial (Lepczyk et al. 2004; Chace and Walsh 2006; Fuller et al. 2008; Robb et al. 2008; Chamberlain et al. 2009). Positive effects include increased winter survival, larger population sizes, and for raptors, a greater prey base (Chace and Walsh 2006). Most studies on the influences of feeding birds have been conducted in rural areas (see Evans et al. 2009); nevertheless, feeding birds is also common in urban areas. There are potential negative consequences of providing food for birds, including reduced diet quality, inadequate diet for nestlings and increased disease transmission, predation risk, and spread of exotics (Chace and Walsh 2006; Chamberlain et al. 2009).

Supplementation of resources is a defining feature of urban ecosystems that may also affect community dynamics, essentially increasing the community carrying capacity, favouring some species, and disconnecting trophic dynamics from in situ productivity (Hairston et al. 1960; Menge and Sutherland 1976, 1987; Fretwell 1987; Oksanen 1991; Polis and Strong 1996; Chesson 2000). In this way, supplementation of resources from outside the urban ecosystem (Polis and Strong 1996) modifies the ways in which competition interacts with predation, facilitation, mutualism, colonization, recruitment, and the productivity and stress of the physical environment to determine diversity (Menge and Sutherland 1976, 1987; Wootton 1994; Jones et al. 1997; Hacker and Gaines 1997; Chesson 2000; Crain et al. 2004). Supplementation may disproportionately advantage birds the scavenge, eat seeds, and nest in cavities, but these effects may ripple throughout urban bird communities as some predators, parasites, excavators, or strong competitors are positively or negatively affected by human supplementation.

Just as humans can affect birds, birds influence humans. Due to the abundance and diurnality of certain species in urban areas, birds are often the most visible wildlife in human-dominated areas. It is possible that just the presence of birds can positively affect human health and well-being (e.g. Fuller et al. 2007). Research has demonstrated that viewing nature can decrease recovery time after surgeries; improve blood pressure, cholesterol levels, and outlook on life; reduce stress and mental fatigue; and improve concentration (Bjerke and Ostdahl 2004; Maller et al. 2005). Birds can also perform certain ecological services for humans, such as decreasing pest arthropod numbers (Blockstein 1998).

The negative aspects of birds living in proximity to humans are mostly indirect – damage to property (including homes, vegetable gardens, and fruit trees) and nesting and defecating in undesirable places; however, birds can transmit disease and some species will even attack humans (e.g. corvids and gulls; Marzluff et al. 1994). The banning of hunting in cities may select for an increased propensity in birds to attack people in urban areas (Knight 1984; Knight et al. 1987).

The interactions between humans and birds in urban areas are influenced by various factors. First, characteristics of the urban environment, such as city age (Marzluff in press), size, geographic location, and habitat type can influence relationships. For example, in comparison to European cities, North American cities are relatively young and species compositions of birds may include species that are currently adapting to urban life or being driven to extinction whereas older European cities may include more adapted species (Martin and Clobert 1996; Marzluff in press).

Human interactions with and attitudes towards animals can be influenced by human demographic, socioeconomic, and cultural factors. For instance, age, gender, and education can affect whether landowners feed birds, and occupation and relative house size can influence if they use pesticides or herbicides, which can harm birds (Lepczyk et al. 2004). In addition, people in deprived areas are less likely to feed birds (e.g. Fuller et al. 2008). Human interest and concern for animals have been shown to vary with age, gender, and education level (see review in Bjerke and Ostdahl 2004). An increase in education corresponds to an increase in positive attitudes towards animals, and there are subtle species preference differences between children and adults and between females and males (Bjerke and Ostdahl 2004). Cultural differences also exist among countries where human attitudes and actions towards animals were surveyed (e.g. USA, Germany, and Japan; Kellert 1994).

Birds' relationship with humans can also vary according to life history and morphological, physiological, and behavioural traits. Habitat use, degree of specialization (e.g. diet), local history (native or exotic), activity patterns (e.g. nocturnal vs. diurnal), migratory and reproductive behaviour, intelligence (e.g. degree of innovative behaviour), physiological tolerance, and personality (e.g. risk adverse or explorative) have all been shown to affect whether bird species are urban adaptors or avoiders (Jerzak 2001; Chace and Walsh 2006; Bonier et al. 2007; Croci et al. 2008; Möller 2008; Marzluff in press).

As interest in urban ecology generally, and urban avian ecology specifically, increases we urge researchers to fully investigate the positive and negative, reciprocal linkages that couple human and natural elements of urban ecosystems (Liu et al. 2007). Here, we describe recent research in avian urban ecology conducted through the Urban Ecology program at Humboldt University in Berlin, Germany (Perspectives on Urban Ecology III – Optimizing urban nature development) that begins to more fully examine human-natural connections. We start with some examples of birds that are adapting to urbanization in Berlin: one an endangered songbird, the other an urban-savvy bird of prey; we then present a comparative study of human–avian interactions in Berlin and Seattle, Washington, USA.

6.2 The Northern Wheatear (*Oenanthe oenanthe*) in Berlin

The Northern wheatear is a widespread but endangered bird species (Baillie et al. 2004; Südbeck et al. 2007). Whereas populations of natural habitats like alpine meadows and tundra do not show a long-term decline, those in man-made habitats like pastures, vineyards, stone pits, or mining areas have shown a severe decrease since about 1870 (Glutz von Blotzheim and Bauer 1985; Bauer et al. 2005). Wheatear populations declined dramatically since the 1990s in Germany as well as in other countries in Europe (BirdLife International 2004; Baillie et al. 2004; Südbeck et al. 2007). The main cause of decline is land-use change. As an insectivorous, long-distance migrant wintering south of the Sahara desert, the wheatear suffers also from drought and overgrazing in its winter habitat (Bauer et al. 2005).

A study on habitat requirements and breeding success of the wheatear in Berlin, Germany, found that residential human population was negatively correlated with wheatear's occurrence, but that increasing impervious surfaces (sealing) encouraged settlement by wheatears (Meffert et al. in prep.). These relationships existed only within 50 m around the plot, whereas the broader urban context of a 2-km scale human activity did not influence occurrence probability. In accordance with previously described habitat requirements of this species, it favoured high proportions of sand cover and very short grass. Wheatears avoided any tree or moss cover and tolerated only very few shrubs. Plot size emerged to be a crucial factor, with occurrence probability being much higher on sites larger than five hectares.

Most pairs settled on wasteland often former railway properties. Almost a quarter of the pairs were found on a former airport site that was transformed to a country park containing a nature reserve that was grazed by sheep. A minor portion of the pairs was found at construction sites, on railroad properties, in storage yards, and in a so-called “meadow park”.

Overall breeding success was high: in 73% of the nests, young fledged. Breeding success did not vary between the 2 years. Approximately half of the nest losses happened on construction sites, where heaps of rubble and stones were altered. Predation rate was comparatively low (seven percent of nests were preyed upon). Compared to other artificial habitats like vineyards (Buchmann 2001) or heathlands (Tye 1980), breeding success was considerably higher in wastelands; natural habitats show approximate similar values (Moreno 1989).

Meffert et al. (in prep.) only found a weak influence of direct disturbance by humans, since plots were large enough for the wheatear to avoid encounters with humans and dogs. Field observations showed that proximity of nest locations of a few metres to railroad tracks, walkways, or benches did not prevent the birds from nesting and feeding chicks. That contrasts to observations of other authors. Possibly, urban populations adapt their behaviour as known for other species (e.g. Luniak and Mulsow 1988).

Our findings show that wheatears are able to cope with or even profit from the urban habitat. The wheatear, settling and successfully breeding on wasteland is an example of an early successional species that, with little direct effort from people, can thrive in urban settings. This might hold true also for other endangered open-land bird species such as tawny pipit *Anthus campestris*, linnet *Carduelis cannabina*, tree sparrow *Passer montanus*, and crested lark *Galerida cristata* that were also found on the study sites.

To maintain habitats, novel approaches in wasteland management and landscaping are needed. Two of the studied areas in Berlin are already transformed to parks, and show that recreational usage and habitat requirements of the wheatear can be balanced.

6.3 The Common Kestrel (*Falco tinnunculus*) and House Sparrow (*Passer domesticus*) in Berlin

The kestrel is the most common bird of prey in Berlin. There are approximately 200–250 breeding pairs in the whole city. From 2002 to 2004, the feeding ecology of kestrels was studied in Berlin across an urbanization gradient, as well as several life history and behavioural traits such as reproductive success and nesting location (Kübler 2006). Data was also collected from 2004 to 2010, however, not systematically.

Kestrels had high reproduction success at all sites in Berlin across the urbanization gradient, if they bred in special nest boxes (about 4.7 young/brood, Kübler 2006). However, effects of the urban gradient are clearly visible in regards to the composition of food kestrels prey on. The diet of kestrels was studied by pellet analysis and the remains of plucked feathers. Birds were found to be the main prey item in the city centre (mainly house sparrows) but this decreased towards the outskirts (Kübler et al. 2005). Rodent prey items (e.g. mice and shrews) follow an opposite pattern, becoming increasingly present in the kestrels' diets when moving outside the city centre. Perhaps the most striking finding was anthropogenic food items, for example bones of human-processed meats (steaks, chops, ribs), found in many nest boxes in the city centre, which shows the adaptation to humans (Kübler and Zeller 2005; Kübler 2006). Some exotic prey birds were found predominantly in the central area, notably budgerigars. Another remarkable behavioural adjustment found in kestrels is their decreasing fear of humans (e.g. foraging on a schoolyard for sandwiches, hunting of pigeons on main streets, nesting on high rise buildings).

The nesting locations of kestrels in Berlin also demonstrate adaptations to living in an area of high human-made structures. Indeed, the German name "Turmfalke", translated literally means "tower falcon". Apart from the common breeding sites (nest boxes/aids, niches of buildings), several very extraordinary nesting sites were documented in Berlin, for example, breeding in a flowerpot. This flexibility in breeding locations has also been observed quite frequently in Tel Aviv, Israel (Charter et al. 2005).

A positive aspect for kestrels living in the highly dense areas of Berlin is the high density of its most common prey item: the house sparrow (*Passer domesticus*). The population of house sparrows in Berlin is estimated to be 100,000 to 200,000 breeding pairs (Otto and Witt 2002) respectively 119,000 breeding pairs (Böhner and Schulz 2007) and their abundance depends on building structures and food resources of human origin. The highest densities were recorded in high-rise apartment building areas (Kübler 2006) confirming their strong attachment to humans. House sparrows also use nesting material of human origins (e.g. thread, wool, plastic, foil).

The population of house sparrows in Berlin is not endangered by the kestrel (or other predators). Both species are thought to enrich the city life and are well-liked by the Berlin inhabitants (Kübler 2005). The two species are also protected by the Environmental Protection Authorities and the German Nature Saving Law ("Deutsches Bundesnaturschutzgesetz"). But, it has to be emphasized that especially in a metropolis like Berlin, there is always need for further research, because the synurbization (adaptation to urban environments) progresses permanently. It is important to understand the developing mechanisms and adaptations in a city, so that one can conserve and protect the avifauna in the long run.

6.4 Human–Avian Interactions in Berlin and Seattle

6.4.1 Methods

We conducted a human survey of attitudes and actions towards birds in Berlin, Germany, and Seattle, Washington, USA, to quantify the level of human engagement with birds. We also quantified bird diversity and nesting behaviour in both cities so that we could determine how human attitudes and actions might influence birds. We conducted the human and bird surveys across an urbanization gradient (see below) to capture various types of habitats, human socio-economic status, and bird communities. Here, we will outline the methods of the study and present some preliminary results and discussion.

6.4.1.1 Study Areas

Seattle, Washington, USA (47°36′35″N, 122°19′59″W)

The area of Seattle was originally settled by persons of European descent around 1850, and in 1889, Washington was declared a state. The population around that time was 80,671 inhabitants (Dryden 1968). Currently, the Seattle metro area covers approximately 21,200 km^2 and has a population size of 3,344,813 inhabitants.

The human survey was conducted in Seattle from October 2009 to February 2010.

Berlin, Germany (52°30′2″N, 13°23′56″E)

The area of Berlin was originally settled by Slavic tribes around 720, but it was not until 1244 that the city of Berlin was founded. By 1400, the population was around 8,000 inhabitants, and by 1709, Berlin had 55,000 inhabitants (Taylor 1997). Currently, the Berlin metro area covers approximately 891.82 km^2 and has a population size of 3,700,000 inhabitants.

The human survey was conducted in Berlin from August 2008 to December 2008.

6.4.1.2 Study Sites

We selected two study sites for each site type along an urbanization gradient: (a) Heavy Urban (city centre, apartments), (b) Medium Urban (suburban, detached family-housing), (c) Medium-Light Urban (suburban, detached family-housing), and (d) Light Urban (village/rural, detached family housing, farms) (see Table 6.1 for study site characteristics, Fig. 6.2 for maps, and Fig. 6.3 for images of study

Table 6.1 Study site characteristics

City	Study site	Urban level	Human density (average resident/ha)
Seattle	Belltown	Heavy	129
	Capitol Hill	Heavy	129
	Ravenna	Medium	37
	Laurelhurst	Medium	24
	Somerset	Medium-light	14
	Westwood	Medium-light	11
	Maltby	Light	2
	Duvall	Light	8
	Lee Forest	Forest	0
Berlin	Moabit	Heavy	350
	Kreuzberg	Heavy	400
	Mariendorf	Medium	45
	Karlshorst	Medium	77
	Rudow	Medium-light	49
	Dahlem	Medium-light	22
	Lübars	Light	15
	Blanken-felde	Light	9
	Stadtforst	Forest	0

sites). We also conducted point counts (see below) at a forested site in each city to represent bird diversity and abundance in a less anthropogenic habitat.

6.4.1.3 Human Surveys

We attempted to conduct approximately 30 personal interview-style, door-to-door surveys at each site (see Table 6.2 for sample sizes). We posted flyers either in mailboxes or in public places about a week before surveying to notify residents of the survey. We first gave each participant information about the study and then asked questions from four sections: A, B, C, and D. Appendix A includes a sample survey of the English version used in Seattle. In Berlin, a German version of the survey was utilized.

Section A consisted of general questions about the respondents' actions and attitudes towards birds (see Appendix A; e.g. do they feed birds, how often they watch birds, if they are bothered by the noise birds make, did they do any actions to discourage birds from their home or yards). This section was designed to measure the level of engagement the participant had with birds and their general opinions of birds.

Section B included specific questions pertaining to the participants' perceptions of two contrasting bird species: finches and crows. Greenfinches (*Carduelis chloris*) and hooded crows (*Corvus corone cornix*) were used in Berlin and house finches (*Carpodacus mexicanus*) and American crows (*Corvus brachyrhynchos*) were used in Seattle (see Fig. 4). These species are found across all sites in each city. We chose these species to obtain a range of attitudes and actions people exhibit towards birds.

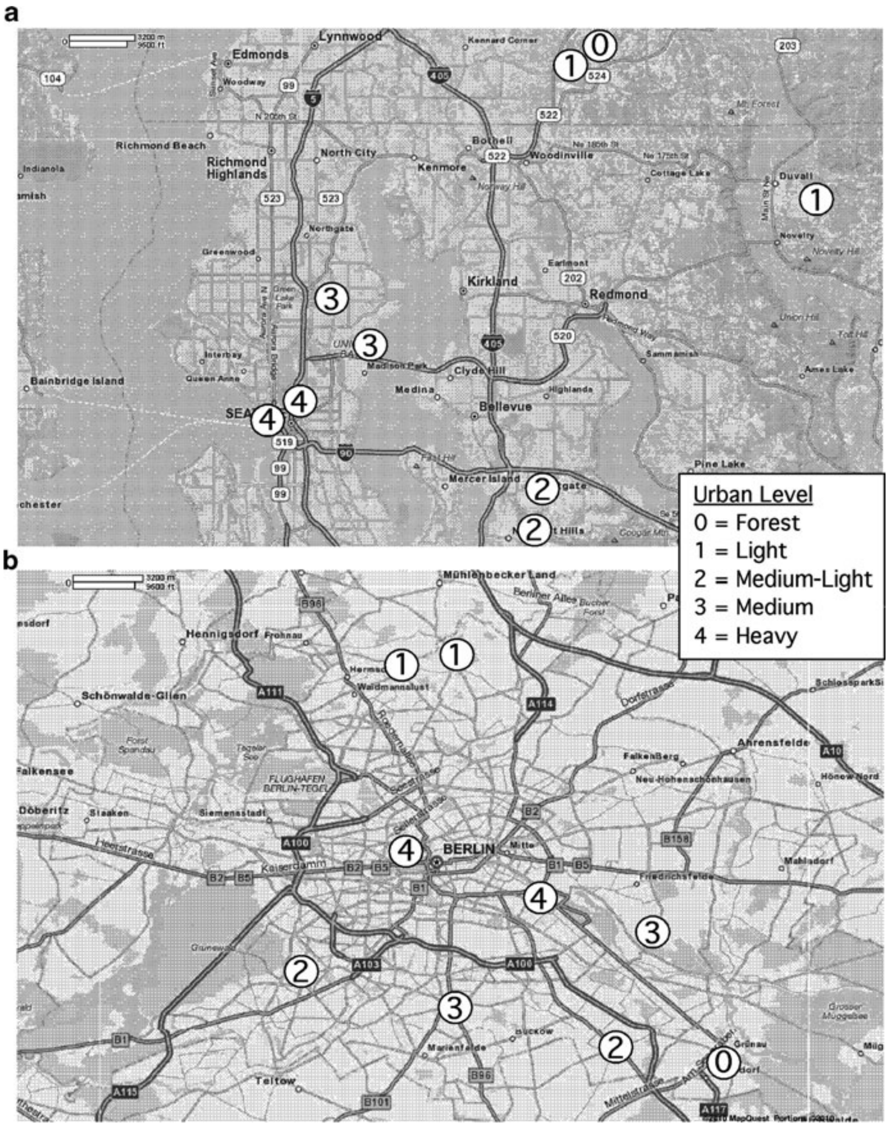

Fig. 6.2 Maps of study site locations in (**a**) Seattle, Washington, USA, and (**b**) Berlin, Germany

We expected that most people would have positive or neutral opinions about the finch species due to their charismatic coloration and vocalizations (finches produce melodic songs). In contrast, we expected most people to have neutral or negative opinions of the crow species because of their negative reputation (e.g. getting into trash) and relatively harsh vocalizations ("caws"). At the beginning of this section, the participant was shown a colour photograph of one of the species (finch or crow, see Fig. 6.4, order was varied across surveys) and asked if they recognized the bird

Fig. 6.3 Photographic images of study sites in (**a**) Seattle, Washington, USA, and (**b**) Berlin, Germany. From top to bottom: Heavy Urban, Medium Urban, Medium-Light Urban, and Light Urban (photograph credits: Seattle: Jacob Clifford; Berlin: Helena Franke)

Table 6.2 Human and bird survey information

City	Study site	Number of surveys	Percent feeding	Percent nest box	Number bird species
Seattle	Belltown	26	11.5	0	8
	Capitol Hill	25	24.0	4.0	13
	Ravenna	28	42.9	17.9	18
	Laurelhurst	25	28.0	16.0	32
	Somerset	25	64.0	48.0	28
	Westwood	29	53.6	13.8	28
	Maltby	25	72.0	24.0	28
	Duvall	26	65.4	30.8	39
	Lee Forest	0	0	0	24
Berlin	Moabit	52	28.8	5.8	16
	Kreuzberg	50	14.0	0	17
	Mariendorf	50	70.0	48.0	16
	Karlshorst	50	76.0	48.0	30
	Rudow	50	62.0	42.0	16
	Dahlem	50	62.0	36.0	20
	Lübars	31	67.7	38.7	28
	Blanken-felde	26	57.7	46.2	31
	Stadtforst	0	0	0	19

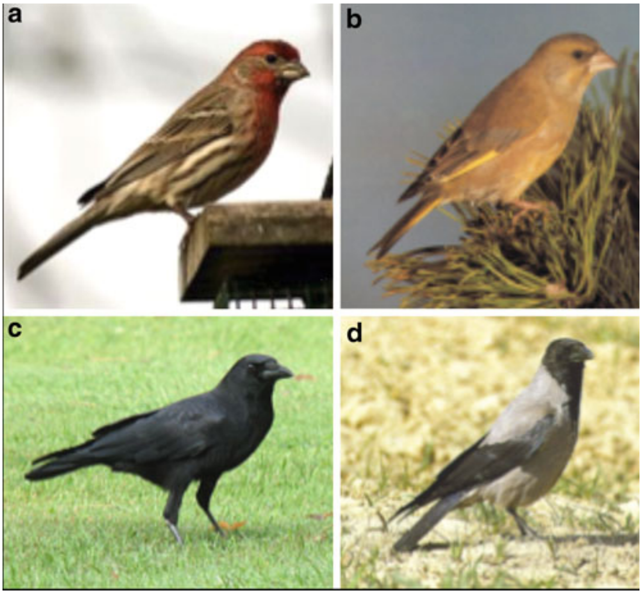

Fig. 6.4 Photographs of bird species used in the human survey: (**a**) house finch, (**b**) American crow, (**c**) greenfinch, and (**d**) hooded crow

(if they recognized the bird, they were also asked if they recognized its vocalization) and then were asked a series of questions that addressed the participants' attitudes and actions towards the species (e.g. how pleasing they found its visual appearance, if they encouraged or discourage it from their home or yard; see Appendix A).

In connection with Section B, Section C asked about willingness to pay for management efforts for finch and crow species (see Appendix A). Based on the participants' responses in Section B, they were asked if they would pay to conserve (positive responses in Section B) or reduce (negative responses in Section B) the species' population in the city. If the respondents' responses were neutral, they were asked both how much they would be willing to pay to conserve or reduce the species' population.

Finally, Section D consisted of demographic questions (gender, age, own or rent housing, schooling, income, etc; see Appendix A).

6.4.1.4 Bird Species Diversity and Nesting/Feeding Behaviour

We determined bird species diversity and abundance by conducting point counts of birds at each site using standard methodology (e.g. Donnelly and Marzluff 2006). Briefly, counts were conducted at three locations 250 m apart per site four times across the breeding season (once a month from April–July, in 2009 for Berlin and in 2010 for Seattle). A count lasted for 10 min and every bird seen or heard within a

50-m radius was recorded on a map of the location. Point counts conducted in the forest sites were done at least 500 m from human structures.

Bird species were categorized into groups based on nesting and feeding behaviours. Categories for nesting behaviour were open nester, primary cavity nester (excavates hole itself), or secondary cavity nester (utilizes a pre-existing hole). We characterized birds as those that forage on bird feeders provided by humans (including consistent to occasional use) and those that do not.

6.4.2 Results

6.4.2.1 Human Attitudes and Actions Towards Birds in Berlin and Seattle

We surveyed 209 residents in Seattle and 356 residents in Berlin. There were no significant differences in the number of males and females surveyed in either city; however, the age structure of Berlin residents was slightly skewed towards an older age (Fig. 6.5). The mean age of people surveyed differed between the two cities with Seattle having a mean of 49.64 years (±1.97 SE) and Berlin having a mean of 54.51 (±0.956 SE) (ANOVA: $F_{1,563} = 9.90$, $p = 0.002$). We found that a majority of respondents in each city watched or identified birds on a daily basis (Fig. 6.6) but that Berlin residents were more likely to watch or identify birds than were Seattle residents (Chi square: $X^2 = 19.37$, df = 5, $p = 0.002$). Residents in both cities rarely reported being concerned with disease transmission from birds (9.8% were somewhat to very much concerned) or bothered by the noise birds made around their homes (12.5% were somewhat to very much bothered).

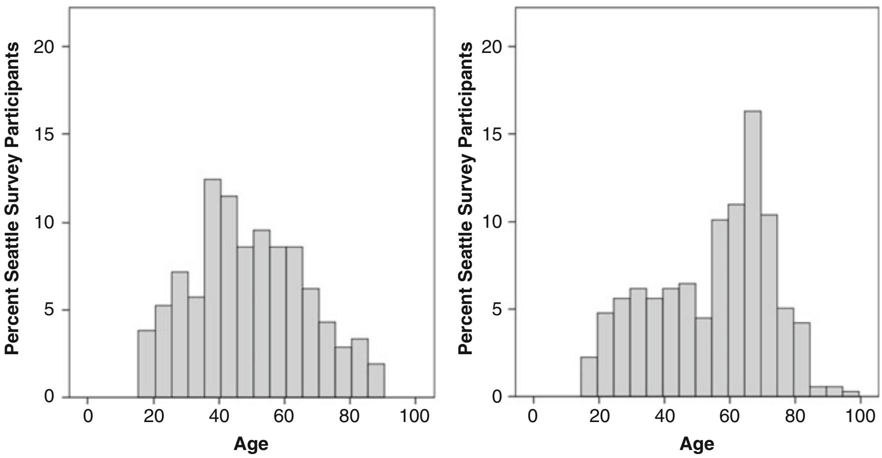

Fig. 6.5 Age distribution of survey participants in Seattle and Berlin

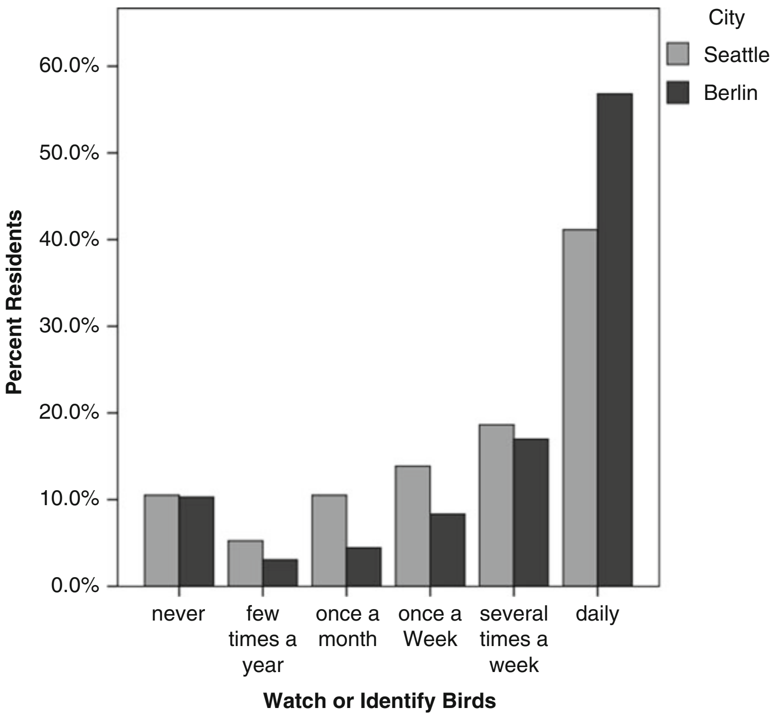

Fig. 6.6 Degree to which survey participants watch or identify birds in Seattle and Berlin

Table 6.3 Factors influencing bird provisioning (feeding and nest boxes) in Seattle and Berlin (Logistic Regression; asterisks indicate significant factors)

	B	S.E.	Wald	df	Sig.	Exp (B)
Percent residents feeding birds						
City*	0.442	0.206	4.609	1	0.032	1.556
Urban gradient*	−0.234	0.042	31.423	1	0.000	0.792
Age*	0.029	0.006	25.535	1	0.000	1.030
Own	−0.445	0.229	3.762	1	0.052	0.641
Constant	−0.620	0.368	2.836	1	0.092	0.538
Percent resident providing nest boxes						
City*	0.920	0.235	15.332	1	0.000	2.510
Urban Gradient*	−0.224	0.051	19.195	1	0.000	0.799
Age*	0.025	0.007	13.828	1	0.000	1.025
Own*	−1.154	0.284	16.500	1	0.000	0.316
Constant	−1.794	0.442	16.492	1	0.000	0.166

The percentage of respondents that fed birds was influenced by several factors: city, location on urbanization gradient, and age of respondent (Table 6.3). First, Berliners feed birds slightly, although significantly, more than Seattleites. Second, respondents living in heavy urban sites feed birds less than those living in medium

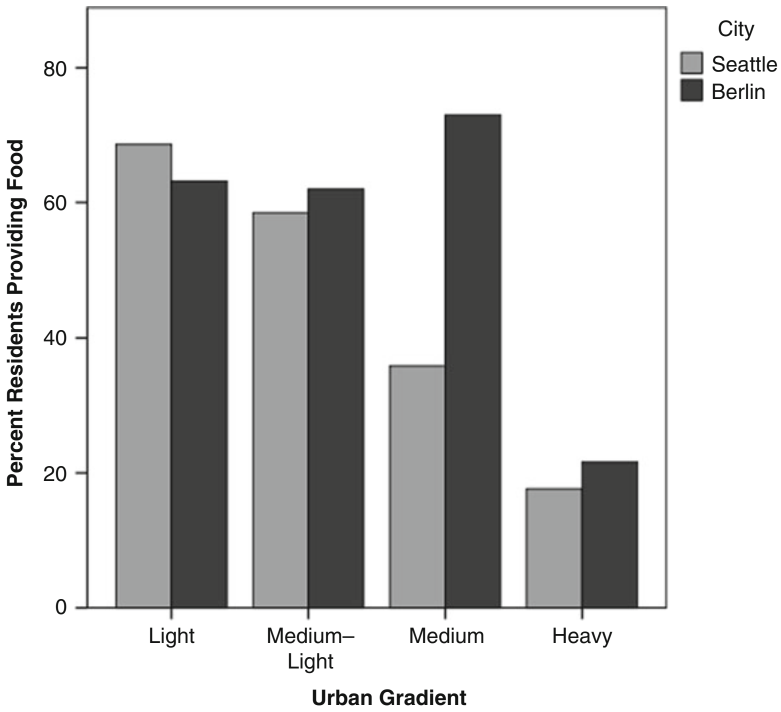

Fig. 6.7 Percent survey respondents that feed birds across the urbanization gradient in Seattle and Berlin

to light urban sites (Fig. 6.7). Finally, older respondents were more likely to provide food for birds than younger respondents. We found similar results for the percentage of respondents that provide nest boxes (Table 6.3, Fig. 6.8); however, there was a significant effect of housing type. Respondents that owned their homes were more likely to provide nest boxes than those that rented (Table 6.3).

Respondent perceptions of finches and crows differed dramatically (Fig. 6.9). In both Seattle and Berlin, survey participants thought the physical appearance and vocalizations of finches were more pleasing than the crows (Chi-square: appearance: $X^2 = 309.5$, df = 20, $p < 0.0001$; vocalizations: $X^2 = 52.32$, df = 25, $p = 0.001$; note that only a subset of respondents recognized the vocalizations of finches and/or crows; therefore, these results are 107 for finches and 457 for crows). We also found that respondents differed in whether they encouraged or discouraged crow versus finches (Chi-square: Seattle: $X^2 = 30.6$, df = 8, $p < 0.0001$, Berlin: $X^2 = 443.8$, df = 15, $p < 0.0001$). Respondents directed more discouraging behaviour towards crow species in both Seattle and Berlin (American crow = 19.6%, hooded crow = 10.8%) than finch species (zero percent for both house finches and greenfinches). Discouraging behaviour towards crows did not, however, differ across the urbanization gradient (Chi-square: Seattle: $X^2 = 36.00$, df = 32, $p = 0.287$; Berlin: $X^2 = 29.25$, df = 28, $p = 0.400$).

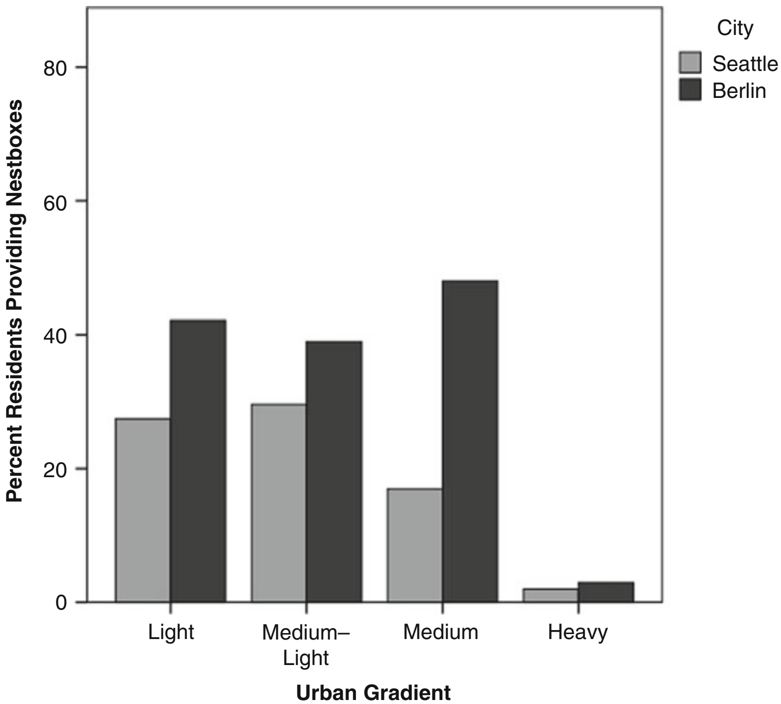

Fig. 6.8 Percent survey respondents that provide nest boxes for birds across the urbanization gradient in Seattle and Berlin

6.4.2.2 Human Influences on Bird Species Diversity and Nesting Behaviour

We counted 1,954 and 2,156 birds in Seattle and Berlin, respectively, across all sites and a total of 58 species in Seattle and 52 species in Berlin. Species diversity (number of total bird species) varied across the urbanization gradient (Fig. 6.10). The lowest species number was found in the city centres (heavy urban) and the highest number in the rural areas (light urban) (Fig. 6.10). Species diversity tended to increase from the city centre out to rural areas; however, there was a slight drop in the forest sites, a trend that has been previously been shown (Marzluff 2005). Interestingly, there was greater species diversity in the city centre sites in Berlin than in Seattle (Fig. 6.10). These relationships held for all species and when only considering secondary cavity nesting species (Fig. 6.11).

Supplementation was correlated with the number of bird species, and to a lesser extent with the number of individuals that use such provisions. The number of bird species that will eat at bird feeders was positively related to the percent of survey participants that feed birds (Pearson Correlation: $r = 0.564$, $p = 0.015$; Fig. 6.12). The number of secondary cavity nesters was also positively correlated with the percent of people that provide nest boxes (Pearson Correlation: $r = 0.756$, $p < 0.0001$; Fig. 6.13). The number of individual birds that use bird feeders was

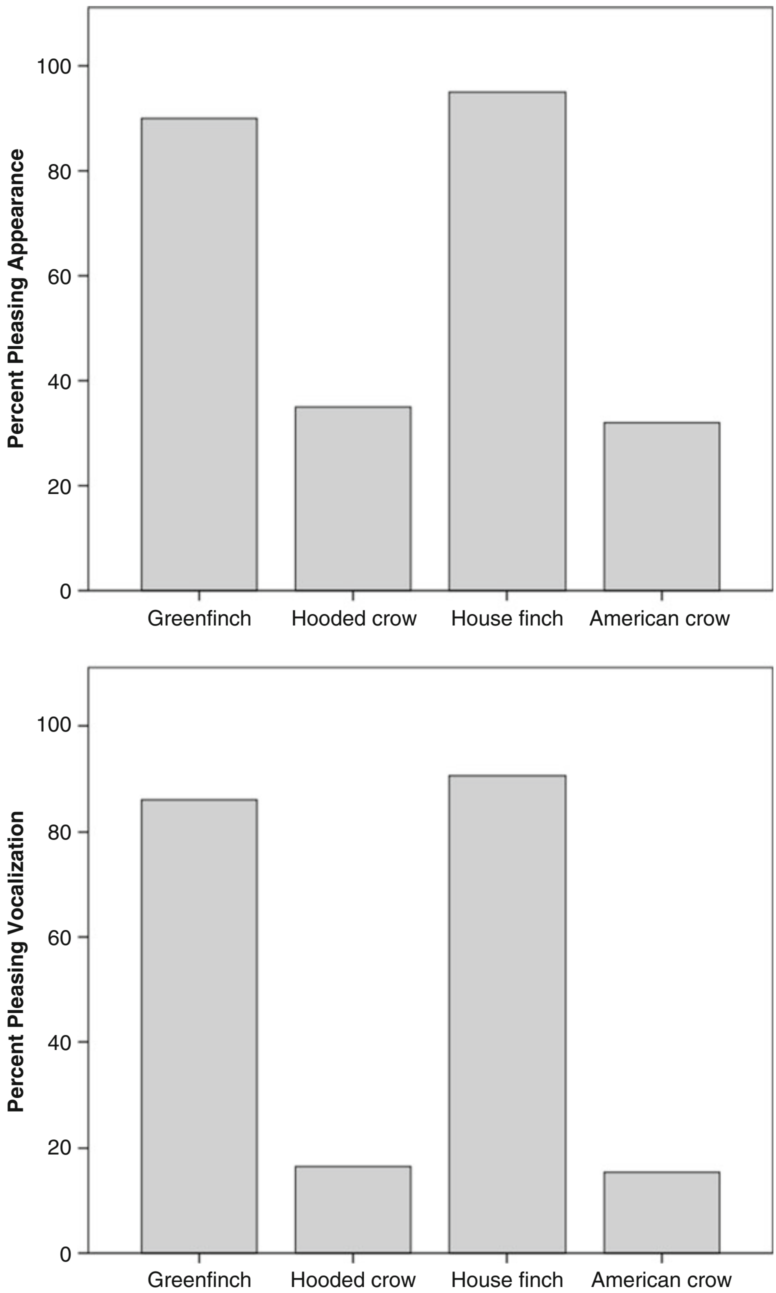

Fig. 6.9 Respondent perception of visual and acoustic characteristics of finches and crows in Seattle and Berlin

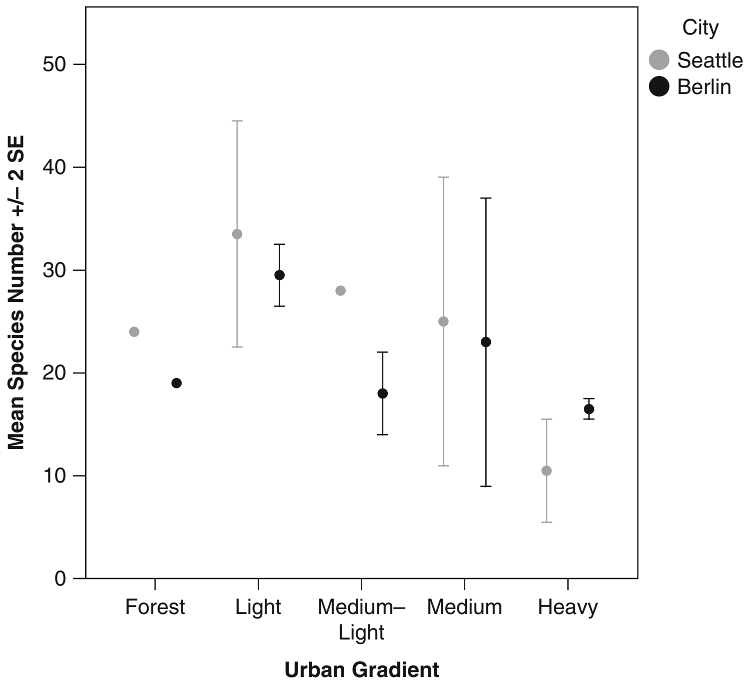

Fig. 6.10 Mean number of bird species across the urbanization gradient in Seattle and Berlin (error bars represent standard errors)

also correlated with the percent of residents providing feeders (Pearson Correlation: feeders: $r = 0.555$, $p = 0.017$). However, the number of individual secondary cavity nesters was not significantly correlated to the percent of residents providing nest boxes (Pearson Correlation: feeders: $r = 0.344$, $p = 0.162$).

6.4.2.3 Human Influences on Finches and Crows

Abundances of finch and crow species (house finches and American crows in Seattle, greenfinches and hooded crows in Berlin) varied across the urbanization gradient (ANOVA: Urban Gradient: $F_{3,16} = 10.24$, $p = 0.001$; Fig. 6.14). However, this response to urbanization differed among the different species (ANOVA: Species: $F_{4,16} = 6.63$, $p = 0.001$) and there was a significant interaction between species and urbanization gradient (ANOVA: Species*Urban Gradient: $F_{12,16} = 2.68$, $p = 0.034$). American crow numbers in Seattle increased linearly moving from forest and rural areas to heavy urban areas while hooded crows were not found in the forest site in Berlin and had similar numbers in light to medium urban areas, spiking in heavy urban areas (Fig. 6.14). House finches in Seattle had the greatest numbers in medium to medium-light urban areas and greenfinches in Berlin in

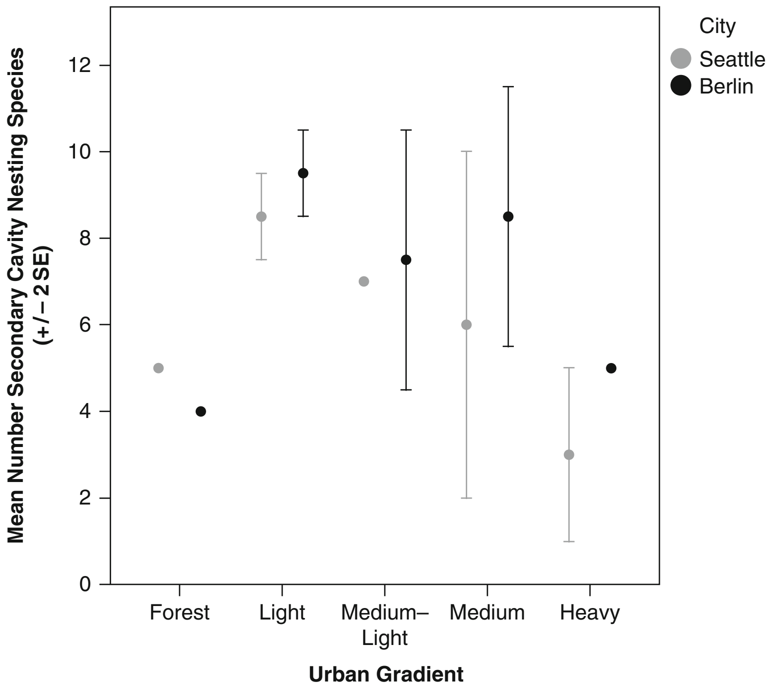

Fig. 6.11 Mean number of secondary cavity nesting species across the urbanization gradient in Seattle and Berlin (error bars represent standard errors)

medium to light urban areas but both species had relatively low numbers in heavy urban areas (Fig. 6.14).

We also found that abundances of greenfinches in Berlin were positively correlated with the percent of residents providing food for birds (Pearson Correlation: $r = 0.814$, $p = 0.004$) while this relationship did not exist for house finches in Seattle or either crow species. Discouraging behaviour towards crows did not have an effect on the abundances of crows in either Seattle or Berlin (Pearson Correlation: Seattle: $r = 0231$, $p = 0.550$; Berlin: $r = 0.019$, $p = 0.962$).

6.5 Discussion

As the number of avian ecology studies conducted in urban areas has increased (see Fig. 6.1), our understanding of urbanization's effect on native bird populations and biodiversity has improved. Notable factors that negatively affect birds are habitat alterations and fragmentation and the introduction of exotic species (Chace and Walsh 2006). However, we remain ignorant about how human behaviour can affect urban birds (but see Fuller et al. 2008), especially how humans affect the cultural

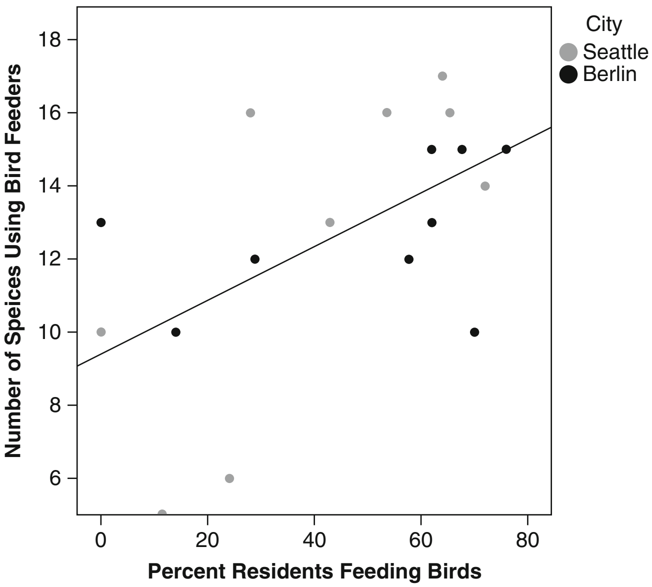

Fig. 6.12 Relationship between percent of survey participants that feed birds and the number of bird species that eat bird from feeders

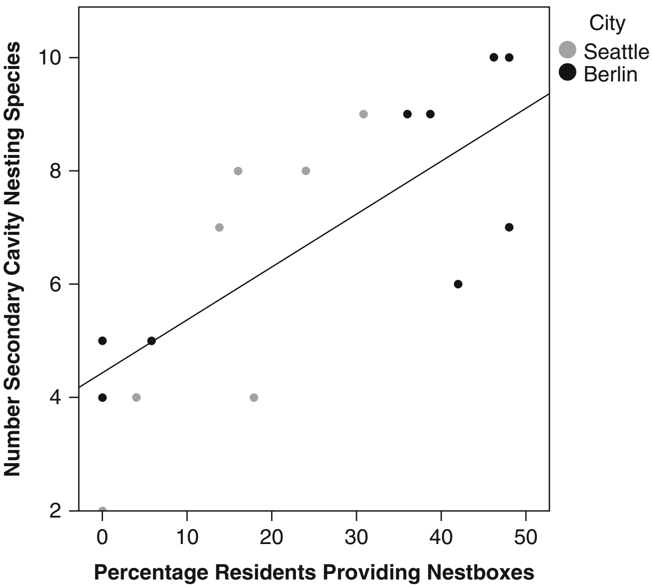

Fig. 6.13 Relationship between the percent survey participants that provide nest boxes and the number of secondary cavity nesting species in Seattle and Berlin

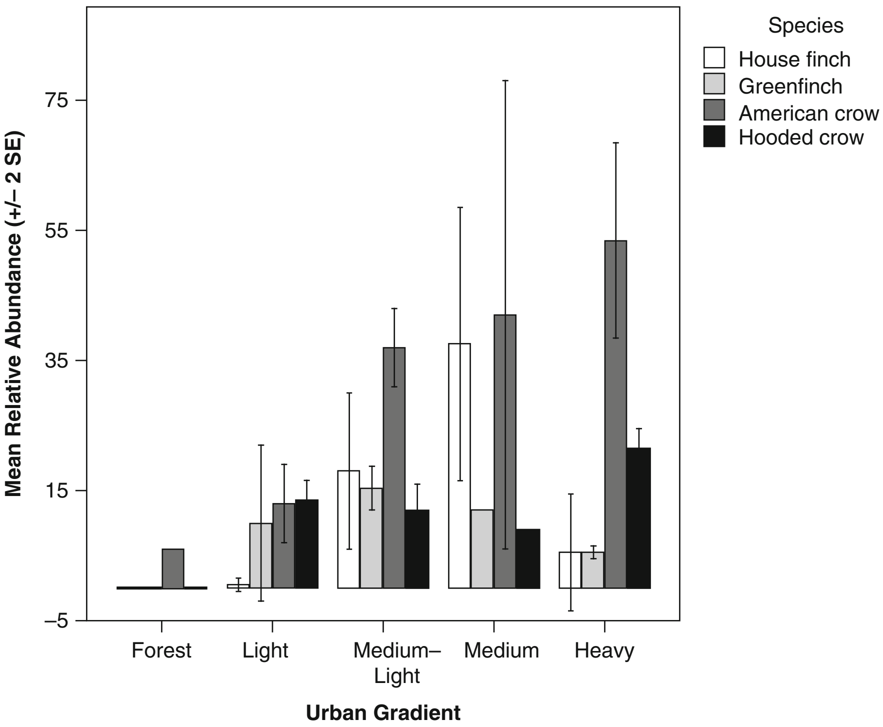

Fig. 6.14 Mean relative abundances of finch and crow species across the urbanization gradient in Seattle (house finch and American crow) and Berlin (greenfinch and hooded crow). Error bars represent standard errors

and genetic evolution in birds (Marzluff in press). We suggest that rather than focusing simply on how humans influence birds, we should study the reciprocal relationships between human and birds. The evidence for coupled human-avian relationships in urban areas suggests that such interactions can produce positive feedback loops (Clucas and Marzluff in press). Humans can promote the conservation or creation of bird habitat and feeding opportunities (e.g. Chamberlain et al. 2004; Fuller et al. 2008) and in turn, birds can provide a window into nature (Fuller et al. 2007). Thus, it will be important for urban avian ecologists to not only look at structural changes in the environment but also include humans (and their behaviour) as components of urban ecosystems. Moreover, researchers should also consider the effects of decreases in urban biodiversity on human well-being. A full understanding of these reciprocal relationships will increase our understanding of, and ability to conserve and restore, urban ecosystems.

Our research in Berlin and Seattle shows that not all native species are negatively affected by urbanization. Novel habitats such as abandoned fields and wastelands enable sensitive grassland species such as the wheatear to exploit cities. Novel subsidies such as the cavities in old buildings and food waste also enable predators such as the kestrel to flourish in cities. These species have adapted their behaviour to live in proximity to people.

These examples of individual species' adjustments to urbanization are mirrored at the community level. In both Seattle and Berlin, we found that species diversity varied across a gradient of urbanization. Light settlement (exurban to suburban, single family) was associated with increased bird diversity relative to no or to extensive settlement (Fig. 6.10). This beneficial influence of human settlement on bird species richness likely results from increased habitat heterogeneity (Marzluff 2005) and increased supplementation of resources (Figs. 6.7 and 6.8). While the pattern of bird diversity and human settlement was similar in both cities, there was slightly higher species diversity in the city centre of Berlin than Seattle. It is possible that the large difference in the time since first human settlement and urbanization of these two cites (at least 200 years) may have allowed more species in Berlin to adapt to heavy urban conditions (see Martin and Clobert 1996). In addition, that Berlin's birds are closely attuned to the actions of humans is also indicated by the positive relationship between abundance of greenfinches and bird feeding by humans. This was not the case in Seattle, where house finch abundance was not strongly correlated with bird feeding.

6.5.1 Importance and Influence of Ex Situ Supplements

We found that Berlin residents supplement birds (by providing food and nest boxes) more than residents in Seattle. Nevertheless, the percentages of residents providing food in both Seattle and Berlin were relatively high (55% in Berlin and 45% in Seattle). Thus, the urban systems we studied had substantial ex situ inputs (meaning inputs from outside the natural ecosystem). These inputs affect at least two conspicuous guilds of birds: seed eaters and secondary cavity nesters. The provisioning of seeds appears to increase the number of seed-eating species and the provisioning of nest boxes appears to increase secondary cavity nesting species. Compared to forested control areas without supplementation, the diversity of secondary cavity nesters is nearly doubled in the light to moderately settled neighbourhoods we studied where provisioning of nest boxes was greatest. In addition, similar to results found in Sheffield, United Kingdom (Fuller et al. 2008), we also found that the abundance of individuals of species that eat from bird feeders increased with the percent of residents supplying food. However, we are uncertain that this is the entire story. Certainly, resources drive bird population increases, but it is also conceivable that as cavity nesters and seed eaters become more frequent in people's yards, the experience of seeing birds may also drive human behaviour to provision more. Birds and humans likely affect each other in a reciprocal manner.

6.5.2 Supplementation Couples Human and Natural Systems

The reciprocal nature of the relationship between birds and people was evident in both Seattle and Berlin. In both cities, people typically watched or identified birds on a daily basis (Fig. 6.6). People typically reported birds as pleasing aspects of their environments and rarely reported discouraging them from their yards and residents. Thus, in our study, the positive feedbacks between people and birds such as the connection between provisioning, increasing diversity, and pleasure of watching and observing birds appear more important than negative feedbacks such as attracting birds to garbage, fear of disease, annoyance of noise, and

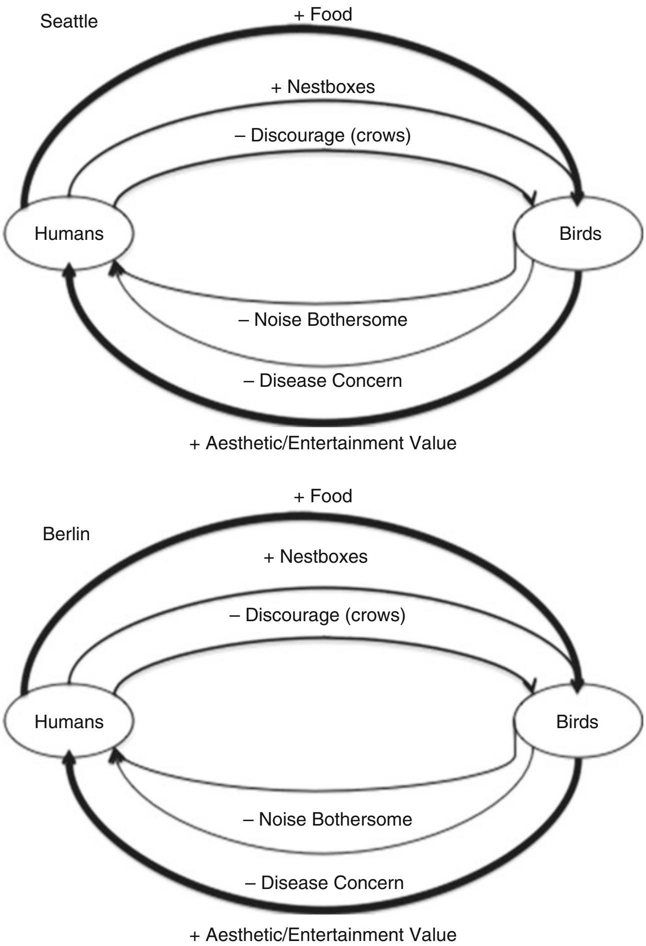

Fig. 6.15 Connections between humans and birds in Seattle and Berlin. Positive connections are indicated by "+", while negative connections are indicated by "–". The thickness of the connecting lines depicts the magnitude of the connection (thicker lines = stronger connection)

reducing population size. The relative importance of positive and negative feedback loops in Seattle and Berlin is similar (Fig. 6.15), but in need of greater elucidation. For instance, supplemental feeding may have positive effects on some bird species (e.g. greenfinches) but may create negative impacts for other species sensitive to disease transmission or interspecific competition (Robb et al. 2008).

The relationship between birds and people is not consistent along the gradients of urbanization we studied. In both Seattle and Berlin, residents in city centres who typically rented rather than owned their homes provided few subsidies for birds and encountered few species of birds. Such "ecological poverty" is typical of city centres (Lehrman and Warren in press), although the cause and effect nature of the relationship is not clear. We suggest that increased subsidies in city centres, especially in the form of nest boxes and well-maintained bird feeders could increase the diversity of birds and the resultant ecosystem services and health and well being benefits (e.g. Fuller et al. 2007) they provide to urban people.

Appendix A

Number of questionnaire--------------.
Date..
Day of the week...................................
Time of day..........................
Study site..
Street and street number.............................

Human-Bird Interactions in Urban Areas

Hello, my name is …and I am from the University of Washington here in Seattle. You may have read a flyer about the survey we are conducting in your neighborhood. This survey is part of a research project aimed at better understanding how people and animals interact around their homes. In particular, we are interested in your opinions about birds. We would greatly appreciate if you could take 20 minutes of your time to complete the survey.

A. Our first set of questions is designed to understand your basic interactions with birds at your home

1. How often do you notice birds around your home?
- ☐ Daily
- ☐ Several times each week
- ☐ About once a week
- ☐ About once a month
- ☐ A few times a year
- ☐ Never

2. How often do you watch or try to identify birds around your home?
- ☐ Daily
- ☐ Several times each week
- ☐ About once a week
- ☐ About once a month
- ☐ A few times a year
- ☐ Never

3. 3. Do you try to attract birds to your home with food, plants or nesting materials? Yes No *(If no, go to 4)*
If yes,

3.a. Do you provide food? Yes ☐ No ☐ (If no, go to 3b)

3.a.1. Do you feed them
- ☐ in the winter
- ☐ in the summer
- ☐ all year round

3.a.2. For how many years have you done so?

3.a.3. What foods do you provide?
- ☐ Basic bird seed
- ☐ Suet balls (or the like)
- ☐ Bread
- ☐ Kitchen scraps
- ☐ Special food for finches
- ☐ Special food for insect eating birds
- ☐ other

3.a.4. (If you buy food) How much do you spend on bird food per month (per winter/per summer)?

3.b. Do you provide nesting material (including bird houses)? Yes ☐ No ☐ *(If No, go to 3c)*

3.b.1. How many bird houses do you provide?

3.b.2. For how many years have you done so?

3.b.3. How much do you spend per month (per year) on nesting material? (If you can't estimate an amount of money, then how often to you purchase materials, how much do you get, and what type do you usually get?)

3.c. Do you provide plants to specifically attract birds?

Yes ☐ No☐ *(If No, go to 3d)*

3.c.1. What kinds of plants?

3.c.2. For how many years have you done so?

3.c.3. How much money do you spend per month (per year) to improve your garden (balcony/windowsills) for birds?

3.d. Are there other activities you do around your house for birds (e.g., bird baths)?

4. Do birds do any damage to your home or yard? Yes ☐ No ☐ *(if No, go to 5)*

4.a. Which of the following problems have you experienced from birds around your home?

☐ Damage to landscape plants
☐ Damage to fruits or garden
☐ Droppings on house/car
☐ Damage to house
☐ Other

4.b. Are you concerned about damage done by birds to your home? Yes☐ No☐ (if yes…)

4.b.1 How much money do you spend each month (per year) to repair damage by birds?

4.b.2 How much time do you spend each month (per year) repairing damage by birds?

5. Are you concerned about disease carried by birds in your backyard/around your home?

☐ Very much
☐ Somewhat
☐ Not really
☐ Absolutely not

6. Are you bothered by the noise that birds make around your home?

☐ Very much
☐ somewhat
☐ not really
☐ absolutely not

6a. If you are bothered, what is it about the bird song that is bothersome (for example, time of day, volume, tone)

7. Do you have a cat(s) that go(es) outdoors? Yes☐ No☐

7.a. How often do you observe your cat(s) catching birds around your house:

☐ Never
☐ Several times each year
☐ About once a month
☐ About once a week
☐ Several times each week

7.b. Do you have a dog(s)? Yes☐ No ☐

7.c. How often do you observe your dog(s) catching birds:

☐ Never
☐ Several times each year
☐ About once a month
☐ About once a week
☐ Several times each week

8. Have you found birds injured or killed by windows at your home?

Yes ☐ No ☐ *(If No, go to 9)*

8a. If yes, how often (can you estimate how frequently per year or how many birds?)

9. Do you use methods to try to keep birds from your home, for example scarecrows? Yes☐ No ☐ *(If No, go to 10)*

9a. If yes, which methods?

9b. If yes, for how long have you done so?

10. How important are environmental or conservation issues to you, relative to other issues like health care, national security, education, and the economy?

☐ Most important
☐ Very important
☐ Moderately important
☐ Least important

11. Do you belong to any organizations that support bird conservation? Yes ☐ No ☐

11.a. If yes, which ones?

11. b. For those you belong to, what do you do?

☐ donate time
☐ donate money
☐ attend meetings
☐ committee work

B. B. Now we would like to ask you a few questions about 2 common birds: ***Show photos (order <u>randomly</u>)***

1. Please name this bird, if you can.

------------------------- -------------------------

☐ House finch ◯ American Crow

<u>If person did not know the bird, tell them now…</u>

2. Do you know its song or call?

Yes ☐ No ☐ *(If no, go to 3)*

Yes ◯ No ◯

2.a. Do you find its song/call:

☐ very pleasing ◯
☐ pleasing ◯
☐ neither pleasing nor displeasing ◯
☐ displeasing ◯
☐ very displeasing ◯

3. Do you think this bird's coloration is:

☐ very pleasing ◯
☐ pleasing ◯
☐ neither pleasing nor displeasing ◯
☐ displeasing ◯
☐ very displeasing ◯

4. Do you

☐ strongly encourage ◯
☐ encourage ◯
☐ neither encourage nor discourage ◯
☐ discourage ◯
☐ strongly discourage ◯

this bird from your home?

5. 5. If this bird comes to your feeder or nests on your house it would be?

☐ very enjoyable ◯
☐ enjoyable ◯
☐ do not care ◯
☐ a nusisance ◯
☐ a strong nusisance ◯

Please indicate the degree to which you agree or disagree with the following statements about this bird:

6. This bird increases my stress.

☐ strongly agree ◯
☐ agree ◯
☐ disagree ◯
☐ strongly disagree ◯
☐ no opinion ◯

7. This bird helps control insect pests.

☐ strongly agree ◯
☐ agree ◯
☐ disagree ◯
☐ strongly disagree ◯
☐ no opinion ◯

8. This bird brings good luck

☐ strongly agree ◯
☐ agree ◯
☐ disagree ◯
☐ strongly disagree ◯
☐ no opinion ◯

9. This bird is a bad omen.

☐ strongly agree ◯
☐ agree ◯
☐ disagree ◯
☐ strongly disagree ◯
☐ no opinion ◯

10. This bird eats baby birds.

☐ strongly agree ◯
☐ agree ◯
☐ disagree ◯
☐ strongly disagree ◯
☐ no opinion ◯

11. FOR THOSE WHO ANSWER QUESTION 4 ABOVE as Neither Encourage or Discourage, Encourage, or Strongly Encourage:

Different cities are actually concerned about declines in this species' abundance. They are considering local and regional restoration programs to improve urban parks and greenspaces for the birds and even considering feeding programs, breeding and release programs. We are investigating this issue in Seattle. If Seattle was to initiate a program to increase this species' population it would cost the city. We estimate that this program would cost an additional $…. in your taxes .

Choose at random from the following annual cost schedules. (for example, if schedule 1 is selected, you as first would you be willing to pay $60 to reduce the species, if they answer yes, then you ask, would you be willing to pay $120, but if they answer no, you ask would you be willing to pay $15.

Would you support a program with that (mid level in random selection) cost to increase this bird species?

Yes☐ No☐

Yes◯ No◯

IF yes, would you support a program with higher (upper amount in random selection) cost to increase this bird species? Or
IF no, would you support a program with lower (least amount in random selection) cost to increase this species?

Yes ☐ No ☐
Yes ○ No ○

1. 15, 60, 120
2. 15, 60,150
3. 15, 90, 120
4. 15, 90, 150
5. 45, 60, 120
6. 45, 60, 150
7. 45, 90, 120
8. 45, 90, 150

12. FOR THOSE WHO ANSWER QUESTION 4 ABOVE as Neither Encourage or Discourage, Discourage, or Strongly Discourage:
Some American cities are concerned about the damage this species does to populations of other native birds and human well-being. We are investigating this issue in Seattle. If Seattle was to initiate a program to reduce this species population by cleaning waste grain and garbage from our streets, and even by trapping and removing birds (Tokyo, for example has hired professional bird exterminators to reduce some birds) it would cost the city We estimate that this program would cost an additional $….. in your taxes (the value you state here is the mid value from the selections below, read on for directions)

Would you support a program with that (mid level in random selection) cost to reduce this bird species?

Yes ☐ No ☐
Yes ○ No ○

IF yes, would you support a program with higher (upper amount in random selection) cost to reduce this bird species? Or
IF no, would you support a program with lower (least amount in random selection) cost to reduce this species?

Yes ☐ No ☐
Yes ○ No ○

C. Now we are almost at the end of the questionnaire. It will help our analysis if record some basic information:
1 a: Gender:
1 b: How old are you? ☐ [If they don't want to answer, estimate: 18-29 30-59 >60].

2. Do you rent or own your place? 2.a. How many people live in the household?

3. How long have you resided here? 3.a. How long have you lived in Seattle?

4. If have or had children, have you involved them in observing or learning about birds? Yes ☐ No ☐
no kids ☐

5. What is your education?

☐ High School
☐ Community College/Technical College
☐ University/College
☐ Higher (e.g., masters, Ph.D, professional degree)

6. What part of the country were you born (circle)?

Pacific Northwest West Coast (California) Central West East Coast Southwest Midwest South Southeast Other:

7. Where you raised in a rural or urban environment or both?
☐ Rural
☐ Urban
☐ Both

8. What is your employment status?
☐ Full time
☐ Part time
☐ Retired
☐ Unemployed
☐ Others:

9. What is this household's annual income? (over the last year)

- ☐ 25, 000 or below
- ☐ 25,001- 50,000
- ☐ 50,001- 75,000
- ☐ 75,001 – 100,000
- ☐ 100,001 - 150,000
- ☐ 150,001 – 200,000
- ☐ 200,001 or greater

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