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The Impact of Urban Life on Bird Communities and Ecosystems

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Abstract: *Urban environments have profound impacts on avian behavior and ecology, leading to both adaptive and maladaptive consequences for bird populations. This editorial explores how urbanization influences bird behavior, including changes in foraging patterns, vocal communication, and nesting strategies, as birds adapt to the challenges of city life such as noise pollution, increased human presence, and altered food availability. Additionally, the ecological consequences of urbanization on bird populations are examined, including shifts in species diversity, changes in predator-prey dynamics, and the potential for urban areas to serve as ecological traps. By understanding these behavioral and ecological responses, this editorial highlights the importance of mitigating the negative effects of urbanization on bird populations and fostering coexistence in increasingly urbanized landscapes.*

Keywords: Urbanization, Adaptation, Behavioral Plasticity, Habitat Fragmentation, Anthropogenic Effects

I. INTRODUCTION

Globally, the footprint of urban areas is growing, and between 2000 and 2030, it is predicted that the amount of land covered by cities will treble. This abrupt shift from naturally occurring or sparsely cultivated land to impermeable surfaces and constructed environments has changed the distribution and composition of species, homogenized communities, and even caused local extinctions. Urbanization is anticipated to be one of the biggest dangers to the persistence of species in the future since hotspots for biodiversity are expected to host the most intensive urban growth. However, cities still host around 20 percent of the approximately 10,000 known bird species. Therefore, it is just as crucial to comprehend the enabling variables that let species to endure in urbanized environments as it is to pinpoint the causes of species extinction.

This issue, "Behavioural and Ecological Consequences of Urban Life in Birds," has thirty papers that, using a variety of perspectives—such as biogeography, community ecology, life cycle evolution, and physiology—offer insights into how different species are responding to urbanization. A recurring subject in several of the publications is behavioral responses, partly because behavior often characterizes early reactions to urbanization and offers insights into how certain animals manage urban environments, human presence, and new resources and circumstances. As Topic Editors, our goals were to showcase global research, particularly those carried out outside of North America and Europe, as well as to cover a broad spectrum of subjects and methodologies. Given that the Southern Hemisphere has the greatest levels of bird variety in the world yet is a relatively understudied region, we think it is important to cover study in this area. The papers in this issue include more than 700 bird species, with 19 different countries from 6 continents represented. The great tit, the house sparrow, and the blackbird were, predictably, the top three species for comparisons between urban and rural areas. This trend supports the idea made in the contributing work by, who demonstrate how urbanization influences not only the birds but also the way that we, as academics, analyze them. A species is examined more often the more urbanized it is.

Here, we go over and summarize the main conclusions of this problem. The papers provide a good summary of the overall developments in urban ecology, particularly as it relates to birds. To preserve bird variety on a globe that is becoming more and more urbanized, these studies also address a number of outstanding concerns at the macro- and micro-ecological levels as well as phenotypic and evolutionary responses to environmental change.

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Fear and Boldness

Bird watching and bird feeding are popular pastimes for millions of people worldwide, however from the birds' point of view, these activities are not necessarily mutually beneficial. Birds have to consider the danger involved in every contact, even though people often find it enjoyable and encourage birds to approach.

It's a widely held belief that urban birds should be less afraid of people than their rural counterparts. A number of contributing studies address the possible dread that birds may feel by using flight initiation distance (FID) as a stand-in for "fear" of people; that is, the lower the FID, the closer humans may get to the bird and the more fearless it is. In fact, two meta-analyses of 32 and 42 European species, respectively, show that the longer a species has been urbanized (i.e., since it first colonized a city), the shorter its flight index distribution (FID) and, most likely, the lower the level of anxiety experienced by the birds. In addition, mating couples in urban as opposed to rural environments showed more fearlessness of people, according to a field-intensive research on burrowing owls.

What, however, motivates such patterns? Specifically examined the degree to which encephalization influenced urban birds' tolerance level, however in this collection of 42 species, there was no discernible correlation between brain size and FID. It's interesting to note that the authors of the two meta-analyses offer opposing interpretations for the shorter FIDs of urban birds. They used statistical methods to separate plastic responses from patterns of non-random distributions of behavioral variation in FID and aggression in the great tit, and they either released selection via reduced predation or enhanced selection of birds with low responsiveness toward humans. The startling finding was that the two behavioral axis were not distributed randomly; brave birds were more common in regions with more automobiles but fewer people, whereas terrified people were more common in areas with less cars and more people. Non-random settlement, habitat- and type-specific survival, or irreversible plasticity in response to prolonged exposure to urban environmental stress are a few possible reasons for this trend. It was discovered that loud metropolitan settings encouraged closer human approaches and, thus, shorter FIDs than more peaceful habitats. This discovery may account for the surprising finding of shorter FID with fewer people.

Using other methods, behavior was examined in other submitted publications. Two studies looked at how great tits in both urban and rural areas coped when handled—a method that is often used to gauge hostility. Senar et al. discovered that whereas great tits from Montepellier showed no such changes, urban tits utilized a more proactive coping technique, as shown by more distress cries and greater pecking rates. Rather, in a new setting, the urban great tits from Montpellier were more adventurous, which is in line with the reported exploratory behavior of urban burrowing owls. The research also used staged trials with a confined mount and song playback to assess great tit aggressiveness. Regarding FID, boldness rose as traffic volume grew.

Behavioral and Fitness Consequences ofHuman-Provided Resources

One of the most obvious ways that urban landscapes vary from non-urban environments is the novelty, availability, and regularity of supplies like bird feeders and nest boxes. However, there are significant differences in how urban-dwelling animals react to and depend on human-provided resources. The "urban adapters" are more opportunistic, whereas the so-called "urban exploiters" are often found in cities and rely on manmade resources.

Although the degree to which human resources benefit or harm birds differs among species, ecosystems, and regions, a number of the articles in this issue provide fresh perspectives in this regard. When compared to natural ecosystems, anthropogenic resources like invasive fruits and birdseeds may provide more homogeneous and predictable environments, which lower selection pressures. This idea is supported by Rodewald and Arcese's findings, which show that, despite similar variations in physical condition, female Northern cardinals in urban settings exhibit less diversity in reproductive contributions both within and among them. In this sense, the performance range of rural women was larger than that of urban women, who were rather homogenous. Reynolds et al. point out that although feeding birds is linked to a number of beneficial effects for birds, community responses might vary throughout continents and hemispheres. In the Southern Hemisphere, for instance, gregarious non-native species often predominate at feeding tables. In fact, according to Galbraith et al., 10 of the 11 species that were seen in New Zealand using urban bird feeders were non-native, including the two dominant species of spotted dove (Streptopelia chinensis) and house sparrow (P. domesticus). The patterns of abundance and dispersal that these species exhibit may be explained by this enhanced advantage for invasive species.

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The trade-offs between the amount and quality of resources associated with cities is discussed in other sections, especially in cases when the resources are less varied and have lower nutritional value. The nutritional fatty acid physiology of four common passerine species varied between urban and rural settings, as reported by Isaksson et al.; these changes were not linked to particular diets. Instead, the fatty acid profiles of urban tits and sparrows imply that the two families' urban diets may have an impact on the birds via two distinct mechanisms, oxidative stress and inflammation, respectively.

Food is not the only urban resource, of course; nest boxes draw a lot of birds, particularly in areas where there aren't enough natural holes. Nest boxes may help some species reproduce more successfully and enable them to colonize places that they otherwise would not have been able to. However, if nest boxes are placed in more accessible locations than natural cavities, there may be a higher chance of predation. In line with this theory, a meta-analysis carried out by revealed that, unexpectedly, in less urbanized locations, artificial nests were less likely to be depredated than natural nests. No biological factors were found, despite the possibility that variations may be due to changes in predator number, composition, or behavior between rural and urban environments. Weather is another ecological aspect, in addition to predation, that may affect the effectiveness of breeding in an artificial nest box. It was unexpected to read in Duckworth et al. that nest boxes are often less insulated than natural nest cavities and, as a result, are linked with decreased nestling survival in inclement weather, despite the painstaking attention to detail that goes into their design and construction.

Physiological and Behavioral Effects to Novel Abiotic Stressors

Pollution from noise, artificial nighttime lighting, and air pollutants is often linked to urbanization. show that the majority of non-essential metals were not detected in the blood of great tigers living in both urban and country settings, despite the fact that nitrogen gas levels were consistently greater in urban than in rural locations.

Pollution does not just impact birds via passive exposure. Some urban birds even go out of their way to find harmful materials to place in their nests, such the butts of cigarettes. This has been shown to lessen the nestlings' ectoparasite burden in the past. The genotoxic effects of cigarette butts on the loving parents of house finches and house sparrows from Mexico City are shown in this contributed research. This resulted to an intriguing trade-off between DNA damage and parasite repellence. This issue's studies explore several different indicators of cellular stress and injury, including telomere length, oxidative damage to proteins and lipids, and the expression of inflammatory genes in passerines from urban and rural areas. The findings showed conflicting information for different species; sparrows, for example, exhibit generally more harm from urbanization than do tits. The precise causative factor causing the stress and harm that urban birds endured could not be determined despite several correlation studies. Welbers et al., on the other hand, experimentally changed ALAN by exposing breeding great tits to white, green, or red LED light or leaving them in the dark as a control. They then examined the impact of this manipulation on daily energy expenditure the study found that during chick feeding, the DEE of great tits exposed to white and green light was considerably lower than that of those subjected to the control treatment. The authors interpreted this trend as an indirect result of the positive correlation between lights and bug abundance. This is a fascinating benefit of an urban pollution source that might counteract some of the more detrimental ones.

An increasing body of research indicates that noise pollution has a significant impact on birds' ability to communicate acoustically and that many bird species exhibit changes in the amplitude, frequency, and temporal features of their songs that improve their chances of being heard by listeners. This issue includes two essays on acoustic communication in urban settings. The first of these, by Sewall and Davies, finds that brain expression of an early gene, a proxy for recent neural activity, differs between groups living in urban and rural areas. This finding suggests that behavioral differences in song sparrows may be due to variations in neuronal reactivity to stimuli. Another research by Sierro et al. demonstrates that European blackbirds reduce the portion of their song with the lowest amplitude in the specific noise environment of an airport by altering the content of their song but not its overall frequency characteristics. Furthermore, during the season when overcraft activity most closely coincides with the morning chorus, birds near the airport increase the time of their singing. However, later in the season, when singing naturally occurs considerably sooner than airport activity, this advance vanishes.

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Reproduction and Life History

Part of the task in comprehending the ecological and evolutionary effects of urbanization is figuring out how urban-related variables affect fitness in phenotypes, populations, and species. While some publications revealed that breeding performance and condition were similar in rural and urban populations, others claimed that cities decreased breeding success via a variety of mechanisms, including clutch size, fledgling success, and chick quality.

While predation is sometimes blamed for decreased production, this trend might simply be the result of urban birds choosing a slower pace of life than their rural counterparts. In this special issue, Charmantier et al. disprove the notion that city dwellers lead leisurely lives by demonstrating that, while producing smaller clutches, metropolitan great tits exhibit behavioral traits associated with a fast-paced lifestyle. Therefore, rather than these variations resulting from an appropriate life-history strategy, it seems that the urban great tits in our research were restricted during reproduction. One limitation may be a mismatch between the time of breeding and the availability of food, or it could be a reduced general access to natural, high-quality meals.

In urban communities, phenological changes may also affect reproduction. Cities often exhibit phenological advancements in the spring, with earlier bud burst and insect emergence, as a result of their higher temperatures. Birds' ability to reproduce may suffer if they are unable to adapt to this environmental shift. On the other hand, a great tit research revealed that urban birds in this case advance their breeding, which is consistent with the earlier phenology of a city. By contrast, the black sparrowhawk's breeding performance in urban and rural regions revealed distinct seasonal patterns; in urban settings, it declined throughout the season, while in rural environments, it improved. However, this was not the time of the mating season. Since black sparrowhawks are relatively new to Cape Town's urban environments, it's possible that the purported benefits of early nesting in the city haven't yet materialized. The fundamental mechanism of male dark-eyed juncos' ability to advance the date of breeding is examined in the contributed work by Fudickar et al. They demonstrate that the earlier timing of breeding in the urban population is supported by an earlier release of gonodal suppression affecting testosterone production and an earlier increase in upstream baseline activity of the hypothalamic-pituitary-gonadal axis by comparing sedentary urban birds with migratory individuals.

Biodiversity and Conservation in UrbanHabitats

One of the biggest dangers to biodiversity on our planet is urbanization. The majority of writers at least mentioned the conservation implications of their results, and many papers in the special issue specifically addressed this problem. Shryock et al. demonstrated, with an emphasis on the Seattle Metropolitan region in the US that urban development acts as a mediating factor in the correlations between bird species richness and vegetative production as determined by the Normalized Difference Vegetation Index. In particular, they discovered that species richness decreased with NDVI in places that were still developing, although this was not as noticeable in areas with existing residential developments and wooded reserves. The functional diversity of bird populations may be impacted by urbanization in ways that might have an impact on ecosystems as a whole. Using 27 characteristics from over 500 species, Oliveira Hagen et al. analyzed the bird functional diversity of 25 metropolitan regions. It is noteworthy that the researchers discovered a greater level of bird functional variety in cities as opposed to semi-natural habitats. This finding is likely due to the fact that cities have more functional habitat diversity than single habitats seen in more natural settings. According to these two studies, by preserving or reintroducing a variety of natural plant types, urban planners may be able to mitigate the negative effects of urbanization on the bird population. According to Evans et al., habitat management may also help species move more easily and disperse, which may be restricted in urban environments even for very mobile creatures.

Many species' living circumstances and interspecific interactions are impacted by the altered habitat layout and simplified avifauna composition in urban areas; this may greatly benefit some species while negatively affecting others. The North American brown-headed cowbird is one species that has profited from these changes. The population density of this brood parasite species has grown in response to deforestation. Concerns about this species' rising abundance for other urban-dwelling birds are expressed in two contributed studies. Several local bird species are directly harmed by cowbirds, people, and feral canines, according to a first research by Stiles et al. The second study by Ladin et al. tests potential solutions to stop cowbirds' detrimental effect on the wood trush, a forest canopy species, population expansion. According to their simulations, replanting and cowbird removal might halt the wood thrush's decline.

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II. CONCLUSION

The several essays in this special issue demonstrate the topic's high level of interest and relevance, and it also reveals certain common themes throughout studies of urban birds. Numerous research that have been submitted compare two separate populations—one rural and one urban. Unreplicated designs provide little information regarding processes and the variety in results, as well as the underlying drivers of the effects and variabilities, even if comparative studies are undoubtedly helpful in finding potential mechanisms and patterns. Finding the drivers is difficult since urban environments vary greatly from rural ones in many ways, and cities also differ from one another. We would want to emphasize that, although if studies are usually challenging to carry out, it is necessary to consider alterations whenever feasible.

When read as a whole, the articles in this special issue show how different people's reactions to urbanization are, both good and bad, and how difficult it is for scientists to make generalizations. Differential species resistance to urbanization modifies the makeup of communities and inters specific connections, hence fostering novel feedback mechanisms that deepen the overall picture. Therefore, there are a lot of obstacles and exciting new study opportunities in the area of urban avian ecology in the future.

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