Chapter 8
Urban Conservation: Toward Bird-Friendly Cities in Latin America

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Abstract Urbanization is a major threat to biodiversity. Nevertheless, an important number of species has been recorded to live, and even thrive, within urban centers. Bird diversity has often been studied among greenspace networks, where most urban biodiversity is sheltered. Although a few studies have directly addressed urban bird conservation, they have shed important light on the directions and implications that evidence-based actions require for proper management and planning to occur in cities. Important international documents (e.g., *Rio+20,* FAO reports) have pinpointed the importance of developing greener cities in Latin America. Also, pioneer conservation ideas, such as *Archipelago Preserves*, have been conceived in Latin America as a way to plan conservation in advance where cities are predicted to grow. Birds are excellent bioindicators in urban areas for diverse reasons, as they quickly respond to habitat alterations and allow to monitor the ecological quality of urban areas. Nevertheless, for proper urban management and planning to occur in Latin America, a broader and robust evidence-based foundation is crucial, followed by interest and willingness from all the implied stakeholders for action to be made. Creating greener and biodiverse cities will not only benefit wildlife groups, including birds, but will certainly have a positive impact on people, making cities healthier and livable.

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8.1 Global Wildlife Sensitivity to Urbanization

Among the main consequences of urbanization, the implementation of nonsustainable processes in the exploitation of natural resources (Grimm et al. 2008; McDonnell and MacGregor-Fors 2016) and the endangerment of wildlife species (Czech et al. 2001; Maxwell et al. 2016) head the list. Many native species disappear from cities or shelter in large vegetation remnants because they cannot adjust to use and/or exploit urban resources and avoid the additional risks faced in cities (Sol et al. 2013; McDonnell and Hahs 2015; Chap. 6). Yet, some species are able to live, and even thrive, in urban areas, highlighting the importance of cities for conservation (Sanderson and Huron 2011; Aronson et al. 2014). Urban systems tend to favor species with greater phenotypic plasticity, such as generalists and species typical of edges and open areas that can adapt to anthropogenic selection pressures (González-Oreja 2011; see Chaps. 2, 3 and 6).

Since the 1970s, urban systems have been documented to support complex bird communities (Emlen 1974; Gavareski 1976; Lancaster and Rees 1979; Moore 1979; Clergeau et al. 1998 and references therein). Birds have been considered as an important biodiversity indicator group (also known as bioindicators) due to their high diversity, as well as the existence of robust methods to survey them and their stable taxonomy (Moreno et al. 2007). Together with the latter, birds have been documented to conform complex communities within urban centers, shifting along gradients of urbanization intensity and human activities (Blair 1996; Clergeau et al. 1998; Melles et al. 2003; Leveau and Leveau 2004; van Heezik et al. 2008; Ortega-Álvarez and MacGregor-Fors 2009; Villegas and Garitano-Zavala 2010; Biamonte et al. 2011; Reis et al. 2012; Clucas and Marzluff 2015; Silva et al. 2015).

Recently, Fischer et al. (2015) revisited Blair's (1996) categorization of wildlife responses to urbanization, concluding that there are species that avoid urban systems (but can dwell within lowly developed areas within cities; i.e., urban 'avoiders'), species that are common in urban areas but are mainly nonbreeders within them and depend on nonurban populations to maintain their dynamics (i.e., urban 'utilizers'), and species that are successful in exploiting urban resources and do not necessarily depend on nonurban populations to maintain their numbers in urban systems (i.e., urban 'dwellers'). This is in agreement with the idea that urban systems pose an ecological barrier for biodiversity, with birds not being an exception (Croci et al. 2008; MacGregor-Fors 2010; Puga-Caballero et al. 2014). Nevertheless, the barrier is 'semipermeable', allowing the entrance of those species that can reach the urban system, use their resources, and survive to their hazards (Emlen 1974).

Although local factors have been suggested to override regional ones (Evans et al. 2009), scale has shown to be determining for urban birds. Also, studies have identified several predictors related to the ability of species to live and/or thrive in urban systems: (i) taxonomical identity (reviewed in Chap. 3); (ii) feeding behavior and requirements (Faeth et al. 2005; Chaps. 3 and 6); (iii) biogeographical origin (González-Oreja 2011); (iv) spatial distribution (MacGregor-Fors and Ortega-Álvarez 2011); (v) physiology (Chávez-Zichinelli et al. 2013); (vi) ecological plasticity (Kenney and Knight 1992); (vii) adaptation (Bonier et al. 2007; Chap. 6); and (viii) sociability, sedentary lifestyle, reproductive cycles, and nesting habits (Kark et al. 2007).

8.2 Avian Conservation in Urban Systems

8.2.1 General Perspectives

Conservation biology in urban areas has been questioned in the past due to the relative impoverishment of biodiversity caused by urbanization. Yet, there are several reasons behind the recent interest in pursuing biological conservation in urban centers, some of which were brilliantly highlighted by Sanderson and Huron (2011) in an editorial of *Conservation Biology*. As they note, the most intuitive reason behind people pushing toward conservation practices and plans in urban centers is because most of us are urbanites. Also, conservation biology in urban areas challenges its concept and requires the development of new frameworks that leap forward toward the accomplishment of biological conservation in human-modified systems and landscapes (Sanderson and Huron 2011).

Greener urban scenarios tend to harbor more bird species (Chace and Walsh 2006; González-García et al. 2014). In fact, the size and connectivity of greenspaces in cities are recurrent topics in the urban bird conservation literature (e.g., Shanahan et al. 2011). In essence, greenspaces may serve as 'sources' for certain species, which can disperse to the surrounding human settlements (van Heezik et al. 2008). This leads to the controversial weighting of the land-sharing/land-sparing paradigms, a debate formulated for agriculture production, but with parallels in urbanization models (Lin and Fuller 2013). In the first case, the whole urban territory would be developed heterogeneously by mixing buildings and greenspaces. For the land-sparing model, large blocks of either intensely urbanized or greenspaces predominate in a broader scale. There are different responses of biodiversity and human well-being for each model, and understanding them may result in functional, well-planned and sustainable cities, thus reducing the overall impact of urban sprawl on biodiversity (Soga et al. 2014).

Several questions have been addressed and have set the foundations to build a framework to generate evidence-based solutions toward healthier cities. Greenspace size is certainly a key element, as larger areas tend to increase spatial and

environmental heterogeneity, and thus shelter greater bird diversity (Fernández-Juricic 2000a; Platt and Lill 2006; Palmer et al. 2008; Evans et al. 2009; Schütz and Schulze 2015; Chang and Lee 2016; MacGregor-Fors et al. 2016). Another factor that has been positively related with urban bird diversity is the age of native vegetation patches and remnants (Fernández-Juricic 2000a). Greenspaces are priority areas for conservation (Palmer et al. 2008), providing the basis toward long-term conservation (Schütz and Schulze 2015; Chang and Lee 2016). In this sense, large greenspaces must be prioritized as they have been shown to offer a trade-off against the deleterious effects of built cover and the discontinuous distribution of potential habitats for native species (Fernández-Juricic 2000a, b; Evans et al. 2009; MacGregor-Fors et al. 2016).

John M. Marzluff (2014) named the 'suburbs' of large cities 'subirdia' due to the surprising biological avian diversity they shelter. In his book, Marzluff (2014) highlights that some urban environments can house and maintain biodiversity if we provide three key elements: (i) suitable habitat, including sites for shelter and breeding, food, and water sources; (ii) safety, reducing bird mortality caused by both direct and indirect human causes (see Chap. 7 for a thorough review on this topic); and (iii) engagement, involvement of residents, including environmental education focused on teens and children. Another iconic book on urban conservation, by Mark Hostetler (2012), underlines the crucial role that engagement of residents as a cornerstone strategy for conservation; otherwise, the urban population would not be aware of, understand, or participate in any actions. Although authorities generally implement conservation policies, they do not necessarily succeed in cities without public participation, highlighting the importance of involving all urban stakeholders in decision-making and practice. For instance, if each household owner in a neighborhood decided to design and manage their lot to integrate and house native plants and animals, the entire area would be benefited by individual decisions (Hostetler 2012).

8.2.2 Perspectives from Urban Latin America

As noted above, there are several reasons behind the development of urban conservation strategies. Yet, there are some biodiverse regions where this must be prioritized, such as Latin America (Hedblom and Murgui 2017). With its territory sheltering important global biodiversity, four out of the five richest countries in terms of bird diversity are Latin American (i.e., Colombia, Peru, Brazil, Ecuador; BirdLife International 2013). Also, Latin America is a region where poverty, inequality, and urbanization rates meet with ~30% of the global hot spots for conservation priorities (Myers et al. 2000; Pauchard and Barbosa 2013).

Although urban bird communities share several hyperabundant species across the globe (Sol et al. 2013; Aronson et al. 2014), leading to the idea that biotic homogenization occurs in urban areas (McKinney 2006; Devictor et al. 2007), global trends are not clear (Sol et al. 2013; Aronson et al. 2014; see Chap. 9 for a

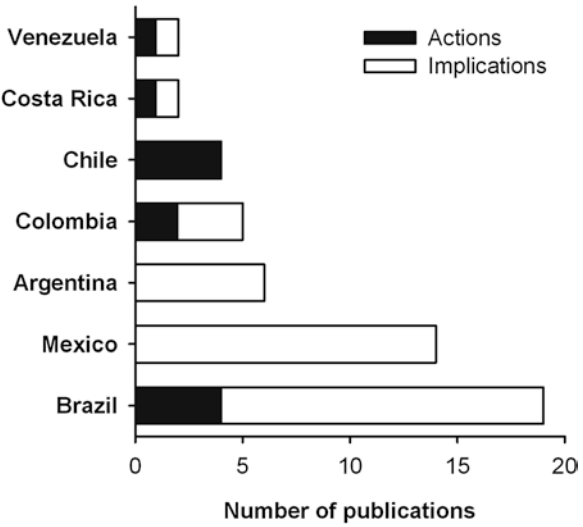

Fig. 8.1 Number of publications focused on conservation implications or actions in urban Latin America

thorough discussion on this topic). Indeed, avian diversity in urban Latin America has shown to be high when compared with that recorded in other well-studied regions. For example, González-García et al. (2014, 2016) report 341 species for the city of Xalapa (Mexico) in the last three decades, while Biamonte et al. (2011) report more than 200 species for San José (Costa Rica), and Franchin (2009) reports more than 150 species in seven Brazilian urban centers (i.e., Londrina, Marabá, Pirassununga, Porto Alegre, Rio Claro, São Paulo, Uberlândia).

Despite the importance of the topic, bird conservation studies from the urban Latin American scientific literature are scarce. In fact, when searching for publications that have dealt with avian conservation in urban Latin America in the Web of Science (www.webofknowledge.com) and Scopus (www.scopus.com) platforms using the keyword combination: 'bird' AND 'urban' AND 'conservation' AND 'each Latin American country' (see Chaps. 2 and 3 for a list of countries), we only retrieved 76 documents from eight countries, with Brazil and Mexico heading the list (Fig. 8.1). Afterward, we filtered the studies that focused on conservation implications or actions. We considered conservation implication studies as those focused on the ecological effects of urbanization on birds that report conservation suggestions based on their findings, while classified those presenting conservation management plans, environmental education activities, and/or community-based conservation efforts as conservation action studies (see Chaps. 3, 4 and 5 for a detailed review and analysis of the conservation implications for bird-friendly cities in urban Latin America).

Studies with urban conservation implications (40 publications) have focused on highly relevant topics, including the effects of environmental characteristics and anthropogenic changes on bird community structure and species diversity (Ortega-Álvarez and MacGregor-Fors 2009; Ruelas Inzunza and Aguilar Rodríguez 2010; Cruz and Piratelli 2011; Domínguez-López and Ortega-Álvarez 2014; Sanz and

Caula 2015), the ecological impacts of urbanization in mutualistic networks (Arizmendi-Arriaga et al. 2007; Maruyama et al. 2012; Ferreira and Consolaro 2013; Oliveira et al. 2013), changes in species distribution patterns (Carvalho and Marini 2007; Carrete et al. 2009), and historical community approaches reporting local extinctions of resident birds (Biamonte et al. 2011; Moura et al. 2014). Among the reviewed studies, some make relevant suggestions for urban conservation in Latin America, such as the importance of increasing environmental heterogeneity and connectivity (e.g., Ortega-Álvarez and MacGregor-Fors 2009; MacGregor-Fors and Ortega-Álvarez 2011; Toledo et al. 2012; MacGregor-Fors et al. 2016) and the relevance of establishing long-term and citywide monitoring (Escobar-Ibáñez and MacGregor-Fors 2016; Chap. 9).

We found 12 publications focused on urban conservation actions, mainly from Brazil, Colombia, and Chile (Fig. 8.1). These studies address a wide array of topics and strategies, such as: (i) using emblematic species to promote conservation actions by local communities (Arango et al. 2007; Azevedo et al. 2012); (ii) considering corridors that increase connectivity and bird dispersal in urban ecosystems (Trujillo-Acosta et al. 2017); and (iii) the need to limit the number of beach tourists to reduce their impact on migratory shorebirds (Cestari 2015). These studies highlight the complexity of applying conservation actions in urban areas, identifying several limitations for them to be successful (e.g., lack of strategies to promote urbanite environmental education, the separation of humans from nature, the unwillingness of all stakeholders to embrace biodiverse urban scenarios; Turner et al. 2004; Bezerra et al. 2012; Cestari 2015).

8.3 Conclusions and Future Directions

Our knowledge regarding the adaptiveness of birds to urban areas is still consolidating, although there is important evidence of avian plasticity in these systems (McDonnell and Hahs 2015; Chap. 6). Several traits related to the capacity to adapt and/or respond (positively or negatively) to urbanization have been identified, including their evolutionary history (González-Oreja 2011), morphology (Evans et al. 2009), physiology (Chavez-Zichinelli et al. 2013), feeding ecology (Escobar-Ibáñez and MacGregor-Fors 2015) (Fig. 8.2), reproductive habits (Chace and Walsh 2006) (Fig. 8.3), sociability (Kark et al. 2007), and behavior (Seress and Liker 2015). Thus, their capacity to quickly respond to human disturbances, from individuals to communities, together with them being highly charismatic and generally well accepted by urbanites, makes them an ideal informative wildlife group for urban conservation.

Given the differential response of urban 'dwelling' birds to urbanization (as described by Fischer et al. 2015) and that rich native bird communities are closely related to large urban greenspaces (see Chaps. 3 and 5), which can include residential and/or commercial components (MacGregor-Fors et al. 2009), conservation strategies based on organisms like birds in urban areas should focus on the maximi-

Fig. 8.2 Chestnut-eared Aracari (*Pteroglossus castanotis*) feeding on the fruit of a palm tree in the city of Uberlândia, Brazil (Photo: AGF)

zation of suitable conditions and resources at different spatial scales (Chamberlain et al. 2009; Gagné et al. 2016). To migrate toward livable, biodiverse, and sustainable cities, urban management and planning is imperative (McDonnell and MacGregor-Fors 2016). In this sense, urban management needs to focus on both the urban matrix and greenspaces (see Chap. 5 for a review and discussion regarding both 'gray' and 'green' urban infrastructure). Due to the biodiversity that greenspaces shelter, there is a generalized bias of urban ecology knowledge and focus regarding conservation issues toward them. Yet, all urban scenarios need to be included in both management and planning strategies to generate favorable environments for both wildlife and urbanites (Hostetler and Knowles-Yanez 2003; Escobar-Ibáñez and MacGregor-Fors 2015). Besides private gardens, which have shown to be crucial for wildlife groups along urban greenspace networks (Cannon et al. 2005; Daniels and Kirkpatrick 2006; Andersson and Colding 2014; Belaire et al. 2016), all other urban spaces, such as sidewalks and median strips along streetscapes (Fernández-Juricic 2000b; Chamberlain et al. 2009; Carbó-Ramírez and Zuria 2011), ought to be considered when managing and planning cities(Matarazzo-Neuberger 1995; Donnelly and Marzluff 2006; Braga et al. 2010; Falfán and

Fig. 8.3 Great Kiskadee (*Pitangus sulphuratus*) nest with nestlings showing the use of artificial components in the campus of the Federal University of Uberlândia, Brazil (Photo: AGF)

MacGregor-Fors 2016). New creative solutions, some of which are often accidental, need to be explored hand in hand with potential wildlife adaptations, such as native Peach-fronted Parakeets (*Eupsittula aurea*) nesting in air-conditioning units in Campo Grande, Brazil (Souza 2016); Azure-crowned Hummingbirds (*Amazilia cyanocephala*) successfully nesting on open-sky metallic structures of the telephone wiring in Xalapa, Mexico (Escobar-Ibáñez and MacGregor-Fors 2015), and Rufous Horneros (*Furnarius rufus*) nesting on high-voltage electricity poles in the state of Santa Catarina, Brazil (Efe and Filippini 2006).

Regarding urban greenspaces, many management and planning strategies have been identified as crucial for creating bird-friendly cities, many supported in Latin American studies, among which the following head the list: (i) diversifying the use of urban greenspaces, including conservation goals (Lagoa 2008; Carbó-Ramírez and Zuria 2011; Domínguez-López and Ortega-Álvarez 2014; Carbone et al. 2015; Sanz and Caula 2015; Silva et al. 2015); (ii) redesigning urban greenspaces considering complex citywide networks (Dredge 1995; Efe et al. 2001; Bargos and Matias 2011; Wendel et al. 2012; Andrade et al. 2013; MacGregor-Fors et al. 2016; Trujillo-Acosta et al. 2017); (iii) promoting native vegetation structure and composition in existing greenspaces, limiting the use of exotic species (although this is a complex issue; see Chaps. 5 and 9) (MacGregor-Fors 2008; Palmer et al. 2008; Ziller and Dechoum 2013; Falfán and MacGregor-Fors 2016); (iv) reconsidering vegetation management strategies and regimes (Sandström et al. 2006; Chang and Lee 2016; Uras et al. 2014); and (v) using low-maintenance trees that provide food and nesting resources (Mendonça and Anjos 2005; Castro et al. 2010; Oliveira et al. 2013).

Additionally, and closely related to urban planning toward wildlife-friendly cities, it is fundamental to protect target native vegetation patch networks where cities are predicted to sprawl. Thus, the use of concepts like Gonzalo Halffter's *Archipelago Preserves* (2007) and other novel biodiversity protection strategies need to be considered and implemented by urban planners and developers together with local and regional authorities.

As reviewed in Chap. 5, all types of urban infrastructure need to be assessed if we aim to achieve livable, sustainable, and bird-friendly cities. We would like to emphasize on the importance of water bodies and their related vegetation, which are often central to the successful management of urban bird diversity. For example, a four-year restoration of a riparian forest dominated by exotic grasses in Puerto Rico has resulted in microclimate stabilization, reduction of herbaceous cover, increased litter fall, and colonization by plant and animal species (Ruiz-Jaén and Aide 2006). In Brazil, there are laws that protect riverbanks as permanent protected areas (e.g., Law 771, Article 1st, 2nd, II, September 15, 1965; Brazil), established to preserve water resources, biodiversity, and human welfare (PRB 1965). Undoubtedly, the protection and restoration of rivers, lakes, and other urban water bodies would also likely favor biodiversity in urban areas where present or manageable (Clergeau et al. 2001; Cruz and Piratelli 2011; Rosselli and Stiles 2012a, b), serving as stepping stones for migratory species, for instance (Fig. 8.4).

For urban management and planning strategies to promote bird-friendly cities in Latin America, we need a robust evidence-based knowledge foundation followed by interest and willingness from all the implied stakeholders for action to be made (MacGregor-Fors 2015). Evidently, the implementation of protected areas and proper management of urban greenspaces require economic resources (Burkhalter et al. 2016); yet, active interest of the implied decision-makers often overrides the importance of investments. Important international documents, such as the *Rio+20–The Future we Want* (Jordán 2013) and a recent report from the Food and Agriculture Organization of the United Nations (FAO 2014) have pinpointed the importance of urban management and planning, seeking sustainable development and greener cities in Latin America. Furthermore, other initiatives, such as the *Latin American Green City Index* (Rodríguez Tejerina 2015), have been created to evaluate the environmental performance of major Latin American cities. The aim, in this case, was to identify the most sustainable cities, according to their practices, considering energy, solid waste management, and water and air quality, among other factors (Siemens 2010). Similarly, *The Urban Management Program for Latin America and Caribbean* (UMP-LAC 2001) aims to achieve environmental sustainability by encouraging urban agriculture and controlling river pollution and solid waste management.

Furthermore, it is crucial to include citizens and promote environmental education to develop successful conservation actions for urban biodiversity. A remarkable example of a citizen-based network of information is the eBird platform, which encourages amateur and professional birdwatchers, as well as ornithologists and ecologists, to report bird observations. The information gathered in the platform is without doubt increasing our knowledge on bird distribution and natural history to

Fig. 8.4 Urban pond in Sorocaba (Brazil) hosting a migratory population of the Roseate Spoonbill (*Platalea ajaja*) (Photo: AJP)

the extent that eBird is considered one of the largest and growing biodiversity data sources worldwide (Sullivan et al. 2014). This kind of effort does not only provide information, but also has an important role in bridging the gap between urbanites, urban ecology, and decision-making (Sullivan et al. 2016). Moreover, local birding and ornithological groups along Latin America work together in several environmental education networks to promote the value of conservation of urban systems.

Yet, many Latin American cities are still growing at unprecedented rates without proper environmental management or planning (Cerrutti and Bertoncello 2003; Cohen 2004; Lankao 2007; Schneider and Woodcock 2008). As stated earlier, birds are an excellent group for studying ecological patterns in cities, even more in those where they are highly diverse, and can reflect the ecological quality of urban systems in urban Latin America (Reynaud and Thioulouse 2000; Alberti 2005; MacGregor-Fors et al. 2009). Creating greener and biodiverse cities will not only benefit birds and wildlife in general, but will have a positive impact on citizens, including health and ecoservices (Gómez-Baggethun et al. 2013; Elmqvist et al. 2016).

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