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Short Communication

Avian biodiversity in the urban green spaces of Paris: higher bird species richness in larger parks and park centers

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ABSTRACT. Diverse anthropogenic threats drive bird population declines, especially for species living in urban areas. Through studies of avian species richness in urban green spaces, i.e., the parks, gardens, and cemeteries of modern cities, we gain a deeper appreciation of refugia for birds living in the urban jungle. Larger urban green spaces are understood to support higher avian biodiversity than smaller urban green spaces. Within urban green spaces, central habitats are thought to support higher avian biodiversity than edge habitats. Through bioacoustic field recordings, we studied these patterns in the green spaces of urban Paris, one of the largest cities in Europe and one of the most densely populated cities on the planet. We found substantial levels of avian biodiversity, recording 36 species of birds across 37 parks, gardens, and cemeteries. Species richness showed a positive relationship with park size, with more species recorded in Paris' larger urban green spaces. Species richness also varied with centrality, with more species detected in the central habitats of Paris' urban green spaces. We conclude that both the size of urban green spaces and the amount of central habitat within those green spaces influence avian species richness. Our findings not only imply that even small green spaces should be protected in dense urban landscapes, but that green spaces should be designed to maximize their size and amount of central habitat to promote high levels of bird species richness.

La biodiversité aviaire dans les espaces verts urbains de Paris : une richesse accrue en espèces d'oiseaux dans les parcs de grande taille et les zones centrales des parcs

RÉSUMÉ. Différentes menaces anthropiques expliquent le déclin des populations d'oiseaux, en particulier pour les espèces vivant dans des zones urbaines. L'étude de la richesse des espèces aviaires dans les espaces verts urbains, c'est-à-dire les parcs, les jardins et les cimetières des villes modernes, nous permet de mieux comprendre les refuges des oiseaux qui vivent dans la jungle urbaine. On sait que les grands espaces verts urbains abritent une plus grande biodiversité aviaire que les petits espaces verts urbains. Dans les espaces verts urbains, on pense que les habitats centraux abritent une plus grande biodiversité aviaire que les habitats périphériques. Grâce à des enregistrements bioacoustiques réalisés sur le terrain, nous avons étudié ces modèles dans les espaces verts de Paris, l'une des plus grandes villes d'Europe et l'une des plus densément peuplées de la planète. Nous avons relevé des niveaux importants de biodiversité aviaire, avec 36 espèces d'oiseaux dans 37 parcs, jardins et cimetières. Cette richesse des espèces traduit une relation positive avec la taille du parc, avec plus d'espèces enregistrées dans les grands espaces verts de Paris. La richesse en espèces varie également en fonction de la centralité, avec davantage d'espèces détectées dans les zones centrales des espaces verts de la capitale. Ainsi, la taille des espaces verts urbains et le nombre de zones centrales au sein de ces espaces verts influent sur la richesse des espèces aviaires. D'après nos résultats, même les petits espaces verts doivent être protégés dans les paysages urbains denses. Par ailleurs, les espaces verts doivent être conçus de manière à maximiser la taille et le nombre des zones centrales et maintenir ainsi une richesse élevée en espèces d'oiseaux.

Key Words: *automated point counts; autonomous recording units; biodiversity; parks; passive acoustic monitoring; species richness; urban ecology*

INTRODUCTION

Across the globe, birds face diverse anthropogenic threats, exhibiting alarming population declines (Lees et al. 2022). Urban areas impose multifarious challenges for wild birds, especially habitat fragmentation and habitat degradation (Snep et al. 2016). In the growing urban jungle, green spaces provide vital habitats for birds in the form of parks, gardens, and cemeteries (Villaseñor and Escobar 2019, Villaseñor et al. 2020). These green spaces serve as habitat islands for city-dwelling birds, providing refugia within anthropogenically modified landscapes (Ikin et al. 2013, Yang et al. 2020). By studying avian species richness in urban green spaces, we build a deeper understanding of their importance to wild birds, which can inform environmentally responsible urban planning that maximizes biodiversity (Amaya-Espinel et al. 2019).

The importance of green spaces has been established through studies of urban avifauna around the globe (Amaya-Espinel et al. 2019, Chaiyarat et al. 2019, Yang et al. 2020, Soifer et al. 2021, Campbell et al. 2022). Larger green spaces foster higher biodiversity than smaller green spaces (Martzluff 2017, Sarı and

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Bayraktar 2023), exhibiting a typical species-area relationship and reinforcing an important prediction of the theory of island biogeography (MacArthur and Wilson 1967, Boecklen 1986). Within urban green spaces, central habitats support higher bird diversity than edge habitats (Soifer et al. 2021), providing a compelling example of well-known ecological edge effects (Freemark and Merriam 1986, Yahner 1988). Through surveys in a major metropolitan area, we sought to investigate whether park size and interior-to-edge comparisons influence urban bird species richness.

The urban environment of Paris, France is a mosaic of densely populated, anthropogenically modified human habitats punctuated by parks, gardens, squares, and cemeteries. Although Paris ranks among the largest cities in Europe and one of the most densely populated cities on Earth (Schwarz 2010, World Atlas 2020), it also supports a high concentration of green spaces. Paris has a longstanding history of protecting green spaces, creating some of the earliest parks in any modern city (Tate 2018). The Jardins des Plantes in downtown Paris, for example, was founded under Louis XIII in the seventeenth century, serving as a location to appreciate native medicinal plants and, later, exotic plants and animals transplanted from global biological expeditions (Deligeorges et al. 2004). Today, the green spaces of Paris vary in size from tiny street-side gardens to the large forests of the Bois de Boulogne and Bois de Vincennes (Stewart 2012). With a large number of green spaces of variable size, Paris offers an opportunity to study variation in park size and edge effects on wild birds.

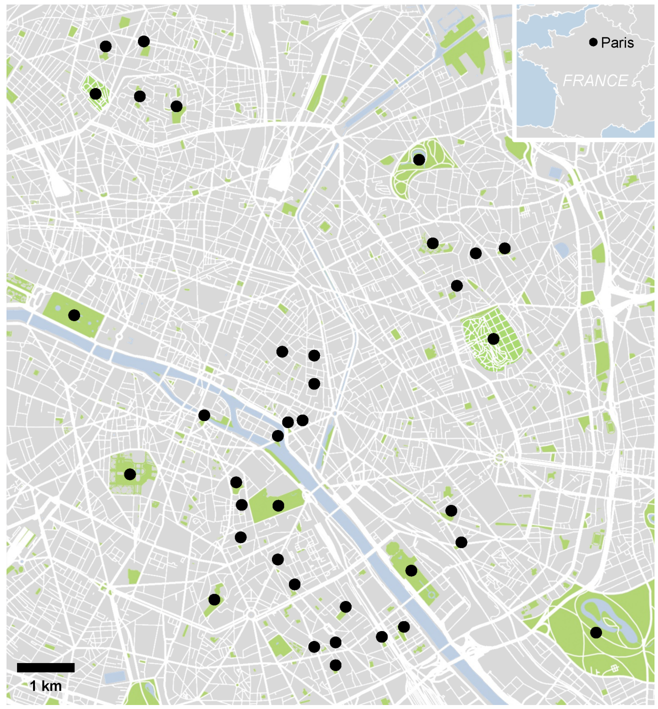
We used bioacoustic tools to survey bird species richness in the urban green spaces of Paris. Our goals were to investigate the effect of the size of green spaces on bird species richness and to assess whether bird species richness varied in a comparison between edges and centers of urban green spaces. We used bioacoustic surveys to address these goals, deploying automated bioacoustic recorders to assess species richness. Based on the hypothesis that larger habitat patches support higher biodiversity, we predicted that recordings made in larger urban green spaces would reveal higher levels of bird species richness. Based on the hypothesis that central habitats support higher biodiversity than edge habitats, we predicted that recordings made in the center of urban green spaces would show higher levels of species richness than recordings made at the edges of urban green spaces. From a descriptive standpoint, we sought to quantify which species of birds are most common in the urban green spaces of Paris.

METHODS

General field methods

We used a bioacoustic approach to survey bird biodiversity in green spaces in Paris, France during a research expedition between April 29 and May 6, 2023. This time period corresponded to springtime in Paris when birds are vocally active at the beginning of the breeding season, and many temperate migrants have returned to breed in central Europe. Our recording locations were 37 sites in urban green spaces covering areas of downtown Paris in the 1st, 3rd–6th, 12th–13th, and 18th–20th arrondissements (i.e., neighborhoods; Fig. 1; Appendix 1, Table S1). Our recording locations included parks, gardens, squares, and cemeteries; hereafter we refer to our recording spaces as parks. We chose the

Fig. 1. Map of 37 parks, squares, gardens, and cemeteries in Paris, France in which the biodiversity of urban birds was sampled at a central location and an edge location. Inset map at upper right shows the location of Paris, France.



37 parks haphazardly with the goal of collecting recordings in as many parks as possible within downtown Paris, across as wide a range of park sizes as possible. The parks ranged in size from 0.1 to 850 ha (Table S1). All of the parks featured natural and planted vegetation, multiple trees, and green areas with herbaceous and shrubby plants. All of the parks were surrounded by urban roads and buildings.

Within each park, we collected a recording at both the center and edge of the park. We selected the edge recording location by choosing the park's main entrance (i.e., a position with a gate or sign designating the name of the park). For large parks that had multiple main entrances, we haphazardly chose one of those main entrances; for small parks that had no clear main entrance, we haphazardly chose a position at the edge of the park. We chose the center recording location of each park by viewing the park on Google Maps and estimating the geometric center of the park. For the four largest parks (Bois de Vincennes, Parc de Bercy, Père-Lachaise Cemetery, and Parc des Buttes Chaumont), we collected multiple recordings, and rather than collecting our recordings at the geometric center of these parks, we ensured that our central locations were located at least 100 m from the park's edge (average: 231 m; range: 128–303 m) and we ensured that all recording locations were separated by at least 200 m. We accounted for repeated sampling in these large parks.

We calculated the size of each park using the measurement tool in Google Earth. We defined the perimeter of each park by viewing satellite images and tracing the boundaries of the green space for each park, and we corroborated these boundaries by referencing Google Earth's green space indicator. Once we defined an enclosed polygon around each park, the perimeter and area measurements were calculated in Google Earth. The area and perimeter of each park were measured four times by four of the authors who collected measurements independently; their measurements were all highly correlated (Spearman's Rho ranged from 0.97 to 0.99) and we used the average of the four measurements as our measure of park area and perimeter.

Acoustic recordings

We collected recordings in the morning between 06:30 and 10:30 h (median recording start time: 08:59 h Central European time zone) using Wildlife Acoustics Song Meter Mini autonomous recorders. Recordings were collected in stereo (WAV format; 44.1 kHz sampling frequency; 16-bit depth). These recorders have been shown to be effective tools for assessing species richness in avian point counts (Mennill 2024). We used seven identical, newly purchased recording units. We confirmed that the recorders had equivalent recording capacities prior to the field expedition by recording reference tones of known amplitude and observing that the amplitude of the recorded tone was similar across the seven recorders. At each recording location, a team of one to four recordists attached an autonomous recorder to a tree or post at chest height and started the recording. We noted the date, time, latitude, and longitude of the recording and spoke this information into the recording. We recorded sounds for 15 minutes. During the recording, we stood silently next to the recorder; we did not wish to leave the recording devices unattended in a busy urban environment and we wanted to ensure that our recorders did not impose an invasion of privacy to passersby (if we had detected private conversations occurring near the recorders, we would have stopped the recording, although this did not occur during our recordings).

As a survey tool for exploring species richness, autonomous recording units have widely recognized benefits and limitations (Shonfield and Bayne 2017, Haupert et al. 2022, Mennill 2024). They permit standardized sampling comparable to data collected by experienced human observers, they can be reviewed multiple times to ensure that every species is recognized, and they provide a long-term archive of survey recordings. However, they often underestimate species richness and tend to miss species recorded at farther distances (Shonfield and Bayne 2017). We recognized that our bioacoustic methods would be expected to produce underestimates of species richness. A recent review suggested that this particular recording device may underestimate species richness, on average, by 12% (Mennill 2024). Furthermore, with 15 minutes of sampling at each location, these acoustic recordings provide only a brief assessment and are not expected to document all species present in each area. However, these bioacoustic methods have provided us with a standard approach to sampling across all of the recording locations, as in many previous investigations of bird species richness (reviewed in Shonfield and Bayne 2017, Haupert et al. 2022, Mennill 2024). Furthermore, this approach allowed us to sample more sites over a shorter time period than if a single surveyor had visited and sampled all of the sites.

We analyzed the field recordings by visualizing our recordings as sound spectrograms in Syrinx-PC sound analysis software (J. Burt, Seattle, WA). We visualized 2-minute intervals of the recordings at a time (recording settings: 1024 Hz, Blackman FFT), scrolling through the entirety of each 15-minute recording. We used the frequency cursors in Syrinx-PC to surround each bird sound on the sound spectrogram, listen to the sound, and create an annotation indicating the species of the bird producing the sound. When viewing the recordings, we regularly adjusted the spectral gain of the spectrogram to ensure that quiet sounds could be detected from background sounds; this was especially important for low-frequency sounds such as the vocalizations of doves. All annotations were done by the same analyst (D. J. M.) who has experience with the songs and calls of European birds and experience with annotating passive acoustic monitoring for studies of biodiversity. To minimize any effects of observer bias with respect to the hypotheses we were testing, recordings were annotated anonymously with respect to which park the recording was collected in, and with respect to whether the recording was an edge or a center site within each park. No more than 10 of the recordings were analyzed on the same day to minimize any effects of observer fatigue.

Statistical analyses

To calculate the species richness at each edge or center recording location, we calculated the total number of species detected producing one or more sounds in each of the recordings. To calculate the total number of species per park, we tallied all the species identified in both the center and the edge recording of each park. For four of the largest parks (Bois de Vincennes, Parc de Bercy, Père-Lachaise Cemetery, and Parc des Buttes Chaumont), we sampled multiple edge and center positions (four positions in Bois de Vincennes and two positions in the remaining three parks). In comparing the total number of species detected in each of these four parks, we randomly selected one of the paired center-edge locations for these four parks and calculated the species richness across those two recordings, so that all parks had an equivalent sampling effort.

Our two measurements of park size, i.e., park area and park perimeter, were highly correlated ($r^2 = 0.98$), and therefore we conducted a principal components analysis on these two variables. This analysis produced one principal component score with an eigenvalue of 1.99 with strong and equal loading from park area (0.71) and park perimeter (0.71). We refer to this principal component score as "park size" hereafter, noting that high values for park size are associated with parks that occupy larger areas and have larger perimeters.

To understand the effect of park size on species richness, we conducted a correlation analysis where our independent variable was park size (the principal component score) and our dependent variable was the number of species detected in the recordings. To understand the effect of edge versus center habitats, we conducted pairwise t-tests for each pair of recordings. For four of the parks, the center recordings ($n = 3$) or the edge recording ($n = 1$) failed due to technical issues or human error in launching the recordings, and these points were not included in paired tests but were included in unpaired tests; therefore our sample size (i.e., number of parks) is higher by four for unpaired tests versus paired tests. All analyses were conducted in JMP 17.2 (SAS Institute, Cary, N.C.).

RESULTS

Through springtime bioacoustic surveys of birds in 37 urban parks in Paris, we detected 36 species of birds (Appendix 1, Table S2). The average number of birds detected in each park was 9.6 ± 0.7 species per park (mean ± SE). Six species were especially common: Carrion Crows (*Corvus corone*), Common Swifts (*Apus apus*), and Eurasian Blackbirds (*Turdus merula*) were each detected in 76% of parks; Common Wood-Pigeons (*Columba palumbus*) were detected in 73% of parks; and European Robins (*Erithacus rubecula*) and Great Tits (*Parus major*) were each detected in 70% of parks. Other species were rare and were only detected in one or two parks: Black Redstarts (*Phoenicurus ochruros*), Eurasian Moorhens (*Gallinula chloropus*), Gray Wagtails (*Motacilla cinerea*), and Herring Gulls (*Larus argentatus*) were each detected in only two parks, and Common Buzzards (*Buteo buteo*), Common Firecrests (*Regulus ignicapilla*), Eurasian Green Woodpeckers (*Picus viridis*), Eurasian Sparrowhawks (*Accipiter nisus*), European Goldfinches (*Carduelis carduelis*), Hawfinches (*Coccothraustes coccothraustes*), Marsh Tits (*Poecile palustris*), and Song Thrushes (*Turdus philomelos*) were each detected in only one park.

Bird species richness showed a positive relationship with urban park size (Fig. 2; r = 0.42, p = 0.01, n = 37). Larger parks had higher species richness than smaller parks. Across the 10 largest parks, we detected an average of 11.9 ± 1.1 species. Across the ten smallest parks we detected an average of 8.4 ± 1.0 species.

Bird species richness varied between center recording positions versus edge recording positions within parks (Fig. 3; paired t-test: t = 3.15, p = 0.004, n = 33). In recordings from park centers, we detected an average of 7.6 ± 0.5 species, which is 1.5 more species than in recordings from park edges, where we detected an average of 6.1 ± 0.5 species.

Fig. 2. Scatterplot of avian species richness (total number of species detected in each park during a 15-minute bioacoustic survey) versus park size (a principal component score summarizing variation in park area and park perimeter) across 33 parks in urban Paris. Species richness increased with park size. Line of fit is shown.

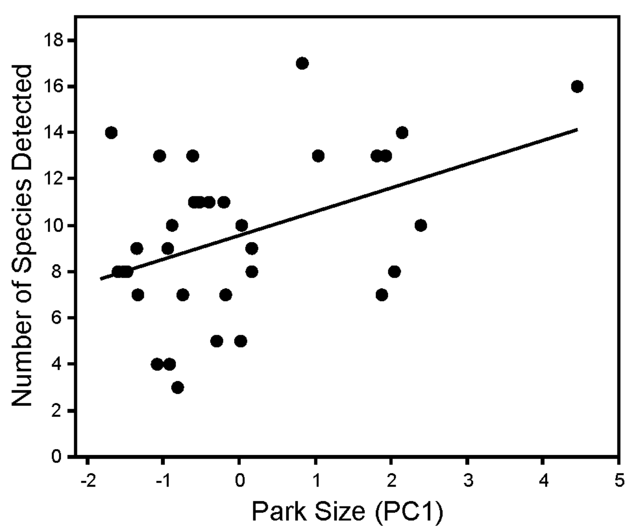
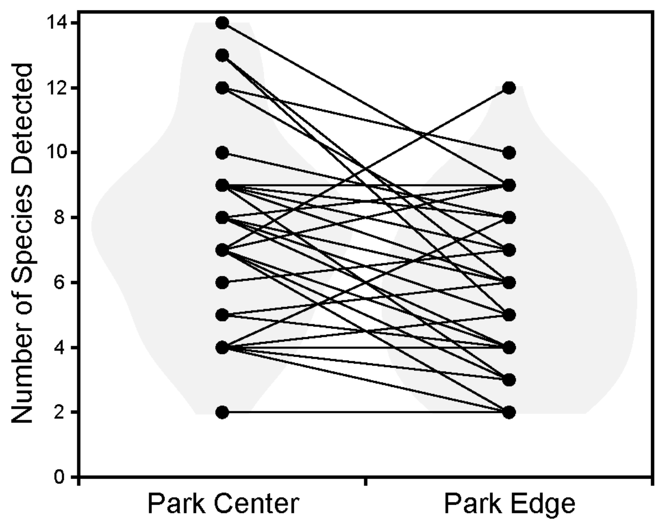


Fig. 3. Comparison of avian species richness (total number of species detected during 15-minute surveys) at the center and edge of parks, across 33 parks in urban Paris sampled with automated bioacoustic surveys. Center locations showed higher species richness than edge locations. Lines connect center and edge data for each park, and violin plots are shown in gray for center and edge locations.



DISCUSSION

We detected diverse species of birds in urban green spaces of Paris using bioacoustic surveys. We detected more bird species in recordings made in larger parks versus smaller parks, although the slope of this relationship was relatively weak (Fig. 2). We also detected more bird species in central locations within parks compared to edge locations. These results match our prediction that there should be higher avian biodiversity in larger urban green spaces and higher avian biodiversity in central habitats versus edge habitats of urban green spaces. Paris includes many green spaces of diverse sizes and shapes (Vaquin 2006), despite being home to one of the largest human populations in Europe and one of Earth's most dense human populations (Schwarz 2010). Our results reveal that Paris' urban green spaces provide habitat for diverse bird species and that larger green spaces and central habitats within these green spaces are more likely to accommodate birds in the urban jungle.

Our bioacoustic investigation of birds in the parks of urban Paris provides a further example of the widely recognized benefits of green spaces in urban areas. Many previous investigations have yielded parallel insights in other cities (Beninde et al. 2015). For example, in New York City, two decades of community science data revealed that larger green spaces provide habitat to more diverse bird species (La Sorte 2020). In Nanjing, China, larger parks are home to higher bird species richness, in association with habitat diversity and distance from the center of the city (Yang et al. 2020). In Bangkok, Thailand, the largest green spaces are associated with higher species richness, and smaller parks near the city's largest parks also show high biodiversity (Chaiyarat et al. 2019). A meta-analysis confirms that this positive relationship between park size and species richness holds true across 37 cities on 4 continents (Leveau 2021). Larger urban green spaces may support higher levels of species richness due to larger resource availability, larger habitat area, or greater niche diversity (Soifer et al. 2021). More generally, these results align with the well-documented species-area relationship that is a widespread pattern for diverse taxa at diverse landscape scales (Lomolino 2000). Our study builds on previous investigations by documenting the important role of green spaces in a city with exceptionally high human density (Schwarz 2010, World Atlas 2020).

We detected more bird species at the center of urban green spaces than at the edges of urban green spaces. Park edges are understood to show a negative association with species richness, given that edge habitats increase the exposure of organisms to human disturbance and other edge effects (Soifer et al. 2021). For example, in green spaces in urban Medellín, Colombia, bird species richness tended to be higher in more regular-shaped patches with less edge habitat (Garizábal-Carmona and Mancera-Rodríguez 2021). In forested urban parks of Madrid, Spain, native birds were found in lower numbers at park edges, whereas species habituated to human activities were found in higher numbers at park edges (Fernández-Juricic 2001). Our results add to these and other previous studies that highlight a generally negative effect of edge habitat on bird species diversity in urban environments.

Our analyses relied on bioacoustic surveys of avian species richness. Bioacoustic methods in urban environments may be challenging if loud urban noises hinder a recordist's capacity to detect the bird species that are present. Even in our noisiest recordings, however, spectrograms were never so saturated with anthropogenic sound that we could not detect bird species that were present. Our bioacoustic methodology does not provide information on animals when they were not vocalizing. Therefore, we cannot rule out the idea that larger parks, and central areas of parks, are more likely to incite birds to sing, possibly due to lower levels of anthropogenic sounds. Our recording surveys lasted for 15 minutes on a single sampling day during springtime. Longer recordings, repeated sampling over multiple days, repeated sampling at multiple times of year, and visual surveys for non-vocal birds, would be expected to provide a more exhaustive sampling of all the species present within these urban green spaces. However, within our 15-minute acoustic surveys, standardized across our sampling sites, we found an effect of higher bird diversity in larger parks and central park habitats.

Taken together with other studies in other urban environments, these findings have implications for city planners interested in maximizing avian biodiversity. First, even small green spaces should be protected in dense urban landscapes because they provide habitat for diverse birds. The smallest park in our dataset, Square Robert Montagne, measures only 90 m² and features just 9 trees, many shrubs, a ping-pong table, and a small children's climber, yet we detected 14 species of birds in this park. It is noteworthy that the bird species we detected in small parks were also found in the larger parks (Appendix 1, Table S2). Second, larger spaces should be protected whenever possible to maximize avian biodiversity. We found a positive linear relationship between park size and avian biodiversity, demonstrating that the larger the green space, the more birds we expect to find vocalizing within that green space. Third, whenever possible, green spaces should be designed to maximize central areas where edge effects are minimized. Given that we found that central areas within parks yield higher levels of biodiversity, compact parks with a higher center:edge ratio are expected to support higher biodiversity of birds than a narrow park with a lower center:edge ratio. Altogether, our findings support a growing body of research highlighting the importance of urban green spaces in providing critical habitat for avifauna, even in large, densely populated cities.

Author Contributions:

All authors worked collaboratively to design the study and to collect the recordings. Field recordings were organized by DJM and SG and recordings were analyzed by DJM. DJM and SMD conducted the statistical analyses and led the writing of the manuscript, incorporating elements from term papers written by the student co-authors. All authors worked together to write and revise the manuscript.

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Data Availability:

The data that support the findings of this study are openly available: https://doi.org/10.5683/SP3/I3YUIO

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Appendix 1. Supplementary material.

Accompanying: “Avian biodiversity in the urban green spaces of Paris: higher bird species richness in larger parks and park centres”

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Table S1. Coordinates and sizes of 37 recording locations in urban Paris.

Park Name	Northing	Easting	Arrondissement	Perimeter (m)	Area (ha)
Arènes de Lutèce	48.845011	2.353402	5th	479	1.2
Bois de Vincennes *	48.834973	2.467698	12th	13837	850.1
Cimetière de Montmartre	48.885544	2.331018	18th	1341	10.6
Cimetière du Père-Lachaise *	48.861554	2.391872	20th	2694	45.5
Jardin Arnaud Beltrame	48.857444	2.366718	3rd	162	0.2
Jardin de la place du Docteur Navarre	48.827914	2.366218	13th	147	0.1
Jardin de la Place Louis-Armstrong	48.836174	2.359885	13th	154	0.1
Jardin de Reuilly-Paul Pernin	48.842219	2.387832	12th	551	1.4
Jardin des Plantes	48.843646	2.359650	5th	1875	16.7
Jardin des Tuileries	48.863628	2.327063	1st	1907	19.5
Jardin du Carré de Baudouin	48.869932	2.393363	20th	166	0.2
Jardin du Luxembourg	48.846119	2.336299	6th	2179	24.7
Jardin Louise Weber dite La Goulue	48.886445	2.337058	18th	232	0.3
Jardin Père Teilhard de Chardin	48.850903	2.362743	4th	137	0.1
Jardins Grands Moulins Abbé Pierre	48.829262	2.380190	13th	426	0.8
Parc de Belleville	48.870711	2.383359	20th	1161	4.3
Parc de Bercy *	48.835052	2.382910	12th	2138	18.1
Parc des Buttes-Chaumont *	48.880250	2.383000	19th	2474	26.1
Place des Vosges	48.855503	2.365395	4th	448	1.3
Square Barye	48.849909	2.359898	4th	299	0.4
Square Carpeaux	48.891635	2.331788	18th	386	0.7
Square des Chamaillards	48.825380	2.369250	13th	231	0.3
Square Cyprian Norwid	48.828244	2.377256	13th	228	0.3
Square des Amandiers	48.865836	2.388268	20th	339	0.7
Square des Saint-Simoniens	48.870210	2.396521	20th	492	1.0
Square Florence-Blumenthal	48.827643	2.367457	13th	277	0.3
Square Gustave Mesureur	48.833888	2.362109	13th	335	0.4
Square Héloïse et Abélard	48.831317	2.370086	13th	397	0.9
Square Henri Galli	48.851369	2.361827	4th	207	0.2
Square Jean Morin	48.838852	2.388817	12th	203	0.2
Square Le Gall	48.832900	2.350060	13th	1023	2.9
Square Léon Serpollet	48.892231	2.338455	18th	554	1.4
Square Léopold-Achille	48.858233	2.363559	3rd	210	0.2
Square Marcel Bleustein Blanchet	48.887861	2.343624	18th	323	0.5
Square Robert Montagne	48.842290	2.353984	5th	135	0.1
Square Théodore-Monod	48.838905	2.353935	5th	206	0.3
Square René Viviani	48.852183	2.347622	5th	268	0.4

* Four recording locations marked with asterisks were large parks that were sampled in multiple locations; see Methods.

Table S2. Summary table of bird species detected in autonomous recorders at 37 park sites in urban Paris.

Park name (park area in ha)	Black Redstart	Blue Tit	Carrion Crow	Common Buzzard	Common Chaffinch	Common Chiffchaff	Common Firecrest	Common Swift	Common Wood-Pigeon	Dunnock	Eurasian Blackbird	Eurasian Blackcap	Eurasian Blue Tit	Eurasian Green Woodpecker	Eurasian Magpie	Eurasian Moorhen	Eurasian Sparrowhawk	Eurasian Wren	European Goldfinch	European Greenfinch	European Robin	European Starling	Goldcrest	Great Tit	Grey Wagtail	Hawfinch	Herring Gull	House Sparrow	Long-tailed Tit	Mallard	Marsh Tit	Rock Dove	Rose-ringed Parakeet	Short-toed Treecreeper	Song Thrush	Stock Dove	Species Richness
Arènes de Lutèce (1)		x	x		x				x	x					x			x			x			x												x	10
Bois de Vincennes (850)		x	x		x	x		x	x		x	x	x	x	x			x			x	x	x	x					x		x		x	x		x	21
Cimetière de Montmartre (11)		x	x								x										x			x				x					x				7
Cimetière du Père-Lachaise (46)		x	x		x			x	x		x	x												x									x	x			10
Jardin Arnaud Beltrame (<1)	x		x					x	x		x								x					x								x				x	9
Jardin de la place du Docteur Navarre (<1)		x	x					x	x		x							x						x								x					8
Jardin de la Place Louis-Armstrong (<1)			x						x		x		x								x			x				x				x					8
Jardin de Reuilly-Paul Pernin (1)					x			x	x	x	x							x			x			x	x												9
Jardin des Plantes (17)			x						x	x	x	x						x			x	x		x						x		x	x	x			13
Jardin des Tuileries (20)		x	x					x			x					x		x												x							7
Jardin du Carré de Baudouin (<1)								x	x		x							x			x			x				x									7
Jardin du Luxembourg (25)		x	x					x	x									x						x									x	x			8
Jardin Louise Weber dite La Goulue (<1)			x		x			x	x		x	x									x			x				x									9
Jardin Père Teilhard de Chardin (<1)					x			x	x		x										x			x				x						x			8
Jardins Grands Moulins Abbé Pierre (<1)		x	x							x	x		x					x										x									7
Parc de Belleville (4)		x	x					x	x	x	x	x						x			x	x		x								x	x				13
Parc de Bercy (18)		x	x		x	x		x	x		x	x				x		x			x			x						x			x			x	15
Parc des Buttes-Chaumont (26)		x	x		x		x	x	x		x	x	x					x			x	x		x									x	x			15
Place des Vosges (1)			x					x	x												x							x									5
Square Barye (<1)		x	x		x			x	x	x	x									x				x	x			x				x	x				13
Square Carpeaux (<1)		x	x					x			x																						x				5
Square des Chamaillards (<1)		x	x					x		x	x	x			x						x		x	x						x							11
Square Cyprian Norwid (<1)		x						x	x															x													4
Square des Amandiers (<1)			x		x	x			x	x	x										x		x	x					x								10
Square des Saint-Simoniens (1)								x			x										x							x									4
Square Florence-Blumenthal (<1)								x										x						x													3
Square Gustave Mesureur (<1)			x					x	x	x	x		x		x			x			x							x								x	11
Square Héloïse et Abélard (<1)		x			x			x	x	x	x	x	x					x			x							x									11
Square Henri Galli (<1)					x			x													x							x									4
Square Jean Morin (<1)										x		x																									2
Square Le Gall (3)	x		x	x				x	x	x	x	x					x	x			x	x		x			x						x	x	x		17
Square Léon Serpollet (1)			x					x		x	x	x									x			x				x									8
Square Léopold-Achille (<1)			x						x		x	x									x							x									6
Square Marcel Bleustein Blanchet (<1)		x	x					x	x		x							x			x			x		x		x					x				11
Square Robert Montagne (<1)		x	x					x	x	x	x									x	x			x			x	x				x		x		x	14
Square Théodore-Monod (<1)		x	x					x	x	x		x	x					x		x	x			x				x					x				13
Square René Viviani (<1)		x	x					x	x											x						x				x							7