# Changes in the nocturnal activity of birds during the COVID–19 pandemic lockdown in a neotropical city

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**Abstract**

*Changes in the nocturnal activity of birds during the COVID–19 pandemic lockdown in a neotropical city*. The COVID–19 lockdown provided the opportunity to measure species biodiversity in urban environments under conditions divergent from regular urban rhythms. For 90 days, including weeks of strict lockdown and the subsequent relaxation of restrictions, we measured the presence and abundance of birds that were active at night at two sites in the city of Cali, Colombia. Our results show that species richness of nocturnal birds decreased 40 % to 58 % during the weeks with more human activity, adding further evidence to the biodiversity responses of the 'anthropause' on urban environments.

Key words: Anthropause, Artificial light at night, COVID–19 lockdown, Tropical cities, Urbanization, Urban ecology

**Resumen**

*Cambios en la actividad nocturna de las aves durante el confinamiento decretado con motivo de la pandemia de la enfermedad por coronavirus (COVID–19) en una ciudad neotropical.* El confinamiento decretado con motivo de la pandemia por COVID–19 ofreció la oportunidad de medir la biodiversidad de especies en ambientes urbanos en condiciones diferentes a las del ritmo urbano habitual. Durante 90 días, incluidas varias semanas de estricto confinamiento y la posterior relajación de la restricción de la actividad humana, se midieron la presencia y la abundancia de aves nocturnas en dos sitios de Cali, en Colombia. Los resultados de este estudio muestran una reducción de entre el 40 % y el 58 % de la riqueza de aves nocturnas durante las semanas con mayor actividad humana, lo que suma otro indicio de la respuesta de la biodiversidad ante la "antropopausa" en ambientes urbanos.

Palabras clave: Antropopausa, Luz artificial en la noche, Confinamiento debido al COVID–19, Ciudades tropicales, Urbanización, Ecología urbana

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The 'anthropause' (Rutz et al., 2020) produced by the COVID–19 strict lockdowns provided a unique and probably unrepeatable opportunity to measure the effect of pervasive influence of human activities on urban animals. Lockdowns reduced the effect of human–induced pressures such as anthropogenic noise (Bates et al., 2020). The global reduction in activity allowed the study of the possible effects of human activities on natural and transformed ecosystems. In urban ecology, the effects of artificial light at night (ALAN, *sensu* Gaston, 2018) and noise on urban wildlife populations have long been a subject of study (Fröhlich and Ciach, 2019). However, the effects of human activity have received less attention and have mainly concerned differential wildlife detectability between weekdays and weekends in natural areas, for instance (Nix et al., 2018).

Neotropical nocturnal birds (Strigiformes, Caprimulgiformes, Nyctibiiformes) are among the most poorly–studied avian groups (Fröhlich and Ciach, 2019) even though they play key roles in ecosystem functions and their species richness is high (Kettel et al., 2018). Additionally, some diurnal birds, such as seagulls, herons, and swifts, are also active at night (La, 2012). This nocturnal behavior can be opportunistic and rarely permanent, showing that circadian rhythms in birds can vary (Mukhin et al., 2009).

Little is yet known about key issues for the conservation of nocturnal bird species, such as their sensitivity to human disturbance and environmental requirements that could impact their behavior, population dynamics, and distribution. The lack of knowledge on this subject is mainly because such study is challenging due to their low density and detectability (Fröhlich and Ciach, 2019). Nevertheless, their presence in highly–transformed environments, including cities and agro–ecosystems, is frequent and common, and with the development of new technologies of passive monitoring, we are learning more about the ecology of nocturnal birds (Marín–Gómez et al., 2020). In the case of diurnal birds that are active at night in urban environments, however, very little is known. Besides, the information available is mainly anecdotal and refers to birds foraging in night lighting (La, 2012). Despite the scarcity of information published to date on the ecology of nocturnal birds in urban environments, several characteristics have been identified as drivers of their presence and distribution (Chace and Walsh, 2006). Low urbanization levels, well–vegetated urban spaces, and high density of prey are the principal factors associated with an increase in the appearance of nocturnal birds (Kettel et al., 2018). Nevertheless, their populations are limited due to the wide spectrum of hazards in urbanized areas, such as collisions with human infrastructure, artificial lighting, noise, disease, and poisoning (Marín–Gómez et al., 2020). Specifically, anthropogenic noise at night may reduce the availability of prey and interfere with communication behavior among individuals (Marín–Gómez et al., 2020). Notwithstanding, recent studies have suggested that ALAN can benefit several nocturnal species by increasing the abundance of potential prey and improving their detection (Marín–Gómez et al., 2020). However, disentangling the dynamics of ALAN and anthropogenic noise, and even the consequences of other human activities, remains a challenge as it has been almost impossible to isolate the role of each factor in urbanized ecosystems.

In this study, we surveyed active birds at night in the city of Cali (2.5 million people, 137.5 $km^2$), Colombia, at different moments during the COVID–19 lockdown. The lockdown in Colombia involved varying intensities of human activity. During the first six weeks (March 23rd to June 30th, 2020), lockdown was strict. There were mandatory restrictions for the entire population regarding mobility and most economic activity was suspended. Then, for the following six weeks, until June 30th, the restrictions were gradually lifted regarding human mobility. To evaluate the relationship between nocturnal birds and human mobility in Cali during this study period, we used the most complete and detailed dataset of human mobility available during the lockdown (Google, 2020), as a proxy. Human mobility in Cali decreased by 25 % to 60 % during the time of this study, compared to pre–lockdown activity, showing a constant gradual increase ($r = 0.98$, $P < 0.001$) throughout the window of time of the study (fig. 1A). Avian surveys were performed at least five times per week in a peri–urban site (site A, 3º 27.103' N 76º 32.738' W) and in an urban site (site B, 3º 25.987' N 76º 32.746' W) from March 23rd to June 30th, 2020. Surveys consisted of point–count repetitions of 10 minutes in a circular fixed–radius (50 m) between 21:30–22:30 h (three hours after sunset) on nights without rain or strong winds. One observer per site (site A: FAE; site B: CMWW) recorded all birds seen or heard during the point–count. To assess the relationship between the recorded nocturnal birds and the time elapsed after the lockdowns started, we performed a GLM per site (Poisson error distribution, link = log) considering the number of nocturnal records as the dependent variable and time (week) as the independent variable, considering the average weekly time at which surveys were conducted as a random factor. Both GLMs were run in R (R Core Team, 2020).

After conducting 194 point–count repetitions during the nocturnal surveys, we recorded nine species on 62 occasions (table 1). Five species of the recorded species are commonly classified as diurnal; three of these species were songbirds that mainly consume insects in flight (Tyrannidae), while the other two were foliage gleaners (Troglodytidae, Parulidae). The number of records and species richness of birds during the surveys at site A decreased significantly across time (GLM $\chi^2 = 8.79$, $P = 0.003$; fig. 1B). Comparing the first six weeks of strict lockdown with the latter six weeks, we observed that in Site A the decrease in observation was 52 %, and 52 % for species richness. Site B showed a non–significant negative trend (GLM $\chi^2 = 10.46$, $P = 0.142$; fig. 1C), with a reduction of records of 40 % and 58 % less for species richness.

Although the detectability of birds at night could have changed across the surveyed time, we did not

directly measure it. Besides the fact that changes in the environment could have shifted avian detectability, it also could be affected by seasonal patterns of activity of the birds according to their life cycle. However, as seasonality is not as marked in a neotropical city like Cali as in other regions, there is not a clearly evident breeding season, and this could reduce potential sources of detection bias.

Among the nine species recorded during this study, two of them are some of the most commonly reported birds in Colombian cities: the tropical kingbird (*Tyrannus melancholicus*) and house wren (*Troglodytes aedon*). Although the nocturnal vocalization of diurnal birds is not uncommon behavior, it is poorly understood. However, our records suggest that it could be similar to that promoted by ALAN, and where anthropogenic noise seems to be a limiting factor. Further experimental studies are therefore needed to understand this relationship in depth as it could have potentially significant importance in the management of urban systems.

The small sample size of this study is a limitation that does not allow us to generalize our results. However, it is of interest that we were able to record some patterns in such an unexpected anthropause scenario. At both studied sites we recorded a higher number of records and higher species richness during the early stages of the lockdown. The fact that more species and more individuals were more active during the initial six weeks suggests that the normal rhythm of the city could represent a constraint for them. Additionally, given the inherent differences between peri–urban and urban sites (MacGregor–Fors, 2010), it was not surprising that the recorded patterns were stronger in the peri–urban site, suggesting that the city outskirts became even more diverse during lockdown than the intra–urban area of the city.

It is notable that, during the lockdown in Cali, ALAN in public spaces was constant, with the same intensity, number of lights, and schedule as the previous weeks and after the lockdown. Therefore, the nocturnal birds' exposure to ALAN during lockdown was comparable to that during 'regular' nights. However, there was a notable reduction in human activity and mobility at the beginning of lockdown, such as less traffic, fewer pedestrians, closed establishments, and general anthropogenic noise, suggesting that the changes in nocturnal bird species' richness and frequency was enhanced by a quieter and calmer environment. Under usual conditions, it would not be easy to interpret all of the potential associations between noise and ALAN because of many factors. As mentioned above, the anthropause offered a unique opportunity to study calmer cities. Although the effect of urban noise on diurnal bird activity has received attention in the past, a recent study showed that decreases in diurnal bird numbers in noisy urban settings could be related to temporal responses of birds or our inability to detect them in highly noisy conditions (Carral–Murrieta et al., 2020). Also a recently published study from Spain showed a significant increase in bird detectability in the early morning, suggesting a rapid behavioral response of urban birds to novel environmental conditions (Gordo et al, 2021).

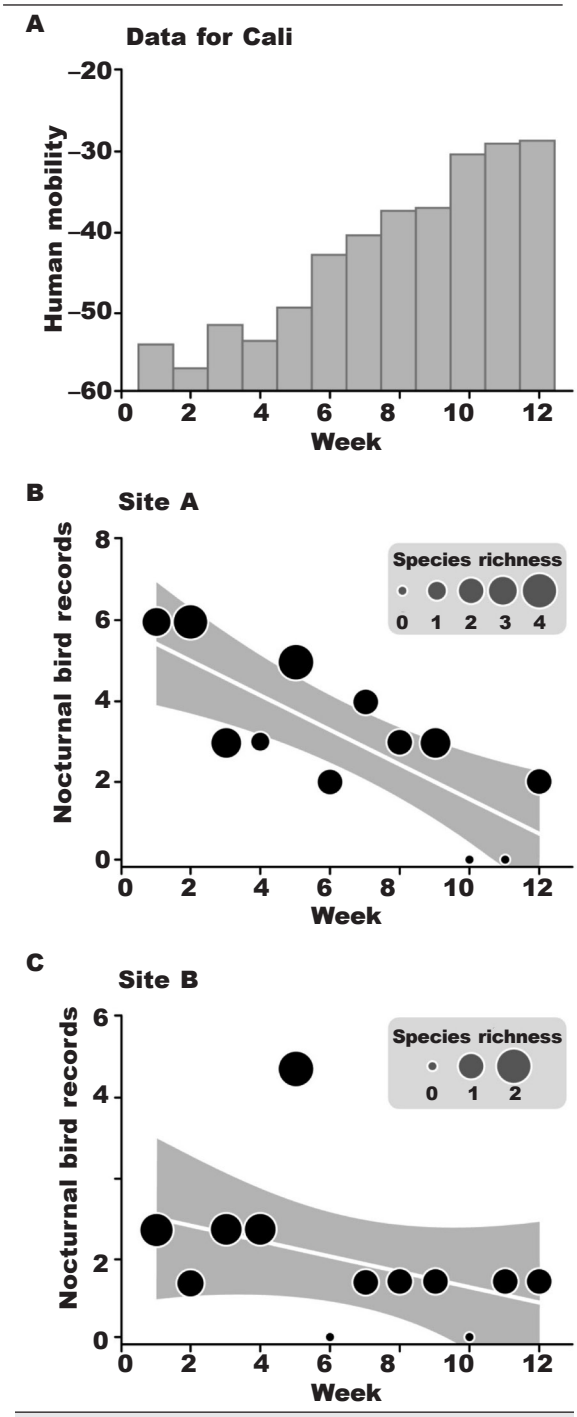


Fig. 1. Increase in human mobility (A) and relationships between nocturnal bird records at night during COVID–19 lockdown in a peri–urban (B, site A) and in an intra–urban (C, site B) site in Cali, Colombia.

*Fig. 1. Aumento de la movilidad humana (A) y relaciones entre los registros de aves nocturnas por la noche durante el confinamiento decretado con motivo de pandemia por COVID–19 en dos zonas de Cali, en Colombia: una periurbana (B, sitio A) y una intraurbana (C, sitio B).*

Table 1. Species recorded at night in Cali during COVID–19 lockdown.

*Tabla 1. Especies registradas por la noche en Cali durante el confinamiento decretado con motivo de la pandemia por COVID–19.*

| | Weeks | | | |
|---|---|---|---|---|
| | Site A | | Site B | |
| Species | 1–6 | 7–12 | 1–6 | 7–12 |
| *Nyctibius griseus* | 3 | 2 | 6 | 3 |
| *Nycticorax nycticorax* | 2 | 5 | | |
| *Tyto alba* | | | 1 | |
| *Megascops choliba* | | | 5 | 2 |
| *Pyrocephalus rubinus* | | | 1 | 1 |
| *Myiozetetes cayanensis* | 11 | | | |
| *Tyrannus melancholicus* | 4 | | | |
| *Troglodytes aedon* | 6 | 5 | | |
| *Myiothlypis fulvicauda* | 2 | 4 | | |

In summary, the results of this study suggest that the number of birds present and active at night in a tropical city increased notable during the strict lockdown that took place in Cali.

We recognize that this study has limitations of sample size and spatial representation. Furthermore, it was developed under the unique and probably unrepeatable circumstances of the anthropause brought about by the COVID–19 lockdown. According to the aforementioned observations, the reduction in numbers of pedestrians and vehicles as a direct consequence of these changes in human activity appeared to have an effect on the nocturnal activity of several species of birds. These results therefore also add to the quantitative and standardized evidence of the responses of biodiversity to the anthropause in urban environments. We consider that specific findings such as those presented here should be taken into account in future urban planning and conservation strategies.

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