

Citizen Science in Action: Preliminary Observations on Bat Box Use in the Perth and Peel Regions, Western Australia

KELLY SHELDRIK^{1,2} , KELLY DUCKWORTH¹

¹ Conservation Council of Western Australia,

² Murdoch University

Keywords: bat boxes, citizen science, artificial roost, climate change, metabolic bone disease, heat stress

<https://doi.org/10.70880/001c.141521>

Abstract

Artificial roost structures such as bat boxes are increasingly used to support bats in urban environments, particularly where natural hollows are scarce due to habitat loss and fragmentation. Despite widespread installation across the Perth and Peel regions of Western Australia, coordinated monitoring to assess their effectiveness remains limited. This research note presents preliminary findings from an ongoing citizen science initiative aimed at understanding bat box occupancy and informing conservation efforts. Monthly monitoring at three sites, Canning River Regional Park, Paganoni Swamp, and Samphire Cove, involved visual inspections, guano recording, and acoustic surveys. Consistent occupancy was only observed at Canning River Regional Park, likely influenced by factors such as freshwater proximity, habitat connectivity, box design and age. Non-target fauna including wasps, moths, skinks, and geckos was also recorded. Notably, two deceased bats were found in one box, and a live bat showing signs consistent with metabolic bone disease was observed, raising concerns about bat health in urban environments. As climate change leads to more frequent and intense heat waves, further investigation is needed into how environmental conditions, urbanisation and bat box design together influence roost temperatures and other aspects of bat welfare. These early insights highlight the value of community-led monitoring in guiding future conservation planning.

INTRODUCTION

Bat boxes are commonly used in wildlife conservation, particularly in urban and peri-urban areas where natural roost sites for bats may be limited (Ruegger 2016). These artificial roosts provide additional roosting habitat in landscapes affected by habitat loss, urban development, or land-use changes. Bat boxes have become a popular conservation tool to support bat populations amongst community conservation groups and members of the public (e.g., Van Helden *et al.* 2024), and for development and habitat loss mitigation (e.g., Brittingham & Williams 2000).

Despite the widespread installation of bat boxes across the Perth and Peel regions, there has been little ongoing monitoring to assess their effectiveness in fostering long-term bat populations. Without regular monitoring, it is difficult to determine whether bat boxes are being used, whether they support breeding colonies, or whether they present any welfare risks to the bats. This knowledge gap is a significant barrier to refining conservation strategies and ensuring that artificial roosts effectively contribute to bat conservation efforts.

Citizen science has emerged as a powerful tool for addressing monitoring challenges (e.g., Greenwood 2007; Barlow *et al.* 2015; Ilhami *et al.* 2024). By engaging the public in data collection and species observation, citizen science initiatives can help bridge the gap in scientific knowledge, particularly in large-scale monitoring efforts. In response to the lack of systematic monitoring of bat boxes in the local region, our project engages citizen scientists to collect data on bat box occupancy, observe roosting behaviour, and help identify priority boxes for further targeted monitoring and resource allocation.

This research note presents preliminary insights from an ongoing citizen science initiative investigating bat box use in the Perth and Peel regions. We highlight potential factors influencing bat box occupancy and considerations for bat welfare, providing a foundation for future investigations. Full data analysis and detailed findings will be shared in forthcoming peer-reviewed publications.

METHODS

Ongoing bat box monitoring is being conducted at three sites in the Perth and Peel region: Canning River Regional Park (21 boxes, commenced February 2024), Paganoni Swamp (24 boxes, commenced May 2024), and Samphire Cove (8 boxes, commenced December 2023). At each site, data were collected for each individual box, including details on placement, aspect, box type, height, and installation date. Boxes were then checked monthly to record bat occupancy. Initial checks were conducted from ground level using torchlight to confirm the presence or likely presence of bats, along with reporting any signs of guano. As of March 2025, 500 bat box checks have been carried out at 53 bat boxes across the three sites, with further monitoring ongoing as the project continues.

Where bats were observed, emergent counts were carried out in the evening using Echo Meter Touch 2 (Wildlife Acoustics, Inc., Maynard, MA, USA) bat detectors to estimate the number of individuals and identify species. At Canning River Regional Park, more detailed assessments have recently commenced to investigate breeding status and gather general bat health information. These procedures follow methods outlined in *Wildlife Research in Australia: Practical and Applied Methods* (Smith *et al.* 2022) are implemented under Wildlife Animal Ethics Permit number WAEC 24-05-27, and involve accessing boxes during daylight to record species, take biometric measurements, and assess visible breeding and health indicators.

Citizen scientists have been actively involved in the monitoring process, contributing to torchlight inspections, emergent counts including acoustic recordings, and identifying bat boxes for more intensive monitoring as the project progresses. Further methodological details and results will be reported in a forthcoming full-length research article.

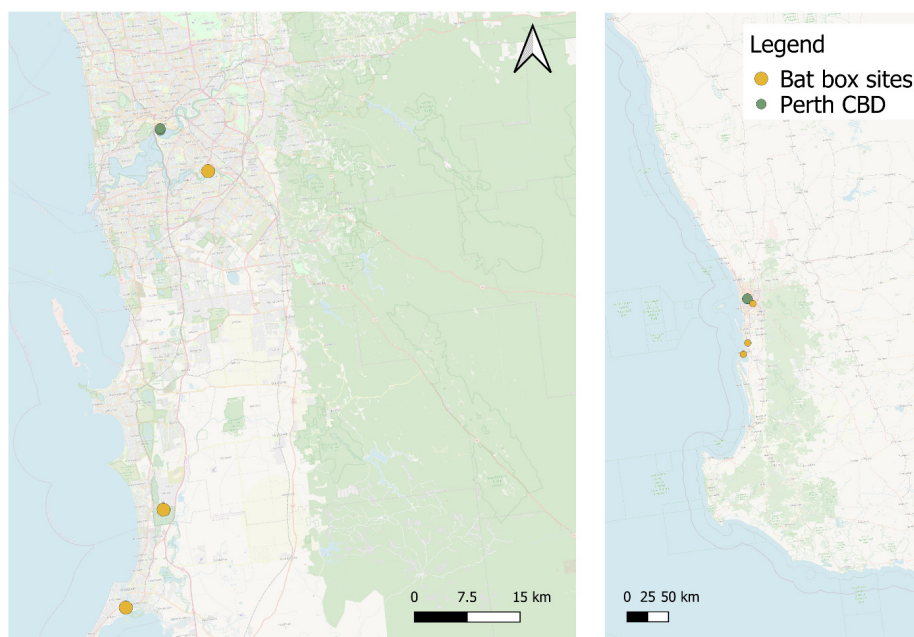


Figure 1. Map of citizen science bat box monitoring site locations referenced in this research note.

Left image shows Perth and northern Peel regions; right image shows position in South West Australia.



Figure 2. Initial bat box checks carried out by torch light from ground level by trained citizen scientists at Canning River Regional Park.

Photo: Lana Harvey-Draper.

PRELIMINARY OBSERVATIONS

While this project is ongoing, early patterns are beginning to emerge. Initial observations suggest variation in bat box use across the three study sites, with notable differences in occupancy and species pres-

ence. We have found that environmental and climatic factors, such as increasing temperatures, seem to be important, and our preliminary observations have raised concerns for bat health and conservation.

This research note discusses only some of the preliminary findings of bat box usage and site variability; a full analysis, including limitations and methodological evaluation, will be provided in a forthcoming publication.

Bat box usage and site variability overview

Of the three monitored sites only Canning River Regional Park has shown consistent bat box occupancy to date. Two species, Gould's wattled bat (*Chalinolobus gouldii*) and lesser long-eared bat (*Nyctophilus geoffroyi*), have been recorded roosting in the boxes at this site, with some indications that breeding may also be occurring. These early findings suggest that certain environmental and site-specific factors at Canning River Regional Park are contributing to higher observed occupancy rates.

These factors may include the site's proximity to freshwater, which likely provides important foraging and hydration opportunities for bats. This may be particularly important for maternity colonies (Blasco-Aróstegui *et al.* 2021). The presence of a variety of bat box designs may offer a broader range of roosting options (Rhodes & Jones 2011; Ruegger 2016; Crawford *et al.* 2022), while the age of the boxes, many of which have been in place for over a decade, could promote long-term use through established site fidelity (Kapfer *et al.* 2008; Lewis 1995; Perry 2011). Placement within the site may also play a role. For example, boxes positioned higher off the ground and closer to vegetation may provide shelter from predators (Blasco-Aróstegui *et al.* 2021), especially for low-flying species like the lesser long-eared bat, which may be more vulnerable to threats such as predation by domestic and feral cats (Szentivanyi *et al.* 2023).

In contrast, bat occupancy at Paganoni Swamp and Samphire Cove has not yet been recorded, indicating that factors such as freshwater availability or surrounding land use may influence box uptake (Blasco-Aróstegui *et al.* 2021). Ongoing monitoring is being carried out to de-

termine whether bat presence increases over time or if changes in box placement or design are needed.

Signs of use by other fauna species have been observed, including mud dauber wasp nests, cocoons of what may be antheiid moths, and sightings of small skinks and geckos. No feral bee colonies have been found inside the bat boxes themselves during these checks, although hives have been observed in trees where boxes are installed. We will continue to document these observations as the bat box monitoring progresses with the intention of publishing consolidated findings and analysis in the future.

Environmental and climate considerations

Preliminary observations have highlighted temperature regulation as a potential concern for bats using artificial roosts. Unlike natural tree hollows, bat boxes generally lack insulation and do not offer the same spatial flexibility for bats to move and escape thermal extremes (Crawford *et al.* 2022). In natural roosts, bats can reposition themselves within the hollow to avoid overheating or excessive cold; however, artificial boxes provide limited capacity for such microclimate regulation (e.g., Turbill & Geiser 2008).

This concern is particularly relevant in the context of climate change, as increased temperatures, more frequent heatwaves, and longer drought periods could increase internal box temperature, a concern that ecologists have raised for boxes for bats (e.g., Crawford & O’Keefe 2021; Lausen *et al.* 2022) and other taxa (e.g., Larson *et al.* 2018). During one routine check, a partial bat forearm was observed protruding from a box entrance. Upon further inspection, two deceased bats, a Gould’s wattled bat and a lesser long-eared bat pup, were found inside. While the cause of death is unknown, elevated internal temperatures may have contributed, especially given the lack of insulation and the known risks of heat stress in artificial roosts, which have been reported elsewhere in Australia (e.g., Griffiths 2022).

Research conducted in Victoria has demonstrated that dark-coloured bat boxes can reach temperatures exceeding thermal tolerance limits for temperate bat species (Griffiths *et al.* 2017). As many species are habitual and return to the same roost sites over time (e.g., Perry 2011), poor thermal regulation in boxes raises potential concerns for long-term bat welfare, particularly in ageing boxes such as those at Canning River, which were installed over a decade ago.

These risks may become even more significant under warming and drying climatic trends in Western Australia. The cumulative impacts of climate change (e.g., Matusick *et al.* 2023), native vegetation clearing (e.g., Andrich & Imberger 2013), intensive burning regimes (e.g., Bradshaw *et al.* 2018) and urbanisation (e.g., Lewanzik *et al.* 2022) are progressively reducing the availability and quality of natural roosts, exacerbating pressures on bat populations.

Artificial roosts may provide supplementary roosting habitat; however, their design and placement may inadvertently create thermal stress. Therefore, monitoring internal box temperatures may be a valuable addition to future monitoring efforts. This will help to determine whether heat exposure plays a role in occupancy patterns or mortality, as well as informing climate change adaption strategies for bat conservation.

Bat health and conservation implications

Baseline monitoring at Canning River Regional Park has raised potential concerns about the health of bats using artificial roosts in urban areas. During targeted surveys, a Gould’s wattled bat (*Chalinolobus gouldii*) was found showing signs consistent with metabolic bone disease (MBD). Symptoms include thinning fur, inflamed skin and visibly misshapen and swollen joints in the metacarpals and tail bone, all of which were observed on this individual, and are consistent with descriptions of MBD in other studies (e.g., Roswag *et al.* 2011) and personal communications with Bat Rescue WA (pers. comm. 2025).

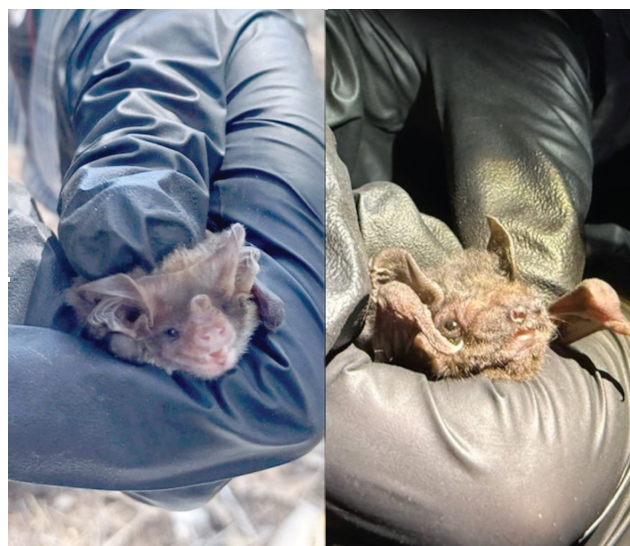


Figure 3. Lesser long-eared bat (*Nyctophilus geoffroyi*, left) and Gould’s wattled bat (*Chalinolobus gouldii*, right) processed at Canning River Regional Park.

Note *C. gouldii* photographed was displaying symptoms consistent with MBD (thinning fur, inflamed skin, and visibly misshapen and swollen joints in the metacarpals and tail bone). Photos: Lana Harvey-Draper.

Although the bat’s flight and behaviour appeared normal and it remained integrated in the colony, these symptoms warrant further investigation.

MBD, often associated with calcium and vitamin D deficiencies, can lead to bone deformities and may impair flight capability (El Demellawy *et al.* 2018). While only a single confirmed case was recorded during this monitoring session, distant visual inspection of other individuals in the same box suggest that further bats may be similarly affected.

No signs of the condition were observed during recent large-scale bat trapping surveys undertaken in remote areas of the southwest (where over 300 bats were processed, unpublished 2025 data of Sheldrick). However, some bats recently surveyed in the City of Wanneroo (situated in the northern suburbs of Perth, approximately 25 km from the Perth CBD) have also shown early signs of MBD (unpublished 2025 data of Sheldrick).

In addition, Bat Rescue WA (<https://www.facebook.com/Bat-TeamWA/>) has reported an increase in bats presenting with MBD symptoms across the Perth region in recent years. Although the underlying causes remain uncertain, potential contributors may include nutritional deficiencies, habitat degradation, and environmental stressors, including possible exposure to environmental pollutants such as pesticides (e.g., Di *et al.* 2023; Baradaran *et al.* 2024; Park *et al.* 2024). Continued monitoring will be essential to better understand these health risks and the potential role of artificial roosts in exacerbating or mitigating them.

CONCLUSION

This research note highlights the potential of bat boxes to support urban bat populations in the Perth and Peel regions while also serving as a vital tool for monitoring bat health. Early observations at Canning River Regional Park have shown that these artificial roosts provide an important opportunity for early detection of health issues in bats, such as MBD and thermal stress, that likely reflect broader environmental challenges. Engaging citizen scientists in ongoing monitoring not only helps detect these concerns early but could also inform future improvements in bat box design and placement. Together, community

involvement and research will enhance conservation efforts and contribute to the long-term wellbeing of local bat species.

ACKNOWLEDGEMENTS

We acknowledge the Traditional Custodians of the lands on which this work was undertaken: the Whadjuk and Bindjareb people of the Noongar Nation. We pay our respects to Elders past and present, and recognise their enduring connection to Country, culture, and community. Sovereignty was never ceded.

A huge thank you to all the amazing volunteers and organisations who have contributed to the project so far. Particular thanks to Robyn Devenish OAM and Daniela Buters of the Mandurah Environment and Heritage Group for monitoring at Samphire Cove; Leonie Stubbs and the volunteers from the Friends of Paganoni Swamp for monitoring Paganoni Swamp; our CCWA interns, Pinidi Abeysekara Jayawardana and Opal Byworth; and the dedicated volunteers involved at

Canning River, including Jim Prince, Tash Anderson, Amy Evans, Anne Holder, Catherine White, and Louise Morton.

Special thanks to Lana Harvey-Draper and Brandon Friend from the City of Canning, and to Bryce Angell from SERCUL for their ongoing support and funding — without which the Canning River bat box monitoring would not be possible.

Finally, sincere thanks to Bat Rescue WA, particularly Tony Hodges and Sam de Hann, for their guidance and expertise on metabolic bone disease in bats and broader bat health concerns (and for all you do for our West Aussie bats!) And to my partner, Michael Cowgill for his constant support and understanding, especially when it comes to all the late-night surveys and non-stop bat chat.

Submitted: June 03, 2025 AWST. Accepted: June 25, 2025 AWST.

Published: July 04, 2025 AWST.



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