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## Progress Report for 2024 FAR Grant

# Torpor use and burrowing behaviour in an arid zone passerine

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Occupying arid zone regions characterised by highly variable conditions and low productivity poses significant challenges for small birds. The White-backed Swallow *Cheramoeca leucosterna* (~15 g) predominantly inhabits arid environments and occurs in a large area across central Australia (Fig. 1). The White-backed Swallow, a member of the order Passeriformes (family Hirundinidae), is the sole species in the genus *Cheramoeca*. Its closest relative is the African Grey-rumped Swallow *Pseudhirundo griseopyga*. Like that species, White-backed Swallows are nest-hole excavators that burrow into the vertical sandy faces of riverbanks and drainage lines. Despite its burrowing behaviour and ability to thrive in harsh and unpredictable arid habitats, there have been very few studies that have sought to understand the ecology of this fascinating species.

Maintaining a positive energy budget is likely to be an important challenge for White-backed Swallows because of their small size, non-migratory behaviour and reliance on aerial insects for food, which become less available in cold, rainy, or windy conditions. Roosting at night in burrows provides some insulation from temperature extremes and protection from most predators. Resting in a burrow could also be used during the day to avoid unfavourable weather when foraging is unproductive. Indeed, anecdotal reports have documented cases where White-backed Swallows have been found inactive inside their burrows during the day, unresponsive and apparently in a state of deep torpor. It was these reports that I found most intriguing, and they motivated my study into their thermal biology and burrow roosting behaviour. Torpor refers to a controlled and temporary reduction in metabolic rate and body temperature, and entering a state of torpor by a mammal or bird is the most effective physiological mechanism for reducing energy expenditure. Passerine birds are generally thought to avoid torpor, but few studies have actually measured the body temperature of wild passerine birds. I thought the burrowing behaviour of White-backed Swallows, a reliance on aerial foraging and the challenges of their arid habitat could select for torpor, and the historical reports seemed to support this hypothesis.

Therefore, with my supervisor, Christopher Turbill, at Western Sydney University, the bird-banding expertise of Tony Hunt, and help of volunteers, I conducted several research trips to Sturt National Park, where White-backed Swallow sightings are regular, to investigate their use of burrows for resting, and whether they can use deep torpor to survive unfavourable conditions during winter. This research addresses a critical gap in our understanding of how Australian avifauna, especially passerines, overcome periods of energy stress and thrive in arid and hypervariable environments.

**Figure 1.** *White-backed Swallow in Sturt National Park.*
Photo by Alice Barratt

### METHODS

We studied White-backed Swallows in Sturt National Park, near Tibooburra, in central Australia (-29.47 °S, 142.23 °E). We located active burrows in drainage lines and creeks, determining if they were recently used by the presence of fresh excavations (Fig. 2). We caught birds using a hand net placed over the burrow entrance as they emerged at sunrise. All birds were weighed, and their plumage and colouring assessed to determine if the birds were juvenile or adult. Only adult birds were included in the study. We then attached temperature-sensitive radio transmitters (Holohil, LB-2XT) using a latex glue to the mid-dorsal skin of the bird to measure its skin temperature, which gives a close approximation of core body temperature in small birds. We radio tracked at night to locate roosting swallows in their burrows. We then deployed autonomous receiver/logger units to monitor the bird's skin temperature, from which we inferred body temperature, while it rested in the burrow (Fig. 3).

We also deployed motion-activated camera traps to collect data on timing of activity at the burrows and if predators (e.g., feral cats) were present at the burrow. Lastly, we measured burrow characteristics, including the height and orientation of the creek bank, as well as the entrance size and depth of the burrows, to better understand preferences for burrow location and qualities of active burrows. We also measured external air temperature and internal burrow temperature using data loggers to determine the thermal conditions of burrows. We sourced data on local weather conditions (e.g., wind speed, relative humidity, cloud cover and rainfall) from the Tibooburra Airport weather station (#046126) of the Australian Bureau of Meteorology, located approximately 16 km from the field site.


**Figure 2.** *a) Burrow with fresh excavation. b) Bank containing multiple burrows. c) Close up of burrow entrance for scale.*

Photos by Alice Barratt

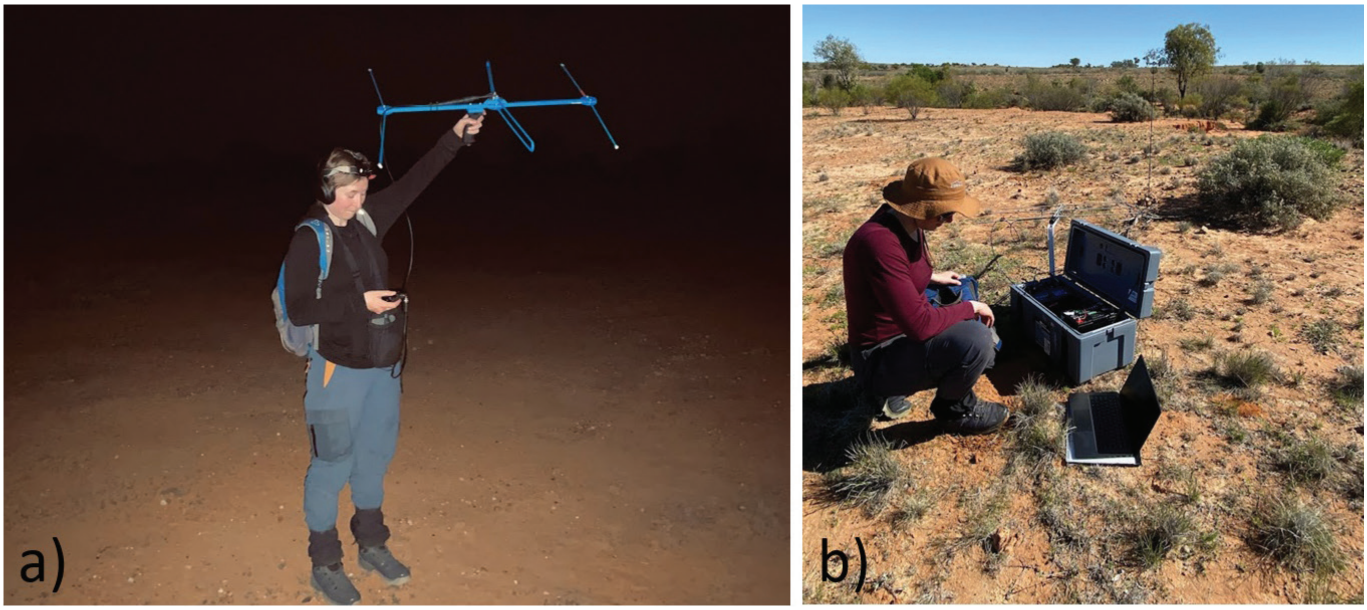


**Figure 3.** *a) Radio tracking swallows at night-time to locate roosting birds. b) Downloading and maintaining autonomous receiver/logger units deployed near burrows to record body temperature data.*

Photos by Chris Turbill.

## PRELIMINARY RESULTS AND DISCUSSION

Over two years we conducted four trips to Sturt National Park during winter, for a total of 50 days in the field. We faced our own challenges working in the remote field site during several rain events; however, these provided opportunities to test our prediction that White-backed Swallows would respond to inclement weather conditions by remaining in their burrows during the daytime and using torpor to save energy.

In total we caught and radio tracked 16 birds (average body mass 14.1 ± 0.81 g) to nine different burrows. There were more burrows in the area that appeared active (fresh dirt excavated) but were not used by any of the tagged individuals. Initial analysis shows birds preferred to burrow along fine sandy drainage lines that were relatively sparsely vegetated. The depth of active burrows ranged from 35.5 to 65.5 cm. Burrows were more stable in temperature than ambient air temperature but still ranged from 5.2 to 23.3°C during the study periods in winter (Fig. 4). Tagged individuals were recorded roosting in different burrows and with different individuals. On the three occasions we caught birds, the number in the same burrow was eight, three, and 12. Burrows appeared to be susceptible to damage from occasional large rain events, as almost all roosts found

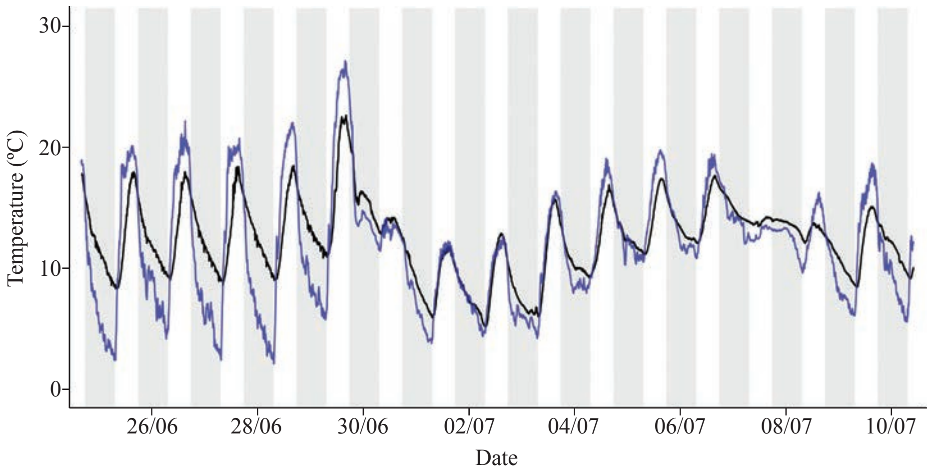


**Figure 4.** *Example of burrow (black line) and air (blue line) temperatures (°C) during the study. Vertical grey bars indicate night-time.*

in 2023 were absent in 2024, with some banks substantially eroded. I am still analysing camera trap data to determine the number of birds in burrows, timing of activity and the presence of predators at the roost.

We recorded body temperature data for 98 bird days. On most nights, the birds only used shallow torpor with a minimum body temperature of around 36°C. However, following heavy rain, the birds strongly increased their use of torpor, and we recorded a minimum body temperature of 18.8°C—lower than the previously recorded minimum for any passerine species of 22.5°C for the Southern Double-collared Sunbird *Cinnyris chalybeus*. Further, we recorded the White-backed Swallow using torpor during the daytime when usually active, which was also previously undocumented in any passerine bird and unusual among all birds known to use torpor. Our data confirm early reports that White-backed Swallows use profound torpor to save energy during unfavourable conditions. Our findings are important because they demonstrate that passerines are capable of using deep torpor and suggest avian torpor appears to be more common and widespread than previously appreciated. The ability to reduce the risk of starvation by using torpor has implications for our understanding of foraging behaviours, roosting ecology, and resilience to environmental pressure. Further, our findings demonstrate the need for more data on free-living birds, especially passerines, to understand the true extent of energy saving torpor in birds and its role in their survival.

Working in remote arid zones is challenging and I am very grateful for the support I received from the Australian Bird Study Association. The Fund for Avian Research Grant was instrumental in helping me to complete this study. I am also very grateful to staff of the National Parks and Wildlife Service, who generously provided accommodation and assistance throughout the study. We acknowledge the traditional custodians of the land where this study was undertaken: the Wadigali, Wongkumara and Malyangapa peoples.

## Erratum

Barker, A.J. (2023). Dispersal of juvenile Southern Scrub-robins *Drymodes brunneopygia* in the Murray Mallee of South Australia.

*Corella* **47**: 88-97.

Under **Methods**, in the section *Vegetation surveys*, page 90, the sentence

“A 30 m² quadrat (marked every 5 m) was studied within each of these areas, recording the plant species present, and visually estimated per cent cover of understorey and tree canopy” should read

“A 30 **m x 30 m** quadrat (marked every 5 m) was studied within each of these areas, recording the plant species present, and visually estimated per cent cover of understorey and tree canopy.”