Just another bat in the wall–observations of a microbat maternity colony

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The White-striped Free-tail Bat (*Austronomus australis*) is one of Australia's most common bats. Despite this, they have been rarely studied. A maternity roost of this species has been studied since 2006 using video-recording, Anabat detection, radio tracking and PIT tagging to determine roost use and composition. The seasonal use of the roost, gender composition, breeding and potential changes to roost use as a result of climate change is discussed.

Introduction

The White-striped Free-tail Bat (*Austronomus australis*) (Figure 1) is one of Australia's most common bats. They are one of the few bat species that produce echolocation sounds that can be heard by humans. Though rarely seen, except flying quickly overhead, their echolocation calls are one of the most common sounds of the night. Their body fur can vary from dark brown to almost orange above and is slightly lighter below. Wide white stripes are located on each side of the body under the wings. Ears are large and leathery. Their wingspan can reach 40 cm, body length 10 cm and their 'free' tail extends well beyond their flying membrane. They fly high above the canopy, in a fast, relatively straight path in search of high-flying insects. Due to this they are rarely trapped and little is known of their ecology.

In 2002, a colony of White-striped Free-tail bats was found within a building in the Newington Armory during a bat survey by Glenn Hoye (Turton and Hoye, 2011). This was very unusual as this species is more commonly found roosting in trees; to date this is the only known maternity colony of this species to have a maternity roost in a building. The location of this colony seemed to provide a perfect opportunity to learn more about this little-known species. This study is the only long-term monitoring of this species to be carried out, and has much potential to expand existing knowledge.

Figure 1 White-striped Free-tail Bat

Early days

I undertook monitoring of the colony in December 2005. This initial monitoring was carried out over a period of four months (December 05 – March 06), and comprised a combination of night-long video and Anabat recording on a monthly basis. This study revealed interesting bat behaviour and noted an increase in colony numbers, indicating that indeed, this was a maternity colony.

From September 2006 to August 2007, further video recording was undertaken one night per month. As with the earlier monitoring, equipment used was fairly primitive by today's standards, using a security-type camera, with Infra-Red spotlights pointing at the exit point and recorded onto video tape. One drawback with this method was that the time required to review a 10-hour tape was ....10 hours. My volunteer base rapidly dwindled after a few hours of looking at video of a brick wall waiting for a flash of activity as a bat emerged!

In addition to the video recording and bat call detection, a small 'ibutton' data logger was lowered into the roost to determine the temperature and humidity of the roost. Unfortunately, when it was retrieved after 12 months it had been infiltrated with bat urine and small brown mites and the data was unable to be retrieved.

Although the techniques in those early years were basic, we did deduce that:

- The roost was being used yearly, with bats showing a high roost fidelity to the site, and that it met the highly specific conditions required for a maternity colony;
- Bats were not recorded using the roost in the winter months of June and July;
- A better understanding of the size of the maternity colony was determined.

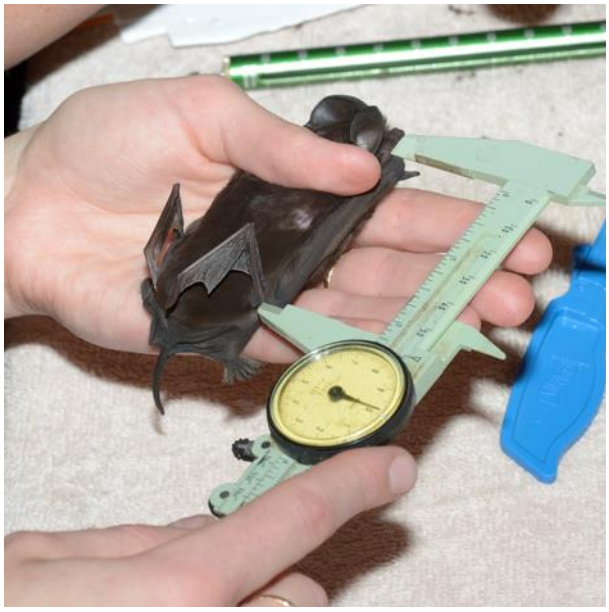

Figure 2 A White-striped Free-tail Bat in the hand having its forearm measured.

2008 onwards

In March 2008 we upgraded to an automatic system! A generous Queensland bat researcher (Bruce Thomson) lent me equipment to upgrade the project into the next phase using PIT tags (Passive Integrated Transponders) in the bats and an antenna at the roost entrance.

For this new system, bats were caught in a mist net as they exited the roost, examined, tagged and released (Figure 2). Once trapped, the bats are weighed, sexed, measured and, if not previously trapped and tagged, are injected with a uniquely numbered PIT tag (ISO standard 134.2khz full duplex Passive Integrated Transponder (Allflex)). When the bats enter and exit the roost, their unique tag number is picked up by an antenna located at the roost entrance and the number and time transmitted to a laptop that is running continuously. This data is then downloaded regularly and analysed (Figure 3).

This technology not only told us how many bats were using the roost, but whether the same bats were returning each night, the gender composition of the roost, how many times an individual left and re-entered, if the same adult females used the same maternity roost year after year, if their female young use the roost, and ultimately how long the bats are reproductively active and their longevity.

In our first 2008 season, we tagged a total of 27 bats over six trapping sessions. As of 2020, we have tagged a total of 98 individual bats.

Date,Time,Bat number
2008-03-13,20:27:49.413,009105952189
2008-03-13,20:31:55.997,009106179683
2008-03-13,20:34:30.017,009106184217
2008-03-13,20:37:48.004,009106145195
2008-03-13,20:41:36.852,009105952189
2008-03-13,20:41:54.704,009105828189
2008-03-13,20:45:14.882,009105952189
2008-03-13,20:48:35.814,009106179683
2008-03-13,20:48:46.356,009105952189
2008-03-13,20:50:03.803,009106159225
2008-03-13,20:50:58.067,009106179683
2008-03-13,20:51:10.165,009105952189

Figure 3 Example of the data collected from the roost

Unfortunately, the 2018-2019 and 2019-2020 maternity seasons were plagued by equipment failures and I was forced to look into a new system. Luckily, I was successful in obtaining a grant and have now set-up a brand-new Biomark IS1001 reader system and custom made antennae which should see the project continue successfully for a few more years.

Breeding

Mating, ovulation and fertilisation in the White-striped Free-tail bat occurs around late August. Most females, including young of the previous season, become pregnant each year and give birth to a single young, usually between early December and late January.

Bats start returning to the roost around October, although they may come and go for a while until numbers start to stabilise around mid-November. In March the young become mobile and start to leave the roost to forage. In April the bats may leave the roost for several days at a time and then return, this activity is at least partially explained by the radio-tracking results discussed below. By the end of April, most bats have left the roost for the winter period. It is not known where they go at this time, although it is thought that colonies disperse over winter allowing mixing of colonies and mating.

During the peak months from December to February, the majority of bats within the roost exited within an hour and a half after sunset. During the afternoon, audible social calling (chittering) can be heard in the late afternoon until the colony exits the roost.

One bat that was originally trapped and tagged in April 2008 was re-trapped in 2018, the first time she has been re-trapped. Surprisingly she was found to be lactating, showing not only longevity but a long reproductive life. She was

Figure 4 As bats get older, tooth wear becomes more obvious, caused by a life-time of chewing on the hard exoskeletons of invertebrates.

showing some signs of aging however, with thinning fur on her back and extensive tooth wear (Figure 4).

Roost Fidelity

This species has high roost fidelity. Approximately one third of the PIT tagged bats have returned to the roost in subsequent maternity seasons and stayed for the entire maternity season. Naturally as the bats age, these numbers are expected to decrease over time. Many of these bats have returned to the roost every year after they were first tagged.

Gender composition of roost

As of 2019, only 21 of the 97 bats tagged have been male (21%); it is not known if this is unusual amongst bat species. The majority of the males tagged as juveniles do not return to the roost, however there have been a few exceptions to this.

Most notable is the thirteenth bat tagged whom we have named Gandalf the Gray (Gray after J.E. Gray, 1838) who first described the species. This bat was last detected in February 2019 when it would have been at least 11 years old. This male is a consistent visitor to the roost, visiting regularly but rarely staying longer than a day or two. Gandalf was re-trapped in 2018 and the photo shown in Figure 5 taken; he was going a little grey and had quite pronounced tooth wear. Now the

faulty equipment has been upgraded we hope to find that Gandalf is still visiting the roost.

Figure 5 Gandalf the Gray, an 11-year-old White-striped Free-tail Bat.

Weather

Bat maternity roosts require very specific temperatures and humidity requirements and need to be fairly stable. The roost faces west, which enables the roost to warm up before the cooling of the evening.

Extremely hot weather has led to the desertion of the roost on a few occasions. Although White-striped Free-tail Bats appear to have a higher heat tolerance than many other bat species, (Lyman, 1970), it is assumed there is a limit to the temperature and humidity able to be tolerated by the adults and young. The 2016–17 summer was the warmest on record for Sydney Observatory Hill with the mean temperature 2.8°C above average (Australian Bureau of Meteorology data). Rainfall was average to below average across the city, with a dry December and January but a wetter than average February. The number of tagged bats in the roost started declining from the 23rd December with only a few tagged bats returning sporadically to the roost. Bats did not start returning to the roost in appreciable numbers until March.

Winters are also becoming warmer. The winter of 2017 had the most bats overwintering than ever before, with 14 bats present when in previous years it has been less than 5.

The potential impacts of climate change and resulting higher temperatures may mean that the suitability of the site as a maternity roost may change, and that it may move to being more of a 'hub' roost than exclusively a maternity roost. The next few maternity seasons will hopefully show the likely trends.

Rain also impacts on bat movements with decreased activity recorded on rainy nights.

Radio-tracking

To attempt to determine where the bats were going when they left the roost in April, a radio-tracking program was started. In April 2010, five White-striped Free-tail Bats were radio-collared (Holohil BD-2C 1.6 gms) and both day roosts and foraging areas were radio-tracked with Titley regal 2000 and Australis 24K receivers with Yagi 3 element antenna, over a period of eight weeks (Figure 6). Extensive movement of bats between roosts was noted, with bats moving between the main maternity roost and tree spout roosts in Scribbly Gums (*Eucalyptus haemastoma*) located in adjoining woodland.

Initial results appear to reinforce the findings of Rhodes (2007), of a network of roosts consisting of a 'communal' roost (which appears to be female dominated and is also a maternity roost in the breeding season) and associated satellite roosts. Roost fidelity of the communal roost is high during the months December to April (until the young become independent) then the satellite roosts are utilised. These satellite roosts may also be used by individual males during the breeding season.

Roost switching occurred between the four satellite roosts and also between satellite roosts and the communal roost.

After a few weeks (just before the cold and wet weather set in) the bats left the area, therefore the woodland roost trees may just represent 'stepping stones' between the main communal roost and the winter destination.

Figure 6 White-striped Free-tail Bat with a radio collar.

Summary

To date this project has monitored 11 maternity seasons. Unfortunately the 2018–19 season had equipment failures (laptop broke down while I was on an extended holiday in Western Australia). And the 2019–20 season was also plagued with equipment failures. However with the new equipment, monitoring is expected to remain trouble-free for quite a few years. This project provides a unique snapshot into the ecology of this species over time.

Acknowledgements

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