



Assessing nocturnal bird species diversity in the Western Arc of the Lockyer Valley using bioacoustics



Photo Credit: CNZdenek

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Background

Bird diversity sampling is an effective proxy for measuring overall ecosystem health due to the sensitivity of birds to environmental changes and their ease of detectability (Smits & Fernie, 2013). This is applicable to diurnal birds however, nocturnal birds are much more difficult to monitor using traditional methods (Matsubayashi et al., 2021). Bio-acoustic recorders have emerged as an effective, non-invasive method of monitoring wildlife over long periods of time with little operational input (Frommolt & Tauchert, 2014; Zwart et al., 2014) and are especially effective at detecting cryptic species such as nocturnal birds compared to traditional surveys (Zwart et al., 2014). While conventional surveys do provide population size data, they are limited to short periods, typically only 20 mins in duration (Watson, 2004). In contrast, bio-acoustics can be scheduled to record for extended periods, thereby creating large, extensive datasets and increasing the probability of finding cryptic species (Zwart et al., 2014). Audio moths, a type of bio-acoustic recorder, are relatively inexpensive, user-friendly and, can be easily deployed to detect the presence of nocturnal birds and other vocal, cryptic species that would otherwise remain undetected (Law et al., 2022).

Aims

1. To collect presence/absence data on nocturnal bird species as means to augment LUCIs ongoing Bird Survey project.
2. To collect presence/absence data on Powerful Owls as a component of Birdlife Australia's' Powerful Owl project in Southeast Queensland

Methods

General

1. Identify key properties and sites within said properties - Note: Identification of key properties is more important than ideal sites.
 - 1.1. Ideal properties will have one or more of the following:
 - Powerful owl calls heard by landowners.

- Powerful owl pellets - can be distinguished from other owl pellets by size.
 - Remains of prey species - often possums - tails and intestines found at base of trees.
- 1.2. Ideal sites will have the following:
 - Black She-oak trees (*Allocasuarina littoralis*), Coachwood trees (*Ceratopetalum apetalum*), Turpentine trees (*Syncarpia glomulifera*)
 - Whitewash under trees - often under key tree species mentioned above.
 - Proximity to creek lines
 - Dense canopy cover
 2. Provide landholders with consent forms that are to be signed to provide permission for surveys to be conducted upon their properties.
 3. Program audio moths to record a 3 hour audio file just before dusk, a 1 hour audio file in the middle of the night and a 2 hour audio file before dawn - When programmed in this manner the audio moths should continue to record every night for the duration of 30 days before battery becomes low and the device needs to be recharged and will recording during peak hours of powerful owl activity. No recordings will be taken during the day. See next page for more details.
 4. Attach audio moths to key tree species at head height, at ideal sites if possible. If ideal sites are not identified, attach audio moths at head height at trees where pellets and/or prey remains have been seen or in the vicinity of where powerful owl calls have been heard.
 5. Check on audio moth often outside of recording hours to ensure the device remains attached to the tree.
 6. Collect audio moth after recording period is over and transfer files to computer for analysis in the BirdNET software.
 7. All species recordings will be uploaded to WildNet by LUCI and Powerful Owl records will be given to BirdLife Australia for their Powerful Owl project.

Programming

1. In the “Schedule” tab, input time periods for recording to take place.

Recording **Schedule** Filtering Advanced

00:00 06:00 12:00 18:00 24:00

Start recording:

End recording:

Add recording period

Remove selected period

Clear all periods

08:00 - 11:00 (UTC)
13:00 - 14:00 (UTC)
16:30 - 18:30 (UTC)

- 1.1. Input '18:30' into "Start recording" and '20:30' into "End recording". Then click "Add recording period".
- 1.2. Input '06:00' into "Start recording" and '09:00' into "End recording". Then click "Add recording period".
- 1.3. Input '13:00' into "Start recording" and '14:00' into "End recording". Then click "Add recording period".

2. Once completed, the schedule tab should look the same as Figure 1.

Figure 1: The completed "Schedule" tab. Make sure your tab looks the same prior to uploading the data into your audiomoth.

3. In the "Recording" tab, make sure the "Sample rate (kHz)" is set at '48' and the "Gain" is set at 'High' as shown in Figure 2.

Figure 2: The completed “Recording” tab. Make sure your tab looks the same prior to uploading into your audiomoth.

Recording	Schedule	Filtering	Advanced					
Sample rate (kHz):	<input type="radio"/> 8	<input type="radio"/> 16	<input type="radio"/> 32	<input checked="" type="radio"/> 48	<input type="radio"/> 96	<input type="radio"/> 192	<input type="radio"/> 250	<input type="radio"/> 384
Gain:			<input type="radio"/> Low	<input type="radio"/> Med	<input type="radio"/> High			
Enable sleep/record cyclic recording:								<input type="checkbox"/>
Sleep duration (hh:mm:ss):								<input type="text" value="00:00:05"/>
Recording duration (hh:mm:ss):								<input type="text" value="00:00:55"/>
Enable LED:								<input checked="" type="checkbox"/>
Enable low-voltage cut-off:								<input checked="" type="checkbox"/>
Enable battery level indication:								<input checked="" type="checkbox"/>
Each day this will produce 3 files, each up to 1037 MB, totalling 2073 MB. Daily energy consumption will be approximately 75 mAh.								
<input type="button" value="Configure AudioMoth"/>								

Results

A total of 26 surveys were conducted between the months of February and August. Of these, 12 recorded for the full duration, 6 did not record for the full duration but still acquired usable data and 8 either did not record or did not

acquire any data.

Species detected

BirdNET Analyzer targeted a total of 14 species, those being the Powerful owl, Barn owl, Australian owlet nightjar, Southern boobook, Rufous owl, Barking owl, Australian masked owl, Sooty owl, White-throated nightjar, Spotted nightjar, Large-tailed nightjar, Tawny frogmouth, Marbled frogmouth and Australasian grass owl.

Of these 14 species BirdNET Analyzer detected 10, the Powerful owl, Barn owl, Australian owlet nightjar, Southern boobook, Barking owl, Australian masked owl, Sooty owl, White-throated nightjar, Marbled frogmouth and Tawny frogmouth. Manual examination of these detections confirmed that 6 of these species were accurately detected, the Powerful owl, Barn owl, Australian owlet nightjar, Southern boobook, White-throated nightjar and Tawny frogmouth. Of the unconfirmed species the Barking owl was mistakenly detected from barking dogs in the proximity of the audiomoth and the marbled frogmouth was falsely detected with no obvious reason. Calls that sounded like the Australian masked owl were recorded and identified at the Scanlan property however, due to the similarities between the Australian masked owl and the Barn owls calls it was not possible to confirm whether this detection was correct. To verify whether this species is present an alternate sampling method may be required such as spotlighting due to the difficulty in differentiating the calls of these two species. This seems to be a trend for species in the *Tyto* genus as the Sooty owl also has a very similar screech to the Barn owl and was also unable to be differentiated. The Sooty owl has a unique trill that would act as a distinguishing call however, this specific call was not detected in any surveys.

The most frequently detected species was the Barn owl, which was detected on 99 nights across 6 properties. This was followed by the Australian owlet nightjar which was detected on 43 nights across 6 properties. The White-throated nightjar was detected on 6 nights across 3 properties with 4 of these nights being from the Kidd property and 3 of these being from the same survey. The Tawny frogmouth and Southern boobook were only detected on 2 nights, with the Tawny frogmouths being detected on 2 properties and the Southern boobook only detected on the Guthrie property. The Powerful owl was detected on 5 nights and from 2 properties, those being the Darvall and Scanlan properties.

Temporal variation

Figure 3 shows the changes in species detections throughout the period the surveys were undertaken. Barn owls showed an increase in detections from February to April and remained consistent till June. They were not detected in July. White-throated nightjars showed an inverse relationship with the most detections in February and decreasing until April before they were no longer detected from May onwards. Australian owlet nightjars increased in detections from February onwards, peaking in May before declining again. The first Powerful Owl detection was in March and continued until July, with an absence in May. This period matches with their breeding season and it is unsurprising that there detections would be the highest during this time (McNabb, 2021). Tawny Frogmouths and Southern Boobooks were only detected in May.

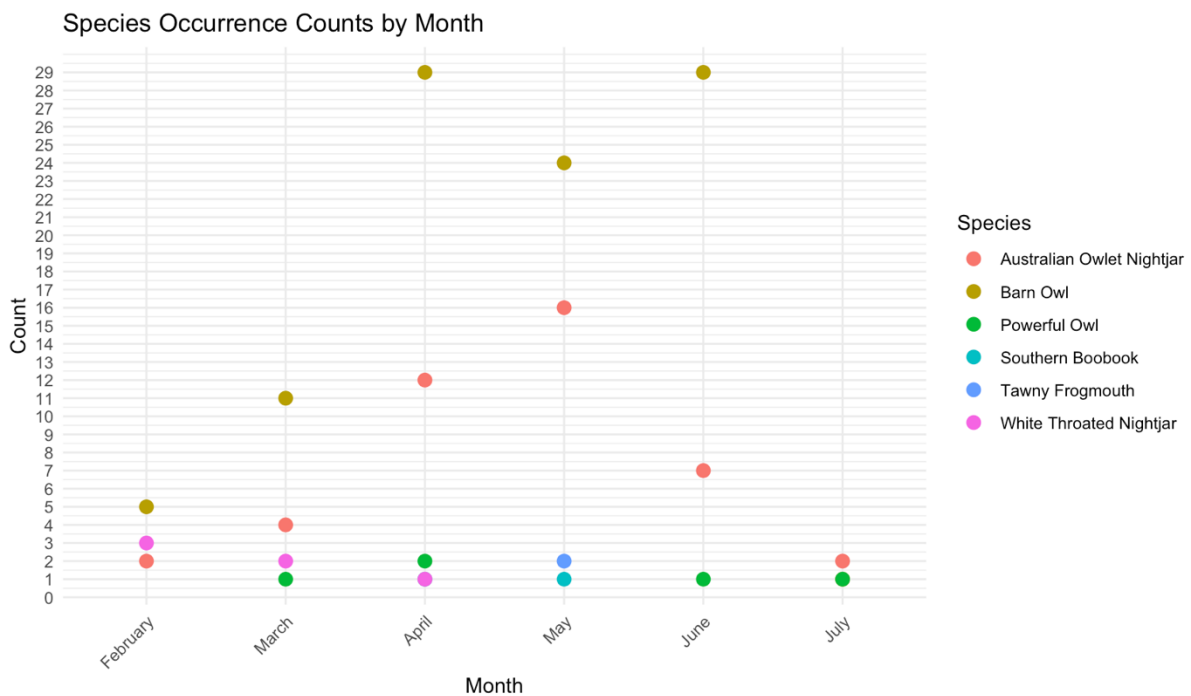


Figure 3: A scatterplot depicting the changes in species detections across the survey period.

Unfortunately, any correlations made from these changes in detections throughout the year are not robust. The initial surveys in February were only undertaken on one property (Kidd). As a result, the increase

in detections seen in some species may be a result of more sites being sampled. Similarly, technical issues began to present themselves after May and many audio moths were failing to record for the full length or at all, which may have led to declines in detections. The strongest case for a temporal relationship in detections belongs to the White-throated nightjar as despite having only a single audiomoth recording in February, the White-throated nightjar had the most detections in that month followed by a gradual decrease despite more audio moths being put out. Further work will hopefully reveal whether these relationships between detections and time of year are tangible.

Spatial variation

Across the 8 properties that returned results, a total of 10 different sites were surveyed. All the survey sites were classified as dry sclerophyll, wet sclerophyll or rainforest with 7 dry sclerophyll sites, 2 rainforest sites and 1 wet sclerophyll site.

Unsurprisingly, due to most sites being dry sclerophyll followed by rainforest and wet sclerophyll, the number of detections is highest in dry sclerophyll and lowest in wet sclerophyll. The number of Barn owl detections also follows this trend, while the Australian owlet nightjar also follows this except for at rainforest sites, where there were no detections at all. Habitat use by Australian owlet nightjars has been shown to have little correlation with tree species, but is significantly impacted by the availability of hollows and cavities for structure, with the species preferring habitats that provide several areas for shelter (Brigham et al., 1998). The absence of Australian owlet nightjars in the rainforest sites may be a result of there being fewer hollows in these areas. White-throated nightjars showed the inverse pattern, with the least number of detections at dry sclerophyll and the most at wet sclerophyll (See figure 4). However, the wet sclerophyll site was only surveyed once in February, and this may be related to the time of year rather than vegetation type.

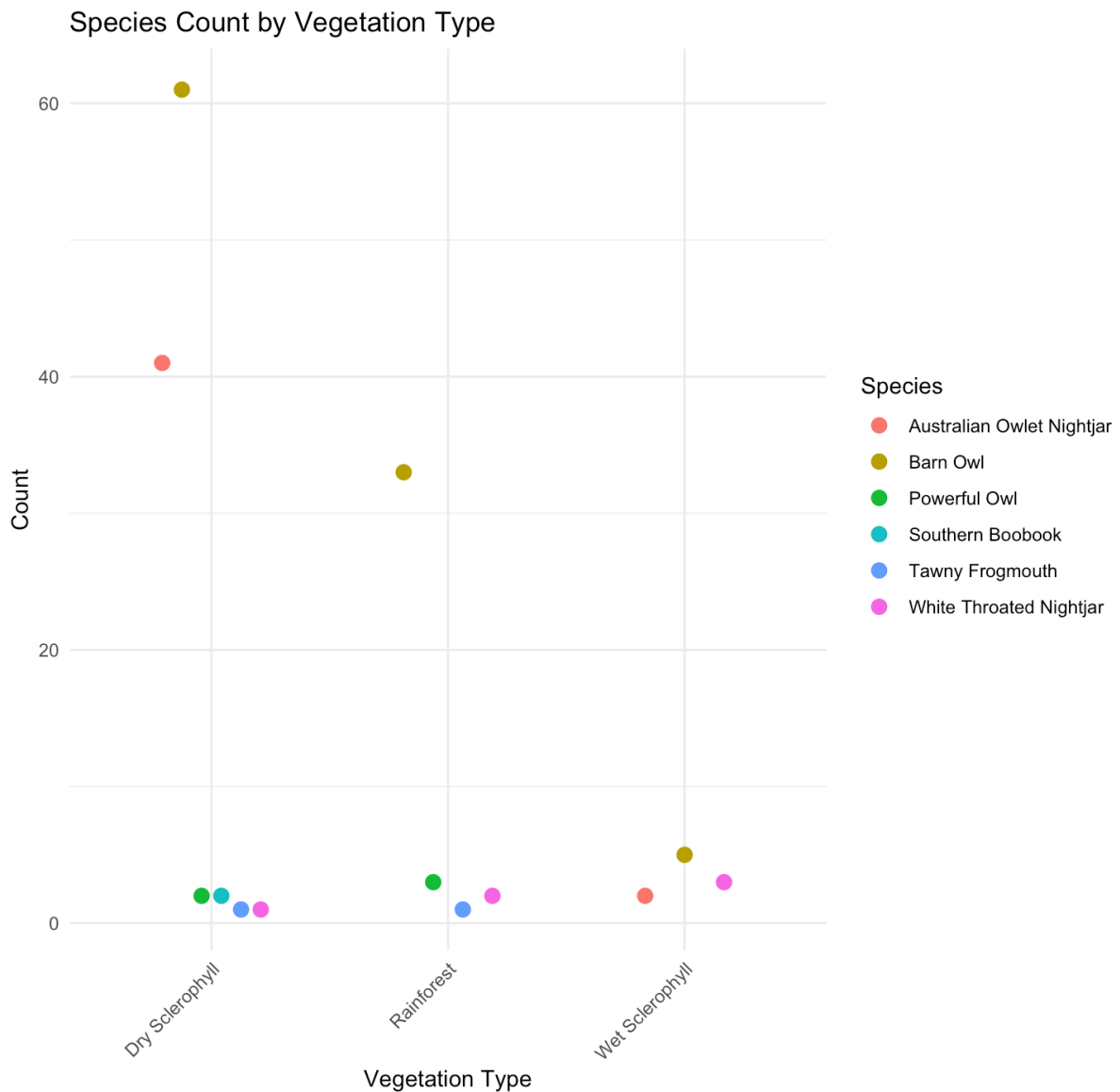


Figure 4: Scatterplot depicting total species detections at the 3 vegetation types; Dry sclerophyll (7), Rainforest (2) and Wet sclerophyll (1).

Conclusion and Recommendations

The nocturnal bird project successfully detected several target nocturnal bird species using bio-acoustic recording devices (audiomoths). This information can be used to compliment the previous work conducted by Roger Jaensch on diurnal bird species utilising traditional bird survey methods. While the previous work has data on the number of individuals, the audiomoths have collected data over long periods of time and detected cryptic species that may have otherwise remained undetected.

This is exemplified by the results of the first survey conducted on the Darvall property which recorded for approximately 1 month. Powerful owls were detected on 3 days, that were scattered throughout the month. If a traditional bird survey had been conducted on any single or even several days during this period, the Powerful owl most likely would not have been detected. Similarly, if the audiomoth was in the field recording for a shorter period, the species may have gone undetected.

This work was completed utilising several of Birdlife Australia's audiomoths that were provided to be utilised specifically for their Powerful owl project. As such, the recording timetable is designed to maximise the detection of Powerful owls by accommodating to known periods of vocalisations by the species. Inadvertently, this may be causing other species that are active at other periods of night to be missed.

Future work should aim to maximise the time periods that these moths remain in the environment collecting results as this will result in greater detection rates of cryptic species. The direction of the future work should also be discussed, as to whether the methodology should be adjusted to maximise the sampling of nocturnal bird diversity or continue as it is with a preference for the Powerful owl, a threatened species.

The greatest issue faced by the project, was the malfunctioning of audiomoths, likely due to issues with the device writing the files to the SD card because of faulty batteries. This is believed to have been the cause of 6 surveys abruptly ending and 8 surveys returning no results at all. The next step will be to resolve this issue and remove any faulty batteries that created this issue.

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