

# COMMUNITIES LISTENING FOR NATURE

Citizen science in Bunyip State Park 2016–2018



Photo: Andrew Haysom

A REPORT ON A COMMUNITY PARTNERHSIP  
IN ECO-ACOUSTIC MONITORING IN BUNYIP STATE PARK.

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## Victorian National Parks Association

The Victorian National Parks Association (VNPA) helps to shape the agenda for creating and managing national parks, conservation reserves and other important natural areas across land and sea. We work with all levels of government, the scientific community and the general community to achieve long term, best practice environmental outcomes.

The VNPA is also Victoria's largest bush walking club and provides a range of information, education and activity programs to encourage Victorians to get active for nature.

## NatureWatch

NatureWatch is a citizen science program which engages the community in collecting scientific data on Victorian native plants and animals. The program builds links between community members, scientists and land managers to develop scientific, practical projects that contribute to a better understanding of species and ecosystems, and contributes to improved management of natural areas.

## Project Partners



### Museums Victoria

Museums Victoria has been trusted with the collection and curation of Victoria's natural history for over 160 years and serves as a key international research institute and experts in data archiving and long-term data protection. Responding to changing intellectual issues, studying subjects of relevance to the community, providing training and professional development, and working closely with schools, communities, and online visitors, Museums Victoria works to disseminate our collective knowledge through online resources and image, audio and video databases.



### Friends of Bunyip State Park

Friends of Bunyip State Park (FoBSP) is a community group working to foster public awareness and appreciation of the natural values of Bunyip State Park and surrounding area. They undertake habitat restoration activities (tree planting), flora and fauna surveys, walking track development and maintenance, and improving interpretive signage in the park. FoBSP also contributes to the VNPA's Caught on Camera wildlife monitoring project.

## Acknowledgements

Victorian National Parks Association: Matt Ruchel, Emily Clough, Heath Rickard

Friends of Bunyip State Park Team Leaders: Ian Vaskess & Jasper Hails, and all of the community volunteers who spent many days in the field helping to collect the data for this project.

Parks Victoria: Anthony Hester, Andrew Musgrove

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Helen Macpherson Smith Trust

## Summary

Monitoring bird population is an effective way to evaluate local biodiversity, and corresponding habitat condition. However, it is time-consuming to both collect and analyse bird sightings or bird call data. The study of eco-acoustics allows for the collection of bird call data across large areas of land and over an extended period with a minimal number of people in the field.

In 2016, VNPA partnered with Museums Victoria and Friends of Bunyip State Park, to use song meter recorders to survey bird populations in Bunyip State Park. The friends group provided local expertise and collected data while Museums Victoria analysed the data. VNPA worked with Museums Victoria on the research design and data management and provided equipment and support to the friends group. Together this partnership delivered a current snapshot of the health and distribution of bird populations across many different habitat types in the Bunyip State Park.

- 2,935.2 hours of recordings were collected
- Sites were monitored for 378 days
- 47 volunteers assisted with the project
- 83 volunteer days (approx. 498 hours) were contributed

45 bird species were identified from the recordings, including two threatened species, Sooty Owl and Powerful Owls.

This information will help the local community and land managers, Parks Victoria, with their land management planning including the management of threats and the protection of threatened species. In addition, this project has been an excellent way to increase expertise in local bird species and their habitat requirements as well as increasing awareness of the value of protected areas in preserving local biodiversity.

This project has provided Museums Victoria with a new bird call data set to add to their online collections and to enhance their bird call recognition software to improve their ability to identify quickly and accurately assess bird populations in Victoria.

This project was conducted in tandem with the VNPA's Caught on Camera project, where motion-detection cameras photographed wildlife. Together these programs provided new knowledge of the state of both bird and mammal populations in Bunyip State Park, and impacts from introduced animals and planned burning.

This research was conducted under DELWP research permit #10007964.

Species Detected
Australian King-parrot
Australian Magpie
Australian Owlet-nightjar
Australian Raven
Bassian Thrush
Brown Thornbill
Common Bronzewing
Corella spp.
Crimson Rosella
Eastern Whipbird
Eastern Yellow Robin
Fan-tailed Cuckoo
Flame Robin
Galah
Gang-gang Cockatoo
Golden Whistler
Grey Butcherbird
Grey Fantail
Grey Shrike-thrush
Laughing Kookaburra
Masked Lapwing
Noisy Miner
Olive Whistler
Pied Currawong
Pilotbird
Powerful Owl
Red Wattlebird
Rose Robin
Rufous Whistler
Satin Flycatcher
Scarlet Robin
Sooty Owl
Southern Boobook
Spotted Pardalote
Sulphur-crested Cockatoo
Superb Fairy-wren
Superb Lyrebird
Tawny Frogmouth
White-browed Scrubwren
White-eared Honeyeater
White-throated Nightjar
White-throated Treecreeper
Willie Wagtail
Yellow-faced Honeyeater
Yellow-tailed Black-cockatoo

# 1. Introduction

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## **Communities Listening for Nature**

Communities Listening for Nature is an exciting citizen science project, run by the Victorian National Parks Association in partnership with Museums Victoria, and local community groups and land managers. The program involves collaborative research design and implementation utilising new acoustic technology to monitor native birds in Victoria.

The aim of Communities Listening for Nature is to engage, train and equip community groups and volunteers in Victoria as citizen scientists who can detect, record and study Victorian birds, including some of the State's threatened species. This program supports local community expertise in bird identification and habitat use, providing important knowledge of Victorian bird species to assist with active management and conservation planning.

Data collected by citizen scientists will contribute to answering the project research questions, be added to the Victorian Biodiversity Atlas, and contribute to Museums Victoria's curated sound reference library of Victorian birds. Scientists, land managers, conservation groups and the general public worldwide can use this reference library to investigate Australia's unique bird life.

## **The study of bioacoustics**

Bioacoustics combines acoustic and biological principles to record and analyse sounds in nature. It goes beyond just species identification and can investigate how an animal relates to their environment.

Recording devices, such as Song Meters, are easy to install in the field to record bird sounds. They can be programmed to focus on recording at certain times of the day and the frequency of recording. They can also be set up simultaneously at multiple locations and rotated regularly to new locations, to maximise data collection. This survey method can provide data on the presence of secretive species or species that vocalise infrequently which have a greater probability of being missed during human-based surveys.

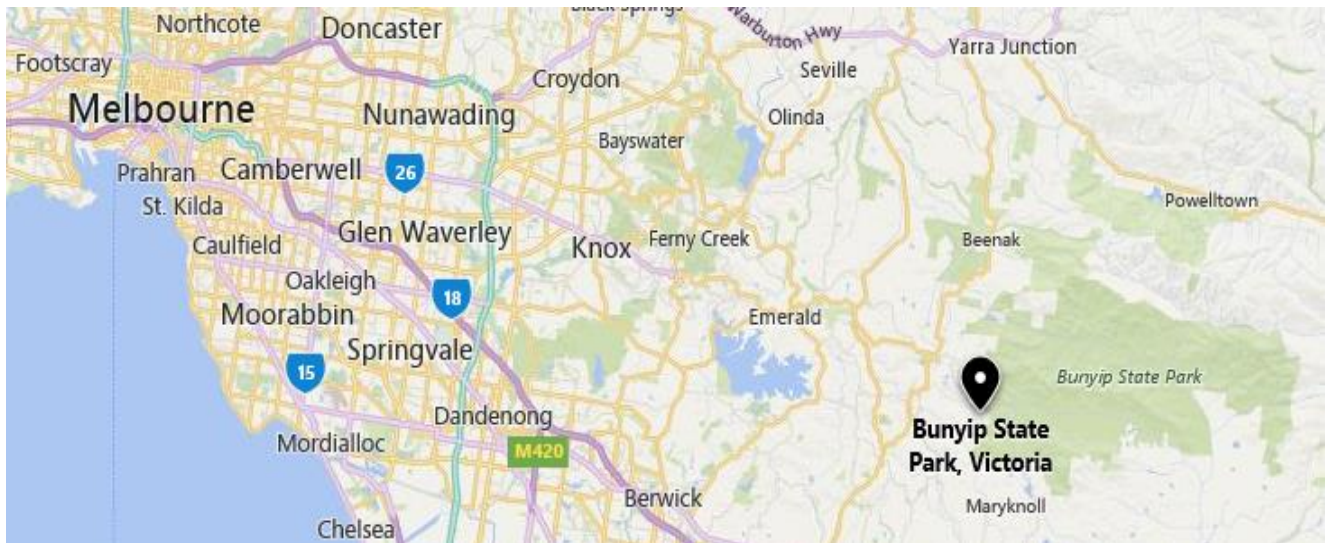
The recordings collected from the field are analysed using specialised software that interprets bioacoustic sound frequency as visual displays called spectrograms. Spectrograms essentially graph the sound and can be annotated by bird sound identification experts to identify the species. They can also be run through auto-detection software that can pull extract patterns for specific species against recognisers in models developed from previous identifications. However, whilst acoustic monitoring can provide clear evidence of the presence of particular species, and presence within different habitats, it cannot give comprehensive information about how many individuals there are in an area.

Acoustic monitoring also allows the assessment of the soundscape of a site, a reliable ecological monitoring tool for biodiversity (Fuller et al. 2015) that is an indicator of the natural calling activity of species across long periods of time that may not be possible in time-restricted, human-based surveys. One way to summarise soundscape data is to calculate an Acoustic Complexity Index (ACI) at each site (Pieretti et al. 2011). This calculation measures the complexity of bird sounds in a soundscape as a way to indicate both singing activity and the diversity of birds present. Higher ACI values indicating more singing activity and greater bird diversity. ACI values can then be compared across sites to help understand how different sites compare with one another or are associated with different characteristics (e.g., do sites differ in their ACI in different Ecological Vegetation Classes).

Beyond drawing out ecological information from sound recordings, audio clips of local soundscapes and species are a great educational resource which can be presented back to the community. In this project, each recording is independently analysed by experts

at Museums Victoria, archived digitally and stored in their collections into perpetuity. This makes them permanent, verifiable evidence of the presence of bird species at specific locations, and serving as a valuable tool in monitoring threatened and other species.

## Monitoring in Bunyip State Park



Bunyip State Park covers approximately 16,000ha and is located 45km south-east of Melbourne. It contains a variety of vegetation communities including heathland, heathy woodland, lowland forest, damp forest and wet forest (DEPI 2013). In 2009, approximately 45% of the park was burnt by bushfire (PV 2010).

Bunyip State Park is home to many native animal species, including a number of state and federally listed threatened species. Threatened mammal species include the Broad-toothed Rat (endangered), the Southern Brown Bandicoot (near threatened), and Swamp Antechinus (near threatened) (DSE 2013). Threatened bird species include the Helmeted Honeyeater (critically endangered), Masked Owl (endangered), Barking Owl (endangered), Powerful Owl (vulnerable), Sooty Owl (vulnerable), Square-tailed Kite (vulnerable), Chestnut-rumped Heathwren (vulnerable), and White-throated Needletail (vulnerable) (DSE 2013).

Key fire response species in Bunyip State Park include the Bush Rat, Black Wallaby and Mountain Brushtail Possum (MacHunter et al. 2009). These species are interesting to monitor because they are known to have either a positive or negative response to changes in their population due to impacts of fire on their habitat (MacHunter et al 2009). For example, Black Wallabies are known to decline in numbers after a fire event but then recover as their habitat recorded to pre-fire levels (MacHunter et al. 2009).

## Project Stages

This project was developed in conjunction with all project partners in early July 2016. Song Meters were active in the field from between August and November 2017. Song Meters were moved to new locations every three weeks, across five sites each. With each move, the data was collected and delivered to Museums Victoria for analysis.



## **Project Aims - Research**

1. To coordinate acoustic surveys at existing Caught on Camera sites to build understanding at these core monitoring locations;
2. To provide an updated species list for the park based on known occurrence records and confirmed from species detected in the recordings, including a focus on key fire response species (from MacHunter et al. 2009);
3. To confirm the potential presence of threatened bird species in Bunyip State Parks;
4. To explore patterns in bird singing activity between the dawn and dusk choruses by quantifying the soundscape using the Acoustic Diversity Index.

## **Project Aims – Community Outreach**

5. Create educational tools such as soundscape recordings and sample bird calls to use by the FoBSP in increasing community understanding, knowledge and interest in local biodiversity.
6. To contribute bird call recordings to the development of species recognizers and the online collections at Museums Victoria.



Friends of Bunyip State Park volunteers. Photo: Christine Connolly

## 2. Methods

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### Site Selection

Sites for this project were selected across a range of Ecological Vegetation Classes (EVCs) within Bunyip State Park, primarily to match existing Caught on Camera sites. This provided the greatest opportunity to survey bird species that live in particular habitat types and that match existing monitoring locations. Bunyip State Park lies within the Gippsland Plain Bioregion of Victoria (DELWP 2018). This project focussed on seven EVCs with varying ecological composition and conservation status (Table 1). Where possible, multiple sites were added in each EVC, with the majority of sites in the most common Healthy Woodland and Lowland Forest areas (Table 2).

Table 1: Ecological Vegetation Classes represented in this project and their conservation status. (DELWP 2018)

Ecological Vegetation Class	EVC Number	Conservation Status
Lowland Forest	16	Least Concern
Damp Forest	29	Least Concern
Riparian Forest	18	Vulnerable
Wet Forest	30	Least Concern
Heathy Woodlands	48	Depleted
Riparian Scrub	191	Endangered
Scrubby Foothill Forest	45	Least Concern

Table 2. Sites monitored in this study and their ecosystem type. Ecological Vegetation Class (EVC) is the standard unit for classifying vegetation types in Victoria.

Site	Ecological Vegetation Class
FR01	Riparian Forest
FR02	Wet Forest
FR03	Damp Forest
FR04	Damp Forest
FR05	Wet Forest
FR06	Riparian Forest
FR07	Heathy Woodland
FR08	Riparian Scrub
FR09	Shrubby Foothill Forest
FR10	Wet Forest
FR11	Damp Forest
FR13	Lowland Forest
FR14	Wet Forest

Site	Ecological Vegetation Class
HW01	Heathy Woodland
HW02	Heathy Woodland
HW05	Heathy Woodland
HW08	Heathy Woodland
LF01	Lowland Forest
LF06	Lowland Forest
LF10	Lowland Forest
LF11	Lowland Forest

## Song Meter Methodology

Communities Listening for Nature uses 'Song Meter SM4' devices from Wildlife Acoustics. Each Song Meter contains two built-in microphones for multidirectional recording and two 64 GB SD cards, all contained within a weatherproof protective case.

Field recording occurred from 6<sup>th</sup> August to 25<sup>th</sup> December 2016. Song Meters were in operation for three weeks at each site. They were secured on a tree trunk, at approximate chest height, at the centre of each site, with two motion-sensing cameras located on either side, 50-100 m apart. At each site, volunteers located the centre of the site (using GPS coordinates and used the nearest suitable tree to set up the Song Meters. Song Meters were fixed to a tree trunk at approximate ear height (about 150 cm) above the ground with an elastic strap and secured with a cable-lock to prevent damage and theft. Locations were recorded with GPS. Recording began on the day they were set-up and stopped either when the SD cards were full or when the Song Meter was retrieved.

To increase the chances of detecting all species present, the Song Meters were programmed with a recording schedule of:

- a) an hour before sunset, recording for three hours
- b) an hour before sunrise, recording for two hours
- c) 10 minutes for each hour throughout the day



Figure 1: Song Meter SM4 attached to a tree. Photo: Sera Blair



## Data analysis

Acoustic field recordings were sent to Museums Victoria for analysis where species-specific recognisers were generated for commonly detected and threatened bird species previously recorded in Bunyip State Park.

Recognisers are a type of model created based on available, pre-existing high quality vocalisations ('template vocalisations') for a species. Once created, recognisers were used in an automated process to scan the acoustic field recordings collected by Song Meters to detect vocalisations ('candidate vocalisations') that matched the template vocalisations. Candidate vocalisations were then manually checked to verify species presence.

Species-specific recognisers were used to produce a general species list for Bunyip State Park. Further analysis to produce site-level lists and detect further species is possible but requires a longer time period to process the data.

## 3. Results

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### Acoustic recordings

Altogether, 8598 acoustic field recordings were collected from 378 days of acoustic monitoring, with most sites recorded around 170 hours of data (Table 3). The combined duration of field recordings collected was 2935 hours and 20 minutes. This equated to 1.04 Terabytes worth of data.

The Song Meter at one site (HW01) was not turned on, resulting in no data collected. The data files from two other site, FR02 and FR14, were corrupted and unable to be analysed.

### List of species recorded

Forty-five bird species have been identified in initial analysis from the acoustic field recordings across all sites in Bunyip State Park (Table 4).

### Threatened species

Two threatened species have been detected in the audio field recordings. Both are nocturnal and listed as vulnerable in Victoria. (DSE 2013)

- **Powerful Owl:** detected at 2 sites, FR11 (1 day, 3 recordings), FR13 (2 days, 1 recording per day).
- **Sooty Owl:** detected at 1 site, FR10 (1 day, 1 recording).



Powerful Owl. Photo: Damian Kelly

Table 3. Numbers of days and files recorded at each site, and total duration of audio recordings. (Note: days where Sone Meters were swapped between sites are counted as 1 day).

Site	Days	Files	Duration of audio recordings (hours)
FR01	22	503	171.3
FR03	22	501	171
FR04	22	499	170.7
FR05	22	501	170.9
FR06	22	500	170.8
FR07	22	501	171
FR08	21	484	164
FR09	22	501	171
FR10	22	501	171
FR11	22	499	170.7
FR13	22	503	171.3
HW02	22	501	171
HW05	22	501	171
HW08	22	500	170.8
LF01	22	500	170.8
LF06	22	499	170.7
LF10	5	103	36.3
LF11	22	501	170.9
<b>Total</b>	<b>378</b>	<b>8598</b>	<b>2935.2 hours</b>

### Key fire response species

Twenty-eight key fire response bird species were detected in the audio field recordings. Two species, Flame Robin and Pied Currawong, have a positive response to fire in that these species tend to move into recently burnt areas. Twenty-four species are associated with a negative response to fire (Table 4). These species tend to be absent in recently burnt areas due to population declines following fire. Southern Boobook and Laughing Kookaburra typically experience a long-term decline following fire in moist forests while the other species will increase in burnt areas following an initial decline (MacHunter et al. 2009).

### Nocturnal species

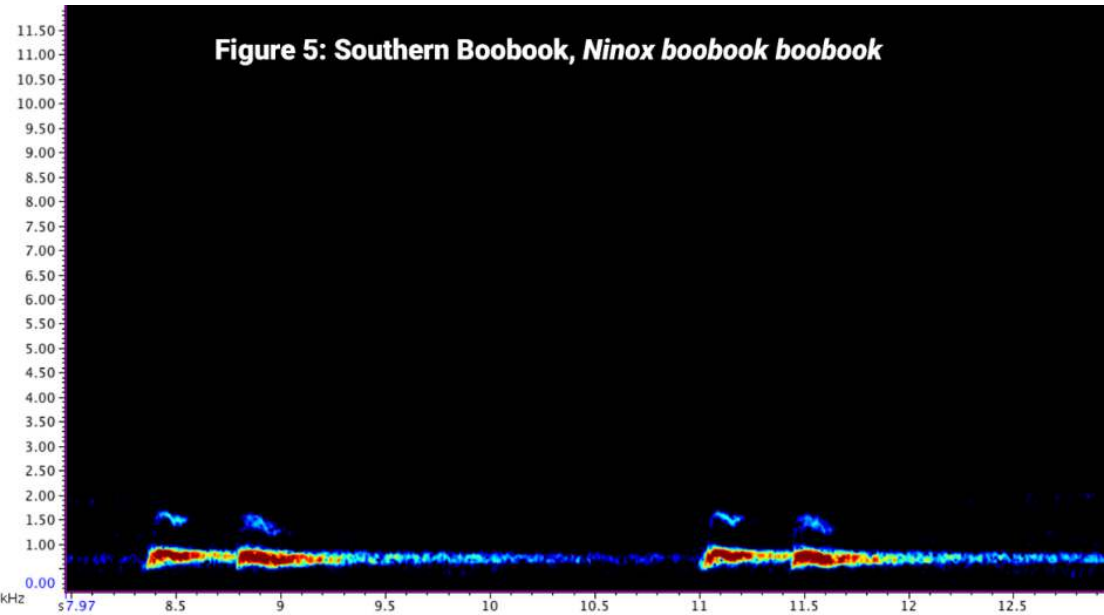
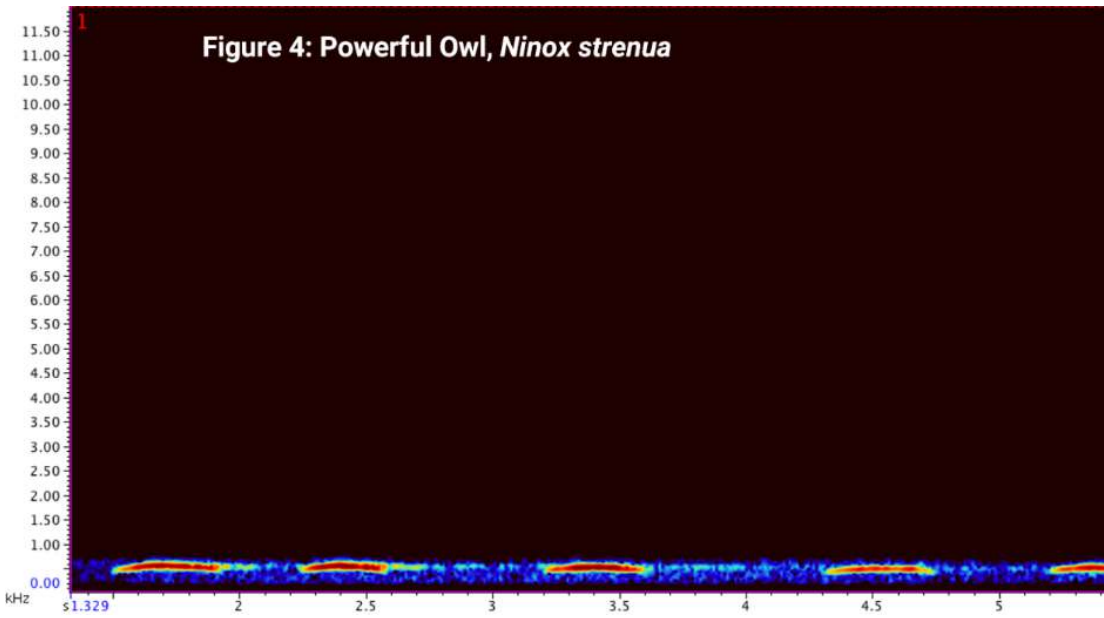
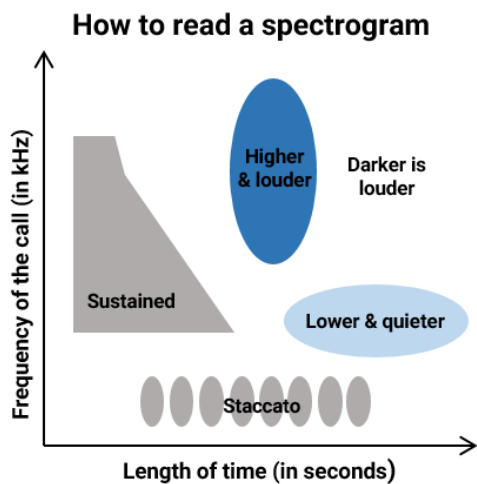
Six nocturnal bird species were detected in the audio field recordings. The most commonly recorded species was the Southern Boobook, which were recorded at all of the sites. Other nocturnal species recorded were Powerful Owl, Sooty Owl, Tawny Frogmouth, Australian Owlet-nightjar and White-throated Nightjar. Figures 4 to 8 illustrate the different spectrograms for nocturnal species.

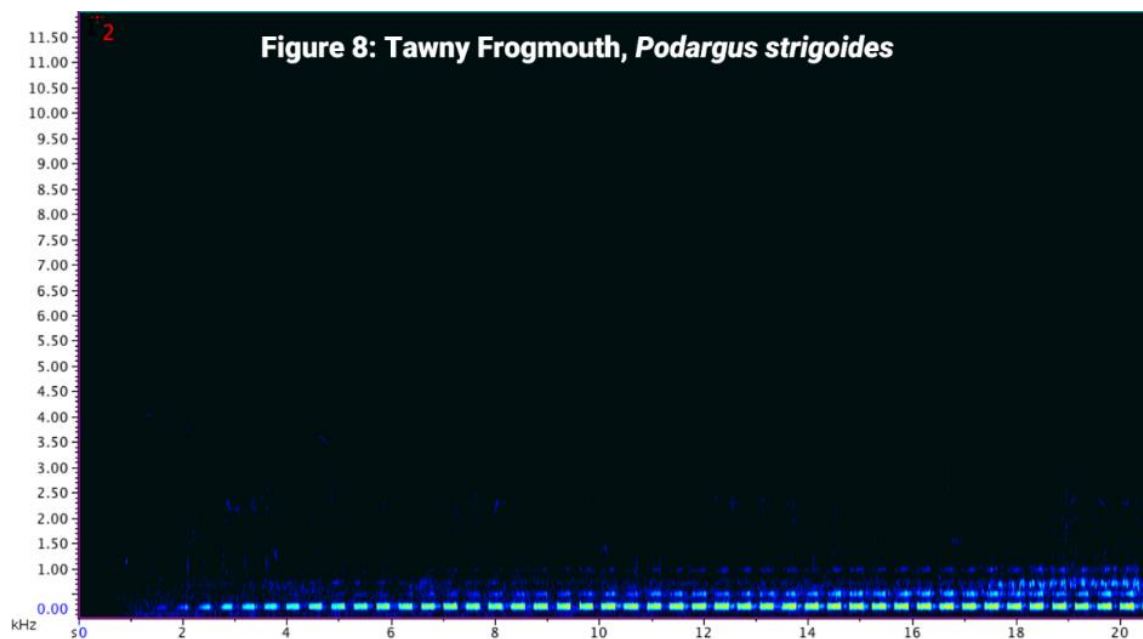
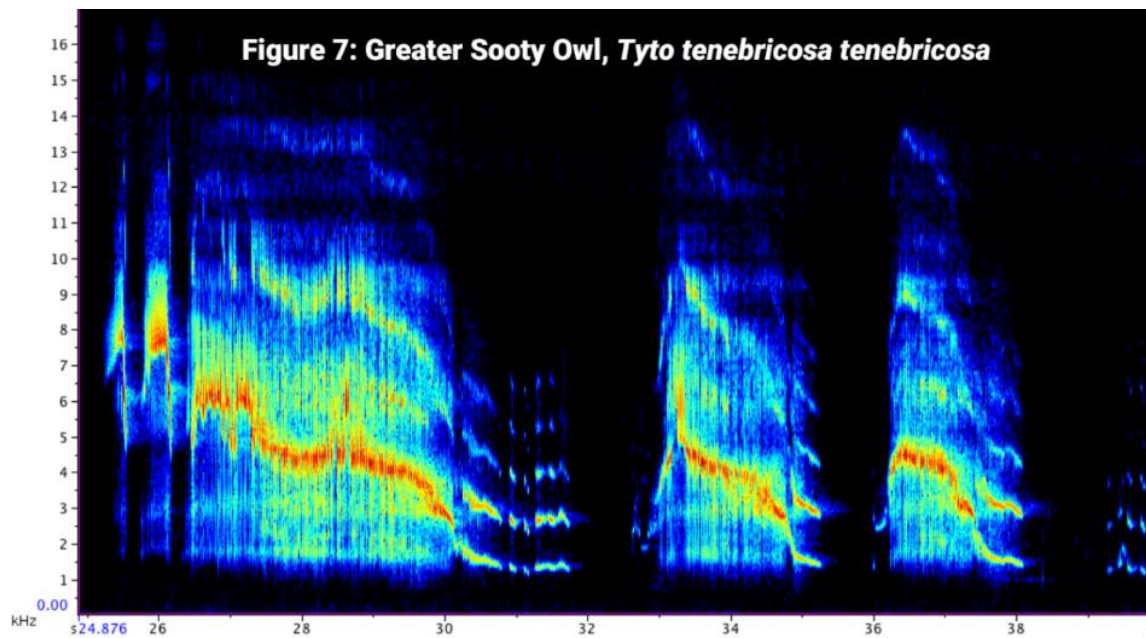
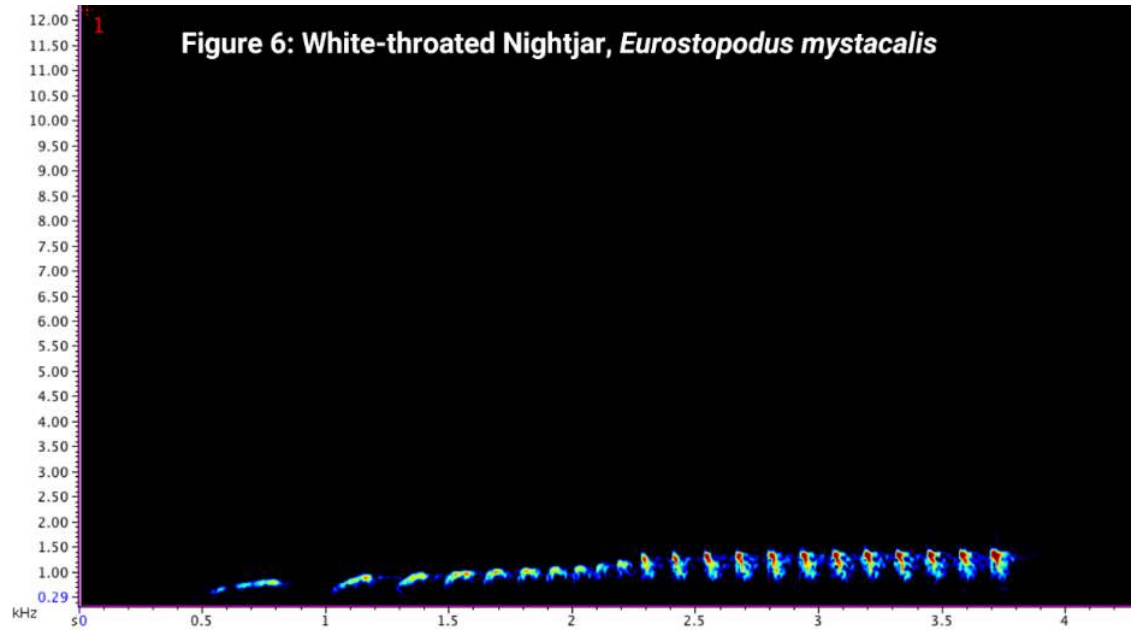
Southern Boobooks most frequently call prior to dawn, with calls extending into the beginning of the dawn chorus. White-throated Nightjar calls were detected both during the night and the day, generally in the afternoon. Calls from Powerful Owls were detected between 12 am and 4 am. The frequency of calling by Powerful Owls ranged from a couple of calls within a recording to continuous calling for an entire 10 minutes. Fan-tailed Cuckoos were also detected calling through the night as well as during the day.

Table 4: List of bird species identified from acoustic recordings including nocturnal classification and response of key fire response species (MacHunter et al. 2009).

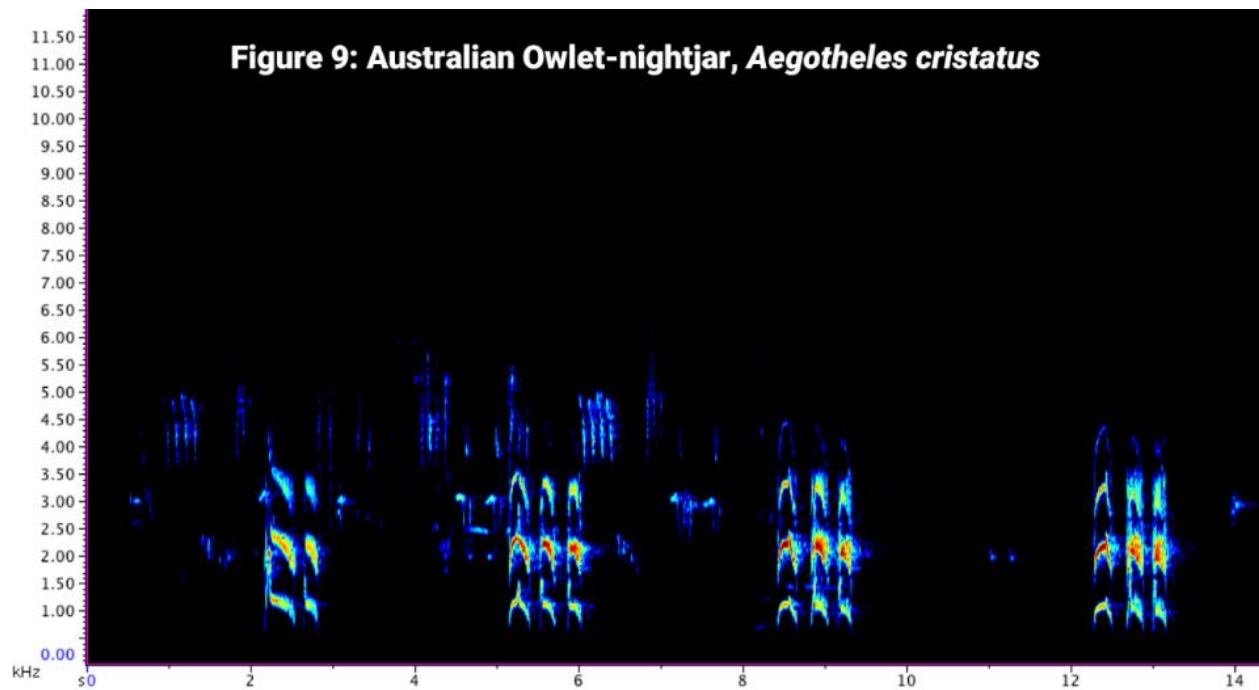
Common Name	Fire Response	Nocturnal
Australian King-parrot	negative	
Australian Magpie		
Australian Owlet-nightjar	negative	✓
Australian Raven		
Bassian Thrush	negative	
Brown Thornbill	negative	
Common Bronzewing		
Corella spp.		
Crimson Rosella	negative	
Eastern Whipbird	negative	
Eastern Yellow Robin	negative	
Fan-tailed Cuckoo		
Flame Robin	positive	
Galah		
Gang-gang Cockatoo	negative	
Golden Whistler	negative	
Grey Butcherbird	negative	
Grey Fantail		
Grey Shrike-thrush	negative	
Laughing Kookaburra	negative	
Masked Lapwing		
Noisy Miner	negative	
Olive Whistler	negative	
Pied Currawong	positive	
Pilotbird		
Powerful Owl	negative	✓
Red Wattlebird	negative	
Rose Robin	negative	
Rufous Whistler	negative	
Satin Flycatcher		
Scarlet Robin	negative	
Sooty Owl		✓
Southern Boobook	negative	✓
Spotted Pardalote	negative	
Sulphur-crested Cockatoo		
Superb Fairy-wren	negative	
Superb Lyrebird	negative	
Tawny Frogmouth		✓
White-browed Scrubwren	negative	
White-eared Honeyeater	negative	
White-throated Nightjar		✓
White-throated Treecreeper	negative	
Willie Wagtail	negative	
Yellow-faced Honeyeater		
Yellow-tailed Black-cockatoo		

Spectrograms of the audio recordings of the nocturnal bird species detected in this study.









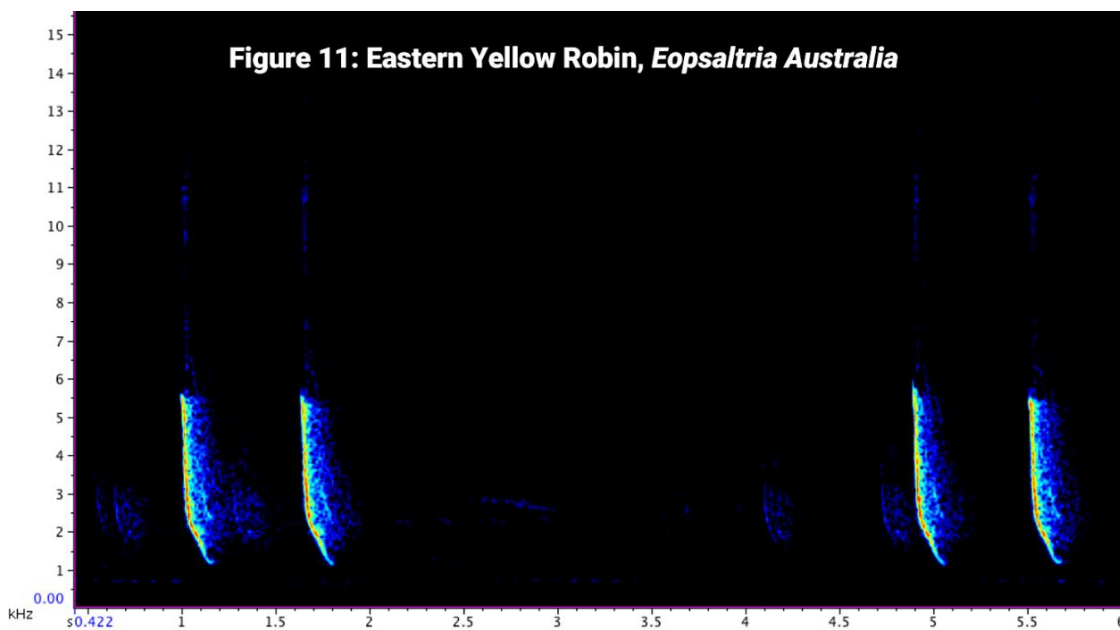
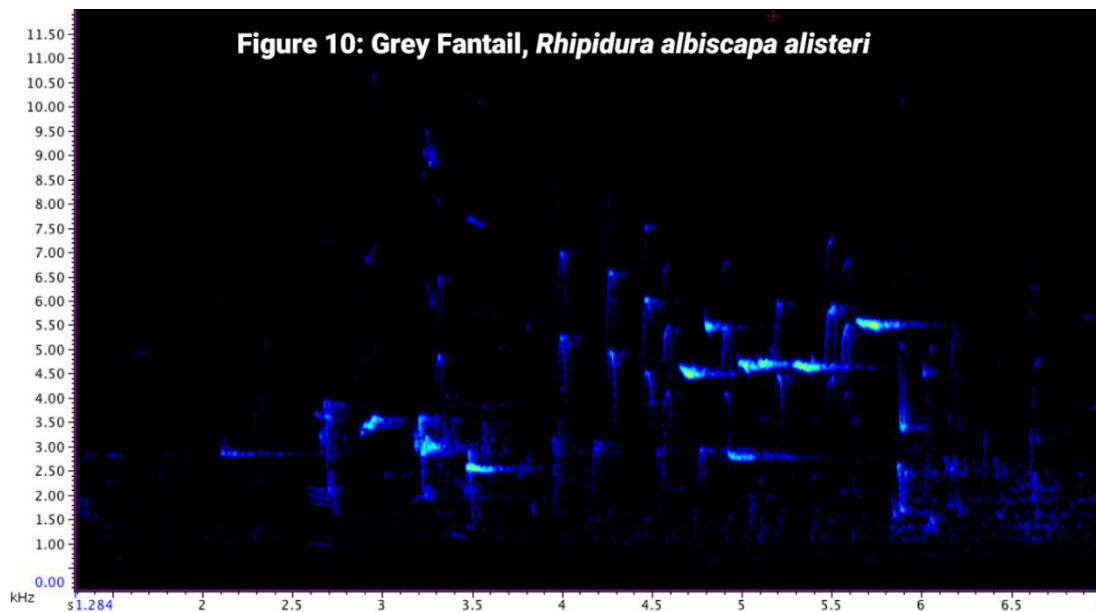
Australian Owlet-nightjar. Photo: Damian Kelly

### Differences between dawn and dusk choruses

The most commonly recorded species during the dawn chorus were the Grey Fantail and Eastern Yellow Robin. Grey Fantails were recorded at the majority of the surveyed sites and were the first diurnal bird to call in the mornings (Figure 10). Vocalisations from Southern Boobooks commonly overlapped with calls from Grey Fantails. Eastern Yellow Robins were generally the second diurnal bird to begin calling in the mornings (Figure 11).



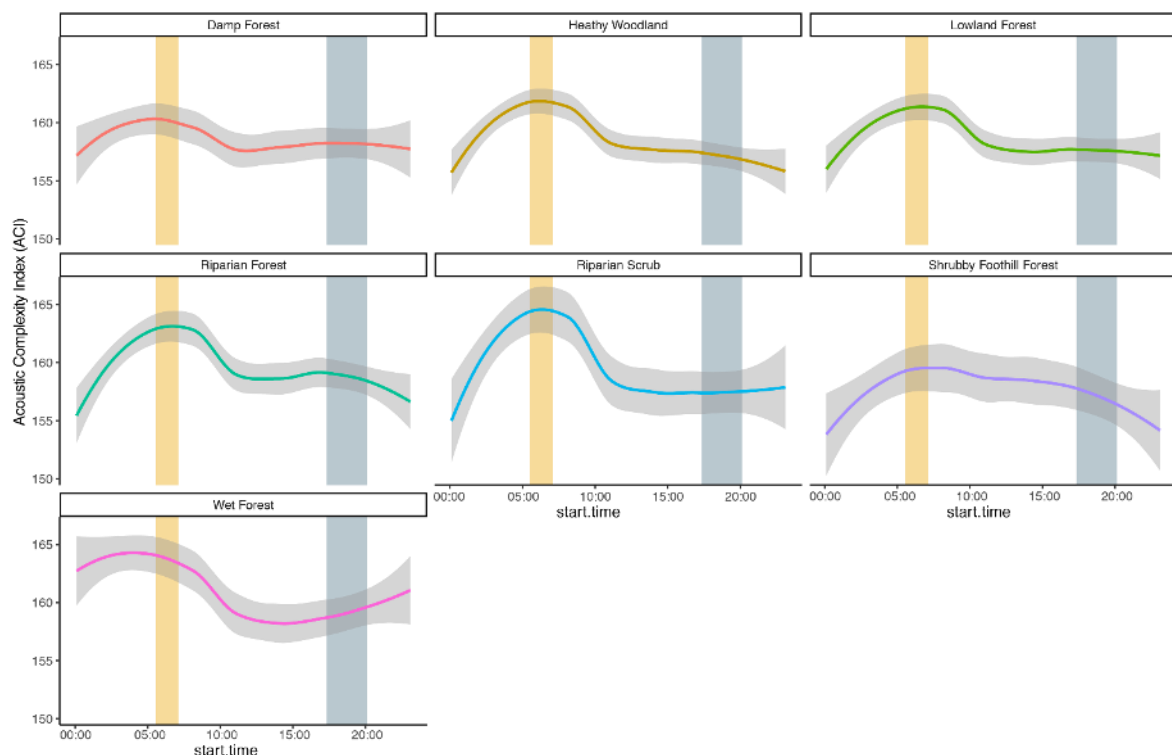
Grey fantail. Photo: Andrew Haysom



## Acoustic Complexity Index (ACI)

Comparisons of the recordings using the Acoustic Complexity Index (Pieretti et al. 2011) revealed that the dawn chorus had more bird calls than the dusk chorus. Generally, a distinct dawn chorus would occur around 6:00am and following that episode, calls would decrease. A slight increase in bird calls happens again for the dusk chorus followed by a decrease in calling at night. Figure 5 illustrates the changes in the ACI at the dawn and dusk chorus.

Figure 5: Plots showing the ACI values across 24 hours for each site based on Ecological Vegetation Class. The two vertical lines represent sunrise (left, yellow) and sunset (right, blue). Higher the ACI values indicate greater complexity based on the range of species calling, or the greater number of calls.



## Non-target species vocalisations

Insects, amphibians and mammals were also detected within field recordings, although bird vocalisations were the primary target for this project. Three of the more notable vocalisations from non-target species included:

- Sambar Deer *Rusa unicolor* (LF10)
- Sugar Gliders *Petaurus breviceps*, (LF11)

## Museums Victoria Sound Library

Recordings collected as part of this project have been registered into the Museums Victoria digital wildlife sounds library as the “Communities Listening for Nature: Bunyip State Park” project. A total of 2119 soundscape files (10 minutes each) have been uploaded and can be played at the following URL: <https://collections.museumvictoria.com.au/articles/16436>.

## 4. Discussion

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Overall, this Communities Listening for Nature project accomplished many of its aims. The presence of two threatened bird species, the Powerful Owl and the Sooty Owl were confirmed in Bunyip State Park. Many key fire response species were identified as present, most of which responded negatively to fire impacts and therefore are important to consider in management planning for controlled burns in the park. Six nocturnal species were recorded and records of their calling patterns analysed which will assist with future identifications, nesting locations and identification of bird territories. Two distinct bird song choruses were identified with the dawn chorus being the most pronounced and diverse. No pest bird species were identified in the park. Copies of all bird call recordings, sample spectrograms and park soundscapes have been provided to the Friends of Bunyip State Park for use in local education programs and to assist with future bird identification efforts.

The annotated data collected in this project will be incorporated into Museums Victoria's species recognizers and online collection of bird sounds. This data is freely available worldwide and will help scientists, land managers, conservation groups and the public connect with Australia's unique and charismatic bird life. In addition, this project has led to the creation of a new collaboration with Museums Victoria and the University of Melbourne, on a Masters Student project investigating the impact of multi-use road activities on bird singing across Bunyip State Park. Beginning in September 2018, this research explores how different road types in the park vary in the amount of anthropogenic noise they generate and whether this noise impacts the singing activity of the birds within this protected landscape.

Along with the achievements of this project, the collection of terabytes of data from the sound recordings and their associated metadata proved to be challenging to store and to manually catalogue. It was estimated that one hour of mono recording resulted in half a gigabyte of data to be stored. Future projects should consider these challenges when estimating the timeline, funding, data storage and staffing requirements to complete a similar project.

Ultimately, this project provided an excellent example of the NatureWatch model bringing together the local community with scientists and land managers to improve our collective understanding of species and ecosystems and to inform management of natural areas. Because of this partnership, we now know more about the avian species and their distribution in Bunyip State Park and have a set of skilled citizen scientist who are now deeply embedded contributors to the development of bioacoustic monitoring and the on-going management of Bunyip State Park.





## 5. References

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