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SOUNDS OF THE SUNSET COAST

Using eco-acoustics to measure the condition of the Murray mallee threatened bird community

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1. INTRODUCTION

The semi-arid mallee woodlands and shrublands of the Murray-Darling depression bioregion are recognised internationally as important for bird conservation (Clarke et al. 2021). The area supports a unique bird assemblage, including many endemic species (Verdon et al. 2025). The mallee bird community (and many of its constituent species) is recognised under federal legislation as an Endangered ecological community (Environment 2021). The compounding impacts of habitat destruction, altered fire-regimes, and climate change are pushing this ecological community toward extinction. Unfortunately, effective conservation management has been hampered by logistical constraints associated with the cost of monitoring in the remote areas inhabited by this community. Recent advances in eco-acoustics, particularly the development of open-access platforms allowing users to train deep-learning bird call recognition models, provide a way forward for bird conservation in this landscape. The aims of this study were to:

a. Train call recognition models for 20 species listed as either mallee specialist or mallee dependent within the mallee bird community
b. Develop a metric which relies on acoustic call data to quantify the condition of the mallee bird community at a given location.
c. Measure baseline condition of the mallee bird community across a ~645,00 ha area of contiguous mallee with varying habitat condition and management history.

2. METHODS

2.1 Training recognisers and assessing performance

To develop recognisers for the 20 focal mallee birds, we first collated a library of calls for each species. This was achieved through obtaining examples of calls from publicly accessible databases, from collaborators, and by making targeted field recordings of focal species. We used this call library to train a '1st iteration recogniser' for each species. Recognisers were trained using BirdNET, an open source research platform which offers a deep-learning solution for bird call classification (Kahl et al. 2021). An average of 234 examples (min 51, max 570) of calls were included as training data for each species. The number of examples varied for each species due to availability, complexity of call and number of unique call phrases included per species.

We also deployed autonomous acoustic recorders (AARs) at 60 sites designed to capture the full breadth of species in the mallee bird community. The sites were located at Nanya Arid Research Station in N.S.W, Gluepot Reserve in South Australia, and Hattah-Kulkyne National Park, Wypereld N.P., Annuello Flora and Fauna Reserve, and a private property in Patchewollock, Victoria. This dataset of field recordings was used to test and refine call recognisers. For each species, the 1st iteration recogniser was tested against an independent set of field recordings. A subset of detections were manually verified and both correct and incorrect detections were fed back into the training dataset as either examples of the target species, or background examples (i.e., sound

signatures that the recogniser should identify as non-targets). An improved version of the recogniser could then be trained on the updated dataset. This process was repeated iteratively.

To generate performance metrics, the recogniser for each species was used to search through an independent testing dataset of field recordings (74 hours of field recordings collected at 43 sites across the Murray Mallee). Potential detections are automatically assigned a confidence score between 0 and 1. For each species, a random sample of 50 detections were manually verified and recorded as either true or false positives (Wood and Kahl 2024). Logistic regression was then used to determine the relationship between the confidence score generated by the recogniser and probability of a true positive detection.

2.2 Assessing condition of the mallee bird community as a response to vegetation state

'The mallee' is a general categorisation which encompasses a wide variety of vegetation communities, all of which feature a low canopy of multi-stemmed 'mallee' eucalyptus trees. Factors like local climate, geology, flora composition, fire history and landscape features all influence the composition of the mallee bird community in any given area. Condition of the mallee bird community may also decline because of disturbance, agriculture, and other anthropogenic impacts. To investigate how the condition of the mallee bird community changes as a response to human-induced degradation of mallee habitat, we focused our study on a ~645,000 ha network of reserves and conservation properties, the Bookmark region of South Australia. The history of land use varies widely across this region (Mackenzie and Fitzsimons 2013). As part of a parallel project at La Trobe University, Dr Alex Maisey, Dr Rodolfo Anderson and Assoc Prof Jim Radford, have developed a state and transition model which represents both the variability in ecological condition across the Bookmark, and the processes that drive positive and negative transitions in condition (Maisey et al. 2025). Structuring the deployment of AARs according to this state and transition model provides us with a framework for quantifying the condition of the mallee bird community as a response to habitat degradation. Between August and November 20205, AARs were deployed in vegetation ranging in condition from 'reference' (considered the best available habitat in this landscape) through to absent overstorey with highly modified understorey (vegetation with a legacy of overstorey clearing and recent moderate-high grazing pressure, Figure 1).

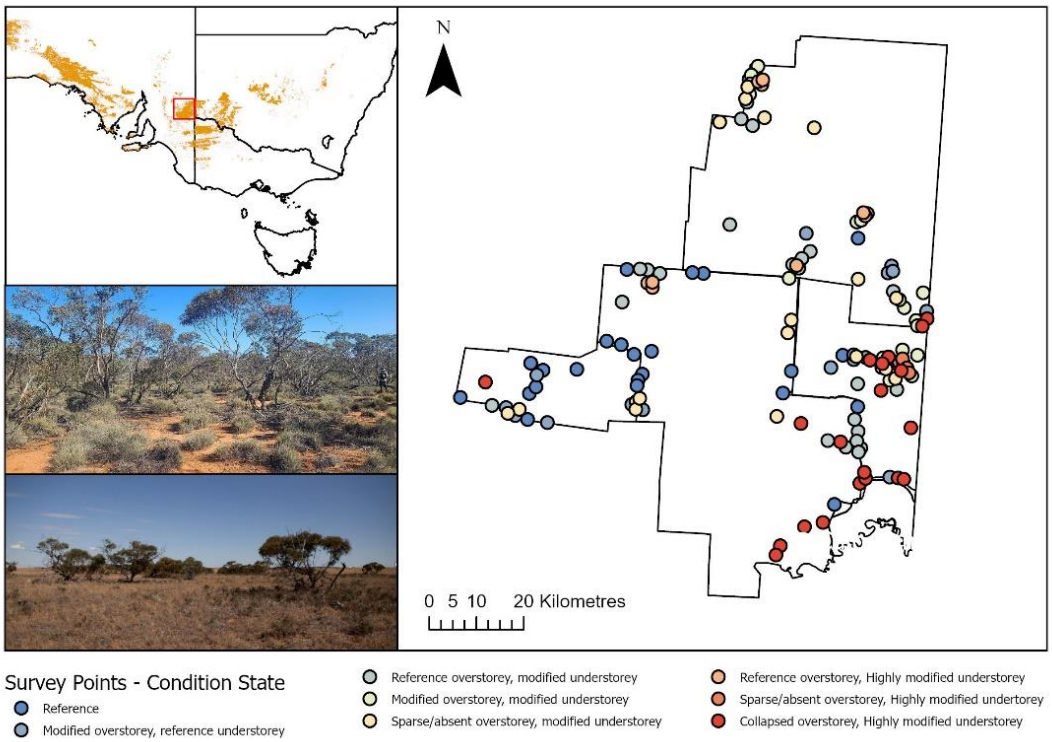
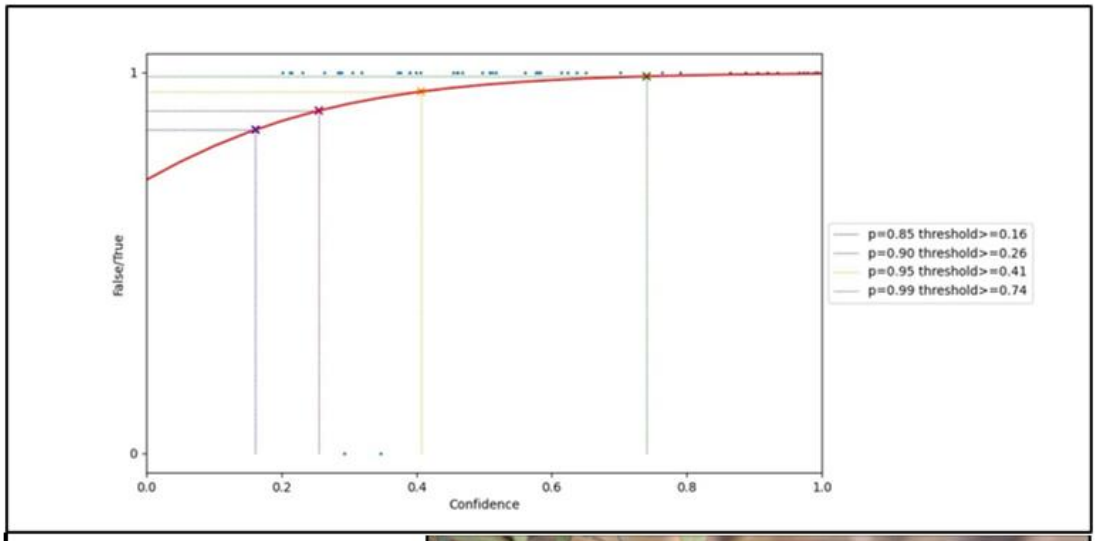


Figure 1: Clockwise from top left. a) Extant mallee vegetation in SE Australia. b) AAR deployment points in the Bookmark region of South Australia, structured by vegetation condition state. c) an example of mallee vegetation in a 'highly modified overstorey and highly modified understorey' condition state (photo: Alex Maisey). d) an example of mallee vegetation in a 'reference' condition state (photo: Flynn Kearney).

3. RESULTS AND DISCUSSION

While there is scope for further refinement, the recognisers for all twenty focal mallee species performed well (scores for mallee specialist species provided in Fig. 2) Performance scores represent the confidence above which one can expect a 95% probability of a true positive detection. Baseline acoustic monitoring of the mallee bird community across the Bookmark region of South Australia is ongoing and expected to be completed by November 2025

This study outlines the development of condition metrics derived from acoustic data which provide managers with a measure of the health of the mallee bird community at a given location. We provide a timely baseline update on the condition of this community across a vast region of conservation significance. We provide a reference against which future impacts on the community may be measured and provide a foundation for adaptive management of mallee birds in the Bookmark. Finally, by structuring the deployment of AARs within an existing state and transition model framework, this study provides insight about the conservation value provided by vegetation with variable management history and ecological condition.



Mallee Specialist	Call A
Black-eared Miner	0.6
Chestnut Quail-thrush	0.95
Mallee Emu-wren	0.89
Malleefowl	0.94
Red-lored Whistler	0.41
Scarlet-chested Parrot	0.87[1]
Mallee Striated Grasswren	0.93

Figure 2: Clockwise from top. a) Logistic regression with recogniser confidence score on x-axis and probability of true positive on the y-axis. Red-lored whistler typical call. b) female red-lored whistler (photo: W Mitchell). c) Recogniser performance scores for mallee specialist species.
[1]A single false positive detection from testing dataset. Score generated from an independent testing dataset recorded at Nanya Arid Zone Research Station.

4. ACKNOWLEDGEMENTS

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