

Acoustic analysis and bat call identification from Mt Holland, Western Australia

Prepared for **Ecoscape Australia Pty Ltd**

Version **17 June 2021**

SZ project reference **SZ564**



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Specialised Zoological (2021). Acoustic analysis and bat call identification from Mt Holland, Western Australia. Unpublished report by Specialised Zoological for Ecoscape Australia Pty Ltd, 17 June 2021, project reference SZ564.

Summary

Bat identifications from acoustic recordings are provided from near Mt Holland, Western Australia. The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics. Six species of bat were identified unambiguously as being present (**Tables 1** and **2**). Representative echolocation calls for each identification are illustrated (**Figure 1**), as recommended by the Australasian Bat Society (ABS 2006). Further details are available should verification be required.

Methods

The data provided were recorded in full spectrum WAV format with Wildlife Acoustics Song Meter SM4BAT (sampling rate 384 kHz, set to turn on automatically at sunset and off at sunrise).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong and Aplin 2014; Armstrong et al. 2016) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language script that performed three tasks:

1. undertook a Discriminant Function Analysis on training data from representative calls from southern Australia;
2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over confidence regions for the defined call types; and
3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition CS6 version 5.0.2.

Species were identified based on information in Churchill (2008) and the authors' own unpublished material; and nomenclature follows Jackson and Groves (2015).

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of bat species in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was not set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.

References

- ABS (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. *The Australasian Bat Society Newsletter* 27: 6–9. [ISSN 1448-5877]
- Armstrong, K.N. and Aplin, K.P. (2014). Identifying bats in an unknown acoustic realm using a semi-automated approach to the analysis of large full spectrum datasets. Oral presentation at the 16th Australasian Bat Society Conference 22–25 April 2014, Townsville, Queensland. *The Australasian Bat Society Newsletter* 42: 35–36.
- Armstrong, K.N., Aplin, K.P. and Crotty, S. (2016). A pipeline and app for massive filtering, and assisted inspection of enormous acoustic datasets. Poster presentation at the 17th Australasian Bat Society Conference, 29 March-1 April 2016, Hobart, Tasmania, Australia. *The Australasian Bat Society Newsletter* 46: 51.
- Churchill, S.K. (2008). *Australian bats*. 2nd ed. Allen and Unwin, Crows Nest, NSW.
- Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

Table 1. Species identified in the present survey from all sites combined.

VESPERTILIONIDAE	
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>
Chocolate Wattled Bat	<i>Chalinolobus morio</i>
Southern Forest Bat	<i>Vespadelus regulus</i>
MOLOSSIDAE	
White-striped Free-tailed Bat	<i>Austronomus australis</i>
Western Free-tailed Bat	<i>Ozimops kitcheneri</i>
Inland Free-tailed Bat	<i>Ozimops petersi</i>

Table 2. Species identifications, with the degree of confidence indicated by a code. Date and recording unit number correlates with site; see *Table 1* for full species names.

	<i>A. australis</i>	<i>C. gouldii</i>	<i>C. morio</i>	<i>O. kitcheneri</i>	<i>O. petersi</i>	<i>V. regulus</i>
SM4BAT 1147						
3/05/2021	X	—	X	—	X	X
4/05/2021	X	—		—	—	X
5/05/2021	X	—	X	—	X	X
6/05/2021	X	—	X	X	X	X
7/05/2021	X	—	X	X	X	
SM4BAT 1233						
3/05/2021	X	X	X	—	X	
4/05/2021	X	X		—	—	X
5/05/2021	X	X	X	—	X	X
6/05/2021	X	X	X	X	X	X
7/05/2021	X	X	X	X	X	X
SM4BAT 1247						
3/05/2021	X	X	X	—	X	X
4/05/2021	X	—	X	—	—	X
5/05/2021	X	X	X	—	X	X
6/05/2021	X	X	X	—	X	X
7/05/2021	X	X	X	—	—	X

Definition of confidence level codes

— Not detected.

X Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or a DNA sequence.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the *Comments on identifications* section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

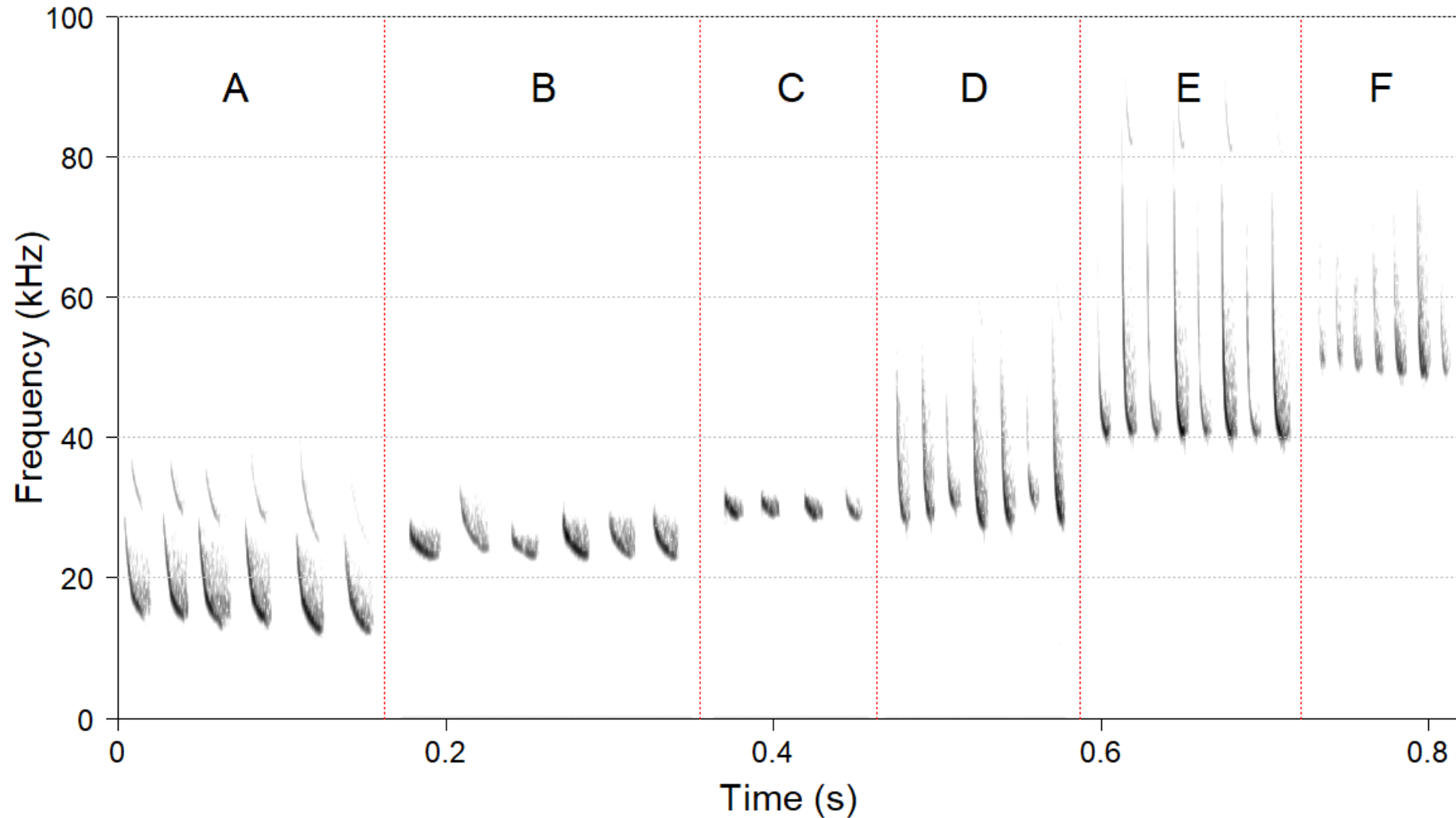


Figure 1. Representative echolocation call sequence portions of the species identified (**A:** *Austronomus australis*; **B:** *Ozimops kitcheneri*; **C:** *Ozimops petersi*; **D:** *Chalinolobus gouldii*; **E:** *Vespadelus regulus*; **F:** *Chalinolobus morio*; time between pulses has been compressed).