Appendix 24

Mount Emerald Wind Farm – Microchiropteran Bat Ultrasonic Call Assessment

Prepared by RPS

Mount Emerald Wind Farm

Microchiropteran Bat Ultrasonic Call Assessment

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1.0 Introduction

The proposed Mount Emerald Wind Farm (MEWF) project consists of construction and operation of a wind farm located approximately 20km SSW of Mareeba on the Atherton Tablelands including of approximately 70 wind turbines, associated access tracks and an electricity substation that will feed into the main electricity grid (the Chalumbin – Woree transmission line). The general characteristics of wind turbines being considered include the following:

- upwind pointing horizontal axis wind turbine;
- three-bladed design with blade lengths between 50m and 54m (100m to 108m diameter);
- turbine capacity of approximately 3.0MW;
- cylindrical steel towers providing a hub height of 78m to 80m;
- blade length of approximately 50m; and
- total height to blade tip between 130m and 134m.

This project is intended to supply approximately 500,000 megawatt hours which should supply sufficient renewable energy to power the equivalent annual needs of approximately 75,000 North Queensland homes over a 20 year period. The site has been selected primarily as it displays an excellent wind resource, there are few residences in close proximity to the site, and the site is traversed by existing Powerlink transmission line infrastructure (providing ease of connection).

1.1 Site Description

The wind farm project site, hereafter referred to as the "site" or "project area" is a single rural property, formerly described as Lot 7 on Plan SP235244, and covering an area of approximately 2422 ha (**Figure 1**).

The site is situated at the northern most end of the Herberton Range, which forms part of the Great Dividing Range. The site varies in altitude from 540 m ASL at the northern-most point along Kippen Drive to 1089 m ASL in the south-eastern most section closest to Mt Emerald. The north-western section of the site is dominated by Walsh's Bluff (907 m ASL) (**Figure 1**).

The site is dominated by a series of three, approximately parallel high rhyolite ridges running in a south-east to north-west direction (**Figure 1**). There is a large area (~500 ha) of relatively flat country located in the western section (**Figure 1**). The site is dissected by a series of steep rocky ephemeral drainage lines and gorges, including the headwaters of a tributary of Granite Creek (**Figure 1**).

The site is intersected by a 5-10 m wide, 6.7 km long access track for Powerlink's Chalumbin to Woree 275 kV transmission line that roughly traverses the property (**Figure 1**). Two other vehicle tracks, 750 m and 2.95 km in length respectively, connect the two test wind towers with the main power line access track (**Figure 1**).

The site is not currently grazed by domestic stock and aside from the cleared areas of access tracks and test wind monitoring tower pads, consists entirely of remnant vegetation. The site is located on the boundary of the Einasleigh Uplands and the Wet Tropics Bioregions, both of which are characterized by high levels of bioregional endemic flora and fauna species.

1.2 Objective

Under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*), actions that have, or are likely to have, a significant impact on a Matters of National Environmental Significance (MNES) require approval from the Australian Government Minister for the Environment (the minister). The proposed development has been deemed a controlled action under the provision of the *EPBC Act* as the action has the potential to have a significant impact on a number of MNES and therefore required an EIS before approval could be considered.

The controlling provisions for the proposal under the *EPBC Act* are:

(a) Listed threatened species and ecological communities (sections 18 & 18A);

(b) Listed migratory species (sections 20 & 20A);

(c) World Heritage Properties (sections 12 & 15A); and

(d) National Heritage Places (sections 15B & 15C).

The following three species of EPBC listed threatened microchiropteran bats are assessed as moderately to highly likely to occur on (or in the immediate vicinity of) the MEWF site:

- Greater Large-eared Horseshoe Bat, *Rhinolophus philippinensis* (large form), listed as endangered under the EPBC;
- Bare-rumped Sheathtail Bat, *Saccolaimus saccolaimus nudicluniatus,* listed as critically endangered under the EPBC; and
- Semon's Leaf-nosed Bat, *Hipposideros semoni,* listed as endangered under the EPBC.

Of these species, only *S. s. nudicluniatus,* has been detected at the proposed Mt Emerald Wind Farm project site.

The purpose of this report is to present the findings of all of the pre-construction bat call surveys conducted at the MEWF project site. Ultrasonic call using detectors based on the ground or on wind monitoring towers are the standard methods used to conduct microchiropteran bat utilisation at Australian wind energy facilities and were deployed on the study site.

2.0 Methodology

2.1 Early Dry Season 2010

During the early dry season surveys, passive monitoring was undertaken for four consecutive nights in the vicinity of Granite Creek at c. 327359 8099784 between 10 and 13 May 2010 (**Figure 1**).

2.2 Late Wet Season – Dry Season 2011 Surveys

During the late wet season surveys (28/3/2011 to 1/4/2011), passive monitoring using ANABAT SD1 detectors (Titley Electronics, Ballina NSW) were conducted for 1-2 nights at a number of the proposed turbine locations, i.e. # 30, #26, #60, #56, #55 (April 2011 layout) (**Figure 1**). At each site, monitoring commenced at dusk (approximately 1830 hours) and continued until dawn (approximately 0545 hours). ANABAT SD1 detectors were attached to tree trunks and set ~2m above the ground with the microphones angled 45 degrees upwards. Active monitoring was also conducted on the nights of 29 and 31 March using an ANABAT SD1 detector from a slow-moving vehicle travelling along the power line access track from the vicinity of proposed turbine # 67 to the south-eastern section of the property in the vicinity of proposed turbine #22 (**Figure 1**).

Ultrasonic call monitoring was conducted within the proposed rotor sweep area between 1/06/11 and 4/6/11 using stereo-channel SM2BAT full-spectrum detectors (Wildlife Acoustics, 2011) fitted with two omni-directional ultrasonic SM-UX microphone at the two meteorological testing towers (80 m high and 50 m high respectively) (**Plate 1**). A SM2BAT unit was attached to each tower at ~ 3 m off the ground with one microphone directly connected to the unit oriented horizontally and the other microphone connected to the unit by an extension cable and attached in a horizontal orientation to the top of each tower.

Additional ground level ultrasonic call monitoring was conducted at shrub-level (~3 m above the ground) at three proposed turbine locations between 8/06/2011 and 11/6/2011 (**Figure 1**).

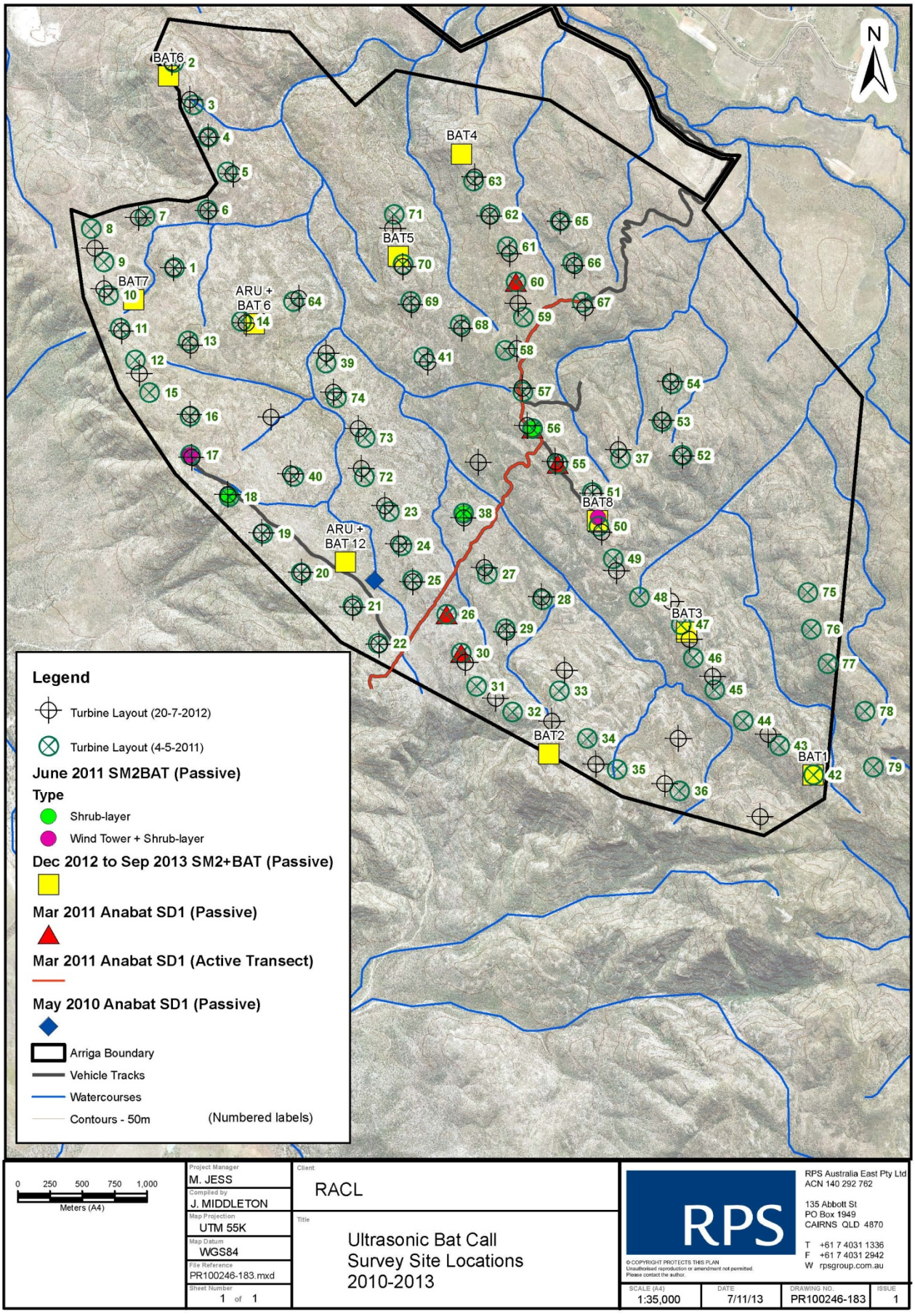

Figure 1 Bat Call Survey Sites 2010-2013

2.3 Permanent Monitoring Towers (Dec 2012 to Sep 2013)

Ten permanent monitoring sites were selected to provide optimal spatial coverage of the site and were located along representative ridge lines where turbines are proposed to be located (**Figure 1**).

A six m tall tower (50 mm diameter steel pipe; guyed with 4 mm wire ropes attached at 4 m above the ground) was erected at each site in December 2012. A Wildlife Acoustics SM2+BAT unit fitted with a SM-UX ultrasonic microphone and a SMX-FMC "night flight" acoustic microphone and powered by a 12V 30 amp hr sealed lead acid gel cell battery and charged by a 30W solar panel was established at each site. The two microphones were located at the top of the tower approximately 6 m above the ground and connected to the SM2+BAT unit by 6 m cables.

Each SM2+BAT unit was programmed to sample in stereo (left channel ultrasonic and right channel acoustic) continuously in one hour-blocks from sunset to sunrise in Wildlife Acoustics proprietary WAC compression format on either four 64 GB or 16 GB Lexar SD-XC memory cards (256 GB or 64 GB total memory). The recording setup file was reviewed by Wildlife Acoustics Australia supplier (Faunatech) and by Greg Ford (Balance Environmental). Sampling commenced at each site on 12 December 2012.

Each site was visited approximately every two months, the four 64 GB cards collected and replaced with four 16 GB cards. One week later, each site was then revisited and the four 16 GB cards were then replaced with four 64 GB cards.

The total survey duration varied from 42-96 nights across the ten detector tower sites (**Attachment A**). A total of 631 detector survey nights were conducted in the 257 days between 11 December 2012 and 28 August 2013 at the ten detectors towers.

Microbat call analysis was conducted by recognised microbat bat call analyst Greg Ford (Balance Environmental, 2013), who is familiar with North Queensland species likely to occur on the site. Balance Environmental possesses an extensive bat call reference library including numerous calls from the critically endangered Bare-rumped Sheath-tail Bat (*Saccolaimus saccolaimus nudicluniatus*) from a range of locations. Details supporting the identifications are provided, as recommended by the Australasian Bat Society (ABS 2006) in **Attachment B**.

2.3.1 Limitations

Due to the inherently high wind and harsh monsoonal conditions combined with the remoteness of the ridgelines of the study site (albeit consistent with positive conditions for wind turbine operations), data collection was not continuous. Issues arose from water-damaged microphones, wind-damaged night-flight microphones, and access where weather and helicopter availability were restrictive. There were also occasional hardware and software malfunctions, regardless, extensive wet and dry season records have been collected across the site aspect.

Plate 1 Bat Call Detection Tower (ultrasonic microphone shown at top of pole)

3.0 Results

A total of 654 detector nights of microchiropteran bat call surveys were conducted within the MEWF site between May 2010 and September 2013 (**Attachment A**).

Over the entire sampling period, a total of 17 species of microchiropteran bats were assessed as occurring on the site on the basis of calls that were identified as belonging to the particular species with a high degree of certainty (**Table 1**). Additional species (between three and six species) were assessed as potentially occurring on the site, on the basis of the calls not being able to be reliably separated from other species with similar calls (**Table 1**).

Table 1 Summary of Call Analysis

Scientific Name	Common Name	Family	EPBC	NCA
Calls Identified with High Certainty				
Saccolaimus flaviventris Peters, 1867	Yellow-bellied Sheathtail Bat	Emballonuridae		
Saccolaimus saccolaimus Temminck, 1838	Bare-rumped Sheathtail Bat	Emballonuridae	CE	E
Hipposideros diadema Geoffroy, 1813	Diadem Leaf-nosed Bat	Hipposideridae		NT
Austronomus australis (=Tadarina australis)	White-striped Freetail Bat	Molossidae		
Chaerephon jobensis	Northern Freetail Bat	Molossidae		
Mormopterus beccarii	Beccari's Freetail Bat	Molossidae		
Mormopterus loriae ridei Felten, 1964	Eastern Little Freetail Bat	Molossidae		
Mormopterus 'species' 2	Undescribed species Adam *et al.*, 1988)	Molossidae		
Rhinolophus megaphyllus	Eastern Horseshoe Bat	Rhinolophidae		
Chalinolobus gouldii	Gould's Wattled Bat	Verspertilionidae		
Chalinolobus nigrogriseus	Hoary Wattled Bat	Verspertilionidae		
Miniopterus australis	Little Bent-wing Bat	Verspertilionidae		
Miniopterus orianae oceanensis (=M. schreibersii oceanensis)	Eastern Bent-wing Bat	Verspertilionidae		
Pipistrellus adamsi	Forest Pipistrelle, Cape York Pipistrelle	Verspertilionidae		
Scotorepens orion	Eastern Broad-nosed Bat	Verspertilionidae		
Scotorepens sanborni	Northern Broad-nosed Bat	Verspertilionidae		
Vespadelus troughtoni	Eastern Cave Bat	Verspertilionidae		
Species/Calls Not Reliably Identified				
Taphozous georgianus	Common Sheath-tail Bat	Emballonuridae		
Taphozous troughtoni[A]	Troughton's Sheath-tailed Bat	Emballonuridae		LC
Nyctophilus species	Long eared Bat (could be Eastern Long-eared Bat (*N. bifax*), Lesser Long-eared Bat (*N. geoffroyi*) and Gould's Long-eared Bat (*N. gouldii*). Not possible to differentiate with Anabat zero-crossing files.	Verspertilionidae		

[A] *T. troughtoni* is currently only known to occur in the vicinity of Mt Isa.

The surveys conducted at the 80 m tall test wind tower detected a total of five or six bat species with the majority of call sequences recorded with the microphone set at 80 m (91 calls) compared with the microphone set a 3 m above the ground (32 calls) (**Attachment B**). At the lower 50 m tall wind tower, a similar number of species was recorded; however, no calls were detected at the microphone at 50 m, only from the 3m microphone (**Attachment B).**

3.1 Conservation Significant Species

3.1.1 Diadem Leaf-nosed Bat (*Hipposideros diadema*)

A single call belonging to *H. diadema* was recorded on an Anabat SD1 detector in the vicinity of Granite Creek on the 12 May 2010 (**Figure 1**). No subsequent calls were recorded for this species during the survey period at any location on the site.

3.1.2 Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*)

The characteristic call attributes of *S. saccolaimus* (**Attachment B**) according to Ford (2013) include:

- a dominant harmonic with characteristic frequency around 22-25 kHz;
- at least 3 and up to five distinct harmonics at approximately 13 kHz intervals (1 below and up to 3 above the dominant harmonic); and
- call pulses sometimes in “triplet” sets with pulse intervals of approximately 10-20ms between first and second pulses and 20-40ms between second and third pulses and an inter-triplet interval of about 80-100ms.

A single call, potentially belonging to *S. Saccolaimus,* was first recorded on the site in March 2011 (**Attachment B)**. However, it was not possible then to reliably discriminate between three species with similar call attributes (i.e. *S. flaviventris, S. saccolaimus* and *T. troughtoni*) as the calls were recorded on Anabat detectors which do not allow harmonic characteristics of the calls to be examined, unlike full-spectrum Wildlife Acoustic Song Meter (SM2Bat and SM2+BAT) detectors, which were used on all subsequent surveys. A single call sequence was recorded in June 2011 on a full-spectrum SM2BAT detector and it was considered highly probable that it belonged to *S. saccolaimus* (**Attachment B).**

A total of 182 call sequences from nine of the ten 6-m tall towers were recorded between 20-28 February 2013 that could have potentially been Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus)* (**Attachment B**). However, after further examination, it was concluded that the calls were more likely to have been *Mormopterus beccarii* (Beccari’s Freetail Bat). A total of 30 call sequences recorded between 11 December 2012 and 28 May 2013, were assessed with high confidence of belonging to *S. saccolaimus* (**Attachment B**).

4.0 Discussion

The relationship between call activity and actual population abundance of microchiropteran bats is not well understood. In addition, the detection distance of the Wildlife Acoustics SM2+BAT Song Meters is only recently thought to be 20-30 m (Wildlife Acoustics, pers. comm.). *S. saccolaimus* is thought to be a fast, high-flyer and even the microphones placed at the top of the 6 m towers may not have been able to sample the lower limit of the rotor sweep area (~35 - 135 m above the ground) adequately as the microphones were angled at 45 degrees to reduce exposure of the sensitive diaphragm to rain. Therefore, it is difficult to make reliable assumptions about the relative abundance (actual call activity) of the species within the site.

Best practice guidelines from Australia and overseas highlight the requirement to monitor the call activity of microchiropteran bats at the proposed turbine hub height (EPHC, 2010; Bat Conservation Trust, 2011). Due to the large area of the MEWF site (2422 hectares) and the difficulties imposed on access due to minimal track coverage, rugged terrain and weather conditions, it was considered that to gain an indication of spatial and temporal patterns of microbat utilisation, a higher frequency of monitoring points was preferential to the limited wind monitoring tower locations that were available for higher elevation monitoring;

Only a relatively few call passes were classified as belonging to *S. saccolaimus* with high confidence. It is possible that the species is not present in high abundances, calling activity of the species on the site was low or simply that its' preferred foraging zone was not adequately surveyed.

4.1 Future Research

Faunatech Australia has recently developed a pulley system that allows microphones and cables to be easily placed within the proposed rotor sweep zone on meteorological towers. Further surveys should be conducted within the proposed rotor sweep area zone at the two test towers on the site, in order to better understand the temporal utilisation patterns of microchiropteran bats, particularly the Bare-rumped Sheathtail Bat, at these two locations.

Very lightweight full spectrum bat detectors, such as the Nanobat device being developed by Roger Coles (University of Queensland) or FM-radio microphones (Griffin & Thompson, 1982; Fenton & Griffin, 1997; Albrecht and Grünfelder, 2011 in BSG, 2011) could be attached to moderately sized (3-4 m3) helium balloons or kites (Gilliam et al., 2009) to monitor bat calls within the rotor sweep area at the proposed turbine locations rather than being restricted to the two meteorological towers.

5.0 References

Australasian Bat Society (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. http://ausbats.org.au/resources/4553704436

Albrecht, K., and Grünfelder, C. H. (2011). Pre-construction study: Recording bats in heights with collision risk using a helium balloon and an automated system *In* BSG Ecological Consultants (2011). Bats and onshore wind farms – technical review of presentations from the Tronheim Conference on Wind Energy and Wildlife, May 2011.

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Bat Conservation Trust (2011). *Bat Surveys – Good Practice Guidelines, 2nd Edition. Surveying for Onshore Wind Farms*. Bat Conservation Trust, London.

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Gilliam, E. H., McCracken, G. F., Westbrook, J. K., Lee, Y., Jensen, M. L., and Balsley, B. B. (2009). Bats aloft; variability in echolocation call structure at high latitudes. *Behav. Ecol. Sociobiol*., 64: 69-79.

Griffin, D. R., and Thompson, D. (1982). High altitude echolocation of insects by bats. *Behavioural Ecology and Sociobiology,* 10: 303-306.

Fenton, M. B., and Griffin, D. R. (1997). High-altitude pursuit of insects by echolocating bats. *Journal of Mammalogy*, 78(1): 247-250.

Attachment A

Summary of Microchiropteran Bat Call Surveys

Detector Type	SITE ID	Survey Type	Detector ID	Easting	Northing	Survey Period Start Date	Survey Period Finish Date	Survey Duration (Nights)	Total Survey Duration (Nights)
Wildlife Acoustics SM2+BAT	ARU 12 + BAT	Passive	RPS 010342	327124	8099910	30/12/2012	4/01/2013	5	78
						8/01/2013	20/01/2013	13	
						20/02/2013	28/02/2013	9	
						18/04/2013	30/05/2013	43	
						17/07/2013	24/07/2013	8	
	ARU 6 + BAT	Passive	RPS 010379	326444	8101751	12/12/2012	6/01/2013	25	42
						20/02/2013	28/02/2013	9	
						22/05/2013	28/05/2013	7	
						13/08/2013	13/08/2013	1	
	BAT 1	Passive	RPS 010388	330752	8098285	11/12/2012	21/12/2012	11	45
						20/02/2013	28/02/2013	9	
						17/04/2013	5/05/2013	19	
						16/07/2013	21/07/2013	6	
	BAT 2	Passive	RPS 010375	328705	8098455	11/12/2012	23/12/2012	13	68
						20/02/2013	28/02/2013	9	
						17/04/2013	22/05/2013	36	
						17/07/2013	26/07/2013	10	
	BAT 3	Passive	RPS 010359	329769	8099386	11/12/2012	31/12/2012	21	58
						20/02/2013	28/02/2013	9	
						17/04/2013	6/05/2013	20	
						21/08/2013	28/08/2013	8	
	BAT 4	Passive	RPS 010382	328025	8103096	11/12/2012	22/12/2012	12	96
						20/02/2013	28/02/2013	9	
						18/04/2013	7/05/2013	20	
						17/06/2013	11/08/2013	55	

Detector Type	SITE ID	Survey Type	Detector ID	Easting	Northing	Survey Period Start Date	Survey Period Finish Date	Survey Duration (Nights)	Total Survey Duration (Nights)
	BAT 5	Passive	RPS 010386	327545	8102283	11/12/2012	25/12/2012	15	54
						20/02/2013	28/02/2013	9	
						16/04/2013	25/04/2013	10	
						17/06/2013	4/07/2013	18	
						13/08/2013	14/08/2013	2	
	BAT 6	Passive	RPS 010372	325749	8103687	11/12/2013	24/12/2013	14	76
						16/04/2013	16/05/2013	31	
						17/06/2013	17/07/2013	31	
	BAT 7	Passive	RPS 010360	325476	8101965	11/12/2012	5/01/2013	25	63
						20/02/2013	28/02/2013	9	
						16/04/2013	26/04/2013	11	
						17/06/2013	4/07/2013	18	
	BAT 8	Passive	RPS 010387	329079	8100241	11/12/2012	24/12/2012	14	51
						26/01/2013	26/01/2013	1	
						20/02/2013	28/02/2013	9	
						17/03/2013	17/03/2013	1	
						16/04/2013	26/04/2013	11	
						16/07/2013	30/07/2013	15	
Anabat SD1	Turbine #35 (20/7/12 layout)	Passive	AB01	328045	8099230	28/03/2011	28/03/2011	1	1
	Turbine #26 (4/5/11 layout)	Passive	AB01	327901	8099510	29/03/2011	30/03/2011	2	2
	Turbine #60 (Apr 2011 layout)	Passive	AB01	328432	8102088	31/03/2011	31/03/2011	1	1
	Turbine #56 (Apr 2011 layout)	Passive	RPSZcairn	328560	8100966	28/03/2011	29/03/2011	2	2

Detector Type	SITE ID	Survey Type	Detector ID	Easting	Northing	Survey Period Start Date	Survey Period Finish Date	Survey Duration (Nights)	Total Survey Duration (Nights)
	Turbine #55 (Apr 2011 layout)	Passive	RPSZcairn	328780	8100670	30/03/2011	31/03/2011	1	1
	22-67-22 (Apr 2011 layout)	Active	AB03			29/03/2011	29/03/2011	1	2
	Granite Creek			327359	8099784	31/03/2011	31/03/2011	1	
Wildlife Acoustics SM2BAT	Turbine #56 (Apr 2011 layout)	Passive	SM2BAT_005106	328578	8100964	8/06/2011	11/06/2011	4	4
	Turbine #38 (Apr 2011 layout)	Passive	SM2BAT_0057322	328058	8100294	8/06/2011	9/06/2011	2	2
	Turbine #18 (Apr 2011 layout)	Passive	SM2BAT_005733	326229	8100414	8/06/2011	8/06/2011	1	1
	Test Wind Mast (30 m) (Turbine #15)	Passive		325929	8100744	1/06/2011	3/06/2011	3	3
	Test Wind Mast (80 m) (Turbine #47)	Passive		329098	8100274	1/06/2011	4/06/2011	4	4

Attachment B

Bat Call Analysis – Balance! Environmental

Anabat echolocation data interpretation summary

Client: RPS (Cairns/Townsville) **Job no.:** RPS-1002 **Analysis Date:** 11/06/2010

Project name/location: Arriga Palteau (May 2010 Survey)

Numbers in columns represent number of calls attributed to each species or species group

Species	10-May	11-May	12-May	13-May	Total calls for species
Calls positively identified					
Hipposideros diadema			1		1
Scotorepens sanborni	3				3
Vespadelus troughtoni	1				1
Miniopterus australis	5		1	4	10
Miniopterus orianae oceanensis	20	3	13	21	57
Austronomus australis	1		4		5
Chaerephon jobensis	1				1
Mormopterus ridei				2	2
Saccolaimus flaviventris	1				1
Total calls positively identified	32	3	19	27	81
Calls NOT positively identified					
Chalinolobus nigrogriseus / S. sanborni	1				1
S. flaviventris / C. jobensis	2	1		2	5
unknown bat call	24	1	4	13	42
Total calls NOT positively identified	88	8	41	69	206
Total calls for night	59	5	23	42	129

Species nomenclature:

Species names used in this summary follow Churchill (2008).

Call identification & reporting standard:

Call identification was based on published call descriptions for southern Queensland (Reinhold *et al* 2001) and the Northern Territory (Milne 2002) and on reference calls collected from central and northern Qld.

Determination of species' identification was further refined by considering probability of occurrence based on distributional information presented in Churchill (2008) and van Dyck & Strahan (2008).

The format and content of this report complies with nationally accepted standards for the interpretation and reporting of Anabat data (Reardon 2003); latest version available from the Australasian Bat Society on-line at http://www.ausbats.org.au/.

Notes to the table - discussion of species/groups with low reliability of identification

Chalinolobus nigrogriseus / S. sanborni	calls are at similar frequencies; usually differentiated on slightly different pulse shapes but one call form this survey with intermediate shape and could have been either species
S. flaviventris / C. jobensis	call frequency overlaps; usually have different pulse shapes but a few brief calls could have been either species
Unknown calls	these are calls that were too brief, weak or noisy to enable reliable species identification; they represent species already listed above, not additional species

References:

Churchill, S. (2008). *Australian Bats* . Jacana Books, Allen & Unwin; Sydney.

Milne, D.J. (2002). *Key to the Bat Calls of the Top End of the Northern Territory* . Technical Report No. 71, Parks and Wildlife Commission of the Northern Territory, Darwin.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales.* Department of Natural Resources and Mines, Brisbane.

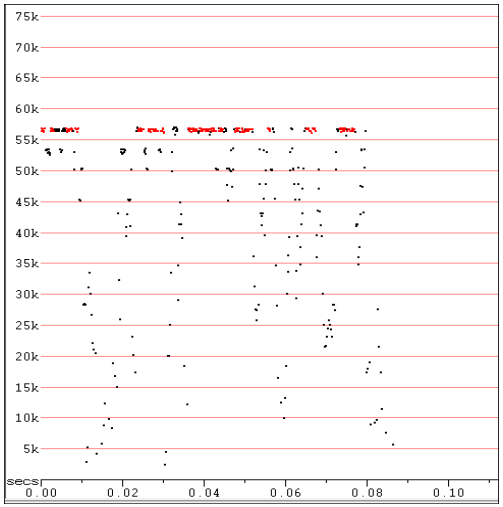
van Dyck, S. and Strahan, R. (ed.) (2008). *The Mammals of Australia* (Third Edition); New Holland; Sydney.

Anabat Data Analysis Summary

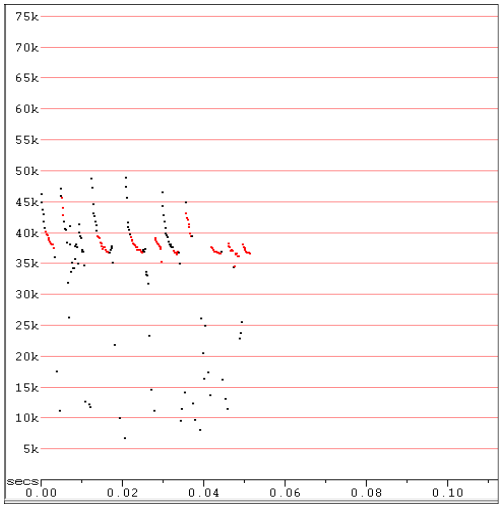
Sample calls extracted from theArriga Plateau survey data (RPS Townsville; May 2010)

Scale: 10 msec per tick; time between pulses removed (*AnalookW* F7 compressed mode)

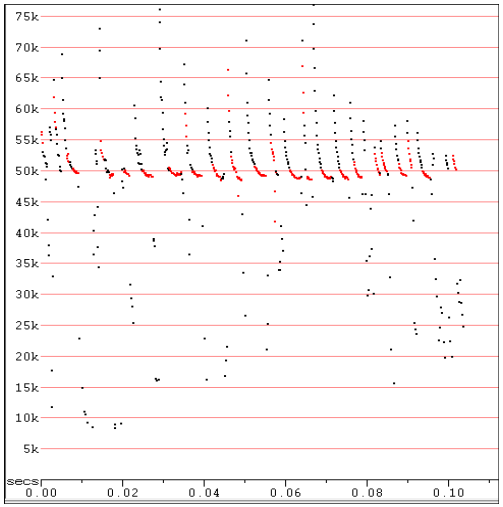
Species positively identified



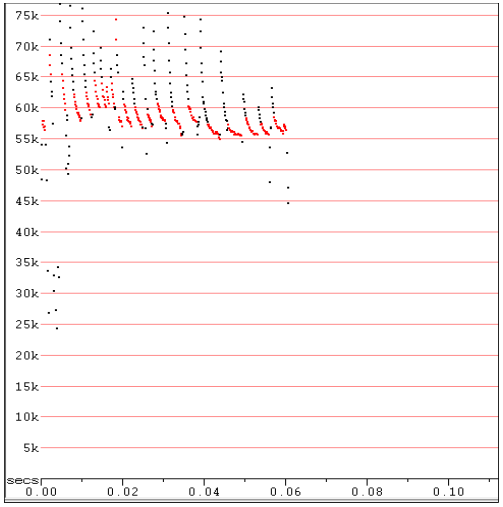
Hipposideros diadema



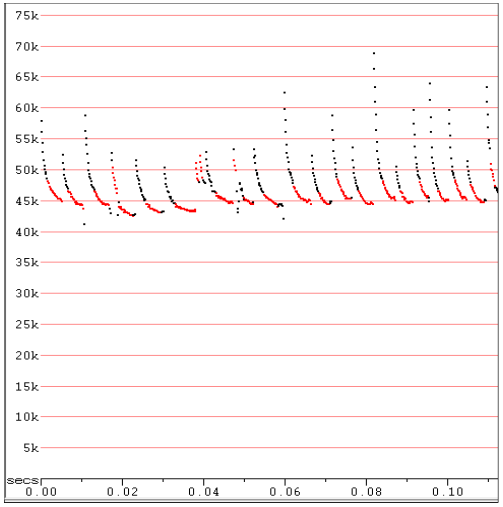
Scotorepens sanborni



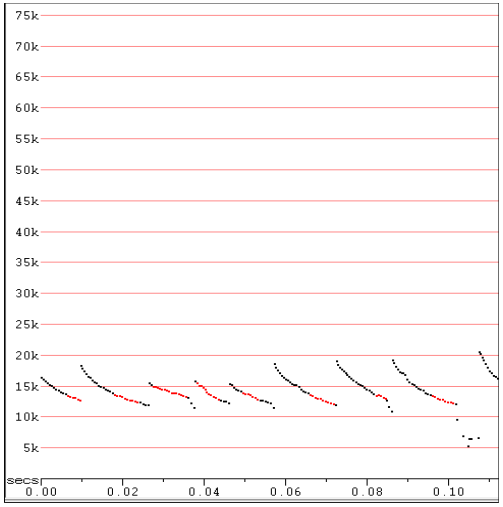
Vespadelus troughtoni



Miniopterus australis



Miniopterus orianae oceanensis



Austronomus australis

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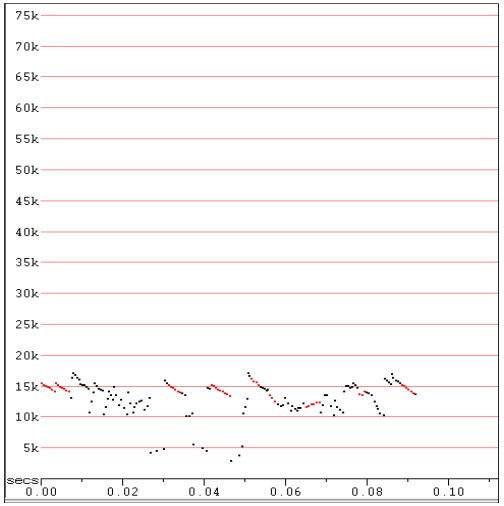
Anabat Data Analysis Summary

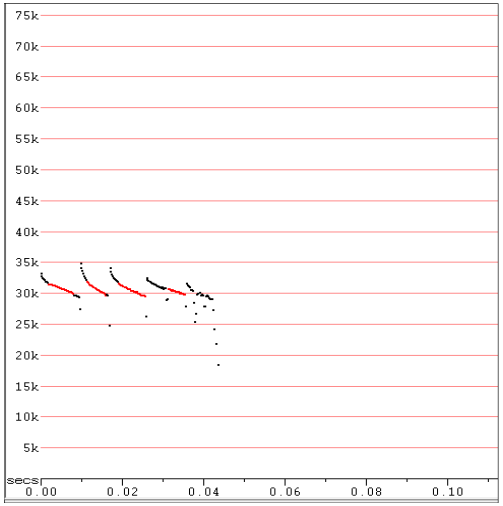
Sample calls extracted from theArriga Plateau survey data (RPS Townsville; May 2010)

Scale: 10 msec per tick; time between pulses removed (*AnalookW* F7 compressed mode)

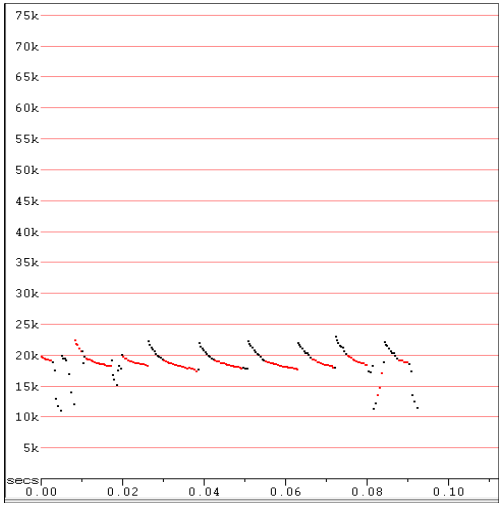
Species positively identified



Chaerephon jobensis

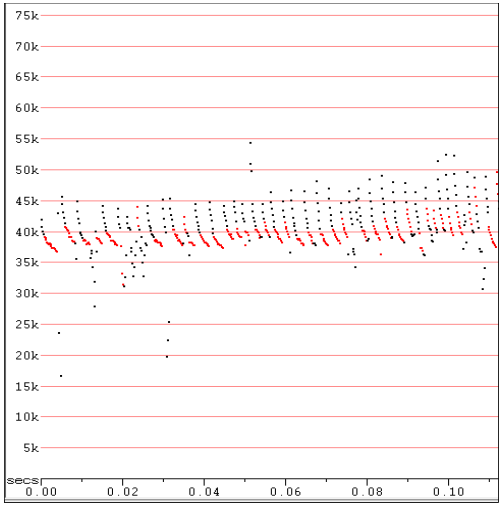


Mormopterus ridei

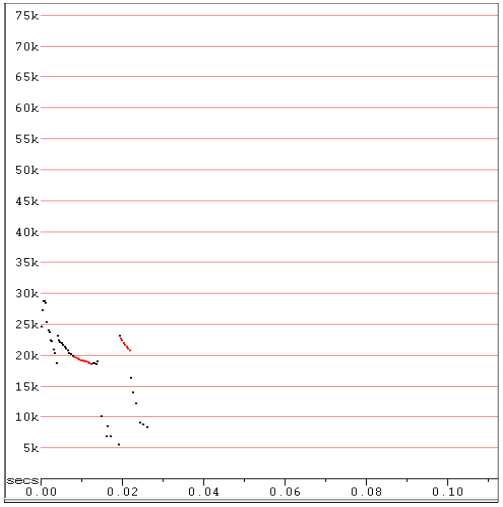


Saccolaimus flaviventris

Calls NOT positively identified



Chalinolobus nigrogriseus / S. sanborni



S. flaviventris / C. jobensis

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Anabat echolocation data interpretation summary

Client: RPS (Townsville) **Client reference:** PR100246-1 **Balance Job no.:** RPS-1104

Project name/location: Arriga Plateau, Atherton Tableland; 28-31 March 2011

Species identification summary:

Numbers in columns represent number of calls attributed to each species or species group

Detector:	AB01				AB03			RPS Zcaim			
Date:	**28-Mar**	**29-Mar**	**30-Mar**	**31-Mar**	**28-Mar**	**29-Mar**	**31-Mar**	**28-Mar**	**29-Mar**	**30-Mar**	**31-Mar**
Species positively identified											
Rhinolophus megaphyllus			3		7	1					
Chalinolobus gouldii							4				
Nyctophilus species	2	1	1			3			1		
Scotorepens orion	3	1	1		4	1			1		
Vespadelus troughtoni										1	
Miniopterus australis	1	1	6	1	33	15	6	3	5	2	3
Miniopterus orianae oceanensis	1	5	122	39	11	8	54	29	16	1	1
Chaerephon jobensis			3			1					
Mormopterus beccarii	2	4	5							1	
Saccolaimus flaviventris	2	3	7		2		2	3	2	2	
Total positively identified calls	11	15	148	40	57	29	66	35	25	7	4
Calls NOT positively identified *											
Scotorepens sanborni or *Chalinolobus nigrogriseus*	7	3	7		11	81		1	2	5	2
C. jobensis or *S. flaviventris*	1		1								
M. beccarii or *Taphozous troughtoni*	1		3								
M. beccarii or S. flaviventris	1		1								
S. flaviventris or ***S. saccolaimus*** or *T. troughtoni*			1								
Unidentified bat calls	1		10	1	5	10				1	
Total calls NOT positively identified	11	3	23	1	16	91	0	1	2	6	2
Total calls recorded	22	18	171	41	73	120	66	36	27	13	6

***** Species listed in this section and not above should be considered as possibly present in the study area.
See notes below regarding species identity for calls with poor resolution.

Client: RPS (Townsville) **Client reference:** PR100246-1 **Balance Job no.:** RPS-1104

Project name/location: Arriga Plateau, Atherton Tableland; 28-31 March 2011

Species nomenclature:

Species names used in this summary follow Churchill (2008).

Call identification & reporting standard:

No call descriptions or key exists for the survey region; however, published keys and descriptions from other regions (Milne 2001; Reinhold *et al.* 2001; Pennay *et al.* 2004) were used to guide this analysis. Reference was also made to calls collected from bats of known identity in southern, central and north-eastern Queensland.

Determination of species' identification was further refined by considering probability of occurrence based on distributional information presented in Churchill (2008) and van Dyck & Strahan (2008).

The format and content of this report complies with nationally accepted standards for the interpretation and reporting of Anabat data (Reardon 2003); latest version available from the Australasian Bat Society on-line at http://www.ausbats.org.au/.

Notes - species/calls not reliably identified

***Nyctophilus* species**

The long-eared bats produce distinctive linear calls that are usually distinguishable from other species; however, the species within the genus *Nyctophilus* cannot be differentiated using Anabat data. Three species potentially occur in the survey area: *N. bifax* , *N. geoffroyi* and *N. gouldii* .

Scotorepens sanborni or Chalinolobus nigrogriseus

Calls from these species are virtually impossible to differentiate and both are likely to occur in the study area.

C. jobensis or S. flaviventris

Most calls from these bats are easy to distinguish; however, brief and/or weak calls in the frequency overlap zone (*ca.* 17-20kHz) can sometimes be confused. A few such calls from this survey could not be reliably identified.

M. beccarii or Taphozous troughtoni

These species overlap in frequency around 23-25kHz, but can usually be distinguished due to unique pulse shapes. *M. beccarii* was positively identified from a number of calls; however, a few low quality calls in the frequency range had insufficient definition in the pulse shape to reliably attribute to either species.

M. beccarii or S. flaviventris

Some attack-phase pulses from *S. flaviventris* are similar in appearance to the erratic, steep pulses of *M. beccarii* . Most calls were positively attributed to either species based on distinctive search-phase pulses, but a couple of noisy and weak calls could not be reliably differentiated.

S. flaviventris or S. saccolaimus or T. troughtoni

A single call from AB01 on 30/3 contains clear search-phase pulses like those of *S. flaviventris* , but the frequency is higher than expected for such a call (around 22kHz). It is possible that the call came from *T. troughtoni* , but that species usually generates flatter pulses than those exhibited in this call. With a frequency at *ca* . 22kHz and smoothly-curved, low-bandwidth pulses, it is considered highly probable that this call came from the endangered *S. saccolaimus* as they match the description provided by Corben (2010).

Unidentified bat calls

These were calls that were too brief and/or weak and/or noisy to allow reliable attribution to any species or species group. All such calls were within the frequency ranges of species otherwise listed in the table and are unlikely to represent additional species.

Client: RPS (Townsville) **Client reference:** PR100246-1 **Balance Job no.:** RPS-1104

Project name/location: Arriga Plateau, Atherton Tableland; 28-31 March 2011

References:

Churchill, S. (2008). *Australian Bats* . Jacana Books, Allen & Unwin; Sydney.

Corben, C. (2010). Acoustic identification of *Saccolaimus* . *Proceedings of the 14th Australasian Bat Society Conference, Darwin, Australia, 12-14 July 2010* .

Milne, D.J. (2002). *Key to the Bat Calls of the Top End of the Northern Territory.* Technical Report No. 71, Parks and Wildlife Commission of the Northern Territory, Darwin.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales.* Department of Natural Resources and Mines, Brisbane.

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales.* Department of Environment and Conservation, Hurstville.

van Dyck, S. and Strahan, R. (ed.) (2008). *The Mammals of Australia* (Third Edition); New Holland; Sydney.

Anabat Data Analysis Summary

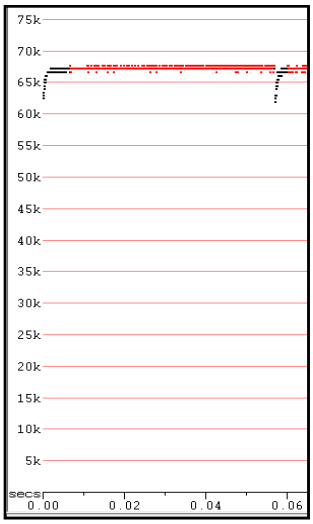
Client: RPS (Townsville) **Client reference:** PR100246-1 **Balance Job no.:** RPS-1104

Project name/location: Arriga Plateau, Atherton Tableland; 28-31 March 2011

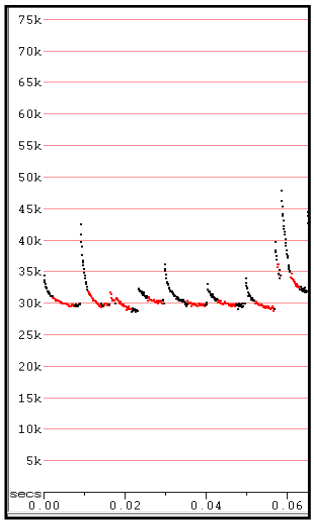
Sample calls extracted from the survey data.

Scale: 10 msec per tick; time between pulses removed (AnalookW F7 compressed mode)

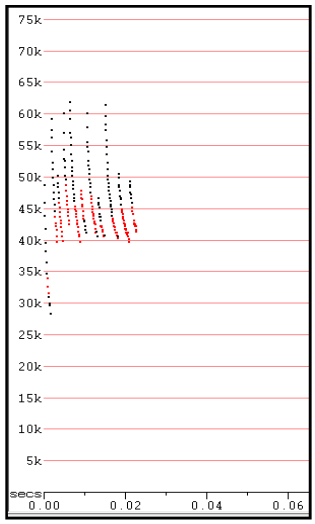
Species positively identified



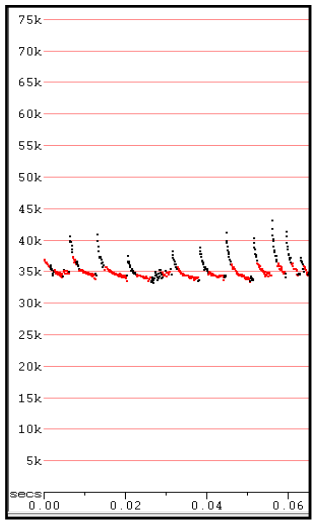
Rhinolophus megaphyllus



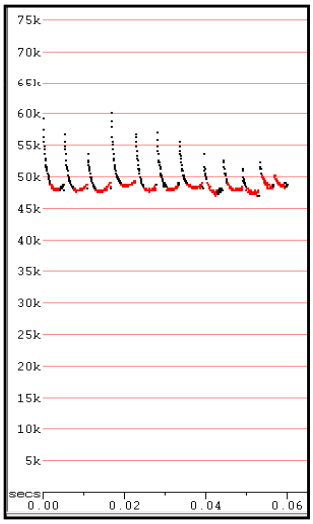
Chalinolobus gouldii



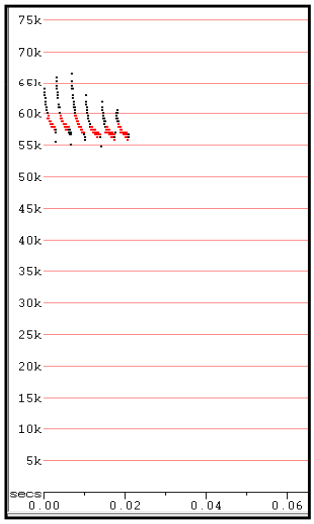
Nyctophilus species



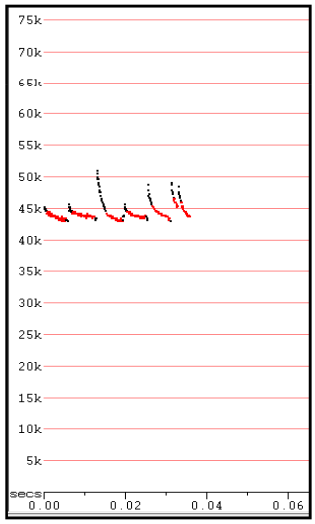
Scotorepens orion



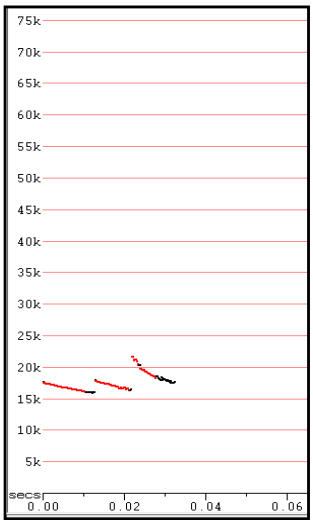
Vespadelus troughtoni



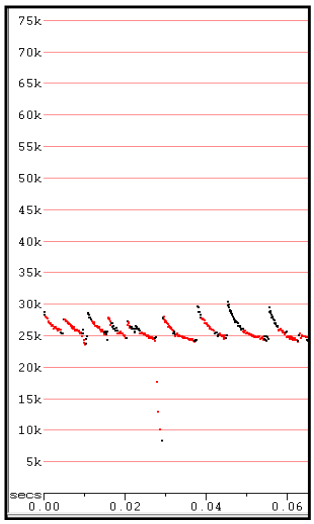
Miniopterus australis



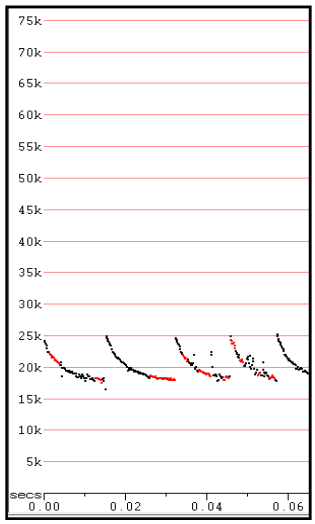
Miniopterus orianae oceanensis



Chaerephon jobensis



Mormopterus beccarii



Saccolaimus flaviventris

Anabat Data Analysis Summary

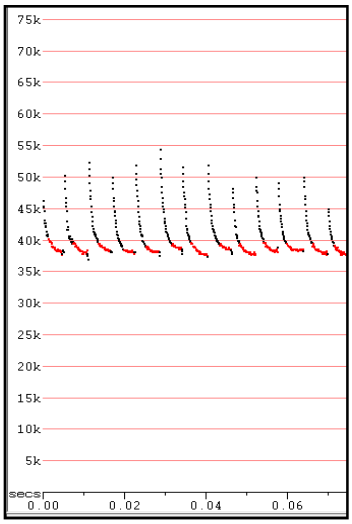
Client: RPS (Townsville) **Client reference:** PR100246-1 **Balance Job no.:** RPS-1104

Project name/location: Arriga Plateau, Atherton Tableland; 28-31 March 2011

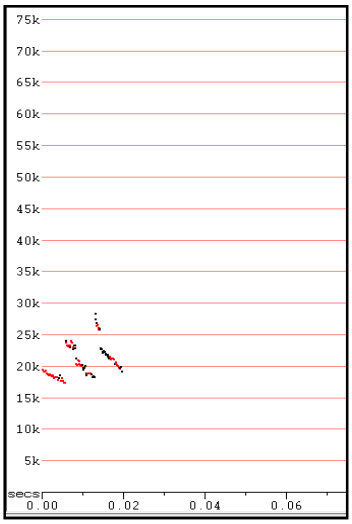
Sample calls extracted from the survey data.

Scale: 10 msec per tick; time between pulses removed (AnalookW F7 compressed mode)

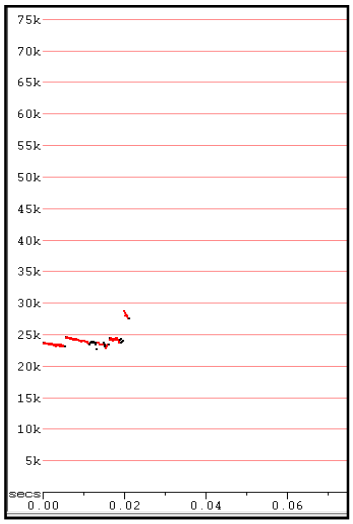
Calls not positively identified



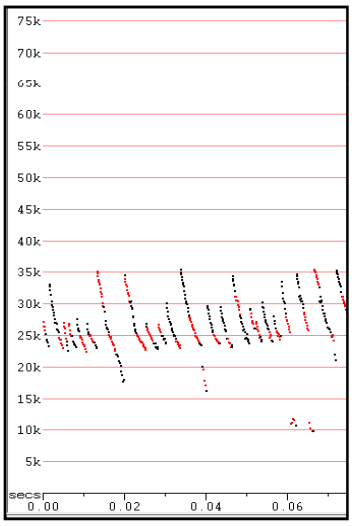
S. sanborni or *C. nigrogriseus*



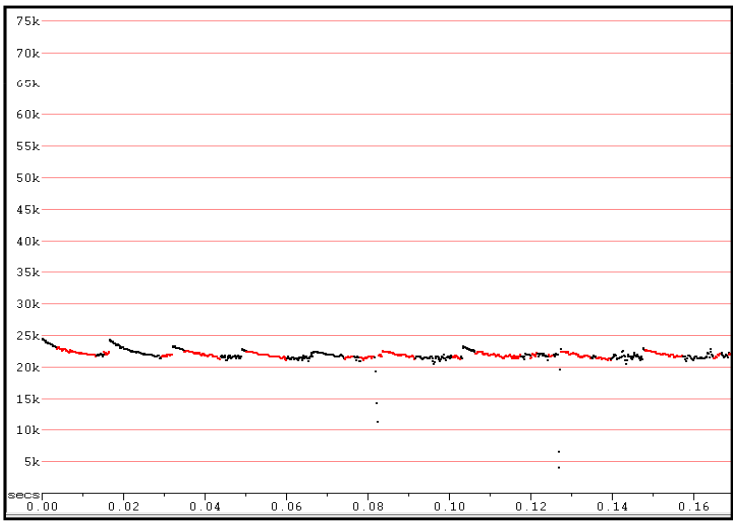
C. jobensis or *S. flaviventris*



M. beccarii or *Taphozous troughtoni*



M. beccarii or S. flaviventris



S. flaviventris or ***S. saccolaimus*** or *T. troughtoni*

Anabat Data Analysis Summary

Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011

Data received for analysis

The echolocation call data analysed here was recorded using several Wildlife Acoustics SongMeter SM2BAT detectors (192kHz Stereo model).

Data was received as WAC files (Wildlife Acoustics proprietary lossless compression format), sorted by SM2BAT unit number or Turbine (site) number.

WAC files were converted to zero-crossing files (ZCA) using *WAC2WAV Version 3.2.3* (Wildlife Acoustics, 2011).

ZCA files were then viewed and calls identified in *AnalookW Version 3.7w* (Corben, 2009).

The WAC to ZCA conversion process generated very large data sets (2,000-10,000 ZCA files) for each detector; however, noise filters applied in *AnalookW* (and also in additional trials using *WAC2WAV*) produced relatively low numbers of files that actually contained bat calls(<100 per night per detector).

TABLE 1 Species identified from the Mt Emerald echolocation call data

Note: The following three SM2BAT detectors were operated with just one microphone connected to the ***Left*** channel and set at shrub level.

Detector	SM2BAT_005106				
Date	8/06/2011	9/06/2011	10/06/2011	11/06/2011	Total
Channel	left	left	left	left	Calls
Species					
Austronomus australis	2	8	6	17	33
Chaerephon jobensis		2			2
Chalinolobus nigrogriseus or *Scotorepens sanborni*	3	3		2	8
Miniopterus australis	4	7	2	8	21
Miniopterus orianae oceanensis	11	27	23	15	76
Mormopterus ridei					0
Rhinolophus megaphyllus		2			2
***Taphozous troughtoni* or *Saccolaimus* species**		**1**			1
Unidentified bat calls	7	11	4	7	29
Total calls recorded	27	61	35	49	172

Detector	SM2BAT_0057322			SM2BAT_005733	
Date	8/06/2011	9/06/2011	Total	8/06/2011	Total
Channel	left	left	Calls	left	Calls
Species					
Austronomus australis	1		1	4	4
Chaerephon jobensis			0	2	2
Chalinolobus nigrogriseus or *Scotorepens sanborni*	2		2		0
Miniopterus australis			0	13	13
Miniopterus orianae oceanensis	1	2	3	6	6
Mormopterus ridei			0		0
Rhinolophus megaphyllus			0		0
Taphozous troughtoni or *Saccolaimus* species			0		0
Unidentified bat calls	1		1	3	3
Total calls recorded	5	2	7	28	28

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Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011

Table 1 (cont.)

Note: Both channels were used at the following turbine sites. ***Left*** channel microphone was placed at approximately 80m above ground level. ***Right*** channel microphone was placed at approximately 30m above ground level.

Detector	Turbine #15						
Date	1/06/2011		2/06/2011		3/06/2011		Total
Channel	left	right	left	right	left	right	Calls
Species							
Austronomus australis		3				3	6
Chaerephon jobensis							0
Chalinolobus nigrogriseus or *Scotorepens sanborni*		8				1	9
Miniopterus australis		4				1	5
Miniopterus orianae oceanensis		13		2		3	18
Mormopterus ridei						1	1
Rhinolophus megaphyllus							0
Taphozous troughtoni or *Saccolaimus* species							0
Unidentified bat calls		1		6			7
Total calls recorded	0	29	0	8	0	9	46

Detector	Turbine #47								
Date	1/06/2011		2/06/2011		3/06/2011		4/06/2011		Total
Channel	left	right	left	right	left	right	left	right	Calls
Species									
Austronomus australis	5		15	8	12	3	1	1	45
Chaerephon jobensis		3		1				1	5
Chalinolobus nigrogriseus or *Scotorepens sanborni*	2								2
Miniopterus australis									0
Miniopterus orianae oceanensis	1	1			1				3
Mormopterus ridei					1				1
Rhinolophus megaphyllus									0
Taphozous troughtoni or *Saccolaimus* species									0
Unidentified bat calls	9	8	17	4	20	1	7	1	67
Total calls recorded	17	12	32	13	34	4	8	3	123

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Anabat Data Analysis Summary

Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011

Species nomenclature:

Species names used in this summary follow Churchill (2008).

Call identification & reporting standard:

Call identification for this data set was based on call descriptions and keys presented in Reinhold *et al.* (2001) and Milne (2002) as well as reference calls collected in eastern & northern Queensland and the Northern Territory.

Species' identification was further refined by considering probability of occurrence based on distributional information presented in Churchill (2008) and van Dyck & Strahan (2008).

The format and content of this report complies with nationally accepted standards for the interpretation and reporting of Anabat data (Reardon 2003); latest version available from the Australasian Bat Society on-line at http://www.ausbats.org.au/.

Notes on species present and reliably of call identification

POSSIBLE OCURRENCE OF THREATENED SPECIES - *SACCOLAIMUS SACCOLAIMUS*

Taphozous troughtoni or Saccolaimus species

The calls of these species are dificult to differentiate, as there is significant overlap in their characteristic frequency range and pulse shapes. Typical characteristics, extracted from available reference calls, are compared in Table 2.

A single call of fair quality, recorded on 9/6 by SM2BAT_005106, could have been from any of these three species.

A comparison of major call parameter means (t-test) between the Mt Emerald call and reference calls of these three species suggest it is significantly different from *S. saccolaimus* but that most parameters are not significantly different from either of the other species. It should be noted, however, that the Mt Emerald call only provided 10 pulses for this comparison. The P values for these t-tests are shown in Table 3.

Further analysis by plotting values for major parameters against one-another suggest the call is most similar to reference calls from *T. troughtoni* , although the spread of points for *S. saccolaimus* reference calls (D. Milne, NT specimens) further reduces the reliability of this analysis. See Figures 1-4 for this comparison.

TABLE 2 Typical call characteristics of *Taphozous troughtoni* and two *Saccolaimus species*

Species	*Pulse shape*	*Characteristic freq.*	*Maximum frequency*	*Pulse duration*
T. troughtoni	mostly curved; short initial sweep	21-23 kHz	24 kHz	3-10 ms
S. flaviventris	flat to curved; often steep initial sweep	18-21 kHz	28 kHz	5-15 ms
S. saccolaimus	flat to curved; no apparent steep initial sweep	20-23 kHz	27 kHz	10-25 ms

OTHER SPECIES IDENTIFIED IN THIS DATA SET

Austronomus australis

Calls are distinctive - lower frequency than most other species. Minor frequency overlap with *C. jobensis* (at ca. 14-17kHz), but calls from *A. australis* in overlap zone are 'approach-phase' with steep erratic pulses, *cf.* flat 'search phase' pulses from *C. jobensis* .

Chalinolobus nigrogriseus or Scotorepens sanborni

These two species produce very similar calls, with characteristic frequency around 36-40kHz, that are difficult to differentiate. Both species are likely to be present in the study area, so all relevant calls were considered to potentially represent either.

Chaerephon jobensis

Search phase calls have mainly flat pulses around 14-17kHz and are generally easy to identify. 'Approach phase' calls have steeper pulses that overlap in frequency with those of *Saccolaimus flaviventris* (around 17-21kHz), but which have erratic changes in pulse shape and frequency within the call sequence (*cf.* uniform pulses in *S. flaviventris*). All calls in the relevant frequency range were attributable to *C. jobensis* with no evidence of typical *S. flaviventris* calls.

Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011

Miniopterus australis
Highly distinctive calls with characteristic frequency 56-60kHz - not possible to confuse with any other species that would occur in the study area.

Miniopterus orianae oceanensis
Distinctive calls around 44-48kHz, which are not likely to be confused with any other species that would be present in the study area.

Mormopterus ridei
Calls are fairly distinctive, with flat pulses and frequency range around 30-35kHz. Frequency overlaps with several other species that may be present (e.g. *Scoteanax rueppellii* , *Scotorepens orion*), but those species almost always have steep, curved pulses, rather than the flat pulses typical of *Mormopterus* species.

Rhinolophus megaphyllus
Cannot confuse this species with any other that would be present in the study area. It produces long-duration, constant-frequency pulses around 65-70kHz.

Unidentified bat calls
These were calls that contained only one or two pulses, usually of indeterminate shape, or incompletely recorded, or confused amongst background noise. All such calls were within frequency ranges of species listed above and are unlikely to indicate additional species present in the survey area.

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Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales* . Department of Natural Resources and Mines, Brisbane.

van Dyck, S. and Strahan, R. (ed.) (2008). *The Mammals of Australia* (Third Edition); New Holland; Sydney.

Anabat Data Analysis Summary

Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011

Table 3 Results of t-tests for Mt Emerald suspect *Saccolaimus saccolaimus* call against reference calls for similar species.

	P values for call parameters										
	Dur	**TBP**	**Fmax**	**Fmin**	**Fmean**	**Tk**	**Fk**	**Tc**	**Fc**	**S1**	**Sc**
Mt Emerald & *S. saccolaimus* (NT)	0.1717	0.0000	0.0000	0.2127	0.1056	0.0099	0.1693	0.4254	0.5472	0.4233	0.0003
Mt Emerald & *T. troughtoni* (NW Qld)	0.0000	0.0000	0.0000	0.6402	0.0031	0.0576	0.0000	0.0000	0.1483	0.0000	0.0000
Mt Emerald & *S. flaviventris* (SEQld)	0.2233	0.0000	0.0000	0.0004	0.5600	0.0000	0.2290	0.1579	0.0006	0.0000	0.0000

Call parameter glossary:

Dur Pulse duration

Prev Time between pulses

Fmax Maximum frequency of pulses

Fmin Minimum frequency of pulses

Fmean Mean frequency of pulses

Tk Time to knee (from start of pulse to first significant change in slope)

Fk Frequency of knee (frequency at which pulse slope changes)

Tc Time from start of pulse to beginning of characteristic section ('body')

Fc Characteristic frequency (lowest frequency in the characteristic section)

S1 Slope of initial frequency sweep (before knee)

Sc Slope of characteristic frequency section

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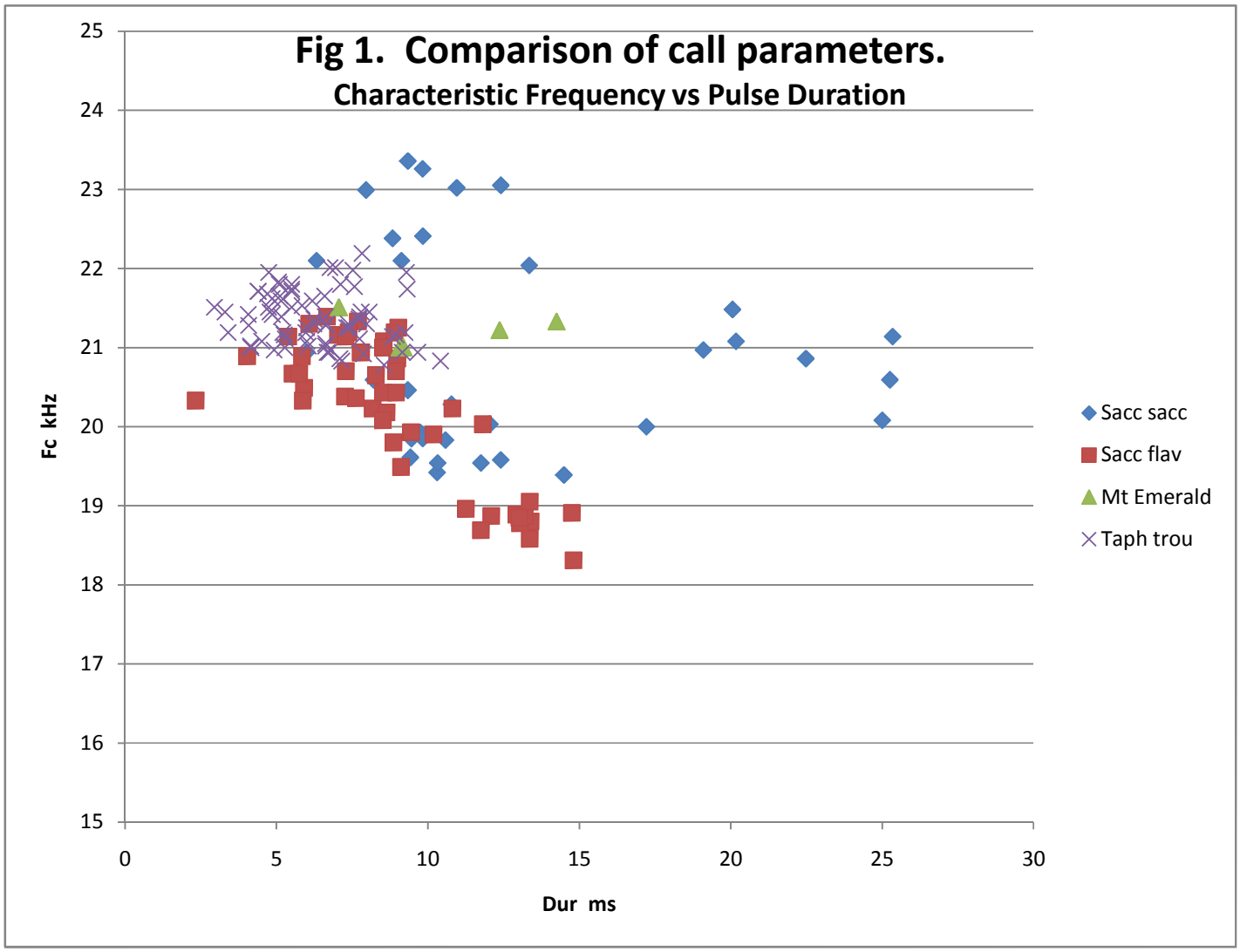
Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011



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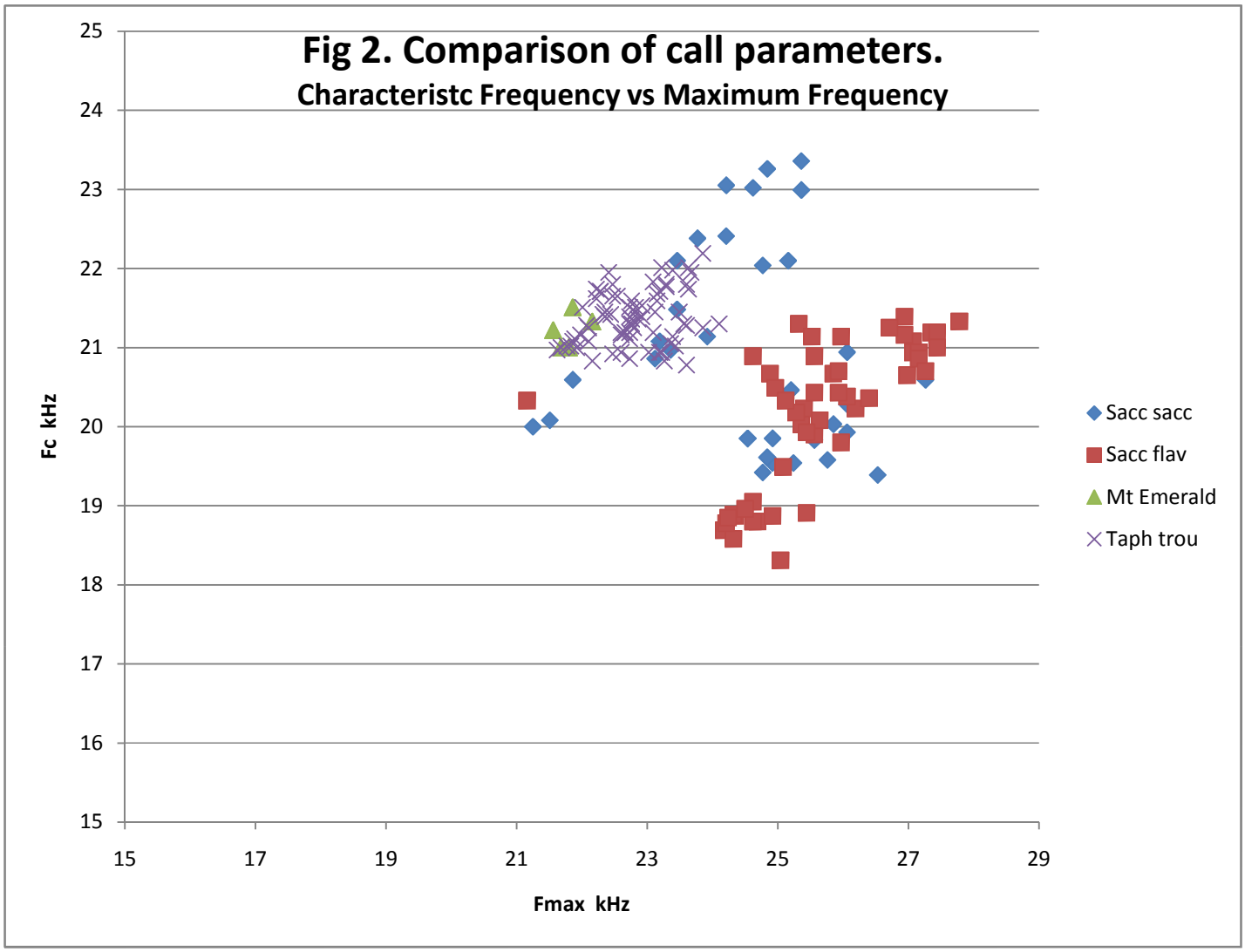
Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011



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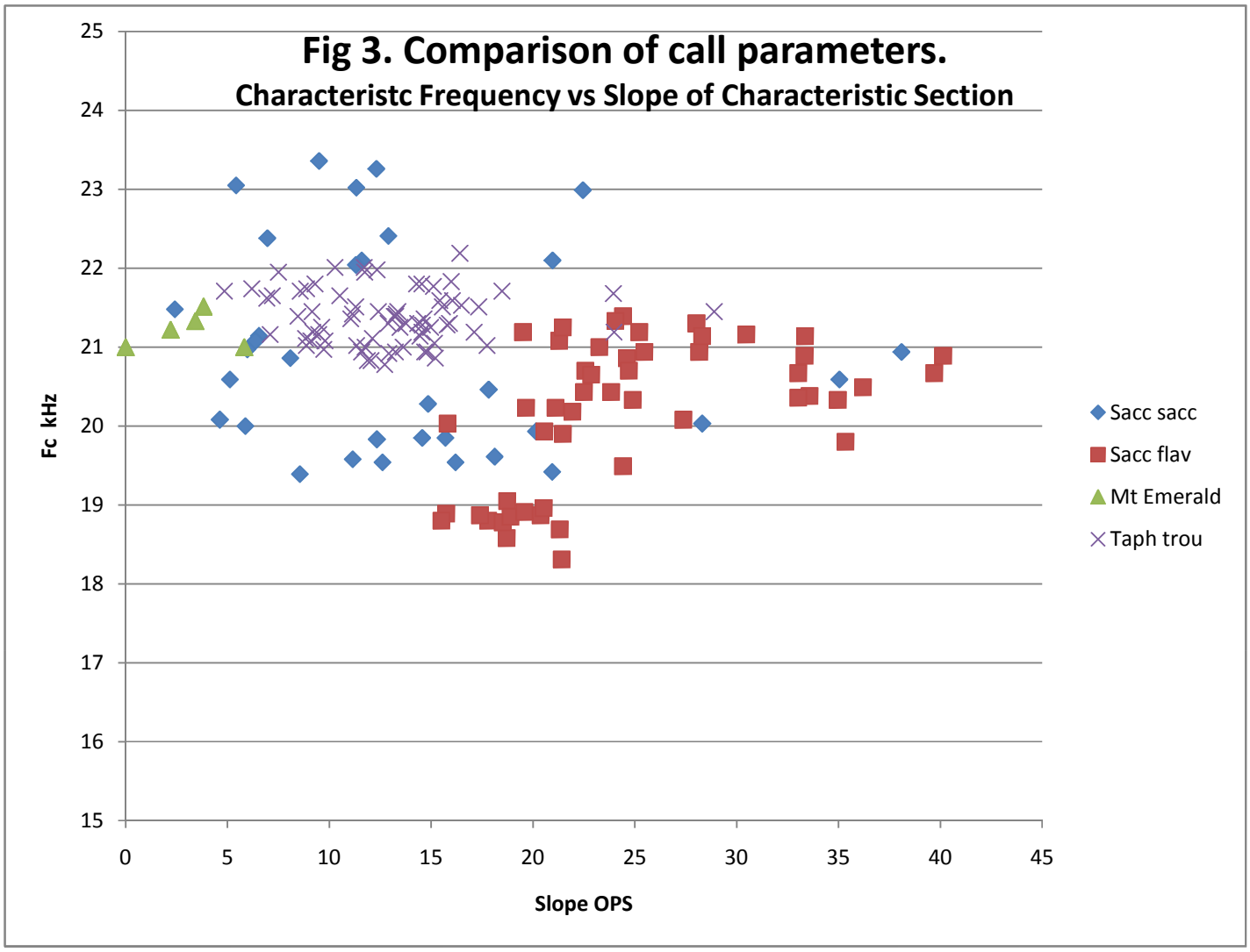
Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011



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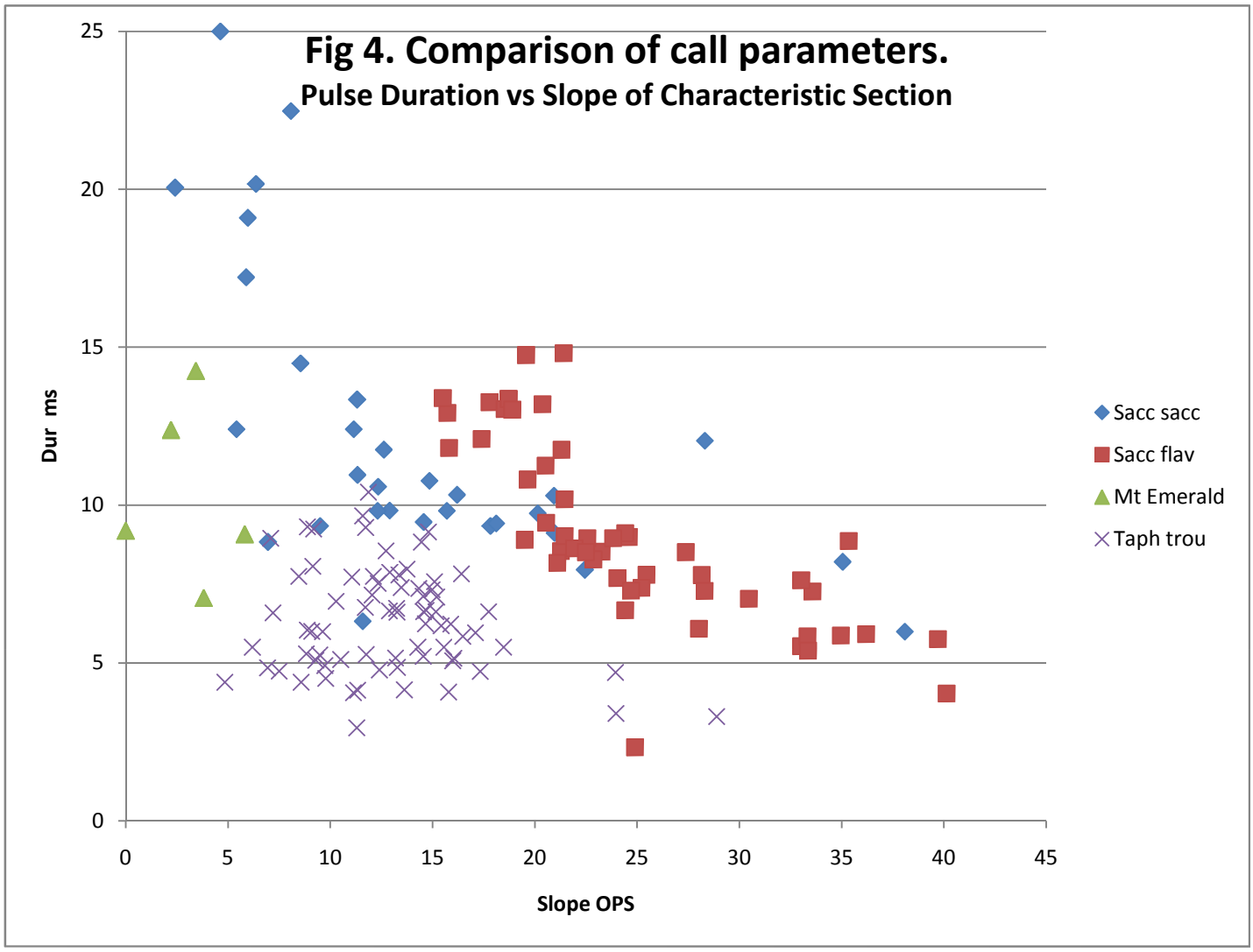
Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011



Prepared by Greg Ford

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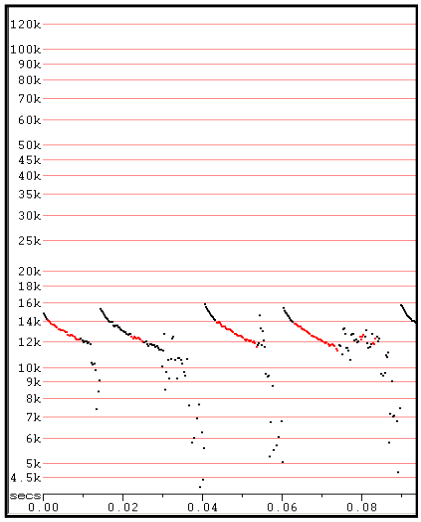
Anabat Data Analysis Summary

Client: RPS Cairns **Contact**: Jeff Middleton **Job no.:** RPS-1106

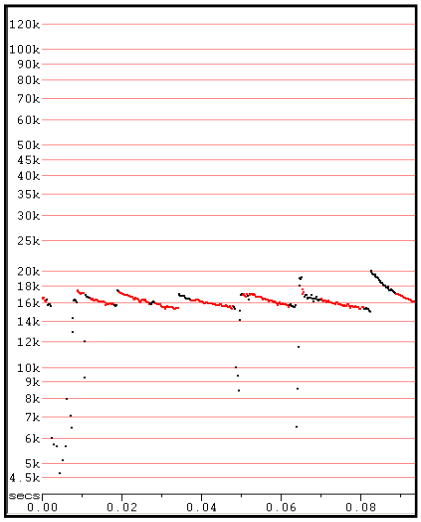
Survey Location & Period: Mt Emerald SM2BAT monitoring, June 2011

Sample calls extracted from the survey data

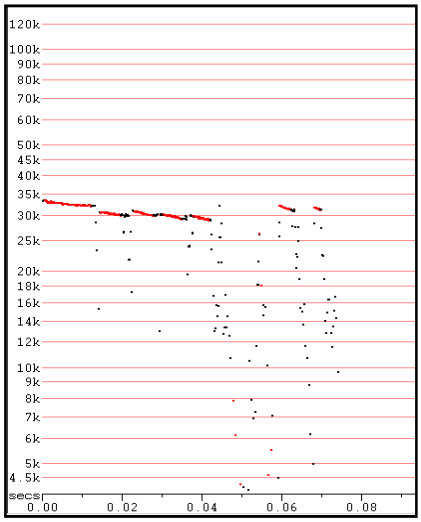
Scale: 10 msec per tick; time between pulses removed (AnalookW F7 compressed mode)



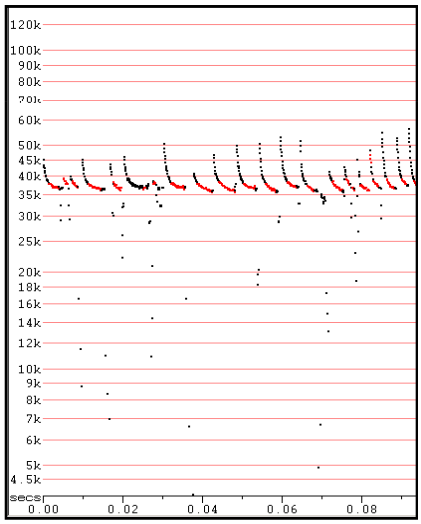
Austronomus australis



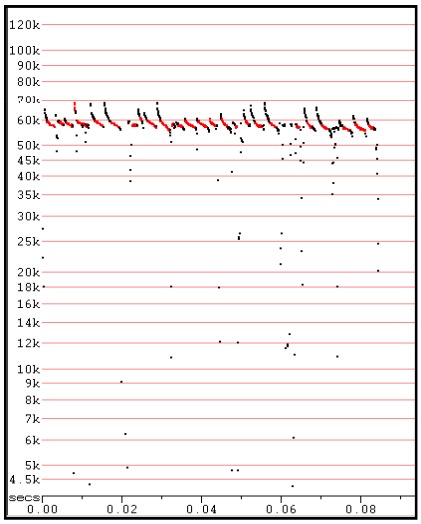
Chaerephon jobensis



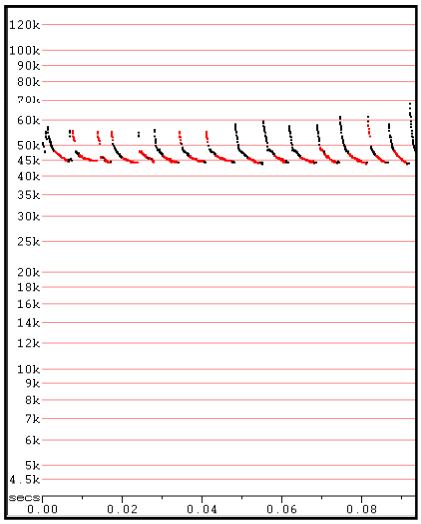
Mormopterus ridei



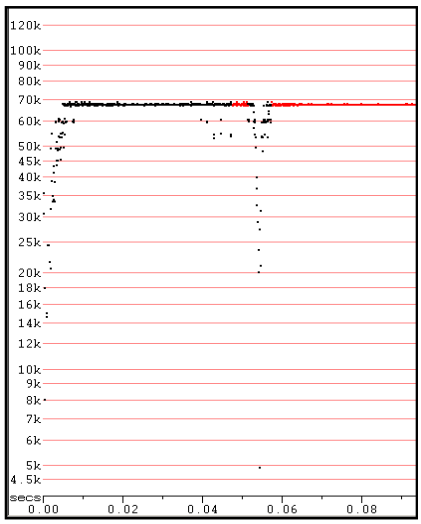
C. nigrogriseus or *S. sanborni*



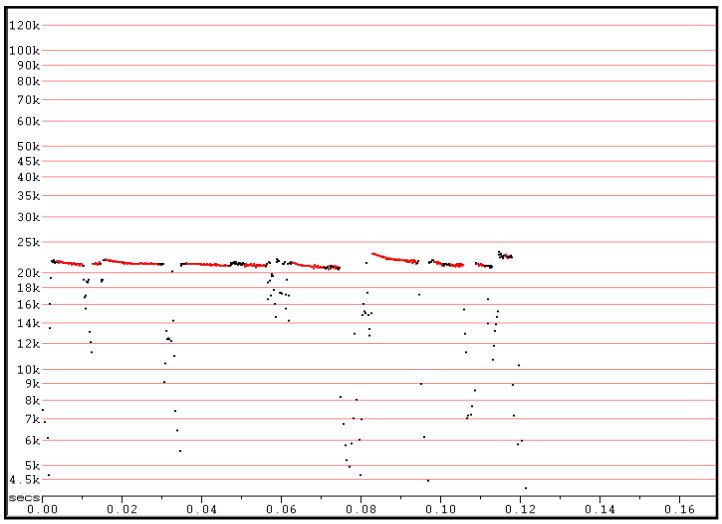
Miniopterus australis



Miniopterus orianae oceanensis



Rhinolophus megaphyllus



Taphozous troughtoni or *Saccolaimus* sp

Microbat Echolocation Call Analysis
Mt Emerald Wind Farm Supplementary - RPS Cairns

Call Parameter	Mean Values Sacsac Cairns reference calls	Mean Values MtEmerald call	P value for t test (2 tails, equal variance)
Dur	12.44252685	10.388	0.05448089
TBP	498.3324268	1479.938	0.00008132
Fmax	24.83718771	21.812	0.00000000
Fmin	22.19417687	21.054	0.15404314
Fmean	23.7098445	21.396	0.00000000
Tk	1.291834129	1.226	0.84852076
Fk	24.33355499	21.628	0.00000000
Tc	11.33818944	9.934	0.16408922
Fc	23.22302431	21.212	0.00000000
S1	38.04766689	-58.528	0.00012234
Sc	7.286603374	3.056	0.00000044
n calls	25	1	
n pulses	297	10	

Fig 1. Comparison of call parameters.

Characteristic Frequency vs Pulse Duration

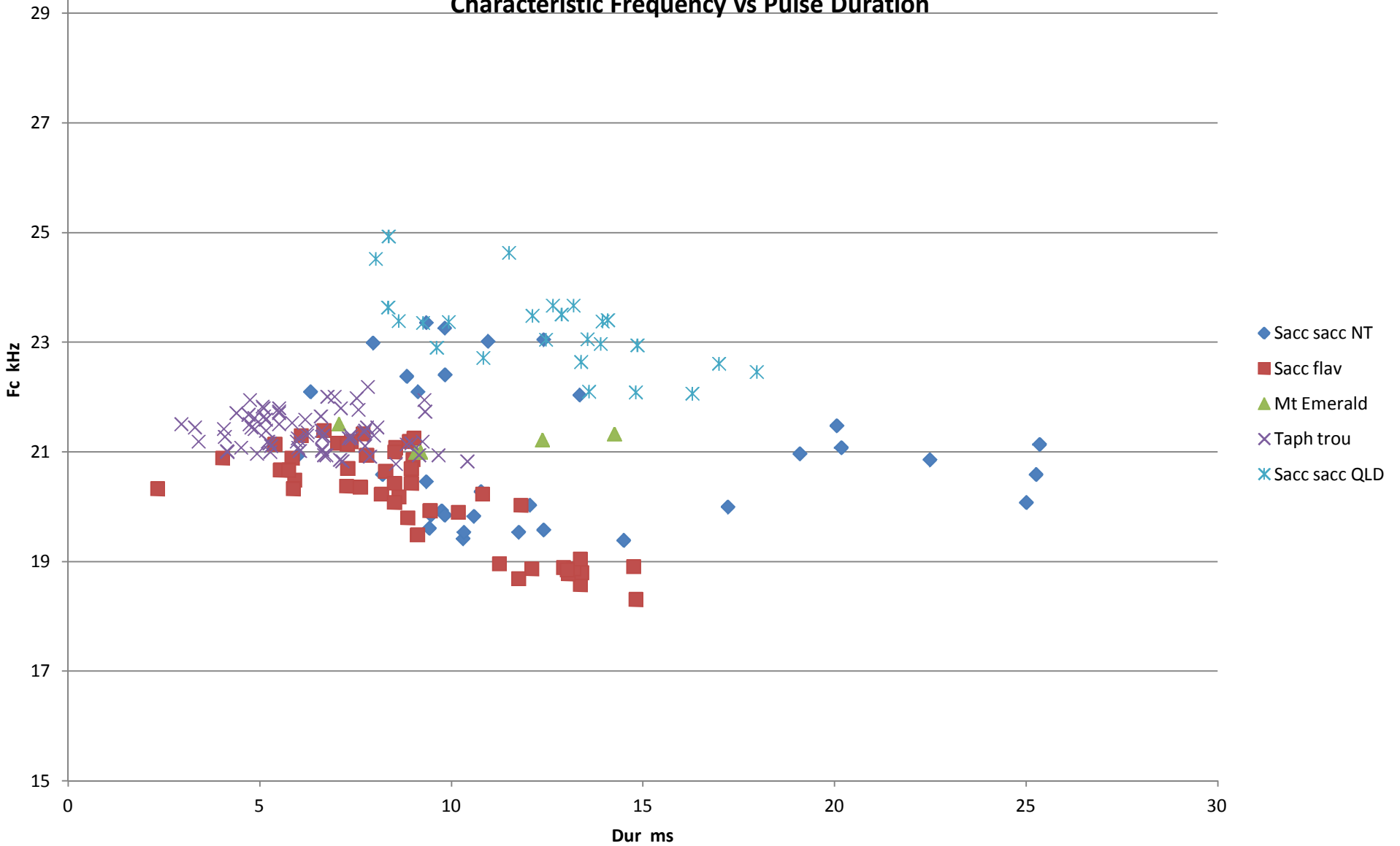


Fig 2. Comparison of call parameters.

Characteristc Frequency vs Maximum Frequency

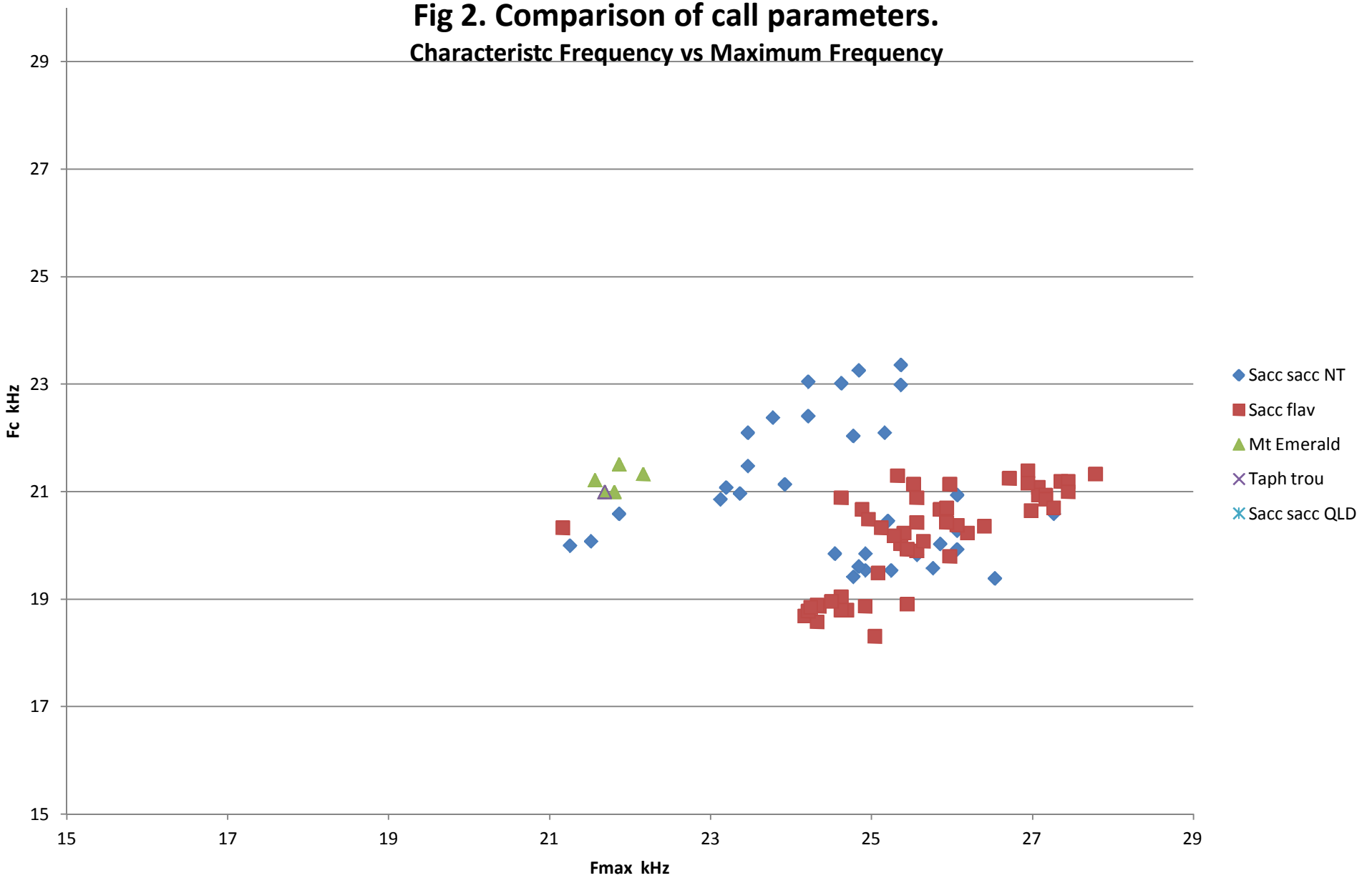
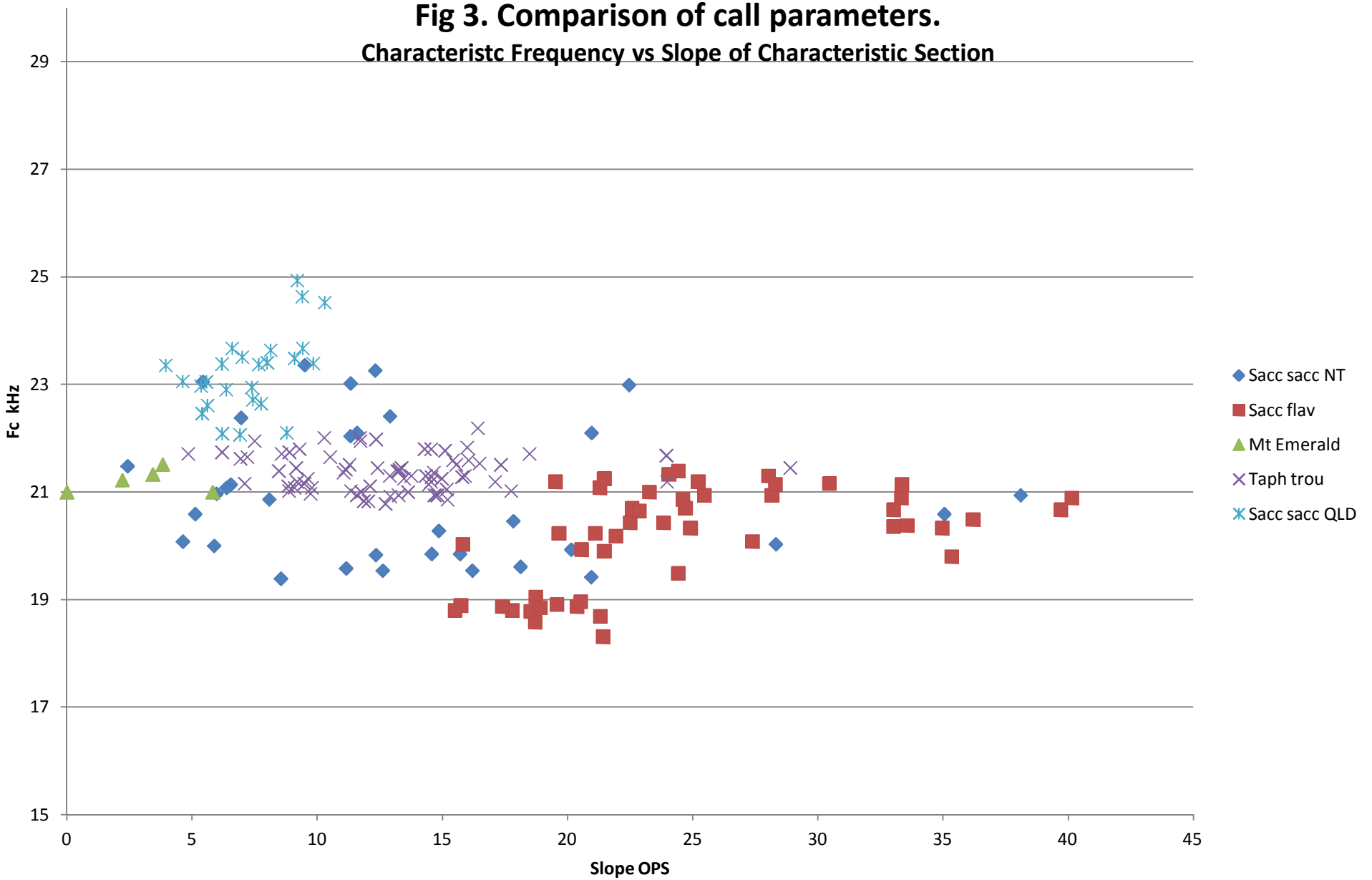


Fig 3. Comparison of call parameters.

Characteristc Frequency vs Slope of Characteristic Section



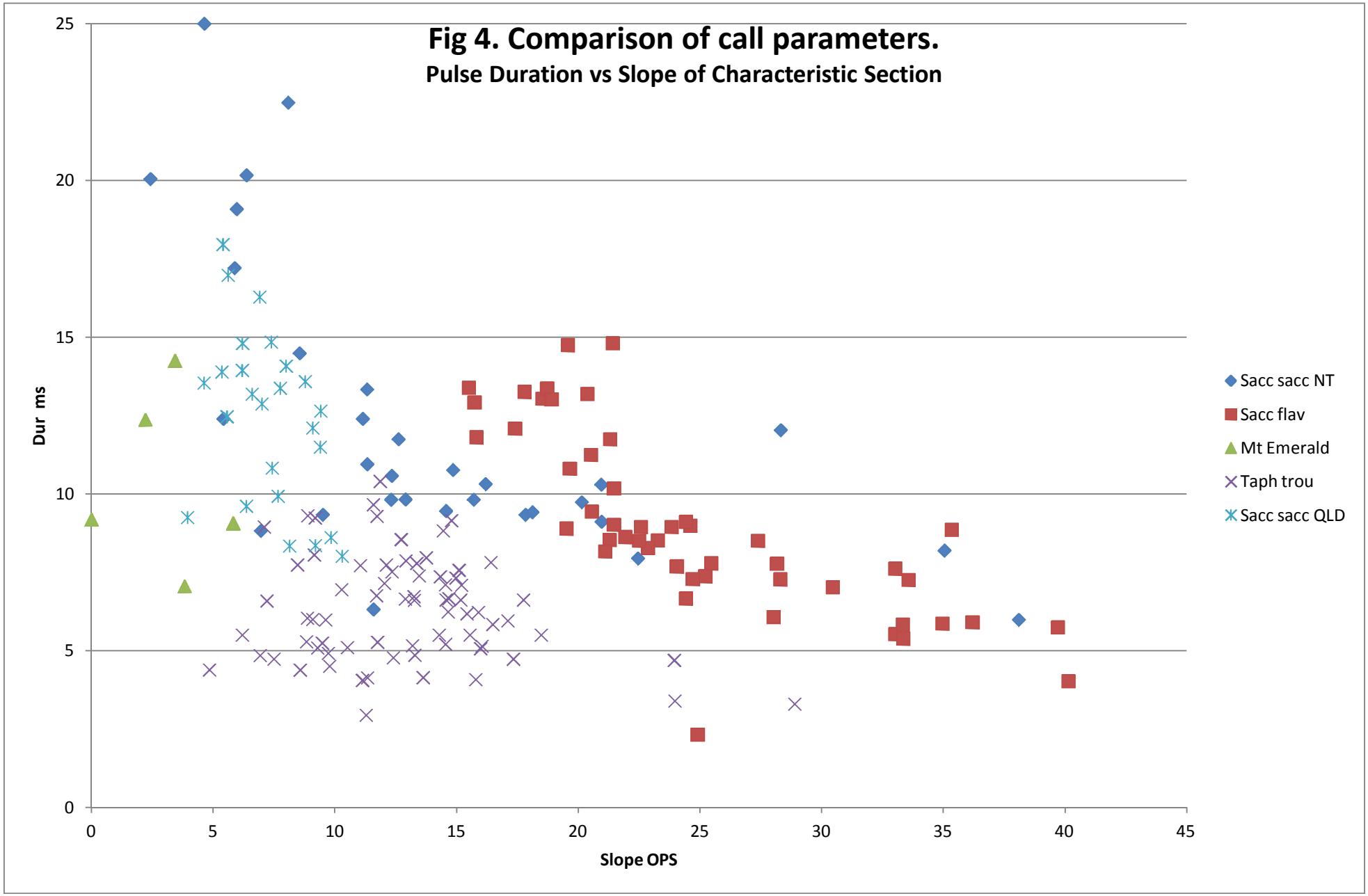


Fig 4. Comparison of call parameters.
Pulse Duration vs Slope of Characteristic Section
Dur ms
Slope OPS
0
5
10
15
20
25
30
35
40
45
Sacc sacc NT
Sacc flav
Mt Emerald
Taph trou
Sacc sacc QLD

Microbat Call Identification Report

Prepared for ("Client"):	RPS (Cairns)
Survey location/project name:	Mt Emerald Wind Farm
Survey dates:	
Client project reference:	PR100246-1
Job no.:	RPS-1303
Report date:	21 May 2013

Methods

Data receipt and processing

Bat calls were recorded using Song Meter detectors (Wildlife Acoustics, Concord MA, USA) and the full-spectrum data files were sent to *Balance! Environmental* for processing and analysis.

All full-spectrum data files were processed with Wildlife Acoustics' *Kaleidoscope* program (version 1.0.0) to produce Anabat sequence files (zero-crossing, or ZC, format) for the primary analysis and call identification. Where necessary, relevant data files were also converted to WAV files for secondary analysis of calls in full-spectrum format.

Dates attached to the data show the surveys were conducted from 20th to 28th February 2013.

Zero-crossing analysis

All Anabat sequence files were viewed using *AnalookW* (version 3.9f; Corben 2013), and species identification attempted on all calls that contained four or more distinct, non-fragmented pulses.

Species identification was achieved manually by comparing calls with published call descriptions (e.g. Reinhold *et al.* 2001; Milne 2002; Pennay *et al*. 2004) and/or with reference calls from Queensland and the Northern Territory.

Specialised *AnalookW* filters were also used to identify files potentially containing calls from the threatened bare-rumped sheath-tailed bat (*Saccolaimus saccolaimus*). These filters were based on call characteristics derived from *S. saccolaimus* reference calls recorded from Cairns in 2012.

Species' identities were also guided by considering their probability of occurrence based on general distribution information (e.g. Churchill 2008; van Dyck & Strahan 2008) and/or database records obtained from the Atlas of Living Australia (http://www.ala.org.au), Wildlife Online (http://www.ehp.qld.gov.au/wildlife/wildlife-online/index.html) and the Queensland Museum.

Full-spectrum analysis

All files identified as containing "possible" *S. saccolaimus* calls during the ZC analysis were subject to more detailed assessment using full-spectrum data (WAV files) in an effort to confirm the presence of *S. saccolaimus*. This species' calls appear very similar to those of several other bats in ZC data, but are somewhat more distinctive in full-spectrum format due to differences in harmonic range and pulse-repetition patterns.

The WAV files were analysed using *Song Scope* (version 4.1.1; Wildlife Acoustics) for both automated identification, using call recognisers built from reference calls collected in Cairns, and for manual identification (i.e. visual comparison of suspect sonograms with those of reference calls).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Armstrong & Reardon (2006).

Results & Discussion

Zero-crossing analysis

At least twelve microbat species were identified from the data set, with another two species potentially also present but not reliably identified due to inter-specific similarities in call characteristics.

Table 1 provides a breakdown of the species recorded by each of the eight detectors over the 8-night monitoring period. Where calls were recorded that may have been from more than one species, all potentially-responsible species are shown as "possibly present". Problems associated with call identification for these species, along with their likelihood of occurrence at the study site, are discussed in the next section.

Relative activity levels (numbers of calls attributed to each species) on each night of the monitoring period are presented for each detector in Appendix 1; and Appendix 2 shows example ZC sonograms extracted from this data set for each of the identified species.

Table 1. Microbats identified by zero-crossing analysis from the Mt Emerald Wind Farm February 2013 echolocation monitoring data.

Detector names relate to the primary folder names provided in the submitted data set.

♦ = species positively identified from call data

□ = species possibly present, but not reliably identified

Detector:	ARU + BAT7 010379	BAT1 010388	BAT2 010375	BAT3 010359	Bat4 010382	BAT5 010386	BAT6 010327	BAT7 010360
Species								
Chalinolobus gouldii	♦	♦	♦	♦	♦	♦	♦	
Chalinolobus nigrogriseus	♦	♦	♦	♦	♦	♦	♦	♦
Nyctophilus sp.							♦	
Scotorepens sanborni	♦	♦	♦	♦	♦	♦	♦	♦
Vespadelus troughtoni		♦	♦	♦	♦	♦		
Miniopterus australis	♦	♦	♦	♦	♦	♦	♦	
Miniopterus schreibersii	♦	♦	♦	♦	♦	♦	♦	♦
Tadarida australis	♦	♦	♦	♦	♦	♦	♦	♦
Chaerephon jobensis	♦	♦	♦	♦	♦	♦	♦	♦
Mormopterus beccarii	♦	♦	♦	♦	♦	♦	♦	♦
Mormopterus species 2	♦	♦	♦	♦	♦	♦	♦	♦
Saccolaimus flaviventris	♦				♦	♦	♦	
Saccolaimus saccolaimus	□	□	□		□	□	□	□
Taphozous georgianus	□	□	□	□	□	□		□

The majority of calls were reliably attributed to known species or pairs of indistinguishable species; however, a number of species were only identified tentatively due to incomplete knowledge of their call characteristics and/or because of the close similarities between some species' calls. Calls that could not be reliably identified due to these factors are attributed to a species group depending on pulse shape, band-width and characteristic frequency (Fc).

Species groupings used in this analysis for calls with low reliability of identification include:

- *Chalinolobus gouldii* / *Mormopterus* sp. 2;
- *Chalinolobus nigrogriseus* / *Scotorepens sanborni*;
- *Nyctophilus* spp.;
- *Chaerephon jobensis* / *Saccolaimus flaviventris*; and
- *Mormopterus beccarii* / *Saccolaimus saccolaimus* / *Taphozous australis*.

Where a species group is identified, all species within the group are listed as "possible" in the results; however, if a species within the group was also identified positively from other calls recorded in the same session, then it is listed as such. Identification issues and probability of occurrence for the various group members is discussed below.

C. gouldii / Mormopterus sp. 2

Characteristic frequency (Fc) overlaps (*C. gouldii* Fc=28-34 kHz; *M*. sp. 2 Fc=32-36 kHz), but calls are usually differentiated on the basis of steep, broad-band (*C. gouldii*) versus flat, narrow-band (*Mormopterus*) pulse shapes. However, some brief and/or low-quality calls had pulses of intermediate shape that could have belonged to either of these species.

Chalinolobus nigrogriseus / Scotorepens sanborni

Characteristic frequency (36-40 kHz) and pulse shapes are almost identical in these species and calls are difficult to discriminate. Some *C. nigrogriseus* calls have a flatter pulse body of relatively longer duration than those observed in *S. sanborni* and this feature was used to identify a number of calls to *C. nigrogriseus* for most sessions. Calls with uniformly short duration and curved to cup-shaped bodies were attributed to *S. sanborni*; however, many calls in the relevant frequency range had intermediate pulse characteristics and could have been from either species.

Nyctophilus species

These species' calls are readily distinguished from those of other bats; however, the species within the genus *Nyctophilus* cannot be reliably differentiated from each. Three *Nyctophilus* species potentially occur in the study area, including *N. geoffroyi*, *N. gouldi* and *N. bifax* and any or all of them could have been responsible for the recorded calls.

Chaerephon jobensis / Saccolaimus flaviventris

Frequencies overlap around 17-20 kHz, but *S. flaviventris* pulses are generally uniform and gently-curved, whereas those of *C. jobensis* are more erratic and range from flat to steeply curved within the

same sequence. Numerous calls were readily identifiable to each species, but for some sessions, only a few calls with intermediate features were recorded.

Mormopterus beccarii / Saccolaimus saccolaimus / Taphozous georgianus

M. beccarii was positively identified for most sessions from calls with distinctive curved pulses and Fc in the range 24-27 kHz. This frequency range, however, overlaps with that of both *S. saccolaimus* and *T. australis* and some calls had flatter pulses that could have been from one or other of these species.

A small number of calls from several sessions had relatively short-duration, flat pulses around 23-24 kHz and were thought to probably be from *T. georgianus*.

When viewed in zero-crossing format in *AnalookW*, many calls recorded by all detectors had characteristics similar to those of reference calls recorded from *S. saccolaimus* in Cairns. These calls had Fc=22-24 kHz with long-duration pulses that were flat to slightly curved. Such calls are thought to be highly likely from *S. saccolaimus*; however, *M. beccarii* sometimes also produces calls of this type, so the identity of these calls was not conclusive.

Full-spectrum analysis – was *Saccolaimus saccolaimus* present?

Detailed analyses of all calls in the 20-27 kHz frequency range were carried out in an attempt to confirm the presence of *S. saccolaimus*. Numerous files potentially containing *S. saccolaimus* calls were identified by applying *AnalookW* filters to the ZC files and *Song Scope* call recognisers to both ZC and WAV data sets (see Table 2). However, when the full-spectrum sonograms for these files were viewed in *Song Scope*, none contained the diagnostic features typified by the reference call set collected in Cairns.

The key diagnostic criteria used for *S. saccolaimus* calls (see example sonograms at Fig 1) include:

- dominant harmonic with characteristic frequency around 22-25 kHz;
- at least 3 and up to five distinct harmonics at approximately 13 kHz intervals (1 below and up to 3 above the dominant harmonic); and
- call pulses sometimes in “triplet” sets with pulse intervals of approximately 10-20ms between first and second pulses and 20-40ms between second and third pulses and an inter-triplet interval of about 80-100ms.

Table 2. Number of "possible" *Saccolaimus saccolaimus* calls recorded on each night by eight detectors at the Mt Emerald Wind Farm site during February 2013.

Detector names relate to the primary folder names provided in the submitted data set.

Detector	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
aru-bat7	2		1	22	1	1		1	
bat 1				6			1		3
bat 2		1	1	2				4	2
bat 3				51	1	1			2
bat 4	1			10		4	4	7	3
bat 5	7		2	17		1	1		10
bat 6	1	1			1	1			1
bat 7				3		1		2	1

All of the "possible" *S. saccolaimus* calls had either no evidence of additional harmonics or just a single harmonic at approximately 20 kHz above the dominant harmonic (which had Fc = 23-25 kHz). furthermore, there was no evidence of triplet pulse patterns, rather pulses were either uniformly spaced or erratic in nature. A typical example of these "possible" calls is shown in the sonogram at Figure 2.

The characteristics exhibited by the "possible" *S. saccolaimus* calls are all considered more typical of *Mormopterus beccarii*, for which numerous other calls were positively identified during the zero-crossing analysis.

It is concluded, therefore, that *S. saccolaimus* was probably not recorded on any detector during the February 2013 surveys at the Mt Emerald Wind Farm site.

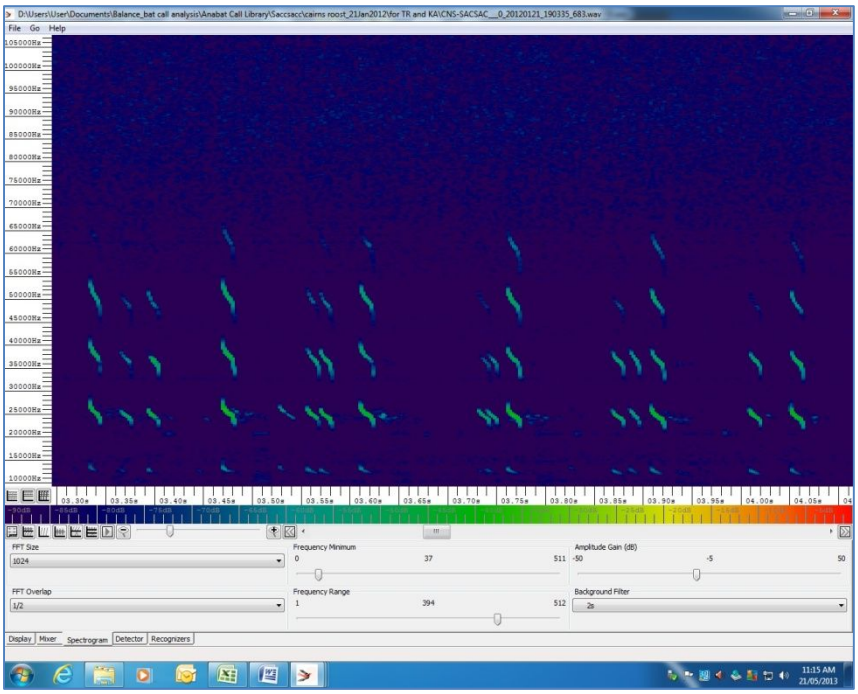


Figure 1. *Song Scope* sonogram of *Saccolaimus saccolaimus* reference call, showing multiple harmonics and pulse triplets described in text.

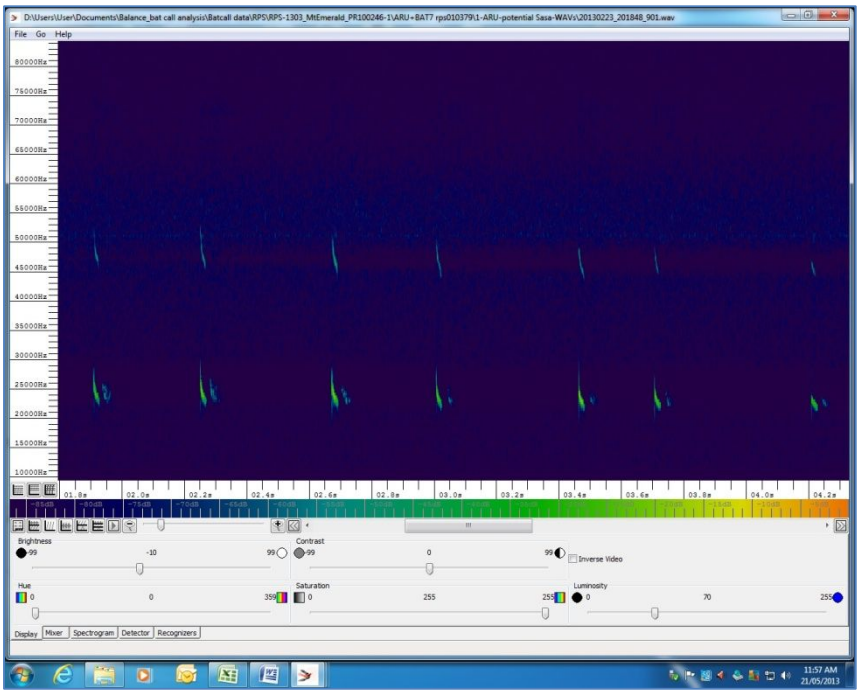


Figure 2. *Song Scope* sonogram of typical "possible" *S. saccolaimus* call from the Mt Emerald data set. Note only one additional harmonic and somewhat uniform repetition of single pulses. The call is probably from *Mormopterus beccarii*.

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Appendix 1. Relative activity levels of microbats (number of calls positively identified) at the Mt Emerald Wind Farm site during February 2013.

Detector:	ARU+BAT7 rps010379								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	25	16	45	72	23	29	51	41	0
No. calls identified:	23	11	34	61	21	26	49	37	0
SPECIES									
Chalinolobus gouldii	1		4	2			1		
Chalinolobus nigrogriseus	1	1	1	4		5	9	7	
Nyctophilus sp.									
Scotorepens sanborni	3	2	6	3	7	8	9	15	
Vespadelus troughtoni									
Miniopterus australis	7	4	6		2	1	17	3	
Miniopterus schreibersii	1	1	2	5	3		1		
Tadarida australis				1					
Chaerephon jobensis			2			1	3		
Mormopterus beccarii	2	1	1	10	1	1	1	1	
Mormopterus species 2	4		2			1	1	4	
Saccolaimus flaviventris	1								

Detector:	BAT1 rps010388								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	181	56	36	94	165	123	59	68	191
No. calls identified:	35	0	26	66	10	15	46	62	33
SPECIES									
Chalinolobus gouldii				4				1	
Chalinolobus nigrogriseus								7	
Nyctophilus sp.									
Scotorepens sanborni	6		4	1	1				
Vespadelus troughtoni				2			1	2	
Miniopterus australis	13		9	5	4	3	3	10	3
Miniopterus schreibersii	1		5	11	2	2	3	23	2
Tadarida australis	2			14		2	26	7	12
Chaerephon jobensis				7			1	3	5
Mormopterus beccarii				2					
Mormopterus species 2	9		2	8		8	4	3	7
Saccolaimus flaviventris									

Appendix 1. Relative activity levels of microbats (number of calls positively identified) at the Mt Emerald Wind Farm site during February 2013.

Detector:	BAT2 rps010375								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	23	589	11	35	24	14	71	94	65
No. calls identified:	13	24	8	15	7	8	65	88	43
SPECIES									
Chalinolobus gouldii	1		2	2	4		3	2	
Chalinolobus nigrogriseus		1	1	2	1	3		1	1
Nyctophilus sp.									
Scotorepens sanborni						1	19	3	8
Vespadelus troughtoni	5	18					17	5	
Miniopterus australis			1					2	
Miniopterus schreibersii			1	2	1	1	5	2	
Tadarida australis		1	2	1	1	1	3	59	23
Chaerephon jobensis	3		1	1		1	5	6	2
Mormopterus beccarii		1						4	1
Mormopterus species 2				2				1	3
Saccolaimus flaviventris									

Detector:	BAT3 rps010359								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	130	64	153	935	108	104	107	86	173
No. calls identified:	123	54	145	608	95	89	84	79	152
SPECIES									
Chalinolobus gouldii	24	1	10	22	10	1	2		11
Chalinolobus nigrogriseus	5		12	8	1		1		
Nyctophilus sp.									
Scotorepens sanborni	9	7	14	12	15	8	1	13	6
Vespadelus troughtoni	1						6		
Miniopterus australis	26	3	2	11	5	4	5	6	2
Miniopterus schreibersii	3	7	35	34	3	1	3		4
Tadarida australis			2	79	12	8	31	7	74
Chaerephon jobensis			1			4		4	5
Mormopterus beccarii				167	1	2		6	1
Mormopterus species 2	34	5	5	120	12	25	11	17	20
Saccolaimus flaviventris									

Appendix 1. Relative activity levels of microbats (number of calls positively identified) at the Mt Emerald Wind Farm site during February 2013.

Detector:	Bat4 rps010382								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	107	153	77	193	67	88	188	68	83
No. calls identified:	91	144	76	190	35	81	183	56	75
SPECIES									
Chalinolobus gouldii	4			8	1	13	1	3	
Chalinolobus nigrogriseus				7	2	4	12	4	1
Nyctophilus sp.									
Scotorepens sanborni	65	124	62	79	16	29	19	5	6
Vespadelus troughtoni				2			1		1
Miniopterus australis	3	3	4	3		3	10	2	3
Miniopterus schreibersii	2		1	17	4	3	7	5	2
Tadarida australis	1					2	5		5
Chaerephon jobensis				4		1	12	1	3
Mormopterus beccarii		2		2		3	4	1	1
Mormopterus species 2	2	2	1	2		6	6	12	9
Saccolaimus flaviventris							1	1	

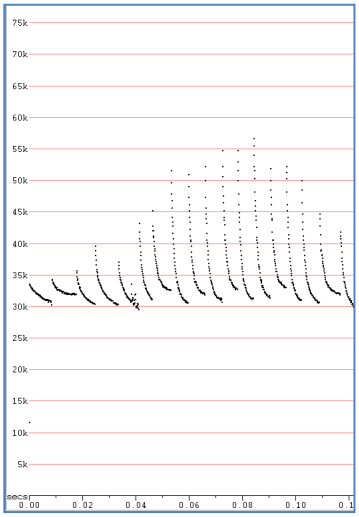
Detector:	BAT5 rps010386								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	444	225	417	152	199	180	151	66	115
No. calls identified:	408	1	370	140	92	172	145	58	74
SPECIES									
Chalinolobus gouldii	44		24	16	6	33	2	11	4
Chalinolobus nigrogriseus	3		1	1		1	1	1	
Nyctophilus sp.									
Scotorepens sanborni	54		37	26	10	4	7	1	6
Vespadelus troughtoni			1				2	1	
Miniopterus australis	16		4	4	3	5	5	4	3
Miniopterus schreibersii	3		1	1	1	2	1	1	
Tadarida australis			3		1		1		11
Chaerephon jobensis						2	12		2
Mormopterus beccarii	3		3	21		3	1	2	7
Mormopterus species 2	5		21	10	6	12	21	4	13
Saccolaimus flaviventris								2	

Appendix 1. Relative activity levels of microbats (number of calls positively identified) at the Mt Emerald Wind Farm site during February 2013.

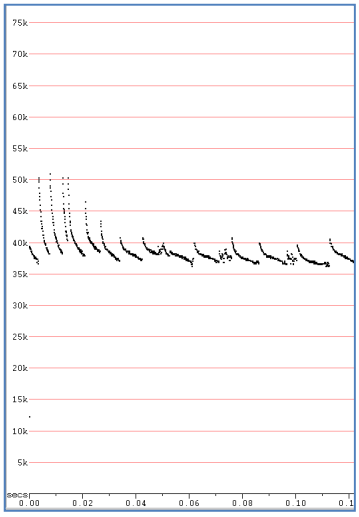
Detector:	BAT6 rps010327								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	67	97	51	38	43	37	61	33	66
No. calls identified:	61	85	44	39	35	37	58	32	59
SPECIES									
Chalinolobus gouldii	6	2	1	2	7	2	1		1
Chalinolobus nigrogriseus		1	1		1	1	1		
Nyctophilus sp.				1					
Scotorepens sanborni	11	25	2	5	10	1	14	15	12
Vespadelus troughtoni									
Miniopterus australis	3	3	2	2		1	2		4
Miniopterus schreibersii	3	6		14			1	1	5
Tadarida australis				2		1	10		5
Chaerephon jobensis	1	1	1	4		2	5		1
Mormopterus beccarii	4	4			1	12	4		
Mormopterus species 2					2			1	1
Saccolaimus flaviventris							2		1

Detector:	BAT7 rps010360								
Date:	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
Total sequence files:	3	2	2	11	5	9	4	6	13
No. calls identified:	3	0	2	9	5	8	4	6	14
SPECIES									
Chalinolobus gouldii									
Chalinolobus nigrogriseus									
Nyctophilus sp.									
Scotorepens sanborni				1				2	
Vespadelus troughtoni									
Miniopterus australis									
Miniopterus schreibersii					1	1			1
Tadarida australis				1			2	2	11
Chaerephon jobensis			1			1	1		
Mormopterus beccarii				3		1		2	
Mormopterus species 2					2	3			
Saccolaimus flaviventris									

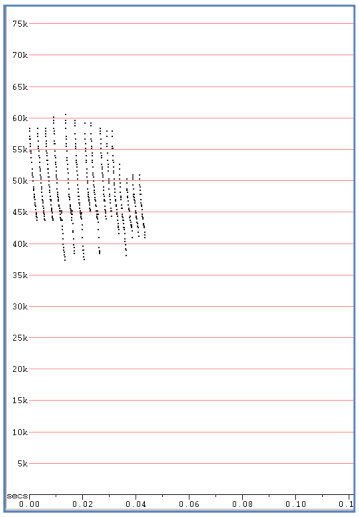
Appendix 2. Representative Anabat call sequences recorded at Mt Emerald, February 2013.
(10msec per tick; time between pulses removed)



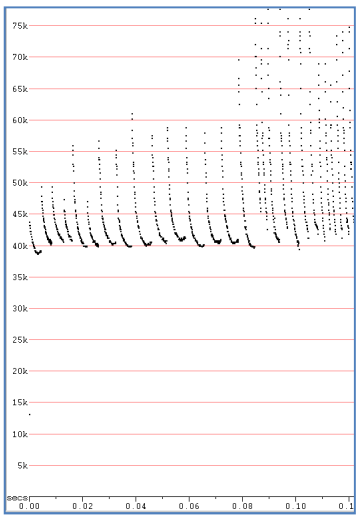
Chalinolobus gouldii



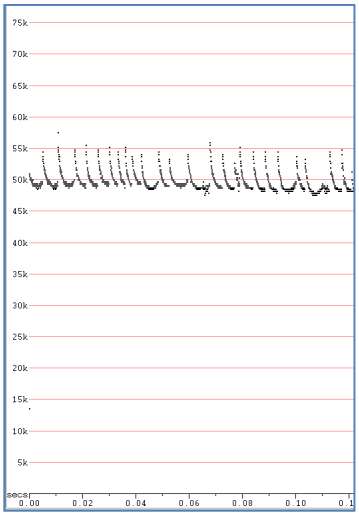
Chalinolobus nigrogriseus



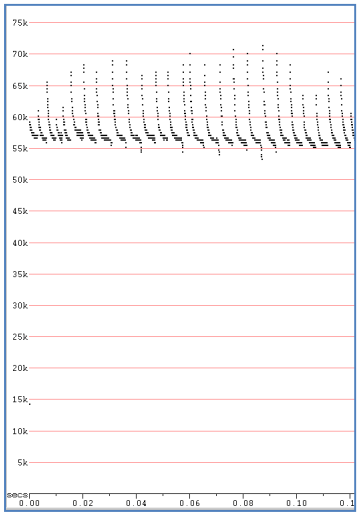
Nyctophilus species



Scotorepens sanborni

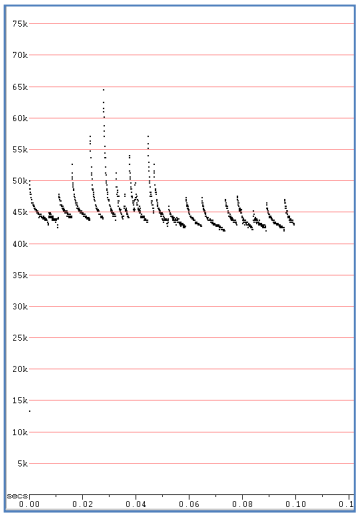


Vespadelus troughtoni

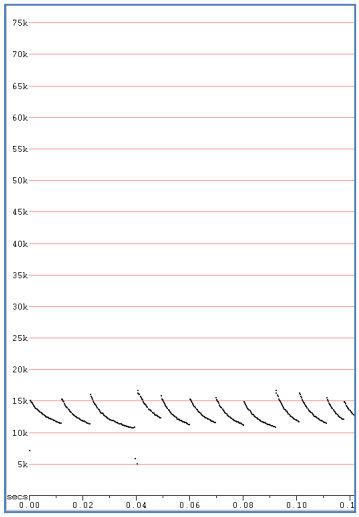


Miniopterus australis

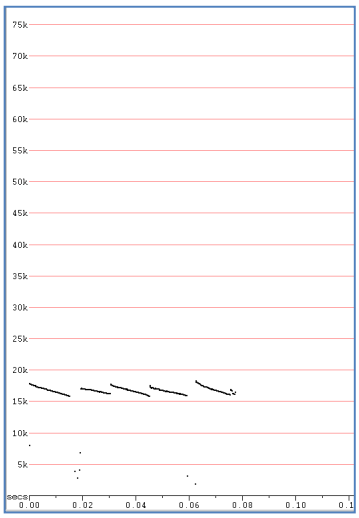
Appendix 2. Representative Anabat call sequences recorded at Mt Emerald, February 2013.
(10msec per tick; time between pulses removed)



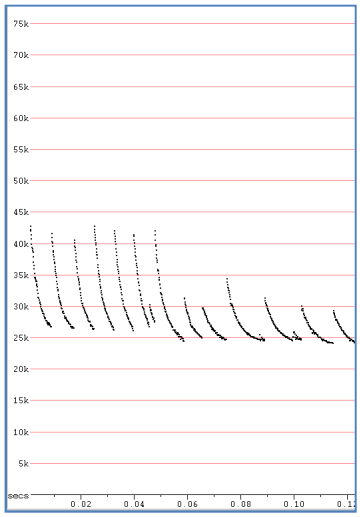
Miniopterus schreibersii



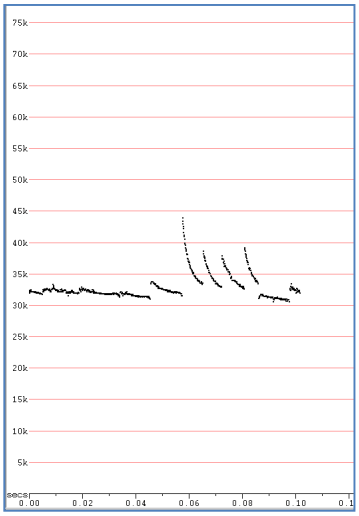
Tadarida australis



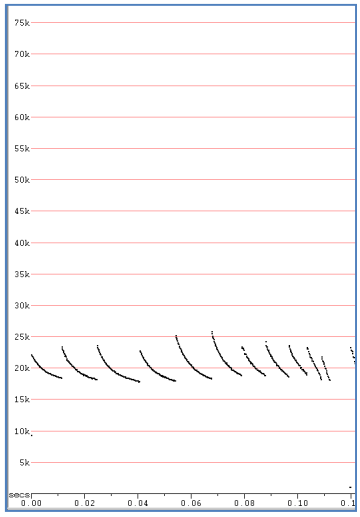
Chaerephon jobensis



Mormopterus beccarii

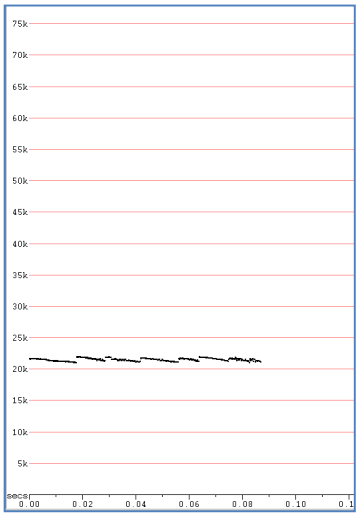


Mormopterus sp. 2

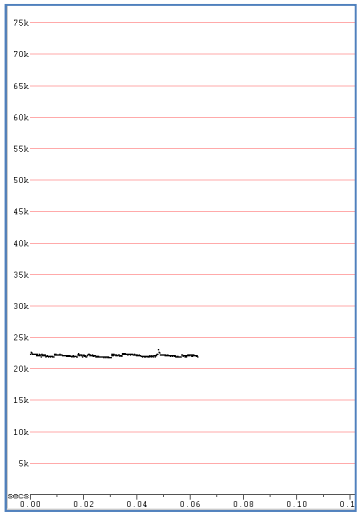


Saccolaimus flaviventris

Appendix 2. Representative Anabat call sequences recorded at Mt Emerald, February 2013.
(10msec per tick; time between pulses removed)



Possibly *Saccolaimus saccolaimus*



Possibly *Taphozous georgianus*

MEWF Data Summaries

Detector	ARU 12 + BAT 010342																																										
Date	17/12/2012	30/12/2012	31/12/2012	1/01/2013	2/01/2013	8/02/2013	9/02/2013	10/02/2013	11/02/2013	12/02/2013	13/02/2013	14/02/2013	15/02/2013	16/02/2013	17/02/2013	18/02/2013	19/02/2013	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013	24/04/2013	25/04/2013	26/04/2013	27/04/2013	28/04/2013	29/04/2013	22/05/2013	23/05/2013	24/05/2013	26/05/2013	ARU 12 Total
Total calls identified	1	3	6	18	22	2	7	7	5	3	6	6	3	38	22	33	18	38	34	53	34	41	28	34	32	11	24	30	2	31	13	11	1	617
POSITIVELY IDENTIFIED CALLS																																		
Rhinolophus megaphyllus																					1	1	2	1										5
Chalinolobus gouldii							2																											2
Nyctophilus sp																					1		1											2
Vespadelus troughtoni																																		
Miniopterus australis			1		3	2		1		1		1	1	2	6	1	6	7	8	13	5	8	14	6	8	7					1	2	7		111
Miniopterus oceanensis					3	2	2	3	4	1	1	2	2		6	3	3		5	8	6	3	8	5	1	5	5	2	1	2	2	2	3	1	91
Austronomus australis												1		1	1		1		4	1	1	5	4		1				5		3	4			32
Chaerephon jobensis																														2	2			4
Mormopterus beccarii	1				3	5								2	6		1	1	1	11	2							2		3				38
Mormopterus ridei						4								17		1		1	4	17	1	1	1	2				1						50
Saccolaimus flaviventris																				3														3
***Saccolaimus saccolaimus* (high confidence)**																																		
***Saccolaimus saccolaimus* (low confidence)**																																		
CALLS NOT POSITIVELY IDENTIFIED																																		
Chalinolobus nigrogriseus or *Scotorepens sanborni*		2	5	3	6		1	1	1	2	2	2		5	4	13	8	19	6	2	12	10	10	21	19	6	20	18		4	3	1		206
V. troughtoni or *M. oceanensis*														1		1																		2
M. oceanensis or *Pipistrellus adamsi*																																		
C. jobensis or *M. beccarii*																																		
M. ridei or *C. gouldii*																					1		1							3				5
M. ridei or *C. nigrogriseus* or *S. sanborni*																																		
S. flaviventris or *C. jobensis*				1																1			2				2	3						9
S. flaviventris or *M. beccarii*				2	2							1			3					1										3				12
S. saccolaimus or *M. beccarii*			1	3	1			2	2						2	7	2		1	6		3			1					7				38
Taphozous troughtoni or *M. beccarii*															3	1														3				7

MEWF Data Summaries

Detector	ARU 6 + BAT 010379																																
Date	12/12/2012	13/12/2012	14/12/2012	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	20/12/2012	21/12/2012	22/12/2012	24/12/2012	25/12/2012	26/12/2012	27/12/2012	28/12/2012	29/12/2012	30/12/2012	31/12/2012	1/01/2013	2/01/2013	3/01/2013	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013	24/04/2013	25/04/2013	26/04/2013		
Total calls identified	3	1	1	5	9	13	7	10	3	1	4	5	8	13	20	8	2	4	12	4	8	1	38	42	56	35	48	32	28	12	2		
POSITIVELY IDENTIFIED CALLS																																	
Rhinolophus megaphyllus																								2		1		1					
Chalinolobus gouldii								1														1				1		1					
Nyctophilus sp																																	
Vespadelus troughtoni																																	
Miniopterus australis	2			1	1	3	1		1		1			1						1	1		2	2	4	4	1	2	2	1			
Miniopterus oceanensis		1	1	2	7	2	2	3		1	1	3	3	1	2			1	1	2	1		5	8	1	1	8	5	11	7			
Austronomus australis								1										2					3		3		4	2		1	2		
Chaerephon jobensis																							5	9	6	7	6	6	10				
Mormopterus beccarii						3	1				1	2	1	8	10		1		2	1			2	3	6	2	6	3					
Mormopterus ridei															1								3	5	4	1	3	1	1				
Saccolaimus flaviventris																																	
***Saccolaimus saccolaimus* (high confidence)**																																	
***Saccolaimus saccolaimus* (low confidence)**										**1**													**4**	**3**	**1**								
CALLS NOT POSITIVELY IDENTIFIED																																	
Chalinolobus nigrogriseus or *Scotorepens sanborni*	1				1		1	1			1		1	2	1	6	1						5	6	21	13	4	6	4	3			
V. troughtoni or *M. oceanensis*																					2												
M. oceanensis or *Pipistrellus adamsi*																												1					
C. jobensis or *M. beccarii*																											5						
M. ridei or *C. gouldii*																												1					
M. ridei or *C. nigrogriseus* or *S. sanborni*																																	
S. flaviventris or *C. jobensis*							2	2	1						1				2				3										
S. flaviventris or *M. beccarii*				1		5		2					3		3	1		1	6		4			1		1							
S. saccolaimus or *M. beccarii*				1										1	2	1			1				9	6	10	4	11	3					
Taphozous troughtoni or *M. beccarii*									1														1		1								

Detector	ARU 6 + BAT 010379																																	ARU 6 Total
Date	27/04/2013	28/04/2013	29/04/2013	30/04/2013	1/05/2013	2/05/2013	3/05/2013	4/05/2013	5/05/2013	6/05/2013	7/05/2013	8/05/2013	9/05/2013	10/05/2013	12/05/2013	13/05/2013	14/05/2013	15/05/2013	16/05/2013	17/05/2013	18/05/2013	19/05/2013	20/05/2013	21/05/2013	22/05/2013	23/05/2013	24/05/2013	25/05/2013	26/05/2013	27/05/2013	28/05/2013		
Total calls identified	8	23	18	5	5	6	9	3	8	5	13	3	5	4	18	13	23	22	22	17	9	8	5	21	60	63	3	4	3	1	2	844	
POSITIVELY IDENTIFIED CALLS																																	
Rhinolophus megaphyllus		1																			1					1						7	
Chalinolobus gouldii							1		1					2		1	1		1							1						12	
Nyctophilus sp																																	
Vespadelus troughtoni																																	
Miniopterus australis	1							1									2			1	5			1	1	2					1	46	
Miniopterus oceanensis	2	4	13	3	2	2	4	2	4	1	11	3	1	2	12	8	8	3	2	5		4	1	2		3		3	1		1	187	
Austronomus australis	3	17					2		2	1					3			1		6	1				3	13				1		71	
Chaerephon jobensis	1	1	4	2	3	2				2	1		2		2		1		2	1			1	4	9	25						112	
Mormopterus beccarii															1	2	1	2	3				1	2	4	1						69	
Mormopterus ridei																																19	
Saccolaimus flaviventris																									4	3						7	
***Saccolaimus saccolaimus* (high confidence)**																									**1**							**1**	
***Saccolaimus saccolaimus* (low confidence)**																	**1**							**1**								**11**	
CALLS NOT POSITIVELY IDENTIFIED																																	
Chalinolobus nigrogriseus or *Scotorepens sanborni*	1		1			1	2			1	1					1	4	7	9	4	2	4	1	3	21	8	2	1				152	
V. troughtoni or *M. oceanensis*																																2	
M. oceanensis or *Pipistrellus adamsi*									1																							2	
C. jobensis or *M. beccarii*																																5	
M. ridei or *C. gouldii*													2						1							1			2			7	
M. ridei or *C. nigrogriseus* or *S. sanborni*																																	
S. flaviventris or *C. jobensis*																										2						13	
S. flaviventris or *M. beccarii*																									4	1						33	
S. saccolaimus or *M. beccarii*						1										1	5	7	3					5	12	2	1					86	
Taphozous troughtoni or *M. beccarii*																	1	2	1				1	4	2							14	

MEWF Data Summaries

Detector	BAT 1 010388																		BAT 1 Total
Date	11/12/2012	13/12/2012	14/12/2012	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	17/04/2013	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013	26/04/2013	30/04/2013	3/05/2013	
Total calls identified	2	1	3	21	39	5	16	1	2	3	19	38	9	6	4	1	1	1	172
POSITIVELY IDENTIFIED CALLS																			
Rhinolophus megaphyllus																			
Chalinolobus gouldii																			
Nyctophilus sp					1														1
Vespadelus troughtoni				1															1
Miniopterus australis		1			3						1	2		2					9
Miniopterus oceanensis				1	3	1	1				3	18		1	1		1	1	31
Austronomus australis										2	4	4	1	2	2				15
Chaerephon jobensis									1	1	4	2							8
Mormopterus beccarii				3	6		2					3	2						16
Mormopterus ridei				5	9		4	1							1				20
Saccolaimus flaviventris			1																1
***Saccolaimus saccolaimus* (high confidence)**																			
***Saccolaimus saccolaimus* (low confidence)**																			
CALLS NOT POSITIVELY IDENTIFIED																			
Chalinolobus nigrogriseus or *Scotorepens sanborni*	1			2	4		5		1		6	1	3	1		1			25
V. troughtoni or *M. oceanensis*																			
M. oceanensis or *Pipistrellus adamsi*				1									1						2
C. jobensis or *M. beccarii*												1							1
M. ridei or *C. gouldii*																			
M. ridei or *C. nigrogriseus* or *S. sanborni*																			
S. flaviventris or *C. jobensis*			2	2			2												6
S. flaviventris or *M. beccarii*				1															1
S. saccolaimus or *M. beccarii*	1			5	13	3	2				1	4	2						31
Taphozous troughtoni or *M. beccarii*						1						3							4

MEWF Data Summaries

Detector	BAT 2 010375																									BAT 2 Total
Date	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	20/12/2012	21/12/2012	17/04/2013	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013	25/04/2013	13/05/2013	14/05/2013	15/05/2013	16/05/2013	17/05/2013	18/05/2013	19/05/2013	20/05/2013	21/05/2013	22/05/2013	
Total calls identified	3	8	44	61	4	7	6	13	27	25	65	10	25	27	2	4	43	5	7	1	5	1	1	2	31	427
POSITIVELY IDENTIFIED CALLS																										
Rhinolophus megaphyllus																										
Chalinolobus gouldii							4				2			1		2		1								10
Nyctophilus sp																										
Vespadelus troughtoni									1	1																2
Miniopterus australis			1							1	2															4
Miniopterus oceanensis	1							3			2		4	14						1						25
Austronomus australis								1		3	11	2	5	2					1		1			1	10	37
Chaerephon jobensis										6	5	1	8								1	1	1		1	24
Mormopterus beccarii	1	4	3	3		5		3	2	2	7	4					2									36
Mormopterus ridei		2	1						3		5		3				13									27
Saccolaimus flaviventris								2							1											3
***Saccolaimus saccolaimus* (high confidence)**																										
***Saccolaimus saccolaimus* (low confidence)**																										
CALLS NOT POSITIVELY IDENTIFIED																										
Chalinolobus nigrogriseus or *Scotorepens sanborni*								2	2	1	10	1	1	5			2	2			1			1	1	29
V. troughtoni or *M. oceanensis*										4	1			2		1					2					10
M. oceanensis or *Pipistrellus adamsi*										1																1
C. jobensis or *M. beccarii*																									1	1
M. ridei or *C. gouldii*					1			1						1			1									4
M. ridei or *C. nigrogriseus* or *S. sanborni*																										
S. flaviventris or *C. jobensis*	1	1	37	57	2	2																				100
S. flaviventris or *M. beccarii*							2		1	1	2		1		1											8
S. saccolaimus or *M. beccarii*		1	1	1	1			1	18	4	15	2	2	2		1	25	2	6						18	100
Taphozous troughtoni or *M. beccarii*			1							1	2		1													5

MEWF Data Summaries

Detector	BAT 3 010359																														BAT 3 Total
Date	11/12/2012	12/12/2012	14/12/2012	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	20/12/2012	21/12/2012	22/12/2012	23/12/2012	24/12/2012	25/12/2012	26/12/2012	27/12/2012	28/12/2012	30/12/2012	17/04/2013	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013	24/04/2013	25/04/2013	28/04/2013	2/05/2013	
Total calls identified	1	1	2	154	24	20	53	15	6	2	1	3	17	19	23	13	11	1	45	121	136	88	75	253	105	8	4	7	1	1209
POSITIVELY IDENTIFIED CALLS																														
Rhinolophus megaphyllus																														
Chalinolobus gouldii																						1	1	8	6					16
Nyctophilus sp																														
Vespadelus troughtoni																					1				3					4
Miniopterus australis			1	2		1	1		1			1	1		3		2		1			5	2	3						24
Miniopterus oceanensis			1	1	4	1	5	8		1		2	6	9	10	3			15	2	4	5	4	40	20	3	2	1		147
Austronomus australis	1						1	1	3				2	2	2				13	9	7	1	4	42	9	2		3		102
Chaerephon jobensis																			1	1	8	5	2	11	35					63
Mormopterus beccarii				11	4	3							3	1	6	1	2	1	1	12	28	2	6	17	6		1			105
Mormopterus ridei				6	12	6	5	3					2		1	4	3			39	15	14	5	28			1			144
Saccolaimus flaviventris																						7	14	1						22
***Saccolaimus saccolaimus* (high confidence)**																				**1**	**1**	**19**	**2**							**23**
***Saccolaimus saccolaimus* (low confidence)**																						**2**	**1**							**3**
CALLS NOT POSITIVELY IDENTIFIED																														
Chalinolobus nigrogriseus or *Scotorepens sanborni*		1		128		2	29		1					5		5	3		13	2	21	7	16	66	14	3				316
V. troughtoni or *M. oceanensis*							12																							12
M. oceanensis or *Pipistrellus adamsi*																				2										2
C. jobensis or *M. beccarii*																				3			1	4						8
M. ridei or *C. gouldii*																				3	4		1	10	8					26
M. ridei or *C. nigrogriseus* or *S. sanborni*																														
S. flaviventris or *C. jobensis*						3		1	1				3																	8
S. flaviventris or *M. beccarii*								2		1	1			2	1		1			1	1		3	1	4					18
S. saccolaimus or *M. beccarii*				6	4	3													1	45	43	39	16	21				3	1	182
Taphozous troughtoni or *M. beccarii*						1														2	4	2		1						10

MEWF Data Summaries

Detector	BAT 4 010382																														
Date	11/12/2012	13/12/2012	14/12/2012	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	20/12/2012	21/12/2012	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013	24/04/2013	25/04/2013	27/04/2013	28/04/2013	29/04/2013	30/04/2013	1/05/2013	2/05/2013	4/05/2013	5/05/2013	6/05/2013	7/05/2013	BAT 4 Total
Total calls identified	4	2	15	89	32	241	69	71	15	27	72	70	179	98	71	39	10	2	4	10	3	3	1	16	4	1	1	4	1153
POSITIVELY IDENTIFIED CALLS																													
Rhinolophus megaphyllus																													
Chalinolobus gouldii						1										3													4
Nyctophilus sp																													
Vespadelus troughtoni																													
Miniopterus australis	1		1	2				1			2	2	5		4	1	2							1	1				23
Miniopterus oceanensis			14	2	1					1	2	1		9	7	1	2	1	2	1	3			1		1	1	1	51
Austronomus australis						1		1			4		14	26	9	5						3						2	65
Chaerephon jobensis											9	2	9	4	7	11		1						2					45
Mormopterus beccarii					1	12	1				8	6	16	8	5	1							1						59
Mormopterus ridei						7					20	14	20	4	4	1													70
Saccolaimus flaviventris													13	2															15
***Saccolaimus saccolaimus* (high confidence)**																													
***Saccolaimus saccolaimus* (low confidence)**																													
CALLS NOT POSITIVELY IDENTIFIED																													
Chalinolobus nigrogriseus or *Scotorepens sanborni*	3	2		84	30	197	66	65	12	26	4	33	64	25	16	10	5		1	9				11	2				665
V. troughtoni or *M. oceanensis*												1							1										2
M. oceanensis or *Pipistrellus adamsi*																													
C. jobensis or *M. beccarii*												1	1			1	1												4
M. ridei or *C. gouldii*												2																	2
M. ridei or *C. nigrogriseus* or *S. sanborni*																													
S. flaviventris or *C. jobensis*				1			2	1	1																				5
S. flaviventris or *M. beccarii*								1	2		2	1	13	7	2	1									1				30
S. saccolaimus or *M. beccarii*						23		2			21	7	24	13	17	4								1				1	113
Taphozous troughtoni or *M. beccarii*																													

MEWF Data Summaries

Detector	BAT 5 010386																						BAT 5 Total
Date	11/12/2012	12/12/2012	13/12/2012	14/12/2012	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	20/12/2012	21/12/2012	22/12/2012	23/12/2012	24/12/2012	16/04/2013	17/04/2013	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013	
Total calls identified	64	9	2	23	276	549	137	365	183	170	19	4	60	32	221	66	54	202	113	129	121	21	2820
POSITIVELY IDENTIFIED CALLS																							
Rhinolophus megaphyllus																							
Chalinolobus gouldii	34			5	81	406	26	279	99	86	12	1	4	8		2	4	4	7		1		1059
Nyctophilus sp																							
Vespadelus troughtoni																				1			1
Miniopterus australis			1	2		1	4	3	4					1	1	3	1	4	3	5	2		35
Miniopterus oceanensis			1		20	7	6	5							6	4	1	1	4	1	12	3	71
Austronomus australis															12	2	2	2	3	2	14		37
Chaerephon jobensis																2	2	6	1	2	5	2	20
Mormopterus beccarii		1			7	6	78	4	8			1	2	1	9	7	4	3	4	3		5	143
Mormopterus ridei									1						4	14	8	20	17	3	3		70
Saccolaimus flaviventris																1			3	2			6
***Saccolaimus saccolaimus* (high confidence)**																							
***Saccolaimus saccolaimus* (low confidence)**																**1**							**1**
CALLS NOT POSITIVELY IDENTIFIED																							
Chalinolobus nigrogriseus or *Scotorepens sanborni*	30	7		16	160	124	21	69	68	83	6	2	52	22	163	9	12	74	22	101	76	8	1125
V. troughtoni or *M. oceanensis*																1							1
M. oceanensis or *Pipistrellus adamsi*															1								1
C. jobensis or *M. beccarii*																					1		1
M. ridei or *C. gouldii*						2		2		1	1				9	1	2	1	6		4		29
M. ridei or *C. nigrogriseus* or *S. sanborni*																		82	25	2	2	1	112
S. flaviventris or *C. jobensis*					1			1					2										4
S. flaviventris or *M. beccarii*		1			4										1	1	4	1	2	4			18
S. saccolaimus or *M. beccarii*					3	3	2	2	3						15	19	14	3	16	2		1	83
Taphozous troughtoni or *M. beccarii*																				1	1	1	3

MEWF Data Summaries

Detector	BAT 6 010327																			
Date	11/12/2012	12/12/2012	13/12/2012	14/12/2012	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	20/12/2012	21/12/2012	22/12/2012	23/12/2012	17/04/2013	18/04/2013	19/04/2013	20/04/2013	21/04/2013	22/04/2013	23/04/2013
Total calls identified	3	3	1	3	13	7	64	24	8	3	3	2	8	97	69	58	119	27	15	8
POSITIVELY IDENTIFIED CALLS																				
Rhinolophus megaphyllus																				
Chalinolobus gouldii					1	2					2		4							
Nyctophilus sp																				
Vespadelus troughtoni															1					
Miniopterus australis	2			2			1			1	1	1	1			1		1	2	1
Miniopterus oceanensis		2		1		2	3			1				1	3	2	5			
Austronomus australis							1			1				20	27	4	4	4	2	3
Chaerephon jobensis														1	1	4	2	1	2	
Mormopterus beccarii	1		1		2	2	5	3	4					7	11	2	3	1	5	1
Mormopterus ridei													1	28	5	13	2		1	
Saccolaimus flaviventris																	4			
***Saccolaimus saccolaimus* (high confidence)**					**1**	**2**												**1**		
***Saccolaimus saccolaimus* (low confidence)**														**1**					**1**	
CALLS NOT POSITIVELY IDENTIFIED																				
Chalinolobus nigrogriseus or *Scotorepens sanborni*		1					42	6	1				1	6	1	17	57	8		1
V. troughtoni or *M. oceanensis*																				
M. oceanensis or *Pipistrellus adamsi*														1	1	7	3			
C. jobensis or *M. beccarii*															3	1		1		
M. ridei or *C. gouldii*															1	1	5	4		
M. ridei or *C. nigrogriseus* or *S. sanborni*															1		1			
S. flaviventris or *C. jobensis*					1		12	11				1			2		4			
S. flaviventris or *M. beccarii*								1	2						2	1	7			
S. saccolaimus or *M. beccarii*					6	1		3	1				1	33	10	5	22	2	3	2
Taphozous troughtoni or *M. beccarii*					3													5		

Detector	BAT 6 010327																				
Date	24/04/2013	25/04/2013	26/04/2013	27/04/2013	28/04/2013	29/04/2013	1/05/2013	2/05/2013	3/05/2013	5/05/2013	6/05/2013	7/05/2013	8/05/2013	9/05/2013	11/05/2013	12/05/2013	13/05/2013	14/05/2013	15/05/2013	16/05/2013	BAT 6 Total
Total calls identified	17	7	5	3	5	4	7	6	3	4	2	1	1	2	4	5	7	13	17	3	651
POSITIVELY IDENTIFIED CALLS																					
Rhinolophus megaphyllus																					
Chalinolobus gouldii																					9
Nyctophilus sp																					
Vespadelus troughtoni	1																				2
Miniopterus australis				1		2				2							1				20
Miniopterus oceanensis				1	2		3	4	3	2	1		1			4	1	1			43
Austronomus australis	2		5	1		1						1						2	3		81
Chaerephon jobensis	1																1		1		14
Mormopterus beccarii					2		4											2	5	3	64
Mormopterus ridei															1		1				52
Saccolaimus flaviventris		3																			7
***Saccolaimus saccolaimus* (high confidence)**																					**4**
***Saccolaimus saccolaimus* (low confidence)**																					**2**
CALLS NOT POSITIVELY IDENTIFIED																					
Chalinolobus nigrogriseus or *Scotorepens sanborni*	11	2			1										1	1	1	1			159
V. troughtoni or *M. oceanensis*																					
M. oceanensis or *Pipistrellus adamsi*		2															1				15
C. jobensis or *M. beccarii*																					5
M. ridei or *C. gouldii*	1							1													13
M. ridei or *C. nigrogriseus* or *S. sanborni*																	1				3
S. flaviventris or *C. jobensis*																					31
S. flaviventris or *M. beccarii*														1					3		17
S. saccolaimus or *M. beccarii*						1		1			1			1	2			7	5		107
Taphozous troughtoni or *M. beccarii*	1																				9

MEWF Data Summaries

Detector	BAT 7 010360													
Date	11/12/2012	12/12/2012	13/12/2012	14/12/2012	15/12/2012	16/12/2012	19/12/2012	20/12/2012	16/04/2013	19/04/2013	20/04/2013	21/04/2013	23/04/2013	BAT 7 Total
Total calls identified	13	16	20	9	4	6	20	8	1	1	1	1	1	101
POSITIVELY IDENTIFIED CALLS														
Rhinolophus megaphyllus														
Chalinolobus gouldii														
Nyctophilus sp														
Vespadelus troughtoni														
Miniopterus australis	2	1	2	2	1		4	2						14
Miniopterus oceanensis	6	14	16	6	1		6	1						50
Austronomus australis	4					3	1	2						10
Chaerephon jobensis														
Mormopterus beccarii					1	1								2
Mormopterus ridei														
Saccolaimus flaviventris														
***Saccolaimus saccolaimus* (high confidence)**			**1**					**1**						**2**
***Saccolaimus saccolaimus* (low confidence)**														
CALLS NOT POSITIVELY IDENTIFIED														
Chalinolobus nigrogriseus or *Scotorepens sanborni*		1		1		2	1							5
V. troughtoni or *M. oceanensis*														
M. oceanensis or *Pipistrellus adamsi*														
C. jobensis or *M. beccarii*														
M. ridei or *C. gouldii*														
M. ridei or *C. nigrogriseus* or *S. sanborni*														
S. flaviventris or *C. jobensis*			1				6	3						10
S. flaviventris or *M. beccarii*	1				1		1							3
S. saccolaimus or *M. beccarii*			1				1		1	1	1	1	1	7
Taphozous troughtoni or *M. beccarii*														

MEWF Data Summaries

Detector	BAT 8 010387									
Date	14/12/2012	15/12/2012	16/12/2012	17/12/2012	18/12/2012	19/12/2012	20/12/2012	22/12/2012	23/12/2012	BAT 8 Total
Total calls identified	1	10	14	16	33	5	2	2	1	84
POSITIVELY IDENTIFIED CALLS										
Rhinolophus megaphyllus										
Chalinolobus gouldii					12		1			13
Nyctophilus sp										
Vespadelus troughtoni										
Miniopterus australis		1			1	1	1	2	1	7
Miniopterus oceanensis	1	3	1	1	3					9
Austronomus australis			2							2
Chaerephon jobensis										
Mormopterus beccarii		4	3	5	1	3				16
Mormopterus ridei			3	5	4					12
Saccolaimus flaviventris										
***Saccolaimus saccolaimus* (high confidence)**										
***Saccolaimus saccolaimus* (low confidence)**										
CALLS NOT POSITIVELY IDENTIFIED										
Chalinolobus nigrogriseus or *Scotorepens sanborni*		1	4	5	6	1				17
V. troughtoni or *M. oceanensis*										
M. oceanensis or *Pipistrellus adamsi*										
C. jobensis or *M. beccarii*										
M. ridei or *C. gouldii*										
M. ridei or *C. nigrogriseus* or *S. sanborni*										
S. flaviventris or *C. jobensis*					1					1
S. flaviventris or *M. beccarii*					1					1
S. saccolaimus or *M. beccarii*		1	1		4					6
Taphozous troughtoni or *M. beccarii*										

MEWF Data Summaries

Detector	ARU 12 Total	ARU 6 Total	BAT 1 Total	BAT 2 Total	BAT 3 Total	BAT 4 Total	BAT 5 Total	BAT 6 Total	BAT 7 Total	BAT 8 Total	**Grand Total**
Total calls identified	617	844	172	427	1209	1153	2820	651	101	84	**8078**
POSITIVELY IDENTIFIED CALLS											
Rhinolophus megaphyllus	5	7									**12**
Chalinolobus gouldii	2	12		10	16	4	1059	9		13	**1125**
Nyctophilus sp	2		1								**3**
Vespadelus troughtoni			1	2	4		1	2			**10**
Miniopterus australis	111	46	9	4	24	23	35	20	14	7	**293**
Miniopterus oceanensis	91	187	31	25	147	51	71	43	50	9	**705**
Austronomus australis	32	71	15	37	102	65	37	81	10	2	**452**
Chaerephon jobensis	4	112	8	24	63	45	20	14			**290**
Mormopterus beccarii	38	69	16	36	105	59	143	64	2	16	**548**
Mormopterus ridei	50	19	20	27	144	70	70	52		12	**464**
Saccolaimus flaviventris	3	7	1	3	22	15	6	7			**64**
***Saccolaimus saccolaimus* (high confidence)**		**1**			**23**			**4**	**2**		**30**
***Saccolaimus saccolaimus* (low confidence)**		**11**			**3**		**1**	**2**			**17**
CALLS NOT POSITIVELY IDENTIFIED											
Chalinolobus nigrogriseus or *Scotorepens sanborni*	206	152	25	29	316	665	1125	159	5	17	**2699**
V. troughtoni or *M. oceanensis*	2	2		10	12	2	1				**29**
M. oceanensis or *Pipistrellus adamsi*		2	2	1	2		1	15			**23**
C. jobensis or *M. beccarii*		5	1	1	8	4	1	5			**25**
M. ridei or *C. gouldii*	5	7		4	26	2	29	13			**86**
M. ridei or *C. nigrogriseus* or *S. sanborni*							112	3			**115**
S. flaviventris or *C. jobensis*	9	13	6	100	8	5	4	31	10	1	**187**
S. flaviventris or *M. beccarii*	12	33	1	8	18	30	18	17	3	1	**141**
S. saccolaimus or *M. beccarii*	38	86	31	100	182	113	83	107	7	6	**753**
Taphozous troughtoni or *M. beccarii*	7	14	4	5	10		3	9			**52**