A report to CRA on the Orange Horseshoe Bat (*Rhinonycteris aurantius*) at Klondyke Mine, near Marble Bar.

by

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Background

Rhinonycteris is a monotypic genus endemic to Australia. It is listed as "rare or likely to become extinct" under Schedule 1 of WA State legislation, and "insufficiently known (K)" in the Federal Government's "Bat Action Plan". The only described species, *R. aurantius*, occurs in mesic areas of tropical NT, north-western Queensland and WA, with an outlying population in the Pilbara, and roosts in warm, humid, fully-dark chambers of deep caves and old mines. The ecology and roost requirements of the northern populations have been studied (Churchill 1991a, Churchill 1994), but knowledge of the Pilbara population is scant (Churchill, Helman & Hall 1987).

Klondyke Mine (AMG 50K 799405E, 7637811N) is the only colony known from the Pilbara. In April 1981, when the colony was discovered, the resident population was estimated at approximately 350 individuals (only 32 males and 40 females were actually captured: Churchill et al. 1987). In 1925, a specimen was sent to the WA Museum from Red Hill Homestead, 390 km WSW of Klondyke. In 1985, one has been found dead in a carpark in Karratha and, in 1990, another was killed by a car on the highway 2.5 km south of Fortesque Roadhouse (350km west of Klondyke). In June 1994, Dr Tony Start and I re-visited Klondyke, confirmed the persistence of the colony, and measured the flight indices of five individuals. In view of the low wing loading and aspect ratio of the species, and the distance between Klondyke, Red Hill and Fortesque, it is probable that other colonies will be found in the Pilbara.

The project components necessary to clarify the species' regional conservation status (a search for other colonies in the Pilbara, determine colony-sizes and minimum total population, examine taxonomic status, reproduction and roost requirements, etc) were discussed at a 27 March 1995 meeting between staff from:

- CRA Exploration (Mike Christie & Barry Davis),
- CALM (Norm McKenzie),
- University of WA Zoology (Jamie O'Shea), and
- an environmental consultant to CRA (Ray Hart).

As part of their mine feasibility study, Mike Christie asked me to re-visit the mine from 17 - 21 July 1995 to provide:

1. Advice on a safe method of carrying out a survey of *Rhinonycteris aurantius'* geographic distribution in the Pilbara region. Many of old mines in the Pilbara are now too dangerous to enter.
2. CRA with the technical data on *R. aurantius'* ultrasound that is needed to carry out such a survey.

3. CRA project geologist (Barry Davis), and the UWA graduate student who may be asked to carry out the study, with a full demo of the relevant echolocation and mist netting survey techniques.

Traditional bat survey techniques include mist nets and harp traps. However, *Rhinonycteris aurantius* uses very high resolution sonar and has a in-flight turning radius of < 0.2 metres, so its capture in nets and traps is by no means certain. The positioning of the capture device is critical, and requires experience as well as luck. Nets must be attended all the time, and most captures are achieved by pushing two narrowly converging nets together at the critical moment.

During the last 10 years, Tony Start and I have developed the technology to identify most Western Australian bat species from the ultrasound calls that they emit during flight. Bats use these echolocation calls to locate and identify objects in the dark.

Results

1. Survey

Echolocation calls were recorded from *Rhinonycteris aurantius* flying along mine passageways and outside its entrance. We also recorded from hand-held individuals, and others released with bioluminescent tags. In all cases, the calls had a CF frequency of between 123 and 127 KHz, depending on the sequence, and the species' ultrasound could not be detected at ranges > 2 metres from the microphone.

Rhinonycteris aurantius echolocation calls are distinctive; they cannot be confused with any of the other bats known from the Pilbara region. Table 1. gives some indication of how distinctive this species is compared with other cavern-dwelling bats found in the Pilbara.

Table 1. Free-flight echolocation call characteristics of the mine- and cave-dwelling microchiroptera that occur near Marble Bar.

	Shape[a]	Freq[b]	N[c]
Rhinonycteris aurantius	CF-FM	123-127	5
" " (hand-held)	CF-FM	123-124	18
Vespadalus finlaysoni	st-FM	52-55	6
Taphozous georgianus	sh-FM	23-25	5
Macroderma gigas	sh-FM	55.5-56.5	2
" "	st-st-FM	33-58[d]	5

a FM = frequency modulated; st-FM = steep-sweep FM; sh-FM = shallow-sweep FM.
CF-FM = constant frequency, with a brief period of FM at ends of the call.

b Frequency (Khz) of shallowest part of frequency sweep (normally = lowest frequency in FM calls).

c N = number of bats.

d Minimum to maximum call frequency values (frequency sweep has no shallow part).

To test the echolocation survey method, we visited the Comet Mine on the evening of 19 July 1995. Situated 20 Km NW of Klondyke, Comet is another deep and complex working with permanent water in its lower parts. At 1845 hrs we detected *Rhinonycteris aurantius* echolocation calls inside the Comet Mine, and were able to confirm this record by capturing a male in a mist net set in the main drive. On the following night we surveyed

the Bulletin Mine, 57 km ENE of Klondyke, but without success. Results of these surveys are summarised in Table 2. At the Bulletin Mine, our survey efficiency was reduced to about 50% by interference caused by the ultrasound of other bats, particularly *Macroderma.* This problem would be eliminated by using a more sophisticated frequency divider, such as the British QMC S200, that can be tuned to a particular frequency band.

Table 2. Bats found in three abandoned deep mines near Marble Bar in July 1995.

	Klondyke	Comet	Bulletin
Rhinonycteris aurantius	X	X	-
Macroderma gigas	X	X	X
Taphozous georgianus	X	X	X
Vespadalus finlaysoni	X	X	X

Zero Crossing Analysis (ZCA), such as the Anabat5 system supplied by Titley Electronics (P.O. Box 19, BALLINA, NSW 2478, Phone/fax 066-866617), provides a simple, unambiguous and cheap (less than $2000) method of detecting the presence of *Rhinonycteris aurantius* without the safety problems of venturing beyond the entrance tunnel of abandoned mine workings. Frequency-time plots for sequences of Pilbara *Rhinonycteris* calls derived using ZCA are provided in Appendix 1. If you have a multi-media 80486 computer, and read this file using WORD6 for windows, you can listen to a sample of its ultrasound (divided by 16) by double-clicking the mouse button on this icon:

2. *Taxonomic Status*

Pilbara *Rhinonycteris* may be genetically distinct from their counterparts in the far north, from which they are isolated by at least 400 km of desert. Their susceptibility to dehydration, flight morphology and observed flight behaviour, in combination with the Late Pleistocene climatic history of the region, leave no reason to suppose that these populations have regularly exchanged genetic material during the last 25 000 years. One occurs in a seasonally mesic, productive environment; the other must survive in an unpredictable, arid climate.

We noted direct evidence of difference between Kimberley and Pilbara populations: Pilbara *Rhinonycteris aurantius* have echolocation call frequencies about 10% higher than those in the far north.

To provide a basis for assessing the taxonomic status of the Pilbara population, tissues were sampled for DNA and electrophoretic analyses during our July 1995 work. These are lodged at the W.A. Museum. Preserved voucher specimens already held in the collections of the Western Australian Museum should be sufficient for relevant anatomical comparisons.

Conclusions

A survey of the distribution of *Rhinonycteris aurantius* in the Pilbara is technically straight forward if an ultrasound detection method is used to check potentially suitable roost-sites such as old mine workings and deep cave systems. It could be undertaken during 3 - 6

months of dry season field work by one zoologist. The taxonomic component of the study is considered essential, but would take no more than 6 months and mostly involve laboratory work on existing collections.

In the event that only a few colonies are found, a population census should be carried out at several locations over at least a full year, but this could be undertaken concurrently with the roost characterisation and reproductive study that would be necessary if translocation has to be attempted. The most economical approach might be to fund the work as part of a PhD project.

References

Churchill, S.K., Helman, P.M. & Hall, L.S. (1987). Distribution, populations and status of the Orange Horseshoe Bat, *Rhinonycteris aurantius* (Chiroptera: Hipposeridae). *Australian Mammalogy* **11**, 27-33.

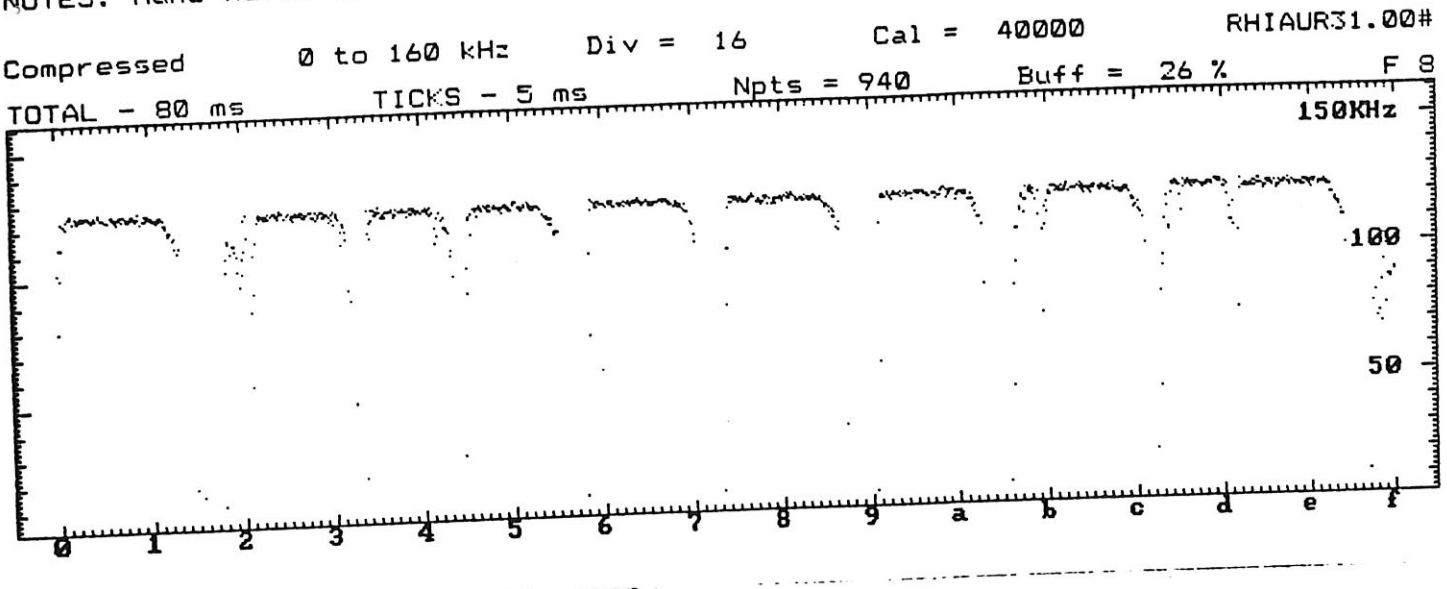
Churchill, S.K. (1991). Distribution, abundance and roost selection of the Orange Horseshoe Bat, *Rhinonycteris aurantius*, a tropical cave dweller. *Wildlife Research* **18**, 343-353.

Churchill, S.K. (1994). Prey selection and foraging behaviour of the Orange Horseshoe Bat, *Rhinonycteris aurantius*. *Wildlife Research* **21**, 115-130.

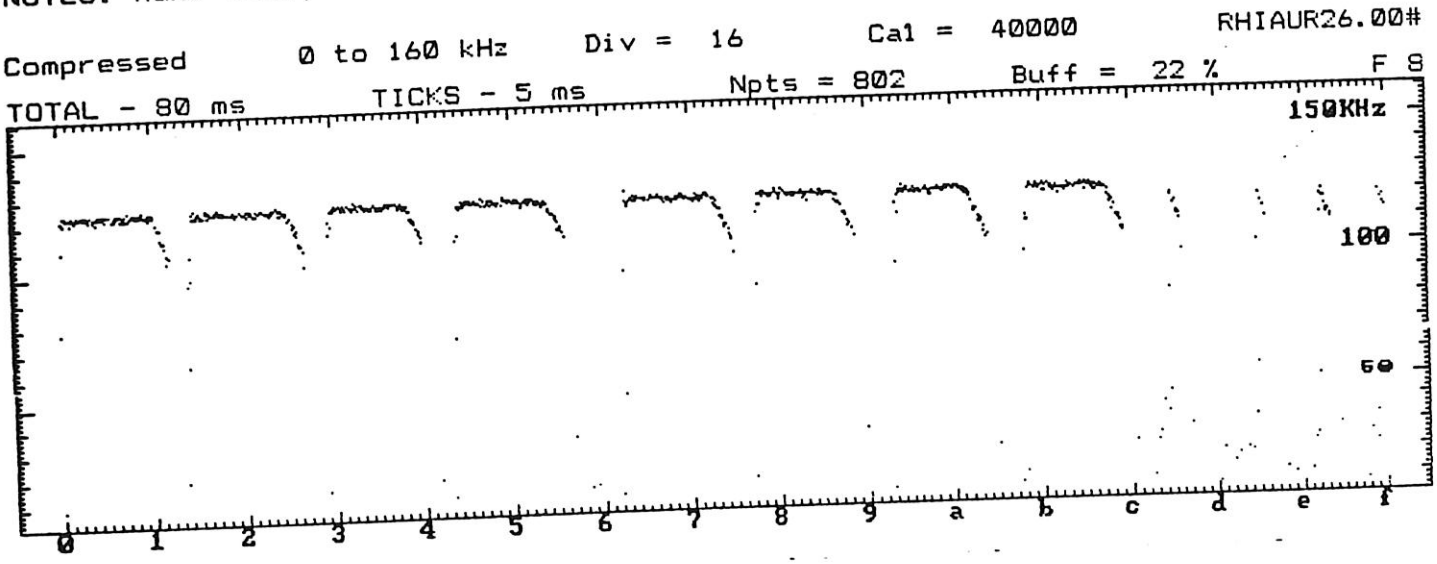
Appendix 1.

Frequency versus time plots of bats recorded in mines near Marble Bar during July 1995.

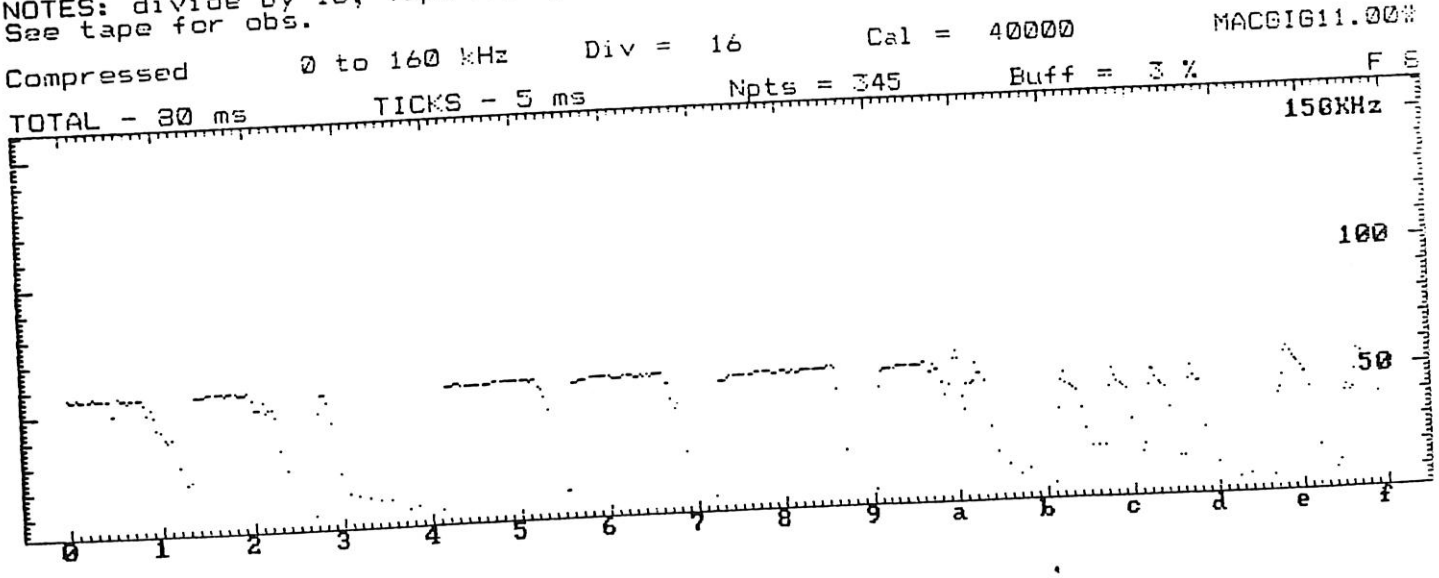
TAPE: July95/2 DATE: 18July95 LOC: Klondyke Queen, Pilbara SPEC: Yes
SP: Rhinonycteris aurantius
NOTES: Hand held. divide by 16, netted in main drive, Tape A214



TAPE: July95/2 DATE: 19July95 LOC: Comet Mine, near Marble Bar SPEC: M44921
SP: Rhinonycteris aurantius
NOTES: hand held, divide by 16, netted in main drive, tape B416.



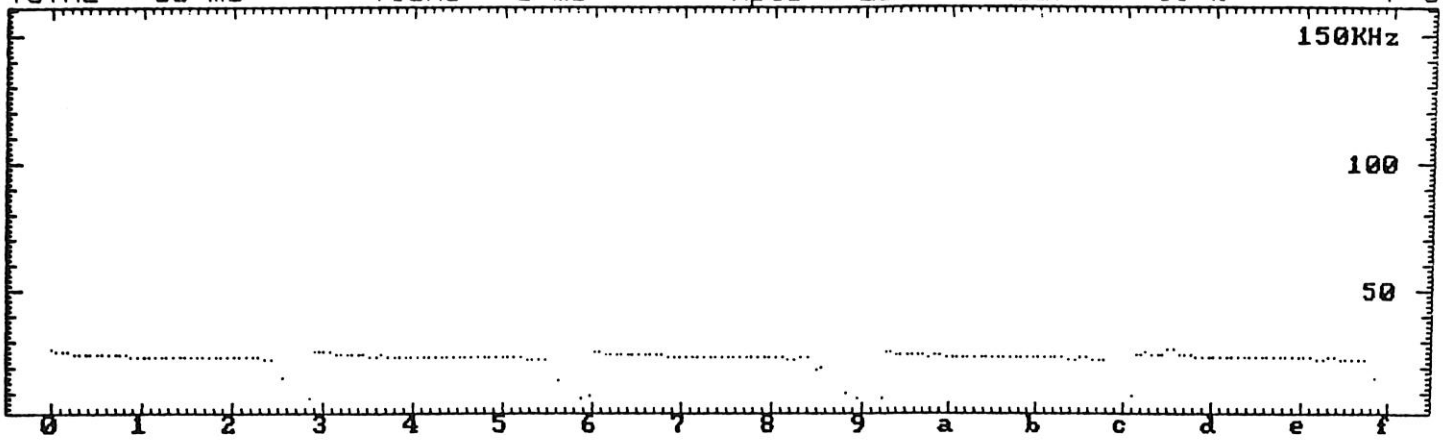
TAPE: july95/1 DATE: 17July95 LOC: Klondyke Queen, Pilbara SPEC: yes
SP: Macroderma gigas
NOTES: divide by 16, Tape A412, both sh-FM and st-FM calls, cyalume release.
See tape for obs.



TAPE: July95/2 DATE: 18July95 LOC: Klondyke Queen Mine, Pilbara
SP: Taphozous georgianus SPEC: Yes
NOTES: Released from net outside mine, divide by 16, tape counter A022

Compressed 0 to 160 kHz Div = 16 Cal = 40000 TAPGEO2.00#

TOTAL - 80 ms TICKS - 5 ms Npts = 206 Buff = 11 % F 8



TAPE: july95/1 DATE: 17July95 LOC: Klondyke Queen Mine, Pilbara
SP: Vespadalus finlaysoni SPEC: yes
NOTES: Cyalume release and several passes, divide by 16, Tape A434.
BS/O with curving irregular flight at tree height

Compressed 0 to 160 kHz Div = 16 Cal = 40000 VESFIN11.00#

TOTAL - 80 ms TICKS - 5 ms Npts = 425 Buff = 18 % F 8