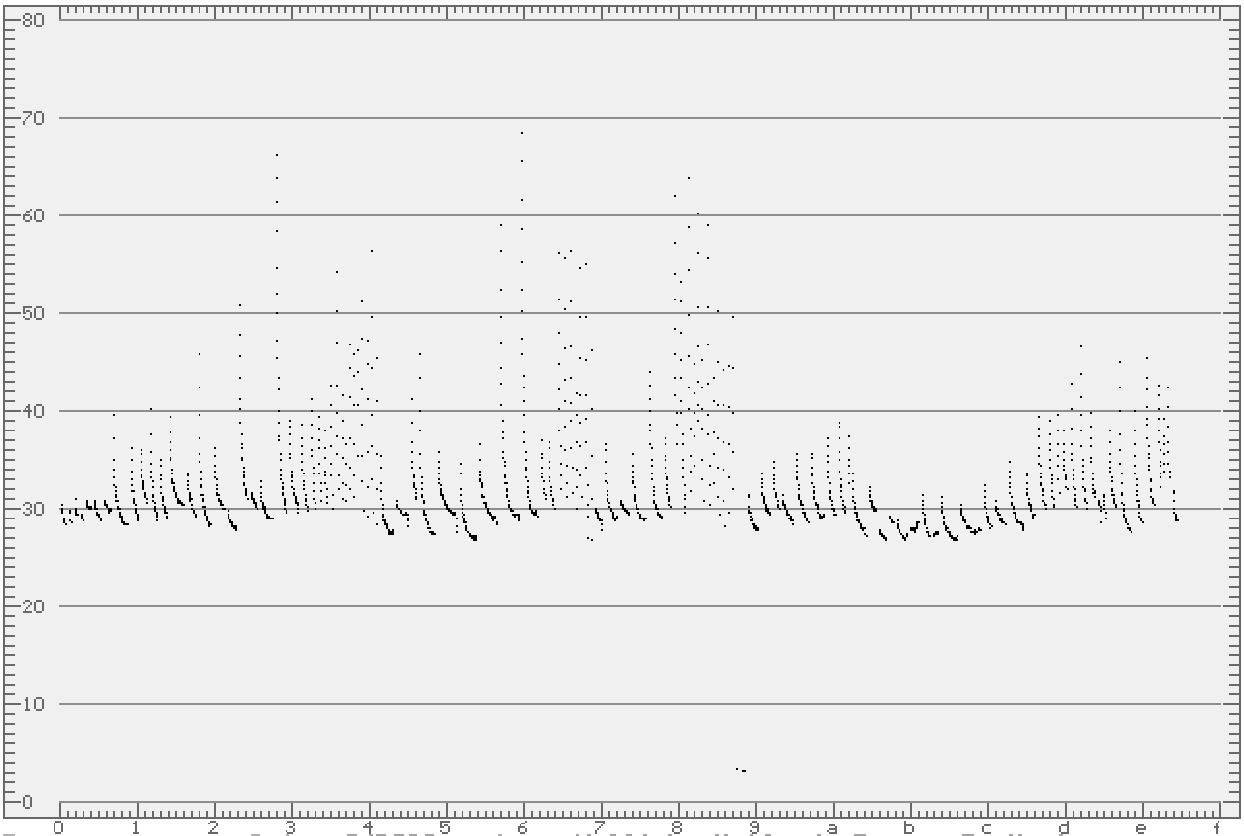
March 1996 Number 6

Australasian Bat Society Newsletter

Bat detecting: in the spotlight at Naracoorte.



Tape: Date: 940829 Loc: Yollinko Wetland, Barwon R, Newtown
Sp: Chalinolobus gouldii Spec:
Note: Free flying, feeding over ponds. Identified & recorded by Lawrie Conole.
Yollinko is in suburbs of Geelong on the banks of the Barwon River.
CHGOULO2.LC# Div 16
Tot 750ms Tk 50ms f5 Comp St 2 Filt 6
ANALOOK 2.0 July 1995

EDITORIAL

Our esteemed leader, his Grey-headed Eminence from the Northern Camp (aka Dr Len Martin), is unable to give us one of his entertaining Presidential addresses this time, so I'd suggest coming along to Naracoorte for a live performance! There are many other reasons why you should come to Naracoorte, so if you haven't booked, get your late registration fee organised, read Terry Reardon's notice in this issue, and come along.

So, what's in this issue? A new member, Duncan Kirkely, has taken up the challenge to provide a lighthearted and brutally frank story about his steep learning curve with acoustic identification of microbats in South Australia. Greg Richards provides a rigorous comparison of trapping and acoustic identification of microbats and implications for survey design and methodology. Hugh Spencer and Roger Coles provide answers to questions you haven't even thought of yet in their piece which explains in plain language what bat sonar and detecting it are all about. Chris Corben provides some very practical and useful advice for the recording of reference library call sequences from microbats. Jillian Snell gives us something to think about - harvesting flying-foxes for export. From an obscure site on the World Wide Web in Minnesota, USA, I've lifted an interesting piece on the rearing of orphaned microbats by Mike Fry.

This issue, my second as editor, once again owes its content entirely to ABS office-bearers and/or members I was able to pester by email. There are **no** contributions from non-Internet members, but I hardly think this means that you are all either totally inactive or too busy out there! Indeed, the people who wrote for this issue, some at fairly short notice, are very busy people. If you look through this issue and the last, you'll see much the same names appearing in each (well, give or take a couple!). I cannot continue to persecute the core ABS members by email; it's unfair. Unless I receive articles, news clippings, state and regional reports, and so on, from the general membership, the next issue will, I fear, be VERY thin indeed. A word of warning ... if you intend being at our conference in Naracoorte, I'll be chasing people for contributions to the October 1996 issue and beyond. September 21 is my next deadline - START WRITING NOW ....

On page 26 you'll find the forerunner of another new section of the newsletter - a "recent publication" list. The papers featured here were brought to my attention by the editors of *The Victorian Naturalist* (journal of the Field Naturalist Club of Victoria), and a couple of colleagues. A number of members have suggested the inclusion of such a section in the newsletter, and with a little help that's what I intend to do. I'd like to develop this section, and there are two main ways you can help me:

- each time you publish something, send me a reprint
- if you come across any relevant papers in the journals you read, send me a copy or at least the citation details.

The bat detector page has mutated and taken over the newsletter! As it's clearly a mainstream batting issue now, that seems entirely appropriate. However, if I get enough copy from other specialist areas, I might be able to force detecting back inside the previously set boundaries.

So now I have a couple of things off my chest, you can get on with the business of enjoying the newsletter. Read on ....

Lawrie Conole
Editor - Australasian Bat Society
☒

7th Australasian Bat Conference

Naracoorte South Australia

9 to 12 April 1996

The conference will be held in the week following Easter, and our venue is the recently renovated Naracoorte Town Hall. Naracoorte is about 350 km from Adelaide and 500 km from Melbourne.

Registrations are flowing in, so if you've been a little tardy, REGISTER NOW. If you're yet to send your paper abstract in, then you really need to get a wriggle on!! The deadline was 29 February. Please assist the organisers by getting your registration and paper details in as quickly as possible. If you have special requirements with transport or other matters, then you should ring Terry Reardon immediately (see contact details next page). The proposed program for the conference follows:

Tues. 9th April, 6-8pm: Registration - ice breaker; wine tasting and light food

Wed. 10th April, 9am-4pm: Papers
4 - 5 pm: ABS executive meeting
7pm - ?: Conference dinner

Thurs. 11th April, 9am - 1pm: Papers
2:30 - 10pm: Trip to Naracoorte Caves Reserve.

Participants will be divided into two groups, each of which will visit in turn the World Heritage listed Victoria Fossil Cave (led by Dr. Rod Wells), and the new Bat Interpretation Centre which is linked to infra red video cameras inside the Bat Maternity Chamber. There will be a barbecue at the reserve after the tours. The Ranger in charge at the reserve has offered an opportunity for a limited number (up to 30 in smaller groups) of delegates to make a brief visit to the maternity chamber.

Fri. 12th April, 9am - 1pm: Papers and workshops. Conference end.

2pm - 5pm: Free time to visit wineries, Bool Lagoon local attractions.

5pm until late: Field demonstratioms at the nearby Penola State Forest.

Workshops:

Microbat rehabilitation. To provide the opportunity for bat carers to meet one another and exchange ideas and knowledge, and to summarise guidelines for rehabilitation of sick and injured bats.

Artificial roosts for microbats. To exchange ideas, results and strategies for the provision of artificial roosts for microbats. Please bring box designs, results and ideas, from which a summary will be prepared.

ANABAT call library and call exchange. The aim of this workshop is to decide on a range of issues associated with an ANABAT call library.

Bat survey methods and standards. This workshop stems from recent discussion on BATLINE and disquiet from some bat researchers about poor quality surveys based on the misuse of ANABAT call data. Issues for discussion will include: what constitutes a reliable bat survey?; how should bat call data be used and analysed?; should there be an accreditation scheme for expertise in ANABAT call analysis?

Bat conservation: Two key issues will form the focus of the workshop.

> ***How do we evaluate the conservation status of a bat species?*** Many bat researchers believe that the IUCN criteria for assessing the conservation status of species are inappropriate for bats. This workshop will aim to determine a more relevent set of criteria for bats, and the discussion will focus on the criteria rather than any particular species.
>
> ***What are the primary threats to bat conservation?*** This will aim to identify the most critical conservation threats to bats and to suggest what research, management, educational and political strategies should be adopted to counter the identified threats.

Workshops will be planned to have some introductory or opinion papers given initially, and conducted so that there are real outcomes. If anyone wants to run a workshop please contact us.

A variety of accommodation is available within a short walk of the conference venue, which itself is in the main street of Naracoorte. Registration forms, calls for papers and posters and local area information kits will be sent out later in the year. The conference, because of its location would lend itself for delegates to bring their families. Childcare can be arranged. Airfare discounts will also be available for flights between capital cities. We will arrange bus transport from Mt Gambier for those who fly to there.

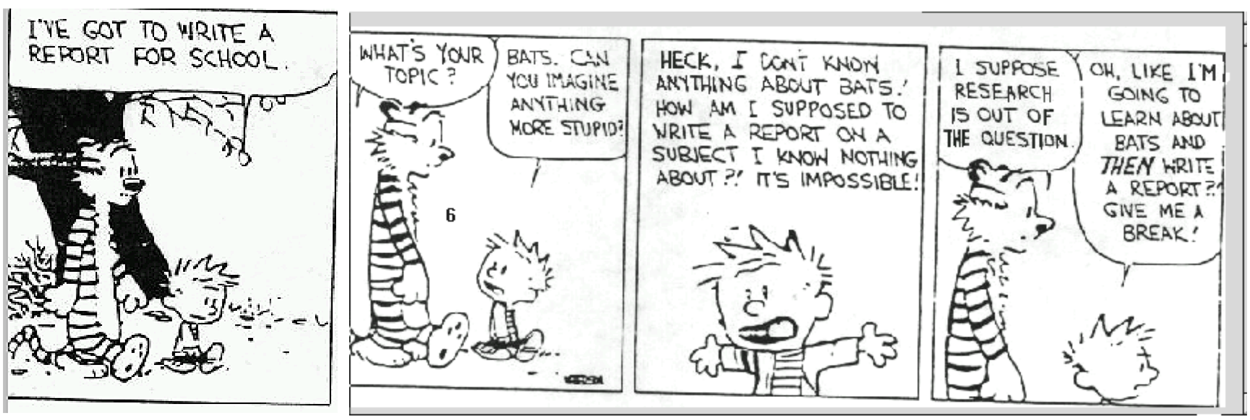
PLEASE NOTE also that the phone number for the Kingcraig Hotel is (087) 622200 and not the number given in the registration pack.

Organisers:

Lindy Lumsden
Arthur Rylah Institute
PO Box 137
Heidelberg VIC 3084
ph (03) 9450 8694
fax (03) 9450 8737
email: lxl@dce.vic.gov.au

Terry Reardon
South Australian Museum
North Terrace
Adelaide SA 5000
ph (08) 207 7460
fax (08) 207 7222
email: treardon@zoology.adelaide.edu.au

☒



NOTICEBOARD

BAT LITERATURE LIST ON THE WORLD WIDE WEB

Alexander Herr and Nicholas Klomp

Following up on a discussion on the batline a few months ago, we did some additional work and have added a publication list to our batcall library (http://batcall.csu.edu.au/batcall/batcall1.html). This list offers a search on publications on bats and allows you to add your own publications, or any others we have missed. With enough input from outside it might well become a reasonable source for citation searches. Currently the list contains more than 100 references on bats.

The URL is: http://batcall.csu.edu.au/batcall/batlit.html

☒

BAT ECOLOGY SYMPOSIUM AS PART OF ECOLOGICAL SOCIETY OF AUSTRALIA CONFERENCE, TOWNSVILLE, 9-12 JULY 1996.

Greg Richards

The 21st AGM and scientific meeting of the Ecological Society of Australia (ESA) will be held at James Cook University, Townsville from Tuesday 9/7 to Friday 12/7/1996. There will be a mix of special interest Symposia and Open Forum sessions. Symposia topics:

- Frugivory & seed dispersal.
- Metapopulations.
- Ecology for everyone - communicating ecology to scientists, the public and the politicians.
- Ecological & evolutionary processes at species borders.
- Replenishment of populations.
- Bat ecology.

Open Forum sessions are open to any contributor on any ecological topic. Work-in-progress reports are welcome. Open Forum sessions will not be run concurrently with Symposia.
Symposium abstracts must reach the convenor by 12/4, and the convenor for "Bat ecology" is:

Greg Richards
Resource Ecology Assessment Program
CSIRO Division of Wildlife and Ecology
P.O. Box 84, Lyneham ACT 2602

Conference address for enquiries and registration:

ESA96
Dep't of Zoology
James Cook University
Townsville, Qld 4811

Contact: Mrs Barbara Kayrooz
Phone: (077) 81 4858
Fax: (077) 25 1570
Email: <esa96@jcu.edu.au>

☒

REQUESTS FOR INFORMATION

BATS ROOSTING IN BIRD NESTS

I am currently reviewing records of bats roosting in bird nests throughout Australia. Bats of various species appear to be most frequently encountered in disused Fairy Martin (*Hirundo ariel*) nests. I am especially interested to hear if anyone has come across bats in scrubwren, sunbird or gerygone nests. I would be most interested in hearing from anyone who has encountered bats, whether identified to species or not, in bird nests anywhere in Australia.

Martin Schulz
Faculty of Resource Science & Management
Southern Cross University
P.O. Box 157
Lismore, NSW 2480.

Phone (066) 49 7853 after hours.

☒

AUSTRALIAN WORK EXPERIENCE ON TELEMETRY PROJECTS WANTED

Dear Len Martin. I found your address on batline and feel so free to contact you in a personal matter. I am a Zoologist with a diploma from University of Zurich. I concluded my studies with a research programme concerning the nutritional characteristics of the Serotine *Eptesicus serotinus*. In addition to my University work I had the possibility to work for several years with a gouvernment sponsored bat programme. I would like very much to continue to work with this fascinating animals, to use and broaden my knowledge by becoming involved in further project work. Of special interest for me are projects observing the behaviour of bats by means of telemetry. In this regard I would like to ask you whether you know of any possibility to contribute to existing or forthcoming projects. If you can help me on my request please contact me and send me further information. Thank you in advance for your attention.

Esther Gerber
Zoologist, Seefeldstrasse 44, CH - 8008 Zuerich, Switzerland. Phone: +41 1 261 17 20
Fax: +41 1 257 45 05 e-mail: rzust@rzu.unizh.ch

☒

INPUT REQUIRED FOR NEW BAT BIBLIOGRAPHY

The Biodiversity Survey Co-ordination Unit of the NSW National Parks and Wildlife Service is compiling a "bibliography on the taxonomy and ecology of bat species occurring in NSW". The aim of this bibliography is to provide a useful aid to bat researchers by using cross-referencing in a way directly applicable to bat workers, ie. Cross-referencing for different species, taxonomy, techniques, nomenclature and habitat. The aim is to produce a useful tool that can be used by everyone and that will save individuals many hours of literary searches. It is proposed that the bibliography will be available to the general public in printed form for a nominal fee, and ultimately be available in electronic form on the Internet or on CD-ROM.

A veritable gold mine of information that would be of use to bat researchers exists in most bat-workers' offices and minds. If we could somehow tap into this unpublished information and include it in the bibliography it

Contact:

Margaret Turton
Biodiversity Survey Co-ordination Unit
NPWS
PO Box 42
Blackheath NSW 2782
BH (047) 87 8877
AH (047) 87 8514

would be invaluable, however the method of achieving this has yet to be determined. Any input on this project from ABS members would be greatly appreciated, either on content or method or how to make it into a useful tool for researchers.

☒

NEWS FROM AROUND THE TRAPS ....

Western Australia

Since the last edition of the *Australasian Bat Society Newsletter*, a new bat project has commenced at The University of Western Australia. Kyle Armstrong is undertaking a Masters Degree on aspects of the biology of the Orange Horseshoe-bat *Rhinonycteris aurantius* in the Pilbara region of Western Australia. The project is being partly funded by CRA and is being co-supervised by Jamie O'Shea. It primarily aims to document the status and distribution of Orange Horseshoe-bats in the region since recent evidence suggests they may be far more widespread than was previously thought, and to document roost requirements and other aspects of the bats ecology. Jamie O'Shea is also currently investigating aspects of the renal morphology of Gould's Wattled Bat *Chalinolobus gouldii*. *C. gouldii* have been the subject of two other recent studies at UWA: one documenting the use of torpor and another plasma progesterone, sperm storage and sperm viability. Both of these are currently being reviewed for publication. In other news, Norm McKenzie was the senior author of a recent publication that investigated the correspondence between flight morphology and foraging ecology in some mega and microchiropteran bats from Lombok, Indonesia (*Australian Journal of Zoology* **43**:241-57) and congratulations to one of the co-authors, Andrew Gunnell, who has recently submitted his PhD thesis.

David Hosken
Zoology Dept.
UWA, Nedlands WA 6907
<dhosken@uniwa.uwa.edu.au>

☒

New Zealand

BATS UNFAZED BY RUAPEHU ERUPTION

In response to concerned enquiries, I report that as far as we can tell, recent volcanic events have not had any impact on the Short-tailed Bats (*Mystacina tuberculata*) that live in the forest on the south side of Mt. Ruapehu. The eruption so far has been confined to the top of the mountain, and while entertaining at times, has not disrupted our work. The ash falls have mostly been to the east and south-east of the mountain, because the prevailing winds are westerly or northwesterly. We were fortunate to keep some contact with the bats over the winter. By catching a few in May and June, and attaching transmitters to them we were able to track them to a winter roost which was occupied until early September. Although they are playing hard to get, many long fruitless hours mist-netting during September payed off when a veritable swarm flew into the nets one night. Our spring/summer field work was off to a good start. Ironically, the first bat caught this spring was a Long-tailed Bat (*Chalinolobus tuberculatus*), and even more unusual was that it was caught within 2 metres of the ground. These bats generally fly at the height of the tree canopy. For more detailed accounts of our work see the Proceedings of the 1st New Zealand Workshop on Bats, which should be out by the end of the year. If you are in the Ohakune area, please feel free to contact us at phone (06) 385 9082.

Shirley McQueen & Brian Lloyd, Science & Research Division, Department of Conservation, Wellington, New Zealand.

Taken from *Peka Peka* **2**: 5-6 (*Peka Peka* is *The Newsletter for New Zealand Batworkers*).

☒

SO YOU WANT TO BUY A BAT DETECTOR!

Hugh Spencer[1] & Roger Coles[2]

[1] Cape Tribulation Tropical Research Station
PMB 5 Cape Tribulation, Q 4873
<Hugh.Spencer@jcu.edu.au>

[2] Vision, Touch & Hearing Research Centre
Dept of Physiology & Pharmacology
The University of Queensland
St. Lucia Q 4072
<r.coles@mailbox.uq.oz.au>

Introduction

Bat sonar detectors and their use are currently a "hot"topic in bat-dom. More and more people are surveying bat fauna using sonar detection, especially in areas where trapping is difficult or otherwise impossible.

Microchiropteran bats, and some insects, emit sound in the 20 kHz to 200 kHz ultrasound frequency range. Human hearing usually terminates at about 20 KHz in young people, declining rapidly to 12 kHz or less in ancients like ourselves. So to hear bats echolocating, we need a method of detecting their calls and translating these into something we can perceive either visually or, more usually, audibly.

Bat detectors

Ultrasonic sound detectors have been around for quite a while. They have been used as gas leak detectors, and for analysing some industrial processes. The first "ultrasonic" microphone was invented in the late 1930's and the first detector that batters knew about was the QMC mini-detector made in UK in the 1970's. This was a modified transistor radio with a hearing aid microphone and a little horn attached to improve sensitivity.

Choosing the microphone

Broadband microphones are necessary for detecting the full range of ultrasound used by bats. Unfortunately, your standard hi-ball style PA microphone just won't do; these microphones are insensitive, and have a frequency response that cuts out above 25 kHz.

Para-Broadband ultrasonic microphones normally have a very delicate diaphragm to detect sound; ideal bat detection microphones must have a flat response to 200KHz or more, and have a high sensitivity. There are lots of mass produced ultrasonic microphones available commercially, but most are designed for specific applications (e.g. old style TV remote controls, burglar alarms, transducers for Polaroid camera sonar auto-focus systems). These usually have a peak response at the frequency of interest for the man made sonar (typically around 40 KHz) and do not have the "flat" broadband response batters need. Using these microphones will allow detection of some bat species more effectively than others, and fail to detect bats using "high frequency" ultrasound. However, they are cheap and robust.

Hearing aid (electret) microphones are used in the mini-bat detectors - these respond to our own audio band and fortunately, by a sheer accident of design, they have a reasonably good frequency range that extends into the ultrasonic range. They are not sensitive, but can be useful to detect ultrasound especially with some electronic massaging, and are very cheap.

A "laboratory" grade ultrasonic microphone, frequently used by bat researchers, consists of an ultra-thin film of mylar (a plastic) only microns thick, metal coated on one side and stretched over a metal "back plate". An excitation (polarization) voltage of 100 Volts DC or more is applied between the back element and the metal coating on the outside of the film. Sound waves vibrate the diaphragm which generates a voltage signal, which is an electrical analog of the sound pressure waves hitting the microphone, and this is the crucial event for detecting bat ultrasound. This signal is amplified electronically and either sent directly to a suitable recorder or further processed by the bat detector circuitry. These condenser-style microphones can be highly sensitive to ultrasound, but their method of construction and the high voltage use makes them difficult to use in the field. This is especially true in the high humidity of the wet tropics where we work and where the bat fauna is the most diverse! However, these calibration standard microphones have set the standard for all other ultrasonic microphones designed for field use.

One important thing to remember is that for a given sound frequency, the larger the diameter of the microphone's diaphragm, the narrower will be the angle of the receiving "beam" of sound detected by the microphone. So for every microphone in a bat detector, this beamwidth gets narrower as the ultrasonic frequency increases. A beam angle of 30-50° can be considered appropriate for surveying bats but its obvious that a narrow acceptance angle for a bat detector microphone can have a profound effect on the ability to detect bats flying at an angle to the detector. In other words a bat detector is a directional device like a spotlight. Cheap mini-detectors, which usually use Knowles electret hearing-aid microphones, have quite a wide detection angle, but are relatively deaf, and hence only good for loud or close-by bats.

When the bat's call has been detected and converted into an electrical signal, it has to be further processed to make it useful to the researcher. Bat researchers use 3 types of procesing; direct recording, heterodyne and frequency division.

Direct recording

Once upon a time, a truly serious bat researcher would appear in the field with a large semi-portable high-speed tape recorder and a Bruel and Kjaer ultrasonic microphone to make "archival-quality" recordings. Alternatively the researcher could watch the signals flickering on a small postage stamp sized oscilloscope screen. With the wonders of modern digital systems, using these methods is no longer necessary. Signals can be digitised at high rates and stored on memory chips in portable processors, provided the calls don't last for more than 5 seconds or so; then they can be down-loaded into a laptop computer for processing.

Heterodyne detectors

When two sounds of different frequency are played together, "difference" or "beat" or heterodyne frequencies are produced. Listen to an out of tune piano... if one of 3 strings of a given note is out of pitch, a low frequency off-note is produced (1-10 Hz), and we say that there is a discord. Alternatively, if the frequency is 100 KHz, and we mix it with a frequency of 101 KHz, we hear a whistle, (1KHz) - the peak of sensitivity of the human ear. Generating this heterodyne frequency is the basic operating principle of most radio receivers.

Mini-detectors such as the mini-3 from Ultra Sound Advice, and the "Bat Box" for example use the heterodyne principle to make the bat's call audible to our ears. A built-in signal source (oscillator) which can be varied by the operator, using a dial calibrated in KHz, is mixed with the unknown signal from the microphone. If the operator has guessed that a bat maybe present, and set the detector's frequency correctly, an audible sound should come from the speaker as the bat flies by. Other bats, with frequencies with a greater difference than, say, 10KHz, from the expected one, probably won't be heard. When you correctly predict what bat you will encounter, a heterodyne mini-detector is great! It is also good for demonstrating bat calls to newcomers. Unfortunately it is very limited for detailed surveying because things happen in real time and accurately tuning a dial is slo-o-w.

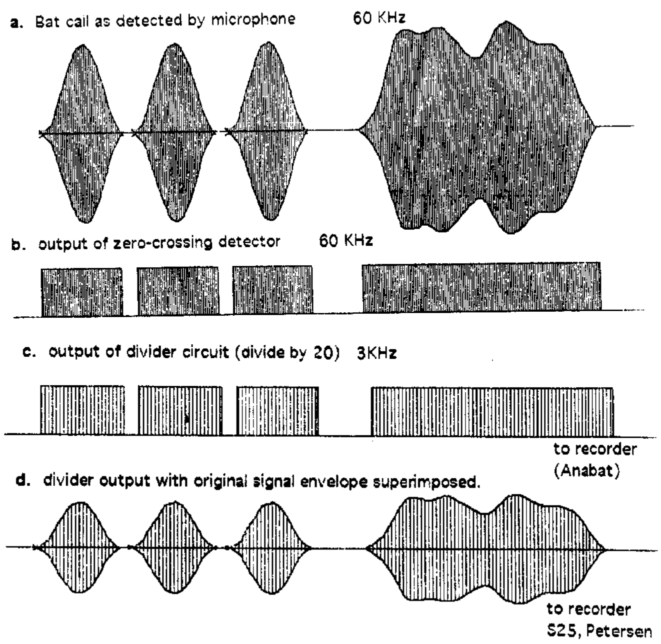
Frequency dividers

These, as the name implies, use digital techniques to divide incoming ultrasonic signals to produce a lower frequency range either that we can hear, or that we can record on a modern high quality audio cassette recorder.

Example: An Eastern Horseshoe-bat *Rhinolophus megaphyllus*, with a main sonar frequency of say, 70kHz, if divided by 10, gives us an audible 7kHz signal (not too high for comfortable human hearing). At the same time another bat, operating its sonar in the 160 kHz frequency band, such as the Dusky Leaf-nosed Bat *Hipposideros ater*, will be heard simultaneously at 16 kHz. and so on. (Dividing the original ultrasound by 16 or 20 is also very useful - putting frequencies up to 200 kHz well below 10kHz, a range good for humans and for recorders.)

Frequency divider (or count down) bat detectors are fantastic for surveying - you can hear the calls and record the main bat call spectrum without having to re-tune the detector. However, there is a price to pay for this convenience. Crude division, that is dividing the number of times the original analog signal passes through zero (Fig 1e, b and c) certainly lets us hear the signals, but we lose all information about the strength of the signal (whether the bat is near or far from the microphone) and the envelope or shape of the bat's call (Fig 1a), often of diagnostic importance. To solve this problem, more elaborate bat detectors (eg Ultra Sound Advice U-30, Peterssen D-940) retain the shape of the call as well (Fig 1d).

Fig 1



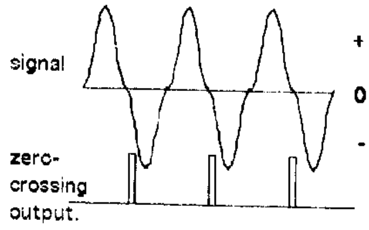
For some purposes, retaining this information may be entirely irrelevant; if all you need is the dominant harmonic and the temporal pattern of the call. For other types of work such as surveying, especially where the researcher is in an environment where unknown bat species likely to be encountered or bats with similar sonar calls, it is critical to accumulate as much information as possible about the structure of the calls.

Heterodyne systems remain the most sensitive method of detecting bats, but the microphone sensitivity has to be taken into account, so a bat detector such as the U-30 or the Peterson D900 series, which combines a high quality microphone with a heterodyne circuit, is optimum for detection. However, you still only get one species at a time as a general rule.

Recording

Once you have determined which detector system to use, the signal must be recorded. For non-digital direct ultrasonic recording, you are restricted to a laboratory grade high frequency instrumentation recorder which costs heaps and is not exactly portable; we will not discuss it further.

Fig 1 e.



For digital "real-time" ultrasonic recording, the samples of sound are usually downloaded from the digital recorder onto a large hard disk-drive of a laptop PC, or converted to analog form and replayed at slow speed (time expansion). This latter approach is attractive because the entire ultrasonic sonar call can be brought into the audio band and even re-recorded on a conventional tape recorder. From here they can be processed using whatever analysis package is appropriate.

The sonar call output from digital count-down (divider) systems are normally recorded on a stereo portable cassette recorder. Because of its quartz-locked speed control feature, the Sony Professional Walkman recorders (both analog and DAT forms) are favoured so that play-back is at the same speed as the recording. This consideration is vital if quantitative informatio is needed from the analysis of sonar recordings. The simple calculation of the frequencies contained in a sonar call, either by a rough estimate from zero crossings or more accurately by spectral analysis techniques such as the FFT (Fast Fourier Transform), depend entirely on a constant and reproducible tape speed. Cheaper, non-speed controlled recorders can vary the record/play speed significantly (wow and flutter), and in fact there can be large differences in absolute tape speed between recorders. For this reason, it is advised, at least, that one should always replay on the instrument used for recording. This is especially true when surveying for new species or geographic call variants of the same species, and where small differences in sonar call frequencies between species are apparent.

Calibration

The problems above highlight the need for a calibrator so that signals with a known frequency can be interspersed with sonar recordings, to check the accuracy of the heterodyne dial or the sonar analysis itself.

Obviously, the best method is to use a source of ultrasound at a known frequency, and use it to provide calibration points on analysis equipment. We discovered that old TV ultrasonic remote controls can be used; they generate a series of very stable frequencies centered about 40 kHz When you have one, ask a competent electronic lab to tune one button to, say, 40 kHz (and check how flat batteries affect the calibration) and disconnect the remainder of the buttons.

Calibrators should be checked regularly and used at least at the beginning and end of every field recording session. Besides generating a calibration signal, the calibrator enables one to check the operation of the whole system, microphone, detector electronics, recorder (before embarking on an evening's surveying) and ultimately the analysis system.

Reference call libraries

For compiling a library of reference sonar calls, the better the fidelity of the recording in the first place, the more valuable the reference. Only direct recording will give a true picture of the bat call (assuming that the recorder is capable of recording frequencies 3-4x the dominant frequency of the bat call). All other systems degrade the signal to a greater or lesser degree.

Next best, would be to use the state-of-the-art, genuinely broadband bat detectors , such as the Ultra Sound Advice U-30 (now superseded by the S-30) or the Peterssen D-9xx series, which preserve the call envelope shape even though it reduces the frequency. The original ultrasound is available from these detectors (HF output) contains the full signal bandwidth, such as the harmonics of the bat's call - limited only by the frequency response and dynamic range of the microphone.

In this context, of least value are detectors such as the Anabat since the only output is the pulses of the zero crossings (or threshold detector) resulting from a call; all amplitude and harmonic information is lost. Some mini-detectors have a HF output but the sonar calls are quite poor reproductions of original because the microphones are not true high frequency devices.

Heterodyne outputs available from several detectors (mini and broadband) preserve the approximate timing of the call, but lose the envelope shape of each pulse and original frequency information can only be referred to the tuning dial.

It doesn't take much thought to see that the more information you can get as you record your call the better, but better systems often cost more. If the quality of your sonar data is paramount, then the best systems for detection, recording and analysis are no longer prohibitively expensive. The beauty about having the highest resolution calls available in a reference library, is that the calls can always be played through the system you are using (detector, analysis system or whatnot), and compared with the calls you have been getting.

Commentary channel

The second stereo channel of the recorder can be used for recording commentary in most systems (the ultrasound microphone also works quite well at audio frequencies). In the more sophisticated systems (Ultra-Sound Advice, Petersen) the audio is separated from the ultrasound calls and recorded on the commentary channel, allowing the researcher to make a continuous commentary onto the tape while recording the ultrasound.

A brief note on signal processing

There are many ways to analyse ultrasonic signals and their recordings, traditionaly based on analog filtering techniques but nowadays algorithms are implemented digitally.

Zero (or threshold) crossings

A very old and simple way to estimate the sound frequencies in a bat sonar call is to generate a plot of the instantaneous frequency against time. To do this, the time intervals or periods (hence the alternative name period analysis) between the individual crossings of a signal (the point when the electrical signal waveform crosses the zero line or a preset threshold value, in one or other direction - Fig 1 e) is measured, and often converted into frequency (reciprocal of time interval), which is then plotted against time.

This method is necessarily crude, and is prone to errors unless the input signal is well behaved (ie low noise, dominated by a single harmonic), but when applied to bat sonar for example, gives us the basic call frequencies and their variation during the call. This allows us to characterise the call as CF, FM or whatever and probably provides some identification the bat by species (comparison to reference calls). Works best when the recordings are clean (good signal to noise ratio) and provided some error is accepted in estimating frequency, although it should be pointed out that this technique is extremely unreliable for calls with poor amplitude and also for noisy recordings.

Spectral analysis

In this mode, the sound energy of a signal is analysed, normally by use of the FFT (Fast Fourier transform, ubiquitous in signal processing), to reveal the intensity of the different harmonics and non-harmonically related components in the call. These are plotted - as the spectrum of the whole call (temporal information lumped together), with frequency along the X-axis, and intensity along the Y-axis. This enables us to characterise the call spectrally and examine many parameters, such as where the frequencies with maximum energy lie, and whether there are sibilant components (non-harmonic hisses for example), in the call, a sort of sonar fingerprint, if you will. Sequential spectra can be arranged to examine the change in spectral energy, during the call, resulting in a so-called waterfall display (also known as hills and valleys).

Sonagraph display

This is an early form of spectral analysis, performed on a segment of call recorded on a special analyser (such as the Kay Sonagraph), Bat calls are analysed by slowed replay (1/8 or 1/16) to bring the frequency into the audio range. The result produced a sonagram, which generates a graphical display, showing changes in frequency and the intensity versus time. This display method is still used by current computer methods, to produce a digital sonagram: it gives a spectral analysis versus time (X-axis); frequency is represented on the Y-axis, while the intensity of the sounds are represented by gradations in trace intensity (Z-axis). With a little experience, looking at a Sonograph trace, one can take an enlightened guess as to what the bat's call will sound like. However, the caveats for spectral analysis apply here too, as the rules for producing the graphical display are fixed by the method (FFT).

There are many variations on producing "sonagrams", and a number of computer packages are being offered that perform this type of analysis; some present them in very gaudy graphics on the colour screen.

Conclusion

Understanding the way in which different bat detectors operate is, to our minds, essential for making informed choices and decisions. All bat detectors are definitely not created equal - especially since the wrong choice can consign lots of time and material to the trash bin. We trust that this exposition has helped a bit. There may be many further developments in the processing technology, but the basic principles will remain valid.

☒

AN ASSESSMENT OF TWO TECHNIQUES FOR OBSERVING MICROCHIROPTERAN BATS IN FAUNA SURVEYS.

Greg Richards

Resource Ecology Assessment Program,
Division of Wildlife and Ecology, CSIRO, P.O. Box 84, Lyneham, ACT 2602

INTRODUCTION

Several techniques are now employed in the study of microchiropteran bat communities, particularly for the preparation of Fauna Impact Statements and management plans. These include mist netting, harp trapping, the electronic detection of species-specific echolocation calls, and roost searches (Tidemann and Richards 1988). It appears to be essential to use a variety of methods if all species in a microchiropteran community are to be given every chance of being recorded, but the necessity for applying capture and detection has never been assessed. To make an initial assessment, this paper summarises results of three major bat fauna surveys in eastern Australia.

METHODS

Data collected from fauna surveys in three biogeographically different regions were used in this study. Bat surveys were conducted in state forests of the subtropical Murwillumbah and temperate Wingham areas of NSW, and at a military facility in the tropical Shoalwater Bay area of central Queensland. These surveys were conducted by using mist nets, harp traps, and electronic detection in tandem, and constituted a total of 22 weeks of field work between 1991 and 1995.

Sampling points were stratified according to generalised habitats based upon vegetation communities, but also included other foraging habitats for bats, such as rivers and lake shores. At each sampling point, mist nets were employed in conjunction with a portable harp trap, and two nets were each set with one end against the side of the trap so that they could be extended to form a shallow Vee that would guide some individuals into the trap, particularly those that tend to avoid nets. If nets could not be regularly inspected, plastic sheeting or synthetic open-weaved cloth was substituted. This method allowed a consistent catching area that was used in dense habitats such as rainforest or mangroves, but also gave a wide area to intercept species in open habitats such as eucalypt woodland. The net/trap array therefore gave a consistent and standardised method for all the habitats likely to be encountered in eastern Australia, and elsewhere.

Electronic bat detectors (ANABAT II) were operated at each site, and at Shoalwater Bay and Wingham a timer commenced a 45-60 minute recording session 30 minutes after dusk to allow bats to commute from roosts to foraging habitats. At Murwillumbah the detectors operated continuously from dusk to dawn using a call-activated switch.

RESULTS

Over 200 sampling points were censused: 61 at Wingham, 75 at Murwillumbah, and 65 at Shoalwater Bay. Of the 32 species recorded in total from the three study areas 23 were distributed in more than

one study area, and 8 of these are found in all three. A dataset of 1073 captures and 1533 passes was produced from the censuses.

Table 1 shows that there were six species that were detected and never captured. These included the emballonurids *Taphozous georgianus* and *T.australis*, *Saccolaimus flaviventris* and an undescribed species of *Saccolaimus*, and the molossids *Chaerephon jobensis* and *Mormopterus loriae*. There were also two species, the vespertilionids *Nyctophilus timoriensis* and *N.gouldi*, that were only captured and never detected. However, if the proportions of captures to detections is examined, many other species fall into groups that also have a low probability of being recorded by either method. For example, species such as *Nyctinomus australis* and *M.beccarii* had only one capture each and many more passes recorded. Conversely, *Kerivoula papuensis* calls were recorded on only one occasion and the majority of records were from harp trap captures. Species such as *C.morio* have an almost equal probability of being recorded by either method (45 captures and 51 passes, a ratio of 47:53).

Richards (1994) identified four foraging modes for Australian insectivorous bats; these being aerial pursuit, aerial intercept, prey ambush and gleaning. These foraging groups appear to have survey data biased to one technique. For example, species that have a low proportion of captures and a high proportion of passes primarily forage by aerial intercept, especially above the canopy where they cannot be trapped. Similarly, species that forage by gleaning insects from substrates and either have soft echolocation calls, or listen for prey movement and accordingly do not echolocate (Hosken *et al* 1994), have a low probability of detection but appear to be easily captured.

Table 2 shows summary statistics for the proportion of captures and passes for each species observed, grouped by their foraging mode. In the combined dataset of 2602 observations, aerial intercept species had an average of 0.01 captures compared with an average of 0.92 captures for gleaning species. Values for the average number of passes in these two groups are, of course, the opposite. These proportions can be translated into a 'probability of observation'. Aerial intercept species have a 1 in 100 chance of being captured in surveys, so electronic detectors must be used to incorporate them in surveys; gleaners have an 8 in 100 chance of being detected, making traps an essential survey tool.

DISCUSSION

The level of probability of echolocation calls being detected being related to flight and foraging mode is exemplified by Fenton's (1982) analysis, where there was a 1000-fold difference in the intensity[1] of calls from species that would be allocated to the fast flying aerial intercept group (e.g. *Tadarida*) compared with gleaners (e.g. *Plecotus*). To place this difference into human terms, Fenton used the broad comparison between the sound from a jackhammer and that of a typewriter to distinguish the detectability of these taxa.

It is hoped that the methods described in this paper study will standardise research for, particularly, the preparation of Environmental Impact Statements and studies of habitat use by bat communities. It has been shown that it is essential to use several techniques in tandem to accommodate the utilisation of different niches by different assemblages within an insectivorous community. This is especially important for the aerial intercept assemblage that typically forages above forest canopies and can only be observed by electronically monitoring echolocation calls. Conversely, the gleaning assemblage that is virtually indetectable electronically, appears to be primarily recorded by captures. It is therefore essential to use capture and detection methods in tandem if all species in a microchiropteran community are to be given every chance of being recorded.

REFERENCES

- Fenton, M.B. (1982). Echolocation, insect hearing, and feeding ecology of insectivorous bats. IN: Kunz, T.H. (Ed.) *Ecology of bats.* (Plenum Press: New York).
- Hosken, D.J., Bailey, W.J., O'Shea, J.E. and Roberts, J.D. (1994). Localisation of insect calls by the bat *Nyctophilus geoffroyi* (Chiroptera: Vespertilionidae): a laboratory study. *Australian Journal of Zoology* **42**: 177-184.
- Kitchener, D.J., Cooper, N. and Maryanto, I. (1995). The *Myotis adversus* (Chiroptera: Vespertilionidae) species complex in eastern Indonesia, Australia, Papua New Guinea and the Solomon Islands. *Records of the Western Australian Museum* **17**: 191-212.
- Parnaby, H.E. (1992). *An interim guide to identification of insectivorous bats of southeastern Australia.* Technical Report of the Australian Museum No.8.
- Richards, G.C. (1994). Relationships of forest bats with habitat structure and foliage nutrients in south-eastern Australia. *Abstracts of the 6th Australasian Bat Research Conference, Lismore, 1994.*
- Tidemann, C.R. and Richards, G.C. (1988) Field study techniques. (Bats) *Australian Science Magazine* **2** : 46-49

Table 1 : Data pooled for all species recorded in the Shoalwater Bay, Murwillumbah and Wingham study areas, ranked as the capturability increases. Note that for some rare species the low number of captures and passes may result in inaccurate proportions.

Taxa	**Total**		**Proportion**	
	captures	**passes**	**captures**	**passes**
S.flaviventris	0	22	0.00	1.00
Saccolaimus sp.	0	2	0.00	1.00
T.georgianus	0	5	0.00	1.00
T.australis	0	14	0.00	1.00
M.loriae	0	4	0.00	1.00
C.jobensis	0	9	0.00	1.00
N.australis	1	112	0.01	0.99
M.norfolkensis	1	45	0.02	0.98
M.schreibersii	3	88	0.03	0.97
M.beccarii	1	22	0.04	0.96
C.nigrogriseus	7	58	0.11	0.89
C.gouldii	7	59	0.11	0.89
Mormopterus sp.	1	7	0.13	0.87
F.tasmaniensis	2	13	0.15	0.85
S.orion	3	16	0.16	0.84
V.troughtoni	6	31	0.16	0.84
S.rueppellii	5	22	0.19	0.81
R.megaphyllus	47	146	0.24	0.76
V.pumilus	114	360	0.24	0.76
V.darlingtoni	57	110	0.34	0.66
C.dwyeri	4	7	0.36	0.66
M.australis	50	124	0.40	0.60
V.vulturnus	58	80	0.42	0.58
C.morio	45	51	0.47	0.53
V.regulus	34	24	0.59	0.41
S.greyii	3	2	0.60	0.40
M.adversus[2]	472	107	0.81	0.19
N.bifax	35	5	0.88	0.12
K.papuensis	9	1	0.90	0.10
N.gouldi	96	7	0.93	0.07
N.geoffroyi	13	0	1.00	0.00
N.timoriensis	1	0	1.00	0.00

Table 2 : Summary statistics for each species, grouped by major foraging modes. *R.megaphyllus* also gleans by ambushing prey, and has been added to the aerial pursuit group for simplicity.

	Foraging modes		
	Aerial intercept	**Aerial pursuit**	**Gleaning**
Proportion of captures			
Mean	0.010	0.292	0.920
SD	0.015	0.166	0.074
Min	0.000	0.110	0.810
Max	0.040	0.600	1.000
n	10	16	6
Proportion of passes			
Mean	0.990	0.708	0.080
SD	0.015	0.166	0.074
Min	0.960	0.400	0.000
Max	1.000	0.890	0.190
n	10	16	6

Table 3: Taxa in foraging groups

S.flaviventris	*R.megaphyllus*	*K.papuensis*
Saccolaimus sp.	*C.gouldi*	*N.bifax*
T.australis	*C.dwyeri*	*N.geoffroyi*
T.georgianus	*C.morio*	*N.gouldi*
M.schreibersii	*C.nigrogriseus*	*N.timoriensis*
C.jobensis	*F.tasmaniensis*	*M.adversus*
N.australis	*M.australis*	
M.norfolkensis	*S.orion*	
M.loriae	*S.greyii*	
M.beccarii	*S.rueppellii*	
	V.darlingtoni	
	V.pumilus	
	V.regulus	
	V.troughtoni	
	V.vulturnus	
	Mormopterus sp.[3]	

1. Where sound intensity was measured in micropascals.
2. The genus *Myotis* was recently revised by Kitchener *et al* (1995), so under the name *M. adversus* data may also be present for *M. moluccarum* and *M. macropus*.
3. The "*Mormopterus* sp. no. 1" of Parnaby (1992).

☒

GETTING GOOD CALLS FROM CAPTURED BATS

Chris Corben

PO Box 128
Olema CA 94950, USA.
<corben@delphi.com>

Associating bat calls with the species producing them is the biggest problem faced by anyone trying to refine the process of acoustic identification. Because bat calls are typically so variable, it is necessary to attempt documentation of the total range of calls produced by each species. This process needs to be repeated at a wide range of locations to determine the influence, if any, of geographical variation.

One of the most promising techniques is to record calls from bats being released after catpure. But this approach can be very ineffective or misleading if not carried out with a clear understanding of how the process can affect the range of calls given by the bat. What I want to do here is to explain the methods I have found effective, and give the rationale for these. I hope that others will make suggestions to improve on what follows.

The Problem

Most bats produce a wide range of echolocation calls, depending on their immediate surroundings and probably on other factors, such as how familiar they are with the terrain. In general, these echolocation calls fall along a broad continuum. At one extreme, in cluttered environments, typical calls may be very short in duration and steep, consisting of a linear downsweep across a wide range of frequencies. At the other extreme, as the bat flies through broadly open space, such as when commuting, calls may be much longer in duration, flatter and more varied in slope. Although the steeper calls are rather stereotyped, there is much more variation in calls at the flatter end of the spectrum, so these flatter calls are more likely to be useful for species identification.

When a bat is released, it will most often start off by giving calls at the steep end of its spectrum. If the surroundings are open enough, it may eventually start calling with flatter calls, but this may not happen until it is beyond detector range, especially if the surroundings are complex. Since the idea is to obtain calls from as much as possible of the bat's repertoire, the results will often be very disappointing.

1) Choose a wide open space

Ideally, bats should be released in a huge, open space, devoid of any objects which might produce echoes. Releasing a bat in a room, even a very large room, will almost always result in calls only from the steep end of the spectrum. This should be expected even for whispering bats. I have recorded a number of calls from *Nyctophilus* in open country which were much flatter than anything I have obtained from inside a large lecture theatre. I'm guessing that the problem is that the bat will head straight for the walls, so that even if the room is huge, it will fly around the perimeter, so that it constantly receives echoes from the walls as it interrogates the nature of its confines. Release it in a complete void, though, and it will have nothing obvious to head for.

I'm not talking about releasing the bat in the average backyard. More appropriate is something like a deserted football field! There is an additional benefit in choosing a really big open space. It is really difficult to follow a bat with a light when it passes in front of a complex background, like a bush. If any background is too far away to be effectively illuminated by the light you use to follow the bat, then you will have a much better chance of keeping the bat in sight as it gets further away. This might get you better calls, if the bat returns. Remember, you have to be sure that the bat you are recording is the one you released.

2) Choose an area with no other bats

Obviously it's a problem if other bats are flying in the release area. I've lost many sequences due to a second bat coming in and flying around with the one I've just released. If you release several bats in a short time, there is a good chance one of the previously released bats will reappear later. You can't do anything about it, you just have to accept that not all releases will result in good call recordings.

3) Don't use a really bright light.

For bat watching, I like to use a 100 Watt spotlight, because brighter light shows up more detail on a free-flying bat. But such a bright light certainly repels bats, and is inappropriate for release work, where the hope is that the bat will stay around for a while. On the other hand, too dim a light will make it too difficult to follow the bat once it gets more than a few metres away. I've been using a 50 Watt floodlight with about a 90 degree beam and finding that a good compromise, though it may be useful to have a second person on hand to track the bat with a brighter light when it gets further away. I would expect that to be a bigger advantage with louder bats, from which good calls can be obtained at longer distances. My 100 Watt spotlight actually throws a very broad beam of low intensity around the central spot, and this can be used, keeping the bat out of the main beam until it gets too far away to follow without a brighter light. In general, try to use the lowest light intensity which is sufficient to keep the bat in sight.

Another option is to use light tagging. This allows you to follow the bat without having to illuminate it at all. I have mixed feelings about this. While there may be an advantage in not shining a light on the bat, it might also be that the irritation of carrying a light tag makes the bat more likely to want to get out of the area quickly. It's not at all clear to me how much advantage light tagging gives, though it might be of most benefit in the case where there is only a single bat of a particular species to be released. In this case, light tagging has the advantage of identifying that bat if it returns to the area later on.

4) Record direct into a computer

If you use ANABAT, you will get better results if you record the calls directly into a laptop, than if you record them into a cassette-recorder first. There's a lot of work in obtaining reference calls of known species, so you want to get the best you can.

5) Release the bat hot

It's very common to find that a released bat just flops to the ground, or doesn't want to leave at all. Usually, this isn't because there's anything wrong with it, but because it's gone into torpor. Many bats will go into torpor incredibly fast, and even though they might struggle as you take a few measurements, they aren't up to flying when you get them to the release point. So keep them warmed up. I've been using a small esky with a sealed container full of hot water at the bottom, insulated enough that the bats can't possibly come into contact with anything that could hurt them. My impression is that you need to keep them at above about 25 degrees C to keep them from going torpid, but I presume this varies between species. Obviously, you mustn't overheat them.

Sometimes it will be good enough just to process the bat quickly and release it as soon as possible after capture. But some bats will be in torpor before you can even get them out of a net. If it's necessary to hold them some time before release, let them go into torpor and heat them up just prior to release. Presumably it takes longer to warm up larger bats (my experience has mostly been with smaller species).

6) Don't throw them away!

I've often seen people release bats by throwing them into the air, or even hurling them off into the distance. You'll get better calls if you let the bat release itself. Just open your hand and let it fly off, or place it on your shirt so it can climb up to your shoulder and jump off there. If it's reluctant to leave, it's probably torpid.

I've heard it said that some species aren't capable of flying off unless they have sufficient height from which to launch themselves. Two of the species for which I have heard this claim are *Lasiurus cinereus* in North America and *Nyctinomus australis* in Australia. But others have told me that both these species can take off from the surface of the water when triplined! These observations seem to be in contradiction. My suggestion is that it might just be harder to get these larger bats warmed up enough after they've gone torpid. Maybe someone else can throw more light on this.

7) Keep conspecifics, but ONLY conspecifics, nearby

A released bat will often tend to fly off in a particular direction, so it may be out of detector range before giving any good calls. But others will circle around, giving a good range of calls before leaving the area. That's what you want. One way to improve your chances is to keep other bats of the same species close to the release point. Communication between the released bat and those still captive will often result in the released bat staying close by for a while.

A second advantage of doing this is that you may get recordings of some social calls, and these might ultimately prove very useful for species identification. That's why bats of other species should be kept right away from the release area. You want to be sure that any calls you record come from the species being released.

8) Keep data with the calls.

It doesn't take much effort to at least record the sex and forearm length of each bat as it is being released. Although this might seem peripheral to the object of the exercise, it may prove useful later. If you are using ANABAT with a laptop, it's a simple matter to save this data into the default header (using ctrl F10) before the release of each bat, so that sequences recorded using the s key or by pressing the calibration button on the detector, will automatically include this data.

9) Keep other people away

It's hard for people to keep still and quiet when faced with the sight of a bat flying around nearby. Shuffling feet, rustling clothes and whispering all produce a lot of ultrasound which can interfere with the recording process. Try to keep the number of people at the release point to a minimum. If you use ANABAT, it's easy for one person to track the bat with a light and make the recordings by pressing the calibration button on the bat detector (avoiding the need to look down to the computer to hit the s key). Another person can release the bat, hang on to a bag of conspecifics and follow the bat with a more powerful light when it gets further away. If two people work together on this, it can be very efficient, with one person noting the sex and forearm while the other enters this into the default header.

I've had good results from using the approach outlined above, with a variety of species. I've also tried following light-tagged bats on foot. The latter technique has the disadvantage that recordings must be made initially on cassette tape, degrading call quality. It's also dangerous - twisted ankles are a definite risk. But it can be combined with recording directly into a laptop at a fixed position, to maximise the chance of getting good calls from a single bat.
☒

Just published!

"*The biology & management of flying-foxes in NSW*" by Peggy Eby. Published by the NSW National Parks & Wildlife Service. Species Management report Number 18.

Available for $15 from: NPWS
PO Box 1967
Hurstville NSW 2220

ph (02) 585 6444, fax (02) 585 6555

NOVICE RAMBLINGS

Duncan Kirkley

<florida@adam.com.au>

In March of last year (1995) I found myself left to release several bats that had been captured at Yookamurra Sanctuary (near Sedan, South Australia) by Terry Reardon - thus began a fascination for me and an endurance test for my wife and Terry, my suffering mentor and guiding light. I have since acquired mist nets, my own Anabat system and am in the process of building five harp traps. This introduction is by way of letting you know that this article is written by one who is long on enthusiasm though of limited experience, which will become obvious.

Initially I thought that recording of the echolocation calls of the bats and identifying them by their calls through the use of a sonograph would be relatively easy. Those in the know smile and think "out of the mouth of a babe". I took my newly acquired Anabat system to Bali with me and filled up several tapes - it was interesting; however, I've not a clue what species I might have recorded as there is nothing to compare with.

Anyway, what I would really like to share with you is my recent discovery (for me anyway) of the tremendous call variations that can come from one particular species. In this case *Nyctinomus australis*; (they just had to go and change the name when I was just learning to remember and pronounce *Tadarida*), anyway, the White-striped Freetail -bat.

Recently while at Buckaringa Sanctuary in the Buckaringa Gorge, Middle Gorge area of the Lower Flinders Ranges I was mist netting at a dam, which is probably the only water for a considerable distance. There are two permanent water holes locally; however, both are very small and protected by the surrounding rocks in such a way that only the one presents anything like a feasible flight path. Well there I was with a mist net at each end of the dam and my Anabat set on the hood (whoops bonnet) of my pickup (ute), guess where I originated. As I approached one of the nets I thought "Oh My God!" I've caught a monster - my previous experience has been confined to bats around the 10g weight mark. Well I had just caught my first White-stripe and what a beautiful creature she was. Imagine the Australian Museum having the audacity to refer to "The grotesque, savage appearance of this bat". I think they look kinda like a Rottweiler. On that first night I caught two White-stripes one male and one female, a number of Southern Freetail-bats *Mormopterus planiceps* (all were females making differentiation between Big and Little Dick somewhat difficult), and a couple of Gould's Wattled Bats *Chalinolobus gouldii* and a single Chocolate Wattled Bat *Chalinolobus morio*.

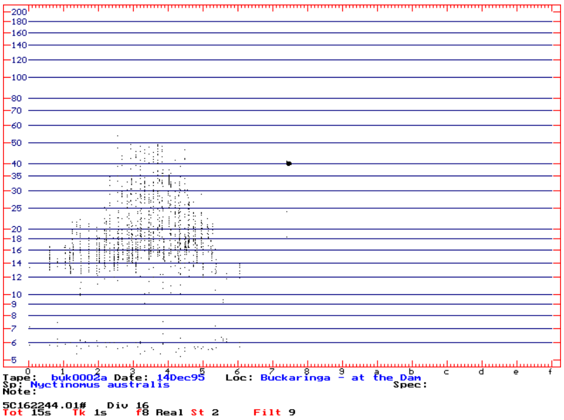
The next bit of excitement came when I got home and started looking at the calls that I had recorded. My limited experience told me that a White-striped Freetail-bat had a call that was at the 12kHz mark, reasonably flat, and of fairly long duration. Now here I was with this tape full of something that was base lining in the 14~15kHz area, FM shifting from as high as 25kHz and coming pretty rapid in comparison to what I was expecting. The other thing was that in my previous experience the White-stripe traffic was always one or two passes intermixed with a multitude of other activity. This unknown (?) was extremely active.

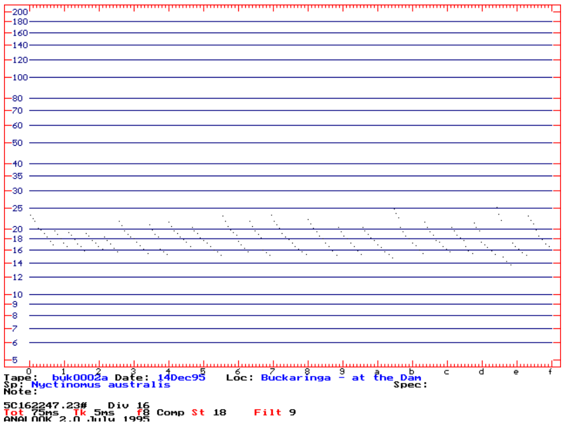
I went rushing off to the SA Museum to pester the long suffering (and this is only the beginning, Trust me) Terry with my disks in hand. He had a quick look and shook his head in a knowing manner but did not reveal what it was he was knowing at the time. So, I thought I would put a request onto Batline and see what I got. I had a response from Martin Rhodes, currently down in Tassie, who advised me that in his experience, around a dam where bats are coming in to drink and the area is congested with other bats, the calls will be different to the open area cruise call. I pointed out Martin's response to Terry who said he agreed and then I got a email message from Chris Corben who also agreed that what I had was simply *N. australis*.

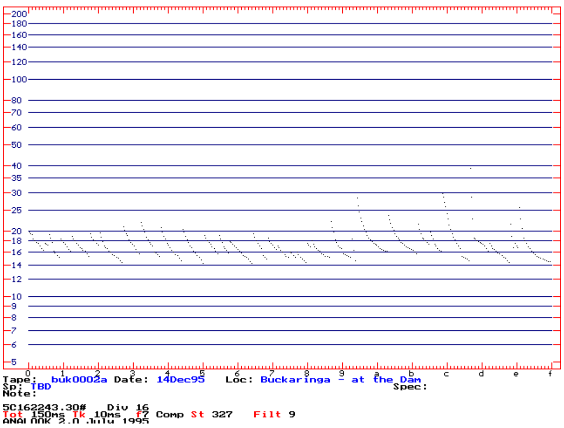
During our discussions Martin advised that he was going to be in Adelaide over the Christmas break and would like to take a trip up to the Flinders - so we did. Another excellent trip. If I could only remember but half of what Martin told me. In addition to the mist nets, and one of my homemade harp traps, Martin showed me how to lay out a trip line and we only covered about a quarter of the water surface area and still had many swimming bats. *M. planiceps* has one hell of a butterfly stroke. Again, two more White-stripes were captured, this time as swimmers, both were females. I thought they might have been pregnant but Martin felt they were just full from feeding. Again, the tapes show a lot of activity in the area by the White-stripe and my gut feeling is that there is a colony close by. There is a dry river/creek bed nearby which has many trees which would make ideal roosting sites.

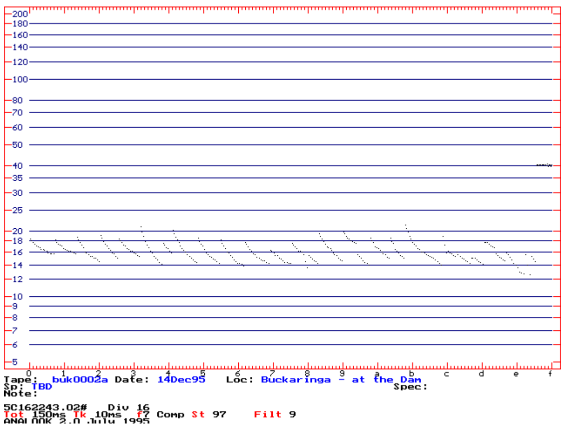
There must be at least a little interest in what my recorded calls attributed to *N. australis* look like so here's a few examples: It is a shame I can't present the full sequence as a couple show the full sequence of the pass. If anyone would like to have any of these cuts sent to them just let me know and I'll be glad to send them on.

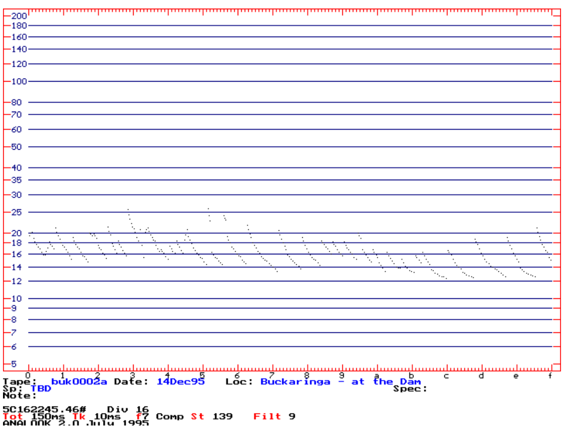
If I can find this colony I would like to undertake an extended study over a period of time. So, if anyone would like to help by giving me some helpful hints on the "How To" of studying a colony, feel free.











http://www.skypoint.com/members/mikefry/bat.html

Infant Insectivorous Bat Rehabilitation

by Mike Fry

ABSTRACT

Despite a lack of evidence to support it, there is a common belief that infant insectivorous bats are incapable of being successfully raised and returned to the wild. Some wildlife rehabilitators have speculated that: young bats are incapable of learning to catch live food without the assistance of adult bats; captive raised bats might not be accepted into colonies of wild bats; captive raised bats would be incapable of finding shelter.

In the face of no scientific evidence to support these speculations, the author attempted to collect data that would shed light on the releasablility of captive raised insectivorous bats.

INTRODUCTION

During the spring and summer of 1993, the author networked with the Minnesota Department of Natural Resources, local nature centers, wildlife rehabilitators, pest control companies and naturalists in order to acquire infant bats in need of rehabilitation. Infant bats were then raised with limited human contact and provided with large amounts of natural food sources. When the young were old enough to fly, they were placed in a flight cage at Tamarack Nature Center in Ramsey County, Minnesota.

The cage was constructed in such a way as to allow the free movement of flying insects into and out of the enclosure. A battery powered fluorescent lantern was suspended in the center of the enclosure, attracting large quantities of flying insects in the evening. Supplemental food was gradually reduced over the summer and weights were monitored twice daily.

Radio transmitters weighing 0.6 grams were purchased from Holohill Telemetry and ATS Systems. Dummy transmitters were attached to the backs of two bats, using ANDREA Perma-Lash Adhesive.

In addition to the active rehabilitation that took place during the study, opportunities arose to explore more proactive approaches to suburban habitat preservation of maternal colonies.

PHILOSOPHY

1) During the course of this study, in the face of little or no scientific data concerning the release of infant bats, there were a number of assumptions made by the reasearchers. The primary assumption was that fundamental rehabilitation principles that were effective with other species of animals would also apply to infant insectivorous bats. Based on this assumption, we made the following decisions:

2) Each individual animal would be measured against a specific set of release criteria.

3) Whenever possible, bats would be raised with con specifics.

Whenever possible, we would attempt to reunite young bats with their mothers rather than pursue rehabilitation.

In addition to these decisions, we concluded that bats were poor candidates for life-long captive care. Therefore, any bats which were deemed unreleasable were humanely euthanized.

RABIES

Due to the seriousness of potential exposure to rabies, careful consideration needs to be made prior to handling bats. This study does not propose to make any claim as to the safety of handling bats with regard to this disease. Nor does this study propose circumstances that would be safe for handling any species of bat.

In some areas of the United States, it is illegal to rehabilitate bats due to the potential for spreading this disease. So the importance of considering this aspect of bat rehabilitation can not be understated. For the purposes of this study, all persons responsible for handling bats received pre-exposure rabies vaccinations.

NON-REHABILITATION ACTIVITIES

During the season, we encountered two maternal colonies of Little Brown Bats which were in danger due to construction or demolition of the buildings in which they resided. Through the efforts of project volunteers, both construction projects were postponed to a point when young bats were capable of flying. This also provided the rare opportunity to observe some mother/infant interaction in a natural setting.

REHABILITATION

Neonate bats were housed in Styrofoam coolers with air holes punched through the sides to allow for ventilation. Soft cotton cloth was hung on the sides of the coolers and placed on the bottom. The cloth provided folds in which the young bats would hide. The material also facilitated daily cleaning of the enclosures. The ambient room temperature of the bat nursery was kept at about 90°F during the day with the temperature dropping to about 80°F in the evening. Infant bats were initially fed small amounts of formula mixed with a rehydrating solution of 2.5% Dextrose in Lactated Ringers. Once infants appeared stable and no signs of digestive problems were observed, the amount of rehydrating solution was decreased and the amount of formula was increased. By their third day in the bat nursery, infant bats were being fed 100% infant bat formula. For a detailed description of the formula fed, see Table 1.

Since no data could be found concerning the maximum comfortable stomach capacity of bats, the stomach capacity was assumed to be similar to most other placental mammals. Therefore, feeding schedules were calculated based on a stomach capacity of 50 cc per kilogram of animal body weight.

Anecdotal information received from talking with other rehabilitators suggests that infant bats may have a comfortable stomach capacity that is considerably larger than this. However the 50 cc per kilogram volume is recommended as a starting point in feeding.

Table 1 - Infant Bat Formula

Ingredients:	Amount:
Waxworms	250
Multi-milk (liquid)	3 tbs
Crickets (large)	24
Nutri-cal	1" ribbon
Large Mealworms (optional)	24
Natural insects*	1/4 cup

*Natural insects can include an assortment of: flies, moths, gnats, leafhoppers, mosquitoes, and bealtes.

Preparation Instructions:

Place all of the above ingredients in a blender. Add an appropriate amount if your favorite all-purpose multi-vitamin and blend until smooth.

Pour this mixture through a fine strainer to remove hard solid pieces which would tend to clog syringes.

Fill 1cc syringes with formula and freeze. Keep frozen until ready to

Bats were weaned off formula onto a combination of live and dead insects including crickets, mealworms and waxworms. Flies, leafhoppers, moths, mosquitoes, gnats and beetles were also provided.

During the summer, 16 bats were accepted. Big Brown Bats (*Eptesicus fuscus*), Little Brown Bats (*Myotis lucifugus*), Silver-haired Bats (*Lasionyceris noctivagans*), and Red Bats (*Lasiurus borealis*) were all seen. Lone infants as well as injured females carrying young were treated.

MOTHERS WITH YOUNG

All infant bats that were admitted with a mother were left with their mothers during the rehabilitation process. Even stressed and injured mother bats demonstrated great care in tending their young. On the basis of this observation it is recommended that young be cared for by their natural mothers for as long as possible. Further study needs to be conducted concerning the release of young with their mothers. However, given the territorial nature of most bats, as well as their willingness to care for their young under stressful circumstances, there does not appear to be any reason to remove the young prior to releasing the mother, assuming they can be returned to their colony.

PRE-RELEASE CONDITIONING

A total of four infant bats were raised over the summer which could not be returned to their original maternal colony with their mothers, two Big Brown Bats, one Silver-Haired Bat, and one Red Bat. For the purposes of this study, a flight cage measuring 8 feet (h) x 8 feet (w) x 16 feet (l) was constructed.

When the young, motherless bats reached approximately 5 weeks of age, they were moved into the flight cage. Their Styrofoam coolers were mounted to the walls in an area of the enclosure that was protected from weather.

Once active flight patterns were observed, supplemental feeding was gradually reduced. Weights were monitored throughout the summer. Dramatic weight fluctuations were observed throughout the season. Many possible variables seemed to affect the weight of the young bats, including: temperature, bad weather, amount of supplemental feeding, the presents or absence of live insects in the enclosure, and the bats activity levels.

While bats were not directly observed catching live food, all of the data indicates that young bats were self-feeding on live, flying insects.

Suggestive data includes:

1) All of the bats showed weight gains, even in the absence of supplemental food.

2) Weight gains accelerated after supplemental feeding stopped.

3) Live insect populations inside the flight cage dropped throughout the summer.

4) Feeding-type behavior was observed from all four bats in the flight cage.

5) Echolocations observed with through a bat detector indicated feeding buzzes as bats flew in the aviary.

RELEASE CRITERIA

When measured against our release criteria, all four of the orphaned bats qualified for release to the wild. Our primary criteria were:

1) Bats could maintain prolonged, strenuous flight.

2) Bats were capable of self-feeding.

3) Bats were recognizing humans as natural predators.

4) Bats were locating and using various shelters (other than their coolers) in the aviary.

TELEMETRY

To minimize the negative impact of a transmitter on a released bat, the recommended transmitter weight should be kept to under 5% of the animal's body weight. Due to this weight restriction, only the

two infant Big Brown Bats were large enough to carry the 0.6 gram transmitters.

Three weeks prior to their planned release, we glued dummy transmitters to the backs of the two Big Brown bats. This was to provide an opportunity for the bats to adjust to flying while carrying the additional weight. Dummy transmitters were made by filling short sections of PVC tubing with latex material to achieve the desired weight.

Commonly used glues in telemetry studies include Skin Bond (a product used for affixing colostomy bags to human patients) and eyelash glue. We used a product called ANDREA Perma-Lash Adhesive. As predicted by the literature, after a period of about 2-1/2 weeks, the dummy transmitters fell off.

Unfortunately, there was considerable damage to the skin of the bats under the transmitter. Injuries resulting from the eyelash glue prevented the timely release of these two bats.

CONCLUSIONS

Based on the lack of scientific data concerning the release of infant insectivorous bats, wildlife rehabilitators have to make decisions about these animals with incomplete information. There is great opportunity for future study in this area, not only in regard to the releasability of infant bats, but also on the potential effects of glues used in telemetry studies.

While we were unsuccessful in proving or disproving the releasability of captive raised bats, we found no evidence to support speculation that proven rehabilitation techniques that work with other species of animals will not work with bats as well.

In our literature searches, we found no rehabilitation studies performed where infant bats were released and known to have died. If such a study existed, it would not prove that captive raised bats are not releasable, only that the rehabilitation techniques used were not effective with the bats in that study.

We found infant insectivorous bat rehabilitation to be challenging, time consuming, and labor intensive, but results of this study suggest that successful rehabilitation of insectivorous bats is possible.

☒

Noticeboard (continued ...)

CAPE TRIBULATION TROPICAL RESEARCH STATION

Dr. Hugh Spencer

Director

Cape Tribulation, some 160 km north of Cairns, in far North Queenland, Australia, is home to the Cape Tribulation Tropical Research Station. It is the only research facility in the coastal lowland seasonally-wet tropical rainforests of Australia. The Station is surrounded by the World Heritage listed Cape Tribulation National Park and private land. The dominant forest type is complex mesophyll vine forest, which reaches its pinnacle of complexity in Australia in the forests of this region. Forest which is over 100 metres altitude is untouched primary forest. However the area contains a diversity of habitats, from mangrove forests (with over 30 species of mangrove recorded), littoral rainforest (the Station is less than 1 km from the coast) to relict sclerophyll woodlands on dry slopes.

Backing the area is the coastal range which varies in height from 700-1,348 metres (Thornton's Peak). This range has a major impact on the local weather, and is the cause of the exceedingly high precipitation the region experiences; on the average, 4 metres per annum. The climate is seasonally wet with a monsoon-influenced wet season lasting from January to May and a dry season from June to January.

The research station was established in 1988, as a non-affiliated research station,during the height of the controversy over the listing of the region in the Register of World Heritage. A tax-deductible foundation, The Australian Tropical Research Foundation (AUSTROP), has been set up to operate the Station. A formal relationship with the local university, James Cook University in Townsville (some 500 km to the south) is presently being negotiated.

Facilities

The Station facilities are presently fairly basic, and comprise laboratory space and limited accomodation. There is a good range of field equipment, microscopes, radio-tracking gear, plant drying facilities, survey gear, etc., as well as workshop facilities. The region is remote from grid power and the station is served by a generator and solar power. There is no air-conditioning. Water-borne pathogens are virtually unknown in the region, and hence most surface water is safe to drink. Adjacent to the station is an extensive exotic fruit orchard, primarily specialising in fruit of Indo-Malayan origin.

Access

A bitumen sealed road extends most of the way from the Daintree Ferry to Cape Tribulation. driving time from Cairns is about 3 hours.

Education

The "Bat House" is an education and interpretation building for tourists, operated by the Foundation and which doubles as a classroom for small groups. Entry is free, but a donation (gold coin) is requested. it gets its name "Bat house" from the fact that there is always a tame flying-fox present as a "rainforest ambassador" to help explain to visitors the importance of such animals to the conservation of the forests. Inside the "Bat House" is detailed pictorial information on the rainforest, the Wet Tropics World Heritage Area, and the local environment, as well as current research at the Station.

Recreation

The area is adjacent to some of the finest coral assemblages of the Great Barrier Reef, and small diving and snorkelling tour boats leave Cape Tribulation daily.

Research

Present research by Station personnel centers on phenology of cluster figs, population biology and ecology of the blossom-bats and their relatives, genetic diversity of the rare and endemic plants and rainforest regeneration research.

Information for prospective users

Bookings are struictly on a first-come first-served principle, with preference given to long term researchers. Further information is available from the Director, Cape Tribulation Tropical Research Station, PMB 5, Cape Tribulation, QLD 4873, Australia. Phone +6 1 (0)70 980 063. Faxes may be sent to the same number provided 15 minutes warning is given of transmission. Otherwise faxes may be sent to (070) 314 429 (AUSTROP) but there may be several days delay in our receiving them. Our e-mail address is <x-eehs@jcu.edu.au>.

The Cape Tribulation Tropical Research Station has a Home Page on the Internet.

http://www.ece.jcu.edu.au/...../cape_trib/cape_trib.html

or use a browser to search for Cape Tribulation Tropical Research Station.

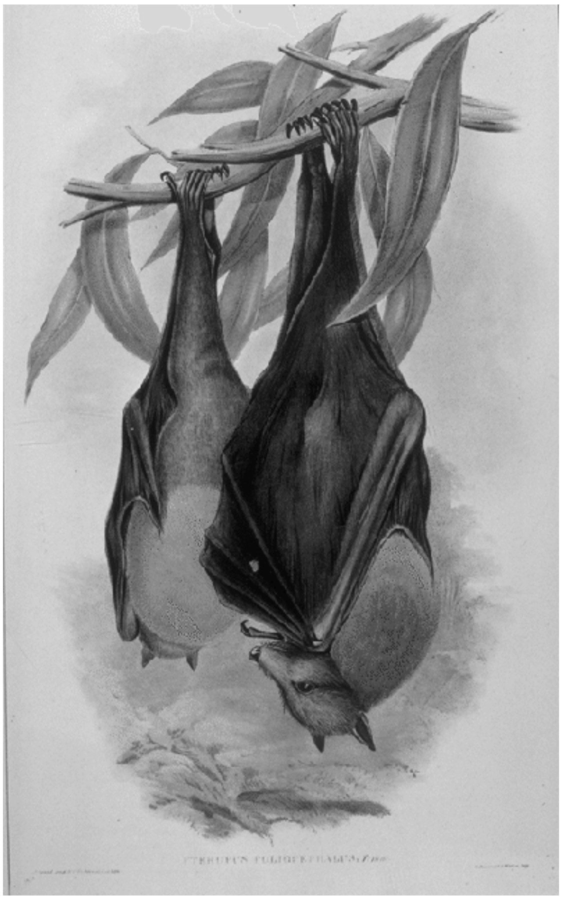
☒

SHOULD WE HARVEST FLYING-FOXES FROM THE WILD WHEN THEIR NUMBERS ARE DECLINING?

Jillian Snell

PO Box 612
Milson's Point NSW 2061

The following are human induced problems which cause the death of many flying-foxes. Items 1, 2, 3 which include shooting, electrocution & loose netting entrapment, kill flying-foxes which would not normally succumb at this early stage therefore preventing their contribution to the gene pool during their normal lifespan ie. non-selective culling.



1. **How many flying-foxes are shot each year by orchardists?** National Parks & Wildlife Service have no resources to monitor licensed shooting let alone unlicensed shooting of flying-foxes. In Spring & Summer most females have dependent young so if the mother is shot the baby also dies. Furthermore how many shot animals fly away only to die elsewhere of blood loss and their injuries. The Ku-ring-gai Bat Colony Committee regularly receives reports of animals with shattered wings dying in trees, or found crawling along the ground within the neighbourhood of the fruit growing area, their spines fractured by buckshot. If orchardists had kept up with current advances in netting technology their orchard would be showing a profit by now, and they would not have to shoot flying-foxes. (See Flying-fox Workshop Proceedings Wollongbar 1990)

2. **How many flying-foxes are electrocuted on power lines** each year Australia wide?

3. **Do we know how many flying-foxes die caught in netting** thrown over crops not properly constructed?

4. **To what extent is deforestation & urban sprawl reducing flying-fox food resources?** The Ku-ring-gai Bat Colony Committee receives reports of instances where large numbers of flying-foxes are starving, fragmented into ones and twos frantically searching for food even during the day. This occurs because one or maybe several tree species have failed to flower and the animals were not able to migrate because the distances between feeding sites were too great, especially with dependent young. An incident just such as this occurred in Brisbane 1991. (Ref. 'Flying-fox Camps', Les Hall & Greg Richards, *Wildlife Australia*, Autumn 1991,19-22).

Before we can even begin to consider harvesting wild flying-foxes we look forward to extensive and conclusive study of flying-fox populations, population distribution, flying-fox habitat, their diet and social structures, their importance and current impact on pollination and also the impact of the proposed harvesting on all of the above.

Mr David Butcher, Chief Executive Officer, Word Wide Fund for Nature, said that it is hard to see any conservation benefits of harvesting wild flying-foxes. Human greed proliferates again at the expense of another species. Assuming that the ecosystem sustains a certain number of flying-foxes and knowing that flying-fox populations are diminishing throughout the world, who has the right to further disrupt this ecosystem ie. by free shooting for profit, while others work feverishly to conserve protected flying-fox species and their habitat.

It would need to be known, how the number of flying-foxes shot for restaurants could be regulated and who would be assessing their slaughter & preparation? Would shot animals be harvestable? How would shot animals be removed from trees? How would it be established if an animal is female and lactating before being shot? Or will it be that dependent young die as well?

Why can't Pacific Islands protect their own endangered flying-foxes? Why do they set their sights on our declining flying-fox numbers for their restaurant trade? In some islands flying-foxes are protected, for example Western Samoan flying-foxes (Ref. 'The Flying-fox Trade' BCI Spring 1990, pp 6-9) their pollination & seed dispersal activities seen as invaluable to the ecosystem balance of the island.

All the questions that must have been answered before the granting of approvals to farm crocodiles and other species, certainly need to be addressed to the farming of flying-foxes:

> A suitable diet at least better than their natural diet. Black Flying-foxes eat 450 g fruit per day plus protein supplement and Grey-headed Flying-foxes consume 375-400 g fruit per day plus protein supplement. Therefore the cost to feed these animals must be allowed for.
>
> An enclosure for free range development of flight muscles (their only meat) and enough separation to allow for preening and sunning themselves to avoid fungal infection, as well as good management and flexibility within the 'pen' to prevent males fighting incessantly and/or killing the females with affection.

We have to consider the consequences of our actions, ie. ensure sustainable use of wildlife does not have a net monetary advantage for a few individuals at the expense of wildlife, and in the case of flying-foxes and forests, this would be unethical and unacceptable.

I would like to quote the final summation of the seminar proceedings on the 'Sustainable Use of Wildlife' by Hal Cogger (Live Wires Vol. 6 No 4 Summer 1995)

“I get the clear impression that there is a significant proportion of the people present who, like me, have reservations about a free market-driven approach to sustainable use of wildlife but who have no philosophical objection to sustainable use provided that:

- it is assessed on a case by case basis
- appropriate protocols and safeguards are put in place regarding animal welfare considerations and rigorous monitoring of sustainability, and
- in Ray Nias's words “there is demonstrably a 'net conservation advantage'”.

Proposed hunters or harvesters of flying-foxes please explain .....

☒

RECENT PUBLICATIONS

- Churchill, S.K. (1995). Reproductive ecology of the Orange Horseshoe-bat, *Rhinonycteris aurantius* (Hipposideridae: Chiroptera), a tropical cave dweller. *Wildlife Research* **22**: 687-698.
- Conole, L.E. & Baverstock, G.A. (1995). Bats in remnant vegetation along the Barwon River, Victoria. A survey by electronic bat-detector. *The Victorian Naturalist* **112**(5): 208-211.
- Falkingham, C. (1995). Naturalist note from the naturalist in residence: The Grey-headed Flying-fox. *The Victorian Naturalist* **112**(2): 102-103.
- Irvine, R. & Bender, R. (1995). Initial results from bat roosting boxes at Organ Pipes National Park. *The Victorian Naturalist* **112**(5): 212-217.
- Kutt, A.S. (1995). Activity and Stratification of Microchiropteran Bat Communities, East Gippsland. *The Victorian Naturalist* **112**(2): 86-92.
- Lumsden, L.F. & Bennett, A.F. (1995). Bats of a semi-arid environment in south-eastern Australia: biogeography, ecology and conservation. *Wildlife Research* **22**: 217-240.
- Lumsden, L.F., Bennett, A.F., Krasna, S.P. & Silins, J.E. (1995). The conservation of insectivorous bats in rural landscapes of northern Victoria. **IN:** Bennet, A., Backhouse, G. & Clark, T. (Editors). *People and Nature Conservation. Perspectives on Private Land Use and Endangered Species Recovery*. (Transactions of the Royal Zoological Society of New South Wales: Sydney).
- Martin, L., Kennedy, J.H., Little, L., Luckoff, H.C, O'Brien, G,M., Pow, C.S.T., Towers, P.A., Waldon, A.K. & Wang, D.Y. (1995). The reproductive biology of Australian flying foxes (genus *Pteropus*). IN: Racey, P.A. & Swift, S.M. (Ed's). *Ecology, evolution and behaviour of bats.* (Clarendon Press: Oxford).
- McKenzie, N.L., Gunnell, A.C., Yani, M. & Williams, M.R. (1995).Correspondence between flight morphology and foraging ecology in somePaleotropical bats. *Australian Journal of Zoology* **43**: 241-257.
- Menkhorst, P.W. (Editor) (1995). *Mammals of Victoria. Distribution, Ecology and Conservation.* (Oxford University Press: Melbourne).

⊠

INSTRUCTIONS TO CONTRIBUTORS

The *Australasian Bat Society Newsletter* will accept contributions for one of two broad sections of the Newsletter. For consistency the following guidelines should be followed:

For Scientifc Articles:

- Hard copy manuscripts should be posted to the Newsletter Editor at the address below.
- Electronic copy manuscripts should be submitted in plain text (ASCII) form on an IBM format 3½" floppy disk to the above address, or as an email attachment to the Newsletter Editor.
- Manuscripts should be submitted in clear, concise English, double-spaced (with generous margins, and on A4 paper for hard copy) and free from typographical and spelling errors.
- Papers should include: Title; Names and addresses of authors; Abstract (approx. 200 words); Introduction; Materials and methods; Results, Discussion and References. References should conform to the Harvard System (author-date).
- All pages, figures and tables should be consecutively numbered and correct orientation must be used throughout. Metric units and SI units should be used wherever possible.
- The Newsletter does not have the facility for photographs. Diagrams and figures should be submitted as "Camera ready" copy, sized to fit on an A4 page. Tables should be in a format suitable for reproduction on a single page.
- Manuscripts are not being refereed routinely at this stage, although major editorial amendments may be suggested and specialist opinion may be sought in some cases. Articles will generally undergo some minor editing to conform to the Newsletter.

For News, Notes, Notices, Art etc.:

Hard copy should be posted to the Newsletter Editor at the address below. Electronic copy should be submitted in plain text (ASCII) form on an IBM format 3½" floppy disk to the address below, or as an email attachment to the Newsletter Editor. Manuscripts should be submitted in clear, concise English, double-spaced (with generous margins, and on A4 paper for hard copy) and free from typographical and spelling errors. Art in the form of line drawings and other monochromatic media may also be submitted. "Camera ready" copy, sized to fit on an A4 page, is essential for illustrations. The Newsletter does not have the facilities for photographs.

Special notes for electronic submission:

Although electronic submission is strongly encouraged, there are a few ground rules. I use IBM-PC and UNIX computers, and have very limited means to decode files generated by Amiga, Macintosh or other systems. Plain text (ASCII) is by far the best format to eliminate compatibility problems, and can easily be sent as part of the body of an email message. This is the **only** convenient way for me to receive text generated on an Amiga or Macintosh. If attaching formatted IBM-PC files to email, please remember to tell me what word processing package has generated the file. I can handle UU or MIME coding, but cannot decode BinHex attachments. If none of this makes sense, please ask for advice from your local computer guru, system administrator or Internet access provider.

President

Dr Len Martin
Department of Physiology
& Pharmacology
University of Queensland
QLD 4072
Australia
Ph (07) 365 3128
Fax (07) 365 1766
Email: martin@plpk.uq.oz.au

Secretary

Jillian Snell
PO Box 612
Milsons Point
NSW 2061
Australia
Ph (02) 264 1800
Fax (02) 267 5363

Newsletter Editor

Lawrie Conole
2/45 Virginia Street
Newtown
Victoria 3220
Australia
Ph BH (03) 9669 9732
Fax BH (03) 9663 3669
Ph AH (052) 29 4037
Email: lconole@mov.vic.gov.au