THE AUSTRALASIAN BAT SOCIETY NEWSLETTER

Number 7
October 1996

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ATTACHMENT: Dick Allison's Naracoorte conference handout on Australian *Mormopterus* nomenclature.

INSTRUCTIONS TO CONTRIBUTORS

The *Australasian Bat Society Newsletter* will accept contributions for one of two broad sections of the Newsletter. There are two deadlines each year: 21 February for the March issue, and 21 September for the October issue. The Editor reserves the right to hold over contributions for subsequent issues of the *Newsletter*, and meeting the deadline is not a guarantee of immediate publication. For consistency the following guidelines should be followed:

For Scientific 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 e-mail 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 ideally 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.
- Some black and white photographs can be reproduced in the Newsletter after scanning and digital editing (consult the Editor for advice). Diagrams and figures should be submitted as "Camera ready" copy, sized to fit on an A4 page, or electronically as TIFF or BMP image files. 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 e-mail 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. Some black and white photographs can be reproduced in the *Newsletter* after scanning and digital editing (consult the Editor for advice).

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 e-mail 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 e-mail, please remember to tell me what word processing package has generated the file. I can decode UU, MIME and BinHex attachments. If none of this makes sense, please ask for advice from your local computer guru, system administrator or Internet access provider.

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EDITORIAL

Lawrie Conole

The *ABS Newsletter* Number 7 is a bumper addition, the biggest yet thanks largely to the Naracoorte conference, and yet again the batologists in cyberspace. Apologies for the big blocks of text with no pictures, but there's a lot to report (and nobody sends pictures!!). This is my third newsletter as editor, and whilst I'm still enjoying putting it together, one day soon I look forward to receiving some *unsolicited* copy from the general membership. The select band of batters on e-mail have always been generous in their response to my requests for copy, but I think it's well past the due date for other members to start making a contribution.

A couple of prominent bat researchers have passed on into the big hibernaculum in the sky during 1996 - John McKean and Dick Allison. I was particularly shocked to hear about Dick, so soon after the Naracoorte conference where he so obviously enjoyed himself, and where he and I had enjoyed a discussion of his useful work on *Mormopterus* nomenclature, with a view to publication in this newsletter (see the attached pages at the back of this issue for a copy of Dick's conference handout). Both men made significant contributions to Australian biological research, including work on bats. John (known almost universally simply as "McKean") also had quite an impact on professional ornithology in Australia; and on the amateur side, almost singlehandedly introduced the sport of competitive birdwatching (aka *birding* or *twitching*) to this country. Appropriately, John's obituary in one birding newsletter was on the twitcher's page. My thanks to Greg Richards and Les Hall for the obituaries that appear in this issue.

Len Martin has written a comprehensive (and, of course, entertaining) paper on that very topical subject - viruses and flying-foxes. Forget what you've been reading in the mainstream media, and get "behind the news" with this informative piece. One of the crucial questions is of couse whether viruses such as the newly discovered *Lyssavirus* are endemic, or have they arrived recently by human or other agency? It would seem likely that there is a fairly robust chain of contact amongst the various species of megabats from Northern Australia through Wallacea to the Asian region - plenty of opportunity for transmission ***in*** or ***out*** of Australia. Does this *Lyssavirus* or a similar one occur outside the Australian region? Plenty of new research questions, and interesting times ahead!

The interest in acoustic surveying of microbats continues to grow - almost exponentially. In this issue, Maritza de Oliveira makes a vital first step towards developing a common language and nomenclature to describe bat calls recorded by the AnaBat system (in an expanded version of her poster paper presented at Naracoorte this year). Simon Jolly has literally taken some AnaBat sequences apart, and statistically analysed them pulse by pulse. His preliminary work points to the possibility of routine batch processing, or even automated processing. Terry Reardon's comments on Simon's paper point out the pitfalls as well as the benefits. Ken Sanderson describes his use of this detector to measure winter activity of bats in the Adelaide area.

What's in a name? Harry Parnaby raises the possibility that the word "Common" in a common name might in itself be an endangering process, because it engenders a false belief that a "Common Bentwing-bat" is abundant and secure. Asian-Australian *Miniopterus* taxonomy is complex and in need of review - if the Naracoorte *Miniopterus* is specifically distinct from east coast and Top End bats (a distinct possibility), then it would be a very vulnerable taxon indeed, confined to one substantial maternity site.

All of the abstracts, as well as summaries of several of the workshops, from the *1996 Australasian Bat Conference* held at Naracoorte, South Australia, in April, are included here. Those who were lucky enough to attend were treated to a well organised and interesting program (thanks Lindy and Terry). The field trips to view the flyout of Common Bentwing-bats, and the in-cave video monitoring system, at Naracoorte Caves park, as well as the demonstration field trip, were also very well attended. Len will fill you in on some of the details.

Many thanks to founding and outgoing President, Len Martin; but don't fear, he's not getting away as easily as that, and is now a Vice-President, along with Lindy Lumsden (re-elected). [Who was it who took the photographs of Len hanging upside down from the tree-climbing gear at

Naracoorte - what a great front cover image for March 1997!] Our new President is Greg Richards, and a few other faces in the executive and committee have changed (see Len's report). Greg opens his presidential account with a report on the society, an update on "*The Australian Bat Action Plan*" (it's finished!!), and on a more sombre note, an obituary for a friend - John McKean.

Meanwhile in cyberspace, Len Martin has been so well behaved on BATLINE of late, that Terry Reardon took it upon himself to liven things up somewhat. By judicious use of the vernacular shorthand for "go forth and multiply", Terry achieved his desired aim, and took the trophy from Len. Relatively few protests were lodged - silent testament to the style and panache with which Terry wields the language.

Back to ornithology, briefly. A top-order predator of small mammals in wetter forests of eastern Australia and New Guinea, the Sooty Owl is a keystone species for fauna conservation in native hardwood production forests. Its foraging range was previously believed by NSW Forestry to be somewhere between 100-200 hectares (Paul Peake pers. comm.). A radiotracking study by Kavanagh (1996) found one Sooty Owl to forage over about 3,000 hectares near Sydney. It was previously thought they only foraged in riparian wet forest, occurring mostly in small gullies, and that small linear streamside reserves in clearfelling areas would be adequate for roosting, nesting and foraging. Now that it's clear that Sooty Owls forage extensively outside gullies in drier open-forest, the previous regime of streamside reserves is probably inadequate for long term conservation of this predator in hardwood production forests. Milledge (1996) found that the likelihood of Sooty Owls occurring in Victorian montane forests increased with an increase in old-growth forest elements. Old-growth provides more hollows for nesting and roosting, but also greater prey species diversity and abundance. The Sooty Owl may be an effective bioindicator of biodiversity and sensitive vertebrates in Mountain Ash forests. Clearly these findings are also significant for other hollow dependant fauna such as bats.

There are a few thought provoking topics covered in issue 7, and I look forward to receiving your correspondence. I'm keen for the newsletter to carry debate as well as discourse!

References:

1. Kavanagh, R.P. (1996). Home range, movement, habitat and diet of the Sooty Owl *Tyto tenebricosa* near Royal National Park, Sydney. Abstracts of the third Australasian Raptor Association conference. *Australasian Raptor Association News* **17**(1): 43.
2. Milledge, D. (1996). The distribution and ecology of the Sooty Owl in Mountain Ash forests of the Victorian Central Highlands. Abstracts of the third Australasian Raptor Association conference. *Australasian Raptor Association News* **17**(1): 43-44.

VALE JOHN L. McKEAN

An obituary by Greg Richards

It is with great sadness that I report the sudden death of Johnsie McKean, one of our old mates in the bat game, in mid-February this year. I don't quite know where to start with an obituary. He was only 55, but shit he crammed a huge amount into that brief period, and I guess that living life to the fullest was his unwritten rule. Maybe whilst we all face the possibility of having our own lives cut short, his outlook of "living life to the max" is food for thought.

I could bore you with biographical details, but I'd prefer to tell a few stories. I first met Johnsie in 1968 when I started as a junior technician at CSIRO's Wildlife Division. That institution was considerably less refined in those days, a bit rough and tumble. New-un's like myself were taught the finer points of field work by colleagues such as John, including how to extract vehicles from mud with the bare essentials in equipment, how to incorporate momentum and gravity and a housebrick on the throttle to drive an underpowered Landrover on hilly roads, but of most importance - how to purchase bat equipment on funding intended for rabbit research. Johnsie and his colleague in crime, Les Hall, were great mentors, and their enthusiasm for bats not only rubbed off easily, but they made it stick to green youths like me.

Johnsie and Les introduced me to the unique biology of living bats, but our mate now gone was such an enthusiastic taxonomist that he also taught me the finer points of their insides as well. I always blamed Johnsie when my wife grizzled about the multitudes of vials containing *Eptesicus* penises dominated her kitchen whilst bacula were staining, much to her embarrassment when she had to explain them to visitors in my absence. But what Johnsie was also subtly showing this bat student was that if you were going to learn about this relatively unknown wildlife then you had to do as much at home as you could get away with, because the 9 - 5 time frame at work was taboo. This ethic (if that's what you call it) was predominant within the small band of battos around in the early 70's.

In those years most of us felt a little embarrassed about working on such weird and filthy creatures, but Johnsie was proud of it. When it came to writing something of interest that would contribute to the much needed knowledge of Aussie bats, you didn't fiddle with complex statistics or rigorous sampling, if you were Johnsie you bashed something out at midnight on a typewriter at the kitchen table, and next day it was sent to the nearest journal that was due for publication. If you look back at his bat papers from the 60's and 70's, you can see amongst them the "kitchen table" efforts that provided the basis for our knowledge of the natural history of many species. The paper on the 1974/5 Queensland expedition with Bill Price was written in the Toyota on the way home, the systematics section for our 1978 *Eptesicus* revision was written on a plane returning from Darwin. He must have driven the flight attendants mad as they tried to serve his lunch amongst bits of paper and reference material!

I could tell you other stories about his wild times in rough and tumble pre-Tracey Darwin but won't, except to say that not many people could keep up with him. After he moved to the US quite a while ago he eventually settled down and was probably as 'normal' as most of us, but those who knew him probably prefer to keep the memories of those early days.

So, you can see what I mean about him maximising life and productivity, but bats were probably a quarter of his effort on wildlife study. He was a mad ornithologist who ravaged the nation with tick lists and competitions with others to see who could observe the most species. Whilst doing this though, he was accumulating a vast knowledge of the natural history, taxonomy, and biogeography of Australia's bird fauna. It is some solace to understand that his death arose after an accident in Mexico and he eventually passed away in Arizona. At the time he was birding in both places.... doing what he loved most.

We've lost a great friend, one of the original crew who not only gave some of us sound training, but through his writing provided everyone with a good background to the basic natural history of Australian bats.

For that Johnsie we thank you, but thanks mate for also making it such a lot of fun.

VALE F. R. (Dick) ALLISON

An obituary by Les Hall

Dick Allison passed away on 22 May, 1996. We all knew Dick for his passionate interest in bats, and his willingness to share his knowledge with us. Many of us also knew of Dick's extensive knowledge of other animal groups, such as fleas, bat flies, birds, and African mammals. He will also be remembered as a devoted family person.

Dick was born on 27 June, 1931, in Leeds, England. His father was the Master of Architecture at the University of Leeds, and his mother was a school teacher. The Allisons also had a daughter, Margaret. From his early childhood days, Dick showed a great interest in natural history and ventured out into the countryside on his bicycle in search of bird's eggs, insects and other natural history objects that fascinate little boys. This early interest was to later lead him to choose a degree in science at the University of Leeds, where he graduated in 1951.

After graduating, Dick enlisted in the Royal Air Force, where he rose to the rank of Flying Officer in early 1954. He transferred to the RAF Emergency List, where he remained listed until 1964. Dick held a pilot's licence. After leaving the RAF, Dick obtained a position with the British and American Tobacco Company, where he was to supervise tobacco growing trials in Africa. From 1954 to 1968 Dick worked in Ghana, Ethiopia, Sierra Leone, and in the Sudan. While he was performing his duties for BAT (an interesting and prophetic acronym), Dick never lost his interest in natural history and continued to collect fleas, (even collecting a new species from a mangy dog on a bar in Sierra Leone), and built up his knowledge on wildlife, particularly bats and birds. Dick could speak several African languages and was fluent in Swahili. He left Africa in January 1968, visited north America briefly, and emigrated to Australia in October, 1968. Dick became an Australian citizen in 1976.

His first appointment in Australia was in Townsville working on crocodiles with the Queensland Department of Primary Industry (Extension Branch). In 1975, he moved to Brisbane and began working in the Fauna Conservation Branch of DPI at Yeerongpilly. This was later to become the National Parks and Wildlife Service and Dick transferred to its regional centre at Moggill where he worked until his retirement in 1989. Dick was secretary of The Australian Mammal Society from 1984 to 1986.

Dick met his wife Marjorie, in 1987, and they were married in April, 1988. On Dick's retirement, they moved to Maryborough, and in 1994 they moved to Lowood, just west of Brisbane. Dick's mother, father and sister are deceased.. Although Dick's marriage came late in his life, he was an integral and devoted part of Marjorie's life, and they shared many happy times together and with Marjorie's family. He will be sadly missed by Marjorie, her two daughters, two sons, daughter-in-law, two sons-in-law, and seven grandchildren.

Science has also lost a pillar. Although a quiet person, Dick was well known in the scientific community and his excruciatingly accurate knowledge of bat taxonomy will be greatly missed by all his "bat" colleagues. There is some compensation in the fact that the collection of books that Dick assembled over the years on bats, birds and African mammals will be housed in the Biological Sciences Library at the University of Queensland.

During his career, Dick published a number of scientific papers, and had a flea named after him. His major contribution however, was his willingness to check, advise, and help his colleagues in a very unselfish manner. He will be pleasantly remembered for this reason.

Footnote:

As mentioned in the obituary, Dick Allison's personal library is being purchased by the University of Queensland, Biological Sciences Library. Duplicates or material not wanted by the Biological Sciences Library (such as reprints, etc.), will be sold separately. A list of these publications will appear in this newsletter at a later date.

PRESIDENT'S MESSAGE

This is my first report as the new President of the Society, and it is quite it is hard to know where to start. Filling Len Martin's shoes (not a nice prospect if taken literally) isn't easy; he is always a hard act to follow. The membership and I thank him profusely for his untiring efforts as Founding "Pressie", and because I now know what the job involves I can understand why his hair went so grey!

The year so far has been quite eventful, but unfortunately there haven't been many highlights. We lost two of the pathfinders in the bat game, with the deaths of Johnsie McKean in February and Dick Allison in May. As seems to be the way in this fraternity, working colleagues are also good friends, so they will be sadly missed by many. However, their contributions to our knowledge of bat taxonomy will stand for eons. Whether their opinions were right or wrong they both gave the classification of our bats a significant nudge, helping immensely our understanding of this fauna. Keep in mind too, that this happened in an environment when there were absolutely no funds for bat research. Their research was done at home at night or on weekends, testing family tolerances whilst day jobs were also maintained.

Through the year we have had to contend with several major issues concerning our bat fauna, some of which have taught us a few lessons. The first of these issues arose when flying-foxes were supposed to have been implicated in the transmission of Equine Morbilli Virus. Alarmist reporting in the tabloids dressed this up as an issue that the public should be worried about, and phones and fax machines ran hot for weeks. I responded for the Society by taking the "were are also worried" approach, and attempted to counter the human health concern with the statistic that none of us had become ill during the three decades that we had been handling these animals. I forced the issue by insisting that the health authorities take blood samples from members, so those who ended up with a sore arm can blame me!

The lessons that we learnt here were primarily about communication. I don't know how we control the tabloids, but as a committee we worked well in producing our own press release, after having ascertained which of us had the best skills to write one on this subject. Len Martin co-ordinated our response, and his expertise in understanding virus problems is shown in his terrific article in this newsletter. Thanks Len, where would we be without you?

Several Society members were called upon by the Australian Animal Health Laboratory to assist with the design and operation of EMV transmission experiments at their Geelong laboratory. This proved to be quite a challenge, as the animals had to be in a high security room, and were to be handled by staff wearing full suits, breathing apparatus, and double gloves. Again, we learnt about communication, because AAHL we contacting several of us at the same time yet neither knew about each other, but worse, after our personal expense to assist them, we have (as I understand) had no feedback. I'm starting to wonder whether we shouldn't put such organisations on a bond of some sort, something along the lines of "the information is free but unless you report back in *x* days you will be invoiced by the Society for *x* thousands of dollars".

The second major issue was *The Rabies Scare Of 1996* that Len has expanded upon in his article in the following pages. Groan (!) ...... here we go again was our general response. This proved to be another furphy that hit the media, one that was hard to control, which had many members giving responses in an unco-ordinated manner. We had already learnt from the EMV fiasco that we must centralise these issues with one expert so that we can keep control to some extent. The relevant government authority had contacted me as the first Society contact point, before their media release to alert us to the problem. I was in Sydney at the time and cut my tasks short to get back to Canberra to my fax machine to co-ordinate the response through Len. However, whilst en route I was astounded to be phoned on my mobile by a member of a carer group who was going to give a radio interview in an hour's time, and she needed information on the subject! The whole issue ran riot, and I still don't know the final outcome or what was said to the media.

If we are going to be an efficient group, and effectively analyse and counter where necessary the bad publicity about bats that is generated by an alarmist and uninformed media, then it is essential that members don't place themselves in situations where inexperience may result in further bad publicity. Every year we face issues about diseases or conservation problems, so could I ask that for the former we initially contact Len, and for the latter contact me. It is far better for the Society to use its weight make an official response, than for the Oodnagalabie Save the Wart-faced Bat Council to do so on its own.

Anyway, enough negatives and now to positives. The year so far has also had wonderful highlights, particularly the biennial meeting at Naracoorte. Lindy Lumsden and Terry Reardon are to be congratulated for their efforts as organisers, for there was rarely a moment when we weren't active, either giving papers, or learning about new techniques in the field, or swapping embarrassing yarns over beers and dinners. The Lindy and Terry Adventure will be a hard act to follow, but there have been several suggestions by a few who are game enough to do so. Ann Munster has offered Rockhampton as a venue, and can arrange cheap but basic accommodation to compensate for the expense of travelling there. Roger Coles has suggested the Cairns area, especially because it is in one of the bat capitals of the nation. Others have suggested that we alternate venues each time between remote and close locations, so maybe the 1998 meeting should be halfway between the Melbourne - Brisbane concentration of the membership .... Oh-Oh(!), that means Canberra or Sydney (or Molong near Parkes if you use a ruler), doesn't it? Perhaps we could resolve the venue selection before the March issue of the next newsletter, so could those who have other suggestions please send me an estimate of costs, activities, etc. I will do the same should Canberra be an option, and maybe someone who lives on a winery near Molong could also make an offer!

Finally, many thanks to Lawrie for producing this mammoth newsletter, and for being a tough nut in his efforts to keep our publication at a high standard. His ability to crack the whip to gather contributions is on the same par as the efforts of my ex-mother-in-law to stop me buying into racehorse partnerships, the only difference is that he always wins and she never did!

BAT ACTION PLAN - PROGRESS REPORT

Greg Richards[1] and Les Hall[2]

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Introduction

At last the Australian Bat Action Plan is reaching it's grand finale, after a very lengthy gestation. With thanks to members who provided feedback at the Naracoorte conference, the second draft was finalised and submitted to the Australian Nature Conservation Agency in July 1996. Copies were then circulated to experts and fauna agencies, and comments are due back for appraisal at the end of this month (September). It will be a great relief to see the document in print as a bible for bat conservation efforts for the next five, probably ten, years. A summary of the pre-review draft is outlined below.

Revision of the national species inventory

The Action Plan reinforced the age-old problem facing bat conservation planning - that there has been a relatively insignificant input into full-time taxonomic research in Australia. As a consequence the list of Australian bat species is today a mixture of named species, undescribed species, and species complexes with taxa awaiting specific recognition. Eighty-seven forms of bats were recognised as conservation units for use in analyses in the Action Plan, fifteen of which are yet to be formally described.

Survey effort and patterns of biodiversity

A database was compiled from distribution information that could be obtained from museums, wildlife authorities, the literature, personal observations, and from the Australian Bat Banding Scheme. Over 60,000 records were available for GIS mapping of survey effort and biodiversity, using as a framework a grid of 3070 mapsheets at the 1:100,000 scale.

The majority of the continent was considered to be inadequately surveyed, with a distinct lack of survey in arid regions. A high proportion of the land mass had no bat records at all (63%) or had less than 25 records (28%), giving a total of 91% of the continent where the bat fauna is poorly known. In terms of land area, nearly 5 million km^2 has minimal observations of bats.

GIS analysis of species richness showed that areas with 21 species or more only covered approximately 60,000 km^2 (0.1%) of the continent, and these areas were primarily in the far north Queensland/Cape York region, the Shoalwater Bay overlap zone in central coastal Queensland, the northeast NSW/southeast Queensland border region, and Kakadu National Park. These areas, and several others, were identified as key conservation zones.

Relative abundance

A factor that emphasised the degree of difficulty of observing each taxon was used to weight the number of observations of each to give an index of ***relative*** rarity in the distribution database. Although some forms may be regionally abundant, at a national level the majority of them fell into the uncommon or rare categories.

Analysis of threatened species

This analysis allocated points for twelve biological variables that were pertinent to the long-term conservation of species, the points for each variable being weighted differently according to the severity of the biological threat to each species. These values were used to rank species within each IUCN category.

Recovery outlines for threatened species

The status of each species was determined by using IUCN criteria, with the Precautionary Principle being applied to take into account the lack of information for many. Of the 87 bat taxa currently known from Australia and external territories, 42 (48%) were allocated to IUCN threat categories : 2 are Extinct, 4 are Critically Endangered, 5 are Endangered, 23 are Vulnerable, 6 are Lower Risk - near threatened, and 2 are Data Deficient.

Analysis of threats

There appeared to be a bias towards certain taxonomic or biological groups being under threat. Of 14 Pteropodidae, 9 species are endangered, with one-third of the order being either Extinct or in the Critically Endangered category. Bats that roost underground appear to be in serious trouble, with 18 out of 27 species being threatened to some extent. The conservation problem with subterranean roosting bats is emphasised when considered at a family level, where high proportions of the species in the families Rhinolophidae, Hipposideridae and Emballonuridae (*Taphozous*), and especially Megadermatidae, are under threat.

Threats to taxa in all roost categories included habitat loss or modification, colony disturbance, roost destruction, predation, direct killing, isolation of population, starvation, poisoning, environmental pollution, and new parasites.

Recovery outlines

Recovery outlines were prepared for each species. The estimated cost of recovery projects exceeds $1,800,000. However, since many projects centred around ecological surveys, and many were in similar biogeographic provinces, we suggested that regional recovery planning be considered. Costs of recovery projects could be categorised under several research themes, as follows :

Taxonomy :	$ 137,000
Genetic studies	74,000
Field survey	1,242,000
Ecology	371,000
Historical study	12,000

Recovery research priorities

The following generalised procedure for action was recommended :

- ◊ That taxonomic and genetic research be given the highest priority for the initial allocation of funding, prioritised according to the severity of the IUCN classifications of each taxon. This appears to be integral to defining the Australian bat fauna, and in combination with the re-examination of museum specimens, it was envisaged that many species would quickly be removed from the threatened fauna list. A national research project proposed to compile regional field guides would follow this line of research.
- ◊ That field survey in priority biogeographic regions be conducted, after review by a steering committee to identify a preferred strategy. It is apparent that Cape York Peninsula would be the first of these regions, having a high number of species that do not have threats mitigated as yet.

National conservation and recovery research

National projects integral to the conservation of Australian bats that have a national application were proposed, with an estimated cost of $520,000, and included :

1. Taxonomic resolution of bat species of conservation concern
2. Public education of the role of bats in Australia's environment and biodiversity
3. Reference library of echolocation calls for use in ecological surveys
4. Re-assessment of cave bat populations
5. Fine resolution targeting of areas for urgent survey of endangered species distributions
6. Changes in flying-fox distribution patterns in southeast Queensland and northeast New South Wales
7. Assessment of known and potential roosts in caves and abandoned mines
8. Non-destructive displacement of Flying-fox colonies
9. Review of results from the "5 Year Plan" for Australian bat conservation

The priorities for national research projects were set by the consensus of delegates to the Australasian Bat Research Conference, Naracoorte (April 1996)..

NEWS FROM THAT POLIOCEPHALIC, BENT OLD BAT, LEN MARTIN: STILL HANGING ON IN THE GREAT NORTHERN BAT CAMP

Dear friends and colleagues, I have great pleasure in welcoming Greg Richards as our new President, and offer my wholehearted support as a vice-president. Welcome also to the new committee members. As outgoing Prezzy, I thank all previous committee members and helpers, but in particular, Elizabeth Hartnell for drafting our constitution [and nagging me about it], Jillian Snell who continues to put in a vast deal of work as treasurer, secretary and flying-fox conservationist, and Lawrie Conole for his energetic and innovative efforts on the Newsletter - a great job Lawrie - and a crucial one. If I aggrieve by omission, blame my incipient Alzheimer's and inability to echolocate.

In a society like ours, where membership is diverse and dispersed, and general meetings not held annually, it is difficult to maintain cohesion and momentum. I am conscious that we did not, perhaps, make as much progress as we should, after the Lismore conference [eg., not promulgating the constitution until Naracoorte]. On the other hand, if memory serves me correctly, the feeling of the ABS meeting at Lismore was not one of great enthusiasm about the society's future; alas no minutes were kept. In contrast, at Naracoorte, there was very strong support from the floor for the activities of ABS, for its playing an active role in bat conservation, for voicing members' concerns on public issues and supplying expert advice both to members and to governmental bodies.

There was active and constructive discussion of the proposed constitution - and not too many amendments. It is now being reviewed by your committee [those who watch *Yes Minister* will know what I mean!]. One excellent suggestion from the floor [not from me, as the minutes suggest] was that ABS prepares position-papers/ information-sheets on crucial issues for members to use in dealings with the public, eg., diseases in bats [of which more anon]. Another suggestion was for ABS to enter Cyberspace, ie. set up a World Wide Web Site. And indeed it happened - as near as instantaneously as you can get. So, for

BATS IN CYBERSPACE

the address is:

http://batcall.csu.edu.au/batcall/abs/abs1.html

Many thanks to Alex Herr for doing a speedy, excellent, and remarkably tasteful job of putting it all together. The site was immediately useful for promulgating two ABS press-releases, but has a multitude of other uses, to which I have not yet had time to contribute. I encourage you to visit our site, to contribute to it, and to publicise its existence. Net-Surfing is much overrated - frustratingly slow and boring, boring, boring. Nonetheless, it is extremely useful for obtaining/ disseminating information. Most useful is e-mail for rapid communication. It would be nice if all ABS committee members were e-mailable. Alas they ain't, so we shall need phone conferences to deal with issues arising from Naracoorte.

With larger e-mail discussion groups like *Batline*, there are problems; too much crud, too many private messages - a pain to review each morning - too much irrelevant to one's interests and some times [you may find this hard to believe] even bad language!! That is the down-side, with much recent de-subscribing. On the up-side are illuminating, relevant discussions, as those recently about problems of displaying bats publicly in good ol' rabies-ridden USA. One also gains picturesque, useful phrases like the recent, "I don't give a rodent's rectum".

At Naracoorte, our treasurer reported that on 28/03/96, ABS had 149 members and $2379.13 credit, the major recurring expense being the *Newsletter*. It was agreed that the annual subscription remain at $30 [$20 student]. Since then membership has grown to 167, though this is offset by persistently-non-financial individuals [among them some eminent oz-chiropterologists] who are in immediate danger of losing membership!! Thanks to Nancy Pallin for minuting our meeting in the absence of Jillian; I have available copies of minutes, treasurer's report and proposed constitution [with amendments], if anyone wishes to view them.

The Naracoorte conference more than covered its own expenses, which means that the organisers didn't use the $790 sent to them by The Treasurer of the long-ago *4th Australian Bat Conference* in Brisbane [ie. me]. Given the superb hospitality at Naracoorte and registration fee of $50, this is an incredible performance. To put the fee into context, registration for the rather basic *4th ABC* was $35; that for the 1996 Ecological Society of Australia meeting in Townsville was $160 - a meeting that didn't approach Naracoorte for organisation or hospitality. If ABS is to maintain the large non-professional membership that is its strength, the *Australasian Bat Conference* must keep registration fees low, so unsubsidised ABS members can afford to attend [professionals get tax relief and sometimes institutional support].

Please note that the present connection between the *ABC* and ABS is a loose one, and that conference profits do not constitute part of ABS funds. With ratification of the constitution, this may be rodently rectified. I personally favour each biannual *ABC* being the official meeting of ABS, the society providing initial float, and conference profits going to swell the society's coffers; this is in line with current practice in all other learned societies to which I belong.

The *7th ABC* was absolutely fabulous and fantastic and... and I'm not just saying that to generate envy in non-attendees, or to put-down previous *ABC*s, which were all pretty plurry good. A huge congratulation to Lindy and Terry and all their helpers. "The Seventh" just seemed to fire on all seventeen cylinders; even the freezing cold couldn't spoil it [Kay had to get a thrift-shop-woolly to keep me warm in the opening sessions]. In what follows, I may run out of superlatives. The refurbished Naracoorte Town Hall was a delightful venue. Registration and documentation were right on ball. The welcome wine-tasting was rich in Coonawarras. Morning and afternoon teas were unbelieveably rich and figuratively ruinous - even outshining those magnificent Lismore doughnut-rainbows!!

Programming was excellent, with the workshop-forums in particular providing a great deal of interesting discussion - and momentum for the society! There was a good, diverse turn-up, with many non-members [now new members?], including a group of youngsters doing a park-rangers course at the Port Lincoln SA TAFE. Papers were diverse, ranging from modern molecular-biological genomics to basic field observation reports, but the standard was uniformly high and time-keeping excellent. As usual, the non-professionals made a great contribution. It was also great to have such a strong contingent from New Zealand, with top-quality papers superbly presented - and those videos were a wow! There were also some very interesting and valuable "anecdotal" presentations which, I hope, will appear in the *ABS Newsletter* - though a certain zoological magazine was competing for some of them; don't underrate the anecdotal, folks.

On a sadder note, Dick Allison's paper on *Mormopterus*, which I chaired on the first morning, was his last as Dick died shortly after the conference. He was a lovely bloke, a great bat worker and will be sadly missed. Both Les Hall and I attended and spoke at his funeral and I was able to tell his family just how good a time he had in Naracoorte, and the great respect and affection felt for him by our community of bat workers. As I write this, I have Dick in my mind's eye - at The Dinner - chortling with the rest of us at the more remarkable of those remarkably remarkable....... objects(?) selected for the quiz by Dr Reardon - what a mind that man has, what a vocabulary, as any Batliner knows (sorry Terry). Yes the dinner was pretty-bl**dy-good.

Then there were the caves - World Heritage and rightly so - and our appetites whetted by Elery Hamilton-Smith's fascinating account of the cave's treatment in the early years of European settlement. Aside from the inherent beauty of the formations, we had the mammal cave, with magnificent customised exposition of the geological history and fossil fauna. Then the *Miniopterus* cave. A "privileged" few were allowed downstairs into the exciting odoriferous blackness, but the real excitement was all upstairs at the display, seen via infra-red illumination and remote-control TV cameras. Bat behaviour like you've never seen before; quite apart from its merit as a tourist attraction and educational facility, what a research tool! Finally, into the dusk with drinky-poos and nibblys, to watch an impressive fly-out, then to an scrumptious barbecue.

After the meeting, most joined The Field Trip at Stony Point. There was much to fascinate an elderly mega-chiropterologist [extra-mega after such food]. How to make your own harp-trap. How to erect a 20 metre mist-net, while avoiding self-strangulation. How to make a plastic-pipe contraption, which fires spuds with a loud bang but has no apparent use *vis-a-vis* bats [a <u>really</u> remarkable mind, that Reardon chap]. How to make pretty patterns in the night by glueing reflective foil to fledermausen, or colouring them luminescent green. The duel of the computerised bat-detectors - a fierce contest. Who <u>was</u> the winner? How to shoot an arrow into the air. How to shoot a lead shot into the air by sophisticated, probably illegal, shanghai - disappointing that there were no crossbows.

How to elevate oneself into a tree: Ian Up-in-a-flash Temby, with harness and ascenders for up, harness and whale's tail for down - what grace, what speed, such ease. If a maturish-megabatlady from NSW could do it...? I was tempted. I succumbed. The first problem was Snake-Hips Temby's harness versus me - tears to the eyes stuff - an inability to breathe - that's why I couldn't get above 2m - though muscular weakness and total loss of coordination brought on by the altitude did contribute - an ungainly descent. Then Jane Sedgeley demonstrated a trans-Tasman ascending-frog technique without whale's tail - speed and greater grace and ease - surely I could manage that? Given a non-emasculating harness, I could. I rose, even unto 4m - an estimate perhaps biased by the altitude-euphoria which destroyed coordination. Thus, descent was slow and awkward to about 1m.

Then, demonstrating that no equipment is idiot-proof [as I have done before] I released both ascenders, to descend rapidly into the delivery position - back flat to ground and feet in stirrups. Just as well I was no longer President. I am willing to pay the money for the photographs, and the wounded finger has healed. Thanks, Jane Sedgeley, for the tasteful shocking-pink rosette reading, "I climbed a tree at Naracoorte and survived"

The joys of Naracoorte were offset by what we saw on the way there and back; going, NE NSW, Dubbo, Parkes, Condoblin, Hay, Hell and Booligool, the Victorian Mallee National Parks; afterwards, Mount Gambier, the SA coast, Coorong, Murray Bridge, Adelaide [plastered with "Batman Saves Homes" posters - that Reardon chap again], Adelaide hills, east to NW Victoria, the Murray, the Lachlan, the Darling, Lake Mungo & Kinchega National Parks, Wilcannia, Cobar, the NSW cotton country. The last being the most obscene - horizon to horizon clearing. Overall, the massive extent of clearing and environmental degradation is appalling - disastrous. The media repeatedly refer to rural populations as "the bush". It is inappropriate - there's no bush left. Signs welcome you to Mallee country, but there's no Mallee to be seen, only bare earth. Indeed, in April, most of rural SE Australia appeared to comprise bare or near-bare earth. Native birds are few and limited in species. One travels hundreds of kilometres seeing european starlings and sparrows as the dominant or only species. Only Galahs prosper widely.

National parks too are usually heavily degraded: previous overgrazing by sheep or cattle and clearing; current overgrazing from rabbits and kangaroos; water tables altered by irrigation flood-control. Feral weeds proliferate, little understory remains intact. The famous *Walls of China* of Lake Mungo are not romantic in context - simply horrific erosion relics of overgrazing by sheep and rabbits, and still eroding fast! And overall degradation continues apace; overgrazed, near-bare paddocks abound; unabated clearing in NSW and QLD; proposals for cotton farming on the Cooper. Has nothing been learned? Present federal/ state coalitions appear not to. That is why learned societies like ABS must make their voices heard. So, congratulations to all who generated the ABS press release on threats from land clearing to bats, and to our members for unanimous support.

Nonetheless, given the cotton fields of NSW, I was in a rather black mood on returning home, only to be woken at 07.30 on a Sunday by a certain ABS member concerned at the headlines.

FLYING FOXES SPREAD EQUINE KILLER VIRUS

PAPERS

VIRUSES IN AUSTRALIAN FLYING FOXES

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Ross River Virus

Early in 1995, the press made scare-headlines of flying-foxes as a possible reservoir of Ross River Virus [RRV] and so as a major threat to humans. As a result, I produced a simplified account of the epidemiology of RRV, to put the matter into perspective for ABS members (Martin, L. (1995). *ABS Newsletter* **4**,3-5.). To reiterate the points made then:

- ◊ one can only be infected by mosquito bite, not by contact with animals;
- ◊ many animals, notably marsupials, are known to harbour RRV;
- ◊ a mosquito only becomes infected if the animal on which it feeds has many virus particles in its blood at the time;
- ◊ a mosquito only becomes infective if it ingests enough virus particles and these proliferate - proliferation can happen only in some mosquito species;
- ◊ an animal only becomes infected if the mosquito injects sufficient virus;
- ◊ if an animal is infected, virus proliferates and many virus particles may appear in the blood (viraemia) - the animal is then infective to mosquitoes;
- ◊ an animal's viraemia is usually transient - lasting only days, after which the animal becomes non-infective;
- ◊ an infected animal usually develops antibodies which recognise and help destroy the virus;
- ◊ the presence of such antibodies indicates previous infection by RRV;

◊ many humans living where RRV is endemic show immunological evidence of infection [ie. antibodies against RRV] but few develop clinical symptoms;
◊ the frequency of RRV infection in humans is sufficiently high to be maintained via mosquitoes without any wild-animal reservoir;
◊ we do not know why some RRV-infected humans develop disease and others not.

Because there were so many "ifs" about RRV infection arising from flying-foxes, I became involved in experiments to determine:

◊ if mosquitoes can infect flying-foxes with RRV;
◊ the severity and duration of any consequent viraemia in the bats.

So, Peter Ryan [Queensland Institute of Medical Research] and I encouraged RRV-infected mosquitoes to feed on 10 juvenile male RRV-antibody-negative flying-foxes. We then encouraged uninfected mosquitoes to feed on the bats each day for a week. These mosquitoes were tested by Peter to determine if they, in turn, had become infected with RRV. After the bats had been bitten by the infected mosquitoes, we collected several blood samples from each, to test for RRV and antibodies to RRV. None of the animals showed overt signs of disease or distress after infection. Finally they were euthanased by anaesthesia, stored frozen, and various organs tested for RRV by RT-PCR (reverse-transcriptase-polymerase-chain reaction; the ultimate molecular biological tool for absolutely everything). The work has been submitted for publication in the *American Journal of Tropical Medicine and Hygiene.* as,

◊ Ryan, P.A., Martin, L., Mackenzie, J.S. and Kay, B.H. (1996) Investigation of Grey-headed flying foxes, *Pteropus poliocephalus* (Megachiroptera: Pteropodidae) as potential vertebrate hosts of Ross River virus in Australia.

I quote from the paper, "Experimental infection of 10 juvenile *P. poliocephalus* produced low level viremias in five animals, up to four days in duration. Three percent of *Aedes vigilax* which fed on the ten animals during this period became infected. One of the five viremic flying foxes and two of the five aviremic animals produced a detectable immune response...", so the results, "suggest that *P. poliocephalus* are low grade vertebrate hosts of RR virus compared to wallabies, kangaroos and marsupial mice..."

Antibodies usually develop within 14 days post-infection, but in our experiment they developed in only one of five bats which showed detectable RRV viraemias, and in two without detectable viraemias! So, 7/10 bats became infected and developed low-level or undetectable viraemias. After euthanasia, organs which might be expected to contain residual virus were screened for virus by RT-PCR, but none was found. However, there were doubts about RT-PCR efficacy on this occasion.

Because some bats failed to develop antibodies, questions remain about: the extent to which flying-foxes might spread RRV; interpretation of serological surveys; susceptibility of flying-foxes to reinfection; long-term latent viral infections. As is often the case in science it is not possible to give unequivocal answers. Perhaps the important one is that the chance [probability] of infection, by mosquito, with RRV derived from a flying fox is small and much less than that of infection with RRV derived from a human or a friendly neighbourhood possum - but then I do have an axe to grind.

Virus infection and species-jumping

Chance, probability, hit and miss, there is much of it about in science - and virology in particular. No, I am not being rude. Let me explain. I worked in cancer research and one model for experimental genesis of cancer [carcinognesis] is viral. Here, one grows "normal" animal cells in culture-dishes [thousands of cells per dish] adds large numbers of virus-particles - [hundreds of thousands to millions/ dish] and a few cells are "transformed" by virus into cancer-like cells.

"Transformation" is a rare event, requiring a virus-particle to "hit" a cell in a particular way. This is why one must add huge numbers of particles - to guarantee that some cells in each dish are transformed. In the same way, a male mammal must inseminate millions of sperm to guarantee that one "hits" the egg to fertilise it. Nevertheless, in virus-cancer experiments, one can obtain reproducible results which relate numbers-of-cells-transformed/dish [eg., 10, 20, 30, 40, 50, 60, etc.] to numbers of particles added [eg., 2, 4, 8, 16, 32 millions], even though one cannot predict which particular cells will be transformed. Likewise, with artificial insemination one can relate number-of-eggs-fertilised to millions-of-sperm-inseminated.

Infective processes are never 100% effective: in the above, this would mean 100 cells transformed after mixing 100 cells with 100 virus particles. Most infective processes are much much less efficient and one must talk in "probabilities": eg., given 1000 cells and 10,000 virus particles, what is the probability [chance] of 10 cells becoming transformed? Just as "one swallow doth not a summer make", so in the vast majority of cases, "one particle doth not an infection make". Thus, any link between RRV in a flying-fox and a human developing clinical RRV-polyarthritis involves a whole series of low-probability events.

RRV is known to infect a range of unrelated mammals, but to my knowledge, its relative ability to infect different species is not known. In other words, given a 100 individuals of each species, each exposed to 10 mosquitoes delivering 100 virus particles/feed, how many will become infected? How many develop viraemia? Will magnitude and duration of viraemia differ? Will the proportion falling sick differ? Will the nature of the sickness differ? And so on.

On the other hand, many viruses appear able to infect [proliferate in] only one or a few closely-related host-species. When virologists describe a virus as being restricted to one host-species, it means that, in nature, it has been found [isolated from] - or observed to cause disease in - only one species and that, in the laboratory, it has not proved possible to infect any other species: mind you, such testing, of necessity is usually restricted to a few commonly-used domestic and laboratory animals. Can such host-specific viruses ever infect other species? Is it, "not now, not ever"? Or, "well, hardly ever"?

Again we must speak in "probabilities", "chances of". The extreme opposite to 100% infectivity is 0% infectivity, where 0 is absolute zero - not a very small number like 0.0000000001%. The latter means that there is a very, very tiny but finite probability ["real chance or possibility"] of infection. With the figure given, infection is highly unlikely - it will happen only once in a million million times. However, given enough "times" [eg., by taking enough "wrong" animal cells and exposing them enough times to large numbers of the "wrong" virus] then sooner or later, something is almost certain to happen [ie. becomes highly probable].

This is the idea behind the hypothesis that human-HIV originated from a "natural" monkey HIV-like virus, which was present in monkey kidney cells used to make poliomyelitis vaccine. Thus, it is suggested that so many people were exposed so many times to the virus, that eventually one or several monkey-virus particles, perhaps with a particular genetic constitution, "hit" one or more human cells in such a way that they were able to infect - to proliferate and evolve in them - and so, it is postulated, human AIDS was born - a virus had "jumped species".

It is such species-jumping that is thought to have happened with Equine Morbillivirus [EMV] - the jump being from flying fox to horse! Questions immediately spring to mind. If species-jumping is rare and flying foxes and horses have been around each other in OZ for a couple of centuries, what precipitated such a jump? Is EMV a recent exotic invader? Why flying-foxes?. What is the evidence?

Equine Morbillivirus

EMV was isolated in September 1994 as part of an investigation of two episodes of racehorse and human deaths, which were close in time (September-October) but 800km apart (Brisbane, Mackay). A characteristic of EMV infection in horses and humans, and major cause of death, is acute pulmonary haemorrhagic oedema [lungs leaking fluid and blood]. Experimental laboratory infection with EMV produces the disease in cats and guinea-pigs, but not in dogs, rats, mice, rabbits or chickens.

EMV also infects a broad range of animal cells grown in culture dishes. Although various characteristics led EMV to be classed as a "morbillivirus" and a member of the paramyxovirus group, which includes human measles, canine distemper, rinderpest and seal morbillivirus, it appears to be only distantly related to these in its DNA and amino acid sequences, and differs in infecting a relatively broad range of species, whereas other paramyxoviruses are species-specific.

Tests were developed to enable identification of viral material in formaldehyde-fixed material and to detect the presence of antibodies which "recognised" the virus. It was primarily the antibody-test which was used to screen large numbers of individual animals, particularly horses and cats, and a large number of species. There was a particular interest in birds and bats as species capable of carrying EMV between Brisbane and Mackay. Then, in May 1996, came a DPI press release which read [my underlining],

"DPI SCIENTISTS CLOSER TO SOLVING VIRUS PUZZLE... with the discovery that some flying foxes (fruit bats) have been infected by a similar virus... DPI scientists had tested 5300 blood samples from 46 species of domestic animals and wildlife... Species tested included horses, rats, mice, possums, cane toads, native rodents, birds, cattle, cats, dogs, pigs, kangaroos, cockroaches, snails, slugs, donkeys and bandicoots... flying foxes were the only animal species, other than the seven horses involved in the initial outbreak, to have recorded antibodies that reacted to EMV... DPI... would continue their work to determine whether this newly detected flying fox paramyxo-virus and equine morbillivirus were similar... would include further surveying of flying fox colonies and research to isolate the virus from flying foxes.....discovery of the virus in flying foxes represented an excellent piece of scientific detective work... However,... there was still a long way to go to determine the origin of EMV virus... detection of this similar virus in flying foxes is not cause for alarm... the very fact that this virus has apparently been present in flying fox populations for some time and that these populations have been in close contact with people without any obvious evidence of cross infection, reinforces the initial belief... that the virus, if it is the same as EMV,... represents a very low risk".

Interesting wording; "further surveying", implies that flying foxes were collected from the wild. To my knowledge all anti-body positive bats were captive animals from carer groups. Thus this "excellent piece of scientific detective work" was only made possible by the services of flying fox carer groups.

As a professional biologist who has used antibodies to detect and measure hormones I am very much aware that antibodies are not perfect - they can frequently cross-react with substances whose molecular shape "fits" the anti-body site, yet are chemically unrelated to the original antigen. In the present case, flying fox antibodies which "recognise" part of the EMV were assumed to have been generated in the bats by a putative EMV-related virus, or EMV itself. Not unreasonable? Nonetheless, I believe that the press release was perhaps-a-little-premature in equating detection of such antibodies with a "newly detected paramyxovirus in flying foxes"; in suggesting that DPI were nearer to solving the EMV puzzle by the "discovery that... flying foxes... have been infected by a similar virus"; and in using the expression "the very fact that this virus has apparently been present in flying fox populations for some time".

It is not surprising, therefore, that the release generated such headlines as,

"FLYING FOXES SPREAD EQUINE KILLER VIRUS",

and the letter from the University of Queensland ethics officer warning staff who handled flying foxes that, "work... to determine the native host(s) of Equine Morbillivirus has shown reasonably high titre level in 11 out of 55 flying foxes".

At this stage both Greg Richards and I were expressing serious concerns to DPI and, to cut a long story short, in consultation with other ABS committee members, eventually generated a press release on May 27 1996 which read,

NO EVIDENCE OF TRANSMISSION OF SERIOUS DISEASE FROM FLYING-FOXES TO HUMANS. There has been much alarmist reporting since the announcement by the Queensland Department of Primary Industry of the detection, in flying foxes, of antibodies which recognise the equine morbillivirus (EMV). It is important to note that:

◊ the EMV itself has not been isolated from flying foxes;

◊ the antibodies detected may reflect infection by a related virus;

◊ for the past decade and a half, many hundreds of people in Queensland and NSW have, each year, handled and raised wild orphan and crippled flying foxes;

◊ amongst this large human population in direct, prolonged and intimate contact with flying-foxes, there have been no reports of serious disease attributable to the bats.

Thus there is no evidence of the transmission of serious disease from flying-foxes to humans. Indeed, the epidemiological data, based on many thousands of human-bat contact hours, show that, if there has been a morbilli-like virus circulating within the flying-fox population, it has posed little or no risk to humans.

In preparing this, I had extensive discussions with several virologists involved with EMV, and the statement was scrutinised and approved by UQ Professor of Microbiology, John Mackenzie.

In May 1996, only *P. conspicillatus* and *P. alecto* from north and central Queensland had been found antibody [AB]-positive. At this stage, it also became clear that the virologists were convinced that flying-foxes did have a virus, and that it was probably the precursor of EMV if not actual EMV! I suspect that most still hold this view. Subsequently, some Brisbane ONARR *P. poliocephalus* proved to be AB-positive. At this stage there was much networking, with a major push from Greg and me, and carers groups to initiate blood testing of flying fox carers/ handlers. I should emphasise the major role played by carers groups, and their positive, cooperative and highly scientific attitudes throughout. I do not know how many micro-bats have been tested, if any. So, what is the situation for megachiroptera in September 1996?

◊ **No EMV or EMV-like virus has yet been isolated from flying foxes!**

◊ **No serious disease attributable to flying foxes has occurred in flying fox carers**

◊ **No EMV-recognising antibodies have been found in nearly 100 flying fox handlers!**

An ABC radio account of the human blood results (12-8-96, my underlining) went,

"no bat handler has shown antibodies for equine morbillivirus... despite 10 percent of the State's fruit bats having antibodies to the virus... that they've all been negative is very encouraging and probably suggests that it's [caring for flying foxes] a low risk activity".

Note the "10% of the State's" [QLD] and the assumptions still being made about the AB. A virologist I discussed this with was frankly puzzled by the 100% AB-negative results in humans - he fully expected a substantial proportion to be positive. Mind you, **I** haven't been tested yet!

And I need to be - some of my *P. scapulatus* and about 10% of my captive *P. poliocephalus* proved to be AB positive, including 2 of 12 young males born last year in my breeding colony. Most interesting is that I received the information about these youngsters, while standing bitten and scratched, minutes after catching them from their large outdoor cage and placing them in a smaller indoor cage prior to sending them to the Australian Animal Health Laboratory [AAHL] for infection experiments with genuine EMV.

At first, AAHL did not want the 2 AB-positives, "they would not be of any use" [an indication of a certain degree of closed mind?] but then took them and AB titres [levels] have since fallen. These juveniles were all born and housed in one 12mx2mx2m open wire-mesh cage and were in intimate contact with each other and parents from birth. This raises some interesting questions about the origins of the AB and transmissability of the AB-inducing agent. The AB-positive young may have been "infected" by wild bats visiting the cage. Alternatively, they received AB from their mothers, via placenta or milk - the progressive fall in AB titre supports this idea. Unfortunately the young were not banded and their mothers cannot be identified. I hope to rectify this in the coming birthing season.

These young *P. poliocephalus* were dosed with live EMV in the AAHL on 4/9/96. As I write [14/9/96] they are still apparently in good health. I share the concerns of all flying fox lovers for these animals, but make no mistake, EMV is a major serious health issue and the experiment needs to be done. It may or may not solve the puzzle of the origin and transmission of EMV. In the-best-of-all-possible flying-fox-worlds, it will prove impossible to infect the bats with EMV. Whatever the results, we need them to enable appropriate decisions to be made for long term management of our native flying fox populations. Because these bats are so visible, they will always be prime candidates as reservoirs and vectors of disease. And indeed, in June, in the midst of EMV - another disease reared its ugly head in flying foxes.

Lyssavirus

Outside Australia, it is the microchiroptera that are usually associated with transmission of disease to humans, and in particular that most famous of panic-inducing diseases [long before Mad-Cow-Disease-Panic-Disease] - yes,

RABIES!!! or HYDROPHOBIA!!!

Which of us does not have the mental picture of mad dogs and Englishmen, running, foaming at the mouth, biting and infecting all in their path and

STARK RAVING MAD

Rabies is a neurological disease [disease of the nervous system] produced by one of a group of related *Lyssa* viruses [LVs]. Members are related, in that their DNA/ proteins have many base/ amino-acid sequences in common, and it is these sequence-homologies which enable virologists to detect, isolate and identify previously unknown members. LVs affect the nervous system and can produce behavioural and movement disorders of varying severity, often accompanied by encephalitis [inflammation of the brain] and death. Usually, there is a relatively long interval between exposure and development of clinical symptoms [incubation period].

In North America, the one form of rabies, "Sylvatic Rabies" is predominant, and present in many species, including bats. It appears to be easily transmissible between all mammalian species, including humans, and highly virulent, in that it is believed to kill all individuals which become infected, surviving in the wild because of its long incubation period. Effective vaccines are available, but need to be given before, or shortly after exposure, to guarantee protection. All U.S. bat-handlers are vaccinated. See also, *Rabies in Bats* DA Brass, 1994 Livia Press. In Europe, Sylvatic Rabies occurs in many mammals, but not bats. European bats have a related, but distinct "European Bat Lyssavirus" [EBLV, with two types, 1 & 2] which has never been recorded in other animals. EBLV is widespread in western Europe, but appears not to be endemic in Britain. However, a British [but possibly migrant] *Myotis daubentonii* made headlines in June by behaving uncharacteristically, biting its handler and testing positive for LV-proteins and LV-DNA-sequences. I do not know if the type has been identified.

It is accepted that a person can only contract LV by bite or scratch from an infected animal, and there is no evidence that EBLV-infected bats attack, unless provoked. A Batline report of the *M. daubentonii* incident also suggested that bats cannot "have the virus without dying of it"; ie., EBLV produces a 100% mortality in bats. I have discussed LV virulence with two virologists. One asserted that any animal infected by a LV would die [100% mortality]. The second admitted that, in relation to both North American and European mammals, it was not actually known what mortality rates were in wild populations. Apparently, however, EBLV strains have recently been isolated from three humans [1 in Finland, 2 in former USSR] with illnesses indistinguishable from rabies. Thus there is a small but finite risk of EBLV infecting and killing humans.

In June, the NSW Minister for Agriculture announced that a

"Lyssavirus which is related to the rabies virus was discovered in a Black Flying Fox from... Northern NSW... While the discovery of the Lyssavirus poses little or very low risk to human health [sic], people... ought to take extra precautions to ensure they aren't bitten... it is likely that the Lyssavirus has been present in Australian bat populations for millennia without causing any problems to human or animal health... the bat... was... exhibiting mild nervous disorders... Lyssavirus is common in bat populations in Europe... at this stage it isn't known if it is precisley the same virus... there have been no unusual illnesses or deaths reported in bat colonies and it should be remembered these bats are a protected species... people who live near bat colonies are not at risk... Mr Amery said Australia's rabies-free status has not been altered... and urged the media to be balanced in its reporting... The discovery... is... evidence of the quality and capability of Australian science"

Not bad, even though there was no mention that the scientific excellence included the carer's observations of the bat's abnormal behaviour and her taking the initial steps crucial to the detection of LV. Inevitably, there was a

WARNING OVER 'RABIES' VIRUS IN FRUIT BATS

headline, over a Kelvin Bissett byline, which read,

"A RABIES-like virus responsible for deaths in Europe has been detected in a flying fox in the north of the state", followed by quotes from the press release then, "The virus is common in fruit bats in Europe [sic], where human deaths are said to occasionally occur from bites". This passage was repeated in a side panel which also stated that the Lyssavirus "Spreads readily through fruit bat colonies due to their frequent scratching and rubbing of each other".

Where do they find such journalists? Where do they find their material? There are no fruit bats in Europe!!

In July, a brief but very useful report, "Human Health Aspects of a Possible Lyssavirus *in a black flying fox*" by Crerar, S., Longbottom, H., Rooney, J. and Thornber, P., appeared in *Communicable Diseases Intelligence*, **20**, 325. The article summarised the biology of the *Lyssavirus* group and suggested that,

"The extremely low health risk posed by rabies-like *lyssaviruses* combined with the probable isolated nature of this incident in Australia indicates there is not a need to change current public health advice... there is no indication for specific *lyssavirus* treatment in people bitten or scratched by flying foxes... The exception would be if the flying fox... was known to be infected with a *lyssavirus*... It is unclear... whether *lyssaviruses* are endemic in Australian flying fox colonies, although it is considered unlikely." [my underlinings].

It is not clear why this article took the opposite view to the June press release as to the likelihood of *lyssavirus* being endemic in Australian flying foxes.

What is the situation in September 1996? LV was isolated from the juvenile black flying fox of the press release, and characterised as being similar to, but distinct from, EBLV. Autopsy brain samples from another N-NSW juvenile black, which had shown behavioural abnormalities and bitten a carer in March 1995, were later shown to be LV-positive by antibody tests. Eighteen months later, the carer remains free of symptoms and a recent blood test was negative. A Townsville *P. scapulatus* showing signs of neurological disease has tested positive for LV, as has a black flying fox from Robina in SE Queensland, and several other bats are currently being tested. So we now have close on a half a dozen cases from widely spread locations.

The *Brisbane Courier Mail* (5-9-96) carried a small item ,

FLYING FOX SCARE

"Health authorities have warned people to avoid flying foxes after the discovery of a rare, rabies like virus... should avoid being bitten because of the potential risk of contracting lyssavirus"

In discussing these findings with carers, it is clear that there have always been a small proportion of bats coming into care with neurological problems, notably paralysis of the hind legs, a condition previously attributed to spinal injury - but this syndrome may well have been due to LV; the Townsville *P. scapulatus* had paralysed hind-legs. I emphasise that we really don't know what the probability is of our local LV infecting humans, but if infection occurs, then the subsequent disease could be nasty and life threatening.

What to do? Be aware - take care. If bitten, wash the wound immediately. If the biter was showing behavioural or movement abnormalities indicative of neurological problems then it should go straight off to the vet to be euthanased and tested for LV. I shall attempt to keep updates available on our bat web-site. Meanwhile, assuming that the newly detected LV is not a recent exotic import, I reiterate the ABS statement about EMV:

◊ Amongst a large human population in direct, prolonged and intimate contact with flying-foxes, there have been no reports of serious disease attributable to the bats. Thus there is no evidence of transmission of serious disease from flying-foxes to humans. Indeed, the epidemiological data, based on many thousands of human-bat contact hours, show that any LV circulating within flying-fox populations poses little or no risk to humans.

Nonetheless, there is some risk - very small perhaps, but finite, ie. real.

There has been much recent discussion on Batline about bats and rabies in the USA. This material can be accessed electronically from Batline archives and includes: bats being singled out as particularly dangerous, even though rabies transmission-to-humans statistics show otherwise; a not uncommon problem, but one that seems to have been exacerbated by U.S. public health authorities; panic over risk of being bitten by a micro-bat while watching a fly-out; removal of a batbox because of rabies-infection risk to the kiddies - this bringing forth ironic arguments for the need to remove all flowers etc, because of the much greater mortal danger from bees etc. And it goes on - but a valuable lesson for what may lie in store for us.

For a long time we have enjoyed the disease-free state of Australian bats, and being able to demonstrate the animals freely to the public - allow them to be handled etc. Alas, all flying fox carers and bat handlers must to look long and carefully at how they present their beloved animals to the public in the light of EMV and OZBLV.

Again, Batline has much to offer with cautionary tales of bat displays in the rabid USA; bats behind glass; personal vaccination of the bathandler; no bat-cuddling by the handler as this might encourage children to handle rabid bats in the wild; no touching whatsoever by children - emphasised by the tale of the kiddy who touched and later claimed bitten [an untruth] with the result - euthanasia of all bats for rabies testing. And another import from the USA - risk of litigation!

SPIT, IT'S A BAT'S LIFE!!

PROPOSED UNIFORM TERMINOLOGY FOR THE DESCRIPTION OF MICROCHIROPTERAN ECHOLOCATION CALLS, USING ANABAT

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Introduction

A microchiropteran bat echolocation call consists of a sequence of high frequency pulses or train of pulses punctuated by intermittent pauses. Different species of bat emit calls of a characteristic frequency and structure due to individual size, wing aspect-ratio and foraging strategy differences (Aldridge and Rautenbach 1987). Furthermore, intraspecific variations in the structure of calls (the design of high frequency pulses) is not unusual. Call structure varies with behaviour (Obrist 1995, Thomas *et al* 1987), age (Jones and Kokurewicz 1994), sex or varying hunting strategies used in different foraging habitat (Schumm *et al.* 1991). Brigham *et al.* (1989) also suggests that call variation may be a function of intraspecific communication, genetic differences between individuals and morphological differences in vocal structures.

The structure of calls or the pulse design (shapes) will differ according to the analysis applied to interpret bat signals, and each species is likely to use several shapes to gain information on habitat and prey distance and size. These inherent differences complicate both the acoustic identification of bats, or any attempt at describing the full spectrum of calls each species utilise in different situations. A uniform terminology describing the variations in pulse shape does not currently exist, apart from the generic terms used to identify the two basic pulse types (Constant Frequency = CF and Frequency Modulated = FM), and the discrete phases of a call sequence (search, attack, and feeding buzz: Griffin, 1958).

Simmons and Stein (1980), expanded a system proposed by Simmons *et al* (1975) to classify sonar signals into identifiable categories. Their system used the presence and arrangement of CF and FM elements in the waveform of sonar signals, including consideration of the harmonic and amplitude features of the call. This system is inappropriate for the classification of call sequences generated by Anabat detectors, whose output records the dominant harmonic of the call pulses but not the amplitude modulation and harmonic content (Corben 1989). This is not a problem for the Anabat detectors, which have been designed as an inexpensive, robust and simple microchiropteran inventory and identification tool (Corben 1989). However an uniform terminology is needed for the description of the recorded output of Anabat II system (Titley Electronics, Ballina, NSW). This note proposes such a classification system.

Pulse design

Five common pulse shapes are characteristic of the calls obtained in extensive surveys of Southern Queensland microchiropteran species (de Oliveira unpubl. data). These are classified as **basic shapes** and are the foundation and building blocks for other call shapes. This foundation is modified by alteration in the frequency pattern of pulses, a total of seven frequency features were identified and bring forth another group of characteristic shapes, termed **variant shapes**. Using these features and examining the recorded call variation in microchiropteran calls, eleven variant shapes can be identified. The range of shapes employed by each species are not necessarily always used in the same sequence.

I have given the basic shapes a code in upper case (F, FM-CF-FM, L, R and C, Figure 1), whereas the frequency features appear in lower case (sw, s, x, d, o, b and t, Figure 1). A variant shape may have more than one feature and, in this case will have a three letter code (eg. dsR, dtC, obC).

These abbreviations state the following :

F = Flat, FM-CF-FM = Constant Frequency, L = Linear, R = Right-angled, and C = Curvilinear; i=inclined, s=short, x=extended, d=decreasing, o=open, , b=bi (two), and t=tri (three).

The terminology of the shapes is based on frequency features of the different pulses, the definition of each term is given below:

◊ Flat refers to a pulse of constant frequency applied to members of the Molossidae and Emballonuridae families.

◊ Constant Frequency pulses are composed of mainly one constant frequency component but also possess frequency modulated components. The pulse design described here was adapted from Simmons and Stein (1980) to avoid divergence from widely used description of Rhinolophids and Hipposiderids pulses and it applies to only one species of Rhinolophid, the Eastern Horseshoe-bat, *Rhinolophus megaphyllus*. It consists of a long constant frequency component in the middle of two frequency modulated components. The first FM component briefly increases in frequency, whereas the second briefly decreases in frequency.

◊ Linear reflects a very steeply sloped pulse decreasing rapidly in frequency over time.

◊ Right-angled is a pulse ranging in frequency on a right angle slope.

◊ Curvilinear pulses feature a more gentle angle of slope than Linear pulses.

◊ Inclined refers to a flat pulse that retains its constant frequency characteristic only at the end, thus featuring a gentle sloping start.

◊ Short refers to pulses with a much lower start frequency than typical Right-angled pulses.

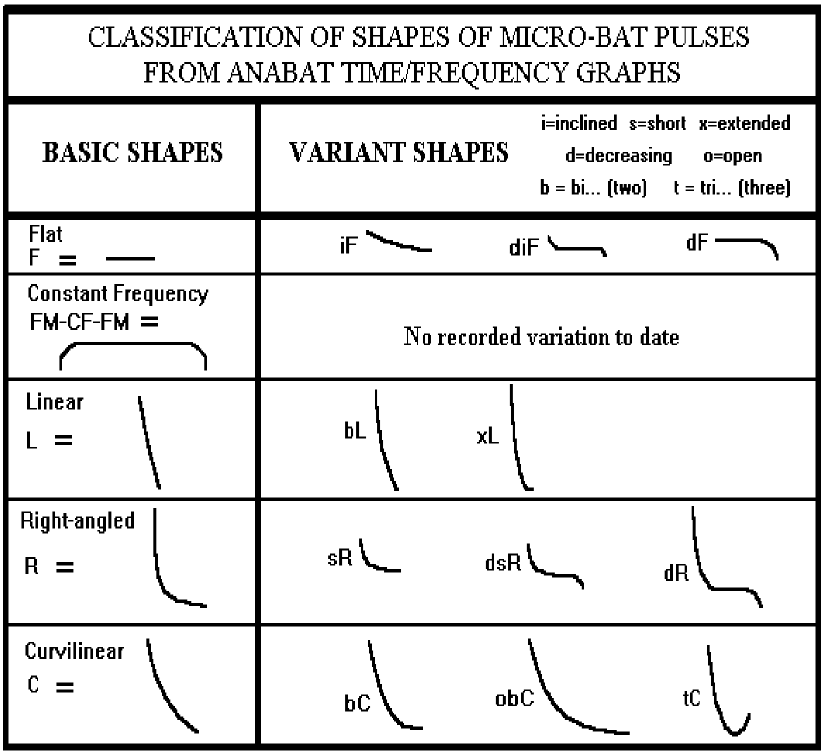
◊ Extended refers to Linear pulses that possess a 'tail' (characteristic frequency). These pulses resemble biCurvilinear pulses, however the main feature is the rapid change in frequency at the start of the pulse, ranging from at least 20 to 30 kHz in a few milliseconds (3-5).

◊ Decreasing refers to those pulses which decrease in frequency close to the termination of the call.

◊ Open refers to the wide-angled nature of certain biCurvilinear pulses.

◊ Bi refers to pulses with two distinct curves (either of Curvilinear or Linear nature).

◊ Tri refers to pulses of Curvilinear nature with three curves, where the last curve increases in frequency.



The range of shapes employed by each species are not necessarily always used in the same sequence. However, a sort of cycle may be used by certain species when a full sequence is recorded, *ie.* both attack and search phases are recorded, the basic shapes may give way to variant shapes which in turn develop into a feeding or terminal buzz, which is usually followed by the start of the cycle or basic shape pulses. Nevertheless some species do actually exhibit the opposite, where variant shapes usually prevail and sometimes precede basic shapes, eg. *Chalinolobus gouldii, C. nigrogriseus, Miniopterus australis, M. schreibersii.*

The concepts and terms presented here are an initial attempt to develop a consistent acoustic language between bat workers, intended to facilitate the much needed exchange of information. This terminology, in conjunction with detailed call measurements of seventeen species around South-east Queensland, is the subject of another paper in preparation.

Acknowledgments

Shape terminology was partially conceived by Chris Corben. Thanks to Martin Schulz, Chris Pavey and Alex Kutt for commenting on an earlier draft of this note.

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ANALYSIS OF ANABAT FILES: BAT ECHOLOCATION CALL RECOGNITION

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Introduction

The AnaBat electronic bat detection system is widely used for acoustically identifying bats. It is very easy to use in the field, and an extremely useful feature is the digital storage of calls for reference and analysis. The system has its short-comings however (see Spencer and Coles, 1996) and a major difficulty is the subjective method of visually comparing different calls. AnaBat files are packed with information however, and they are rarely used to their full potential. It is possible to extract this digital information and statistically analyse the characteristics of each individual pulse. The mathematical description of bat calls means the species of bat can be determined objectively, and opens the possibility of automated species determination. Other potential uses are the study of regional call variations within species, and call variation as an indicator of taxonomic relationships. Beware, however, that serious research of this nature would be more appropriate with more expensive call analysis systems. This paper describes some call attributes that can be extracted from AnaBat files and gives some examples of the sorts of statistical analyses that can be done.

Extracting call attributes from AnaBat files

The AnaBat II file structure allows large volumes of data to be stored in relatively small files. It is a great credit to Chris Corben, the programmer, that from a typical 5K AnaBat file one can extract an array of over 4 000 frequency values (kHz to three decimal places) with corresponding times (ms to three decimal places). A great many of these data points are "noise" of course and in most files less than 20% of the data points actually belong to pulses. The first job is to get rid of the extraneous data points. I use a complicated algorithm that goes through all the data points several times, initially removing points that are clearly not part of the call, building up a picture of what the pulses look like, and finally ending with pure pulse data.

From the time and frequency arrays, a variety of measurements that describe the individual pulses can be calculated. Table 1 shows a range of these measurements for the first six pulses from the AnaBat file 55311234.bin. This is the first reference call for *Vespadelus vulturnus* in the South-eastern Australian bat call library (**http://batcall.csu.edu.au/batcall/files;** Herr and Klomp 1995). The first two pulses are shown graphically in Figure 1. Some of the pulse characteristics listed may not seem very useful (and clearly highly variable), but it only takes the computer a few seconds to collect them all, and we can discard what we don't need later on.

A curve is fitted to each pulse by the least squares method. Simple quadratic curves fit bat pulses very well, with frequency being related to time squared. The equation for the curve is :

$$\text{Frequency} = \text{Intercept} + \text{Slope} \times \text{Time}^2$$

Real-time is converted to a more manageable (and more meaningful) relative time, with time-zero chosen to maximise the R-squared value. R-squared is a measure of how well the curve fits the data. The best possible R-squared is 1.0, so values over 0.95 (as they are in most pulses from most calls I have looked at) indicate a good fit. The frequency where the curve cuts time-zero is called the intercept. Time-zero is the lowest point of the curve so the intercept is usually close to the minimum frequency. There are, however, subtle differences in different shaped pulses. In many calls the frequency is still declining fairly sharply at the end of the pulse and in these cases time-zero occurs after the pulse has ended with the intercept less than the minimum frequency. It should also be noted that the intercept is calculated using every data point in the pulse, while minimum frequency is just a single data-point. The shape of the curve (ie. the rate at which the frequency changes during the pulse) is encapsulated in the slope.

I give the measure "time since last pulse" a little massaging. In the raw data there is a cluster of values around the median, and where one or two pulses are missed, there are minor clusters at twice and thrice the median. These higher values I divide by two or three to give the best estimate of the time since last pulse. Any times longer than three times the median I discard. The distributions of maximum frequency, average frequency and slope are sometimes a little skewed to the right (a few high values) but otherwise all the data are fairly normal.

Call attributes as an indicator of species

It would be nice if each species gave an unvarying call with consistent pulse characteristics, but of course it is never so easy. Note the variation between the pulses in Table 1. Table 2 gives an indication of the variation between different AnaBat files of the same species. The standard deviations in this table show how much variation there is between different pulses within the same file. We can see that the most variable attribute is the slope, while the most consistent are minimum frequency and intercept. The R-squared value is not really a pulse characteristic, but we can see from this that the curves consistently fit the data well. From this it is clear that the large slope variations reflect genuine variations in the rate of frequency change, not just sloppy fits.

Table 3 compares call attributes for several different species. Looking at these data, and bearing in mind that attributes with smaller standard deviations are more reliable, we can fairly easily pick *Vespadelus darlingtoni* from the bunch. Its low minimum frequency/intercept sets it apart from the other *Vespadelus* species, while its long pulse duration and intermediate average frequency separate it from the *Falsistrellus* and *Nyctophilus*. Various attributes also separate *Falsistrellus* and *Nyctophilus* from the bunch. We can apply statistical tests to estimate the probability that a call with certain attributes belongs to a particular species, and we can be more confident comparing measurements rather than making comparisons by eye. There will still be problem species however, and a comparison of the attributes of *V. vulturnus* and *V. regulus* in Table 3 shows that there is almost no difference in the calls of these species.

We should not disregard visual comparisons. Tables 2 and 3 are a meaningless mass of figures to most of us, but some graphical techniques enable us to make rapid judgements about complex data. One visualisation technique is to standardise the attribute estimates for each bat and plot them as "stars". Stars for individual *V. vulturnus* and *V. regulus* calls are shown in Figure 2. A z-score can be calculated for each attribute (for each bat) by subtracting the attribute mean for each bat from the attribute mean of all bats, and then dividing this by the standard deviation. With seven attributes each star has seven points. The distance of each point from the center is proportional to the attribute score, and the circle shows where scores equal to the mean would lie. Using this technique, one can tell at a glance which groups of bats have similarities, and which individuals are unusual.

Discriminant analysis of pulses

Discriminant analysis is a very powerful tool for distinguishing between groups and making judgements about group membership. It is available in most modern statistical packages. We have seen how there is considerable variation from pulse to pulse within each call. Unusual pulses may not tell us much, but within a call, a number of pulses (hopefully the majority) are likely to be characteristic of a particular species. We can use discriminant analysis to look at every single attribute of every single pulse within a call. We can feed in calls from different species and the discriminant analysis procedure will make predictions about which pulses belong to which species.

Table 4 shows the results for such an analysis of most of the files belonging to *V. darlingtoni, V. vulturnus, V. regulus, F. tasmaniensis* and *N. geoffroyi* in the South-eastern Australian bat call library. It does a pretty good job, and even correctly separates most *V. vulturnus, V. regulus* pulses. The real test, of course, is how it goes with calls it has never seen before. The last *V. darlingtoni* file (55311221.bin) and the last *V. vulturnus* file (55311241.bin) were excluded from the initial discriminant "training". When asked to make predictions for these calls it had no trouble with *V. darlingtoni,* and correctly identified 63% of the 54 pulses in the call. It thought 33% of the pulses probably belonged to *V. regulus.* Sadly however, it did badly trying to identify the *V. vulturnus* call, and thought 69% of the 88 pulses in this call belonged to *V. regulus.* It correctly identified only 31% of the pulses in this call.

I did some further analyses trying to discriminate between these two species. The statistical package did well on all the calls apart from the last two *V. vulturnus*. It insisted these were more consistent with the calls of *V. regulus.* These two species are taxonomically close, and the best way to tell them apart is from the shape of the penis. Wouldn't you know it, both these calls were from females so they may possibly have been misidentified (Alexander Herr, pers. com.). The real lesson is, TAKE VOUCHER SPECIMENS!

Cluster Analysis of calls

Unlike discriminant analysis which looks at differences, cluster analysis seeks similarities. It can be used as a taxonomic tool to see which individuals cluster in groups (are likely to be related) and how close the different clusters are. The choice of which attributes to include in the analysis, or the weights given to the attributes, are important, as some features are taxonomically "more conserved" than others. As an example, I performed a cluster analysis on all the frequency attributes for the eight bat species in the South-eastern Australian bat call library. Results of the analysis are presented as a dendrogram in Figure 3. In this figure the degree of similarity is proportional to the length of the branches. As expected *V. vulturnus* and *V. regulus* show the greatest similarity and they form a cluster with *N. geoffroyi* and perhaps *C. morio*. With its very low frequencies, *M. planiceps* is the most distinctive bat of the group. It would be interesting to see which attributes are most closely correlated with taxonomic groupings based upon morphological and genetic features.

Conclusions

Although widely used, AnaBat bat detection systems are a very under-utilised resource. A range of call attributes can be extracted and used to statistically discriminate between species. There is potential to develop automated species determination systems. I will be doing further work refining the analysis system, and I would appreciated any comments or suggestions that readers have. I would be interested to hear from anyone with problems that might be solved with some of the techniques I have discussed.

If you have two or three AnaBat files you would like analysed for research purposes, then e-mail them to me and I will send you a brief numerical summary of each file. If you have a lot of files to analyse, then I can provide summaries, but I would have to charge for my time. Unfortunately I am not in a position to provide detailed statistical analyses of files.

Acknowledgments

I would like to thank Allan Young, Alexander Herr and Chris Corben for help and encouragement.

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Table 1. Measurements of the first six pulses from the AnaBat file 55311234.bin, the first reference call for *Vespadelus vulturnus* in the South-eastern Australian bat call library.

	1	2	3	4	5	6
Time since last pulse (ms)	-	77.5	80.3	83.1	88.3	86.3
Duration (ms)	2.81	3.23	3.06	3.07	3.00	3.86
Maximum frequency (kHz)	71.11	64.78	61.54	71.43	56.54	77.67
Average frequency (kHz)	53.65	51.15	50.90	54.35	48.84	54.44
Minimum frequency (kHz)	46.51	45.58	46.24	47.06	44.82	44.57
Intercept (kHz)	46.30	45.44	46.34	46.68	45.46	45.48
Slope (kHz/ms^2)	4.829	2.918	2.729	4.176	1.649	3.433
R-squared	0.981	0.984	0.979	0.992	0.967	0.966

Table 2. The time since the last pulse, duration, maximum frequency, average frequency, minimum frequency, intercept, slope and R-squared value calculated from six AnaBat files of *Vespadelus vulturnus*. The files are from the South-eastern Australian bat call library. Values are means ± standard deviations.

	55311234	55311236	55311237	55311238	55311239	55311241
Time since last pulse	87	83	84	88	99	92
(ms)	*± 10.2*	*± 4.5*	*± 13.5*	*± 9.9*	*± 21.1*	*± 9.4*
Duration	3.60	2.77	2.55	2.81	4.25	4.02
(ms)	*± 1.07*	*± 0.60*	*± 1.00*	*± 1.28*	*± 1.32*	*± 1.12*
Maximum frequency	64.70	67.50	58.36	58.92	63.63	63.46
(kHz)	*± 9.85*	*± 10.52*	*± 5.42*	*± 7.17*	*± 11.29*	*± 9.89*
Average frequency	50.16	52.56	49.66	49.01	49.21	50.05
(kHz)	*± 2.41*	*± 2.36*	*± 1.67*	*± 1.51*	*± 3.79*	*± 3.15*
Minimum frequency	44.68	46.91	46.14	45.58	42.95	44.81
(kHz)	*± 0.95*	*± 0.46*	*± 0.95*	*± 0.60*	*± 1.08*	*± 0.96*
Intercept	44.69	46.58	45.97	45.25	43.04	45.12
(kHz)	*± 1.02*	*± 0.87*	*± 1.16*	*± 0.87*	*± 0.92*	*± 0.99*
Slope	2.34	3.97	2.97	2.73	1.81	1.87
(kHz/ms^2)	*± 1.00*	*± 1.03*	*± 1.48*	*± 1.17*	*± 1.40*	*± 1.73*
R-squared	0.951	0.974	0.958	0.953	0.971	0.949
	± 0.031	*± 0.012*	*± 0.021*	*± 0.021*	*± 0.013*	*± 0.022*
Number of pulses	38	57	51	44	84	88

Table 3. The time since the last pulse, duration, maximum frequency, average frequency, minimum frequency, intercept, slope and R-squared value calculated for *Vespadelus darlingtoni, V. vulturnus, V. regulus, Falsistrellus tasmaniensis* and *Nyctophilus geoffroyi*. Values are means ± standard deviations of pooled data from all files for each species in the South-eastern Australian bat call library.

	V. darlingtoni	*V. vulturnus*	*V. regulus*	*F. tasmaniensis*	*N. geoffroyi*
Time since last pulse	97	90	87	117	87
(ms)	*± 13.0*	*± 14.5*	*± 7.3*	*± 7.0*	*± 23.6*
Duration	4.76	3.45	3.84	4.19	2.74
(ms)	*± 1.63*	*± 1.28*	*± 1.07*	*± 1.65*	*± 0.93*
Maximum frequency	53.77	63.00	60.69	50.20	61.79
(kHz)	*± 7.99*	*± 9.95*	*± 8.59*	*± 8.33*	*± 8.40*
Average frequency	45.33	50.08	49.04	41.47	50.34
(kHz)	*± 3.31*	*± 3.02*	*± 2.49*	*± 2.99*	*± 4.05*
Minimum frequency	41.90	44.98	44.24	37.38	41.31
(kHz)	*± 1.80*	*± 1.61*	*± 1.40*	*± 1.33*	*± 2.28*
Intercept	42.06	44.96	44.41	37.41	39.66
(kHz)	*± 1.84*	*± 1.54*	*± 1.40*	*± 1.27*	*± 3.32*
Slope	1.05	2.49	1.56	0.96	1.64
(kHz/ms^2)	*± 1.54*	*± 1.58*	*± 1.40*	*± 0.60*	*± 0.65*
R-squared	0.963	0.960	0.969	0.975	0.982
	± 0.016	*± 0.022*	*± 0.013*	*± 0.013*	*± 0.012*
Number of pulses	433	362	162	33	138

Table 4. Results of discriminant analysis of AnaBat files in the South-eastern Australian bat call library. Values are the proportion of pulses from the species in each column ascribed to the species in each row. Values in bold are the proportion correctly predicted.

	True species				
	V. darlingtoni	*V. vulturnus*	*V. regulus*	*F. tasmaniensis*	*N. geoffroyi*
V. darlingtoni	0.74	0.08	0.07	0.03	0
V. vulturnus	0.07	0.64	0.15	0	0.02
V. regulus	0.16	0.25	0.77	0	0.01
F. tasmaniensis	0.01	0.01	0	0.97	0.01
N. geoffroyi	0.02	0.01	0	0	0.96
Number of pulses	379	274	162	33	138

Figure 1. The first two pulses from the AnaBat file 55311234.bin. This is the first reference call for *V. vulturnus* in the South-eastern Australian bat call library.

Figure 2. Star diagrams for six *V. vulturnus* calls and three *V. regulus* calls from the South-eastern Australian bat call library. The distance of each point from the center is proportional to the z-score of each attribute shown on the legend. The circles indicate where scores equal to the mean would lie.

Figure 3. A dendrogram showing the relationship of eight bat species based on four frequency attributes of their calls. The measure of distance is Euclidean distance complete linkage.

A REVIEW OF JOLLY (1996) "ANALYSIS OF ANABAT FILES : BAT ECHOLOCATION CALL RECOGNITION"

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Editor Lawrie asked if I could referee Simon's paper for the ABS Newsletter, but having read it, I thought it best to recommend that it be published as is and offer to review it instead. Lawrie agreed so here goes!

The use of bat detectors has had a major impact upon bat survey methodology and reliability. In fact, there would be little dispute amongst bat biologists today, that bat surveys conducted without bat detectors are likely to be inefficient and incomplete. Those of us regularly using the AnaBat bat detector and call analysis, know however, the system is not perfect, and call identification can be very difficult, especially amongst certain groups of species. So, Simon's paper, which offers a new way of analysing AnaBat derived calls, grabbed my attention and I am sure, will be read with keen interest by AnaBat users.

I think, firstly, a couple of points should be made with respect to the philosophy of the paper and of Simon's background. Simon, as many of you will know, has been involved with bat work for yonks, but he has not used the AnaBat system nor is he particularly familiar with the diversity of variation and quality of calls generated by the system. His contribution to the field had its genesis at the Naracoorte bat conference, where he saw the AnaBat system in use, and as a result, decided that he could help improve the analysis side. Simon has used in his paper calls extracted from the South-eastern Australia bat call library, some of which Herry admits, may be from bats not correctly identified. Nonetheless, the paper was primarily written as a methodological approach for the analysis of calls, and thus the calls used serve the purpose.

I have to admit that at this stage I believe there is much more work to be done to fine tune Simon's statistical approach to call analysis. If I work from the assumption that it is possible to discriminate between species reliably from the AnaBat call data (and this may well be a false assumption for many species), then the question is how to extract the right information. After reading this paper, I tried to work out the process I use to differentiate between AnaBat calls. I concluded that the human eye and brain are very efficient at discarding aberrant signals, recognising patterns and comparing reference patterns, and may be no less efficient that Simon's current level of analysis.

For example, Simon says in the last sentence of paragraph three, page one, that we still need to 'physically' discard the "highly variable" characteristics. In my call library, I have dozens of calls that are recorded as reference calls ie from captured and released bats, and which have some weird characteristics. For example, *Mormopterus planiceps* (short penis), when released, gives an initial train of calls which in isolation are almost identical to *Nyctophilus* spp; the call train then evolves into that typical of *Chalinolobus gouldii*, before finally settling into what I interpret as typical flat *Mormopterus* calls. This progression of calls is familiar to me but how does Simon's analysis deal with such events. If Simon's program analyses all calls within a sequence, then the summation of the calls would show in this case, a huge variance in virtually all statistics, rendering it useless. Other than discarding non-useful calls by eye, I cannot see how calls can be recognised as non-search phase calls using numerical values without knowing *a priori* what values are unacceptable.

The slope statistic that Simon has calculated would appear to be quite a useful one, although it does lose quite a bit of information. Despite the high values of goodness of fit (R-squared value) the slope presumably is an average slope and cannot describe the terminal flattening of the slope adequately. I think the shape of the call is very informative. For example, the steep slope with no terminal flattening in *Nyctophilus* spp is very characteristic of the genus and distinguishes it readily from most other genera. Some work on the call shape parameters is essential in my view.

Notwithstanding these comments, I am impressed that the statistical analyses have discriminated the calls as well as they have - some of the calls used have quite variable pulses. I am not sure which calls were used for the interspecies comparisons - no file numbers were given. I noticed also that some of the *V. darlingtoni* calls needed calibrating, which I hope was done.

Simon has made an important step and contribution to AnaBat call analysis, and his data give reason for optimism that it may be possible for AnaBat call data to distinguish between species with similar calls. I think progress can be made if the statistical analyses are applied only to reliable search phase pulses, rather than using a wider range of calls within a sequence. If these statistics can then discriminate between species, then it should be a simple step to devise computer algorithms that make comparisons of unknown pulses and matching to the parameters of the known calls.

CONSERVING SHORT-TAILED BATS IN THE FRIDGE

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This winter the milk & beer has been kept in the pantry while the kitchen fridge has had a warning posted on it KEEP OUT: BATS. We'd like to tell you how this came about and how we and the bats coped.

Short-tailed bats *Mystacina tuberculata* are one of only two species of bats found in New Zealand (Molloy & Davis, 1995). The species is an intriguing one: it's adapted for terrestrial activity and reputed to have a lek breeding system. It's the only remaining species of the NZ endemic family Mystacinadae which separated out from other bats more than 35 million years ago, and it's closest relatives are thought to be the Phyllostomoidea of southern America.

In 1992 Molloy and Davis ranked *Mystacina* as one of a group of NZ species with the highest priority for conservation action. At that time only two viable populations of *Mystacina* were known, one on Codfish Island, off the north west coast of Stewart Island, and the other on Little Barrier Island in the Hauraki Gulf in the north of North Island. Since then several good populations have been discovered throughout central North Island as well as one in the northwest of the South Island, but that's another story. In 1992 the New Zealand's Department of Conservation decided to attempt to eradicate introduced rodents from Codfish Island by broadcasting a second generation anticoagulant rodenticide. These rodenticides are relatively persistent in the environment and act cumulatively in mammals over a period of many months. Because short-tailed bat's feed on ground dwelling invertebrate such as wetta and cockroaches which feed on rat baits Lloyd (1992) suggested that the bats might be susceptible to secondary poisoning. A programme of research was begun to assess the risk of poisoning short-tailed bats and to develop methods to protect the Codfish Island bat population during a rodent eradication.

Two methods for protecting the bats were considered, translocation to establish a second population, and temporary captivity of a portion of the population over winter during the rodent eradication. Translocation was attempted in September 1994 but failed. Fifty bats were transferred from Codfish Island to Ulva Island, a distance of 40 kilometres (Lloyd, 1994). The transferred bats weren't impressed with their new island and left (for home we hope) on the night they were released. Fortunately the captive option proved more promising. A small group of short- tailed bats was taken into captivity in December 1992 and have been held at Wellington Zoo since then. The bats settled into captivity easily, survival has been good and there have been two births in the zoo but unfortunately no recruitment. The Department of Conservation decided to carry out a trials to see whether short-tailed bats could be held in captivity temporarily over winter and then successfully released back into wild. Jane Sedgely, with help from her friends, including Australia's Lindy Lumsden, undertook the work this winter. Bats were held in an aviary for one month on Codfish Island and then successfully released back into the wild population.

While doing background reading for this captive work we came across a section on artificial hibernation in Barnard (1991). What a revelation, a fridge full of trays of chilled bats and not a mealworm in sight. This was enough to gladden the heart of any one that's experienced the angst of providing captive bats a square meal every night. Although Daniel (1990) and some other workers believe that *Mystacina* don't hibernate, our own work has shown conclusively that during winter and early spring individual bats routinely remain in torpor for periods of 6- 10 days. We decided to test artificial hibernation of short-tailed bats in the belief that it could make holding 300-400 bats in captivity on Codfish Island a more realistic (and cheaper) proposition.

Twenty Short-tailed Bats (*M. t. rhyacobia*) from Rangataua Forest in central North Island were taken into captivity during May 1996. Initially we kept them in a specially prepared bat-room for 25 days to settle them into captivity. Once we were confident the bats had settled into captivity we began an induced hibernation trial. During the trial the bats were kept in a domestic fridge at temperatures between 4°C & 6°C for six periods ranging from 3 to 11 days. Between periods of induced hibernation the bats were returned to the bat-room for at least a week to recover condition. Sixteen surviving bats were released in early September after 123 days in captivity, including 40 days in the fridge. The bat-room was an unheated spare bedroom (3.6 x 2.2 m) specially prepared for them. During the bats active periods in the bat room we provided food nightly on a feeding tray 1.7 m above the floor. The diet comprised mealworms, locusts, and honey water supplemented with huhu (larvae of the longhorn beetle *Prionoplus reticularis*), and a variety of insects caught in a light trap. Fresh water was available at all times. With typical microchiropteran perversity, and despite a selection of what we considered to be very fine roost boxes, the bats roosted under two layers of polar-fleece hung on the wall. (Maybe bat workers providing artificial roost boxes should consider clothes lines hung with polar fleece instead.) Shortly after capture we marked the bats individually with black hair dye (Wella BellaLady) for identification, and dosed them orally with Ivermectin (0.1ml per bat, 0.4%w/v diluted 1:1 in honey water) to eliminate parasitic mites (*Chirolaelaps mystacinae*). These mites have previously caused secondary infections and death in captive short-tailed bats (Blanchard, 1996). Most of the bats either maintained or gained weight in captivity, after 18 days in captivity the average weight had increased by 0.9g, or 6%, to 16.3g . Only one bat consistently lost weight . During the periods of induced hibernation in the fridge the bats were kept in a small box (200 x 150 x 280 mm), lined with and subdivided by slabs of bark. There were ventilation holes in the box and the air in the fridge was refreshed daily by opening the door. briefly A dish of water covered with gauze was placed in the fridge to maintain a high humidity level. The temperature in the fridge was recorded on a Hobologger and monitored with a digital thermometer with an audible alarm set for 3°C & 7°C .

The first period of induced hibernation was traumatic for us. In addition to worrying about the survival of the bats we were repeatedly catapulted out of sleep by the temperature alarm as the fridge temperature lurched around erratically. Fortunately the bats all survived and we were able to identify the fridge's problem. We shouldn't have de-iced it. The fridge thermostat monitored the temperature of the ice-box. As long as the ice-box was iced up the fridge cabinet temperature was relatively stable (as I had found with preliminary temperature monitoring) but when the ice-box was de-iced temperatures lurch erratically. The solution: we replaced the thermostat with one which measured the cabinet temperature. The new thermostat was set to maintain the cabinet temperature between 4°C & 6°C which it did effectively. The rest of the trial went relatively smoothly.

During each period of induced hibernation the bats lost on average 1-2 g of body weight but regained it within a week (probably less, as food consumption declined within 3 days of the bats being returned to the bat-room). Sadly three bats probably died as direct result of induced hibernation. One died overnight following the second hibernation period. This bat was the smallest bat and the only one which had consistently lost weight in captivity which confirms Barnard's (1991) maxim: "Never refrigerate injured, dehydrated or thin bats". Two bats died overnight following eleven days of induced hibernation, confirming another of Barnard's maxims: "Do NOT refrigerate bats for more than 10 days". All autopsy results were inconclusive but the two bats that died after 11 days of hibernation had stomachs distended by gas. We assumed the gas was from fermentation of honey water consumed during post-torpor feeding frenzy. Although fermentation was probably post-mortem there is a possibility that it could have could have been the cause of death. As a precaution we subsequently didn't provide honey water on the first night after induced hibernation.

With three out of twenty bats dying we can't claim complete success for the induced hibernation trial. Despite that we believe that periods of induced hibernation lasting less than 10 days can be used safely with short-tailed bats in good condition. During these trials we were relatively conservative and only kept the bats in induced hibernation for one third of the captive period. We have little doubt that a shorter habituation period of 10-14 days could be safely followed by a more aggressive schedule of 6-7 days of induced hibernation alternating with 3-4 days of activity. This schedule would make the task of holding 300-400 short-tailed bats in captivity over winter on Codfish Island an easier one.

Oh yes; and the winter up here was so cold that the beer in the pantry stayed cold enough for an Australian to drink. Personally I prefer beer that I can taste, preferably luke warm.

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UPDATE ON THE GREAT BAT PHYLOGENY DEBATE.

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Australian perspective

With easy access to both megabats and microbats, Australian researchers are specially placed to contribute to the old debate about whether megabats and microbats had a common flying ancestor. While the Australian populace at large has taken enthusiastically to the “flying primate” hypothesis as a result of local publicity and their experience with the intelligence and personality of hand-reared flying foxes, there is more shyness about mentioning this controversial hypothesis elsewhere. For example, in the new edition of the Australian Museum’s Guide to Australian mammals, the wide-ranging Australian work on “flying primates” does not rate a mention despite the potential for increased understanding of the dramatic differences between microbats and megabats. (Nor is Platypus electroreception mentioned in that volume, despite the importance of this sense for underwater feeding by the Platypus, and despite the large contribution made by Australian researchers to the understanding of electroreception!).

Molecular phylogeny of mammals in the 1990s

It may therefore be appropriate to bring readers up to date on the recent developments in the bat debate. Since the debate moved onto a molecular front in the 90s, I also thought that it would be worthwhile to draw attention to the current ferment in molecular phylogeny as it pertains to the bat problem. Of particular interest here is the startling proposal by Janke and his co-workers (1994), from Pääbo’s lab in Munich, that the “cetungulates” (comprised of whales, ungulates and carnivores) is a monophyletic clade that is a primate sister group to the exclusion of the rodents! Such a proposal is at least as controversial as the “flying primates” hypothesis, so it is well to note the huge amount of molecular data upon which the proposal is based. To come to their conclusion, Janke *et al.* (1994) sequenced hundreds of kilobases compared with the tens of kilobases so far sequenced from bats (see Pettigrew 1995 for a review).

I am personally quite comfortable with the "cetungulate" proposal because of derived brain similarities in artiodactyl ungulates, carnivores and whales, but my point here is that mammalian phylogeny is currently in a state of ferment, with many treasured old phylogenetic hypotheses under attack (another example is the tarsier, an undisputed primate whose relationships with other primates is still unresolved ...see Rosa *et al.* (1996)). It does not seem appropriate to reject the "flying primate" hypothesis on the basis of a few kilobytes of DNA sequence data when hundreds of kilobytes seems to be insufficient to overturn old ways of thinking about mammalian relationships in the case of cetungulates and primates.

Molecular phylogeny using whole genomes

The problems and powers of molecular phylogeny are beautifully illustrated by the recent complete sequencing of the genome of *Methanococcus jannaschii*, a methanobactium first discovered in a deep sea vent. The relevance of bacterial gene sequences to the current debate about bats is two fold:- 1. The new information has settled an old controversy about the relationships of the three major life forms, or domains (Bacteria, Archaea [which includes methanobaceria, sulphur bacteria, halobacteria] and Eucarya). 2. The resolution of the controversy required a move from a gene-by-gene approach to comparisons of groups of genes in whole genomes.

Gene-by-gene comparisons had been unable to decide unequivocally whether Archaea were closer to Bacteria (a first, but apparently wrong, guess that springs intuitively to mind) or whether Eucarya and Archaea shared a more recent common ancestor than either did with Bacteria. In fact, gene-by-gene comparisons of DNA data gave a firm answer in the wrong direction by associating an eucaryote, the slime mould *Dictyostelium*, with procaryote Bacteria. In contrast, a consideration of the whole genome makes it clear that a whole new set of genes for transcription, translation and replication of DNA was "invented" after both Archaea and Eucarya diverged from Bacteria. The sequence data linking Archaea to Bacteria are related to systems related to metabolism and cell wall structure that may be shared requirements for these two groups of organisms that have been retained from a common "bacterium-like" ancestor (plesiomorphies, in other words). The erroneous link between some procaryote Bacteria and the eucaryote *Dictyostelium* is related to a convergence in base composition of their DNA, and disappears in other analyses, including the whole genome approach.

What can we learn from this about the bat debate?

First, it may be premature to declare a winner in the diphyly-monophyly fight on the basis of DNA sequences from fragments of genes. Hundreds of times more data has not been able to settle the issue in other similar cases of disputed phylogeny, such as the question of pinniped monophyly/diphyly (are seals more closely related to ursids and sea-lions more closely related to mustelids, or are seals and sea-lions more closely related to each other?).

Second, it should be noted that base-by-base, gene-by-gene comparisons were abandoned in the settlement of the Archaea-Eucarya-Bacteria debate, in favour of a comparison of whole systems of genes. While the genes of *Methanococcus* were identified on the basis of sequence similarity to comparable genes in other life domains, it was their presence or absence that was crucial to choice of the final tree, not the sequence divergence between genes shared by all three domains of life. In other words, the telling observation was the shared, complex system of enzymes for replication, transcription and translation in both Eucarya and Archaea, not the sequence differences between the house-keeping genes that were shared by Eucarya, Archaea and Bacteria.

This emphasis on whole new gene systems, as opposed to divergence between homologous genes, is reminiscent of the invention in the two kinds of bats of two different sensory systems. Microbats devised a complex system of laryngeal sonar that has involved scores of functional changes in the cochlea (whose dramatic increase in size enables microbats to be recognised unequivocally in 50 MYO fossils) and in the brain (the microbat auditory system has many specialisations that are unique and that contrast with the generally primitive state of its other sensory systems). The comparable invention in megabats is the complex cortical visual machinery for vision that has come to dominate the more reflexive midbrain visual machinery upon which the cortex has left its imprint, in contrast to other mammals where the midbrain has the primitive arrangement. One can gain an intuitive appreciation of this advanced machinery when a flying fox fixates its gaze upon you. My own original interest in the phylogeny of bats was triggered by this finding of advanced visual organisation in megabats that is shared only with primates. While I have no idea of the genes that would be involved in constructing this complex organisation, I think it highly unlikely that they would have been independently discovered by primates and flying foxes, particularly as every year brings new examples to light of complex brain traits that are shared by primates and megabats (see Pettigrew 1995 for a review). Similarly, it is difficult to understand why a nocturnal flier like a megabat would have lost all the genes for laryngeal sonar that are present in microbats as required by the proponents of monophyly.

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I am presently trying to set up a web page on the great bat debate. While I get this completed, those with an interest in more information on the debate can Email me for reprints or discussion at: **j.pettigrew@vthrc.uq.edu.au.**

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THE COMMON NAME AND COMMON MISCONCEPTIONS ABOUT THE COMMON BENTWING-BAT

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Overview

In this article I suggest that the Common Bent-wing Bat, the entrenched vernacular for *Miniopterus schreibersii*, be replaced by "Large Bent-wing Bat". Semantic issues such as vernacular names might at first appear to be very trivial considering the many pressing environmental problems currently facing bat species, but the reasons for believing that the common name of this species is hindering its conservation management are discussed.

Some readers will consider that many of the issues raised here are self evident, but the past five years spent as a fauna consultant in NSW has convinced me that many people apparently do not. In addition, there appears to be no easy way of determining whether the untenable, flawed, misleading and sometimes bizarre statements appearing in many impact assessments of bats in the commercial faunal impact assessment arena, are based on a lack of awareness of basic issues, deliberate misinterpretation, or a combination of the two.

Common misconceptions

A misunderstanding widely held amongst sections of the community, conservation planners, many consultants and a few too many biologists, is to equate commonness with lack of vulnerability. Species which are widely distributed and commonly encountered in surveys are mistakenly regarded as being of low conservation concern, because they are not rare or restricted in distribution. This view is extremely superficial, and perhaps is a hangover from the early naturalist's "stamp collecting" mentality. It implies that a major prerequisite for a species to be considered of conservation concern is that it must be uncommon or rare. Stamp collectors and butterfly collectors alike are far more interested, naturally enough, in the uncommon or rare types: "I say old boy, don't worry about *that* one, its only the *common* variety!".

This view is entrenched in the burgeoning EIS (Environmental Impact Statement) and FIS (Faunal Impact Statement) subliterature. This is less surprising, because many fauna consultants appear to see their role as assisting their clients to jump through the green hoops of environmental legislation to get the development approved ASAP, particularly if such consultants wish to get further work. Part of that process is often, unfortunately, to downplay the conservation significance of any species listed as threatened which occurs or could be expected to occur in the ecosystem proposed for modification.

In NSW the Large Bent-wing Bat is currently defined as a "threatened" species in the *Threatened Species Conservation Act (1995)*, and is listed on Schedule 2 of that Act as "Vulnerable"- this Act replaces the *Endangered Species (Interim Protection) Act (1991)* in which it was listed in the category of "Vulnerable and Rare". The official reasons for listing this species relate to the concentration of populations at key roost sites (i.e. its vulnerability); suspected population decline in NSW, and that it is an ecological specialist facing "severe threatening processes".

In contrast to fauna consultants and biologists who presumably should know better, members of the community, upon entering a cave containing countless thousands of Large Bent-wing Bats, might be forgiven for thinking that the species is common, and wonder why it is regarded as an endangered or threatened species - after all, there are so many bats!. An abundant and widely distributed species is of high conservation concern if it is vulnerable to catastrophic population decline. I would have thought that this is pretty obvious. Many Australian vertebrate species which are now long extinct were once described as common, even abundant, and were widely distributed shortly before their presumed extinction.

The potentially high vulnerability of the Large Bent-wing Bat in south-eastern Australia has been recognised for more than 30 years (e.g. Dwyer 1964; Hamilton-Smith 1966). The reliance of a population of this species on one or a small number of maternity cave roosts, to which adult females converge during maternity colony formation from up to several hundred kilometres away, has been well documented, e.g. by Dwyer and Hamilton-Smith (1965), and Dwyer (1966).

Major disturbance or destruction of the maternity colony, in which the majority of adult females of that population presumably gather, obviously has a high potential to have catastrophic consequences for the survival of that population. The vulnerability of this species is not a new concept. However, the view that the species is highly vulnerable and is of significant conservation concern appears to be news in some quarters, which begs the question as to why such well documented vulnerability has been consistently ignored by those who state or imply that the species is not of significant conservation concern.

It is possible that in addition to the misleading or flawed claims resulting from the commercial pressures on consultants involved in impact assessment, that genuine misunderstandings exist about basic issues of conservation evaluation of species, and the Large Bent-wing Bat is a good example of this. For example, frequent references can be found in the NSW FIS literature which imply, almost with indignation or disdain, that the species should not be listed in the category of "Vulnerable and Rare" in the *Endangered Species Interim Protection Act (1991)*. The usual reasons which are stated, but more often implied are:

1) it is "abundant" - the obvious implication being that populations are secure - there are plenty of them so why worry?;

2) is it widely distributed in NSW, northern Australia and adjoining countries ("this species has a near world wide distribution"). This approach is inappropriate and flawed because it ignores a number of documented points:

   - conservation of the species should concentrate on management of discrete populations (Hamilton-Smith 1980);

   - the legislative framework - for better or worse - whereby State Governments are responsible for and control conservation issues within each State.

   - it is not at all clear how many species exist in Australia under the name "*M. schreibersii*", let alone whether any Australian populations are really the same species as overseas populations accredited with that name.

3) It is often implied that records from a wide range of habitats indicates that the species is "versatile", i.e. resilient and adaptable to any impacts. While roost sites have certainly been recorded in a wide range of habitats (Dwyer 1966), the foraging habitat requirements of this species are essentially unknown. Although individuals have been trapped or detected from calls in a wide range of habitat types, the way in which such individuals were utilising habitats, and the importance of such habitats to the species, are usually unknown. Given the potential mobility of this species, animals could have been commuting through areas that are otherwise not used for foraging. The possibility remains that the species could have specialised foraging habitat requirements, so why assume that it is a generalist?.

4) Another issue relating to claimed adaptability of this species is its presence in buildings in capital cities. This is also incorrectly cited as indicative that it is indeed highly versatile, and by implication should not be listed in the Act. This view appeals to the public misconception that endangered species are only found in virgin habitat on the most remote mountain tops. The presence of the species in buildings does not in itself necessarily indicate the claimed versatility. The circumstances of such occurrences must be understood before such claims are justified. For example, the species might have highly specific roost requirements which happen to be met in a small proportion of human structures; occupation of buildings might not be possible if adjoining unmodified habitat is removed; in some circumstances occupation of buildings might be a suboptimal response to destruction of more suitable roost sites, and might not be viable in the long term, etc etc.

Those who are dazzled into complacency by the sight of large aggregations of this species should recognise not only its vulnerability to population decline, but that nothing is known of minimum population thresholds in this species. For some reason humans tend to think in a linear, incremental way: e.g. if there are 10,000 bats in a cave, there is a long way to go before we are down to "the last few". However, it is plausible that populations of the species could crash below some minimum number of individuals, and that this could even be a relatively "high" number, particularly in a communal roosting species.

Is the species really as abundant as is commonly assumed? I am surprised at the number of bat surveys in NSW which have failed to detect this species, or in which it can hardly be considered one of the more commonly encountered species. While there is no doubt that large aggregations of the species exist in a limited number of roost sites, there is always the danger that this is clouding peoples evaluation of its status. Certainly, bat surveys in some districts indicate that it could be regarded as common based on call detection and trap records. However, if the preconception of abundance is put to one side, I doubt whether this species would accurately be termed abundant or even common in many areas within its range on the basis of cave/mine inspections, or trap and call detection records. Generally, the species is infrequently captured in bat traps compared to other bat species which are regarded as common or abundant. This could be a sampling artefact if the species routinely flies too high for capture. Likewise, call detection might be limited if the species routinely flies too high for detection. Then again, perhaps it really is not as abundant as we think. I raise these issues simply to encourage a more open minded consideration of its status in future surveys, as opposed to the blanket assumption that the Large Bent-wing Bat is "abundant".

A vernacular change for some kind of political correctness?

Is the suggested name change simply an instance of some kind of environmental political correctness? After all, imagine standing in front of the bulldozers to save the "Common Bent-wing Bat"!? One goal of people aware and concerned about bat conservation is surely to alert the community to the conservation threats facing bat species, and to dispel any misunderstandings about the conservation status of species such as the Large Bent-wing Bat. This understanding is seriously hindered by the current name "Common Bent-wing Bat", which reinforces the mistaken popular view that common species are automatically not of conservation concern. I suggest that this is the main justification for changing the vernacular name to remove the word "common". The common name itself might even be a threatening process to this species because it reinforces this misconception.

There are at least three factors which indicate that this species is of sufficient conservation concern to justify any inconvenience and possible initial confusion which might result from a name change:

1. The obvious vulnerability of populations to catastrophic population decline by reliance on a small number of maternity cave sites, in addition to the predisposed vulnerability conferred by being a cave\mine roosting species;

2. The suspected decline in numbers of this species in southeastern Australia (e.g. Hall and Dunsmore 1974; Hamilton-Smith 1979, 1980);

3. The uncertainty about the taxonomic status of different populations of "*M. schreibersii*" in Australia. This has been recognised for decades (e.g. Dwyer 1965; McKean 1966). A comprehensive modern taxonomic assessment has not been undertaken on Australian populations, but there is little doubt that their taxonomy is complex (e.g. Wilson 1984). It has been suggested that not only are Australian populations a separate species from *M. schreibersii* (e.g. Richards 1983; Hamilton-Smith 1984), but that populations from north western Australian, South Australian, and populations from eastern Australia might all be distinct species. Until this is clarified, it leaves open the prospect that resolution into more than one species in Australia will necessarily reduce the distributional range of the species recognised.

Confusion resulting from a vernacular name change can be minimised of course, by simply using the scientific name in conjunction with a new common name at the first use of the name in any text.

A new vernacular

Until someone proposes a more appropriate or popular alternative, I suggest the replacement name "Large Bent-wing Bat", because the species is larger than the Little Bent-wing Bat *Miniopterus australis*, and because it is a reasonably short, and therefore convenient, name.

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LARGE-FOOTED MYOTIS *(MYOTIS ADVERSUS MACROPUS)* ON THE MURRAY RIVER IN SOUTH AUSTRALIA

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Earth Sanctuaries Ltd.

While continuing my bat survey work at Yookamurra Sanctuary, one of the Sanctuaries in the Earth Sanctuaries group, near Sedan, South Australia, I was offered the opportunity of being shown a roosting site which was believed to be occupied by the Large-footed Myotis. It is my understanding that these animals are considered quite rare in South Australia and I therefore jumped at the opportunity to be shown the location. As it turns out, I was able to confirm the identity of the animals and gather some other interesting information that appears further in this document. The site is on the Murray River about 6 kilometres upriver from Nildottie. Nildottie is identified as the site where the specimens currently held by the South Australian Museum were captured.

From the texts available to me I would have initially identified these animals as *Myotis adversus;* however, I remembered something being said at the recent Australasian Bat Conference that there was a division of sorts regarding this animal and its identification. I put a note out on BATLINE asking for help in the proper identification. At the time, I did not know the name of the authors of, or have a copy of the pertinent paper concerning the *Myotis* issue. Anyway, one response advised me that the name was *Myotis macropus*. Well, being the novice that I am, I looked this up in the "*Walker's Bats of the World*" and discovered that *Myotis macropus* is listed as being an animal found in Kashmir. Now I was really confused! It's a bloody long flight from Kashmir to Nildottie. I was finally able to get hold of Terry at the SA Museum who said the proper identification according to the recent work by D. Kitchener *et al.* was *Myotis macropus*. Terry sent me a copy of D.J. Kitchener's paper which I thought would enable me to understand! It didn't! Guess us amateurs are a bit thick; but I still do not understand the situation where two widely separated occurrences of the animal can be named the same. Spoke to Greg Richards who suggested that I contact Daz Kitchener directly. I tried to do that, but he was away so I sent him a fax asking his help and as I write this I have not had a reply.

The roosting site that the animals have chosen is located in a rock overhang that is about 2 meters above the water level and is only accessible by boat. They are tucked up in the holes in the limestone and as best I can determine, totally safe from anything but humans while in the roost and birds of prey while out. In one large hole there was a group of about a dozen animals - when I say large, it was barely big enough in circumference for me to get my hand in and remove one animal which turned out to be a female. In another hole there were about 6 to 10 animals; however, they were too high up and I was not happy about standing on a 44 gallon drum in a rocking boat to reach them. There was another group of about 6 in another hole which I could not get my hand in and another lone individual was found in another hole which I was able to reach him and I now had one male and one female and figured that was enough for proof.

Measurements of these animals were as follows:

	Male	Female
Weight	14 grams	13.5 grams
forearm, right	43.03mm	42.29mm
forearm, left	42.51mm	41.84mm
body length	61.08mm	61.09mm
ear	10.13mm	9.51mm
foot	13.11mm	12.34mm

I noticed that the measurements were a bit larger then those listed in Strahan "The Australian Book of Mammals" and then on further digging, they are pretty close to those listed in Woods Jones. On receiving Kitchener's paper and comparing measurements, I note that the two animals I had are still on the large side. I would stand by the radius measurement as I don't think there is much doubt about measuring from where to where. On the body measurement I measured from the tip of the nose to the beginning of the tail, dorsal; where I notice that Kitchener measured from the tip of the rhinarium to the anus. I was surprised at how their faces seemed to be completely covered with hair and they even had a significant number of whiskers protruding around the muzzle.

I put a note out on BATLINE to see if anyone had kept these animals in captivity. No one seems to have kept this particular species in captivity, or at least no one indicated so, although several people responded with what they thought would be the appropriate care methodology.

So how did these two little guys go? Well on the first attempt at feeding them mealworms they were not overly impressed with the offering. Each took only 6 worms. This was the same on the 2nd and 3rd attempt to feed them. Then they changed and began eating very well. They would take about 16 to 20 worms per feed. I was coating the worms in Wombaroo Small Carnivore Food which is a powder and they loved it. Several times when I did not get a mealworm presented fast enough they began licking the powdered stuff off of my hand. When they got the powder on their face there was a considerable amount of head shaking to get rid of it. I also noted that they made chirping noises while having a drink of water. In the end it got to the point where the male would have a feed and then rest for a minute sitting in the palm of my hand grooming himself. These animals were extremely docile and never once did they try to intentionally bite.

I do not know what is in the Wombaroo stuff but the Male was spending a bit of time attempting to copulate with the female. When they were captured the males testes were not obviously visible. However, on one occasion, when I decided it was feed time, I reached into the box and removed the male from on top of the female - Poor little bugger had an erection and his testes were swollen and quite visible, case of unintentional coitus interruptus. If he was going to bite me, that would have been the time I'm sure.

The individual who showed me the location of the site states that he has known of this location for some time and estimates that the population of the colony ranges between 20 and 50 animals. He has never actually counted noses, this is an estimate. He did state that a couple of years ago when the big mouse plague was on, the colony seemed to be at its peak, maybe conditions for mice are good for bats too! Anyway, as the mouse population dropped off, he noted that there were several Barn Owls who had taken up position along the cliff where the bat roost was. He never actually saw an Owl take a bat; however, he feels that the colony did reduce in size during this period and he believes that the Owls had something to do with it.

Another item of interest is the point that this colony has been observed having two birthing periods. I'm advised that in late March, early April there were young in the colony. Again, from the texts I have available to me I'm led to understand that this could be expected further north; however, would seem to be unusual for this latitude.

It was also pointed out to me that this roosting area has been used by Common Bentwing-bats (*Miniopterus schreibersii*). The identification has been made using the key contained in Reardon & Flavel's "*The Bats of South Australia*" I was unable to confirm this as there were no other species detected using the roost at the time.

On the first of July the two animals were returned to the roost. Both were at the same weight as when first captured. They were introduced into the hole from whence the male had first been removed. They both went immediately to the top of the hole, huddled together and seemed quite content. On this visit to the site it was noted that all of the animals seemed to have congregated in the one hole. I would estimate that there were at least 20 or so animals in the hole and that is based on the noses I could count. They were packed in quite tight and I did not want to disturb them in an attempt to get a more accurate count.

We took the boat along the cliff face and found another overhang about two kilometres away that matched the physical properties of the first and on investigation, another group of bats was found. These too were quite tightly packed in and I could only count seven noses - there could have been more. No animals were removed for positive identification and it was assumed that they too were *Myotis*.

Well where do I go from here. It is my intention to closely monitor this site into the foreseeable future. I would hope to periodically capture individuals and take their details, keep tabs on the population size, determine if there is any pattern to their feeding times, record a library of Anabat sequences for this species in this locale, see if I can determine their range, find out what they eat (if someone will tell me how!), monitor the birthing sequence, see when the young are born, when they are left in the roost and when they start hunting on their own. Anyway, that's what I hope to do. If there is anyone who wants any specific information regarding the activities of this colony let me know and I'll do my best to gather the information.

WINTER BAT ACTIVITY IN BELAIR NATIONAL PARK, SOUTH AUSTRALIA.

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In 1996 I am continuing Anabat surveys of bats in Belair National Park, about once per week, together with surveys of bats across the road from the park, in my backyard. These surveys show that there is still significant bat activity around Playford Lake in Belair National Park for at least an hour after dusk, in June and July, with temperatures around 8-12°C. The most active species is the Large Forest Bat *Vespadelus darlingtoni*, which can be seen foraging 2-4 meters above the water surface, from dusk (and also some mornings at first light). Other species which have been occasionally detected at Playford Lake in June and July are Little Freetail-bat *Mormopterus planiceps*, Gould's Wattled Bat *Chalinolobus gouldii* and White-striped Freetail-bat *Nyctinomus australis*. All of these species were detected on July 8th, in a period of an hour from dusk onwards (temperature 7-9°C, clear dark sky) there being continuous activity recorded from *V. darlingtoni* (48 passes in the hour), about 20 minutes activity of the audible calls of *N. australis* (10 passes on bat detector) and a couple of passes from *M. planiceps* (2 passes) and *C. gouldii* (1 pass).

Away from the lake there is very little bat activity. At my house (about a 10 minute walk from the lake) the bat activity recorded in 2-4 hours recording (9 recording sessions) after dark in June and July has ranged from 0-4 bat passes (in total 8 passes *V. darlingtoni*, 2 passes *M. planiceps*, 4 passes *C. gouldii*), compared with up to 40 bat passes in a similar period of recording in the warmer weather earlier in the year. These observations would appear to confirm the general belief that bat activity over the winter months is in general much less, but show that in a particular preferred spot (Playford Lake) there is still significant activity, mostly from *V. darlingtoni*, with at least 3-4 individual bats typically present.

MORNING ACTIVITY OF THE LARGE FOREST BAT *VESPADELUS DARLINGTONI*

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This year I have watched Large Forest Bats *Vespadelus darlingtoni* foraging near a small lake (Playford Lake) in Belair National Park on 10 occasions (March 22nd/ 23rd, April 6th - temp 18°deg, May 4th - temp 16°, May 19th - temp 9-10°, June 27th/28th - temp 10-12°, July 1st/3rd - temp 10-11°, July 23rd - temp 13°) in the mornings, just as it is becoming light. My initial observation (March 22nd) was accidental - I had gone for a walk in the park before dawn, and was heading towards the lake at about 6:45 am, and realised that 3 bats were circling just overhead, 3-4 meters above the ground. They continued to do this till around 7:00 am, when it was reasonably light. I came back the next day with a bat detector and recorded the calls, and have also done this on the other days listed. Most recently [July 23rd] I recorded and watched between 6:25 and 7:05 am. The observations of this week are reasonably typical of other occasions. I saw bats [*V. darlingtoni*] at several locations around the lake between about 6:40 and 7:00 am, and finally from about 6:57 to 7:02 am I watched [and recorded] 2 bats as they circled continuously in a small area at about treetop height or a bit below [but on a level with me since I was standing on the raised bank of Playford Lake]. I had continuous recording on the bat detector for this time, and activity continued until I could clearly see the colours of some wattle trees some distance away, at which time the bats appeared to fly into a close-by tree and roost. Several times parrots (rosellas, lorikeets) flew quite close to the bats, and bat activity continued for a few minutes after the dawn chorus (Noisy Miners, other birds) began. The sky was very overcast and rain fell as I was walking home. On other occasions when the sky was clear, my notes show that bat activity continued a few minutes after the stars faded, and the southern cross was no longer visible.

There was one morning (July 7th - temp 7°) where I saw no bats, possibly because the temperature was a bit low. I have not been out on other cold mornings. I have not seen other bat species foraging in the mornings at Belair, but know that they are sometimes around, since I have a few Anabat records of other species in the mornings in the 30-60 minutes before first light (March 23rd - Gould's Wattled Bat *Chalinolobus gouldii*, 1 pass, Lesser Long-eared Bat *Nyctophilus geoffroyi*, 2 passes, April 6th - *C. gouldii*, 3 passes, *N. geoffroyi*, 1 pass, April 20th - *C. gouldii* 2 passes, Chocolate Wattled Bat *C. morio* 1 pass, May 4th - *C. gouldii*, 10 passes, *C. morio* 1 pass, White-striped Freetail-bat *Nyctinomus australis*, 5 passes). The number of calls recorded from *V. darlingtoni* has been always much greater, and on 7 occasions was many (20-40, or difficult to quantify) in a short period (5-10 minutes) since I was standing underneath or beside the area where 1-3 bats were circling at first light.

SUMMARY OF THE WORKSHOPS HELD DURING THE 7th AUSTRALASIAN BAT CONFERENCE, NARACOORTE, SOUTH AUSTRALIA, APRIL 1996.

ANABAT CALL LIBRARY AND CALL EXCHANGE

Alexander Herr (Herry)

Although the importance of ultrasonic bat identification for successful bat conservation is widely accepted, no national body has been created to collect bat calls and administer their exchange. Creating the South-Eastern Australian library of AnaBat call sequences (**http://batcall.csu.edu.au/batcall/batcall1.html)** was the first step in to establishing an exchange network for bat calls in Australia.

The future of WWW bat call libraries currently depends on the ability and time of the people who support them. Moreover such a WWW resource raises issues on effectiveness and acceptance of publicly available bat reference calls, which could be overcome by a centralised storage. These issues are discussed in the following:

◊ How reliable are reference calls? Calls are generally ground-truthed by the person surveying a particular site. Consequently the reliability depends on the ability of the researcher to identify and record. bat calls.

◊ A national call collection should have corresponding voucher specimen to allow for future taxonomic adjustment. Standardisation of call collection (eg. recording techniques, call quality, etc.) must be prerequisites for a national bat call collection. Regional call variation can indicate taxonomic differences, but intraspecific call variation can be estimated for taxonomically clear species without voucher specimens.

◊ Where is the best place to store bat calls? Current WWW call libraries may not provide secure future support. Institutions providing long-term stability like museums or tertiary institutions are able to store calls and voucher specimen securely, but financing storage and call vetting will be the main cost factor. Consequently, charges for accessing the facility could be applied from public institutions to recover costs. The Australian Museum has offered to store information and allow access, but would require expert assistance to assess call quality.

◊ Reluctance to share calls publicly. There is a reluctance on the part of some experienced researchers to contribute to WWW libraries because these publicly available reference calls can be misused by private consultants. Such misuse is clearly a breach of copyright, and expertise in identifying bat calls cannot be learned solely from downloading files. Consequently the general feeling is that some control over the availability of calls is needed. However, there is an ethical consideration in this debate: Since most of the of the bat researchers are funded with public money, some people might argue that information generated from such research should be publicly available.

The AnaBat call library workshop identified lack of funding as being the main drawback in creating a national bat call library. A short term solution may be to provide a list of researchers who are willing to exchange their reference calls. This list can now be accessed on-line on the WWW via **http://batcall.csu.edu.au/batdbase/batxlst1.html**

TOWARDS CONSERVATION

Elery Hamilton-Smith

This workshop followed on presentations by Greg Richards and Harry Parnaby, both of whom discussed variuous issues in relation to the incipient *Bat Action Plan*.

An action plan is a strategic guide to the management and research required for conservation of a group of animals. A plan contains an overview of conservation status of the group, with lists of threatened taxa and the management strategies and/or research required for conservation. It should identify the relevant threatening processes for the group. We need plans because the number of declining species is increasing and resources are limited. Thus, we need to prioritise our efforts.

A recovery plan details, schedules and costs the actions required for the recovery of a species or species group. It can recommend research, management or both; it indicates the people to be involved. An action plans leads to the process of listing under the Commonwealth Endangered Species Act. Any species so listed then requires an action plan. But action can begin before listing The Department has an annual funding program for endangered species. (Anne Duncan, Endangered Species Unit, ANCA).

Protected areas are not representative of the range of ecosystems across the country. Large areas of important habitat, e.g., two-thirds of Victoria is in freehold status. A large proportion of this is under agriculture, but has great conservation potential. Agriculturalists can be involved in conservation at all sorts of levels. For instance, many colonies of the endangered Grey-headed flying foxes occur on private lands. But although it is a protected species, any owner of a colony site can bulldoze it flat.

There is always going to be a need for conservation outside of protected areas especially for migratory species like the Grey-headed flying fox. It may be possible to liaise with private land owners to save important habitat. At the 1986 flying fox conference there was liaison between conservationists and fruit growers. This kind of communication can have very positive outcomes.

Landcare groups come together for a specific reason e.g., salinity. They may move readily from the initial issue to others, such as endangered species. Community groups are an important part of the solution because they influence politicians, but bat people must supply information. Other groups, e.g. those interested in birds, have been very successful in developing education programs. Thus, programs concerned with tree hollows for birds are up and running. Their interests obviously overlap with ours, and this highlights a lateral thinking approach. The Royal Australian Ornithologists' Union is interested in working with us. We should also present to the public the benefits of healthy microbat populations, e.g. their insectivory and its relevance to the ecology of the farming system. Since the Native Vegetation Act (1985) many land owners have not been granted consent to clear in South Australia, but no-one has gone out to tell them of the worth of their remnant vegetation. This is now happening and provides an opportunity for conservation issues to be raised with private land owners.

There is an active infrastructure in the landcare system that could do more if given adequate information. But in the US regional groups have been effective in circulating conservation information to land owners. This is beginning to have a real impact, even without anything like the Landcare infrastructure which we have.

Although a lot has been done and more can and should be done at the grass roots level, there is still a place for experts to lobby governments directly. Unfortunately a lot of the approaches to government have rather negative results, particularly for those who seek funding from the ARC. But at the same time, It can take a long time to change things in the bush. Up until only a couple of years ago people were still burning scrub to graze sheep despite the fact that it's illegal.

The Bat Action Plan has been slow in coming, which has not been good for bats. But, once the action plan is in place, there is a lot of other government policy that must follow. In NSW this has led to bats coming formally to the attention of those logging forests.

IUCN criteria will determine what funding and research is done on bats in the future. It may be that these criteria are not appropriate for bats. Our data is very poor on many species, so that we don't know whether populations are increasing or decreasing . We don't have the information to pigeon hole many of the species and so, we might give them a higher status which could then be reduced when we have enough information. There are many evaluation systems and it might be worthwhile trying them all to see how they compare for our bat species.

Even though there are doubts about the extent to which the IUCN criteria are useful for bats, they structure the political reality within which we have to work within.Any international framework cannot by itself satisfy local needs but is a tool which can be used to help meet those needs. So, we should use the IUCN criteria as a tool while recognising their limitations and looking into other ways we can put the case for bats.

In framing a recovery plan, the species by species approach is not always the most efficient way. The ecosystem approach is being encouraged. There should also be a national approach rather than a state one because state approaches don't look at the whole range of most species. At the same time, it needs to be applicable to action at the state level.

We have huge numbers of flying foxes in the tropics. It may be possible to come up with a number of these bats which we could export to islands in the Pacific to take the pressure off populations there. Perhaps we should also be looking at what indigenous people are telling us e.g. Aboriginal and Islander people on Cape York and the Torres Strait Islands are convinced that flying foxes cure asthma. There are rumours that flying foxes are already exported to the Pacific Islands from Papua New Guinea. We shouldn't shy away from the commercial uses of bats if these can play a role in conservation.

On the positive side we have been able to reverse the decline of a couple of populations of bent-winged bats with very little formality. The population at Bat Cave here in Naracoorte is one of those. It's all been achieved at an informal level, through talking with landowners, land managers, cavers and others. Local government authorities may well have a role, e.g., in convening meetings which can open up communication channels, especially to land owners.

One council initially wanted to bulldoze a maternity cave used by *Miniopterus* *schreibersii* because their concern about histoplasmosis. The same council was eventually convinced to preserve the cave. But now, because of disagreements about how the site might be managed, the cave is not being managed by anyone.

We shouldn't become complacent about protected areas. Legislation can be and is being changed to allow the exploitation of wildlife in parks, or even to de-gazette some parks in order to allow mining. Visitor management in protected areas is being privatised and this could lead to a whole shift in priorities to mass visitor numbers rather than the care of the protected area.

In looking for action, The committee of the ABS could be broadened with perhaps additional members to consider and take political action. We could have state representatives. Phone conferences and the e-mail system both provide very effective forms of meeting.

[Contributions from Simon Bey, Nicholas Birks, Barry Clugston, Lawrie Conole, Anne Duncan (ANCA), Greg Ford, Richard Griffiths, Elery Hamilton-Smith (Chair), Glenn Hoye, Dan Lunney, Len Martin, Doug Mills, Ann Munster, Nancy Pallin, Harry Parnaby, Kerryn Parry-Jones, Terry Peacock, Lynette Queale, Terry Reardon, Greg Richards, Andy Spate and several others who regrettably are not identified in the record.]

ARTIFICIAL ROOSTS FOR BATS

Ian Temby

The workshop concept worked very well. Discussion ranged widely over roost boxes, roost sites, predation and other issues related in some way to the subject of the workshop. Seven of the contributors to the workshop have been or are currently involved in artificial bat roost projects. These are based in Singleton NSW (Glen Hoye); Organ Pipes National Park Vic (Robert Irvine and Robert Bender); Bendigo Vic (Bill Holsworth); Keith SA (Nick Birks); Sunshine Coast Hinterland Qld (Luke Hogan); Yallambie Vic (Ian Temby); Port Lincoln SA (Delia Russell).

At least 11 roost box designs are involved. Materials include 12 and 22 mm marine ply; *Pinus radiata*; cardboard tubes and rough-sawn timber coated in paraffin wax; BCI-type bat houses; bags rolled up inside tubes; and adapted natural hollows.

There was some discussion of what might be critical factors in bat house design. From the literature it seems that female overwintering requirements are highly specific. Harry Parnaby suggested that evenness of humidity is important for juvenile survival. Long boxes may provide a temperature gradient, allowing bats to move within the space to regulate temperature. Sealed tops provide still air and permit the build-up of high humidity, a factor students of John Nelson considered to be important.

Whether boxes need to be insulated was the subject of some debate. Lorraine Jansen commented that energy is conserved by undergoing torpor in a low temperature environment. Elery Hamilton-Smith observed that bats roosted under metal power pole caps in western NSW and Qld - sites with little insulation and subject to wide temperature fluctuations. A single power pole cap in Bendigo had three species and up to 14 individuals roosting under it. Bill Holsworth recorded temperatures up to 10 degrees above ambient under the cap.

In Poland, bat boxes have been used for fifty years. Up to 20 boxes per tree in some urban areas. Some discussion of apparently low occupancy rates revealed that Charlie Mackowski, when working on the development of hollows in Blackbutt *Eucalyptus pilularis* cut down 30 trees with hollows, but found no bats (perhaps they flew off while the trees were being cut down). Lindy Lumsden reported that in her research on natural roost sites, individual bats used a large number of sites. Boxes found empty may therefore be in use, intermittently.

Antechinus will prey on bats in Harp traps, and may influence where bats roost in trees. Placement of boxes may facilitate access by such predators. Boobook Owls also learn to wait for bats leaving roosts.

Bees are a potential problem. Some researchers use Shelltox Pest Strips to kill or deter bees. Nick Birks thought that since bee hives have ventilation holes around the top, bat houses without ventilation may deter bees. At Organ Pipes National Park, bat houses with bottom entrances had no bee use, while Sugar Glider boxes, with a side entrance, are often occupied by bees.

There were some good suggestions for sources of alternative or cheap materials for making bat houses. The wooden end caps from sheets of imported glass are almost ‘ready-made’ bat houses and may be obtained free of charge. Sawdust and cement mixtures are used with success in Germany and are worthy of experiment here. These are likely to be termite and rot resistant.

A matter of concern not related to bat houses was Nick Birk’s observation of the spraying of insecticides at night in South Australia to avoid poisoning bees. Many bats could be seen foraging when the aircraft landing lights crossed the fields. What impact does this have on bats?

Copies of the transcription of the workshop may be obtained from Ian Temby, 4/250 Victoria Parade, EastMelboune 3002.

BAT SURVEY METHODS AND STANDARDS

Doug Mills & Glenn Hoye

A workshop on bat survey methods and standards was conducted at the recent Naracoorte Bat Conference. This was initiated due to concerns by many researchers over the quality and adequacy of the bat component in many Environmental and Faunal Impact Statements (FIS and EIS). In many cases bats are not even considered when such surveys are conducted. Although the main focus of discussion centered on microchiroptera, many of the issues raised are applicable to megachiroptera as well.

There are many reasons for the inadequacy of many FIS's and EIS's. Methods used to survey bats have only been developed in the last 20-30 years and these methods are still poorly understood. This has a serious flow-on effect when surveying for and assessing the impact of land-use changes on microbats. The number of species known from the Australian mainland has steadily increased since the 1960's when approximately 40 species were recognised. The latest edition of *The Mammals of Australia* recognises approximately 60 species! It is not surprising that identification of many species remains problematic. This applies to identifying animals in the hand and echolocation calls recorded by bat detectors.

Basic ecological and biological data is still lacking for most Australian microchiroptera and, as a consequence, habitat suitability is often determined on the basis of the apparent presence or absence of the target species listed (assuming the species has been correctly identified). It is obvious that a poorly conducted survey may fail to identify the presence of a particular species even if the researcher is competent in identifying microbats.

Although there is a peer-review system in place for most research that is published in scientific journals, no such protocol exists for surveying microbats in EIS's and FIS's. This means that the bat component of such surveys may consist of someone with no prior experience waving a detector around for 30 minutes after sunset, finding no bat activity and concluding that because they could find no bats, there would be no effect of the proposed land-use change to bats in general. Several issues were raised at the Naracoorte workshop.

Perhaps the main point was one of accreditation and registration. We believe that this is a critical issue and even if it can't be enforced legally then at least it can be supported by the Society with a view to encouraging good bat surveys and hopefully discouraging bad ones. There was not enough time to discuss what constitutes good and bad surveys, but the same principles apply. The Certified Wildlife Biologist system in the US was mentioned as a model that might be worth following. Dan Lunney suggested that registration as opposed to accreditation was a better direction to take as there could be legal ramifications. Anyone not accredited as a member could be seen as having their livelihood intefered with. A number of people commented that a code of ethics should be drawn up and that more should be done to criticise sub-standard EIS's and FIS's. There was agreement that something needs to be done regarding setting standards for bat surveying.

We see this as comprising two levels. The first is some form of accreditation/registration and the second is a set of survey standards approved of by experienced bat researchers and conservation biologists. We would like to canvas a rough list of things we think are important and ideas other people have thrown at us. We would like as wide as contribution as possible from anyone wishing to have their 10 cents worth, so please feel free to copy this and pass it on to others who can contribute.

Where questions are followed by a choice of numbers, circle 1 for strongly disagree, 2 for disagree, 3 for no opinion, 4 for agree and 5 for strongly agree. If there are things you think are important and haven't been included please make comments on that too. The primary purpose of this questionaire is to identify factors that members think are important when framing the definition of an adequate survey. The results of this questionaire will be published in the next newsletter. We plan to use these results to draw up a more detailed draft.

Please send the completed form to:

Doug Mills
CRES
Biology Place
Australian National University
ACT 0200.

Thank you for contribution. Doug Mills and Glenn Hoye.

1. Name

2. Address

3. Phone

4. Email

5. Fax

6. Qualifications/Experience

7. Do you support a set of survey standards?
1 2 3 4 5

8. Do you support a code of ethics?
1 2 3 4 5

9. Do you support a registration/accreditation of researchers?
1 2 3 4 5

10. Do you consider the following factors or variables important when considering the design of a set of survey standards.

a. Number of harp-traps employed
1 2 3 4 5

b. Placement of harp-traps
1 2 3 4 5

c. Type of detector
1 2 3 4 5

d. Number of bat detectors employed
1 2 3 4 5

e. Total operable minutes for detectors
1 2 3 4 5

f. Operable period for detectors (time ± sunset)
1 2 3 4 5

g. Hours mist-netting
1 2 3 4 5

h. Hours trip-lining
1 2 3 4 5

i. Subterranean roost searches
1 2 3 4 5

j. Tree roost search/stag watch
1 2 3 4 5

k. Weather conditions
1 2 3 4 5

l. Habitat type
1 2 3 4 5

m. Size of area to be surveyed
1 2 3 4 5

n. Microhabitat variables
1 2 3 4 5

o. Information from past surveys and literature
1 2 3 4 5

p. Experience and qualifications of surveyer
1 2 3 4 5

q. Number of survey nights
1 2 3 4 5

r. Season
1 2 3 4 5

11. Other factors and variables

12. Do you consider the following factors important in the design of a set of accreditation/registration standards.

a. Formal qualifications

1 2 3 4 5

b. Authored publications

1 2 3 4 5

c. Field experience

1 2 3 4 5

d. Review process

1 2 3 4 5

13. Other factors

ABSTRACTS OF SPOKEN PAPERS PRESENTED AT THE 7th AUSTRALASIAN BAT CONFERENCE, NARACOORTE, SOUTH AUSTRALIA, APRIL 1996.

GENETIC RELATIONSHIPS AMONGST AUSTRALIAN AND INDO-PAPUAN *RHINOLOPHUS* (RHINOLOPHIDAE: CHIROPTERA)

Steven Cooper, Terry Reardon and Jana Skilins
Evolutionary Biology Unit, S. A. Museum, Adelaide, S.A. 5000.

Two morphologically distinct species of horseshoe bats, *Rhinolophus philippinensis* and *Rhinolophus megaphyllus*, have been described in Australia. The two species are sympatric on Cape York, and in this region a third form has been observed which is intermediate in size between the two species and has a distinct echolocation call. To resolve the taxonomic status of this third form (henceforth referred to as the "intermediate") we have carried out genetic studies of Australian and Indo-Papuan rhinolophids using both allozyme electrophoresis and sequencing of the mitochondrial DNA (mtDNA) control region.

The surprising results from both studies suggest that the three Australian taxa are monophyletic and recently diverged, in contrast to the traditional view of their phylogenetic relationships based on morphology. No fixed differences were detected at 45 allozyme loci between each of the three Australian taxa, while representatives of eight other species of *Rhinolophus* showed fixed differences ranging from 0 to 50%. The intermediate was found to contain mtDNA haplotypes that were almost identical to those found within *R. philippinensis*, but distinct from those within *R. megaphyllus*. These results suggest that the intermediate is most likely to be either a hybrid resulting from a cross between a female *R. philippinensis* and male *R. megaphyllus,* or a morphological variant of *R. philippinensis*. MtDNA sequence data also reveal major genetic differences between Queensland and Victorian forms of *R. megaphyllus* with both forms being as divergent from each other as either are from the Queensland form of *R. philippinensis*.

FLYING FOX EVOLUTIONARY TRENDS AND THE EYES OF *SYCONYCTERIS AUSTRALIS* AND *PTEROPUS* SPP.

Mal Graydon
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A unique feature of the flying fox eye is the mosaic of projections known as papillae on the entire inner surface of the choroid. The undulating contour of this surface accepts the similarly undulating layers of the retina. However, while the non-neural layer, the pigment epithelium (PE) abuts the papillated surface, the neural layers are separated from the PE by a very narrow, fluid-filled space - the embrological ventricle of the eye. In *Syconycteris australis*, the PE profile is significantly taller than that in *Pteropus* spp. Moreover, in *S. australis*, a white, flocculent material fills PE cells in the dorsal hemiretina. As this species exhibits strong eyeshine under torchlight, it seems likely that the flocculent material functions to reflect light. In other words, the PE acts as a tapetum. As similar material is not evident in *Pteropus* spp. (which also exhibit eyeshine), it is possible that eyeshine in this group derives from refractive qualities of the retina-ventricle interface. In this respect, it seems significant that in both groups, light incident on the retina meets the interface at the same angle despite generic differences in the shape of (subtending) papillae. Differences in chorioretinal architecture may not only indicate different visual ecologies, but also point to phylogenetic trends in the Megachiroptera.

FITTING AND FIXING NAMES TO BATS OF THE GENUS *MORMOPTERUS* OF AUSTRALIA

F.R. Allison
19 Pryde Street, Lowood, QLD 4311.

I think that there are (at least) eight taxa of the genus *Mormopterus*, or similar genera in Australia and I will be presenting a brief history of the discovery of these taxa and their naming.

The eight names I will be using are:

- *Mormopterus beccarii* (Australian form)
- *Mormopterus cobourgiana*
- *Mormopterus norfolkensis*
- *Mormopterus petersi*
- *Mormopterus planiceps*
- *Mormopterus* sp. (Small penis, medium size inland form)
- *Mormopterus* sp. (Larger size inland (Central-NW) form)
- *Mormopterus* sp. (Smallest inland (Central-NE) form)

Hopefully the confusion created by the actions of early workers on this group of bats can be cleared up and the future classification set on a more secure foundation.

INTERSPECIFIC AND INTRASPECIFIC VARIATION OF BODY SIZE OF BATS WITH CHANGES IN ALTITUDE

Alexander Herr and Nicholas Klomp
Johnstone Centre of Parks, Recreation & Heritage, Charles Sturt University, PO BOX 789, Albury, NSW 2640.

The size and body condition of Microchiropteran bats of the genus *Vespadelus* were studied at varying altitudes from 150 to 1150 metres above sea level in the western slopes of the Australian Alps. The proportion of individuals caught of the largest species *V. darlingtoni* was significantly greater at higher altitudes than the proportion caught below 200 metres. Conversely, the proportion of individuals caught of the smallest species *V. vulturnus* was greater at the lower altitudes. Intraspecifically, adult *V. darlingtoni,* had significantly longer forearm lengths, greater body weights (and subsequent body condition indices) at higher altitudes than for those individuals trapped below 200 metres asl.

The influence of altitude on body size is discussed in terms of ambient climatic conditions and maintenance of body temperature by these bats, which are some of the smallest mammals in the world. However, a possible interacting effect of altitude is the recorded significant increase in the size of potential prey of these bats, Lepidoptera and Coleoptera insects, with increasing altitude. Smaller individuals and species may be less able to hunt on the larger insects found at higher altitudes.

MUCH ADO ABOUT VERY LITTLE: BAT GUANO MINING IN AUSTRALIA

Elery Hamilton-Smith
Rethink Consulting P/L, P.O. Box 36, Carlton South, Victoria 3053.

The mining of bat guano has always been a very small and highly localised industry in Australia. However, it has generated various conflicts on a number of dimensions and this often mirrors wider conflicts in society as a whole. The most important sites involved are probably at Nambung in Western Australia, various sites in the Northern Flinders Ranges, and Naracoorte in South Australia.

This paper will use the latter site, which is probably the best documented, as an example. Conflicts between squatters and settlers, between central government (state) and local interests, between bureaucratic power and local initiative, and between various entrepreneurial factions all joined in the play. It is interesting to note that the bats were never considered, and to speculate on the impact of mining upon the bat population.

BANDING OF BAT COLONIES INHABITING HUMAN-MADE STRUCTURES

Loraine Jansen
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Three species of bats in colonies in human-made structures were banded over a number of years. *Nyctophilus geoffroyi* colonies were generally small with a maximum of 29 animals caught per year. Colonies usually contained a single species except for occasional small numbers of males of other species. *Chalinolobus morio* and *Mormopterus planiceps* formed larger colonies (up to 300 and 230 caught per year respectively), often inhabiting the same structure. Occasionally small numbers of other species, usually males, were found with them. Colonies of *C. morio* and *N. geoffroyi* contained an average of 20% adult males while *M. planiceps* had an average of 32%. Over the three species approximately 40% of females banded were recaptured at least once while 23 - 40% of these were recaptured more than once. For males 16% of *C. morio*, 20% of *N. geoffroyi* and 38% of *M. planiceps* banded were recaptured at least once, while 15% - 27% of these were recaptured more than once. No bat was recaptured on all trapping nights for any site. The only conclusive pattern shown is that closely timed trappings generally give more recaptures.

Band injuries for females and males of the three species were not significantly different but I consider them high enough to be of concern. Band injuries for *N. geoffroyi* were 7.6%, *C. morio* 12.4% and *M. planiceps* 21.6%. Although many of these injuries occurred within the first year after banding, intermittent retrapping of a few individuals showed that some injuries did not occur for a considerable time, possibly years after banding.

BANDING BANNED - NECKLACING NEXT?

Ian Temby
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Five vespertilionid and one molossid bat species have been harp-trapped at an artificial bat hollow in a tree in outer suburban Melbourne. Regular use of the hollow as a bat roost site provided the opportunity to band and recapture bats over a six-year period. Band injury rates were recorded and *Tadarida australis* in particular reacted badly to forearm banding. Similar rejection of bands has been seen in overseas molossids.

Larger bands were tried with similar results. Alternative marking using metal bead chain necklaces resulted in very low injury rates, although overall numbers banded were low.

Implications of this work are discussed in light of the Australian Bird and Bat Banding Scheme's proposed moratorium on bat banding.

RATIONALE AND INCIDENTAL OBSERVATIONS ON THE USE OF ARTIFICIAL NEST BOXES (FOR BATS) IN NATIVE FORESTS IN SOUTH AUSTRALIA

B. C. Gepp and D. J. Gray
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Due to the absence of hollows in remnants of native forests and in pine plantations, Primary Industries SA, Forestry commenced erecting artificial bat boxes in 1985. The standard 'wooden' design has been progressively modified and now provides comparisons for the 'new' polypipe tubes. Both boxes and tubes are being used but their design may influence their selective use. Co-operative monitoring programmes are in progress to evaluate some of the design factors.

1988 N.S.W FLYING-FOX MANAGEMENT SURVEY

Dan Lunney and Adele Reid
NSW National Parks and Wildlife Service, P.O. Box 1967, Hurstville, NSW 2220.

The National Parks and Wildlife Service has been responsible for management of flying-foxes since they became protected in New South Wales in 1986. To assist in interpreting the management issues, a questionnaire (free post return) was circulated around the state in early 1988. One of the primary modes of distribution of the survey was via a number of publications including the N.S.W Farmers Association Journal, the Australian Beekeeping Journal, the Exotic Fruit Growers Journal and Horizons (a 4WD magazine). The survey form consisted of a section for name and address and seven straight forward questions, including if flying-foxes were present, what they were eating and if they were a problem. There were approximately 2300 replies, of which 1259 respondents had flying-foxes in their area. From those areas where flying-foxes were present, 355 people said that they were a problem. The high number of "yes" and "no" replies has allowed us to give a portrait of flying-foxes over the whole of N.S.W. The results have provided a 1988 snapshot of where flying foxes occur, what they are eating and where they are seen as a problem. It has been crucial to gain baseline information on flying-foxes shortly after their protection to enable us to evaluate the success or otherwise of flying-fox management and conservation in N.S.W.

PATTERNS OF RESOURCE VARIABILITY FOR *PTEROPUS POLIOCEPHALUS* OVER LARGE GEOGRAPHIC AREAS: CONSERVATION IMPLICATIONS FOR FOREST COMMUNITIES IN SOUTH-EASTERN AUSTRALIA (A brief botanical interlude)

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Strategies for conserving nectarivorous bats in Australia are limited by a poor understanding of broad-scale temporal and spatial patterns in resource availability for these mobile species. Ecological studies of resource use by Australian vertebrate nectarivores have predominantly been concerned with fine-scale examinations of resource limitation, foraging patterns, competitive interactions and community dynamics. Few have addressed patterns of migration or species abundance over large geographic areas. Our current understanding of species/area relationships in Australian nectarivore communities reflects this spatial bias. Ecologists know little of how populations of vertebrate nectarivores function over geographic space and are therefore unable to formulate effective management policies for conserving pollination function in various ecosystems.

In this paper I examine coarse-grain patterns of resource variability for the Grey-headed flying fox *Pteropus poliocephalus* in south-eastern Australia, in a study scaled to accommodate interactions between resource heterogeneity and the capacity of *P. poliocephalus* to track that heterogeneity. I use summary data on the phenologies and distributions of diet plants to describe coarse-grained spatial associations in resource predictability, species richness of diet plants, and seasonal trends in resource abundance. I then use this data to investigate ecological redundancy within the plant groups which provide seasonal resources for *P. poliocephalus*, the spatial scales at which constant resources are produced, and the ecological linkages these resource patterns create between vegetation communities. The summary information used in the study suggests a level of determinism in the spatially and temporally complex resource system inhabited by *P. poliocephalus*. It provides a broad context for the interpretation of work conducted at finer scales; and a preliminary mechanism for identifying conservation priorities and research priorities for Australian nectarivorous bats.

FORAGING BEHAVIOUR AND TICK PARALYSIS IN THE SPECTACLED FLYING FOX, *PTEROPUS CONSPICILLATUS*

Cathy Eggert
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Hundreds of *P. conspicillatus* have been paralysed each year by the Australian Paralysis Tick, *Ixodes holocyclus*, on the Atherton Tableland (far north Queensland) since 1990. Tick paralysis does not appear to have occurred in *P. conspicillatus* prior to 1986.

The diet of *P. conspicillatus* on the Atherton Tableland in the Spring and Summer of 1993-1994 is compared with the observations of Richards[1] from the early 1980s. In October and November 1993, the introduced *Solanum mauritianum* (wild tobacco) predominated in *P. conspicillatus* faeces and ejecta. *S. mauritianum* had not previously been recorded in the diet of *P. conspicillatus.*

S. mauritianum grows to about four metres tall and the inclusion of this species in the diet of *P. conspicillatus* brings the flying fox within close proximity to the ground.

The possibility that tick paralysis in *P. conspicillatus* is related to this change in the foraging behaviour of *P. conspicillatus* is discussed.

[1] Richards G.C. (1990). *Aust. Mammal*. **13**: 25-31.

THE TEMPORAL DISTRIBUTION OF BIRTHS IN FLYING FOXES (GENUS *PTEROPUS*)

Len Martin[1], Linda Collins[2], Dinah Handsman[3], Juleen King[4], Helen Luckhoff[5]
[1] Department of Physiology & Pharmacology, University of Queensland, QLD
[2] Wildlife Information & Rescue Service, NSW
[3] Townsville Wildlife Care Group, QLD
[4] Kuringai Bat Colony Committee, NSW
[5] Orphan Native Animal Rear & Release, QLD.

Australian flying-foxes (genus *Pteropus*) are seasonal breeders. Thus the frequency of conception and parturition peak at different times of the year (Martin *et al*., 1995). Factors controlling such seasonality remain unknown. To gain insight into the problem, relative and cumulative frequency distributions of birth-dates were constructed from records kept by geographically separated conservation groups fostering new-born *P. poliocephalus* and/or *P. alecto* for return to the wild. The distributions are based on date of entry-into-care of young weighing less than 200g at entry and are, as yet, uncorrected for age-at-entry [calculable from forearm-length]. The distributions provide information on the time of onset of the birth season, the rate at which subsequent births occur [spread of births] and how these parameters vary between species, between geographic location, and between seasons.

We thank all of the flying-fox foster parents without whom this study would not have been possible.

Martin, L., Kennedy, J.H., Little, L., Luckhoff, 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*). *Symp. zool. Soc. Lond*. **67**, 167-184.

GROWTH AND DEVELOPMENT OF CAPTIVE MOTHER-REARED *PTEROPUS POLIOCEPHALUS* FROM BIRTH TO RELEASE: IMPLICATIONS FOR MANAGEMENT OF HAND-REARED ORPHANS

Linda Collins
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The number of orphaned flying-foxes requiring hand-rearing as well as the number of wildlife care groups who provide this service is increasing in both New South Wales (NSW) and Queensland. The data recorded on these animals throughout the hand-rearing program has the potential to be of invaluable assistance to captive breeding programs of endangered species.

In 1989 an Orphaned Flying-fox Report Form was introduced to record the growth of all hand-reared young received by the many wildlife care organizations within NSW. Mother-reared young were also weighed and measured at the same intervals to compare growth. At the conclusion of the 1989 season 62% of hand-reared young were not developing at the same rate as mother-reared. This figure remained relatively unchanged for the following season 1990, (56%). The weight recorded on hand-reared young over 3 stages of development was low and/or erratic compared with the growth of mother-reared which was higher and consistently recorded a gradual increase from one stage to the next.

As some carers were able to mirror mother-reared growth, all aspects of management were reviewed after the 1990 season. Improved management based on data collection and observations on mother-reared young was addressed at all flying-fox training courses prior to the 1991 season. At the conclusion of the 1991 season only 16% of hand-reared young did not mirror the growth of mother-reared.

Nine Wildlife Care Organizations now support an ongoing program of weight analysis on all hand-reared and mother-reared young. This combined data is presented to all careers after raising their first flying-fox, at advanced flying-fox training courses. These courses encourage carer discussion and debate on all aspects of flying-fox management. More comprehensive statistics leads to a greater understanding by the carers, of the process by which these animals grow and develop thereby improving the quality of life for the hand-reared young hence, a better chance of survival. The data recorded on 32 mother-reared young weighed fortnightly until released compared with hand-reared young will be presented.

BATS, PUBLIC HEALTH AND BAT CONSERVATION: FLYING-FOXES AND ROSS RIVER VIRUS - A DISTURBING CASE HISTORY

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The chiropterological cyberspatial newsgroup, *Batline*, has recently had much discussion of bats, rabies and Ebola. Fortunately neither disease is here - yet! However, bats and disease, particularly viruses, make big headlines, and subsequent public responses can significantly affect bat conservation. This happened in Queensland. Scientific interest in flying-foxes as possible reservoirs of Ross River Virus (RRV), and a hypothesis linking brackish-water mosquito RRV-vectors and Brisbane River flying-fox camps (Ryan, 1995) led to scare headlines, community disquiet, threats of violence to flying-fox carers and increased opposition to conservation of a flying-fox camp at Hervey Bay. Press reports failed to give adequate accounts of RRV epidemiology and, in particular, that many other mammals - marsupials, rodents, feral and farm animals, domestic pets and humans constitute major reservoirs. The difficulty of explaining complex biological issues to the public was further highlighted by responses of scientific colleagues and ethics/ biohazard committees to experiments in which we infected captive flying-foxes with RRV to quantify the bats' viraemic and immune responses.

Ryan, P. (1995). *Aedes funereus* (Diptera: Culicidae) and *Pteropus poliocephalus* (Chiroptera: Pteropodidae) as respective vectors and vertebrate hosts of Ross River Virus. *BSc Hons Thesis*, Dept. of Microbiology, University of Queensland.

THE USE OF A RELEASE CAGE AS A TRAPPING SITE FOR FLYING-FOXES

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University of New South Wales, Sydney, NSW 2052.

Hand-reared orphan flying-foxes and rehabilitated injured flying-foxes were banded under the auspices of the Bird and Bat Banding Scheme. The flying-foxes were released from an 18m long cage, 500m from the Matcham Grey-headed Flying-fox colony site and under its flight path, on the NSW Central Coast over a two year period.

Food was placed in the release cage throughout the year and the cage monitored to determine its pattern of usage by flying-foxes. Wild animals occasionally used the cage and were caught and banded. Rehabilitated animals did not use the cage at all and were rarely recorded back at the cage once released. In contrast hand-reared orphan flying-foxes used the cage for extended periods of time as both a day-time roost and as a feeding roost. The Matcham colony leaves the site over winter and no hand-reared flying-foxes were present in the cage during this time. A number of animals were identified as using the cage as a night feeding roost over a year from last date they were present as juveniles. Animals retrapped months after release were in good condition and one female arrived carrying a large juvenile which had been conceived in the wild. It appears that although it may take time for hand-reared flying-foxes to move into the wild population, once the move is made there is evidence that a percentage survive for an extended period.

In summary, the use of a release cage as a "trapping site" can provide considerable information on the survival of hand reared flying-foxes which is otherwise unavailable.

IMPROVING THE REHABILITATION ENVIRONMENT OF WILD FLYING-FOXES AND THE MANAGEMENT OF CAPTIVE GROUPS BY RECOGNISING AREAS OF STRESS

Linda Collins
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Stress is an aspect of flying-fox behaviour which is often overlooked in management programs for both rehabilitating wild flying-foxes as well as groups of animals held for education and research.

Wild animals when presented for rehabilitation can be aggressive on receipt, however, most appear to quickly adjust to the captive environment. Permanent groups of flying-foxes do not display obvious outward signs of stress. This has often resulted in the assumption that these animals are not predisposed to stress.

Since 1989 four captive groups of flying-foxes held by wildlife care organizations within NSW have been weighed monthly. All rehabilitating wild flying-foxes are weighed on receipt and at weekly or fortnightly intervals until released.

These weights have not only provided us with an invaluable insight into the social structure of the flying-foxes, they have also highlighted the adverse affects to both the behaviour and condition of the animals when their social requirements are not met.

The stress which is generated from within the group is rarely observed during daylight hours. The resulting weight loses experienced by these animals outside the normal seasonal fluctuations are often not evident until an illness results. It is only by observing these animals at night and weighing on a regular basis that problem areas have been recognized and the full extent of imbalances to their social structure evident.

The data presented will show the four areas which need to be considered when holding animals for short term or permanent confinement. The number of animals in the group, the age of the animals within the group, the ratio of males to females and the size of the enclosure in which the animals are to be housed.

SURVIVAL OF A LONG-TAILED BAT (*CHALINOLOBUS TUBERCULATUS*) POPULATION IN A HIGHLY FRAGMENTED HABITAT

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The two species of bats that still survive in New Zealand are both believed to be threatened. Both have suffered extensive habitat loss since humans arrived in New Zealand and have subsequently declined significantly. Their current conservation status is unknown and what is known of their ecology is largely anecdotal. Threats to populations have yet to be determined but introduced mammalian predators are suspected as potentially having an impact. Long-tailed bats (*Chalinolobus tuberculatus*) are still relatively widespread in New Zealand, but are generally restricted to areas of indigenous forest. However, South Canterbury, which retains very little indigenous forest still supports a population of long-tailed bats.

Between January 1994 and June 1995, the distribution and abundance, habitat use, activity patterns and roost selection of long-tailed bats in South Canterbury, was assessed by radio-tracking, automatic monitoring of echolocation calls and direct observation. Most of the field work was carried out in two very dissimilar areas; Peel Forest (the largest indigenous forest remnant in South Canterbury) and Hanging Rock (retains no indigenous forest but is characterised by extensive outcrops of limestone).

Contrary to expectation, bats were found to be more abundant in the Hanging Rock area than at Peel Forest. Feeding rates were similar in both areas and bats followed parallel nocturnal and seasonal activity patterns to other temperate insectivorous bats indicating that food was not a limiting resource. Although bats preferentially foraged in certain habitats they were flexible about the type of habitat they foraged in suggesting that suitability of foraging habitat was not a limiting factor. Consequently, roost site security was identified as the primary influence on the distribution of bats in South Canterbury. At Hanging Rock, bats roosted in limestone crevices in limestone outcrops that were inaccessible to ground predators. This argument was extended to explain how long-tailed bats have persisted in South Canterbury.

ROOST SITE SELECTION OF THE LESSER LONG-EARED BAT *NYCTOPHILUS GEOFFROYI* AND GOULD'S WATTLED BAT *CHALINOLOBUS GOULDII* IN A FRAGMENTED RURAL LANDSCAPE IN NORTHERN VICTORIA

Lindy Lumsden and Andrew Bennett
Arthur Rylah Institute for Environmental Research, 123 Brown St., Heidelberg, Victoria 3084.

Roost sites are a key resource for bats, and the availability of roosts in remnant woodlands may be an important constraint on the ability of species to persist in rural landscapes. As part of a study of the conservation of bats in remnant vegetation, two species of vespertilionids were radio-tracked to determine their roost requirements. The study area was primarily farmland with small areas of remnant native vegetation, adjacent to an extensive floodplain woodland. In total, 45 individuals of the Lesser Long-eared Bat *Nyctophilus geoffroyi* were radio-tracked, resulting in the location of 139 roosts; and from 27 individuals of the Gould's Wattled Bat *Chalinolobus gouldii*, 91 roosts were located. Selection of roosts occurred at four spatial scales, and both intra- and inter-specific differences were apparent.

1. Type of roost. The two species selected different types of roosts and sizes of roost entrance. *C. gouldii* typically roosted in dead spouts in live trees, while *N. geoffroyi* used sites under bark in addition to fissures, hollows and spouts. Almost all maternity roosts of *N. geoffroyi* were in fissures in dead trees.
2. Tree characteristics. *N. geoffroyi* roosted disproportionately in dead trees, while *C. gouldii* generally roosted in large live trees. Maternity sites of *N. geoffroyi* were in larger trees than those used by males and non-lactating females.
3. Roost area. Both species shifted roosts regularly within a defined area. Roost areas had a higher density of large trees than the surrounding woodland.
4. Position in the landscape. Although all bats were trapped while foraging in remnant vegetation in farmland, all roosts of *C. gouldii* and all *N. geoffroyi* maternity roosts were in the extensive woodland area, a distance of 6-12 km. Most male *N. geoffroyi* roosted in farmland, 1-2 km from their foraging areas.

These results show roost site selection is complex. Implications for management of remnant woodlands and the long-term conservation of bats in rural landscapes are discussed.

SUMMER ROOSTING ECOLOGY OF LONG-TAILED BATS, *CHALINOLOBUS TUBERCULATUS*, IN FIORDLAND NATIONAL PARK, NEW ZEALAND

Jane Sedgeley and Colin O'Donnell
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Long-tailed bats were studied in temperate rainforest dominated by southern beech (*Nothofagus* spp). We describe aspects of roost characteristics and roosting behaviour over three summers (1993-1996).

All roosts found were in trees. The majority (72%) were in red beech, with 10% in silver beech and 18% in dead trees. Generally, roosts were high (mean = 16 m, range = 1-35 m) and occurred in the larger diameter trees. 80% of roost entrances were small knot holes (mean = 112 mm x 83 mm) and found mainly on the tree trunk (48%). Internal cavities varied in shape, some having narrow shafts leading upwards from the entrance hole, a few having shafts going downwards. The dimensions were also relatively small, a mean cross-section being 220 mm x 186 mm (excluding shafts).

About 70% of roosts are used for only one day (mean = 1.6 days, range = 1-9 days). Those occupied for a longer period usually contained a solitary bat. Only 16% of roosts were reused on separate occasions during the study. Numbers of bats using the roosts ranged from 1 to 120, with the largest numbers occurring in the peak breeding period. Most solitary roosts were found in spring and early autumn. Communal roosts were dominated by breeding females, 1 year old and young of the year. Males more frequently roosted alone. By late summer the post-lactating females left the communal roosts and became more solitary. Overall 67% of roosts were communal and 33% solitary.

ROOSTING BEHAVIOUR OF *MYSTACINA TUBERCULATA* IN CENTRAL NORTH ISLAND, NEW ZEALAND

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We are currently using aerial radiotracking and video surveillance to study roosting behaviour of a population of lesser short-tailed bat *Mystacina tuberculata* inhabiting 200 sq km of old growth *Nothofagus* forest near Ohakune in central North Island, New Zealand. The bats roost in cavities in the main trunks of *Nothofagus fusca*. During winter hibernation the bats roost solitarily or in small groups <200 and roosts may be occupied for up to 12 weeks. During the rest of the year day-time roosts are occupied by 1400-4500 individuals and are used for short periods, varying from a few nights to 2 weeks. Although consecutive roosts may be > 6 km apart the bats appear to synchronise roost shifts, most bats move between roosts on the same night. Maternity roosts occur during January & February and are occupied for about 6 weeks. Lactating females often leave their offspring in the maternity roost & occupy daytime roosts with other adult bats, sometimes 4-5 km from the maternity roost.

SOCIAL INTERACTIONS IN A POPULATION OF LONG-TAILED BATS *CHALINOLOBUS TUBERCULATUS* IN A NEW ZEALAND RAINFOREST

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The long-tailed bat (*Chalinolobus tuberculatus*) is one of only two species of bat in New Zealand. It appears to have declined significantly since humans arrived in New Zealand. Little is known about the current status, stability, limiting factors and ecology of long-tailed bat populations. Population biology was studied in beech (*Nothofagus)* dominated temperate rainforest in the Eglinton Valley, Fiordland over three summers, 1993-96. While radio-tracking indicated that foraging ranges of bats (n=58) overlapped considerably, marking of individuals revealed that apparently distinct social groups existed. The bats almost always associated with some of their traditional roosting companions during the day, but appeared to mix at foraging sites during the night. Three sub-groups were studied in detail. Of 1348 captures in 41 harp-trapping sessions at communal roosts there were only 20 cases (1.5%) of individuals switching between groups. Switching only occurred for one night. Those switching were mainly nulliparus (probably 1-year old) females (50%). The remainder were parus females (n=4), adult males (n=4) and one-year males (n=2). Each group contained between 116 and 132 marked individuals, with 35, 49 and 54 breeding females. Communal roosts were dominated by breeding females and young. Only 40% of males were recaptured more than once with the same group of bats compared with c.90% for females. Males roosted more frequently by themselves. The degree of intermixing between groups in the longer term is unknown. Juveniles of both sexes returned to their natal group as one year olds. Results raise questions about how bat populations are defined and have implications for conservation management.

THE SOCIAL BEHAVIOUR OF BREEDING LONG-TAILED BATS *CHALINOLOBUS TUBERCULATUS* IN HAWKES BAY, NEW ZEALAND

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A study of the long-tailed bat was carried out in Balls Clearing reserve, a native podocarp forest remnant in Hawkes Bay, New Zealand. The reserve at 640 metres above sea level and surrounded by pasture comprises a total of 130 hectares, 36 of which is intact mature forest, the remainder regenerating native forest and some exotics. Our aim, using radio-telemetry, was to study the social dynamics of the bats, particularly during the breeding season, in relation to roost selection, composition of maternity colonies and thermoregulation within maternity roosts. Predator impacts were also assessed.

Results show that after the formation of maternity colonies in spring roost selection is confined almost exclusively to canopy trees within the 36 hectare mature forest. Roosts are used for 1-3 days and then a new roost found. Females move between colonies seemingly at random and colony sizes are constantly changing. Adult males are also associated with these colonies. In the roost both male and female maintain body temperatures that are greater than ambient temperature with the female temperature significantly greater than that of the male.

Two predation attempts were observed, both involving the native morepork as the bats were leaving the roosts at dusk.

THE CURRENT CONSERVATION STATUS OF AUSTRALIAN BATS: IS THERE LIGHT AT THE END OF A LONG TUNNEL?

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This paper evaluates the current conservation status of the nearly 90 bat species that are known from Australia, and assesses past conservation effort and the likelihood of rectification of current problems. Nearly 40 species are classified under IUCN terms as being threatened to some extent, but a lack of basic biological information thwarts accurate conservation planning for many, which is particularly problematical since taxonomy is also in chaos. The extent to which each identifiable threat, for each endangered species, had to date had some ameliorative action applied was assessed. This gave an indication of the current status of conservation action for the bat fauna overall, and showed that bat conservation in Australia is in a disturbing situation. There are 36 species facing 92 threats, and less than 16% of problems have received positive attention. Of the five major threats involving as many as 19 species, four of which relate to habitat problems, there has been less than 20% of the effort required to counteract this predicament. These analyses are quantifiable reinforcement for the urgent implementation of the Australian Bat Action Plan, but are also a severe indictment upon the lack of support in the past for research and conservation. Prospects for the future are uncertain because of an apparent lack of researchers, compared with the amount of research required.

DEFAULT ASSUMPTIONS IMPEDE BAT CONSERVATION ASSESSMENT

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Impact assessments and conservation planning for bat species, at least in eastern Australia, often appear to be based on a number of implicit assumptions regarding key aspects of bat ecology and conservation status. Although usually unstated, assumptions that bats are a highly adaptable group of generalist species that are not extinction prone is entrenched. Dogmatic assumptions are re-evaluated in light of existing, often limited evidence, and the lack of intellectual rigour evident in many conservation assessments concerning bats is lamented. It is argued that several entrenched views are a significant threat to bat conservation and a major shift in perspective is suggested.

WHAT ARE AUTOMATED BAT DETECTORS GOOD FOR?

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During the last two years automated bat detector systems based on the Stag Batbox III have been uncritically accepted in New Zealand as a tool both for surveys to determine the distribution of NZ's two bat species, and to monitor changes in bat population levels. In this study we assess the use of automated bat detectors for studying short-tailed bats *Mystacina tuberculata*. Automatic bat detectors were placed at thirteen sites for at least 5 nights each month for 15 months in a 200 sq km tract of forest inhabited by short-tailed bats. Although detailed analysis has not been undertaken, a number of preliminary results are apparent. Calls from the only other NZ bat species *Chalinolobus tuberculatus* could be reliably distinguished. Surveys for short-tailed bats should be carried out during the six months November to April and are best restricted to large tracts (> 1000ha) of undisturbed old-growth forest. Because of the species mobility, bat detectors can be placed 500 - 1000 m apart during surveys. There is a high variability in the numbers of calls both between nights and sites. Some of this variability may be explained by climatic and seasonal factors but the most important factor affecting call counts appears to be the change in bat movement patterns when large colonial roost sites shift. It therefore seems unlikely that automated bat-detectors will provide a reliable method for monitoring changes in the size of populations of short-tailed bats.

COMPARING BAT DETECTORS AND THEIR VALUE FOR FIELD USE

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Bat studies that monitor echolocation calls are, with few exceptions, entirely dependent on the ability to detect ultrasound within the range 20kHz to 200kHz. The key component in the process of recording and analysing bat echolocation calls is the design of the microphone. Best are the smaller calibration-standard microphones made by Brüel & Kjær which provide the flattest frequency response, but they are not very sensitive to low level sound and moreover, they are very expensive and difficult to use in the field. Commercial bat detectors use a range of microphones and the performance of several popular models has been quantified by frequency response curves, sensitivity and directional characteristics; in the end, these parameters control the whole detecting, recording and analysing process. There are significant differences between bat detectors: true broadband detectors such as Ultra Sound Advice (S-25, U30) and Pettersson (D-9xx series) have the best all round performance and use proprietary microphone capsules of a similar design; they have a fairly flat response between 10kHz and 130kHz (±7dB) with modest sensitivity maintained up to 200kHz. The Anabat detector (which uses the transducer made for auto-focus Polaroid cameras) has a peaked response between about 40-60kHz which declines rapidly above and below this range, and is also quite directional. The use of small electret microphones in "mini" bat detectors is common; they are sensitive to ultrasound and not very directional, but the frequency response declines rapidly above 10kHz. Home-made bat detectors based on small burglar alarm microphones work, but the response is very peaked around 40kHz, rendering them useless for a wide range of bat species. The choice of bat detector has serious implications for the quality, or even the detectability, of echolocation calls to be monitored by an observer, especially in the field - notwithstanding the method of recording these signals and choice of sound analysis.

USING ECHOLOCATION CALLS TO EXAMINE THE EFFECT OF LOGGING ON BATS IN TASMANIA

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Detection and recording of echolocation calls was used to compare bat activity in unlogged forest and regrowth forest produced by different silvicultural techniques. The use of timers in association with the detectors meant that bat activity could be recorded in different areas of forest simultaneously. Bat activity was measured in logged and unlogged forest areas by counting the number of bat passes over 45 minutes commencing half an hour after sunset. Activity was compared in evenaged young regrowth produced by clearfelling, partially logged and mature forest in dry eucalypt forest in Eastern Tasmania and in four, twenty and eighty year old regrowth and mature forest in wet eucalypt forest in Southern Tasmania. In dry eucalypt forest bat activity was higher in mature forest than evenaged young regrowth and some partially logged forest, depending on the structure of the remaining stand. In wet eucalypt forest there was apparently no difference in activity between mature forest and regrowth forest of any age. However, bat detectors were placed on the ground and there was some indication that this may have underestimated activity in tall eucalypt forest.

IDENTIFICATION OF TASMANIAN BATS BY ECHOLOCATION CALLS

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The habitat use of active microchiroptera in logged and unlogged Tasmanian forests has been examined by analysis of echolocation call recordings. Species identification of recorded tapes from a previous study (in 1992/3) was based on similarity to 'identified calls'. Each of Tasmania's eight bat species were recorded whilst flying into traps, and during release from the hand, giving 'identified calls'. Anabat detectors and software were used in recording and analysis. Start frequency, final frequency, call duration, and call interval were obtained from 'identified calls' of sufficient intensity. The majority of calls from bats flying into traps were very short and steep, similar to the initial portion of the 'feeding buzz' of free flying bats. Release calls generally become increasingly less steep with time after release, and resemble an intermediate call type between buzz and shallow 'cruise' calls of free flying bats. The information obtained from identified calls was applied to analysis of 1992/3 recordings. I began analysis of recordings in more complex habitats as calls from these most closely resemble 'identified calls'. Differences in species composition between different aged and mature forests from the 1992/3 recordings will be presented. Progress from data collected in February and March 1996 will be presented.

BAT SURVEY AND THE "PRIORITY" SPECIES OF THE WET TROPICS WORLD HERITAGE AREA OF AUSTRALIA

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The current Regional Action Plan for the conservation of threatened species and ecological communities of the Wet Tropics World Heritage Area (WTWHA), identifies a total of 14 "priority" bat species (Nias *et al*. 1993). This plan provides a basis for targeting species with special conservation value, and a general bat survey has been conducted in the region over one year, funded by the Wet Tropics Management Authority. Over 60 study sites, mostly in rainforest, were located in the major biogeographical regions. The results have been combined with existing records, to re-assess the distribution and conservation status of bats in the WTWHA. Orthodox capture techniques were used (bat traps, mist nets, trip lines), as well as intensive sonar surveying of flying bats; searches for bat roosts were also conducted in caves, mines, bridges, tunnels. By capture, the most common species are *Rhinolophus megaphyllus*, *Miniopterus australis*, *Nyctophilus bifax* and *M. schreibersii*. The survey records, together with the results of ground searches, reveal a high proportion of species (over 30%) to be dependent on caves or cave substitutes for roosting and breeding. Targeted species included *Murina florium*, considered to be one of the rarest mammals in Australia (Priority 1a). Autecological studies were carried out on *M. florium* and other rare species, by radio tracking and observation of flight, foraging and echolocation behaviour, location of roost sites and dietary preferences. The currently known of the distribution of *M. florium* suggests an ecotone preference between rainforest and wet sclerophyll forest. A similar ecotone preference is found for *Kerivoula papuensis* (Priority 3a), also captured and studied behaviourally during the survey, which includes the location of roost sites. New observations and historical records of *Macroderma gigas* (Priority 2b) suggest that this species tends to be distributed along the western edge, or just outside of the WTWHA. Foraging areas for *M. gigas* have been found in drier eucalypt forest but cave or mine roosts are essential for survival, and they may well be located in the rainforest of the WTWHA.

PRELIMINARY OBSERVATIONS ON THE BATS OF CAPE MELVILLE NATIONAL PARK

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Cape Melville National Park is located on eastern Cape York at approximately 14^{o}15′ latitude. A feature of the park is the Melville Range which reaches an altitude of 585m and is primarily composed of exposed granite boulders. Beneath the boulders in many areas is a network of passageways which can consist of chambers up to 4m high and containing running streams. The area was surveyed for bats in December 1994 and January 1996. The main emphasis was to investigate the bat fauna around the base of the boulder slopes using bat traps, mist nets, spotlighting, ultrasonic detection and cave searching. Nine species of bats were recorded. In order of abundance they were: *Miniopterus schreibersii, Hipposideros diadema, Taphozous australis, Rhinolophus megaphyllus, Miniopterus australis, Vespadelus troughtoni, Nyctimene* sp., *Hipposideros semoni, Macroderma gigas.* Observations on breeding in January 1996 revealed *M. schreibersii* females to be pregnant and lactating; *H. diadema* females were all lactating or post lactation; *M. australis* and *V. troughtoni* females were lactating, and *T. australis* colonies had large young. The *M. gigas* was a juvenile male caught in December 1994 and was probably dispersing. The predominance of *H. diadema* in the area may preclude *M. gigas* as they undoubtedly overlap in prey species. More species of bats are likely to be found in the area as other locations and habitats are surveyed.

A REVIEW OF INFORMATION ON THE LITTLE PIED BAT *CHALINOLOBUS PICATUS*

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The Little Pied Bat (*Chalinolobus picatus*) generally occurs in the semi-arid interior regions of eastern Australia, although recent evidence suggests that it occurs east of the Great Dividing Range in Queensland. Little is known of its ecology, and it is considered a rare species.

Published and unpublished fauna surveys in semi-arid areas of eastern Australia were examined to determine the relative abundance and broad habitat preferences of *C. picatus*. During these surveys over 3300 bats, representing 18 species, were captured at 125 sites from north-western Victoria to central Queensland. Only 34 *C. picatus* were caught, equivalent to about 1% of the total number of bats captured. Trap success for *C. picatus* was low, with a mean of about 40 bats per 100 trap-nights. *C. picatus* was usually sympatric with *C. gouldii* and *Nyctophilus geoffroyi*, *Vespadelus baverstocki*, *Mormopterus planiceps*, *Nyctinomus australis*. *C picatus* appears to reach its greatest relative abundance in the mallee and mixed species woodlands of the Willandra Lakes area of south-western New South Wales, where about 47% of all *C. picatus* captures occurred. In contrast, an extensive survey of the mallee region of north-western Victoria failed to find any *C. picatus*. Some 26% of reported captures were in mulga and riverine open forest communities on Idalia National Park in central-western Queensland.

SURVEY OF MICROCHIROPTERA IN THE SCOTIA COUNTRY OF FAR WESTERN NEW SOUTH WALES AND OBSERVATIONS ON THE RELATIVE SUCCESS OF SURVEY METHODS

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Bat surveys were conducted between 1993 and 1996 in the Scotia country near the South Australian border. Major vegetation communities in this semi arid region include belah woodland, mallee shrubland and mallee triodia. Bats were surveyed initially using harp traps but trip lines over small earth tanks and an Anabat echolocation call detector were also used in later surveys. Species captured were *Chalinolobus gouldii, Scotorepens balstoni, Mormopterus planiceps, Nyctophilus geoffroyi* and *Vespadelus* species. In addition three individuals of *Chalinolobus picatus* and one *Nyctophilus timoriensis* were captured. In 1995 and 1996 during further surveys, observations were made on the relative success of harp traps, trip lines over water and an Anabat detector. Escapes from trip lines were frequent. *C. gouldii* was the major escapee. Harp trap capture success was markedly improved when traps were placed close to water. Both methods produced inconsistent results between consecutive nights even under ostensibly similar conditions. This presumably reflected local bat activity and behaviour. No injuries were noted with either method. Multiple simultaneous calls made analysis difficult when the Anabat detector and tape recorder were used close to tanks even when used in combination with a delay switch. The problem was reduced by moving the detector fifty metres distant from the water. The use of a laptop in the field linked to the Anabat detector with a zero crossing unit (Titley Electronics) provided further information on bats present but not captured.

This paper was submitted for the conference, however Dr. Kovalyova was unable to attend to present it, but requested that the abstract be included in the book of abstracts.

THE DUAL FUNCTION OF THE FLYING MEMBRANE IN BATS EVOLUTION

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The anatomical structure of Chiroptera reveals that their ancestors, originally having kept the ground way of life and having used the quadrupedal locomotion, subsequently were adapted to the arboreal-rocky way of life, and then - to flight. Appropriate preadaptations of locomotion organs in the ancestors of Chiroptera should occur, that has resulted in essential reorganizations in locomotion itself and occurrence of the new living form. When lengthening metacarpals, the germinal interdigital membrane inevitably arises.

The following thesis are stated by a number of scientists:

1) flying membranes of bats play the essential role in thermoregulation;
2) even the germinal interdigital web promotes heat release;
3) the increased selectivity of the given structure does consist in the function of heat release.

Not putting under doubt the importance of the first two above-stated thesis, we believe that just the gas exchange function of the interdigital membrane was selective. It is confirmed, in particular, by the fact that transcutaneous carbon dioxide exchange in Chiropteran wing membranes is 10 times as large as transcutaneous gas exchange in other mammals. The active flight, as the most energy consumptive form of locomotion, requires the increased gas exchange in animals. The proper respiratory organs of the transitional forms of bats have not yet undergone changes. Thus, in the beginning of mastering flight, the structure, that provides the increased gas exchange, was flying membranes. Being by nature of dual functions, wing membranes were those prerequisites which served to bats in opening up the aerial medium.

ABSTRACTS OF POSTER PAPERS PRESENTED AT THE 7th AUSTRALASIAN BAT CONFERENCE, NARACOORTE, SOUTH AUSTRALIA, APRIL 1996.

BATS OF BULOKE, *ALLOCASUARINA LUEHMANNII* WOODLANDS IN WESTERN VICTORIA

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An investigation of eight buloke, *Allocasuarina luehmannii* woodlands was undertaken in Western Victoria to investigate the impact of site degradation on the bat fauna. The chief sources of woodland degradation were grazing and firewood removal. Sites selected for study ranged from severe degradation to relatively intact remnants with a developed understorey of native shrubs and grasses. The community structure of those woodlands was studied to determine whether their structural characteristics affected species richness and diversity in bat fauna. Eight species of bats were detected using an ultrasonic detector and harp traps from forty eight trapping nights and thirty two hours of echolocation surveys. Significant positive relationships were found between both species richness of the bat fauna and foliage height and buloke age diversity. Also bat fauna diversity was highly correlated with foliage height and buloke age diversity.

DISTRIBUTION MAPS OF BATS OF THE GENUS *MORMOPTERUS* OF AUSTRALIA

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Maps showing the distribution by half degree x half degree blocks (this is the same as 1:100,000 topographic map sheets) of bats of the genus *Mormopterus* in Australia based on literature and museum specimens are presented. The sources of the records for each map are given and the names used in the original records. Where there is some doubt over the identification this is indicated.

It is planned to make available a hand-out of the maps and data of the poster.

A STUDY OF SUCCESSFUL (*CHALINOLOBUS GOULDII*) ROOSTING BOXES AT ORGAN PIPES NATIONAL PARK

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The Organ Pipes National Park provides habitat for seven species of bats in its revegetated riparian woodland. Friends Of Organ Pipes installed ten artificial roost boxes in 1992. First evidence of use by bats was observed late in 1994, and now all boxes have been used despite competition with Sugar Gliders, bees and ants. A total of 56 Gould's Wattled Bats (*Chalinolobus gouldii*) have been banded, two thirds female, in a mix of large maternity groups and small bachelor groups, using different boxes at each inspection. A second generation was born late 1995 with most bats found in large groups, of over 10 bats. Popularity of boxes varies and seems unrelated to compass direction of entrance slit, but it is too early for long-term patterns to be deciphered confidently. Boxes with smaller entrance slits, and others with multiple cavities, have been set up in 1996.

EVALUATING ROLLING BAT-DETECTOR TRANSECTS FOR SURVEYING MICROBATS IN SOUTH-WEST VICTORIA (WORK-IN-PROGRESS)

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This poster paper presents some early results from a work-in-progress to evaluate the use of a bat-detector in transects from a motor vehicle to survey microbats in south-west Victoria. In an area of box-ironbark, stringybark and gum forest and woodland between Bacchus Marsh, Bannockburn and Meredith, where we have trapping data, we commenced driving transects of measured length and duration from a slow moving car in November 1995. Detection rates are compared to capture rates for ten species. As expected, the technique works well for detecting aerial intercept taxa such as *Nyctinomus australis* and *Mormopterus* sp., which are difficult to trap. The most commonly detected and trapped species was the aerial pursuit species *Vespadelus vulturnus*. The calls of *Vespadelus darlingtoni* and *V. regulus* overlap considerably, as do *Nyctophilus geoffroyi* and *N. gouldi*, and accordingly we have pooled the results for these species pairs. Unexpectedly, the 'whispering' genus *Nyctophilus* was also well represented in detecting results. The characteristics of rolling versus stationary bat-detectors, and rolling bat-detector versus trapping, are compared, and the implications for survey discussed.

TERMINOLOGY AND PARAMETERS OF ECHOLOCATION CALLS FOR IDENTIFICATION AND DESCRIPTION PURPOSES

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The study of Micro-bats proceeds with many difficulties: sampling methodology, taxonomy, species identification from echolocation calls, data analysis, terminology. This paper addresses two topics based on experience derived by using the Anabat System (Corben 1989), an ultrasonic instrumentation intended for the identification of micro-bats through their echolocation calls. These topics are related to species-significant call characteristics and the outcome is practical to describe such characteristics. A common language of ultrasonic terms is urgently needed to facilitate the exchange of information between bat workers. By way of contributing to this need, a terminology to classify calls into shapes and another for call parameters was developed. In addition a selection of call parameters was made, based on international microchiropteran literature but adapted to an Anabat perspective.

Categorisation and measurement of calls was carried out solely on good quality ultrasound sequences, and only to the most typical shape of each species for most of South-east Queensland micro-bats.

Differences in average measurements confirm common features of recognised species or subtle differences for similar species, in any case they were originally perceived intuitively. Our brains are good for such distinctions but we need any available tool when facing so many challenges.

BATS IN CYBERSPACE - THE SOUTH-EASTERN AUSTRALIAN BAT CALL LIBRARY

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Ultrasonic echolocation calls for species identification is gaining more and more importance in fauna surveys. Several species of bat can be identified by their calls, although geographical variation exists within species, and only a handful of reference calls are publicly available for any given region in Australia. The need for a national archive of bat calls to alleviate this problem is generally recognised (Kutt 1993, Richards 1993). We established a regional bat call library, creating a central source and exchange network of reference calls of south-eastern Australian bats. The call library has proven to be useful and has been intensively accessed. Still the effectiveness of such a library relies an the willingness of bat researchers to contribute their calls.

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REMOTE BAT DETECTION - METHODS FOR AVOIDING LOGISTICAL AND TECHNICAL PROBLEMS

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Ultrasonic bat detection equipment is a useful and welcome addition to the bat researchers arsenal of survey methods. Use of this equipment (hand held, vehicle mounted or remote detection) can never totally replace field survey techniques such as mist netting, harp trapping or trip-lining. However, it allows researchers the opportunity to gather new and interesting data from situations where traditional techniques are inadequate, thereby opening up new avenues for ecological research. One of the ways of utilising ultrasonic recorders is via remote detection. Of the many benefits associated with this method, one that stands out is the ability to gather data simultaneously from a number of sites without the need for a large field team. A commonly perceived down side to this method is the quantity of technical equipment that needs to be handled, amounting in some cases to a "technophobe's nightmare". This can easily lead to the belief that remote detection is more trouble than it is worth. This poster sets out some of the logistical and technical problems encountered with remote detection during surveys of state forests in Queensland and presents some practical means of preventing or circumventing them. In presenting these technical tips, it is hoped to stimulate a more widespread use of the technique in ecological studies.

THE OVARY OF *CYNOCEPHALUS* IS UNLIKE THAT OF THE MEGACHIROPTERA

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The *Pteropus* ovary is unusual: the cortex of primordial follicles is reduced to a small caudal zone, and the veins enclose the coiled ovarian artery in a characteristic ovarian vascular complex [OVC]. All ovaries from 11 megachiropteran genera show these features (Pow and Martin, 1991). Examination of ovaries from 10 microchiropteran genera and the published literature indicates that no microchiropteran ovary shares these characteristics (Martin and Pow, unpublished observations). Pettigrew (1986) suggested that megachiroptera evolved separately from microchiroptera, possibly from the primate line. I therefore examined the ovary of one putative ancestor, the gliding lemur *Cynocephalus variegatus* (Pettigrew and Cooper, 1986). It has a typical mammalian cortex with primordial follicles extending over the surface, and no OVC. Thus, while ovarian morphology is another feature which separates the mega- and micro-chiroptera taxonomically, it does not, so far, give a clear indication of the validity or otherwise of Pettigrew's "flying-primate" theory.

I thank Dr John Bluemink, Hubrecht Laboratorium, Nederlands Instituut voor Ontwikkelingsbiologie for providing me with the *Cynocephalus* material, which was collected by Professor Hubrecht in 1891.

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WHAT WOULD THE COMMUNITY KNOW ABOUT BAT RESEARCH?

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What would the community know about bat research? Very little is the answer unless the researchers involved take advantage of the communities willingness to learn about our natural environment and the species that are part of it. To most people bats are bats and frogs are frogs and they're happy to sit with that understanding unless we give them an opportunity to understand more.

We have all heard the cry "if only the animal I am researching was cuddly like the koala or the bilby then I would be able to get the general public interested in the research". The public haven't the time or interest (or both) to source the information to be knowledgeable on all aspects of bats, or the research being undertaken. But given the opportunity to participate in a research project they will gain a basic understanding of the subject and an appreciation of the work effort needed to manage our natural environment.

ATCV and other conservation organisations exploit this side of human nature to involve the community. The outcome varies from one individual to the next, but they will always remember the time they helped the researchers do this or that, and they talk about it to others.

The major problem for the professional practitioner is that untrained people may compromise the quality of the data. Is it not possible, that if supervised, the volunteer is a most valuable resource and will improve the outcomes of the project?

Most volunteers are offering their services because they want to learn, help, gain experience, and so on, and they become loyal to the cause they are involved in. You never know, you may have someone with skills that you require, they just need the opportunity to demonstrate their worth.

The community are willing to help if:

- they are contributing
- they are valued
- the project is worthwhile and well organised.

What makes a team? The team behind the team.

FIELD IDENTIFICATION AND DISTRIBUTION OF LITTLE BROWN BATS (*VESPADELUS* SPP.) IN SOUTH AUSTRALIA (CHIROPTERA: VESPERTILIONIDAE)

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Five species of little brown bats, genus *Vespadelus*, occur in South Australia: *Vespadelus finlaysoni, V. darlingtoni, V. regulus, V. baverstocki* and *V. vulturnus*. The former two species can be readily distinguished by their large size and distribution but the latter three form a species group of similar size and distribution and consequently are difficult to identify. As males of this group can be identified by the shape of their penes, the emphasis of this study is on methods to differentiate the females of the similar species. Characters are listed here for identifying *Vespadelus* bats, particularly for use in the field, using external measurements and distribution data. A key to the identification of female little brown bats in South Australia is provided. In areas where the smaller species are sympatric, 10% of female *V. regulus* and 5% of *V. baverstocki* are indistinguishable by size (based on a sample size of 79 *V. regulus* and 38 *V. baverstocki*).

MONITORING WINTER BAT ACTIVITY AT NARACOORTE

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The population of *Miniopterus schreibersii* at Naracoorte Caves Reserve reduces after summer, leaving a smaller resident winter population. Casual observations of bat activity have been made Jan/Feb 88, 91, 93-5 and Oct 92. In July and October 1995, winter activity of bats was observed by direct inspection of caves with photography of bat clusters, counting of bat passes at cave entrances with a bat detector, and inspection of bat guano, with later extraction of fauna present.

	Bats seen	Bat passes per minute	Bat Guano inspected	Bats seen	Bat passes per minute	Bat Guano inspected
Cave	July 95			October 95		
Bat	1	5	mountains	many	many	n.a.
Blanche	~ 200?	n.a.		-	7	
Wet	~ 100?	3-4		-	3-6	
Cathedral	3	3-4		n.a.	6-many	
Robertson	~ 500?	n.a.	recent	1	n.a.	live fauna
campground		0.5			1	

Thus bats at Naracoorte used at least 5 caves in winter 1995, and some were active at temps of 6-9^{o}C . Only 1 bat was seen in Bat Cave, possibly related to construction disturbances [Bat Viewing Centre], though 5 per minute were detected exiting Bat Cave after dusk. A large roost of bats (~ 500?) above a guano pile was photographed in Robertson Cave in July 1995. The roost contained no bats over four summers (Jan/Feb 93-95 and Oct 95), but is presumably used each winter, since there was live guano fauna in Feb 95, with analysis of an Oct 95 sample revealing about 300 orybatid mites, 17 beetles and 6 flies for each 100 gms of wet guano.

A TECHNIQUE FOR HARP TRAPPING AT BAT ROOSTS IN TALL FOREST CANOPY

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Long-tailed bats *Chalinolobus tuberculatus* roost high in trees (mean = 16 m, range = 1-35 m, n = 141) in temperate rainforest in Fiordland, New Zealand. We describe a harp-trapping technique used directly at these roosts for sampling group composition and attempt to assess any effects trapping may have on bat behaviour. A preliminary study of roosting showed that over 60% of roosts were occupied for only one night, thus level of disturbance should be minimal.

We used a collapsible Austbat Research Equipment harp trap. Simple modifications were required to enable the trap to be hoisted up trees. Diagrams illustrate these. Photographs and diagrams will show how to hoist the trap into a tree and place it in front of the roost hole. Capture rates were dependent on the position of the trap relative to the roost hole. Thus we improved our catch from 37% to, often, 100% of emerging bats.

Disturbance of the population was minimised by trapping at only 10% of roosts found. Disturbance was assessed by looking at duration of roost occupancy, whether young were abandoned and first emergence time in relation to sunset. Average occupancy of trapped roosts (mean = 1.6 days, range = 1-5, n = 20) was the same as those untrapped (n = 172). Bats returned to 40% of roosts the day after trapping, compared to 30% for roosts which were not trapped. All roosts were checked the day after trapping, no young were found dead or abandoned. Preliminary investigation suggests emergence times were similar for trapped and untrapped roosts.

BATALOGUE - A BIBLIOGRAPHY OF BAT SPECIES OCCURRING IN NSW

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The Biodiversity Survey Co-ordination Unit of the NSW National Parks and Wildlife Service is compiling a "bibliography on the taxonomy and ecology for 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 i.e. cross-referencing for different species, taxonomy, techniques, ecology, nomenclature and habitat. The aim is to provide 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.

THE ECOLOGICAL SOCIETY OF AUSTRALIA MEETING AND *BAT ECOLOGY SYMPOSIUM*, JULY 1996, TOWNSVILLE

Len Martin

Although trained as a zoologist and ecologist, this was my first scientific ecology conference since childhood - and only because of an invitation to contribute to the *Bat Ecology* symposium by Greg Richards. However, because of other interesting aspects I decided to attend the whole meeting - despite a $160 registration fee! This and the hospitality contrasted with those of the ABS Naracoorte meeting.

The opening symposium *Ecology for Everyone - communicating ecology to scientists, the public and the politicians* was of particular interest, and included some useful, educational papers. Nonetheless, it was apparent that, at present, the ESA does not get involved in, or speak out on, environmental issues - another contrast to the philosophy of the ABS. One speaker, on networking, mentioned that he had been criticised for involving amateurs in data collection - so I just had to get up and emphasise: how important amateurs were to science (eg. Darwin and Mendel); how *Scientistum professionalis* was a very recent, and with current government policies, highly endangered species; how much amateurs contribute to scientific knowledge of bats and are valued and respected colleagues in ABS.

Unfortunately Greg Richards could not attend the symposium, so Les Hall and I acted as joint chairmen. The abstracts are appended, with three from papers presented after the symposium. As you see, there was not much overlap with Naracoorte, and I personally enjoyed the whole collection. One outcome is my current hypothesis that the Megachiroptera evolved in Oz, from the tube-nosed insect bat *Murina florium* - I mean, it's obvious isn't it? Attendance at the symposium was only moderate, possibly because of competition from an action-packed symposium on *Ecological and Evolutionary Processes at Species Borders*, which I too wished to attend. This demonstrates the difficulties inherent in partitioning our scarce bat-resources between different learned societies. It's not that we shouldn't, but how best to do it. For myself I shall remain wedded to ABS, ASRB and the other ESA.

ABSTRACTS OF PAPERS PRESENTED AT THE *BAT ECOLOGY SYMPOSIUM*, ECOLOGICAL SOCIETY OF AUSTRALIA MEETING, JULY 1996, TOWNSVILLE

Roger Coles, **Chris Clague, Hugh Spencer[1], Olivia Whybird**, Vision, Touch & Hearing Research Centre, Dept. of Physiology & Pharmacology, The University of Queensland, St. Lucia, Qld 4072, [1]Cape Tribulation Tropical Research Station, Cape Tribulation, Qld 4873. **The Distribution of Bats in the Wet Tropics World Heritage Area of Australia.**

The Regional Action Plan of the Wet Tropics World Heritage area (WTWHA), identifies a total of 14 priority bat species, with special conservation value, These species were targeted during a general bat survey of the region, funded by the Wet Tropics Management Authority. Study sites were located in representative biogeographical areas and mainly in rainforest traditional bat capture techniques were used (traps, mist nets, trip lines), ground searches for roosts, and sonar surveys. The most common species captured were *Rhinolophus megaphyllus*, *Miniopterus australis*, *Nyctophilus bifax* and *M. schreibersii*. Survey records reveal a high proportion of species (over 30%) to be dependent on caves or cave substitutes for roosting and breeding. Targeted species included *Murina florium*, one of the rarest mammals in Australia. By capturing this and other rare species, their autecology was studied by radio tracking, observation of flight, foraging and echolocation behaviour, location of roost sites and dietary preferences. Based on new records, the distribution of *M. florium* (and *Kerivoula papuensis*) suggests preference for the ecotone between rainforest and wet sclerophyll. New observations and records of *Macroderma gigas* suggest a distribution along the western edge, or just outside the WTWHA; foraging areas have been found in drier eucalypt forest but cave or mine roosts may well be located in rainforest.

Roger Coles & **Hugh Spencer[1]**, Vision, Touch & Hearing Research Centre, Dept of Physiology & Pharmacology, The University of Queensland Qld 4072, [1]Cape Tribulation Tropical Research Station, Cape Tribulation, Qld 4873. **Bat Detector Performance, Field Use & Survey Methods.**

The key component in the process of recording and analysing bat echolocation calls is the design of the microphone. Commercial bat detectors use a range of microphones and the performance of several popular models has been tested for frequency response, sensitivity and directional characteristics. There are significant differences between bat detectors: true broadband detectors such as Ultra Sound Advice (S-25, U-30) and Pettersson (D-9xx series) have the best all round performance and use proprietary microphone capsules of a similar design; they have a fairly flat response between 10 kHz and 130 kHz (± 7 dB) and maintain reasonable sensitivity up to 200 kHz. The Anabat detector has a peaked response between about 40-60 kHz, which declines rapidly above and below this band, and it is also quite directional. The use of small electret microphones in "mini" bat detectors is common; they are sensitive to ultrasound and not very directional, but the frequency response declines rapidly above 10 kHz. Bat detectors based on small burglar alarm (piezo) microphones can be highly sensitive to ultrasound but the transducer response is very peaked around 40 kHz. The choice of bat detector has serious implications for the quality, or even the detectability, of echolocation calls to be monitored by an observer in the field. Limits imposed by the methods of recording these signals and choice of sound analysis is also discussed.

Alexander Herr and Nicholas I. Klomp, Johnstone Centre of Parks, Recreation and Heritage, Charles Sturt University, PO Box 789, Albury 2640 . **Variation in abundance and size of bats: influences of altitude and prey size.**

The morphometrics of bats of the genus *Vespadelus* were studied at varying altitudes (150-1150m asl) in the western slopes of the Australian alps. The relative abundance of the largest species *V. darlingtoni* was significantly greater at higher altitudes than below 200m. Conversely the relative abundance of the smallest species *V. vulturnus* was greater at the lower altitudes. Intraspecifically adult *V. darlingtoni* had significantly longer forearm lengths, greater body weights (and subsequent body condition indices) at higher altitudes than those individuals trapped below 200 meters asl.
Microchiropteran bats are some of the smallest mammals in the world. The influence of altitude on body size is considered in terms of ambient climatic conditions and maintenance of body temperature by these bats, however a possible interacting effect of altitude is the recorded decrease in the relative abundance of prey (Coleoptera and Lepidoptera) of preferred size with increasing altitude.

Bradley Law, J. Anderson and M. Chidel, Research Division, State Forests of NSW, P.O. Box 100, Beecroft, NSW 2119. **Forest fragmentation and bat communities of the southern tablelands of NSW.**

Bats were surveyed in State Forests of the Tumut region of NSW using ultra-sonic detectors, harp-traps, mist-nets and trip-lines. While four of the surveyed forests are extensive (> 20,000 ha), interconnected and adjacent to Kosciusko National Park, clearing for agriculture has to a large extent isolated six others as large islands (> 1,000 ha). Additional pieces of forested Crown Land were surveyed with ultra-sonic detectors only to provide comparable data on 5 small remnants (<10 ha), 3 corridors of vegetation and 4 open paddocks. The survey consisted of 155 trap-nights resulting in over 1,000 bat captures and 622 hours of ultra-sonic detection yielding 5,806 bat passes and 613 feeding attempts. A total of 13 species were recorded. Species richness and levels of activity in isolated State Forests (>1,000) ha) were equivalent to that found in continuous forest, however small remnants (< 10 ha) supported less species and lower levels of activity and feeding attempts. The assumption that corridors of vegetation are of value to bats requires further research as species richness and rates of feeding were low in corridors and most species were recorded flying over open paddocks. In addition, total activity and rates of feeding were relatively high in open paddocks.

Len Martin, Department of Physiology & Pharmacology, University of Queensland, QLD 4072. **What Regulates Seasonal Breeding in Australian Flying-foxes?**

Seasonal breeding, the adaptive strategy whereby young are born in the season most favouring their survival, is regulated in many temperate-region species by changing photoperiod. This is not so in the tropics, where seasonal rainfall is an oft-suggested timer, but actual environmental reproductive cues remain an enigma. Reproduction in flying-foxes is of particular interest since, while the genus *Pteropus* is tropical in origin, Australian species span temperate to tropical habitats. Thus both *P. poliocephalus* (temperate-to-subtropical) and *P. alecto* (subtropical-to-tropical) copulate in autumn and give birth in spring, while the nomadic *P. scapulatus* overlaps the others' ranges, but copulates in spring and gives birth in autumn. Why? Discussion will be based on: (1) the unusual reproductive physiology of *P. poliocephalus*, *alecto* and *scapulatus* as elucidated in wild and captive populations breeding seasonally at ~28°S; (2) cumulative frequency distributions of birth-dates constructed from date of entry-into-cure records kept by groups fostering orphan new-born Pteropus for return to the wild - such distributions define the onset of birth seasons and subsequent birth-rates, and how these vary between species and with geographic location & season.

Kerryn Parry-Jones and Michael L. Augee. School of Biological Science, University of New South Wales, Sydney 2052, Australia. **Evidence for a determinant role of reproductive cycles in colony site usage by the Grey-headed Flying-foxes, *Pteropus poliocephalus*.**

Previous authors have assumed that the occupation of flying-fox colony sites is related to cycles of blossom and availability. Studies carried out at the colony site at Gordon in Sydney N.S.W. have shown that food resources are dependable in the Sydney Metropolitan area throughout the year due to the introduction of plants native to other parts of Australia and exotics from other continents. In this situation colony occupation patterns are not correlated with food use but are correlated with the reproductive requirements of the flying-foxes. While it is clear that the Gordon site is atypical, none the less these findings suggest that movements and patterns of site usage throughout the range of *P. poliocephalus* are not solely determined by the vagaries of food supply.

Martin Schulz and Dave Hannah, Zoology Section, Dept of Primary Industries, PO Box 631, Indooroopilly, Queensland 4068. **Preliminary investigation of an ecological specialist, the Tube-nosed Insect Bat *Murina florium*.**

Murina florium was first recorded in Australia from Mt Baldy State Forest near Atherton in August 1981. Subsequently, despite extensive harp trapping and mistnetting studies in north-eastern Queensland only a further eight individuals have been recorded prior to the present study. Intensive trapping in simple mesophyll vine forest adjacent to the Koombooloomba Dam (17°51′, 145°35′) and in Mt Baldy State Forest (17°17′, 145°25′) on the Atherton Tablelands in December 1994 and 1995 and April 1996 resulted in the capture of 32 *M. florium* in a combined total of 249 harp trap nights. Radio telemetry resulted in the location of three roost sites, including a small colony of up to 12 individuals in the curled up base of a snagged *Archontophoenix* frond. Observations on roost emergence and roosting behaviour will be presented. The results of the analyses of 37 scats and 20 individuals swabbed around the mouth for traces of pollen will be presented.

Martin Schulz, Faculty of Resource Science and Management, Southern Cross University, PO Box 157, Lismore, NSW. **Approaches to ecological studies of rare bat species; *Kerivoula papuensis* as a case study.**

Kerivoula papuensis belongs to a widespread genus of bats which occur in Africa, south-east Asia, Papua New Guinea and Australia. Many species within the genus are known only from single specimens and no ecological studies have been conducted on species within this genus. Until 1981, *K. papuensis* was considered possibly extinct in Australia. From 1981 to 1993 approximately 50 individuals were captured in fauna surveys in eastern Australia. The sudden increase in captures was attributed in part to the introduction and increasingly widespread use of the harp trap. However up until 1993, with the exception of incidental observations, nothing was known about the ecology of this enigmatic bat. In 1993, I was faced with the problem of undertaking a detailed ecological study of *K. papuensis*. An outline of the strategies used to find a reliable trapping technique, locate study sites where individuals could be captured with a relatively low trapping effort and the undertaking of a pilot study to investigate aspects of the ecology of *K. papuensis* such as diet, roost selection and population dynamics will be presented.

Michael T. Vardon, R.A. Loughland, P.M. Brocklehurst and C.R. Tidemann. Australian National University, SREM Canberra ACT 0200. **Habitat usage by the Black Flying-fox, *Pteropus alecto*, in northern Australia.**

Conservation planning for many species of flying-fox is confounded by artefact from habitat loss and modification. In the Northern Territory of Australia vegetation clearance is minimal and the Black Flying-fox (*Pteropus alecto*) is widespread and abundant. Characteristics of colony sites and adjacent foraging areas were compared with the characteristics of randomly selected locations. At the local level, differences between occupied and control sites were trivial. At the broader scale, differences related to seasonal availability of foraging habitat and the reproductive cycle were evident. Roost sites are restricted to riparian vegetation, which is generally not limiting but the availability of foraging habitat shifts seasonally. Historical factors such as cyclones, fires and predation by humans probably influence roost site selection at the local level.

Olivia Whybird, Vision, Touch and Hearing Research Centre, Dept of Physiology & Pharmacology, University of Queensland, St. Lucia, Queensland, Australia 4072. **Vertical Stratification of Bats in the Tropical rainforest of North Queensland, Australia.**

A study was conducted at selected sites in the wet tropics of North Queensland to examine the possible use of rainforest strata by bats. Bats were captured by the use of a pulley system to elevate modified mist nets (vertically orientated) and harp traps at sites in forest and along tracks. A bat detector was also used to monitor and record sonar calls at predetermined heights from ground level to canopy via the pulley system. In addition, canopy towers at two permanent (lowland & upland) sites were used for sonar sampling and direct observation of bats in the forest strata rainforest canopy height varied from 25 m to 32m between sites. Most data were collected by the detection and identification of flying bats from their sonar calls, based on 85 hours of tape recording. Bat activity was measured as "passes per unit time", and found to vary as a function of height above the ground at several sites. For example, within lowland rainforest bat activity was found at or above sub-canopy level. In contrast, some sites along rainforest tracks yielded the highest bat activity only 5m above the ground. Species previously thought to any at low and mid storey levels, such as *Rhinolophus megaphyllus*, *R. philippinensis*, *Hipposideros diadema* and *Nyctophilus bifax,* have been detected by sonar and directly observed to forage 25 m or more above the ground.

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THE AUSTRALASIAN BAT SOCIETY PAGE ON THE WORLD WIDE WEB (A PROPOSAL)

Duncan Kirkley <dkirkley@gist.net.au>

As a result of the proceedings of the recent Australasian Bat Conference I have been attempting to develop a Bat Information Page on the World Wide Web that is aimed at bat research activities within South Australia. This page can currently be found at the URL **http://www.gist.net.au/~dkirkley**. With a lot of help and encouragement from Herry the thing is starting to take shape.

In recent discussions with Lawrie, he was saying how Herry had began the development of a WWW page for the Australasian Bat Society. However, the problem seems to be - what happens when Herry finishes his PhD and heads off back to the Homeland?

I told Lawrie that I am far from an expert on the matter; but, I would be prepared to take on the long term administration of the page. In discussion with Herry, it can be arranged whereas I could administer the page and it could continue to reside on the computer at Aubury. The plan is that we kind of work on it together until such time as Herry leaves, at which point I would take it over.

It would be my suggestion that the page have a number of directories within it and be organised along the following lines:

◊ ***The Home Page of the Australasian Bat Society***
  - The Opening page could be a description of the Society, it aims and goals, who the Officers are and how one goes about joining.

◊ ***Newsletter of The Society***
  - Self explanatory, put the current newsletter on line and possibly make back issues available for downloading. I believe it might be possible to scan the back issues in.

◊ ***Bat Folk***
  - This section could be used to identify individual members and could also be broken down into Regions.

◊ ***Projects & Issues***
  - This area could be used to identify various projects being undertaken by members of the Society. It could also be used as a real time forum for various issues of interest to the membership. (Maybe projects and issues should be separate?)

◊ ***Call Library***
  - Develop a call library that can be used by all. This could be used to incorporate the work already done by Herry and the little bit of work which I have done so far.
  - This library could be set up in such a way as to open with an explanation of the use and analytical techniques employed with the Anabat system. It could incorporate the work done by Maritza on call shape and by Martin Rhodes on sequence analysis.
  - I understand that there are systems other then Anabat being used; however, Anabat seems to be what is currently used by the majority. There is nothing to stop us putting a section in that deals directly with the description of the alternative systems and their uses and analytical techniques.
  - The actual calls could be partitioned into Regions with a start page that highlights the regional variations of calls that can be identified.

◊ ***Bibliography of Recent Papers of Interest***
  - Recent papers and abstracts could be placed in this area for all to keep up to date with.

Needless to say there would be a fair amount of work to be done and considerable coordination and input from the membership. The basic question then is: Does the Membership support the idea? If so, please advise Herry, Lawrie or me.

INFORMATION REQUESTS & MISCELLANY

INFORMATION REQUEST: *MYOTIS ADVERSUS* ROOSTS IN NSW

I am currently undertaking a Master of Science looking at the ecology of *Myotis adversus* including foraging areas, diet, population monitoring, roosting and evaluating the usefulness of this species as a high order indicator of water quality. I am interested in anyone who has knowledge of roost locations of this species in NSW particularly in forested areas.

Jason Anderson
Forest Ecology Section
Research Division
State Forests of NSW
PO Box 100
Beecroft NSW 2119

Phone BH (02) 872 0169

U.S. STEALTH FIGHTERS 'INVISIBLE' EVEN TO BATS?

".... Before the Gulf War few thought it would work, and some were unwilling to trust vital targets to the F-117 stealth fighters ..... General Glosson, though, who was running the air-war planning, had no doubts. He had tried to track F-117s with a flight of his crack F-15 pilots at the testing range in Nevada, and he had seen neither hide nor hair of them. He was pretty sure the Iraqis would not, either. One stealth pilot had any lingering doubts allayed when he noticed that dead bats were lying around his aircraft in its hangar each morning; their sonar could no more detect it that Baghdad's air defence could.......".

***The Economist* June 10th 1995: Defence Technology Survey.**

INTERESTED IN BAT T-SHIRTS?

Choice of 3 designs (2 of them as seen at recent bat conference):

- ◊ Silhouette of flying bats under a full moon, colour black, available size, price $30
- ◊ *Hiposideros diadema* perching on a rock wall, colour black, available sizes, price $30
- ◊ 3 Flying foxes in different postures perching in eucalypt branches, colour unbleached cotton, available sizes M-L, price $25

Price includes postage

To order write or call: Angela, PO Box 510, Indooroopilly QLD 4068. Ph (07) 3878 4603

OPERATING ANABAT 5 IN WINDOWS 95™

Chris Corben
PO Box 128
Olema CA 94950 USA

Several people have asked me about operating AnaBat5 in Windows 95 (Win95), and since I've just got Win95 installed, I thought I'd share my experiences with it. Both ANALOOK and AnaBat should work perfectly well under Windows, in a DOS window, unless AnaBat is used to record new data. AnaBat in record mode has a problem with Windows, since the timing constraints it operates under are very severe, and Windows interferes with the system to such an extent that these timing requirements can't be met. If anything, this will be worse with Win95 than with Windows 3.1. However, the good news is that Win95 provides the facilities to easily deal with this problem, so that there is far less the user has to worry about.

Win95 must be shut down completely and the computer rebooted in DOS mode in order to run AnaBat in record mode. However, it isn't necessary for the user to manually shut down and reload Win95. This can all be done from within Win95 using a single mouse operation. Win95 will then shut itself down and reboot into DOS mode, and when you exit AnaBat, Win95 will load itself up again automatically. Although this is rather time consuming, there's nothing to it from the user's point of view, except that all running applications will have to close (or be closed) before Win95 will shut down.

Here's how to do it.

1) Create a Shortcut to AnaBat5.COM
   - ◊ Open Windows Explorer.
   - ◊ Find the executable file AnaBat5.COM
   - ◊ Right click on it. This will open a shortcut menu.
   - ◊ Left click on "Create Shortcut". A shortcut will then produced in the same folder.
   - ◊ Left click on the name of the Shortcut and you will be able to change its name eg. to "AnaBat5 record".
   - ◊ Press and hold the Right button to drag the shortcut to wherever you want to open
   - ◊ AnaBat5 from, eg. the Desktop. When you release the Right button, a menu will appear. Left click on "Move here".

2) Modify the properties of the Shortcut.
   - ◊ Right click on the Shortcut and Left click on "Properties".
   - ◊ Left click on the "Program" tab.
   - ◊ You will probably want to change the "Working" directory.
   - ◊ Left click on "Advanced".
   - ◊ Left click on the "MS-DOS mode" button. Make sure the "Warn before entering MS-DOS mode" option stays selected. There should be no need to mess with the configuration.
   - ◊ Left click on OK, then OK again.

Now you have a Shortcut to AnaBat5 all set up. To start AnaBat5, just click on the Shortcut. Win95 will shut itself down and reboot the computer. Use AnaBat5 just as you normally would. When you exit, eg. with Ctrl-X, the computer will reboot itself into Win95. Fairly painless, though time consuming. A lot better than what you had to deal with in Windows 3.1, though. Hope this helps!

LOOKING FOR A BAT RESEARCH PROJECT IN THE PHILIPPINES??

Posted on Batline by Angela England of Bat Conservation International:

I recently received a letter from a Peace Corps volunteer named Nancy Dwyer, who just ended her three-year stint as a biologist at a national park in the Philippines. She has asked me to help her draw attention to the bat fauna there and help her solicit the interest of a qualified bat researcher looking for a field site. There is not any paid position availble that she is aware of, but she says that the park could use more help getting to understand their resident species of bats, as well as in developing more educational materials and programs. Here is the information she sent me:

Bats of the St. Paul Subterranean River National Park, Palawan, Philippines

Nancy Dwyer, Annabel Consuelo, Jeanne T. Baldera & Jennifer Neuman

St. Paul Subterranean River National Park is a small (39km^2) but well-protected preserve on the west coast of Palawan, western-most of the Philippine islands. A navigable underground river and scenic karst landscape make this park renowned. The rain forests of Palawan harbor 15 species of endemic birds and 44% of its nonvolant mammal species are found nowhere else in the world. We know that most of these unique species reside in the park, but we still have much to learn about the park's bats.

By catching and keying out (Ingle and Heaney, 1992) 140 specimens, we do know that at least eight chiropteran species roost inside the 8.2 km long underground river cave system (see table below). From annual emergence counts, we estimate the bat population using the main entrance at over 50,000.

More than 17,000 people visit the Underground River Cave annually, with as many as 3,000 visitors per month in April and May. The peak tourist season probably coincides with the most sensitive period of the bats' phenology. The park management is enforcing a 'carrying capacity' of 100 people per day entering the cave in hopes of controlling disturbance to the ecosystem.

BAT SPECIES FOUND IN ST. PAUL SUBTERRANEAN RIVER NATIONAL PARK, PALAWAN, PHILIPPINES

*** = endemic to Palawan; # = roosts in the Underground River cave**

FAMILY	SPECIES	COMMON NAME
Pteropodidae	*Cynopterus brachyotis*	Short-nosed Fruit Bat
Rhinolophidae	#*Rhinolophus arcuatus*	Arcuate Horseshoe-bat
	Rhinolophus acuminatus	Acuminate Horshoe-bat
	*#*Rhinolophus inops*	Mindanao Horshoe-bat
	#*Rhinolophus virgo*	Philippine Lesser Horseshoe-bat
Hipposideridae	#*Hipposideros diadema*	Diadem Leafnosed-bat
	Hipposideros ater	Dusky Leafnosed-bat
Vespertilionidae	#*Myotis macrotarsus*	Pallid Large-footed Myotis
	Pipistrellus javanicus	Javan Pipistrelle
	#*Miniopterus schreibersii*	Common Bentwing-bat
	#*Miniopterus australis*	Little Bentwing-bat
	#*Miniopterus tristis*	Greater Bentwing-bat

Reference:

◊ Ingle, N.R. and L.R. Heaney. 1992. A Key to the Bats of the Philippine Islands. *Fieldiana*: *Zoology*, *n.s.*, **69**. 44p.

For more information, contact :

St. Paul Subt. River Nat'l Park
146 Manalo St.
Puerto Princesa
5300 Palawan
PHILIPPINES

or:

Nancy Dwyer
1172 35th Ave. NE
St. Petersburg, FL 33704
UNITED STATES
telephone 813-894-2891

BATS IN CYBERSPACE

SOME BAT & MAMMAL RELATED SITES ON THE WORLD WIDE WEB .... NEXT TIME YOU'RE SURFING THE NET, TRY THESE.

◊ *The Ascension of Wildlife Rabies: A cause for public health concern or intervention?* **http://www.columbia.net/phys/rabies.html**

◊ *The Australasian Bat Society Home Page* (by Herry) **http://batcall.csu.edu.au/batcall/abs/abs1.html**

◊ *South Australian Bat Page* **(**by Duncan Kirkley**)** **http://www.gist.net.au/~dkirkley**

◊ *South East Australian Bat Call Library* (by Herry) **http://batcall.csu.edu.au/batcall/files**

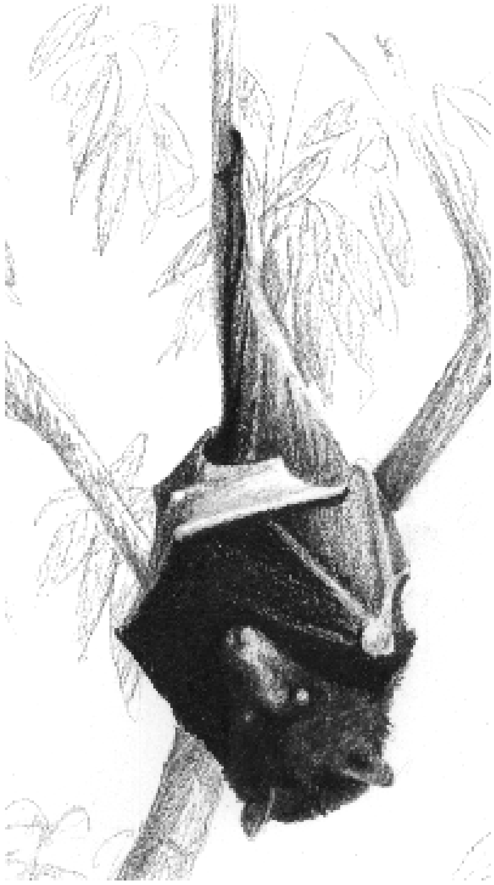
◊ *Bat Literature database* (more of Herry's handiwork) **http://batcall.csu.edu.au/batcall/batlit.html**

◊ *Bat Conservation International* **http://www.batcon.org/**

◊ *David Gee's page "Bats are beaut!"* **http://users.mildura.net.au/users/dgee/**

◊ *New Mexico Bat Survey Information and Acoustic Library* (by Bill Gannon and Chris Corben) **http://sevilleta.unm.edu/~wgannon/batcall.html**

◊ *Action Comores and Livingstone's Flying-fox (*Pteropus livingstonii*) (between Madagascar & East Africa).* **http://ibis.nott.ac.uk/Action-Comores/**



◊ *Mammal Species of the World Home Page* (The Smithsonian Institution, NMNH; a fabulously useful site for nomenclatural minutiae) **http://nmnhwww.si.edu/msw/**

◊ *The Virtual Emu* (this is not mammalogy I know, but a very impressive home page for an Australian biological NGO - the Royal Australasian Ornithologists Union) **http://www.vicnet.net.au/~raou/raou.html**