The Australasian Bat Society Newsletter

Number 17 October 2001

The unique penis morphology of the hairy-nosed freetail bat of central Australia.
Photo: Terry Reardon

- Instructions for contributors -

The ***Australasian Bat Society Newsletter*** will accept contributions under one of the following two sections, Research Papers, and all other articles or notes. There are two deadlines each year: **21st February** for the March issue, and **21st 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.

Opinions expressed in contributions to the Newsletter are the responsibility of the author, and do not necessarily reflect the views of the Australasian Bat Society, its Executive or members.

For consistency, the following guidelines should be followed:

- Emailed electronic copy of manuscripts or articles, sent as an attachment, is the preferred method of submission. Manuscripts can also be sent on 3_" floppy disk preferably in IBM format. Faxed and hard copy manuscripts will be accepted but reluctantly!! All submissions are to be sent to the Newsletter Editor at the email or postal address below.
- Electronic copy should be in 11 point Arial font, left and right justified with 1.6mm left and right margins. Please use Microsoft Word version 97 or earlier.
- Manuscripts should be submitted in clear, concise English and free from typographical and spelling errors.
- Research 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:

  Baker, G.B., Lumsden, L.F., Dettmann, E.B., Schedvin, N.K., Schulz, M., Watkins, D. and Jansen L. 2001. The effect of forearm bands on insectivorous bats (Microchiroptera) in Australia. ***Wildlife Research*** **28**(3), 229-237.

- Technical notes, News, Notes, Notices, Art etc should include a Title; Names and addresses of authors. 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, JPEG or BMP image files. Tables should be in a format suitable for reproduction on a single page.
- Research Papers 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***.
- Please contact the Newsletter Editor if you need help or advice.

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- Editorial -

Just when it looked like I was going to get out of this issue lightly, the contributions began rolling in. So thanks to those of you who have contributed to another large issue of the ***Newsletter***.

This edition again has a mix of scientific articles, observations, news items, opinion, reviews, reports etc. reflecting the broad nature of the membership. The conservation of flying fox species has, and probably will continue to produce strong debate within ABS membership, and between the Society and others outside of it. This inevitably has led to the submission to the ***Newsletter***, articles that express strong personal opinion. The ABS has not produced guidelines for what is and what is not suitable content for the ***Newsletter***, and has always relied upon the judgement of its Editor (who may or may not consult with the Executive). I certainly share the philosophy of previous editors, that the ***Newsletter*** should not only be a vehicle for members to disseminate information and ideas, but also opinion (providing it is defamation free!).

The Melbourne Botanical Gardens/grey-headed flying fox issue also prompted a large submission from Kelvin Grose. Instead of incorporating this 28 page document in the ***Newsletter***, we opted for producing it in electronic form to be linked to the ABS website. However, Kelvin's submission raised the issue of how to deal with larger papers, and whether the ABS wishes to print monographs - something to discuss at Cairns. I would like to thank Kelvin here for making the contribution, and for his patience with the Executive while we were deliberating over how to deal with it.

At the recent Financial Annual General Meeting in Sydney in May this year, it was agreed that the ***Newsletter*** should be upgraded in appearance and format. One main practical concern was that the paper front covers did not give the Newsletter adequate protection. I have looked at a number of options for covers and paper stock, and have some quotes in. I am hopeful that the next ***Newsletter*** will be the first of the new look.

I have written previously of the beginnings of bat newsletters in Australia and have made mention that the 13 editions of the original Australian Bat Research News edited by Elery Hamilton-Smith from 1964-1974, make fascinating reading. It occurred to me that these newsletters may not be easily available to many members, so with Elery's permission, I propose to reproduce them in bound form, and offer them to members at cost (to be determined). Please let me know if you would be interested in receiving a copy (I will try to have them available for the conference in Cairns).

And finally, thanks to Greg Ford for again assembling the (expanded) Recent Literature, and especially to Lindy Lumsden and Paul Gray for helping with editing of this edition.

Terry Reardon

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– Australasian Bat Society: business and reports –

President's report

Certainly the highlight for me over the past few months has been the 12th International Bat Research Conference in Kuala Lumpur. The Australians were well represented and I think a good time was had by all. While there, we also seized the opportunity to publicise our next Australian conference in Cairns and we may now have some extra attendees from o/s including Tom Kunz who has promised to bring his highly expensive passive infrared cameras; truly amazing technology!

Another significant development has been the continued evolution of thinking with regard to flying foxes, and further changes, both in attitude and legislation have occurred. Spectacled flying foxes will soon be officially recognised by the Commonwealth as a Vulnerable species, and so it appears that their status will be changed before that of the grey-headed flying fox. We may see further changes of status, particularly in Queensland where the State Government has now convened a Scientific Advisory Committee. The Committee will meet for the first time in December this year and be asked to consider submissions made with respect to both the grey-headed and spectacled flying foxes. In the meantime, the killing of bats with electric grids has effectively been banned, and several research projects are currently under way to explore a few new ideas for the non-lethal control of flying foxes on crops. Also, in NSW we have seen for the first time, the locations of flying fox camp sites considered in urban planning processes.

Some time ago I remember thinking that we were making very slow progress in flying fox conservation, and issues such as the Melbourne Royal Botanic Gardens bat drama seemed to actually set us back further. Then I read the results of a survey of fruit growers conducted in 1992 and was amazed when I read their comments on flying foxes. It was only then, that I realised how far we had actually come! I think that the next few years will see even more dramatic changes and I have to admit that I am more optimistic now about their prospects for long term survival!! (well - slightly more optimistic anyway!).

The FAGM was held in late May and at that time we had several changes made to the Executive. Nicki has discussed these changes in more detail in her report and so I will not labour over them here. The one move that I would like to briefly mention however, was Greg's move from the Secretary position to that of First Vice-President. I would like to publicly acknowledge the great job that Greg did as Secretary. He kept the ABS alive with discussion and ideas and was responsible for suggesting that Nicki be employed on our behalf to work on the RBG issue. What a great idea it was! I am sure that everyone joins me in thanking him for his great effort and no doubt we will hear more from him in his new role.

Work on our new website is almost completed and I expect that it will be up and running by Christmas. It has been a rather mammoth undertaking and has over fifty pages! I will make a little announcement over our email discussion group when the day arrives.

Bruce Thomson

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Secretary's report

To say that the last six months have once again been busy on the bat(tle) front would be an understatement. Events pertaining to the protection of grey-headed flying foxes in Victoria in general, and in the Royal Melbourne Botanic Gardens in specific, have seen the ABS Executive stretched to its outer capabilities. In addition to many members' individual involvement, the temporary creation of the role of Publicity Officer served to disseminate factual information and represent the views of the ABS regarding the Melbourne issue to the public. Through this role, the existence of the ABS as a body of scientific information was made known to relevant politicians, government representatives, conservation groups and the media, and we took a firm stand ***against*** the culling of flying foxes and ***for*** their protection through state and federal legislation.

The financial annual general meeting (FAGM) of the ABS in May saw a few changes to the evolving line-up of the Society's Executive. Marg Turton resigned as 1st Vice President earlier in the year and was replaced in this role by Greg Richards, who thus vacated the role of Secretary of the Society. As the demands of flying fox politics during the past twelve months had required a near full-time commitment from Greg (to the detriment of his 'real' job), it was decided to ease the burden on the Secretary by dividing the position between two members. Carole West has thankfully taken on the responsibility of Minutes Secretary while the role of Secretary has fallen to myself. All other positions remain unchanged.

Flying fox management and conservation issues remain topical along the entire east coast of the country and are likely to continue in years to come. To address flying fox-related problems in New South Wales, a forum held in Sydney on July 28 focussed on the management of grey-headed flying foxes in that state. In an unprecedented turn-out (~200) to such an event, the theatrette at the Australian Museum witnessed some forthright discussion of the issues by NPWS representatives (including the Director General, who opened the meeting), fruit-growers, scientists, carers and conservationists, both from New South Wales and interstate. The forum served to clearly outline the ethical and economic positions of stakeholders involved in the management of flying foxes (particularly at fruit orchards) and successfully promoted a change of attitude from adversarial to cooperative among these parties. Further outcomes directly attributable to this day have been the setting up of a consultative committee in New South Wales comprising representatives from the National Conservation Council, the RSPCA, local government, fruit-growers and the scientific community (the latter represented by Peggy Eby). The aim of this committee is to advise the NPWS on the delicate transition from managing grey-headed flying foxes as pests in the past to managing them as a threatened species from now on. Culling is to be phased out where alternative management strategies exist, and further development of such strategies will be actively undertaken. The forum's proceedings are currently being prepared for publication by the Royal Zoological Society of New South Wales and will feature a foreword by Peggy Eby and Dan Lunney.

As highlight of the year, some of us had the good fortune to attend the 12th International Bat Research Conference in exotic Kuala Lumpur, Malaysia, in early August. The Executive was amply represented by Bruce Thomson, Greg Richards, Kerryn Parry-Jones, Lindy Lumsden and myself, and our ranks were further boosted by many other members, including Sirena Wan, Peggy Eby, Jane Sedgeley, Colin O'Donnell, Alistair Evans, Kelvin and Jan Grose, Glenn and Margaret Hoye, Martin and Moni Rhodes, Phil and Dari Spark. The atmosphere created by 120 bat-enthusiasts in one venue was once again amazing, and the quality of research undertaken internationally quite inspiring. Amongst the tropical settings of Malaysia (despite the astonishing price of beer and wine!!), many projects were given extra momentum through conversations with international colleagues both during and after the conference. And while on the topic of Malaysia, I'd like to extend a very warm 'Thank you' to Sirena Wan, who (in the guise of batto and travel agent) cheerfully took care of pesky conference details such as pre-registration, airline and accommodation bookings for a large number of us Aussies and thus made the whole event that much simpler and enjoyable.

That's it in a nutshell. As the flying fox breeding season is now almost upon us, stay tuned for further developments – there's never a dull moment …

Nicki Markus

Treasurer's report for the financial year ending 31 Dec 2000

	$	% (of income)
INCOME		
Membership subscriptions	5,660.00	67.3%
NSW National Parks and Wildlife (GHFF Counts)	2,445.00	29.1%
Interest on cheque account	100.29	1.2%
Interest on gift fund (net of bank charges)	3.27	0.0%
Investment Income	199.96	2.4%
TOTAL INCOME	8,408.52	100.0%
EXPENDITURE		
Newsletter (production & postage)	1,747.06	20.8%
Grey-headed flying fox (Counts)	2,212.40	26.3%
Bank fees	909.84	10.8%
Stationery and postage	475.52	5.7%
Insurance (public liability)	455.13	5.4%
Executive committee (including travel expenses)	48.35	0.6%
Incorporation fee	37.00	0.4%
TOTAL EXPENDITURE	5,885.30	70.0%
SURPLUS (DEFICIT)	2,523.22	30.0%
ABS CONFERENCE 2000		
Income	34,208.73	
Conference Sponsorship (ABS Gift Fund)	1,300.00	
Expenses	33,335.91	
Surplus	2,172.82	
ASSETS AT 31 DECEMBER 2000		
ABS Cash Management Trust (Investment)	10,244.30	
ABS Cheque Account	8,271.72	
ABS Gift Fund (Sponsorship/Donations)	1,326.27	
TOTAL ASSETS	19,842.29	
Liabilities		
Unspent balance of GHFF Count Grant (includes unspent balance from previous year)	1,643.15	
Net Assets		
Accumulated Surpluses	18,199.14	

Natasha Schedvin

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Membership Officer's report for the 2000 financial year

Membership levels have continued to increase during the 2000 financial year, with 49 new members joining the Society. The majority of members are financial, although this level has dropped slightly since last year.

	31 Dec 1999	31 Dec 2000
Financial members	205	229
Members unfinancial for 1 year	14	25
Members unfinancial for 2 years	4	8
Total members	223	262
% of members financial	91.9%	87.4%

Email contact

Our recent email to members to remind everyone of the Newsletter deadline, resulted in a large number of returned messages. Mmmm... many of you have changed your email address and haven't let us know – can you please email me to let me know your new email address if you have changed it in the last year. Thanks. <Lindy.Lumsden@nre.vic.gov.au>

Lindy Lumsden

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Publicity Officer's report

In February 2001, the temporary, part-time, paid position of ***Publicity Officer*** (PO) for the ABS was appointed by a majority vote of the organisation's Executive. This position was created in direct response to escalating controversy surrounding the management of a colony of grey-headed flying foxes in the Royal Botanic Gardens (RBG), Melbourne, and the PO was to be active in this role one day per week for a period of twelve weeks. However, the immediacy of the RBG situation led to a change in the terms of employment almost immediately as the demand for action during February/March called for considerably greater input than first anticipated. Rather than one day per week, the position demanded a full-time commitment for a number of weeks, and the Executive agreed to renew the appointment for a second term once the initial 12-day period had expired. In all, the position remained formally active from February to May 2001.

The on-going situation at the RBG involved issues of wildlife management and of species conservation at state and federal levels. As outcomes were likely to set a precedent for flying fox management in the future, it was considered vital that decision-makers be made aware of the ABS as a source of expertise in these areas. Specifically, the PO's aims were to -

Increase the public profile of the ABS as a source of detailed, accurate information about flying foxes.

1. Increase the public profile of the ABS as a body of experts willing to take action on behalf of the bats, whether as educators or lobbyists.
2. Actively lobby the Botanic Gardens/Victorian government (through correspondence and the media) to take a long-term approach to the management of the bats rather than an ineffective and unethical short-term one such as culling.
3. Establish some protocols for how to address contentious bat issues through the media in future.

The Executive's intention was for the PO to act as a conduit between experts, government departments, conservation groups and the public (via the media) on the issue of flying fox management and conservation. This proved to be a very useful undertaking that led to a ready flow of information between government departments, conservation groups and the media.

The initiation of a communication network began with the Gardens' announcement of the intention to cull the flying foxes on **March 15**, which was immediately countered by a media release by the ABS condemning this action. Within the following few days, I contacted or was contacted by organisations including the Humane Society International (HSI), the Australian Conservation Foundation, the Threatened Species Network, Victoria, the Victorian National Parks Association, the Australian Geographic Society, the Victorian Department of Natural Resources and Environment (DNRE) and an assistant of the Victorian Opposition's environment spokesman. Media interest in a pro-flying fox message was limited, amounting to a number of radio interviews conducted by Les Hall, Peter Brown, lecturer in wildlife management from Deakin University in Melbourne, and myself. Despite the limited media response to our press release, it added the ABS name to the files of all contacted parties for future reference. This led to a number of actions. Amongst others, it facilitated regular liaison with the government officials for up-dates on their deliberations regarding the RBG colony, and led to the prompt dispatch of a set of flying fox fact-sheets used widely in Queensland for adaptation to Victorian purposes.

Despite the considerable number of people active on behalf of the flying foxes in Melbourne, information over the following two weeks was often difficult to verify. On **March 21**, an activist organisation calling themselves Group 14 threatened to cut down a tree for each bat killed, thereby upping the ante against the culling. However, a frustratingly biased report on the ABC's 7.30 Report that night clearly indicated that public sentiments would continue to be directed against the bats.

As culling became imminent, I decided to fly to Melbourne at short notice on **March 28** to see the Garden's bats for myself. There were indeed large numbers of bats spread throughout Fern Gully and beyond, although the damage to the Garden's had clearly been vastly exaggerated. Damage to a number of palms was apparent, as was defoliation of a number of branches on other trees such as a large ***Ficus***. None looked likely to become fatal to the trees. To coincide with my visit to Melbourne, a meeting was organised with myself on behalf of the ABS and representatives from Melbourne Zoo, Animals Australia and an independent wildlife activist. More contacts were thus established, and each group's role and limitations in the struggle to prevent the culling were defined. It was decided that the ABS was to issue a further press release and to draft an information leaflet to the press outlining why culling of flying fox would be ineffective. Interestingly, a statement from the RSPCA released on the same day vehemently denied that organisation's support of the culling of the bats in the RBG. This statement directly contradicted previous media reports of the RSPCA's approval of the culling.

On my return to Brisbane, Les Hall and Greg Richards had joined forces to draft a document entitled 'Why culling will fail to solve the flying fox problem at the Melbourne Botanic Gardens'. This information bulletin was collectively refined by Les, Greg and myself over the weekend and sent out to a number of organisations and media agencies on **April 2**. Again, the immediate response was extremely limited, but the information had been filed for future use.

In the first days of April and within days of my return from Melbourne, the culling of the Gardens' flying foxes began. Although a contingent of members of the Humane Society for Animal Welfare (HSAW) had kept a nightly vigil outside the Gardens for some weeks previously, the clandestine culling operation, conducted nightly between 10pm-2am, was only discovered on **April 11**. On **April 12**, Animals Australia held a ceremony for the bats killed at the Gardens. Floral tributes, wreaths and printed messages flowed in from the UK, USA and around Australia and the media took (some) notice.

On **April 10**, a letter on behalf of members of the scientific community and initiated by Peggy Eby was sent to the federal environment minister, Senator Robert Hill and to Bob Beeton, chairperson of the federal TSSC. The letter outlined the group's support for the listing of the grey-headed flying fox under the ***Environmental Protection and Biodiversity Conservation Act 1999***, citing evidence of population reduction that had been reviewed and independently accepted by three scientific panels, including the Victorian Scientific Advisory Committee (SAC). The letter was confidential and therefore not relayed to the media. Nevertheless, in an article in THE AGE on **April 19**, an interview with Mike Archer, Director of the Australian Museum, revealed its existence to the public.

In a further attempt to increase public awareness of the plight of the flying foxes at the RBG, a further, this time open, letter was drafted on behalf of the ABS and requested signatures from local and international scientists for publication. Over 30 signatures were received before the letter was sent to the Victorian Minister for the Environment, Hon. Sherryl Garbutt, the Executive Director, Parks, Flora and Fauna, Michonne van Rees, Director of RBG, Phillip Moors, Robert Hill and the media on **April 26**. By the time this letter was sent, culling at the RBG had unofficially ceased. Although no public statement to this end was ever made, it seems likely that culling ceased in response to the letter sent to Senator Hill on April 10, which resulted in his subsequent request to Minister Garbutt to justify the culling of the bats as a management strategy. Other strategies, in particular relocation of the colony to a site nearby, are now being reconsidered, and a taskforce has been assembled to address the issue of flying fox management outside of the Gardens and the potential for relocating the colony to a less controversial site in the future.

On **May 9**, Angus Martin, a long-standing member of the Victorian SAC, resigned from the committee in protest against the Minister for the Environment Sherryl Garbutt's refusal to list the grey-headed flying fox in Victoria, citing that her reasons for rejecting the SAC's recommendation to do so were invalid and failed to address the issue at a state level as is required by the Flora and Fauna Guarantee Act. Disagreement about the management of the flying foxes was clearly an issue that permeated the ranks of officials far and wide.

Following many months of turbulence, conservation groups such as the Humane Society International are now focussing on lobbying the federal government to list the grey-headed flying fox under the EPBC Act. It is hoped that a federal listing could halt further culling attempts at the RBG and concerted efforts are underway to prepare legal arguments that could trigger the Act if the listing goes through. As another breeding season is about to commence in October and the numbers of bats at the RBG are likely to increase further due to migratory influxes over summer and autumn, the debate about appropriate management is likely to escalate further. The ABS will continue to support non-lethal management options and to lobby for the conservation of the flying foxes. Let's hope that logic, science and ethics may prevail in the end.

Nicola Markus

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AUSTRALASIAN BAT SOCIETY INC.
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FINANCIAL ANNUAL GENERAL MEETING
University Of New South Wales, Kensington, N.S.W.
26th May 2001, 9.30AM

Minutes

1. **Open and welcome:** Bruce Thomson

   Housekeeping: Kerryn Parry-Jones

   Present: B. Thomson (chairperson), C. West (minute secretary), M. Beck, G. Bennett, L. Collins, K. Davis, P. Eby, J. Grace, K. Grose, E. Hartnell, M. Kerr, L. Lumsden, N. Markus, N. Pallin, G. Parry-Jones, K. Parry-Jones, T. Reardon, G. Richards, L. Stevenson, J. Uden, N. Velez, R. Williams, B. Wood, D. Wood.

2. **Apologies:** D. Lunney, N. Schedvin,

3. **Minutes of the previous meeting:**
   Annual General Meeting of the Australasian Bat Society, Inc., April 2000. Chairperson asked if minutes needed to be read. Consensus - no. Any alterations? G. Parry-Jones questioned the minuting of the letters to be sent to the Melbourne RBG and Victorian government. Seconded J. Uden. It was carried that the matter be opened to discussion. It was moved by N. Pallin, and seconded by M. Beck that the minutes be amended to remove the word "lost" and replace with "the outcome of the vote was unclear". The motion was carried, with G. Parry-Jones abstaining from the vote. There was further discussion on actions taken by the executive following the previous meeting regarding RBG issue and it was moved K. Parry-Jones and seconded L. Lumsden that the minutes of the previous meeting be added "that the intention of the ABS AGM was unanimously opposed to the culling of grey-headed flying foxes in the Melbourne Royal Botanic Gardens.

4. **Business arising:** None

5. **Reports of the Executive:**
   These reports were spoken but a summary of each is to be tabled with the secretary to be published with the minutes in the next ABS newsletter

   a) President – Bruce Thomson. Bruce asked for a show of thanks to Greg Richards, who is retiring from the position of Secretary, and the members expressed their disappointment that he was no longer holding the position, and thanked him for his work. The vacancy will be filled by appointment as per the constitution.
   b) Secretary – Greg Richards
   c) 2nd Vice President – Kerryn Parry-Jones
   d) Membership Officer – Lindy Lumsden
   e) Treasurer – Lindy Lumsden for Natasha Schedvin
      No financial report was tabled at this time as the Treasurer was working away from home. It was moved by Lindy Lumsden and seconded Nancy Pallin that when the report became available it would be posted to all members present at the ABS FAGM along with a formal postal vote form, and treated as a continuation of the ABS FAGM. The motion was carried.
   f) Editor – Terry Reardon

6. **General business:**

a) **Discussion of roles of the ABS Executive**. Peggy Eby spoke of the difficulties being experienced by the executive, and foreshadowed the need for a second tier of management.

b) **Update on nominations to list Grey-headed Flying foxes as threatened**
Peggy Eby. It was moved by Peggy Eby, and seconded by Maree Kerr that the ABS extend appreciation to all people who participated in the process resulting in the determination of grey-headed flying foxes as a Threatened species in NSW. The motion was unanimously carried.

It was also moved by Nicki Markus, and seconded by Lindy Lumsden that the secretary sends a letter of appreciation to Angus Martin, formerly of the Victorian Scientific Advisory Committee. The motion was carried.

c) **Report from Publicity Officer**
Nicki Markus. Nicki spoke of ABS involvement with the Melbourne RBG issue stating that the issue was large tract forest management, not just flying fox management. During the process, Nicki has established regular networks with a wide range of organisations. A vote of thanks for Nicki was moved by Peggy Eby, seconded by Kerryn Parry-Jones, and carried unanimously.

d) **Report on assessments of threatened status of Spectacled Flying foxes**
Bruce Thomson
Greg Richards

e) **Reports on conservation of Australasian microchiroptera**
Terry Reardon
Bruce Thomson
Lindy Lumsden. Lindy presented the recently published Microchiropteran Bat Action Plan published by the IUCN. Discussion followed comparing the threat categories used for Australian species in this document compared to those used in the Australian Bat Action Plan

f) **Discussion of "Captive Species Management Plan for Bats" from Assoc. of Zoological Parks and Aquaria** - Bruce Thomson. Following the report, it was moved Marjorie Beck, and seconded by Elizabeth Hartnell that Nancy Pallin be directed to respond to requests for advice on captive management. Carried.

g) **Motion: That the ABS establish a Batwatch network to gather information on flying fox distribution**. After discussion on previous and existing systems, it was moved Kerryn Parry-Jones, and seconded Gill Bennett that the ABS establishes a Batwatch committee to gather and promote information on flying fox distribution. Carried.

h) **Motion: That the ABS fund production of a brochure for Mareeba flying foxes**. It was moved Peggy Eby, and seconded Kathy Davis that a brochure be authorised and funded to an amount approved by the executive. Carried.

i) **Royal Zoological Society forum "Managing the Grey-Headed Flying fox as a threatened species in NSW" date 28th July 2001**. Peggy Eby spoke on the upcoming forum, and encouraged ABS members to participate.

Meeting closed 5.15 pm.

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Notice of the 10th Australasian Bat Conference, Cairns, Queensland, April 2002.

Full details, information and registration forms for the conference accompany this Newsletter.

Dates
Note: Easter is early this year with Easter Monday being on the 1st April 2002.
A welcome buffet at the Cairns Colonial Club will mark the opening on the night of Tuesday 2nd April; the conference activities will be from Wednesday 3rd to Friday 5th April. Field trips have been organised for the days each side of the conference – megabat activities on the days before (1-2 April) and microbat activities on the weekend after (6-7 April).

Venue
The Cairns Colonial Club (CCC) is a 3-4 star resort on 10.5 acres just outside the CBD of Cairns. It has been chosen for its conference facilities and accommodation, both of which are reasonably priced. We encourage as many conference participants as possible to stay on-site for reasons of networking and general conference bonhomie. Use of conference facilities includes breakfast, morning and afternoon teas and lunch. Participants staying elsewhere are therefore welcome to arrive early for breakfast.

Conference papers
The conference venue will have the usual electronic support for oral presentations but those anticipating using Powerpoint or similar must bring their own laptop computer – beware of compatibility problems if using a Mac. It would be a good idea to have overheads and slides on hand in case of technical disasters.

Please email abstracts to Jon Luly (Jonathan.Luly@jcu.edu.au) before 10 February 2002. Abstracts should not exceed one A4 page (about 500 words at 10 point, 1.5 spacing). If sending abstracts by snail mail, send to:

Jon Luly, TESAG,
James Cook University,
Townsville Qld 4811

to arrive not later than 1 February. Late arriving abstracts cannot be included in the conference documents.

Jenny Maclean and Dr. Jon Luly

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Notice of the 7th Australasian Bat Society, Inc., Biennial General Meeting, Cairns, Queensland, April 2002.

The 2000 General Meeting in Paterson, proved to be an epic affair, with many motions proposed and great discussions on various aspects of Society business. Although still six months away, it is time to start thinking about issues, directions and the running of the ABS. The meeting is also a time for you to consider whether you want to play a more active role in the Society by nominating for Executive positions.

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– Research papers –

A maternity roost of the Southern Myotis *Myotis macropus* in a rural landscape

Bradley Law, Mark Chidel and Alison Towerton

Research and Development Division, State Forests of NSW, PO Box 100, Beecroft, NSW 2119
Email: bradl@sf.nsw.gov.au

The southern myotis ***Myotis macropus*** is unusual among Australian bats for its habit of feeding on aquatic prey over streams. Because of its close association with waterways, it is considered a species of conservation concern (Duncan ***et al.*** 1999). In NSW it is listed as Vulnerable on the ***Threatened Species Conservation Act, 1995***. Aspects of its foraging behaviour (Dwyer 1970a; Thompson and Fenton 1982), diet (Robson 1984; Law and Urquhart 2000), reproduction (Dwyer 1970b) and social behaviour (Dwyer 1970c) have been studied, but there is little published information about its roosting habits.

Dwyer (1970a; 1970b; 1970c), and more recently Barclay ***et al.*** (2000), undertook studies on ***M. macropus*** at an abandoned railway tunnel in south-east Queensland. This roost is surrounded by agricultural land and remnants of eucalypt forest, with the bats mostly foraging at a large reservoir 11 km north of the roost. Law and Urquhart (2000) studied the diet of ***M. macropus*** at a bridge roost within a forest environment. Novel observations of roost locations help to broaden the understanding of a species, especially as the landscape context of roost locations will be integral to the ecology of bats.

While undertaking fauna surveys in farmland in northern New South Wales, we located a roost of ***M. macropus*** beneath an old log bridge on Boomi Creek, near Urbenville (Fig. 1). Bats were found roosting in a crevice between two of the logs, 2 m above the water-level. The creek rose considerably after heavy rain on one day of the survey (Fig. 2), yet the bats still had a gap of about 1 m to exit their roost. The bridge was narrow, being about 2.5 m across (Fig. 1) and spanned the 7 m width of the stream (4th order). Although the creek was lined with healthy riparian vegetation consisting of bottlebrush ***Callistemon viminalis,*** lillypilly ***Syzygium australe*** and ***Eucalyptus amplifolia***, the water in the creek was brown and highly turbid (Fig 2). This was because most of the creek's catchment (~ 55% as calculated by Arcview) fell within cleared land grazed by cattle and the fact that the riparian vegetation extended no more than 10 m up the bank from the creek and even less in some places (Fig. 3). The nearest forest was an extension of Yabbra National Park (formerly Yabbra State Forest) about 1.7 km distant, however, this forest is confined to slopes and ridges where mainly small streams (1st and 2nd order) are present.

We placed harp-traps above the bridge from 6-11 November 1999 (Fig. 1). Captured bats were marked on the foot using a coloured Paint Pen, so that recaptures could be recognized. Over the five days, a total of 27 individual ***M. macropus*** were captured (Table 1). Of these 14 females were lactating, indicating that the roost was a maternity site. No juveniles were captured, suggesting that they had not yet developed flight. All males were in breeding condition with enlarged testes, which fits with Dwyer's (1970b) observations that males defend harems of females at this time.

Table 1. Numbers of ***Myotis macropus,*** and their reproductive condition, at Boomi Creek.

Sex	Reproductive Condition	Number Caught	Mean Body Mass (g)
Female	Lactating	14	10.7 ± 0.3
Female	Pregnant	0	-
Female	Non-reproductive	4	11.1 ± 0.1
Male	Testes swollen	9	9.8 ± 0.3

No nocturnal observations were attempted along Boomi Creek. However, observations with a spotlight, nightscope and bat detector identified foraging ***M. macropus*** at two farm dams. One of these required the bats to fly across at least 300 m of cleared paddocks to reach the dam (Fig. 2), while the other was connected by a vegetated creek corridor. The surrounds of the first dam were not vegetated. Aquatic Hemiptera (bugs) and Coleoptera (beetles) were abundant in the dam as were calling frogs (***Litoria latopalmata, L. fallax and L. peronii***) on the edges. Trip-lining at this dam over three nights was unsuccessful at capturing ***M. macropus***.

Law and Urquhart (2000) found that aquatic invertebrates associated with the water surface were the main prey of ***M. macropus*** and that these insects are reasonably tolerant of low water quality (e.g. water boatmen, water striders, whirligig beetles). The observations presented here further indicate that ***M. macropus*** can persist in some agricultural settings if suitable roosts are present. Although further data are required to determine whether survival or residency in such populations is low, it appears that rural creeks with intact riparian vegetation have a good chance of supporting this unusual bat.

Despite an apparent lack of dependence on an intact forest environment, targeted surveys have revealed that this species is clearly uncommon in certain areas, such as along the Murray River (Law and Anderson 1999). It is likely that more intensive agricultural practices, such as cropping with irrigation, could be more detrimental to ***M. macropus*** because of increased fertiliser, herbicide and insecticide run-off. Such areas should receive further study to determine their influence on the presence and ecology of this bat. Indeed, roosts such as the one reported here, provide an ideal location for student research projects. Other practices that affect river ecology, such as loss of riparian vegetation, altered flow regimes, removal of snags and chemical pollution, may have more pronounced effects on ***M. macropus*** than cattle grazing.

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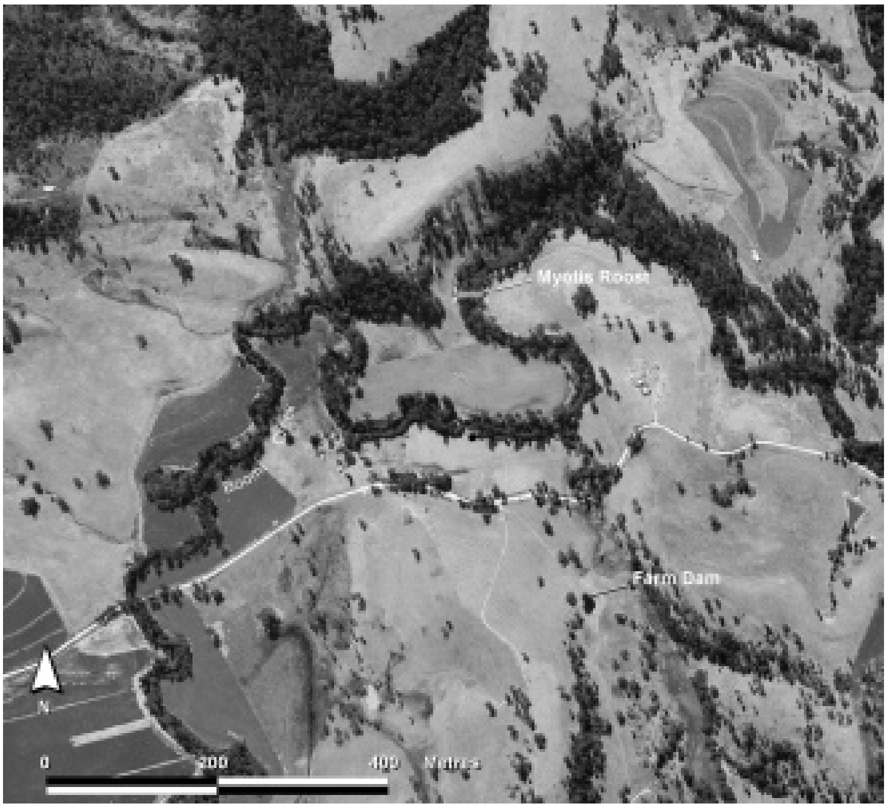
^ Fig 1: Harp traps placed on log bridge over Boomi Creek, which supported a maternity colony of the Large-footed Myotis ***Myotis macropus***.

^ Fig 2: Boomi Creek after heavy rain increased water depth and flow rate. Photo was taken from the log bridge where ***M. macropus*** roosted.



< Fig 3: Aerial photo showing the roost location in the context of the surrounding landscape. Also shown is the location of a farm dam where some individuals of ***M. macropus*** foraged at night.

Aspects of roost selection by microchiropteran bats in Bundjalung National Park, north-eastern NSW

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Abstract

This study describes aspects of diurnal roosts of forest microchiropteran bats in Bundjalung National Park (NP), north-eastern New South Wales. Radio–telemetry was used to track two Gould's long-eared bats (***Nyctophilus gouldi***), two greater broad-nosed bats (***Scoteanax rueppellii***), one undescribed broad-nosed bat (***Scotorepens*** sp.1) and an eastern broad-nosed bat (***Scotorepens orion***) to a total of ten roost trees. All bats captured at the Jerusalem Creek site were found to roost in ***Melaleuca*** spp. which are the dominant hollow-bearing tree species occurring in the extensive swamp woodlands. An incidental record of a Gould's wattled bat (***Chalinolobus gouldii***), was observed to utilise a small stag for diurnal roosting in the melaleuca swamp woodland. Detailed roost descriptions were obtained for the ***N. gouldi***, which were found to roost communally in central hollows of trees between 3.5 m and >8 m above the ground. The single ***Scotorepens*** sp.1 tracked from the Esk River site was found to roost in a mature eucalypt in dry sclerophyll forest. The results reflect other published findings, which suggest that aspects such as roost height, roost type and entrance diameter influenced the roost selection of different species. The results also indicate that selection is likely to be due to factors such as the availability of hollows, or the species' predator response strategy. These results have direct implications for the conservation management of these species.

Background

The availability of appropriate roost sites for microchiropteran bats, is considered to be the single "most important ecological factor influencing the distribution of some species" (Baudinette 1994). For a number of species this dependence upon roosting sites has been well documented and is fundamental to the understanding of the ecology and to the conservation management of these species.

Studies have demonstrated that the selection of roost sites is heavily dependent upon a number of factors. Present information indicates that appropriate roosts must provide suitable protection from predators, offer appropriate microclimate conditions for critical life processes such as periods of torpor, and be located in close proximity to foraging areas to reduce commuting distances (Churchill 1998; Dwyer 1963; Taylor and Savva 1988; Wilson 1997).

The majority of studies have concentrated on the highly specific nature of roost requirements of species that utilise cave roosts. These species belong to the group termed 'cave obligate' species, which constitute less than a third of Australian microchiropteran bat species (Strahan 1995). Cave-obligate species such as the little bent-wing bat (***Miniopterus australis)*** and the large bent-wing bat ***(Miniopterus schreibersii***), are well known to have special requirements for maternity colonies, male colonies, mating colonies, winter roosts, and they travel large distances (~500 km) throughout the year between these sites (Dwyer 1963, 1964; 1966; Dwyer and Hamilton-Smith 1965; Hall 1983).

Most Australian microchiropteran species however belong to the group broadly termed 'forest bats' or 'tree hole' bats (Churchill 1998; Tidemann and Flavel 1987). These species are relatively understudied when compared to the cave-obligate species with the majority of accounts of forest bat roosts obtained from anecdotal observations (Lunney ***et al.*** 1985; Law 1996). These species are known to utilise a wide variety of other sites including man made structures such as telegraph poles, fences and the roofs of houses (Churchill 1998; Hall and Richards 1979; Lunney ***et al.*** 1988). The sites used by these species in natural areas such as tree hollows, tree trunks and shedding bark are however, of the greatest significance to conservation of these species and are the focus of this study.

Tree hollows have long been recognised in Australia as an important natural resource for a wide variety of animals, for the purposes of diurnal shelter and breeding sites (Bennett ***et al.*** 1994; Lindenmayer ***et al.*** 1990a and b; Tidemann and Flavel 1987). The implications of clearing and forestry operations upon the availability of these sites for Australian mammals has been well documented, and is commonly accepted to have contributed to the local decline of species in some areas (Calver and Dell 1998; Lindenmayer 1992). In areas where hollows are scarce there is evidence that the availability of these sites is the limiting factor for some populations of animals (Bennett ***et al.*** 1994; Lindenmayer 1993; Lindenmayer ***et al.*** 1990a). Most of these studies however, "have focused on hollow-dependant arboreal mammals and generally omitted bats" (Law 1996).

In Australian forests, particularly eucalypt forest, hollows appropriate for many species of animals are known to take decades or in some cases over one hundred years to develop (Lindenmayer ***et al***. 1990b, Law 1996; Tidemann and Flavel 1987). As these trees die and eventually fall, this hollow resource is lost from the ecosystem and must be replaced by the recruitment of younger trees as they develop into hollow bearing cohorts (Bennett ***et al***. 1994). If the continuum is broken, animals dependent upon tree hollows are prone to serious depletion of their populations for many years to come (Tidemann and Flavel 1987).

Dwyer (1966) stated that "Meaningful interpretation of ecological data cannot be achieved without a detailed understanding of the species concerned", and this is particularly true for bat population studies as many species only use specific or unique roosts during particular periods of their life cycle. Unfortunately, the few studies that have been conducted on forest bats have also been conflicting in their results, due to inherent bias in survey methods such as trapping and echolocation detection surveys (Law 1996).

Improvements in radio telemetry technology in recent years, particularly in the development of lightweight transmitters, have seen an increase in the number of studies conducted on the roosting requirements of forest bats. Although these studies to date are limited to only a handful of species, they have demonstrated a high variability in the roost selection of different species when compared with the complexities of roost selection known for the cave-obligate species. It is now known that roost selection of forest bats varies according to the habitat, season, age and sex of the bat. These studies also found large variations in roost fidelity with some species using the same roost for months whilst other species were recorded to use a different roost location each day (Lunney ***et al***. 1995).

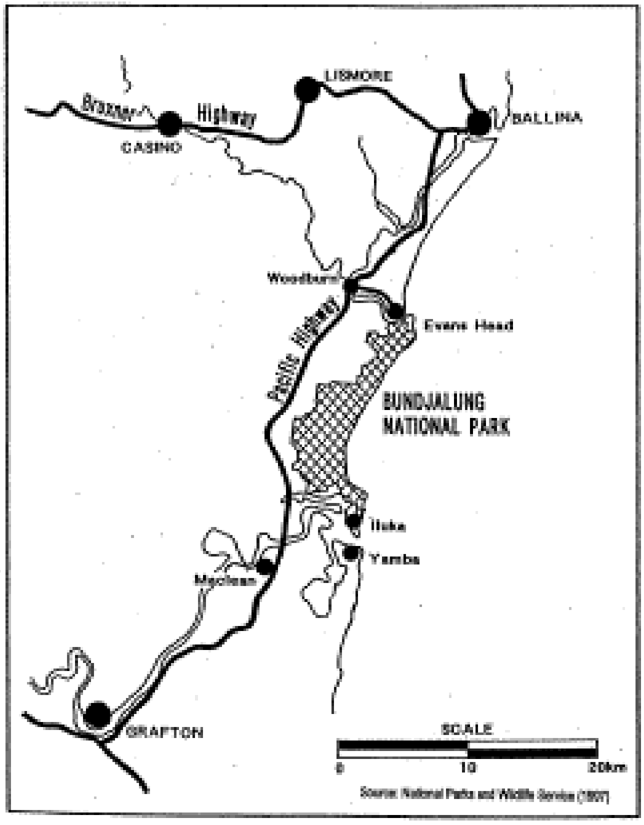
This information has important implications for the conservation management of microchiropteran bats as this suggests that, a number of species require roost sites appropriate for a variety of functions which, will require the protection of a range of tree species with characteristics yet to be determined (Law 1996).

As over 40% of the forest dependant microchiropteran bats occurring in NSW are listed as "Vulnerable" under the Threatened Species Conservation Act (1995) due to severe threats, ecological specialisation of the species or population declines, the current lack of knowledge on the roost preferences and impacts of disturbance is considered as the highest research priority for microchiropteran bats and require immediate broad based fundamental research (Lunney ***et al***. 1996).

Study Area

The study was conducted in Bundjalung NP, located between the Evans and Clarence Rivers on the north coast of NSW, approximately 300 km south of Brisbane (Fig. 1). Bundjalung NP was established in 1980 and comprises an area of approximately 1750 hectares of coastal sand plain country, typical of the "Wallum" coastal region, which extends from Fraser Island in the north to Myall Lakes in the south (Ingram and Corben 1975; Lewis 1996).

A flat to slightly undulating landscape dominates the reserve with only small number of sandstone escarpments present in the western sectors. In the northern section of the park, a hind dune system, which reaches an elevation of 70 m above sea level, is the highest point in the reserve (NPWS 1997).



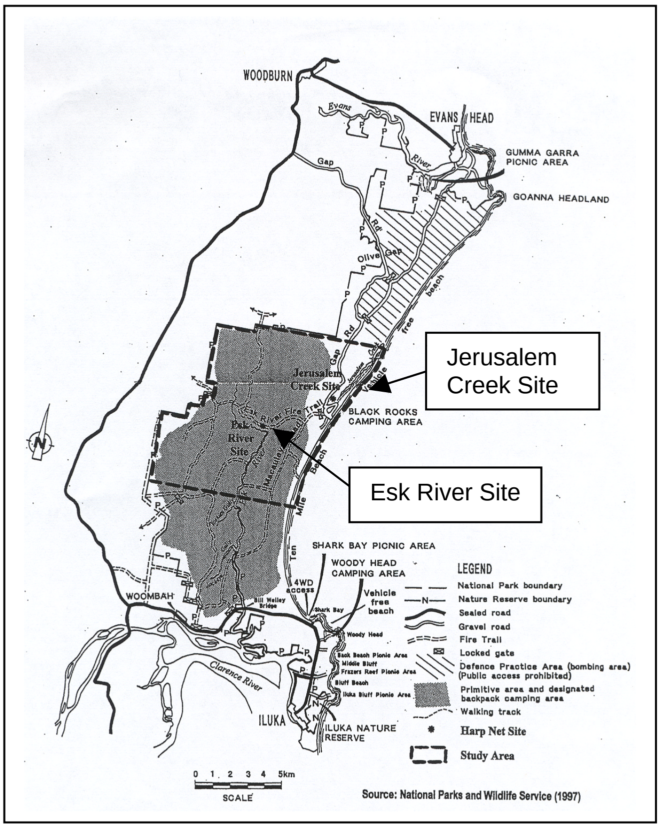


Fig. 1. Location of Bundjalung National Park.

Fig. 2. Location of study areas.

The sand plains originate from Quaternary sand deposits, which overlay the sedimentary rocks of the Clarence – Moreton basin formed in the late Triassic and Jurassic periods. The older sedimentary rocks of the New England fold belt formed during the Carboniferous and possibly the late Triassic period underlie this. The soils of the area consist primarily of sand through the lower sections of the park while the higher older dune systems are comprised of sandy loams with a higher organic content. All soils have a general acidic nature and low nutrient status (NPWS 1997).

The park supports a broad mosaic of vegetation types influenced by the topography, soil drainage, nutrient status, climate, coastal influences, fire history and recent mining activities. The resulting vegetation is typical of many Wallum areas and encompasses a diverse range of communities including mangrove and coastal foreshore communities through to sedgelands, wet and dry heathlands, wet and dry sclerophyll forest and littoral rainforest (NPWS 1989).

Mining has been carried out in the park intermittently for almost a century. The first operations occurred after the discovery of gold in 1895 and in the early 1930s the extraction of mineral sands containing rutile, zircon, illmenite, platinum and monazite commenced. This continued until 1982 when all mining operations were phased out. The rehabilitation success of these sites since this time is varied, with some areas likely to require decades to return to a condition approaching its pre-mined state.

Only small areas of Bundjalung NP have been subjected to selective logging which has been conducted primarily in the south of the reserve along the Esk River. These logging practices were generally limited to saw logs for house construction in the area and has had little influence on the habitats occurring in this area.

Bundjalung NP in known to support a high diversity of fauna, of which over 25 species are listed as threatened in the NSW Threatened Species Conservation Act (1995). At least fifteen species of microchiropteran bats are known to occur in this area, of which seven are currently listed as 'Vulnerable' in Schedule 2 of the TSC Act. These include the eastern long-eared bat (***Nyctophilus bifax***), the little bent-wing bat (***Miniopterus australis***), the large bent-wing bat (***Miniopterus schreibersii***), the hoary wattled bat (***Chalinolobus nigrogriseus***), the greater broad-nosed bat (***Scoteanax rueppellii***) and the southern myotis (***Myotis macropus***) (Campbell 1991; Milledge ***et al.*** 1992; NPWS 1997).

Objectives of the Study

The objectives of this study are to describe details on aspects of the diurnal roosts used by forest microchiropteran bats in Bundjalung NP. This study will attempt to ascertain the occurrence of any relationships between roost selection of different species through the use of radio telemetry methods. Results of this research will contribute to the scientific knowledge of the target species in terms of roosting habitat requirements, leading to a better understanding of their ecological requirements, and providing information for their management and conservation.

Aim To investigate aspects on the roost selection by microchiropteran bat species in Bundjalung NP with particular emphasis on poorly known species.

Methods

The study was conducted over two survey periods between the 24th of August and 14th of October 2000 with each survey undertaken over approximately 15 days. Microchiropteran bats were captured using harp traps placed on regenerating mining tacks and fire trails in dry sclerophyll forest associated with two watercourses in the southern half of Bundjalung NP. The location of the study area and both trapping sites are shown in Fig. 2.

Study Animal Selection

Microchiropteran bats used as study animals were selected from bats captured at both study sites, Jerusalem Creek and the Esk River, according to the following criteria.

Study animals were selected from the adult bats captured based on the weight of the animal, reproductive status and species characteristics, including current roosting knowledge and conservation status. Due to welfare considerations, transmitters were used only on bats where the attachment of the transmitter package constituted less than 5% increase in the animal's weight. As the total transmitter package weight was approximately 0.36 grams, all bats below 7.5gms were released and not included in the study. Of the bats above this weight, female bats identified as being in late pregnancy were also released as it was considered that these individuals may be affected to a greater extent by the application of a transmitter.

All cave obligate species such as the bent-wing bats (***Miniopterus*** spp.) and the eastern horseshoe bat (***Rhinolophus megaphyllus***) were also released without transmitters, as these species were not considered relevant to the study.

Radio Telemetry

The study animals chosen were fitted with the transmitters positioned dorsally below the scapulae to avoid restriction to the flight of the bat. Transmitters were affixed using Selleys superglue to an area of trimmed fur, which is a standard technique (G. Richards, pers. comm.). The transmitters used were Titley Electronics LTM, single-stage transmitters fitted with magnetic reed switches. The antennas attached were whip antennas of fine nickel guitar wire, 150 mm in length.

Bats were initially released within two hours of dusk however this was changed to within two hours of dawn to increase the chance of directly tracking the individual to its roost site. During all releases, notes were taken on each bat's activity until the animal was unable to be located or at dawn. Any opportunistic details on the activities of other study individuals located during any nocturnal radio tracking were also recorded.

A Regal 2000 telemetry receiver was used, combined with either a three element Yagi antenna (Titley Electronics) to locate roosts, or a "wand" antenna (Titley Electronics) for accurate telemetry at close quarters. Reception varied greatly depending upon topography and density of vegetation, ranging from approximately 2 km, to less than 500 m. Searches were conducted both by vehicle and foot along all existing and regenerating tracks within the study area. Along these transects, searches were conducted at regular intervals, generally less than 750 m apart. In particular the highest vantage-points available were specifically chosen so as to increase the reception distance from the transmitter location.

Roost Descriptions

Once a roost tree was located, the location was flagged, its position mapped, photographed and details were recorded on the roost tree species, such as the diameter at breast height (DBH) and the broad forest type in which the roost tree was found.

The exact location of the roosting bat or shed transmitter was then attempted to be ascertained by firstly using the wand antenna to narrow the search area of the roost within the tree. Trees were then climbed, where possible, by free-climbing or using single rope technique where appropriate. The roosts were examined and/ or attempts were made to recover transmitters.

If the actual roost site was located, data was collected on the nature of the hollow, the height of the roost above the ground, entrance dimensions and if possible the internal dimensions. Attempts were also made to ascertain whether a single individual or a colony used the roost. Detailed descriptions of roost sites however, were not conducted in situations where it was believed this activity may create high levels of disturbance to the roosting bat/s, potentially affecting results, or when examination of the roost would result in damage to the site. No sexual demographics were recorded due to the disturbance associated with this.

Where it was not possible to locate the exact roost location by scaling the roost tree, a combined Anabat/stagwatching survey was employed to determine the exact roost entrance location and whether other individuals also used this roost. This was conducted on one night at each of the ***Scoteanax*** and the ***Scotorepens*** roost trees, however all attempts were unsuccessful.

Results

During the study a total of six bats were fitted with transmitters including two Gould's long-eared bats (***Nyctophilus gouldi***), two greater broad-nosed bats (***Scoteanax rueppellii***), listed as "Vulnerable" Schedule 2, TSC Act (1995), a single eastern broad-nosed bat (***Scotorepens orion***) and a single undescribed broad-nosed bat identified as ***Scotorepens*** sp.1 (Parnaby 1993). Of these, five bats were successfully tracked to at least one roost location, and only one bat was never located after release (Table 1).

Table 1. Number of transmitters attached to each species and tracked to roosts.

Species	**Individuals of each sex radio-tracked.**		**No. of transmitters fitted**	**No. never located**	**No. days locations confirmed**	**Total no. of roosts located**
	M	**F**				
Nyctophilus gouldi	0	2	2	0	8	7*
Scoteanax rueppellii	0	2	2	0	5	2
Scotorepens orion	0	1	1	0	0	0
Scotorepens sp.1	1	0	1	1	1	1
Totals	**1**	**5**	**6**	**1**	**14**	**10**

*Includes one roost inhabited by both individuals.

Study Limitations

The effectiveness of the field studies were limited by a range of factors including; the species captured, vehicle and equipment difficulties, equipment limitations, a variety of environmental factors, the inaccessibility of roosting sites, time constraints, limited volunteer labour, safety issues and luck.

In a number of situations it was found to be extremely difficult to attain any telemetry location on the roosting bats due to the poor reception distance. The flat terrain of the reserve was not conducive to attain radio telemetry fixes, especially when traversing the low lying swamp areas. Radio-location is usually made from high vantage points. These low swamp areas are regularly interrupted by small rises in relief which supports drier vegetation types and effectively block reception of the transmitter during the traverses. Most habitats were also found to have extremely thick undergrowth to approximately 3 m high, which also reduced reception capabilities.

This thick vegetation was also found to be extremely difficult to penetrate and required a great deal of effort and time to traverse even short distances in these habitats. The low number of tracks within the study area, adding to the distance required to be covered on foot compounded this problem. The large distances between roost locations and the vehicle or the nearest track created a safety issue for a lone researcher, particularly in respect with tree climbing.

Radio telemetry results

Considering the limitations outlined above, valuable data was obtained during the study. Table 2 summarises the roosting data obtained on each study animal, including details of roost descriptions. All recorded locations of the capture and recapture sites, transmitter recovery sites and recorded roost sites for each study animal including incidental observations, are shown in Figs. 3 and 4. Photographs of selected roosts and roost trees are shown in the Plates.

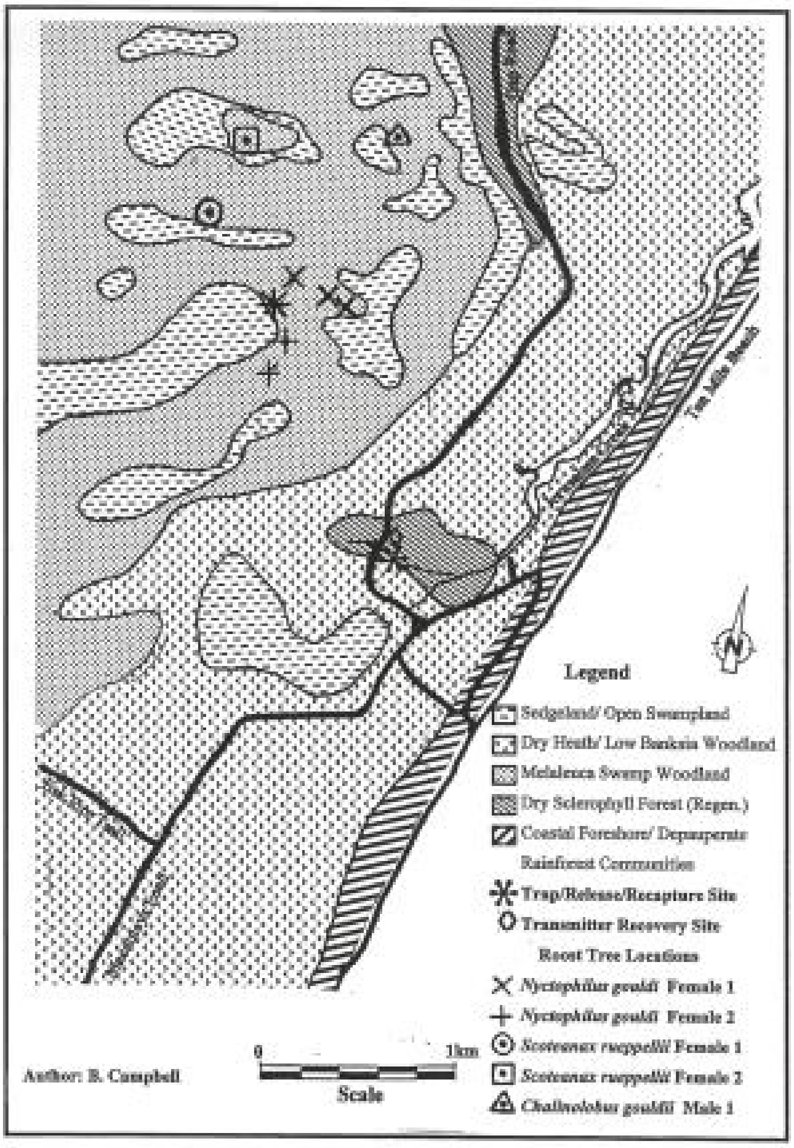


Fig. 3. Locations of the capture/recapture site, shed transmitter and roost trees for Jerusalem Creek study animals.

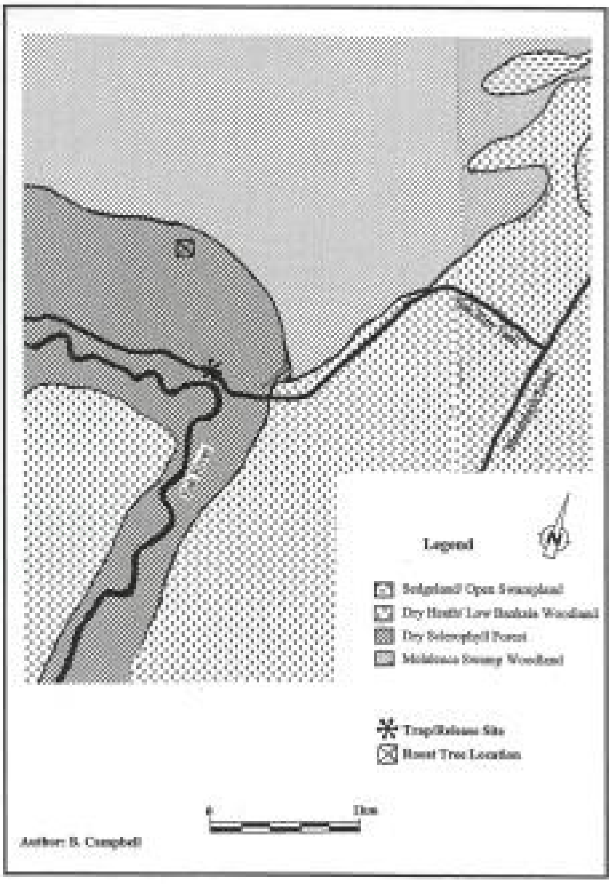


Fig. 4. Location of the capture site and single roost tree for the ***Scotorepens*** sp.1 from the Esk River Site.

Plate 1. Paperbark (***Melaleuca quinquenervia***) with central hollow used as roost tree by ***Nyctophilus gouldi***.

All bats trapped and released with transmitters at the Jerusalem Creek site were found to utilise the Melaleuca Swamp Woodland to the east of the site. ***N. gouldi*** and ***S. rueppellii*** were found to roost exclusively in paperbarks (***Melaleuca quinquenervia)*** or prickly-leaved tea trees (***Melaleuca styphelioides***).

The melaleuca swamp woodland habitat in which the roost trees were found occurs extensively throughout areas of low relief within Bundjalung NP. The mature trees occurring within this habitat are almost exclusively melaleuca, of which, a large majority contain obvious central hollows. These trees are generally thin and tall with DBH's ranging from only 12 cm to 22 cm. All roost trees are affected by fire to varying degree with some hollows developed by fire. The understorey of this habitat varies considerably throughout, generally dominated by sedgeland and wet heath communities. A number of small dry heath and low banksia woodland communities occur on the small rises throughout the area.

The roosts used by the two ***N. gouldi*** were all in central hollows of the roost trees. These sites were accessed by the bat through a large open entrance of a senescent main trunk, and in one instance a vertical fissure in the trunk (see Plate 4, Appendix 1).

The single ***Scotorepens*** sp.1 captured and radio-tracked from the Esk River site was found to utilise a roost in the dry sclerophyll forest of the trap site. The roost was found in a mature swamp mahogany (***Eucalyptus robusta***) however the exact location and period of occupation of this roost could not be determined. This dry sclerophyll forest is characterised by the occurrence of a large number of old growth trees including blackbutt (***E. pilularis***), scribbly gum (***E. signata***), swamp mahogany (***E. robusta)***, ironbark ***(E. siderophloia***), pink bloodwood (***Corymbia intermedia***) and swamp turpentine (***Lophostemon***

Table 2. Summary radio telemetry results including aspects of roost characteristics, for each study animal (including incidental records).

Study Animal	Habitat of roost tree	Roost tree species	Hollow type	DBH (cm)	No. of days confirmed in roost	Roost height (m)	Diameter of roost	Communal roosting recorded	Notes
Nyctophilus gouldi F1	Melaleuca Swamp Woodland	***Melaleuca quinquenervia***	Central hollow	13.5	1	3.5	80 mm	6-9 individuals estimated	Roost abandoned during attempted inspection.
	Melaleuca Swamp Woodland	***Melaleuca quinquenervia***	Central hollow	12.0	1	4.0	50 mm	Not determined	Diurnal roost located after disturbance to original roost.
	Melaleuca Swamp Woodland	***Melaleuca quinquenervia***	Central hollow	13.0	1	8.0	50-150 mm	Yes, but numbers unable to be estimated	Vocalisations heard from the roost site, however numbers could not be accurately estimated.
	Melaleuca Swamp Woodland	***Melaleuca styphelioides***	Vertical fissure	20.0	1	5.0	50-120 mm	Yes, but numbers unable to be estimated	Roost used by other radio-tracked ***N. gouldi*** on following day
Nyctophilus gouldi F2	Melaleuca Swamp Woodland	***Melaleuca quinquenervia***	Central hollow	15.0	3	4.0	100 mm	3-5 individuals estimated	Roost used for three consecutive days.
	Melaleuca Swamp Woodland	***Melaleuca*** spp	Vertical fissure	20.0	1	5.0	50-120 mm	Yes, but numbers unable to be estimated	Same roost as used on previous day by ***N. gouldi*** F1.
	Melaleuca Swamp Woodland	***Melaleuca quinquenervia***	Central hollow, 2 entrances	13.0	1	3.0	90 mm	9 individuals in total	Bat located at the top of the roosting colony with the antenna extruding from the side entrance.
Scoteanax rueppellii F1	Melaleuca Swamp Woodland	***Melaleuca quinquenervia***	Spout	30.0	4	8.0	Not determined	Not determined	Roost details not obtained as the tree was not able to be climbed
Scoteanax rueppellii F2	Melaleuca Swamp Woodland	***Melaleuca quinquenervia***	Unknown	22.0	2	7.5	Not determined	Not determined	Exact roost entrance unable to be determined
Scotorepens orion	Not determined	Not determined	–	–	–	–	–	–	Study animal never located.
Scotorepens sp.1	Dry Sclerophyll Forest	***Eucalyptus robusta***	Spout	<100	2	<15	Not determined	Not determined	One site recorded over five days, possible transmitter detachment.
Chalinolobus gouldii	Melaleuca Swamp Woodland	Stag of undetermined species	Central hollow	10.0	1	3.0	55 mm	No	Incidental record of single male seeking shelter

Plate 2. Paperbark (***Melaleuca quinquenervia***) with central hollow used as roost tree by ***Nyctophilus gouldi***.

Plate 3. The ***Melaleuca quinquenervia*** identified as a roost tree of ***Scoteanax rueppellii*** F1.

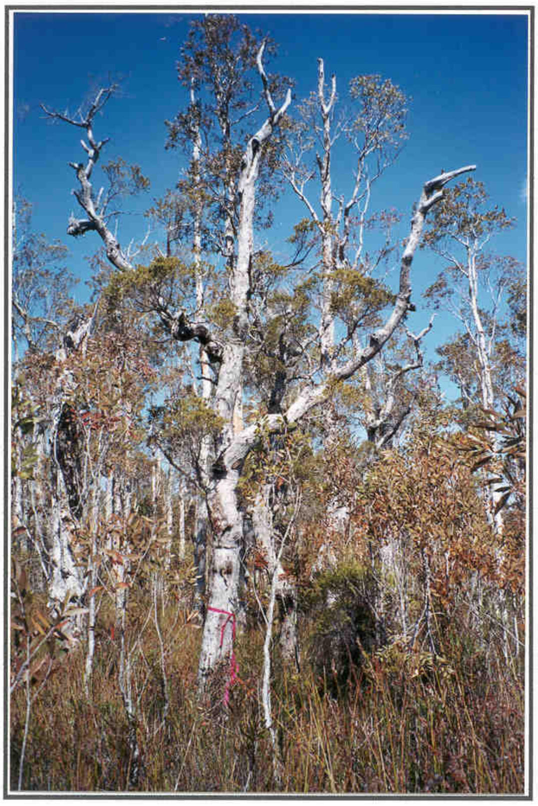


Plate 4. Roost tree used by both ***Nyctophilus gouldi***.

Plate 5. Entrance to roost of tree used by both ***Nyctophilus gouldi***.

suaveolens). This habitat occurs primarily in association with the Esk River and the low hills in the western sectors of the reserve.

A number of the roost trees located were found to be impossible to climb due to their growth form. These roost trees were generally above 10 m in height, extremely thin, hollow and with little branch development. These trees were therefore considered unsafe to climb and no detailed data was obtained on these roosting locations.

Whilst conducting an early roost inspection of a ***N. gouldi***, a melaleuca neighbouring the roost tree was climbed for access. Without touching the actual roost tree, the disturbance from this activity was enough to cause the departure of the colony from the roost. Approximately nine ***N. gouldi*** were observed to desert the roost, including the study animal, which was quickly relocated by telemetry in a second roost less than 150 m away. It could not be ascertained whether this roost was also used by the colony. On further inspection of the first roost, very little accumulation of guano was found, with the number of droppings recorded (less than 25), indicating that the usage of the roost by the colony was for only a short period.

Incidental Observations

During the return traverse through the melaleuca swampland after locating a roost tree, an observation was made of a microchiropteran bat flying to a roost during daylight. The individual was observed at 1245 hrs AEDST and appeared to be searching for a roost site. It was then observed to circle and land on a small (3 m high) stag of unidentified species (probably ***M. quinquenervia***), and enter the central hollow (Plate 8 Appendix 1). The roost was then inspected and the individual captured which was identified as a Gould's wattled bat (***Chalinolobus gouldii***). It was believed that this individual was disturbed from its roost site by some factor other than the researcher's presence in the area. All details of the roost are included in Table 2.

Plate 6. The small stag observed to be utilised as a diurnal roost by a male ***Chalinolobus gouldii***.

Plate 7. The single ***Melaleuca quinquenervia*** identified as a roost tree of ***Scoteanax rueppellii*** F2.

Roost Descriptions

The maximum height of a roost above the ground was estimated to be 20 m for the single (suspected) roost location of the ***Scotorepens*** sp.1 from the Esk River site. All study animals radio-tracked from the Jerusalem Creek site were found roosting below 10 m, with the ***S. rueppellii*** roosting at approximately 7.5 to 8 m high and the two ***N. gouldi*** roosting 3-8 m above the ground. The single ***C. gouldii*** was also recorded roosting 3 m above the ground.

Only the roosts of the two ***N. gouldi*** females and the solitary male ***C. gouldii*** could be described in terms of numbers of individuals in each roost. Both ***N. gouldi*** were consistently found to roost communally with colony sizes estimated between four and nine individuals.
Both ***N. gouldi*** were found to utilise the same roost location on a single occasion, on consecutive days. Because of the possibility of transmitter detachment from the first individual before the second individual utilised the roost, it is impossible to determine whether both animals roosted together or only used the roost on alternate days. However, these results indicate that both animals had knowledge of the roost, that is, they each visited the same location on separate days, indicating that multiple roosting is a facet of this species' ecology.

The largest recorded distance from a capture site to a roost location was found to be approx. 2.2 km, travelled by ***S. rueppellii*** F2. Similarly, ***S. rueppellii*** F1 travelled approximately 2.0 km between its capture and single roost site. Conversely, the two ***N. gouldi's*** travelled only between 1.1 km and 1.25 km between capture and roost sites. The single ***Scotorepens*** sp.1 travelled approximately 1 km between the capture site and the one suspected roost site. Incidental telemetry records of the ***N. gouldi*** taken during the release of the ***S. rueppellii*** indicated that these animals foraged in the proximity of their roost sites.

The recapture of the first ***S. rueppellii*** and the recovery of a transmitter detached from a ***N. gouldi*** less than 100 m from the capture/release site indicates some regular usage of this habitat for foraging.

The second ***S. rueppellii***, although only confirmed roosting for one day, was believed to be using the same roost for a period of at least six days. As attempts to determine the occupancy of the roost, opposed to transmitter detachment within the roost, were unsuccessful the lack of telemetry recorded during one evening from a site with known reception suggests movement away from the roost. This data however does not directly confirm any activity away from the roost, nor the usage of the roost as opposed to the possibility of transmitter detachment, as transmitter failure cannot be discounted as vehicle breakdown precluded further telemetry surveys.

General Observations

On two occasions during the study, hollows similar in appearance to those used by the study animals were observed to be inhabited by colonies of European bees (***Apis mellifera***). As a number of apiary sites were in the vicinity, it is expected that these hives were established from dispersing colonies from these sites.

Discussion

Study Effectiveness

The results obtained during this study varied greatly in the ability to describe the diurnal roost preferences of each species studied. Of the six animals fitted with transmitters, five were successfully tracked to roost trees and in total, ten roost trees were located during the study. The exact roost sites within these trees however could only be described for one species, ***Nyctophilus gouldi*** for which six roosts are described.

This low rate of successful roost identification recorded in the study is consistent with many of the published radio tracking studies on bats. Lunney ***et al***. (1985) reported on a study in which transmitters were attached to four bats with only three of these ever located. Of these, the approximate location of the diurnal roost was located on three days for one individual, and on two days each for the other study animals. Taylor and Savva (1988) also reported low telemetry success, as 14 animals from a total of 28 animals fitted with transmitters were either never located, or were found to have shed transmitters before a roost was located. Their study only detected a total of 23 roosts from the 28 transmitters used.

In contrast, Lunney ***et al***. (1995), conducted a study on ***Nyctophilus bifax***, and recorded a total of 87 roosts from 28 study animals. However this study does not detail whether any telemetry attempts were unsuccessful. The figure of 87 roosts detected also includes 19 roost locations, which were not defined and were referred as "those occasions when the exact location of the bat within the tree could not be determined".

These reports refer to technical difficulties, equipment failure or indicate that due to other limitations roosts could not be defined. Many of these problems are inherent with the current techniques used and relate directly to the technological capabilities of the equipment, primarily with respect to effective reception range and accuracy of telemetry fixes. These difficulties were also encountered in this study and were found to be emphasized by the flat topography, thick habitats and limited roading within the study area. These limitations were however found to affect results obtained for each species to differing levels. During this study ***Scotorepens*** sp.1 was the most difficult species to track followed by both the female ***S. rueppellii***. In contrast, both ***N. gouldi*** were found to be relatively easy to locate and detailed roost descriptions were able to be obtained regularly. These results reflect the data of the previous studies (Lunney ***et al.*** 1985, 1988, 1995; Taylor and Savva 1988; Tidemann and Flavel 1987) which also recorded varying success.

The difference in telemetry results between species (in this and published studies) is believed to be due to the specific characteristics of flight and foraging behavior, particularly in the distances traveled between foraging and roosting areas, for each species. The long-eared bats (***Nyctophilus*** spp.) for example, are all known to have a slow, fluttery fight and forage in relatively dense habitats by gleaning insects from substrates (Hall and Richards 1979). These studies have also demonstrated that these species tend to only travel relatively short distances between roosts and foraging areas and would therefore be expected to be radio-located with relative ease from the animal's last known location during both foraging and diurnal searches. In contrast both ***S. rueppellii*** and ***Scotorepens*** spp. are known to have relatively fast flight and forage by aerial pursuit above the canopy or within the subcanopy. Due to these characteristics and the species morphology, these species are expected to travel large distances between roosts and foraging areas however there is little published data available to confirm this. The distance of effective telemetry would therefore directly influence the amount of area that is required to be searched before successful radio telemetry location could be achieved.

Theoretically when using radiating or similar radio telemetry search strategies, the area required to be searched increases exponentially with increasing distances traveled by the study animal. It is likely to be these factors which were the most influential in the poor level of results obtained for some of the species studied in published reports and is attributed directly to the poor results obtained in this study on the fast flying species.

As with the majority of the limitations encountered during the study, the effectiveness of the telemetry surveys could be greatly improved with greater resources particularly in labour and funding. Increases in the number of personnel with receivers and transport, telemetry boosters or larger antennas are just a few examples of how these limitations could be reduced.

Roosting Habitat

The melaleuca swamp woodland in which the ***N. gouldi***, ***S. rueppellii*** and ***C. gouldii*** were all found to roost occurs extensively through the low-lying swamps and wet heaths within Bundjalung NP. The dominant melaleucas (primarily ***M. quinquenervia***) are distributed in these areas in a mosaic patterning typical of the Wallum, within which the groups of trees vary only slightly in height, age, growth form and their diameter at breast height. A large majority of these trees contain substantial hollows in the centre of the tree and occasionally in the branches, which have been created and developed by natural senescence of the trees, and through fires and storm events.

This melaleuca swamp woodland is the only forested habitat in the vicinity of the Jerusalem Creek site, which contains substantial numbers of hollow-bearing trees. Surrounding the capture site many of the habitats have been previously disturbed by mining and are slowly regenerating. These habitats include wet heaths, swampland/sedgelands, dry heath/low banksia woodland (much of which is regeneration) and regenerating dry sclerophyll forest. All of these habitats at present contain negligible numbers of trees with hollows appropriate for microchiropteran bats.

Of these habitats, the dry sclerophyll sorest is the only habitat (apart from the melaleuca swamp woodland), which is known to produce substantial appropriate roosting hollows once the habitat is mature. However, the dominant tree species occurring in this habitat, blackbutt (***E. pilularis***) is known to require decades to reach a level of maturity appropriate for the development hollows (Law 1996). As this habitat is presently in the early stages of development, it will be considerable time before habitats other than the melaleuca swamp woodland provide suitable microchiropteran roosting habitat. This melaleuca swamp woodland is therefore extremely important as a roosting resource for forest microchiropteran bats in Bundjalung NP at present and, for a considerable period into the future.

With the exception of the single ***E. robusta*** utilised by ***Scotorepens*** sp.1, all study animals were found to utilise ***Melaleuca*** spp. as roost trees. This may suggest a preference for this species as a roost tree however, this result is based on a small sample size, with all these study animals captured and released at the same site. As ***Melaleuca*** is the predominant hollow-bearing tree species in the area, this result is considered to be more likely be a function of roost availability in the area rather than a preference for a particular tree species.

The habitat of the ***S.*** sp.1 in contrast, is extremely diverse and contains a many tall old growth trees of a variety of species. Within this habitat there is an abundance of hollows ranging in a wide variety of forms, it is therefore believed that in this habitat, hollow availability would not be a limiting factor in roost selection.

Types and Dimensions of Roosts

Despite the limited data there were some small differences found in the type of roosts used by each species. Both the ***Scotorepens*** sp.1 and the ***S. rueppellii*** utilised roosts that were generally greater in height than those used by both ***N. gouldi*** and the ***C. gouldii***. Although both ***S. rueppellii*** roosts were recorded at least 12 m below the expected roosting height of the ***S.*** sp.1, the ***S. rueppellii*** roosts were among the highest hollows available in this habitat. It was therefore considered that this species did exhibit a preference for high roost locations.

This observed preference reflects common scientific opinion that, the selection of roosts is again likely to be due to the flight and foraging characteristics of each species. It is generally expected that the higher roosts are used by species with fast flight that forage in the upper canopy as these sites are generally easier to access and depart from for species with low flight maneuverability. Lower roosts, which often require a high level of flight maneuverability to access due to understorey vegetation are known (also recorded in this study) to be the preferred roosts of the slow, 'fluttery' species such as ***Nyctophilus*** spp**.** (Turbill ***et al.*** 2000). It is also possible that these slow flying species could prefer these sites, as they would be more vulnerable to predation commuting in the open to higher roosts.

Interestingly, Taylor and Savva (1987) found no evidence to suggest that bats select roosts based on height above the ground. This finding however appears to arise from the results of all species combined, and therefore would overlook any species-specific preferences of this roost attribute. This result also does not reflect a number of the published observations from the felling of roost trees of fast flying species. These have generally been recorded from quite high in these trees (Law 1996; Rhodes and Hall 1997).

As only one roost was detected for the ***C. gouldii***, no trends can be drawn from the data for this species. This single roost may also, not reflect the typical roost preferences for this species as this particular type of roost may only to be used due to a disturbance.

With the exception of ***Nyctophilus*** spp., Tidemann and Flavel (1987) found a direct relationship between body size and the entrance diameters of roosts for a number of species. These bats were generally found to select entrances only a little larger than the bat's girth. Other radio-telemetry studies conducted more recently have obtained similar results, but to date the most compelling information is from recent studies conducted on artificial bat roosts. These studies have further demonstrated that entrance diameter is critical to the roost selection as some species have inhabited roost boxes immediately following a reduction in this diameter. Other species, in particular ***Nyctophilus***, were found to inhabit roosts with a variety of entrance sizes (Bender and Irvine 2000). This relationship between the body size and entrance diameter therefore appears in certain cases to be species specific.

Although the results of this study for the ***S. rueppellii*** and the ***S.*** sp.1 were again inadequate to quantitatively determine valid relationships, the presumed roosting locations of both study animals could only be accessed by small hollows, consistent with relationships recorded in other studies.

Tidemann and Flavel (1987) attribute this preference exhibited by a number of species to the mechanical exclusion provided by the hollow preventing other larger species and in particular predatory species. This physical or mechanical exclusion provided also reduces competition from other species which utilise similar hollow resources. The entrance diameters of roosts recorded during this study for ***N. gouldi*** however appear to be closer related to the size recorded for a colony rather than one individual. As a result these larger entrances offer little or no protection from known predators such as goannas (***Varanus*** spp.) and water rats (***Hydromys chrysogaster***), both of which are common in the area (Tidemann and Flavel 1987; B. Campbell pers. obs.).

Tidemann and Flavel (1987) and Taylor and Savva (1988) and subsequent studies, have also demonstrated that the relationship between size and entrance diameter is not found for ***Nyctophilus*** spp***.***, and suggest that other predator avoidance strategies, such as particular roosting habits are used by ***Nyctophilus.***

Roost Fidelity and Communal Roosting

The ***N. gouldi*** changed roosts almost daily, with only one of the seven roosts recorded used for more than one day. These results are consistent with the current information from other radio telemetry studies of this and other species of ***Nyctophilus*** (Lunney ***et al.*** 1988, 1995). The recorded usage of a single roost site by both study animals indicate that interactions of colonies are undertaken and that there is a communal knowledge of a large number of suitable roost sites.

This knowledge of a variety of roost sites can be seen to have a number of advantages in particular, Tidemann and Flavel (1987) have suggested that this is related to the particular predator avoidance strategy believed to be used by these species. As the low, exposed roosts used by ***Nyctophilus*** spp. offer little or no protection from predators, by continually swapping roosts they reduce the ability of some predators to track down the roost.

Tidemann and Flavel (1987) also noted that ***Nyctophilus***, due to roost preference, were generally alert throughout the day and frequently took flight upon disturbance. Knowledge of a network of roosts would be integral to such a predator avoidance strategy due to the threats involved with flights during daylight. The ability to quickly fly to the nearest roost away from danger would reduce the time the animal is vulnerable to diurnal predators such as birds. This ability to respond quickly to a predator is also effective in a fire event for the same reasons.

These characteristics were recorded throughout field surveys for ***N. gouldi*** in Bundjalung NP as, vocalisations were consistently able to be heard from the colonies and, the first colony inspected abandoned the roost soon after disturbance. This is further supported as the study animal in this disturbed colony was then found to be located in an alternative roost site 150 m away, very quickly after disturbance.

Knowledge of numerous roosts also allows a greater flexibility to a range of variations in environmental conditions. This is of particular importance to microchiropteran bats due to the specific roost requirements for different periods and functions throughout the year. As it is expected that roosts vary in the micro-climate conditions, it is likely that knowledge of many roosts would allow a greater flexibility in the particular sites chosen for particular functions in particular breeding.

It is also considered that knowledge of a network of roosts would allow greater flexibility in response to changes in the insect population in an area due to factors such as drought or fire. Knowledge of roosts in other areas could potentially allow a greater area to be covered in a night's foraging activities and therefore allow movements to other foraging areas if food resources diminish. If this area is a considerable distance from the original roost, a good knowledge of roost sites would allow the closest roost to be used after foraging, reducing the distances traveled, commuting time and therefore energy expenditure.

The limited data collected on ***S. rueppellii*** indicates that this species exhibits a greater level of roost fidelity than ***N. gouldi***, as one individual was recorded using the same roost for at least 4 consecutive days. The second ***S. rueppellii*** is believed to have used the same roost for a period of at least 6 days, however this was not confirmed. If a trend of higher roost fidelity however does occur for ***S. rueppellii***, this also could be a result of the different roosts selected for predator avoidance.

Studies also refer to the utilisation of a cluster of hollow trees or of a roosting area with some fidelity, which was also recorded during this study. The incidental telemetry results, recapture and transmitter recovery results all potentially indicate some fidelity in utilisation of foraging areas in close proximity to the roosting sites for both ***N. gouldi*** and ***S. rueppellii*** further suggesting that either roost availability and proximity to foraging habitats largely affect roost selections.

Management Implications

Despite the low level of results, the findings of the study have important implications for the conservation management of the species studied, in both Bundjalung NP and the broader management of these species. In particular this study has demonstrated the importance of the extensive melaleuca swamp woodland occurring in Bundjalung NP as a roosting habitat for at least three microchiropteran bat species, including one species listed as 'Vulnerable' TSC Act 1995. As similar melaleuca swamp woodland occurring in many coastal areas of north-eastern NSW and Queensland is under extreme pressure from sand mining and coastal development, this study has direct implications for the planning management of these areas. The use of these areas as roosting sites is particularly relevant in the retention of habitat areas associated with development.

The single roost site recorded for ***Scotorepens*** sp.1, also has some implications for broader conservation, and in particular forestry practises as it was found in a large, mature eucalypt with substantial hollow development. This type of roosting tree is consistent with other species radio-tracked in forests, the implications of this have been discussed in many studies, which emphasise the importance of tree retention of various ages in logging areas to provide a continued hollow resource for a variety of species, including bats (Lunney 1992; Lunney ***et al.*** 1985, 1994; Rhodes and Hall 1997). The forestry management strategies in place in many states are largely inadequate in their ability to provide suitable roosting habitat for many species in the future. Due to the short rotation times of logging areas and current retention practices of corridors, it is probable that declines in populations of some animals in areas will continue for many years. The importance of continued research in order to improve these practices is therefore essential for the survival of some species.

Within Bundjalung NP the current management policies should ensure the conservation of this habitat and therefore the roost sites of a number of microchiropteran bat species. As these areas are protected from development, the largest threat to this roosting habitat appears to be fire. It is likely that only extremely hot fires would pose any threats to this habitat in the short term. However, as fires are required for hollow development and therefore recruitment of roost sites, a continued lack of fire could over time, could cause a limitation in future numbers of hollows. Therefore, the development of these sites by fire should be taken into consideration preparation of fire management plans.

Studies have demonstrated, a number of Australian animals, including microchiropteran bats, are known to be excluded by the invasion of hollows by the European bee (***Apis mellifera***) (Tidemann and Flavel 1987). The utilisation of hollows in this habitat by bees is of some concern as it is suspected that continued apiary activities within Bundjalung NP will, increasingly cause a reduction in the availability of hollows appropriate for microchiropteran bats. The practice of apiary activities, due to this threat to roost sites of microchiropteran bats, including 'Threatened' species, should be phased out within the Park (TSC Act 1995). As this will need to be conducted through legislation these activities are likely to be continued for the immediate future during which time, investigations into management practices should be undertaken.

Further Research and Recommendations

Further research is required urgently into the roost preferences of forest microchiropteran bats in order to understand these species ecology and appropriately manage areas for their continued occurrences. This research needs to be conducted on a variety of species, in different habitats and must be undertaken over the long term.

These studies should target areas of the species ecology in particular, which are fundamental to the conservation of the species. The areas for research should include roost selection of each species including roosting requirements throughout the year for critical life processes especially breeding and hibernation. These studies should also include research on the roost selection in relationship to foraging areas and home range areas.

Due to its National Park status and large size it provides excellent opportunities for long-term studies on the roosting trends over time, in terms of habitat succession and the effects of fire on the preferred roosting habitats, changes in roost habitats with hollow development and foraging movements of the animals. Continuation of study in Bundjalung NP is likely to provide excellent data on microchiropteran roosting preferences which has direct implications for the management of the species in other areas and habitats.

Conclusion

This study despite only obtaining limited data, was able to describe a number of important trends of microchiropteran roost selection. Aspects of roost selection were found to reflect trends in published studies, which largely indicate that roost selection is determined by roost availability and species characteristics such as particular predator avoidance strategies.

The study also found that the most important roosting habitats within the study area are the melaleuca swamp woodland and the dry sclerophyll forest, as these appear to be the only hollow bearing habitats in the study area. It is therefore expected that the preferences in roosting habitat demonstrated by the bats in this study is likely to be determined by the availability of suitable roosts in the area and not a particular preference for a habitat or tree species. The management of these areas therefore must consider the future hollow development factors to ensure the continued long-term conservation of microchiropteran bats in these areas.

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A note on the effect of cave entrance disturbance upon internal bat surveys: a case study from north Queensland.

by Greg Richards[1] and Alison Martin[2]

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Introduction

The authors were given the task of surveying the bat fauna resident in a karst system west of Townsville, Queensland, and took the opportunity to compare two recognised methods. This note describes the results of the survey, and discusses the implications of the vastly different results.

Methods

The study was conducted at the Christmas Creek karst system, approximately 155 km west of Townsville, and 30 km east of Greenvale The purpose of the survey was to obtain information on the distribution of bat colonies resident in caves and used two different methods: the automated electronic detection of species-specific echolocation calls as bats exited at dusk, and the visual inspection of the internal cave environment. This gave two assessment methods through which any effects of human disturbance could be assessed. Because this survey was part of an annual program, prior knowledge of the local bat fauna was available.

At each of the ten caves assessed, an Anabat call detector was placed at the entrance to monitor exiting colonies before internal inspection during the following day. At caves with a single entrance the detector was remotely controlled by a delay switch, which enabled the equipment to commence operation at dusk. At caves with multiple entrances, observers were positioned at dusk to monitor the recording equipment manually until the bat exit was completed.

The degree of difficulty in accessing caves for monitoring may have allowed greater warning to bats that humans would be entering. Three access methods were used:

- an easy walk, which was quick and did not create any excessive noise, and the crew of observers remained together as a group
- a steep hand climb which was slower and created some noise, but the observers still remained as a group
- abseiling into vertical shafts which was the slowest procedure and created the most noise whilst equipment was rigged, and observers waited quite a while until all were together at the bottom of the climb.

When access was rapid, bats inside would have assumedly had less chance to retreat to crevices than in situations where the inspection team entered the cave singly and over a much longer period of time.

Results and Discussion

At each cave, more species were detected as they exited than were noted during the internal inspections. It appeared that some species were sensitive to disturbance, and were apparently able to retreat to sites inside the cave where they could not be seen.

Table 1 shows the species recorded by both methods during the survey, and compares the methods for recording their presence. The most elusive species was ***Miniopterus schreibersii*** when present in some caves as small colonies, but when in large colonies in other (maternity?) caves they appeared to be fixed and were easily observed. Conversely, the species most likely to be observed during internal inspections was ***Vespadelus troughtoni.***

It is noteworthy that three species consistently eluded direct (visual) observation, and this is most apparent when they were in small colonies. ***M. schreibersii*** was only observed visually when numbers were in thousands, as opposed to those that were in small groups (three of less than 10 animals, one of approximately 30, and another group of 70 – 100) and were only electronically detected as they exited the night before.

Table 1: Species recorded in caves during September 2000 at the Christmas Creek karst system. The letters "D" and "I" indicate whether the species was recorded by call detection or internal inspection.

Cave system	***Vespadelus troughtoni***	***Miniopterus schreibersii***	***Taphozous georgianus***	***Rhinolophus megaphyllus***	***Myotis moluccarum***	***Miniopterus australis***	***Taphozous* sp.**	Total D I
Skybridge	D I	D -	D I	D -	D I			5 3
Inverted	D I	D -						2 1
N1		D -	D I	D -				3 1
N2	D I	D -	D -	D -				4 1
Daubers Shaft			D -	D -				2 0
Belfry	D I			D I			D -	3 2
Bat Attack	D I	D -	D I	D I		D -	D -	6 3
Sinking Feeling				D I				1 1
Snake Pit				D -		D I		2 1
Gotham City		D I	D -			D I		3 2

This indicated that bats in caves used for major aggregation, such as maternity sites, may be fixed to that location or feel less threatened when in high numbers, yet when in small groups in 'dispersal' caves may instead opt to retreat from disturbance.

This raised the question that the degree of difficulty in accessing caves for monitoring may allow greater warning to bats that humans would be entering. Each access method created a different level of noise, and the slowness of entry of the inspection team is quite different.

To ascertain whether there was a trend between disturbance during access and the observability of species during internal inspections, each cave was classified by an index of the degree of difficulty of access, based upon whether the entrance could be easily walked into, whether a difficult and noisy climb was involved, or whether abseiling was required.

The results of this analysis are shown in Table 2 and presented in Fig. 1. The results indicate that there is in fact a trend for less species to be observed in caves with difficult access. The proportion of the known species composition (determined without disturbance the night before) that was visually observed varied from 67 – 100% when access was easy, to 0 - 50% when access was extremely difficult and required rope techniques.

Conclusion

It would appear that to most effectively monitor the presence/absence of bat colonies in karst systems, then call detection at entrances is the most reliable method. However, where appropriate, inspection within caves may supplement detection information.

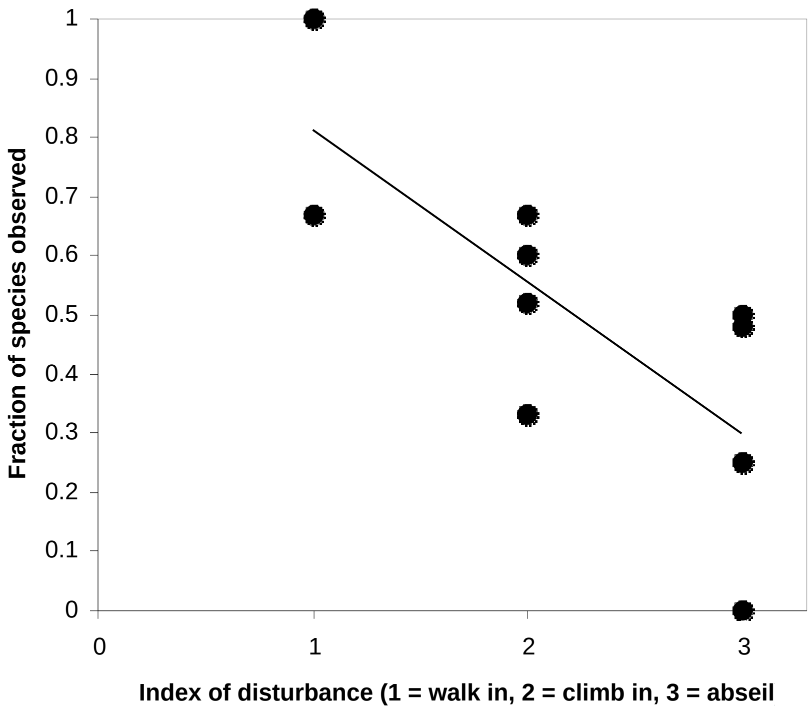
Acknowledgements

We would like to acknowledge Mr John Kersey's guidance on abseiling. Mr Brett Campbell, Mr Ian Gaskell, and Ms Mandy Craig, provided excellent assistance during the field survey. This research was conducted under the auspices of a mining industry consultancy from David Mitchell Limited, and the financial and logistic support of this company is gratefully acknowledged.

Table 2: The degree of difficulty of access and the fraction of detected species that were observed via internal inspection. Caves are listed in the degree of difficulty of access.

Cave system	Access	Fraction visually observed
Sinking Feeling	Walk	1.00
Gotham City	Walk	0.67
Belfry	Climb	0.67
Skybridge	Climb	0.60
Bat Attack	Climb	0.50
N1	Climb	0.33
Inverted	Abseil	0.50
Snake Pit	Abseil	0.50
N2	Abseil	0.25
Daubers Shaft	Abseil	0.00

Figure 1: Relationship between disturbance during access and fraction of species detected at Christmas Creek caves



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Antechinus preys upon bats in harp traps

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Published records of predation on harp-trapped bats are uncommon. Of four such reported incidences, the predator was confirmed to be the bush rat ***Rattus fuscipes*** on only one occasion (Lumsden 1989), although it was also thought to be the most likely predator in a later study (Wallis and Lumsden 1993). On the two other occasions, there was little evidence to suggest the identification of the culprit but the brown antechinus ***Antechinus stuartii*** (now the agile antechinus ***A. agilis*** south of Kioloa, NSW) was considered most likely to be responsible (Schulz and Meggs 1986, Cann ***et al***. 1997). Other bat species (notably the greater broad-nosed bat ***Scoteanax rueppellii***) are also known to prey upon trapped bats (Woodside and Long 1984).

On the morning of 28 February 2001, I collected a male ***Antechinus*** sp. (either the brown or agile antechinus) from a harp trap placed on a track in old regrowth spotted gum forest on the boundary of Kioloa National Park and the privately owned Edith and Joy London Foundation, Kioloa, on the NSW south coast (AMG 260 300E 6063 250N). The trapping was undertaken as part of my PhD field studies being supported by the University of Wollongong and State Forests of NSW. The trap was placed between trees and shrubs bordering the track to create a funnelling effect and there was also a rectangle of shade-cloth hanging from the bottom of the trap's bag to increase this effect. Apart from the antechinus, the trap also contained the remains of a ***Vespadelus vulturnus*** (forearm length 27.6 mm) and 16 living bats, including 12 ***V. vulturnus***, 1 ***V. darlingtoni***, 1 ***Chalinolobus morio***, 1 ***Nyctophilus gouldi*** and 1 ***N. geoffroyi***.

The bat remains comprised both wings, the tail and tail membrane, both feet and the left leg, along with a length of skin and hair from the left dorsal surface of the body. The head, internal organs and the remainder of the skin were missing.

The antechinus was held throughout the day of capture and its faecal pellets collected. At least 8 pellets were produced. They were very moist, soft and dark in colour. This is not the appearance normally associated with the pellets of this largely insectivorous species (Triggs 1996). The pellets were kept in a paper envelope and allowed to dry. The bat remains were stored in 70% ethanol. Hairs from the rump area of the carcass were removed using a sharp razor and mounted whole on a slide. Randomly selected sections of the faecal pellets were teased apart in 70% ethanol, using tweezers, and also mounted. Observation of the faecal slide (whole mount) under x400 magnification of a compound light microscope revealed a large abundance of bat hairs, of similar appearance to previously documented ***Eptesicus pumilus*** (possibly ***V. vulturnus***) hairs (Brunner and Coman 1974). Comparison of the two slides provided confirmation of the antechinus as the predator in this case.

It is likely that the antechinus had only killed and consumed the one bat, as there were no other remains in the trap, although the possibility that it had eaten other bats without leaving traces still exists. In the reports of bat predation where the brown antechinus was the prime suspect, 3 and 7 bats, respectively, were killed (Schulz and Meggs 1986, Cann ***et al.*** 1997). Furthermore, the agile antechinus is strongly suspected of killing and partially consuming feathertail gliders, a much larger prey item (Ward 2000 - a paper that also documented a kill of ***V. vulturnus***, probably by the agile antechinus). Whether the antechinus I trapped at Kioloa had eaten more bats than was apparent, was not hungry enough to eat more than one bat or had not been in the trap long enough to eat as much as it could, remains unknown.

The antechinus could have entered the trap via the vegetation or the attached shade-cloth. Although it is tempting to suggest that access was more likely to have been facilitated by the shade-cloth, which hung close to the ground, this is the first time this harp trap had been host to non-volant vertebrates in its 5 years of extensive use (B. Law pers. comm. 2001). The habitat I was trapping in was quite open and it was difficult to find suitable sites to set the traps, even on the track. While it is very important to consider the consequences of trap placement as it relates to predator access, it will not always be possible to avoid this type of incident and simultaneously conduct a survey that maximises bat trapping success.

My thanks go to Leah McKinnon for her assistance in the field and Brad Law for providing useful comments on this note.

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Remote sensing techniques in bat research

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Introduction

This is an excerpt and summarised version of an undergraduate paper I conducted on the use of remote sensing techniques in bat research – a literature review. Here I share with you the sections on the use of radar and aerial infra-red sensing/thermal imaging systems, uncommon but novel and interesting techniques in bat detection, and from a student's perspective, techniques that I never knew existed in bat research.

It seems that many more bat researchers need to be encouraged to consider imaginative applications of advanced technology. The science of geographical information systems and remote sensing is already entering a new phase with recent studies combining the complexities of radio-telemetry, global positioning systems and geographical systems or using remote sensing and GIS-based models of habitat and biodiversity. At the recent 12th International Bat Research Conference, Professor Kunz spoke about his recent studies using infra-red thermal imaging and Doppler radar imaging. He views these new technologies as challenging but at the same time showing great promise for investigating the ecology, behaviour and physiology of free-ranging bats.

Use of radar as remote sensing in bat studies – some examples and limitations

Radar has been used considerably in the study of bird and insect migrations/movements/flight behaviours (Gudmundsson 1993; Beerwinkle ***et al***. 1994; Hobbs and Wolf 1996; Russell and Gauthreaux, Jr. 1998; Biebach ***et al***. 2000). However, this has not been widely utilised in the equivalent study of bats.

Williams ***et al***. (1973) made one attempt, decades ago, by using search, height finding and weather radar to observe high altitude flight of foraging columns of ***Tadarida brasiliensis*** in Texas. Radar echoes from dense groups of bats covered areas as large as 400 square km and rose to altitudes of more than 3000 m. Bat flights appeared on radar at dusk and dawn as a slowly expanding or contracting target. All the types of radar used were located at airports or air force bases. The search radar detected horizontal distributions. The height finding radar gave information on altitudes. Both height and horizontal distributions were obtained from the weather radar. The wavelengths used varied from 5 cm to 23 cm and all detected the bats. Radar echoes were verified to be bats by using helicopter observations and circumstantial evidence such as the known location of a bat roost nearby and the times these echoes were detected (sunrise and sunset).

Reynolds ***et al***. (1997) used radar in an explorative manner to study the only species of bat and some nocturnal birds on the island of Hawai'i. Modified marine surveillance radar was mounted on a four-wheel-drive truck and obtained information on movement rates (numbers of targets per minute); flight paths (directions in degrees), and ground speeds (km/hr) of night fliers. The radar was equipped with a digital colour display, colour-coded echoes, on-screen plotting of true flight paths, and directional corrections for true north. Bat-like targets were identified through their erratic, slower and non-directional flight behaviours.

Another manner in which bat research can be linked to the techniques of radar remote sensing lies in the fact that radar is a commanding tool for assessing the density of insects in the upper air column. Kunz (1998) suggests that this should be explored for use in combination with feeding studies of insectivorous bats. Radar systems have been used successfully in the study of temporal and spatial distributions of insects at a wide range of altitudes and distances (Beerwinkle ***et al***. 1994). Hobbs and Wolf (1996) believe that airborne radar is the only valid method of observing the spatial organisation of insect migration. Thus, the use of radar to assess airborne insects can give an indication of what insects are available to bats, especially at high altitudes, where ground clutter is least (Kunz 1988).

Radar thus appears to be significant in verifying the presence of bats at high altitudes. It may be used to study high-altitude flight behaviours, high-altitude distribution, the direction and speed of migration-type movements, flying behaviours such as whether bats fly/forage singly or in flocks; and how movements relate to wind jets. Correlation to meteorological data can be made. Aerial densities should theoretically be possible by counting the number of target returns within known conditions, provided that there is only one species detected. Reynolds ***et al***. (1997) believe that the advantage of radar in their study was to detect bats at greater distances (1.4 km) than was possible from previous surveys. Finally, radar is easily used for nocturnal sampling, which needless to say, is essential in bat studies.

The high cost and the difficulty in installing radar equipment, often requiring military assistance, are most likely the reasons why this application has not proliferated (Barclay and Bell 1988). Furthermore, with any use of technological equipment, system errors can occur. For example, a radar system is subject to nightly variations in sensitivity due to changed atmospheric conditions or maintenance adjustments. These changes may affect the size and shape of the radar echoes seen. Anti-clutter techniques can apparently reduce the size of a bat target on display by about 30 per cent, making the echoes difficult to analyse, unless large numbers are detected. They can also accentuate targets moving toward or away from the radar, leading to possible misinterpretation (Williams ***et al***. 1973). However, without these, one has to deal with "background noise" that is inevitably collected with the use of radar, which makes discrimination from real data complex. Insects can interfere with analysis at short range. Operator errors include the difficulty in the accurate identification of the targets, without the use of expensive “ground-truthing” methods (which can involve the use of aircraft/helicopter). Circumstantial evidence is generally used to infer that the vast majority of targets are the research animals indicated.

Thus, for radar systems to be used efficiently, it is essential that the flight behaviours of target species be known, so that reliable identification can be made (Russell and Gauthreaux, Jr. 1998). Unfortunately, much of this data is lacking in many bat species, particularly high-flying species. Woodhouse (2000) claims that many problems related to the use and interpretation of radar echoes is the outcome of users failing to properly conceptualise the radar system and how it actually gathers information about the target.

Use of airborne infrared sensing/thermal imaging systems, as remote sensing in bat studies – is it possible?

Although uncommon, aerial thermal imaging systems have been used to survey populations of animals (Wiggers and Beckerman 1993; Havens and Sharp 1998). Thermal signatures are recorded on videotapes during transect flights and reviewed later. The technique depends on detecting the thermal contrast between biological objects and their environmental background, particularly around sunrise or on overcast days to maximize contrast. In many cases, this is sufficient to permit species identification (Havens and Sharp 1998). The high-contrast signatures appear as white objects on a black background. Generally, so far, it has been used in the survey of large mammals, such as deer.

It is suggested that this technique can be employed during preliminary research, to find areas that are being used by large numbers of flying foxes, particularly in isolated regions. Large numbers congregating together should produce a level of thermal heat easily perceived by thermal sensors. By flying over habitats that may be suitable for camps, thermal images can be recorded and analyzed to assess the presence/absence of camps, before ground-truthing. Pilot research would be essential to analyze the bandwidth of spectral range that is needed, and to determine the specific characteristics of its thermal signature. An example to follow is the laboratory study of Strong ***et al***. (1991) that explored the spectral reflectance curves for four species of geese, defining the level of reflectance at different wavelengths to determine which is the best one to use in the field.

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Evening drinks for grey-headed flying foxes

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Bellingen NSW is in grey-headed flying fox territory. In the centre of town is a flying fox roost which has been used increasingly in the past century and since 1996 has contained bats year-round. The roost is bounded on the southern side by the Bellinger River and limited to some extent on the northern side by the dry bed of what used to be a loop in the river. The change in the river's course leaves a 4 ha area popularly called Bellingen Island. It supports a remnant of lowland sub-tropical rainforest, thousands of grey-headed flying foxes, and occasional little red and black flying fox visitors.

According to popular story flying foxes swoop over water surfaces open-mouthed to scoop a drink, but I have never seen this. For five summers I have lurked beside the Bellinger River, or on it, or in it, watching grey-headed flying foxes at the end of a hot day, just after sunset.

They skim the river, dashing a white bow wave across the dark water. The swish is sharp and loud. As they rise again water droplets trail behind. They land in a nearby tree and stay for some minutes – perhaps five, perhaps ten, then fly off with the general stream of animals. Occasionally they skim the water a second time and land again. I can paddle close enough to see that they are licking their bellies.

It is clear that when they skim over the river they are dipping their bellies in the water – photographs show them at various depths, even almost up to their wing pits (Plate 1). Heads are held high though sometimes a tongue hangs out (Plate 2). Their bellies emerge darkly wet then they land to lick themselves dry.

Plate 1. Grey-headed flying fox plunged deep in the Bellinger River.

Plate 2. The head is held high while dipping the belly into the water.

Plate 3. Youngster just clears the canoe.

Even very young animals may drink in this manner. Last January a very small animal skimmed dangerously close to my canoe (but advantageously close from the camera's point of view) (Plate 3). In the flash of the camera at the time, and in the photograph later, the animal appeared baby-faced. It cleared the canoe, barely, then careened off in the fluttery flying style of juveniles. It was probably too young to join the general fly-out: it was certainly too late to join that evening's crowd.

The length of river that I watch most frequently at dusk stretches from beside the roosting animals, downstream perhaps one hundred metres, towards the bridge. I choose this area for its accessibility and because here I see the greatest density of skimming animals, and those which begin the earliest. However I have also seen them drinking a kilometre further downstream. They may well drink at greater distances from the camp and at other times during the night. Peggy Eby reports seeing them drink as they return in the morning, and there are common reports of them drinking during extremely hot daylight hours.

In my chosen stretch of the Bellinger River grey-headed flying foxes begin their dusk time drinking mainly after a spell of hot dry days. For example, this January when the camp contained as many as 30,000 animals (and twice-weekly ground surveys indicate that the population remained within 10% of the mean for this time) they drank every evening for a stretch of 13 dry days with temperatures above 27°C. About 150 animals skimmed each night except for the 8th of January when there was a very light shower at about 5pm and numbers dropped to about 25 individuals. Four days with rain were followed by four dry days with maximum temperatures ranging from 29°C to 31°C. I saw about 25 animals skimming the water on each of those evenings, then on the fifth evening, after a day of 33°C maximum there were about 300. The following evening, after a maximum temperature of 31°C there were about 200. After that there was serious rain and the show was over.

These preliminary observations matching numbers of animals, temperatures and rainfall will be continued, and the photographing too, but I have more than thirty photographs which show the skimming animals in detail, and in none of these do the animals have their mouths in the water.

For more pictures see www.bellingen.com/flyingfoxes.

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– Reports and Viewpoints –

Tolga Bat Hospital

We are entering the tick paralysis in spectacled flying foxes' (SFF) season this year with a quiet confidence and air of excitement! Last year was a difficult one. The colony moved to a new location that required a 65 km round trip each day instead of the usual 20 km to Tolga Scrub. The colony became 20,000 strong instead of the usual 5000 and so the numbers affected by tick paralysis swelled to over 400, and the number of orphans to over 230.

We found the colony by calling on Dr Andrew Dennis and Dr David Westcott from CSIRO in Atherton. They were equally interested in finding the colony as they have a 3 year project funded through the Rainforest CRC (Cooperative Research Centre) that in part looks at seed dispersal by spectacleds. They had the radiotracking gear and we had the visiting spectacleds - these were orphans released from home some 3 years ago. We caught a particularly large male , with the hand and towel method as they are still remarkably trusting, collared him and released him at 4am the following morning. We had two vehicles with receivers and about 2 hours later were at the colony. There are no previous records of spectacleds camping here, but interestingly there is a traditional maternity campsite about 3 km down the road. This remained unoccupied through the season.

It was difficult to find homes for all the 200 orphans. The Townsville carers were a tremendous help finding foster carers down the Queensland coast, and in turn gathering them up again for the trip back. Carol Booth, on one of her forays to Cardwell, ferried 20 orphans for fostering.

This year we have a $10,000 regional NHT grant from the Wet Tropics Natural Resource Management Board. Some of this is for our partner Dr Andrew Dennis of CSIRO for a project to determine if the SFFs are coming into contact with paralysis ticks in wild tobacco (***Solanum mauritianum***). We will be extracting a canine tooth from every dead adult for later age analysis. There is no data available on the age demographics of a SFF colony. We plan to continue to collect teeth in years to come. These will be stored while we find someone wanting to do the laboratory work, analysis and publication. The grant also provides for the development of materials for raising public awareness of SFF issues. There are some funds for paid work and travel as part of this project. Anyone interested please contact me.

We have also received an International Year of the Volunteer grant for $3400. All volunteers with SFFs rescue, fostering, census etc will receive a specially designed SFF t-shirt. They will also receive a specially designed car sticker and box of laundry detergent! Aware / Planet Arc is donating laundry detergent for the bat hospital on an ongoing basis. They make a good quality detergent concentrate that is not tested on animals and is phosphate free.

Merial, a pharmaceutical veterinary company, have funded Dr Rick Atwell from the University of Queensland to come up at the peak of our season to do research into tick paralysis as it affects the SFF and the best management. Rick heads a team of people at the University that develop the protocols followed by veterinarians for the treatment of tick paralysis in dogs and cats. This is particularly exciting for us as we know we can then offer best practice in the medical / veterinary management of the condition.

We have a Dutch veterinarian for most of this season as well as a volunteer who has undertaken the course 'The Conservation and Captive Breeding of Endangered Species', at the Durrell Wildlife Conservation Trust at Jersey Zoo, Channel Islands. This is not to say we don't have any spaces left for volunteers so please let us know if you are interested in coming up.

We have also developed our website to include a page for people wanting to sponsor a bat. Interest from the UK and USA prompted this **www.athertontablelands.com/bats**

Plans for the 10th Australasian Bat Conference in Cairns Easter 2002 are full steam ahead. I hope you can all make it. (http://batcall.csu.edu.au/abs).

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A Review: 'Flying Foxes – Fruit and Blossom Bats of Australia' by Leslie Hall and Greg Richards: Australian Natural History Series. UNSW Press.

Les Hall and Greg Richards' book Flying Foxes – Fruit and Blossom Bats in Australia is very welcome. There is a distinct lack of books on these animals. This one has been pitched for students and biologists at secondary and tertiary levels, and at general readers. It ranges from a historical background to details of the animals to management and conservation, with colour photographs and anatomical drawings.

A prospective reader would need to be already keen to pursue the subject before tackling this book, as it is not designed to charm or capture attention. The cover has uninviting colours and picture and the text starts off in very text book-like fashion. However it continues with entertaining details, aimed to answer a wide variety of frequently asked questions.

Thirteen species are covered. A reader can pick through to follow any one species. For flying foxes there are details of visual ability, speed of flight, feet that lock during roosting, longevity, age at first breeding, threats to survival, diet and feeding, diseases, why blood doesn't run to their heads – all good stuff, and there's more, the sort of thing that people ask about for general interest. I regret the frequent mention of their hanging "upside down" when clearly head downwards is right side up for flying foxes. But there is more serious looseness in the writing of this book.

Too often information is given without indication of its source. For instance, when talking about flying fox life cycles (page 43) it is described that during February and March "males commence to isolate themselves and establish a display area …". There is no indication of where this was observed, or by whom, and if the pattern is similar in all regions. It seems a daring leap to suggest that the males are choosing to isolate themselves, and is it really true? If the males are isolated is it perhaps because the females chose to leave? Was the choice made for reasons connected with courting and copulation, or is the presence or absence of animals rather a function of food supply? I would like to see the book at least nod towards a complexity of forces in action.

The description of males attracting females by licking their genitals to display them may be another over-simplification. Both males and females stretch their wings and arch themselves towards the sun after licking themselves thoroughly, but I have never seen other animals show much interest. Male methods of gaining females for mating may be very much more complex and interesting.

The page continues with "… as young leave their mothers …" which also could be a rash statement. It may be that in many cases it is the mothers that leave the young. One certain thing about these animals is that they challenge generalisation.

There are further risky leaps in other parts of the book. In the section on flying fox behaviour in camp (page 62) it is stated that mates for the next breeding season are chosen in summer camps. It is disappointing that assertions are made without acknowledgement that little is known.

The book appears to be on more solid ground when dealing with anatomy and physiology, particularly about hearing, and the brain and nervous system. Controversial issues are handled sympathetically and with diplomacy, such as with the information on flying fox numbers (page 92). In the section on conservation and management points are made that are music to the ears of a flying fox admirer, but once again I would like to see more on the sources of information. Information on flying fox diseases is given calmly and clearly.

The final chapter on rehabilitation and rearing puts wise emphasis upon the need to refer distressed animals to appropriate wildlife care groups, yet there is a dangerous slip into giving advice on milk for orphans. This is given without mention of warming the animal before feeding, or holding it with head downwards.

There are some charming photographs. Many of them, however, foster the popular erroneous idea of bats as tree killers by showing them in dead trees. The animals amongst the healthiest foliage appear to be captive bats posed. It would be pleasing to see some strong visual messages of bats being essential forest creatures.

In general, this book is of uneven quality but for many of its details it is a very welcome addition to the Australian Natural History series.

Vivien Jones

^v^ ^v^ ^v^

Habitat and prey-related correlates for microbat assemblages in the Bunya Mountains, southeastern Queensland.

The aim of this project was to investigate a large number of habitat variables (including vegetation structural variables, roost-related variables, prey-related variables and geophysical variables) to see whether there were suites of habitat correlates interacting to affect the microchiropteran bat species assemblages in the Bunya Mountains National Park, southeast Queensland. I was trying to determine whether there were a group of variables that were most important to bats in terms of their habitat preferences, and the relative importance of the remaining variables.

I used harp traps and Anabat detectors to sample a range of habitats for three weeks in late March/early April 2001. Insects were also trapped at each site to determine potential prey abundance and diversity.

Thirteen microbat species were trapped, including two new records for the Park (***Vespadelus baverstocki*** and ***Nyctophilus bifax***). A notable record was the single capture of a female golden-tipped bat (***Kerivoula papuensis***), which alone made the whole project worthwhile. A further 10 species were identified from the Anabat data, giving a total of 23 species.

Several habitat variables were identified as important for certain bat species, with elevation being an overriding factor for many species. Distance to water, small hollows (less than 10 cm in diameter) in trees 5-10 m in height and 20-40 cm in diameter, small hollows in trees 10-20 m and 20-40 cm (plus stem density of trees in this size range), and foliage projective cover in the lower strata, were all important factors in determining bat species assemblages.

The insect data revealed that moths, flies and mayflies were the most important insect orders for the bats.

Analyses are continuing, and I believe that more patterns will emerge with further analysis. I now just have to write it all up.

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Submission on the management of bats on State lands as part of the Southeast Queensland Regional Forest Agreement process, September 3rd 2001

Members of the bat advisory/recovery team that have contributed to this report are listed below in alphabetical order.

Patrina Birt, PhD student, University of Queensland, thesis on flying foxes
Adrian Borsboom, Snr Wildlife Ecologist, QPWS
Dr Greg Ford, Project Officer, North East Downs Landcare Group Inc.
Dr Ian Gynther, Snr Conservation Officer, QPWS
Luke Hogan, Snr Wildlife Technician, QPWS
Dr Nicola Markus, Environmental Consultant
Linda Reinhold, Zoologist, ex-QPWS
Dr Martin Rhodes, Environmental Consultant
Monika Rhodes, PhD student, Griffith University, thesis on bats
Bruce Thomson, Snr Conservation Officer, QPWS
Melanie Venz, Zoologist, QPWS

1. Introduction

The views and facts presented in this short summary report are from a recently formed bat advisory/recovery team. The views expressed are not necessarily unanimous. The team was established to respond to management issues for bats in the Southeast Queensland Bioregion, Kroombit Tops and the Blackdown Tableland, as part of the planning process for conversion of a number of State forests to conservation reserves. The team recognizes there are several management issues to be considered for microchiropteran and megachiropteran bats on public lands in southeast Queensland. **Views and information presented in this document should only be seen as a supplement to information on bats of concern in reports associated with the southeast Queensland RFA process.**

The team could not identify with certainty areas of high insectivorous bat biodiversity and use in the Southeast Queensland Bioregion because of limited distributional and abundance information. Best distributional information is in reports associated with the Queensland RFA process. There is little information on the location of breeding and roost sites. Currently our best knowledge on locations of insectivorous bat roost and breeding sites is for species that utilise caves and old mine shafts. As a consequence of this knowledge gap, we have been predominantly generic in our management recommendations for insectivorous bats. For flying foxes our knowledge of camps, movement, numbers, breeding and general ecology is significantly better.

2. Bats of Concern in Southeast Queensland

Table 1 below provides summary information on bats of conservation concern in southeast Queensland and the management of these species. It lists bats of concern from the Southeast Queensland Regional Forest Agreement process (1997-1998), other bats we consider of regional concern and summary information relevant to their management.

3. High Priority Management Issues

Three high priority management issues have been identified.

3.1 Fire Management

Fire management is important. An inappropriate fire regime for bats (eg. very hot fires) is one that burns out stags (dead trees) and living, hollow trees. Hollow-bearing trees are important as roosting and/or breeding sites for many species of insectivorous bats (see Table 1). Tree hollows are also important to many other hollow-dependent fauna species.

Continued maintenance of firebreaks is recommended. A fire management plan needs to be implemented that continues to burn the natural landscape, but utilises a temporal and spatial burning mosaic that minimises the risk of burning out stags and living, hollow trees. Within the range of bats that are known or strongly suspected to use hollows as breeding sites, avoid burning during the breeding period. Where a hollow tree is known to be regularly used as a breeding site, maintain a fire break at least 2m around the base of the tree (there is anecdotal evidence that even 'cool' fires can burn out hollow trees and stags).

No burning of vegetation should take place during the flying fox breeding season either in or directly adjacent to flying fox camps where breeding is known to occur. One critical period is when young flying foxes are too heavy for the female to carry, but still too young to fly and feed independently. Smoke as well as flames can cause mortalities.

3.2 Public Access and Recreation

The Recovery Team recommends that public access and recreation are compatible with bat conservation EXCEPT for the following situations:

3.2.1 Flying fox Camps

Public access should be restricted in the vicinity of permanent and temporary flying fox camps. This action is necessary for minimising disturbance at camps and also for public health and safety reasons. Some camps are used as breeding sites and undue human disturbance may impact on rearing and recruitment of young to the adult population. The weaning period is particularly critical. Areas with permanent camps should have restricted access via locked gates and signs. Roads and walking tracks should not be sited near these areas unless a carefully managed visitor management plan has been instigated that minimises public health issues and disturbance to bats. **Also refer to Draft QPWS policy "Managing Flying fox Colonies in Urban Areas" (contact Kathryn Adams, QPWS).**

3.2.2 Caves and Mine Shafts

Public access should be restricted or excluded from these areas, particularly during the coldest winter months and breeding season. In caves where bats enter periods of torpor or hibernation during the winter months, frequent human disturbance may result in severe stress or even death of bats. Likewise during the breeding season, microbats can have specialised roosting requirements; with pregnant bats often congregating into maternity colonies with distinct humidity and thermal properties. For most species the critical time occurs between October and January. Disturbance during the birthing and lactation stages of the breeding season of cave-dependent bats must also be avoided.

Table 1: Summary of conservation status, roost and breeding sites, threats and recommended management actions for bat species of concern in the southeast Queensland Bioregion, Kroombit Tops and the Blackdown Tableland. Conservation status abbreviations: C = common; R = rare; V = Vulnerable.

Genus	**Species**	**Common name**	**Conserv. Status#**	**Roosts and/or breeding sitesx**	**Threats (possible and known)**	**Management**
Microbats						
Chalinolobus	***dwyeri***	large-eared pied bat	R*	Shallow caves, old mines, rock crevices, abandoned fairy martin nests	1. Tree hollow loss (felling, clearing or inappropriate fire regime) 2. Fox & cat predation at roost sites 3. Forest clearance or clear fell timber harvesting 4. Rock quarrying/removal 5. Destruction of old mines 6. Re-working of old mines	1. Retention of appropriate densities of hollow trees and future hollow trees 2. Minimize the loss of hollow trees by fire 3. No rock removal from rock piles and outcrops where the bat is known to roost 4. No destruction of old mines used by bats 5. Bat-friendly gating of old mines used by bats, where practical gating to discourage feral predators 6. Retention of large forest blocks within feeding distance of known breeding and roost sites 7. No disturbance of breeding sites during the breeding period **QPWS management profile (SMP) written for this species**
Chalinolobus	***picatus***	little pied bat	R*	Tree hollows, shallow caves and old mines; One colony from inside a deserted farmhouse; Possibly rock outcrops.	1. Tree hollow loss (felling, clearing or inappropriate fire regime) 2. Fox & cat predation at roost sites 3. Forest clearance or clear fell timber harvesting 4. Rock quarrying/removal 5. Destruction of old mines 6. Re-working of old mines	1. Retention of appropriate densities of hollow trees and future hollow trees 2. Minimize the loss of hollow trees by fire 3. No destruction of old mines used by bats 4. Bat-friendly gating of old mines used by bats, where practical gating to discourage feral predators 5. No rock removal from rock piles and outcrops where the bat is known to roost 6. Retention of large forest blocks within feeding distance of known breeding and roost sites 7. No disturbance of breeding sites during the breeding period **QPWS SMP written for this species**
Falsistrellus	***tasmaniensis***	eastern false pipistrelle	C*	Tree hollows, occasionally old wooden buildings and one record from a cave.		**Draft QPWS SMP written for this species**

Hipposideros	***semoni***	Semon's leafnosed-bat	V*	Caves, mines, rock-piles, culverts and old buildings. Recorded at Kroombit Tops from a limestone cave.	1. Fox & cat predation at roost sites 2. Forest clearance or clear fell timber harvesting 3. Inappropriate maintenance or replacement of culverts and bridge works used as roosts sites 4. Destruction of old mines 5. Disturbance or destruction of roost caves (including rock removal or quarrying). [Frequently uses small humid caves]	1. No destruction of old mines used by bats 2. Bat-friendly gating of old mines used by bats, where practical gating to discourage feral predators 3. No rock removal from rock piles and outcrops where the bat is known to roost 4. Culvert and bridge maintenance to be bat-friendly. 5. Culvert & bridge replacement to be bat-friendly and timed to minimize disturbance to roosting bats 6. Retention of large forest blocks within feeding distance of known breeding and roost sites 7. No disturbance of breeding sites during breeding **QPWS SMP written for this species**
Kerivoula	***papuensis***	golden-tipped bat	R*	Abandoned dome-shaped bird nests; one record of a single animal from inside a broken tree trunk.	1. Cat predation 2. Forest clearance 3. Adverse changes to wet sclerophyll habitat structure and composition due to inappropriate timber harvesting or inappropriate fire regime 4. Roadkills	1. Water course protective zones 2. Protection of bird species whose dome-shaped nests are used by the bat 3. Retention of large rainforest and wet sclerophyll forest blocks within the known range of the bat 4. No disturbance of breeding sites during the breeding period 5. Nightime speed limits that minimize the risk of bat road kills on roadways through prime habitat **QPWS SMP written for this species**
Miniopterus	***australis***	little bent-wing bat	C*	Caves		**Draft QPWS SMP written for this species**
Miniopterus	***schreibersii***	common bent-wing bat	C*	Caves, mine adits and road culverts		**Draft QPWS SMP written for this species**
Mormopterus	***norfolkensis***	eastern freetail bat	C*	Tree hollows, under tree bark, building roofs and under telegraph pole metal caps		
Myotis	***moluccarum***	large-footed myotis	C*	Caves, tree hollows, amongst vegetation, under bridges, mines, tunnels and storm water drains		
Scotorepens	***sanborni***	northern broad-nosed bat	C*	Tree hollows and buildings		

Scotorepens	sp. (Parnaby 1992)		C*	No information		
Tadarida	***australis***	White-striped freetail bat	C^{+}	Tree hollows including stags; not known to roost in buildings	1. Tree hollow loss (felling, clearing or inappropriate fire regime)	1. Retention of appropriate densities of hollow trees and future hollow trees in native forest 2. Retention of urban hollow trees and stags (including on roadsides, golf courses, park land & riparian zones)
Taphozous	***georgianus***	common sheathtail bat	C*	Caves, boulder piles and old mines		**Draft QPWS SMP written for this species**
Vespadelus	***darlingtoni***	large forest bat	C*	Tree hollows and in buildings		
Vespadelus	***regulus***	southern forest bat	C*	Tree hollows and in buildings		
Vespadelus	***troughtoni***	eastern cave bat	C*	Caves, sandstone overhangs, boulder piles, mine tunnels and occasionally in buildings		
Vespadelus	***vulturnus***	little forest bat	C*	Tree hollows and building roofs		
Blossom Bats & Flying foxes						
Nyctimene	***robinsoni***	eastern tube-nosed bat	C*	Roosts singly in foliage		
Pteropus	***alecto***	black flying fox	C*	Permanent and temporary camps, normally in native forest	1. Forest clearance and fragmentation 2. Illegal killing 3. Electrocution 4. Fire, especially in camp sites when young are being weaned 5. Insecticide/pesticide spraying 6. Heavy grazing 7. Roost disturbance, particularly maternity sites during the breeding period	

Pteropus	***poliocephalus***	grey-headed flying fox	C*	Permanent and temporary camps normally in native forest	1. Forest clearance and fragmentation 2. Illegal killing 3. Electrocution 4. Fire, especially in camp sites when young are being weaned 5. Insecticide/pesticide spraying 6. Heavy grazing 7. Roost disturbance, particularly maternity sites during the breeding period	**Draft QPWS SMP written for this species**
Pteropus	***scapulatus***	little red flying fox	C*	Temporary camps, normally in native forest	1. Forest clearance and fragmentation 2. Illegal killing 3. Barbed fencing 4. Fire, especially in camp sites when young are being weaned 5. Insecticide/pesticide spraying 6. Heavy grazing 7. Roost disturbance, particularly maternity sites during the breeding period	**Draft QPWS SMP written for this species**
Syconycteris	***australis***	common blossom bat	C*	Roosts in rainforest (sub-canopy and canopy)	1. Coastal forest clearance and fragmentation 2. Barbed fencing 3. Heavy grazing	**Draft QPWS SMP written for this species**

Nature Conservation Legislation Amendment Regulation (No. 2) 1997 (Subordinate Legislation No. 436. 1997)

* Species of concern identified in reports by the Queensland CRA/RFA Steering Committee that formed part of the Southeast Queensland Regional Forest Agreement process (1997-1998)

+ Species of concern identified by this current bat advisory/recovery team

X Roost and maternity site information mainly from ***Australian Bats*** by Sue Churchill, published 1998.

3.2.3 Tracks and Amenities

Placement of tracks and facilities should be done so as to minimise loss/removal of hollow-bearing trees and stags.

3.3 Management of Mines and Caves

No disturbance or destruction of caves used as roosting and/or breeding sites by bats should occur. Cave microclimate may be critical for bats (eg. a humid, warm maternity cave). Old mines are to be treated as caves for bat management purposes. Bat-friendly gating may be required if disturbance by humans is a risk or there are human safety and health concerns. Working mines should minimise disturbance to roosting bats. Management will need to be on a case-by-case basis in consultation with Bruce Thomson, Senior Conservation Officer, QPWS.

3.4 Mining/Quarrying Activities

No removal of large rocks from rock outcrops and cliff lines should take place where insectivorous bats are known or suspected to roost. A field survey may be required to establish if bats are using the site. No quarrying should occur that destroys or disturbs bat breeding and natural roost sites, or modifies the microclimate inside such sites (eg. a humid, warm maternity cave).

4. Medium Priority Management Issues

Two medium priority management issues have been identified.

4.1 Management of Road Culverts and Bridges

All culverts and bridges, prior to any major repair or replacement, should be surveyed for use by bats. If bats are present, repair or replacement should minimise disturbance of bats. This may require blocking access to culvert/bridge roost sites after bats have left to feed.

In the colder months bats may not feed every night. Where this is the case, works may need to be conducted during warmer months. However, we recommend no works take place during the breeding period for bat species that use bridges and culverts as roosts.

4.2 Grazing

Light grazing is considered compatible with bat conservation, except where barbed stock fencing poses a regular threat to the little red flying fox (***Pteropus scapulatus***) or the common blossom bat (***Syconycteris australis***). Both bat species can fly low and have been reported entrapped on barbwire fencing. Barbed fencing also entraps gliders. Where regular entrapment of bats occurs it is recommended to consider replacing the top barbwire strand with plain wire. This will need to be decided on a case-by-case basis and will be particularly relevant when fencing requires repair or new fencing is planned.

We recommend that high stocking rates be avoided, due to the detrimental effects of heavy grazing on plant diversity and plant community structure. This could impact on insect diversity with negative flow on effects for insect-feeding bats. It may also affect flowering species at ground level that are used by the blossom bat ***S. australis***, eg. ***Xanthorrhoea*** spp. Grazing stock may also reduce the quantity of flowering plant species by feeding on seedlings, eg. cattle have a fondness for the seedlings of forest red gum (***Eucalyptus tereticornis***). This tree is a critical flowering species for flying foxes during the maternity period. Clearing or semi-clearing for grazing purposes also reduces flowering trees available to flying foxes.

5. Lower Priority Management Issues

Two lower priority management issues have been identified.

5.1 Apiary Sites

Escape of European honeybees from apiary sites can result in competition for tree hollows with native species. The Team recommends apiarists manage hives to minimise bee swarms establishing in tree hollows. This could require some apiarists to undertake more regular monitoring of hives and to instigate appropriate management strategies to either minimise swarming or provide bee boxes for swarms to establish in.

Competition with native bees and birds for nectar and pollen resources also needs to be taken into consideration. There have been several studies conducted in relation to the impact of European honeybees on native wildlife utilising floral resources, however it remains inconclusive. Further research needs to be conducted, particularly with reference to the impact that the possible displacement of native wildlife has on pollination ie. fruit set and seed viability.

5.2 Artificial Water Points (Stock Dams)

Whilst artificial watering points provide resources (water, insects, etc) for microbats, their artificial permanence may cause changes to faunal communities. It is recommended that consideration be given to not maintaining existing dams, instead allowing them to dry or silt up over a long period of time; thus gradually returning the system to a more natural state. Action should be on a case-by-case basis and take into account the importance of such watering points to other fauna (eg. amphibians), especially if swamps and other natural waters in the area have been drained or severely modified. Some dams are also important as a water source for fire fighting.

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The unusual penis morphology of the hairy-nosed freetail bat

During an examination of spirit-preserved specimens of Australian ***Mormopterus***, I observed that the hairy-nosed freetail bat (***Mormopterus*** sp 6 Adams et al 1988) (Fig 1) uniquely possessed a penis with a striking fleshy finger-like projection. No other Australian ***Mormopterus*** species is similarly formed, and indeed, the projection may be unique amongst all chiropteran bats (Phillip Krutzch ***pers. Comm.***).

All male specimens (n=5) collected from the Northern Territory, New South Wales and South Australia that were examined, were endowed with the projection.

The projection (Fig 2) arises from the dorsal surface of the prepuce at the distal margin, and appears to be integral with the prepuce. The size of the projection varied amongst the specimens examined, the smallest being about 70% in size compared to the largest (the one in Fig 1). The smaller size of the projection in some specimens may have resulted from dehydration during the spirit preservation. Nonetheless, in all five specimens, the projection was an obvious feature.

The projection is adorned by hairs which arise from along its length, with several hairs projecting well beyond the tip of the projection. At this stage, I have not been able to section the projection.

Without examination of a live specimen, it is difficult to assess what changes occur in the projection during penile erection. It remains to speculation what function the projection serves. Finger-like projections occur on the penes of several genera of hoofed mammals, these being interpreted as being stimulators for females during intercourse (Eberhard 1985).

No similar structure is evident in other Australian freetail bats, lending support to the conclusions of Adams ***et al.*** (1988) who in their study, interpreted the large genetic distance between the hairy-nosed freetail bat and other Australian ***Mormopterus***, to suggest it may belong to different genus.

The hairy-nosed freetail bat remains an enigmatic species. Recent collections include a single specimen collected in 1990 near Mt Dare in northern South Australia, and three specimens from near Bourke in NSW in 1998 (Ellis 2001). In total, there are less than 30 specimens in museums, and these have been collected over a large geographic region of Australia, yet nowhere are they common.

Adams, M., Reardon, T.R., Baverstock, P.R. and Watts, C.H.S. 1988. Electrophoretic resolution of species boundaries in Australian Microchiroptera. IV. The Molossidae (Chiroptera). ***Australian Journal of Biological Science*** **41** 315-326.

Eberhard, W.G. 1985. Sexual selection and animal genitalia. Harvard University Press, Massachusetts.

Ellis, M. 2001. The first record of the Hairy-nosed Freetail Bat in New South Wales. ***Australian Zoologist*** **31**(4), 608-609.

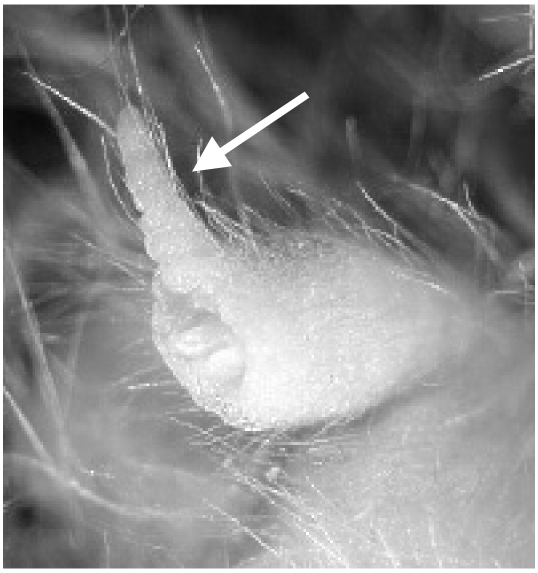

Fig.1 Projection (arrowed) on the penis of the hairy-nosed freetail bat (T. Reardon)

Fig. 2 Hairy-nosed freetail bat (Bruce Thomson)

Terry Reardon

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Artificial bat roost box design

In the never–ending search for a better bat box, the Upper River Torrens Landcare Group and the Reynella East Primary School (Adelaide, South Australia) have built and are testing some boxes which have a bottom opening plate and an inspection hole for video camera monitoring.

The bottom plate is hinged by loose fitting screws or nails, and secured in the closed position by a loose nail in the side of the box. An alternative could be to use a kitchen cupboard lock (magnetic or mechanical) to secure the bottom plate in the closed position

The advantages of a bottom opening plate include

- A hinged top or roof plate is often a weak structural and weather prone point in conventional bat boxes – in this new design the top plate is screwed solidly
- Inspection via the top plate may disturb the bats, bats often hang from the top plate.
- You don't have to climb as high
- Is easy to clean/collect guano

The video camera inspection hole of 30mm diameter is drilled in the bottom plate, and a one-way rubber flap secured to the inner side of the hole.

Terry Reardon

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A long squawk from the old bent bat (TOBB)

It was almost a long silence, due to emotional exhaustion from continuous flying fox (FF) demands over the last year, plus the events of September 11 2001. Last millennium, TOBB was hanging relaxed in his roost at Nimbin Rocks, enjoying the ***Pteropus*** in our Big Fig and ***Miniopterus*** roosting in a cave back of our house. Some years ago Les Hall visited the cave when the bats were in torpor, and estimated numbers at 70,000! TOBB understands Les has named the cave “Martin’s Crack”, a dubious honour, but celebrated by a photo of the eponym posed in front of the cave.

So, idyllic uninvolvement in FF affairs, beyond an occasional self-indulgent snort on Batline, then came the Melbourne Royal Botanic Gardens (RBG) and submissions for assessing the status of grey-headed FFs (GHFF). TOBB became increasingly unrelaxed about the RBG, and wrote an account of the limited reproductive potential of GHFFs, which was sent to the RBG, and the April workshop on the

status of GHFFs. In late 2000, Carol Booth attempted, unsuccessfully, to gain a Court Injunction to prevent the massive electrocution of spectacled FFs (SFF) in a north QLD lychee orchard. In 2001 she re-initiated Federal Court action under Wet Tropics World Heritage Area (WTWHA) legislation. TOBB agreed to be an expert witness on the reproductive potential of SFFs. Others on our side were Olivia Whybird (who was delightful under cross-examination on SFF population counts), Greg Richards, who described the role of SFFs in the WTWHA, and Peter Valentine who dealt with WTWHA values.

At this time, Allen McIlwee had been e-mailing calculations of the devastating effects of the electrocutions on the SFF population. So, we got together in cyberspace and wrote a paper on population dynamics of ***Pteropus***, modified my court report, and submitted both to ***Australian Zoologist***; put them on the internet; sent copies to Environment Australia (EA), the Victorian, NSW and QLD NPWSs. The main paper is accepted by ***Australian Zoologist*** after revision in response to very useful comments from 3 referees - 2 of them population ecologists. Allen was also responsible for setting up the FF web page. Shortly after this, EA asked the Cairns CRC for Rainforest Research to review data relating to SFFs; Allan and I contributed substantial material and criticisms. We saw a draft, but not the final version, which went to EA after external review. Apparently, Senator Hill has decided to list SFF as vulnerable, but the listing has not been gazetted. It is not clear if it will be, before the next lychee season. EA goes through a consultation process before developing guidelines and gazetting. However, it seems that, so far, they have only consulted the fruit growers. Also not gazetted, the QLD decision not to give permits for FF electrocution. This decision is being challenged in the courts by QLD fruit growers. As I wrote this, the phone rang - QLD EPA want me as an expert witness - I kid you not. Spit!

Following the CRC report, the court case. An interesting, often traumatic experience. A 60 hectare orchard employs a 6.4 km electrocution grid to “protect” lychees from SFFs over an 8 week harvest season. I shall not discuss if the grid was used legally, or QLD NPWS’s effectiveness in supervising the damage-mitigation permit system. The essence of the case is that the number of FFs killed in this one orchard would significantly reduce World Heritage values in the surrounding WTWHA. Four once-nightly counts of newly-killed bats were made over a two week period (409, 499, 305, 297) giving a mean ± standard deviation of 378±96 bats per night, and 95% confidence limits of 226-530 (ie., 95% probability that the mean lies within these limits). Perhaps most significant, the grid had operated for some time before the first counts were made, and a large number of bats were still being killed a fortnight later, indicating that the grid had no measurable deterrent effect on the SFF population and was far from effective in “protecting” the crop.

We calculated that in 8 weeks, 21,168 bats were killed. The opposing barrister made much of this number, and that it amounted to 18 tonnes of corpses. However, while the number (and weight) might seem excessive, they should be viewed in the context of an orchard of 10,000 trees - a kill rate of 2 bats per tree per season. Moreover, the counts do not allow for deaths of severely injured animals away from the grid, or for bodies that fell from the grid. Since the kill occurred at the peak of the birth/lactation season, it is likely that the population entering the orchard comprised more than 50% females.

From the reproductive potential of SFFs, we calculated that such a kill rate would put populations of 50,000 - 200,000 females into rapid decline (halving times < 10 yrs). Is this why the SFF population is thought to have declined from 820,000 in 1985, to 80,000 in 2000?

The opposition barristers were good, but all of our witnesses stood up well to hard cross-examination, including Allen McIlwee, who had helped Carol Booth make the counts. Allen received particularly brutal treatment on this subject, over the phone, alone at home. We, in court could hear it all, but could do nothing to help. So, Allen was doubly traumatised; experiencing first the horrific electrocution of hundreds of flying foxes, and then the harshest cross-examination of the case. Talking later to the barrister responsible, I noted how thuggish he had been to Allen. He replied, "but didn't he stand up well". I want to emphasise just how much Allen has put into these FF issues, how much he has contributed to the papers he and I are publishing, and how much of his personal life he has sacrificed - notably completion of his PhD thesis. He is currently having to complete within 3 months - not an easy task. In writing the papers together via cyberspace, I couldn't have wished for a better co-author. So thank you Allen, from all who care about FFs.

Thanks also to Carol Booth for her vast efforts: the initial decision to make the counts; making the counts in an extremely hostile environment; the long period of stressful responsibility for taking the issue to court -TWICE; then undergoing a prolonged, intense cross-examination. Thank you Carol. Thanks also to the Environmental Defenders Organisation: our solicitor Elisa Nicols, and barristers Chris McGrath and Ted Christie for a sterling job. Sod's law saw to it that, on the final day, just before the summing up, Ted had to go to hospital, subsequently to undergo a multiple bypass, thankfully successful. So, at short notice, Chris had to carry the can. Well done Chris, and best wishes for Ted's complete recovery. The judge was charming, razor-sharp, and had read and understood all of the submitted evidence. And the result? Still 1-2 months before we know, but we are optimistic.

All-too-soon after the court case, the Sydney workshop on management of the now-vulnerable GHFF. A packed day - perhaps 2 would have been better - but well organised, and near comprehensive. The main beef was the short time allowed for oral presentation [how the hell do you do "All you ever wanted to know about sex and death in flying foxes" in 8 minutes?]. However, the important outcome will be the written papers, which will go far beyond the spoken, and provide a volume that should be a major tool to influence politicians. The fruit growers' presentations were excellent and, in the breaks, I was able to talk with them, hear their side of things. We conservationists must listen to the growers, so that we can help each other find mutually satisfactory solutions to the problems. So, back to the roost, write Martin/ McIlwee Sydney paper; revise McIlwee/ Martin population paper and explain revisions to editor in relation to referees' comments. Write something for ABS Newsletter; prepare email for the Flying fox Understanding, sorry, Information & Conservation Network. Then TOBB can relax.

Flying Fox Information & Conservation Network (FFICN) is a loose association of people who work with, or care for, FFs. FFICN's terms of reference are to: ***collect and analyse information to improve the care and rehabilitation of FFs; educate wildlife carers and the public about FFs; disseminate information relating to FFs within the scientific and conservation communities; encourage the protection of FFs and their environment.*** Other than this, there is no formal constitution. FFICN appears to function as a civilised anarchy. Recently attending my first, very enjoyable, FFICN meeting, and having nothing better to do (Ha Ha), I offered to act as the network's cyber-clearing house. That is, those with information to share, can e-mail it to me (<Leonard.Martin@mailbox.uq.edu.au>), and I will disseminate it. FFICN members were happy that the network be broadened, so if you wish to join, e-mail me your details. Note: I do emails, not attachments (cause too much trouble), phone-arounds or snail-mail-outs.

Science, extremists, fundamentalists, and their ilk TOBB has always supported wildlife and flying fox carer groups, and emphasised the high quality of the scientific information that they can provide. At the Sydney GHFF and FFICN meetings, I again heard accounts of first-class scientific observations made by individuals who are not professional scientists. Some accounts were presented with diffidence, sometimes almost reluctance, because of lack of confidence on the part of the observer. We really do need a recognised channel for the publication of such material - to get it out into the scientific literature and thereby accessible to all. So, I suggest here that ABS Newsletter and ***Australian***

Zoologist develop sections dealing specifically with observations and data produced by non-professionals. Meanwhile, TOBB offers, with no strings attached, sympathetic-but-critical professional scrutiny of any material any of you care to offer (I may live to regret this!).

Carers and amateurs are often patronised by professional scientists. But, as TOBB pointed out before: Darwin and Mendel were amateurs, and the "Professional Scientist", a recently-evolved species, already looks to be highly-endangered with populations in rapid decline! However, put-down by "The Club" is not new. The recent BBC "***Longitude***", on development of the maritime chronometer by a humble carpenter, showed how he was patronised by the astronomers. Similarly the book, "***The Map that Changed the World***", describes how country surveyor, William Smith, completely self taught, produced the first stratigraphic map of Britain in 1815. He too was patronised by the Geological "Club" of the period and worse - plagiarised by the b*st*rds.

Together with experimentation and observation, the advance of scientific knowledge depends on a body of "established knowledge". However, such is not cast in stone, but is subject to modification and destruction in the light of new knowledge. In this respect it is best likened to bone, firm, but undergoing never-ending remodelling under the stresses of movement. The advance of science is dependent on

scepticism, criticism, continual re-examination of "established knowledge", continual self-criticism, and the ultimate question, "what do the data say". Science is not a religion. Nevertheless, "established knowledge" can all too easily become dogma. Those coming new to the trade may attempt to fit their observations into what appears to be "established fact". Peggy Eby recounts how a visiting scientist complained that the flying fox behaviour he observed did not fit the established zoological rules. Individual scientists become incredibly fond of their own theories [don't I know it] and can be tempted to reject data that do not "fit". It is sometimes said that a new scientific dogma doesn't become established until supporters of the old dogma have died.

So, it mayn't take much time for a body of scientific knowledge and procedures to become dogma. A set of necessarily-limited observations and empirically-achieved best-practices become a set of rules. Rules to be followed exactly as laid down in the good book. Rules that lead to reprimand (or worse) of any individual who does not follow them to the letter. Obviously, such sets of rules require a hierarchy of appropriately credentialled individuals (ACIs) to oversee them. Committees of ACIs are set up to examine the exact meaning of the rules, the limits thereof etc. Heretics are not tolerated. Those professing new and original observations or possibly better methods will be... cast out. Or even worse? Perhaps it is the background to events of September 11 2001 that leads me to such parallels. Why? Because the above appears to be happening within some wildlife carer groups in Australia. It is a tragedy. W*R*S WARS.

In the light of September 11, I consulted Gibbon (1787; ***The History of the Decline and Fall of the Roman Empire***) on what was going on in Arabia around the time of Mohamed's birth - and it was the Christian sects who were slaughtering one another. To quote Gibbon (Chapt. XLVII, p.1),

"After the extinction of paganism, the Christians in peace and piety might have enjoyed their solitary triumph. But the principle of discord was alive in their bosom, and they were more solicitous to explore the nature, than to practice the laws, of their founder. I have already observed that the disputes of the TRINITY were succeeded by those of the INCARNATION; alike scandalous to the church, alike pernicious to the state, still more minute in their origin, still more durable in their effects."

Flying foxes mightn't act like that, but a few wildlife carers seem to.

Here endeth the pontification, and may peace be with you.

Len Martin

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– Contacts, Networks, News, Announcements –

IXth European Bat Research Symposium (26th – 30th August 2002) and the 5th European Bat Detector Workshop (21st – 25th August 2002).

Both meetings will be held in France and pre-registration is being called for now.

Information can be gathered from the website for the symposium
<http://www.univ-lehavre.fr/actu/9EBRS>

For information on the Bat Detector Workshop, email S.Y. Roue <bats.france@wanadoo.fr>

Elery Hamilton-Smith

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News from around the traps

Victoria

Friends of ours are currently building a mudbrick house on their 16 ha property approximately 12 km north of Maffra in East Gippsland, Victoria. The property is mainly uncleared open woodland of Red Box ***Eucalyptus polyanthermos*** and White Stringybark ***E. globoidea*** with a grassy understorey. The walls are up, roofs on, internal framing done, window frames are in, but no glass in the windows as yet and the house is a bit breezy so they are living in a comfy shed next door. In late August (28th), on a chilly but calm night, air temperature around 12°C, no moon, overcast and around 60% cloud cover the lady of the manor happened to be in the house looking for something. She heard squeaks, twitterings and chatterings coming from the dark interior of the house and went off to get her partner. With torch in hand they started to investigate, searching around on the concrete slab but nothing, could still hear chitterings. Finally located the noise, there hanging from the top of the brick wall (normal house bricks) in the bathroom about 2.8 metres off the ground were two small bats mating, both squeaking and chattering in a fairly feisty manner, the larger one making the most noise. The smaller one (from the motions, apparently a male) was on top of the female hanging upside down in the typical bat position. The male seemed to be hanging off the female and she was hanging off the brickwork. They were obviously copulating and weren't disturbed by the torch light. Climbed up for a closer look. The pair continued on, the male was either grooming, similar to a dog fleaing its self or biting the female on the back of the neck, there was no mantling or any other gripping with the wing or fingers observed. They watched for about 2-3 minutes then left the bats alone. Went back to check them about ten minutes later and the male had left, female was still hanging in same position. They took the female inside and identified it as a lesser long-eared bat ***Nyctophilus geoffroyi*** female with a forearm length of approx. 38mm (measured with a ruler).

And coincidentally, another friend brought in a male (looked to be 1st yr) ***N. geoffroyi*** two days later that she had hit whilst driving home. It appears that this species is out and about in Gippsland although it is only late August and the nights are generally pretty cold.

Jim Reside (Observation provided by Deb and Dave Hooper)

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I have just finished the practical side of a bat-box project I have undertaken at Shepherds Bush, Victoria, as part of my final year assessment at Holmesglen TAFE. I have installed 25 boxes, in a valley sclerophyll forest, and am now up to the management strategy and recommendations part of the project. This is where I was hoping for some advice. I have been planning to monitor the boxes 4 times a year, but I don't know if this is enough, or too much. Does anyone have any advice as to the optimum frequency of box monitoring? Species present in the forest are ***Chalinolobus morio, C. gouldii, Nyctophilus geoffroyi, Tadarida australis, Vespadelus vulturnus, V. darlingtoni***, and ***V. regulus***. Any input at all would be greatly appreciated.

Mimi Pohl (to ozbatline) <mimipohl@optusnet.com.au>

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South Australia

In May 2001, I was able to visit St Michael's church in Entringen in Southern Germany, and see ***Myotis myotis*** in residence in the loft of the church. We (Sanderson family) were visiting the Duppel family in Heimsheim Germany, having previously exchanged teenagers with them in 1998 for about 6 weeks. At the church in Entringen we were met by Prof Erwin Kulzer, who has been studying these bats for many years, by Reinhold Bauer, burgermeister (= mayor) and church organist, and by Pastor Frank Schirm. Our host Ursi Duppel, who seems to have many contacts in Baden-Württemberg, arranged all of this for us.

St Michael's Church was founded in 1452, and has a very heavy bell tower, which was too heavy for the underlying substrate, so that the tower began to lean, and in the 1990s it was necessary to take corrective action, which involved drilling through the floor. By this time, it was known that there were bats in residence in the church loft over summer, and that they seemed not to be disturbed by the organ music, so when it was necessary for drilling to occur, Reinhold Bauer played the organ, at the request of Prof Kulzer, to minimise disturbance to the bats. All this was told to us by Prof Kulzer, burgermeister Bauer and Pastor Schirm, and we were given a small book (Der schiefe Turm von Entringen = the leaning tower of Entringen) which was produced for the completion of repairs in 1997 and the dedication of new church bells (lots of church bells were melted down for armaments during the 2nd world war). This small book contains an item called "Myotis Musikalis, Concertino für Mausohren" which is a poem telling about the special organ music played for the bats during the drilling.

The loft (inside the roof) of the church is very spacious, 12.5 m from the wooden floor laid on the ceiling, to the peak of the roof: all this is shown in a scientific article by Kulzer und Müller (1997) Die nutzung eines Kirchendaches als "Wochenstube" durch Mausohr-Fledermause (Myotis myotis). (» Use of church lofts as nurseries by Mouse-Eared Bats). Veroff Naturschutz Lanschaftspflege Baden-Württemberg 71/72, 267-326. There were many bats in residence in the church loft the day I visited. Prof Kulzer plots the locations of the bats once each week from March to October, collects the droppings on big plastic sheets which are taken up at the end of each season when the bats go to their winter quarters, and has also instituted some measures to reduce the parasite load in the bats. This includes the application of double sided sticky tape around some beams to catch parasites.

Finally we couldn't help noting what a great site this is to study bats - it has convenient access up fixed staircases, with a wooden ceiling floor that can be walked on without fear of falling through the ceiling, and comfortable space inside the roof to work in (unlike most of the building roosts we've been into around Adelaide).

Ken Sanderson
Email Ken.Sanderson@flinders.edu.au

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Tasmania

TAFE Adult Education weekend course "Listen to the Bats" in Stanley, Tasmania, late November 2000. Ten very enthusiastic people joined me at a property in NW Tassie for a bat education and trapping weekend. We caught a bunch of very pregnant females and watched some of them fly back to a roost - first time for me!

Dec 2000 to March 2001. Have been trapping to look for more information on birth/weaning timings to follow up my Honours work. Have also been running bat education walks for the public through the Hobart City Council's Bushcare program – booked out and at least one bat every night!

Tamara Kincaid

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New South Wales

14/3/2001 - 4.30 pm I received a rescue call from Byabarra where a householder was distraught to find two "baby bats really crook in my kids' sandpit". He was worried that he may have harmed them by spraying an outside pergola area for white ants. Arrived on the scene to two very sandy and flat juvenile little bent-wing bats, and after scouring the near environs discovered a roost of 5 more equally flat bats in a pergola post hollow. The householder confessed they would have had white ant poison sprayed directly on them two days before - he remembered sticking the spray nozzle in that particular hole. He had thrown away the container so I wasn't able to identify the poison. Once in mobile phone range I 'phoned the Wauchope Vet and asked if he could stay there until I arrived about 5.45 pm with seven poisoned microbats in tow. "They'll need an atropine shot" says I. "They'd weight about 12g?" says he - "No more like 3-6g" I reply. The response was "that'll be a challenge!" Of the seven juvenile little bent-wings, five were female and two male, and average weight was 5 g. Two were dead on arrival, five were treated with atropine, three died two days later, one on the third day, leaving one lucky one who survived her ordeal and was released after gutsing herself on mealworm innards and whatever insects I could catch.

Postscript: In rehab we often don't get animals quickly enough. One bat had been seen the day before the rescue call and it was only the second sick bat that prompted the call to FAWNA. Might the success rate have improved if that 24 hours had not passed?

Meredith Ryan, FAWNA (NSW) Inc., the NSW mid north coast's rescue and rehabilitation group.

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Dear Terry,

The 12th International Bat Research Conference Group at the Hotel Equatorial, Bangi, Malaysia, held between 5 and 9 August 2001. Some 20 ABS members attended, including ABS President Bruce Thomson, Peggy Eby, Nicola Markus, Greg Richards and Lindy Lumsden.

Papers were presented from researchers from Brown University, York University, Boston University, Duke University and the Universities of Munich, Toronto, Virginia, Regina, Massachusetts, Goteborg, Bristol, Leeds, Otago, Montreal, Singapore, Zurich, Tennessee, London (Queen Mary College), Erlangen, Ulm, Tubingen, Illinois, Kent, Nottingham, Aberdeen, Geneva, UCLA & Riverside, Miami, East Michigan, and from Burma, India, Japan, Netherlands, Poland, Portugal, Spain, Tajikistan, South America and the Smithsonian Tropical Research Institute.

Liz Price organised field trips to Dark Cave, Batu Caves and there was a post conference trip to Krau Wildlife Reserve, which was a wonderful opportunity to catch many Malaysian species, including the impressive naked bat, ***Cheiromeles torquatus***.

Zubaid Akbar and his Committee are to be congratulated on a very full and well-organised conference.

Kelvin Grose

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Terry,

Found the following article in a centenary issue of “The Port Macquarie News”.

FOX HUNT
Some thousands killed

Anniversary Day, Jan. 26, 1892 –
About 20 sportsmen assembled, according to agreement, at the same scene of the fox camp on the Ellenborough River, for the purpose of again treating these troublesome little pests to a shower of leaden hail.

The company was comprised of fine jovial, fellows, well armed and equipped, and they found the foxes quite numerous enough to stand the four-hour siege which followed.

The assailants stormed the enemy in a most determined manner, and kept up a vigorous attack during the afternoon, with the result that some thousands were killed and wounded, and general satisfaction was expressed at the success of the onslaught.

It was evident that the “camp” was comparatively thin to what it was on the occasion of the first battle last year, when an immense army of the pests was annihilated.

Greg Little

Queensland

Some news from my part of the world to include in the Qld State roundup.

A team of 11 battos was recently brought together to produce a set of management recommendations for bats on State Lands as part of the Southeast Queensland Regional Forest Agreement process. The development of these management guidelines further highlighted the lack of available information on bat distribution and abundance, and breeding/roosting sites. While some good information is available for cave and forest bats, and especially for flying foxes, little other than generic recommendations could be made based on current knowledge. It was notable that, despite the fact that we all know that some microbats commonly use bridges and culverts for roosts, little has been done to address the issue of what to do with the bats if/when repair or replacement work is carried out on those structures. A quick check around key bat people in several other States revealed that Queensland appears to be the first state to try and tackle this specific management issue.

Perhaps there's a role for the ABS in bringing together our collective knowledge and coming up with some nationally relevant guidelines that can than be adapted as and where needed in the various regions/states.

Nick Baker is nearing the completion of his Honours Thesis (University of Southern Qld) on Habitat Use by Bats in the Bunya Mountains area.
Al Young has been busy, as usual, in his retirement. Most recently, Al has been involved in monitoring microbat activity (and other fauna responses) in an area that has undergone a rabbit control program in southwest Queensland. He's also been flat out writing up some of his work on ***Rhinolophus megaphyllus*** and ***Chalinolobus morio*** in southeastern Queensland.

Greg Ford is looking at using microbats as focal species for demonstrating ecosystem services and the role of on-farm remnant vegetation in biodiversity conservation. This is part of a Landcare project that aims to equip farmers and other community members with a better understanding of ecological processes, and should lead to better incorporation of nature conservation with agricultural production. The Toowoomba Landcare Group is holding a bat (and bird) box building day as part of their biodiversity month activities, so we hope to get lots of people interested in providing some extra habitat for our rural microbats.

Greg Ford

(fordg@powerup.com.au)

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– Recent literature –

Compiled by Greg Ford (with some late additions from Lindy Lumsden)

Haven't the world's bat biologists been busy writing over the last six months? Or, rather, weren't they busy in the previous year or two, given the lag time between writing and publication? The following bibliography (almost 100 papers) was sourced largely from the ***InfoTrac ISI Current Contents*** web search engine and includes material published since March 2001. Papers published in several Australian journals were sourced from various web sites (e.g. Royal Zoological Society of NSW; CSIRO journals). A number of other journals were not sourced, or do not appear on ***Current Contents***.

There's something for everyone here. I have not excluded anything from the ***Current Contents*** search (except for papers on baseball and cricket bats!), so there are lots of international papers that will be irrelevant to many readers, but of some interest to others. For ease of reference, I've tried to categorise the papers into a few general topics. Check out the detailed acoustical anatomy/physiology papers coming out of the northern hemisphere!

Acoustic methods

Duffy, A.M., Lumsden, L.F., Caddle, C.R., Chick, R.R. and Newell, G.R. 2000. The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in south-eastern Australia. ***Acta Chiropterologica*** **2**(2), 127-144.

Fenton, M.B. 2000. Choosing the 'correct' bat detector. ***Acta Chiropterologica*** **2**(2), 215-224.

Fenton, M.B., Bouchard, S., Vonhof, M.J. and Zigouris, J. 2001. Time-expansion and zero-crossing period meter systems present significantly different views of echolocation calls of bats. ***Journal of Mammalogy*** **82**(3), 721-727.

Hayes, J.P. 2000. Assumptions and practical considerations in the design and interpretation of echolocation-monitoring studies. ***Acta Chiropterologica*** **2**(2), 225-236.

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Jones, G., Vaughan, N. and Parsons, S. 2000. Acoustic identification of bats from directly sampled and time expanded recordings of vocalizations. ***Acta Chiropterologica*** **2**(2),155-170.

Korine, C. and Kalko, E.K.V. 2001. Toward a global bat-signal database. ***IEEE Engineering In Medicine And Biology Magazine*** **20**(3), 81-85.

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Parsons, S. 2001. Identification of New Zealand bats (***Chalinolobus tuberculatus*** and ***Mystacina tuberculata***) in flight from analysis of echolocation calls by artificial neural networks. ***Journal of Zoology*** **253**(4), 447-456.

Reinhold, L., Herr, A., Lumsden, L., Reardon, T., Corben, C., Law, B., Prevett, P., Ford, G., Conole, L., Kutt, A., Milne, D. and Hoye, G. 2001. Geographic variation in the echolocation calls of Gould's Wattled Bat ***Chalinolobus gouldii***. ***Australian Zoologist*** **31**(4): 618-624.

Sherwin, R.E., Gannon, W.L. and Haymond, S. 2000. The efficacy of acoustic techniques to infer differential use of habitat by bats. ***Acta Chiropterologica*** **2**(2), 145-153.

Echolocation and auditory neurology

Bodnar, D.A. and Bass, A.H. 2001. Coding of concurrent vocal signals by the auditory midbrain: effects of duration. ***Journal of Comparative Physiology A-Sensory Neural and Behavioral Physiology*** **187**(5), 381-391.

Burger, R.M. and Pollak, G.D. 2001. Reversible inactivation of the dorsal nucleus of the lateral lemniscus reveals its role in the processing of multiple sound sources in the inferior colliculus of bats. ***Journal of Neuroscience*** **21**(13), 4830-4843.

Erwin, H.R., Wilson, W.W. and Moss, C.F. 2001. A computational sensorimotor model of bat echolocation. ***Journal of The Acoustical Society of America*** **110**(2), 1176-1187.

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Table of contents

Instructions for Contributors 2

Editorial 3

Australian Bat Society Inc – Business and Reports
- President's report 4
- Secretary's report 5
- Treasurer's report 6
- Membership Secretary's report 7
- Publicity Officer's report 7
- Minutes of Financial Annual General Meeting, 26 May 2001 10
- Notice of the 10th Australasian Bat Conference, Cairns, Queensland, April 2002 12
- Notice of the 7th Australasian Bat Society, Inc., Biennial General Meeting, Cairns, Queensland, April 2002 12

Research Papers
- A maternity roost of the Southern Myotis ***Myotis macropus*** in a rural landscape – Bradley Law, Mark Chidel and Alison Towerton 13
- Aspects of roost selection by microchiropteran bats in Bundjalung National Park, north-eastern NSW – Brett Campbell 16
- A note on the effect of cave entrance disturbance upon internal bat surveys: a case study from north Queensland – Greg Richards and Alison Martin 34
- Antechinus preys upon bats in harp traps – Maria Adams 37
- Remote sensing techniques in bat research – Sirena Wan 38
- Evening drinks for grey-headed flying foxes – Vivien Jones 41

Reports and Viewpoints
- Tolga Bat Hospital - Jenny Maclean 43
- A Review: 'Flying foxes – Fruit and Blossom Bats of Australia' – Vivien Jones 44
- Habitat and prey-related correlates for microbat assemblages in the Bunya Mountains, southeastern Queensland – Nick Baker 45
- Submission on the management of bats on State lands as part of the Southeast Queensland Regional Forest Agreement process, September 3rd 2001 – from Monika Rhodes and colleagues 46
- The unusual penis morphology of the hairy-nosed freetail bat – Terry Reardon 53
- Artificial bat roost box design – Terry Reardon 54
- A long squawk from the old bent bat (TOBB) – Len Martin 56

Contacts/Networks/News/Announcements
- IXth European Bat Research Symposium (26th – 30th August 2002) and the 5th European Bat Detector Workshop (21st – 25th August 2002) 59
- News from around the traps 59

Recent Literature 64