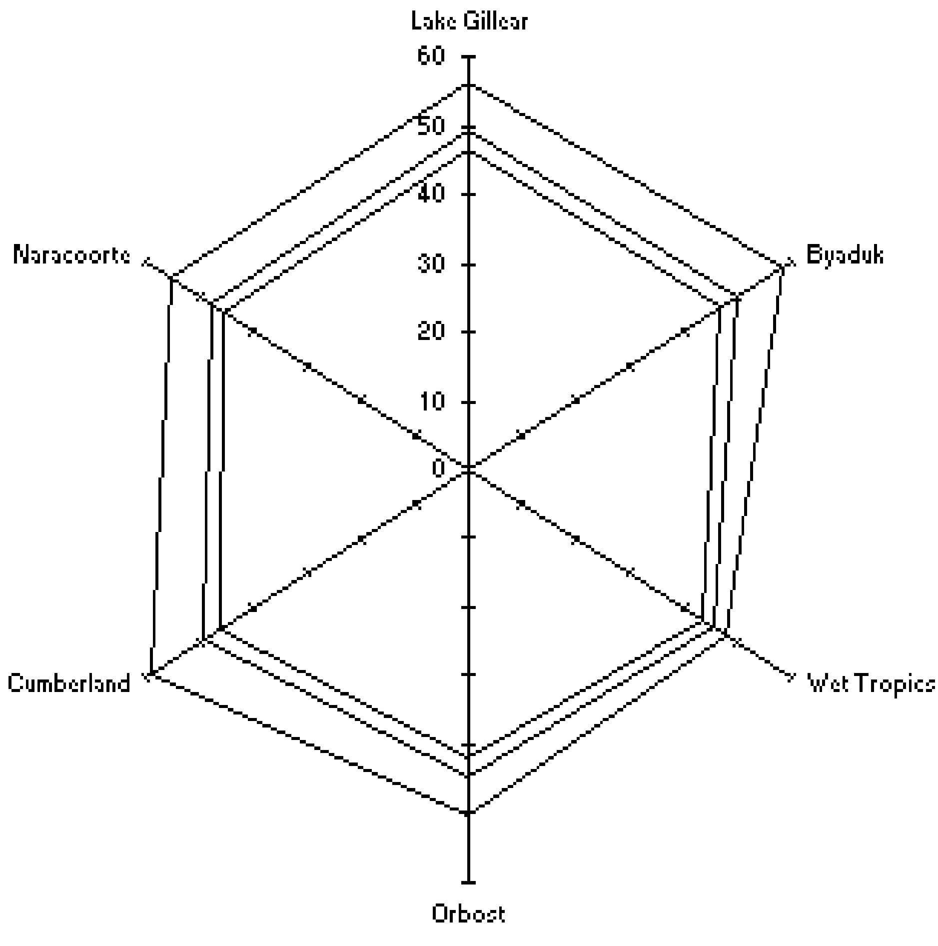
March 1997 Issue 8

Australasian Bat Society Newsletter

Averaged values of F (mean, max, min) (kHz)
for *Miniopterus schreibersii*



INSTRUCTIONS TO CONTRIBUTORS

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

For Scientific Articles:

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

For News, Notes, Notices, Art etc.:

Hard copy should be posted to the Newsletter Editor at the address below. Electronic copy should be submitted in plain text (ASCII) form on an IBM format 3½" floppy disk to the address below, or as an e-mail attachment to the Newsletter Editor. Manuscripts should be submitted in clear, concise English, double-spaced (with generous margins, and on A4 paper for hard copy) and free from typographical and spelling errors. Art in the form of line drawings and other monochromatic media may also be submitted. Some black and white photographs can be reproduced in the *Newsletter* after scanning and digital editing (consult the Editor for advice).

Special notes for electronic submission:

Although electronic submission is strongly encouraged, there are a few ground rules. I use IBM-PC and UNIX computers, and have very limited means to decode files generated by Amiga, Macintosh or other systems. Plain text (ASCII) is by far the best format to eliminate compatibility problems, and can easily be sent as part of the body of an e-mail message. This is the only *convenient* way for me to receive text generated on an Amiga or Macintosh. If attaching formatted IBM-PC files to e-mail, please remember to tell me what word processing package has generated the file. I can decode UU, MIME and BinHex attachments. If none of this makes sense, please ask for advice from your local computer guru, system administrator or Internet access provider.

President

Greg Richards
PO Box 3305 BMDC
Belconnen ACT 2617
Australia
Ph (06) 253 2050
Fax (06) 253 2050
Ph Mobile (0414) 533 305

Secretary

Jillian Snell
GPO Box 5047
Sydney NSW 2001
Australia
Ph (02) 9264 1800
Fax (02) 9267 5363

Newsletter Editor

Lawrie Conole
2/45 Virginia Street
Newtown Vic 3220
Australia
Ph AH (03) 5229 4037
Fax BH (03) 9663 3669
Ph Mobile (0419) 588 993
E-mail: lconole@mov.vic.gov.au

EDITORIAL

This is newsletter number four of those I have edited, and I feel there about two or three more left in me before I hand it over to the next incumbent. I feel that a change of editor, after a respectable period, will be healthy for the organisation, and so look forward to hearing from people clamouring at the door in anticipation of taking over the job for the February / March edition of 1999.

On to more immediate matters, I still have not received enough unsolicited material to put this newsletter together. Most of what you read here has been begged for / sweet-talked / commissioned! Please take the newsletter seriously - if you enjoy reading it, then consider making a relatively small effort to support it with content. If you can read, I presume you can also write!! If I don't get enough copy sent in voluntarily over the next few months, I do not expect there will be a second newsletter in 1997. Grant Baverstock has scratched together another "Recent publications" with almost no help from the authors (thanks to those who have sent citations & / or reprints)..

One the positive side, thanks to Carol Bentley who's cartoon work appears in this issue. Carol, a new ABS member, is available for cartooning commissions. Contact her at:

The deadlines and guidelines for budding authors are all on the previous page. Start writing NOW.

Lawrie Conole
Editor - ABS

PRESIDENT'S REPORT

The ABS committee has tried hard to serve its members during the crises that occurred after the discovery that Lyssavirus is now present in Australia. The death of a colleague from this disease alerted us that we have come of age, and that we have to regard bats in a different way, but no different to colleagues in other countries. Linda Collins has been active in sending information on new handling procedures through the networks, and has been untiring in her efforts to ensure that everyone should be aware that pre-exposure vaccination is essential. Amongst many others, Len Martin, Les Hall, and Helen Luckoff have also been tireless in their efforts to communicate with colleagues and government departments in Queensland. Chris Tidemann endeavoured to put bats into perspective with people at the federal level. The Society thanks these people, who are just a few of the many that committed time and money to face this issue.

I tried too, but gave up, and for doing so I profusely apologise. In November last year, when the issue raised its ugly head, I attempted to contact the senior players in the government departments that were involved, but with little success. It wasn't until I expressed in the news media my frustration that the Society's members - the highest risk group in the nation - had been ignored in the information circuit; when I was quoted in newspapers as being appalled at nil response, after 7 weeks, to urgent faxes requesting information from relevant Commonwealth departments, that I finally received a response on the day after publication. In my opinion, such inaction indicates the extent to which bureaucrats care about our welfare. This was the point at which I gave up wasting my time on this issue.

To meet our decision at the last conference to generate Quality Assurance guidelines for bat surveys, I then decided that time would be better spent pursuing a grant to enable the sub-committee to operate. Funds were available through the Comprehensive Regional Assessment committee of the Department of Prime Minister and Cabinet, which is part of the Regional Forest Agreement process. We prepared a proposal and applied for $5,000 to meet our requirements for CRA publicity, whilst at the same time we established our QA guidelines. Our application was successful, but the funding was reduced to $1,500 with no concomitant reduction in the Society's contractual commitment. We declined the funding because we would be legally obliged to do more than we could afford - the mathematics show clearly that we would have incurred a liability way beyond our means! So far, after a great deal of work which was a waste of time, we haven't had a good run when dealing with administrations that are supposed to support organisations such as ours.

Just to top off these problems, we now seem to have the Bat Action Plan stalled within another government agency. It was submitted to the Australian Nature Conservation Agency in July last year, 9 months ago. This was followed by a review by experts and fauna agencies, which was to culminate with a round table meeting to answer criticisms and comments. Les Hall and I have attempted to pursue its progress, but without success. One could be cynical and wonder whether there are political problems with so many species being listed as endangered, particularly since some of them are flying foxes, but that would be unfair wouldn't it?

As you can see it has been a difficult 6 months for your committee, as it has for everyone when the Lyssavirus is considered. I could very easily stand corrected, but at the moment I feel that bat conservation will not progress in Australia if we deal with Government agencies, and would very much like to be proved wrong.

However, there may be some light at the end of the tunnel. I have just spent two weeks with executives from Bat Conservation International, and after many discussions about our problems in Australia, we finally have some support forthcoming. BCI have agreed in principle to fund the publication of all papers on Australian bat conservation that will be presented at the 8th Australian Bat Conference next year. Considering the problems with the Bat Action Plan, and our lack of a status report on current issues and problems, I would like to suggest that we have an extensive session on conservation biology this time. It seems to me that as well as conservation papers, many of the ecological studies on endangered species/communities/habitats would also qualify for publication in this volume.

I must admit to now feeling rejuvenated after seeing what can be done, and how easily, when support is sought from non-government areas. This offer took less than 30 minutes from proposal to approval - perhaps this is a new national record - and we will have the moral support of BCI for many years to come.

Greg Richards
President - ABS

ABS CONFERENCE - ROCKHAMPTON - 1998

After consideration of several options, it has been decided that the Eighth Australian Bat Conference, and the next meeting of the Australasian Bat Society, will be held at Rockhampton, immediately after Easter in 1998. Apart from being significant as a conservation hot-spot for many years, other reasons include cheap accommodation, good options for field outings, enthusiastic organisers, but most importantly the sponsorship of the venue and facilities by the University of Central Queensland. These positives outweigh the problem of the distance of the venue from major metropolitan centres. It may be possible to overcome this by chartering a "Bat Bus" that commences its travel at Melbourne and collects passengers as it travels the east coast highways.

As mentioned elsewhere, the proceedings of the session on conservation biology and issues will be published by Bat Conservation International. This will be the first time that we have been able to produce a document from one of our meetings.

The AGM of the society will be held underground in the Cathedral Chamber of Olsen's Cave in the Mount Etna complex. This should be a great event, and most appropriate for a society with an interest in bats, and it is possible that several species of bats will be attending the meeting with us!

Being mindful of the huge task that Lindy and Terry accomplished for the Naracoorte meeting, we have decided to spread the load as much as possible. The organising committee - so far - is as follows:

Conference Boss	David Gee
Rockhampton arrangements	Mary McCabe, Dianne Vavryn, Ann Munster and many, many colleagues, plus the University of Central Queensland.
Scientific sessions	Greg Richards and David Gee
Preparation/publication of conservation proceedings	Greg Richards and Bat Conservation International
"Bat Bus" travel arrangements	vacant

Any comments or suggestions can be sent to David Gee:

PO Box 189	E-mail <dgee@mildura.net.au>
New South Wales 2715	Phone (03) 5024 8708
AUSTRALIA	Fax: (03) 5021 3328

LETTERS TO THE EDITOR

7 April 1997

Sir,

The recent public backlash against bats following bat paramyxovirus and Australian bat lyssavirus has highlighted the need for a strong, coordinated advocacy for bats, able to respond quickly in crises and, in the longer term, to proactively address bat conservation issues at a *national* level. It is clear from recent events that it would be unwise to rely on Governments to perform these functions. The Australasian Bat Society, as an independent, non-Government organisation, has the capacity to address these issues. I believe we should use this opportunity to critically evaluate what we should do.

Little of the media coverage of bat-borne diseases gave an objective assessment of the risks to human health, nor did it contain information about the positive aspects of bats to society. The negative image of these animals, already well entrenched in the minds of most Australians, was reinforced and more than a few flying-fox and cave-bat colonies perished in "reprisals". Some of the blame can be attributed to a haphazard response by health and conservation agencies, but blame must also be attributed to a slow and uncoordinated response from people concerned about bat conservation.

If we want the community to view bats as an asset it is vital that pro-bat information goes hand in hand with factual advice about the health risks from bats and how to minimise them; otherwise we run a grave risk of being seen as tunnel-visioned bat fanatics. Similarly, we must confront the undoubtedly genuine bat-related problems experienced by sections of the community, such as fruitgrowers and vegetation rehabilitators. Communication between bat-workers is obviously an important function of a society devoted to the study and conservation of bats, but in many ways this should be secondary to communication with the public, especially rural people, who control most of the land in this country (only 6% is in protected areas) and hence determine the fate of its wildlife.

Immense effort to conserve bats continues to be expended at a local level in many places in Australia, but the actions are almost completely uncoordinated, sometimes conflicting and most of the country remains in ignorance. Effective integration and re-direction of these small-scale activities would eliminate the extensive duplication of effort that presently occurs, thereby leading to many economies of scale. This would help resolve, for example, the present situation of a handful of office-bearers having to shoulder most of the work of the Society.

The Society, if it is to survive, should provide an umbrella for all individuals and groups concerned with bat conservation in Australia. If it were incorporated it could apply for funds as a community group, enabling it to effectively address issues, such as education, at a national level. Several other very important bat conservation issues are unlikely to be achieved by government departments or individual researchers alone, but could, through the provision of appropriate training, become part of the focus of the Society. Examples are monitoring of cave-bat colonies and flying-fox camps as a basis for management. Existing conservation measures for these animals are almost certainly inadequate. In time, one hopes, private sources of funding could also be located for bat conservation as has been achieved by counterpart organisations in other countries, such as the USA and the UK.

To ensure effective conservation and management of Australia's diverse bat fauna we must actively confront the problems and look for solutions to them. A fragmented approach has never been optimal; it is now vital that we pool the resources available to us and address the issues in a concerted fashion.

Chris Tidemann
Australian National University

ARTICLES

Seed dispersal by fruit bats on the Krakatau Islands, Indonesia.

Louise A. Shilton
University of Leeds
c/o P.O. Box 2039
Bogor Timur 16020
Jawa Barat
INDONESIA
Email <lshilton@indo.net.id>

Introduction

The Krakatau Islands, in the Sunda Strait, between the islands of Java and Sumatra, provide a special opportunity to study the processes of forest development and recovery from disturbance. Though the recolonisation of the islands by plants and animals represents perhaps the best documented example of rainforest succession in the humid tropics, the roles of frugivorous (fruit-eating) bats and birds in the recolonisation of the islands by plants has, until recently, received little detailed attention (see Whittaker & Jones 1994, Thornton 1994, Thornton et al. 1996). Mine is the first study to quantitatively assess the role of fruit bats, and to a lesser extent frugivorous birds, in the recolonisation of, and subsequent forest succession on, the Krakatau Islands.

Since the early 1980's, biological research on the Krakatau Islands has primarily been conducted during zoological and botanical expeditions led by Ian Thornton from La Trobe University, Victoria, and Rob Whittaker from Oxford University, England, respectively. The present study has been conducted principally from my own institution, The University of Leeds, England, in collaboration with Indonesian researchers from Puslitbang Biology and the Indonesian Institute of Sciences (PPPB/LIPI), though I have also collaborated with both the La Trobe University and Oxford University teams in the field.

I have been living in Indonesia, and conducting research on the seed dispersal activities of fruit bats on the Krakatau Islands, since June 1995, and will continue to be based here until September this year.

Background to the project

A brief history of Krakatau

In August 1883 the volcanic island called Krakatau attained fame as a result of an explosion of a magnitude so great it defies imagination: more than 10,000 times the force of an Hiroshima-type hydrogen bomb (Thornton 1996). The sound produced during the explosion was the loudest ever recorded, and was heard in such distant localities as Central Australia, Sri Lanka and Rodriguez Island in the Indian Ocean. The rising plume of steam, gases, ash and fractional matter rose to an estimated 40 km, and remarkable sunsets were witnessed in the Northern hemisphere for months or years afterwards as a result.

The explosion caused the total destruction of two-thirds of the island, and completely scorched two neighbouring islands, Panjang and Sertung. The remaining fragment of the pre-eruption Krakatau was, aptly, christened Rakata - a truncation of the original name. Rakata's impressive Northern cliff, an almost sheer face rising 800m directly from the sea to its peak, represents a clean scar where the rest of the island of Krakatau once existed. A near-by island, Sebesi, was also seriously damaged by the eruption, and the West coast of Java was indirectly devastated by an enormous tsunami (tidal wave) that caused the loss of some 36,000 lives. Although nobody can be certain, scientific opinion holds that no biota survived the 1883 eruption on either Rakata, Panjang or Sertung - no plants, no animals, and no propagules.

In 1930 a new island emerged from the submarine caldera, adding to the fascination of the island group. This fourth island was named Anak Krakatau ("Child of Krakatau") and is an active volcano centrally situated in the Krakatau group, separated from the three other islands by distances of only two or three kilometres. The four islands are situated in the Sunda Strait approximately equidistant from the nearest shores of the biologically rich islands of Java and Sumatra, separated by 44 km of sea, and some 13 km from the nearest stepping-stone island, Sebesi.

Over the years since the eruption the Krakatau group has been a focus of attention for many researchers from wide-ranging disciplines, including historians, geologists, volcanologists, botanists, zoologists, ecologists and biogeographers.

Krakatau: the biogeographers dream

Naturalists of the day readily recognised the unique potential the Krakatau Islands - devoid of all life - presented for studying the processes of colonisation. Anak Krakatau's emergence provided a second opportunity for studying one of the main questions of ecology: how are communities of living things assembled? The fact that the Krakatau Islands represent a natural experiment for the studies of colonisation was seized upon by Edward Wilson and Robert MacArthur, two of the greatest ecologists of our time, and the islands played a central role in the development of their equilibrium model of immigration and extinction processes as presented in their classic book *The Theory of Island Biogeography* (MacArthur and Wilson 1967).

Recolonisation of Krakatau

Just nine months after the cataclysmic eruption a French expedition visited Rakata; they found only a living spider. The first botanical expedition to the islands took place two years later in 1886, and was led by a Dutchman, Professor Treub. Treub's expedition found mosses, blue-green algae, flowering plants and ferns. Most of the plant species had been transported to the islands by the wind, though there were also a few species whose seeds may have been transported by the sea.

Other life forms arrived quickly thereafter. By 1887 Rakata supported young trees as well as dense mats of grasses and an abundance of ferns. A few years later, a growing invertebrate fauna was supported by this vegetation including butterflies, beetles and flies; and the Monitor Lizard *Varanus salvator* had already arrived.

By 1934, only half a century after the islands were rendered barren by the eruptions, Rakata, Panjang and Sertung between them held 271 species of plants. About 40 per cent of these species are considered to have been transported to the islands by wind dispersal, 30 per cent by the sea, with the remaining having arrived on, or within the gut of, an animal disperser (zoochorous).

Since 1934 the Krakatau forests have continued to develop and increase in species diversity. Out of the 15 families of spermatophytes which have arrived since 1934 (Whittaker *et al.* 1992), all but one is animal-dispersed. Although the animal-dispersed (zoochorous) component colonised relatively late, it has shown the most significant increase, both as a percentage and in actual numbers (from 48 species in 1934 to 110 in 1989 to 134 in 1992) (Thornton 1996). Dispersal by animals has been of monumental importance in the development of the Krakatau forests. All but ten of these zoochorous species are regarded as having been dispersed endochorously (internally - via the gut). Most of the endochorous colonists are relatively long-lived trees and shrubs of the interior forests. The most important of the later-successional zoochorous trees are Temirit *Timonius compressicaulis*, Teki *Dysoxylum gaudichaudianum* and figs *Ficus* species.

The animal-dispersed floral component on the islands has increased steadily over the past sixty years. This is not surprising, since a positive feedback mechanism operates where increasing numbers of seed dispersal agents bring in more seeds, and more plants grow and produce more fruits which in turn, attract more seed dispersal agents. The zoochorous component is considered to be of great ecological importance on the islands.

This positive relationship between the presence of frugivorous animals and fruiting plant species is nicely illustrated by figs. On the Krakatau islands the number of fig species closely follows the number of frugivores recorded on the islands.

Figs were among the first trees to recolonise the Krakataus, and currently represent one of the dominant floral elements on the older islands, where over 20 species have been recorded (Compton *et al.* 1994). By providing food for a wide range of vertebrate frugivores and thereby supporting seed disperser populations, fig trees potentially influence the dispersal of other zoochorous species, and are considered to be "keystone" plant resources on the islands, and indeed, in many tropical forests (*eg.* Marshall 1985, Terborgh 1986, Lambert & Marshall 1991, Compton *et al.* 1994).

Nowadays the forests of Krakatau support a wide variety of vertebrate and invertebrate fauna; including micro and megabats, land and shore birds, snakes, geckos, monitor lizards, rats, crabs, scorpions, spiders, beetles, butterflies and termites.

More than eighty species of non-migrant vertebrates have been recorded on the islands since 1883 (Rawlinson *et al.* 1992). Approximately 90 per cent of these are believed to have established breeding populations; including 47 species of birds, 17 species of bats 11 species of reptiles and two species of rat (Rawlinson *et al.* 1992; Schedvin *et al.* 1994). Approximately 80 per cent of the resident vertebrate species are volant: bats and birds.

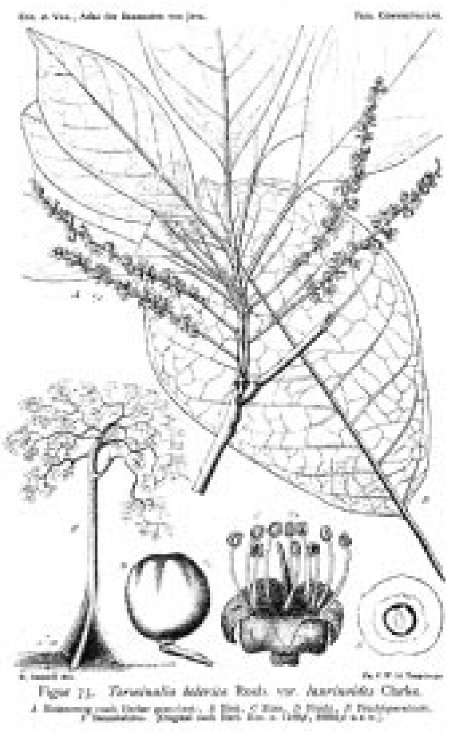
Seed dispersers on Krakatau

There are five groups of potential seed dispersal agents on the Krakatau Islands (excluding introduction and spread by humans).:

◊ fruit bats,
◊ frugivorous birds,
◊ rats,
◊ land crabs, and
◊ ants.

However, while it is possible that rats, land crabs and ants play some role in secondary seed dispersal on a local scale, they are unlikely to have anything more than a minor role in the dispersal of seeds on these islands.

My study has focused on the two groups that are most important in the dispersal of seeds, the only groups capable of inter-island dispersal, and thus in bringing in seeds of colonising plant species: frugivorous bats and birds. However, I have studied the foraging and seed dispersal activities of the fruit bats on Krakatau in much greater detail than the frugivorous birds.



Fruit bats of Krakatau

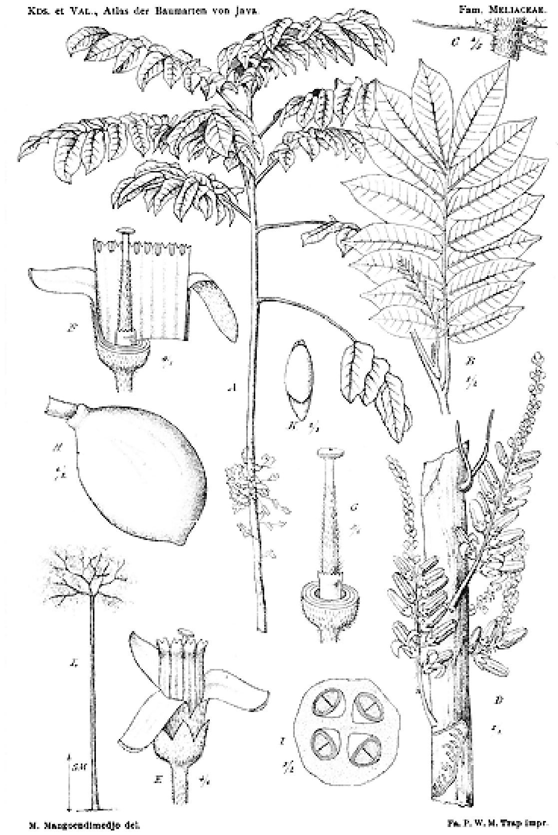
Since the devastation of 1883, 25 species of bats, 11 of which are pteropodids, have recolonised the Krakatau Islands, and adjacent areas of West Java (Tidemann *et al.* 1990). The history of fruit bat decolonisation of the Krakatau Islands has been documented intermittently, and though it is almost certainly incomplete, pteropodids are known to have been the first bat colonists with more recent microchiropteran arrivals. Important early accounts are provided by Docters van Leeuwen (1936) and Dammerman (1948).

The Greater Short-nosed Fruit-bat *Cynopterus sphinx angulatus* was the first fruit bat to be recorded on the islands of Rakata and Sertung, in 1919, and is now common on both islands (Tidemann *et al.* 1990; Shilton, pers. obs.). *C. sphinx* has been recorded on all subsequent surveys and is present on all four islands (pers. obs.). A related species, Horsfield's Fruit-bat *C. horsfieldi*, was observed on Rakata in 1920 and on Sertung in 1930, but was then considered to be extinct (Rawlinson *et al.* 1992; Schedvin *et al.* 1994) until the most recent surveys (present study, data not yet published). A colony of Geoffroy's Rousette, *Rousettus amplexicaudatus*, was first recorded in a cave on Panjang in 1933, and this species now occurs on all four islands (Rawlinson *et al.* 1992). A third species of *Cynopterus, C. titthaecheilus titthaecheilus*, was first recorded on Rakata in 1974, and has since been found on Sertung and Panjang. The Hill Blossom-bat *Macroglossus sobrinus sobrinus* was recorded on Rakata in 1974 (Hill 1983), but was not recorded again until the present study (data not yet published). A smaller, closely related species, the Long-tongued Blossom-bat *M. minimus minimus*, was recorded on the islands as skeletal remains in owl pellets in 1992 (Schedvin *et al.* 1994), along with a single specimen of the larger Leschenault's Rousette

Rousettus leschenaulti. A fourth species of *Cynopterus*, Short-nosed Fruit-bat *C. brachyotis*, is also considered to be present on the Krakatau Islands (Thornton 1994; pers. obs. and data not yet published). A large colony of the Large Malay Flying-fox, *Pteropus vampyrus,* was first recorded on Sertung in 1985, and has been recorded on several occasions since (*eg.* Rawlinson *et al.* 1992, Whittaker and Jones 1994; pers. obs.). *P. vampyrus* is common on both sides of the Sunda Strait and has often been observed flying over the sea (*eg.* Rawlinson *et al.* 1992; pers. obs.).

Bats as seed dispersers

Megachiroptera are known to feed upon fruits of at least 145 genera of plants, from numerous families, but most notably Palmae (Arecaceae), Anacardiaceae and Sapotaceae (Marshall 1985, Whittaker and Jones 1994). *Ficus* species (Moraceae) are major food plants of frugivorous bats and birds in South East Asia (*eg.* Lambert 1991, Lambert and Marshall 1991) and fruit bats are among the most important dispersal agents of many species of *Ficus* worldwide (*eg.* August 1981, Janzen 1979, Utzurrum and Heideman 1991). Bat dispersed plants often appear to be trees which produce sugary types of fruit, rather than the oily fruits important to birds (Snow 1981, Marshall 1985). In *Ficus*, a distinction is often made between cauliflorous species with large, dull "bat-fruits" (eg. *Ficus hispida*), and small, brightly coloured figs that appear to be most suited to bird-dispersal (eg. *Ficus ampelas*).



Figur 98. *Dysoxylum densiflorum* Miq.

A Habitusbild (verkleinert), *B* Blattzweig, *C* Fuss des Blättchens, *D* Zweig mit Blutenständen, *E—G* Blute mit Analyse, *H*, *I* Frucht, *K* Samen, *L* Baumhabitus. [Original, *A* nach einer Photographie (eines Baumes im Hortus Bog.) von Herrn C. Laxo, *B—L* nach Herb. Kds. n. 5104, 12700β, 4967β, u. s. w.].

Frugivorous birds of Krakatau

Important frugivorous birds present on the Krakatau Islands include the Black-naped Fruit-Dove (*Ptilinopus melanospila*), Pink-necked Green-Pigeon (*Treron vernans*), Green and Pied Imperial Pigeons (*Ducula aena* and *D. bicolor*), Yellow-vented Bulbul (*Pycnonotus goiavier*), Black-naped Oriole (*Oriolus chinensis*), Emerald Dove (*Chalcophaps indica*), Ruddy Cuckoo-Dove (*Macropygia emiliana*) and Asian Glossy Starling (*Aplonis panayensis*).

Bats as seed dispersers on the Krakatau Islands

Examples of bat-dispersed species from the Krakatau flora include *Cyrtandra sulcata, Ficus* spp.*, Muntingia calabura, Piper aduncum* and *Timonius compressicaulis*; seeds of which have been recovered from intestines or faeces of *Cynopterus* spp. *Cynopterus* fruit bats were present at the time of the first zoological survey of Anak Krakatau in 1982 (Tagawa 1984), and *C. sphinx angulatus* was found to be common in the vegetated portion of Anak Krakatau in 1984 (Tidemann *et al.* 1990). At this time individuals were seen to be defecating and regurgitating fig seeds, a year before the first fruiting *Ficus* were recorded on the island, strongly suggesting that the fruits were produced by trees on the other islands (Compton *et al.* 1988). Though resident populations of bats might initially be anticipated to be more important as agents of local spread of plants than of their colonisation, fruit bats are known to travel considerable distances to feed. Thus, *Cynopterus* spp. are likely to have been the initial fig seed dispersal agents to Anak Krakatau, and perhaps the other islands in the group.

Whittaker and Jones (1994) argued that bats and birds have partially overlapping, yet complementary roles as seed dispersers on Krakatau. However, it is possible that night-flying fruit bats are far more significant in depositing seeds in open habitats than day-flying birds (Fenton and Fleming 1976, Fujita and Tuttle 1991, Whittaker and Jones 1994) and they are likely to be more important for inter-island seed dispersal because they are less sedentary than the birds on the islands (pers. obs.).

Objectives of the present study

The overall aim of my PhD study on the Krakatau islands is to assess the importance of fruit bats in the dispersal of seeds, on and between the islands, in order to test the hypothesis that fruit bats have a key role in the restoration of tropical rainforests in disturbed areas.

Ten field trips have been made to the Krakatau Islands to date, ranging between five days and four weeks duration. Progress to date is summarised under the six specific objectives being addressed:

1) To identify the most important plant species, in terms of resources available to vertebrate frugivores, and monitor their fruiting phenologies within plots on the islands.

Seven of the nine phenological plots (200m by 10m) established on the Krakatau Islands, five on Rakata (R) and two on Panjang (P), have been monitored for fruiting and flowering trees during each visit to the islands (July to October 1995 and March to September 1996). Two plots on Anak Krakatau (A) have not been accessible since March 1996, due to the resumed volcanic activity of this island. Within each plot all trees with a diameter at breast height of 5 cm or greater have been tagged. Preliminary analysis of results to date suggest *Ficus* species may serve as a "keystone resource" for frugivorous bats on the Krakatau Islands during the dry season (April to September) by supporting disperser populations during periods of lower general fruit availability and thereby directly influencing the dispersal of other zoochorous species.

2) To establish which frugivorous bats and birds are present on the Krakatau Islands, and estimate species' abundance.

Bat captures. Seven hundred fruit bats have been captured on the Krakatau Islands with the use of mist nets (8 on A, 156 on P, 505 on R, and 31 on Sertung (S)). Pteropodid bats captured on the Krakatau Islands to date are *Cynopterus brachyotis* (R, P, S? and A?), *Cynopterus sphinx angulatus* (R, P, S? and A?), *Cynopterus titthaecheilus* (R and P), *Cynopterus horsfieldi* (R, P and S), *Rousettus amplexicaudatus* (R, P and S?), and *Macroglossus* species (R and P). In addition, observations have been made of feeding and commuting *Pteropus vampyrus*(?) (R and P. Present record uncertainties (?) are where the identity of specimens has yet to be confirmed.

Bat splat counts. Bat splat counts have been conducted on Rakata and Panjang during each field trip to Krakatau. These counts are made by walking inland 2 km from the respective camps, and recording all bat splats and regurgitated pellets in alternate 20m lengths of transect; giving a total of 50 counts per island. Preliminary analysis of these counts suggest higher bat feeding activity on Rakata, than on Panjang. However, it is possible that bat splat counts are misleading: for example, higher rainfall (basic rainfall monitoring on Rakata and Panjang during the course of this study suggests that Panjang receives more rainfall than Rakata), and ashfall on Panjang may wash or mask the presence of bat splats on this island.

Bat recaptures. Sixteen ringed *Cynopterus* bats have been recaptured to date (approximately 3 percent of bats ringed). All but two of the recaptured bats were captured near the site where they were marked (0-200m). The other two bats were ringed on Rakata and subsequently recaptured on Panjang Island further supporting the assertion that these bats move between islands in the Krakatau group to feed (Compton *et al.*, 1994; Whittaker and Jones, 1994; Thornton, 1994, 1996). Four of the recaptures have been ringed for a considerable period of time: 161, 196, 220 and 239 days.

Bird surveys. Early attempts to capture frugivorous birds with mist nets on the Krakatau Islands were not successful. Since March nets have not been set during the daytime to capture birds. However, birds are conspicuous by their vocal activity and all frugivorous bird calls are noted during early morning hours on each field trip. Records of bird calls will be used to estimate the abundance of each species.

Surveys to date have confirmed the presence of the most important frugivorous bird species: Black-naped Fruit-Dove, Pink-necked Green-Pigeon, Green and Pied Imperial Pigeons, Yellow-vented Bulbul, Emerald Dove and Ruddy Cuckoo-Dove.

3) To monitor the feeding activity of frugivorous bats and birds in order to relate feeding patterns to the availability of fruits, within plots on the islands.

In addition to information gained from faecal samples and bat splat counts showing the fruits that bats are eating and what seeds the bats are dispersing, information of bat feeding activity has also been obtained during a series of observation periods (morning and evening) at selected fruiting trees. During most field trips three or six fruiting trees have been observed intensively during three consecutive mornings and evenings for bat and bird feeding activity.

Tree species observed to date (male, M and female, F) include *Ficus ampelas* (F), *F. fistulosa* (F), *F. fulva* (M and F), *F. hispida* (M and F), *F. septica* (F), *F. variegata* (M and F), *Timonius compressicaulis, Morinda citrifolia* and *Dysoxylum gaudichaudianum*. Fruit bats (*Cynopterus* and possibly also *Rousettus* species) have been observed taking figs from all *Ficus* species except *F. ampelas* (small, axillary, characteristically bird dispersed figs, though other literature has suggested that bats may be a disperser. *eg.* Thornton *et al.*1996).

In addition, bats have been observed removing *Timonius compressicaulis* fruits (which, in appearance at least, are like small figs), and fruit bat activity has been observed within the canopies of *Morinda citrifolia* (sea dispersed and spread inland by bats) and *Hernandia peltata* (sea dispersed and spread inland by bats). Lesser fruit bats (?) and flying-foxes (*Pteropus vampyrus*?) have been observed in *Terminalia catappa* trees (also known as the "Indian almond"), and certainly readily consume fruits from this species when it is in fruit. Bat activity in *T. catappa* is fairly conspicuous as the *Pteropus* tend to clamber about the tree's canopy, consuming fruits *in situ*, so that the large seeds of *T. catappa* can be heard (and seen) raining down from the canopy. Radiotracking data from *Cynopterus* bats also suggests that these bats either regularly use *T. catappa* trees as feeding roosts, and / or consume *T. catappa* fruits in situ. However, Ian Thornton has observed *Cynopterus* bats dropping *Terminalia* fruits 100m from the nearest possible source tree in Pelabuhan Ratu, on the coast of south-west Java (Thornton 1996, p. 124). This observation suggests *Cynopterus* bats do, at least on occasion, take *Terminalia* fruits to feeding roosts. That *Cynopterus* bats will remove *Terminalia* fruits and carry them some distance from the source tree is confirmed on Krakatau by the presence of *Terminalia* seeds on the floor of *C. tittaecheilus* roosts on Panjang island (Tidemann *et al.* 1990, pers. obs.). Similarly, the calyx / seed of *Hernandia peltata* are frequently observed on the floor of the *C. tittaecheilus* roost (pers. obs.).

Observations of frugivorous bird feeding activity to date include the Black-naped Fruit-dove, the Yellow-vented Bulbul and the Plain-throated Sunbird *Anthreptes malacensis* feeding on the fruits of *Macaranga tanarius*; the Black-naped Oriole feeding upon the fruits of *Ficus fulva* and *Dysoxylum gaudichaudianum*; the Ruddy Cuckoo-Dove, the Pink-necked Green-pigeon and Yellow-vented Bulbul feeding of the figs of *Ficus ampelas*; and the Plain-throated Sunbird in, and possibly feeding on the figs of, *Ficus montana*. No birds were observed feeding on fruits of the *Ficus septica*, *F. variegata*, *F. hispida*, or *Morinda citrifolia* which have been observed intensively during the day.

Bat faecal samples. More than five hundred faecal samples have been collected from netted bats (approximately 60 percent of all captures). Preliminary analysis indicates that more than 90 percent of fruit bat faeces contain seeds of *Ficus* species (Moraceae), with approximately 85 percent containing *Ficus* seeds only. Though data from faecal analysis is biased towards small-seeded fruits, this preliminary analysis suggests that *Ficus* fruits (figs) are a major component of the diet of fruit bats on the Krakatau Islands, and may represent a "keystone resource" for these vertebrate frugivores. Bat faecal samples are currently undergoing analysis; the contents of all of the samples have been identified; though some samples require germinating to confirm species identification.

4) To establish intra- and inter-island movements of frugivorous bats, by means of radio telemetry, in order to determine possible patterns of local and inter-island seed dispersal.

Twelve *Cynopterus* bats have been fitted with radiotransmitters to date. Radiotracking data has been acquired for each bat tagged. Results suggest that *Cynopterus* bats on the Krakatau Islands a) will return to capture sites, even on the evening immediately after their capture; b) may be predictable in their movements, returning to the same site at approximately the same time on several consecutive evenings; c) often roost within 200m of a feeding site; d) may visit more than one feeding site during the same evening or, e) they may return to their roost in between foraging 'bouts'; f) utilise other trees within close proximity to the fruit source as feeding roosts; g) move between islands in the Krakatau group on occasion.

5) To determine gut passage times/seed retention times of each frugivorous species by feeding captive individuals fruits known to be consumed under natural conditions.

Gut-passage / feeding studies with locally captured *Cynopterus* bats will commence shortly. Individual bats will be observed in cages constructed for this purpose, and faeces will be removed on sheets of paper until all material is considered to have been voided. Fruit handling behaviour will also be noted.

Extreme care will be taken to ensure that study bats remain healthy during their brief time in captivity.

6) To perform a series of germination experiments on seeds from bat and bird faeces, and regurgitated ballast, as well as seeds extracted from fresh and fallen fruits, in order to determine the effect of gut passage on the viability of seeds.

Seed germination trials will commence shortly. In addition to the assessment of seed viability, these trials will also confirm the identification of some seeds whose identify is uncertain at present.

Future field schedule

A final data collection field trip will be made to the Krakatau Islands in July / August 1997, in collaboration with Dr Rob Whittaker (University of Oxford, England). During this time all phenological plots established during this study will be monitored for fruiting and flowering trees. Eight fruit bats will be radiotracked for their local (intra-island) and inter-island movements. This work will supplement what has so far been learned about the local movements of these fruit bats, and strengthen any conclusions that may be drawn from the present radiotracking studies, of the dispersal quality (in terms of distance travelled) by these bats.

Anyone who would like to receive more information about this ongoing study and the findings to date can e-mail or write to me at the addresses listed at the head of this paper.

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References

1. August, P. V. (1981). Fig fruit consumption and seed dispersal by *Artibeus jamaicensis* in the Llanos of Venezuela. *Biotropica* **13**: 70-76.
2. Compton, S. G., Ross, S. J. and Thornton, I. W. B. (1994). Pollinator limitation of fig tree reproduction on the island of Anak Krakatau (Indonesia). *Biotropica* **26**(2): 180-186.
3. Dammerman, K. W. (1948). The fauna of Krakatau (1883-1933. *Verhandelingen der Koninklijke Nederlandse Akademie Van Wetenschappen Afdeling Natuurkunde (Tweede Sectie)* 44: 1-594. N. V. Noord-Hollandsche Uitgevers Maatschappij, Amsterdam.
4. Doctors van Leeuwen, W. M. (1936). Krakatau 1883-1933. *Annales du Jardin botanique de Buitenzorg*, **46** & **47**: 1-506.
5. Fenton, M. B. and Fleming, T. H. (1976). Ecological interactions between bats and nocturnal birds. *Biotropica* **13** (supplement): 45-53.
6. Fujita, M. S. and Tuttle, M. D. (1991). Flying foxes (Chiroptera: Pteropodidae): threatened animals of key ecological and economic importance. *Cons. Biol.* **5**(4): 455-463.
7. Hill, J. E. (1983). Bats (Mammalia: Chiroptera) from Indo-Australia. *Bull. Br. Mus. Nat. Hist. (Zool.)* **45**: 103-208.
8. Janzen, D. H. (1979). How to be a fig. *Ann. Rev. Ecol. Evol.* 10: 13-51.
9. Lambert, F. R. (1991). The conservation of fig-eating birds in Malaysia. *Biol. Cons.* **58**: 31-40.
10. Lambert, F. R. and Marshall, A. G. (1991). Keystone characteristics of bird-dispersed Ficus in a Malaysian lowland rainforest. *J. Ecol.* **79**: 793-809.
11. MacArthur, R. H. and E. O. Wilson (1967). *The Theory of Island Biogeography*. (London: John Wiley).
12. Marshall, A. G. (1985). Old world phytophagous bats (Megachiroptera) and their food plants: a survey. *Zool. J. Linn. Soc.* **83**: 351-369.
13. Rawlinson, P. A., Zann, R. A., van Balen, S. and Thornton, I. W. B. (1992). Colonisation of the Krakatau Islands by vertebrates. *Geojournal* **28**(2): 225- 231.
14. Schedvin, N. K., S. P. Cook and I. W. B. Thornton (1994). The diversity of bats on the Krakatau Islands in the early 1990s. *Biodiversity Letters* **2**: 87-92.
15. Snow, D. W. (1981). Tropical frugivorous birds and their food plants: a world survey. *Biotropica* **13**: 1-14.
16. Tagawa, H. (Ed.) (1984). Researches on the ecological succession and the formation process of volcanic ash soils on the Krakatau islands, pp. 1-120. (Kagoshima University: Japan).
17. Terborgh, J. (1986). Keystone plant resources in the tropical forest, pp. 330-344. **IN**: M. E. Soule (Ed.). *Conservation Biology, the science of scarcity and diversity*. (Sinauer Associates, Inc. Publishers: Sunderland, Massuchusetts).
18. Thornton, I. W. B. (1994). Figs, frugivores and falcons: an aspect of the assembly of mixed tropical forest on the emergent volcanic island, Anak Krakatau. *South Australian Geographical Journal* **93**: 3-21.
19. Thornton, I. W. B. (1996). Krakatau. The Destruction and Reassembly of an Island Ecosystem. Cambridge, Massachussetts, Harvard University Press.
20. Thornton, I. W. B., Zann, R. A., Rawlinson, P. A., Tidemann, C. R., Adikerana, A. S. and Widjoya, A. H. T. (1988). Colonisation of the Krakatau Islands by vertebrates: equilibrium, succession, and possible delayed extinction. *Proc. Natl. Acad. Sci. USA*. **85**: 515-518.
21. Thornton, I. W. B. and New, T. R. (1990). Krakatau invertebrates: the 1980s fauna in the context of a century of recolonisation. *Phil. Trans. R. Soc. Lond. B. Biol. Sci.* **322**: 493-522.

22. Thornton, I. W. B., S. G. Compton, and C. N. Wilson (1996). The role of animals in the colonisation of the Krakatau Islands by fig trees (Ficus species). *Journal of Biogeography* **23**: 577-592.
23. Tidemann, C. R., Kitchener, D. J., Zann, R. A. and Thornton, I. W. B. (1990). Recolonisation of Krakatau Islands and adjacent areas of West Java, Indonesia, by bats (Chiroptera) 1883-1986. *Phil. Trans. R. Soc. Lond. B* **328**: 123-130.
24. Utzurrum, R. C. B. and Hiedeman, P. D. (1991). Differential ingestion of viable Vs nonviable *Ficus* seeds by fruit bats. *Biotropica* **23**(3): 311-312.
25. Whittaker, R. J., M. B. Bush, T. Partomihardjo, N. M. Asquith and K. Richards (1992). Ecological aspects of plant colonisation of the Krakatau Islands. *Geojournal* **28**: 201-211.
26. Whittaker, R. J. and Jones, S. H. (1994). The role of frugivorous bats and birds in the rebuilding of a tropical forest ecosystem, Krakatau, Indonesia. *Journal of Biogeography* **21**: 245-258.

Some hints on how to use the new Analook

Catherine Caddle & Lindy Lumsden
Arthur Rylah Institute
Heidelberg, Victoria.

Having just spent some time familiarizing ourselves with Chris Corben's new ANALOOK program (version 3.5), we thought that it might be of value to share some of what we have learnt with others who might be wanting to use Analook. As there is no manual or extensive Help menu available it may save you some time, although this is certainly not an exhaustive description of what this program can do. There are some functions which we have not used and as there are some fairly experimental aspects to the program, we shall leave it to someone else to explain the hard bits! We have found Analook very useful in several capacities; it is an excellent way to clean up and organize your call library, by deleting or moving files between subdirectories and changing text information easily; and it is brilliant for extracting call parameters and establishing data on reference calls, and as an aid to identifying unknown call sequences. If you don't have a copy of the latest Analook (it is now included on the Anabat5 disk), it is available from David Titley, or it should be on Herry's web site (Bat calls of south-eastern Australia).

Getting started

Analook can be saved into it's own subdirectory and then accessed through Windows, File Manager or through the DOS prompt by typing 'Analook'. Initially you are presented with a graphics screen from which you can enter the Help menu by pressing 'Backspace'. The File Menu can be entered by pressing 'Shift L', and drives, directories and files can be accessed in the same way as in Anabat5. Once in a file, 'Shift [' or 'Shift]'can be used to flick backwards and forwards between files. This makes it really quick to identify a batch of call files, and is especially good for getting comparisons between calls by toggling between them. Greater detail is given in Help Menu 4 about these functions.

Moving files

First mark all the files that you wish to move, copy or delete by pressing 'Alt m': files can be marked either in file menu mode when the file name is highlighted, or with the file open. The words *file marked* will flash up if the file is open and a cross will appear next to the file name. By pressing 'Alt v', 'Alt c' or 'Alt d' you will then respectively move, copy or delete the marked files. If moving or copying files you will then be required to specify the destination subdirectory by going to it in file menu and pressing enter when it is highlighted. If moving files you will then be asked if files are to be deleted, this is referring to the files in their original location, so you can answer yes. You can unmark files by pressing 'Alt u' or universally reverse the marking by pressing 'Alt r'. This is covered in Help Menu 2.

Text header information

Once a call is on the screen the text header information is displayed at the bottom of the same page, with the file name and graphics information beneath it. It is great to have all the information displayed on the same screen, (although you will loose this information when you enter measurement mode). Rewriting the text header is straightforward in Analook, press 't' and the text header is highlighted and changes can then be made, these changes can be saved by pressing 'Alt s', or not saved by simply entering or escaping out of text mode. This is outlined in Help Menu 3.

Graphics presentation

The graphics presentation can be displayed either with a linear or log scale by pressing '+' or '-' respectively. There is real and compressed modes which are toggled between with the space bar, but expanded mode and the horizontal cursor, found in Anabat5, are not available. Expanding the calls using the 'F stops' and horizontal movement with the cursors or the '1' to 'f' markers are the same as in Anabat5. Refer to Help Menu 1 for more functions.

Entering measurement mode

By pressing 'm' when a file is open, you enter measurement mode and call parameters of the displayed sequence are calculated. These will appear at the bottom of the screen in place of the header text. The parameters given are the mean values for all the pulses currently on screen. They are displayed from top left to bottom right, as follows:

N number of calls currently displayed on screen

St location of displayed pulses within sequence
Sl initial slope of pulse
Sc slope of the characteristic section
Qu quality of call (indication of how smooth the call is, lower values are better)
Fmax maximum frequency
Fmin minimum frequency
Fmean mean frequency (which is weighted by time spent at each frequency)
Fc characteristic frequency (referring to the flattest part of the pulse)
Fk frequency at the knee (i.e. the point where the slope changes from Sl to Sc)
Dur duration of pulse (msecs.)
TBC time between calls (msecs.)
Ntbc the number of time between calls
Tc time into the pulse when the characteristic frequency is reached
Tk time into the pulse when the knee is reached
Qk quality at the knee (Chris is still working on this one - he advises that at the moment it is not all that useful).

To use Analook to extract parameters you require a computer with a colour screen. How a sequence is displayed can be changed by altering the filters using 'Alt 1' to 'Alt 0'. If filter 0 is employed then no dots will be excluded from the calls and you will have a display in two colours. We use Filter 1 which displays the call in three colours. One colour will show all dots excluded from the parameter calculations, a second colour will highlight the initial slope of each call and a third colour will highlight the characteristic slope of the call, (colours can be customized by pressing 'Alt o' and selecting the part you wish to change and the new colour). This is explained in Help Menu 5.

Edit mode

Analook makes some decisions which may not be to your liking, with nonsensical parameters generated as a result, making it necessary to edit the sequence manually before recording the parameters. By pressing 'Alt e', you will see that the mouse becomes activated, and when the mouse is held at the level of the text then a series of icons will appear overriding the text, these will disappear again if the mouse is raised above the text. You may for a start wish to mark on points as part of a pulse which Analook excluded, and this can be done by clicking on the 'Mark on points' icon. Next, drag the mouse across to form a box around those points you wish to include, after taking your finger off, these points should change to the included colour. The same can then be done to exclude points except click on 'Mark off points' and again define the area. 'Mark to exclude' and 'Mark to include' can change whole pulses and maybe useful if two bats have been recorded together at once and you wish to include only one of them. A whole pulse can be marked on or off by clicking on a single dot in its makeup, however we have found this to be a bit erratic if there are differences in what the computer and operator are defining as a distinct call. Analook has also determined where the change in slope occurs, which may need to be changed using the 'Modifying bodies' icon. By dragging the mouse over a section of the pulse you will redefine that section as being the new characteristic slope. If you are wishing to extend the characteristic slope you will need to highlight the original part as well as the new bit. You may encounter problems if a call is of poor quality as Analook will then view the call as being two distinct calls on top of each other. The parameter calculations are based on everything that is on the screen so make sure you only have good pulses showing - either expand it out to fill the screen by using the F stops or use the horizontal cursors to manipulate the display to obtain a good sequence on screen.

Once you are happy with the look of the call displayed, the parameters can be saved to an Excel file by clicking the 'Send to file' icon or pressing 'Ctrl q'. At the bottom of the screen will appear *Parameters saved to file Parmas.txt*. Unlike the parameters shown at the bottom of the screen, which are means for all the pulses on the screen, the parameters for each individual pulse are saved. Parameters will be sent to this one file from all call files within a subdirectory. It is a good idea on first entering Parmas.txt to save it as an excel worksheet and rename it, as you can potentially generate confusion with multiple Parmas.txt files in different subdirectories. Summary statistics can be performed for all parameters and graphs plotted. This is a great way to characterize a group of reference calls from a particular locality and then use Analook to run through your unknowns and have their parameters displayed for comparison with your reference call parameters. You will probably find different parameters of greater value than others for this purpose. If you wish to analyze files saved with earlier software than Anabat5 then Analook may not be able to read them, but if you load them into the Analook subdirectory and go into filecon.exe, it will convert them into 5.1 compatible files.

Analook is a great aid for detector analysis and the best way to get the hang of it is to have a play around, so have fun using it! When you want to exit Analook, it is 'ctrl x'.

We'd like to thank Chris Corben firstly for writing the program and secondly for showing us how to use it!

Reference calls of the White-striped Freetail-bat *Nyctinomus australis*.

Alexander Herr & Nicholas I. Klomp
Johnstone Centre
Charles Sturt University
PO Box 789
Albury NSW 2640

Introduction

The White-striped Freetail-bat *Nyctinomus australis* is rarely caught in harp traps in bat surveys, because the species is generally a high flier. Hence its presence must be determined by bat call analysis. However, call identification of ANABAT recordings relies on the visual comparison of the recordings with reference calls covering the range of possible variations within a species. Such reference calls are not readily available for *N. australis.* To add to the current library of calls readily available for bats of south-eastern Australia (http://batcall.csu.edu.au/batcall/batcall1.html) a range of calls from two adult female *N. australis* caught at their roost at Mt. Big Ben, Victoria are presented.

Methods

The bats were released 4m above ground standing at the back of a car in an open space surrounded by 40m tall trees. Upon release the bats descended to approximately 0.5 m above ground before flying away from the area, spiralling upwards. The bats' flight was followed with a 30 W spotlight. Echo-sounds produced by the bats were recorded with an ANABAT detector (Titley Electronics) on a tape recorder (Realistic Minisette 20) and later digitised with the ZCAIM and ANABAT 5.2b software (Titley Electronics).

Reference calls were prepared by determining the mathematical parameters of each pulse in the calls (a pulse is a single group of data points, one of several repeated patterns in a call, as shown in Figure 1). Any noise distorting the clear definition of a pulse was excluded manually. The ANALOOK (version 3) call analysis program (Corben pers. comm.) was used to determine all the mathematical parameters of the pulses that could be precisely defined and measured. Time between each pulse (Tbp), duration (Dur), maximum frequency (Fmax), minimum frequency (Fmin), average frequency (Fmean), and the characteristic frequency (Fc, the frequency at the point of the lowest slope) of each pulse within all the calls were determined.

Results

Examples of the calls of the bats at different stages of flight after release are presented in figure 1.

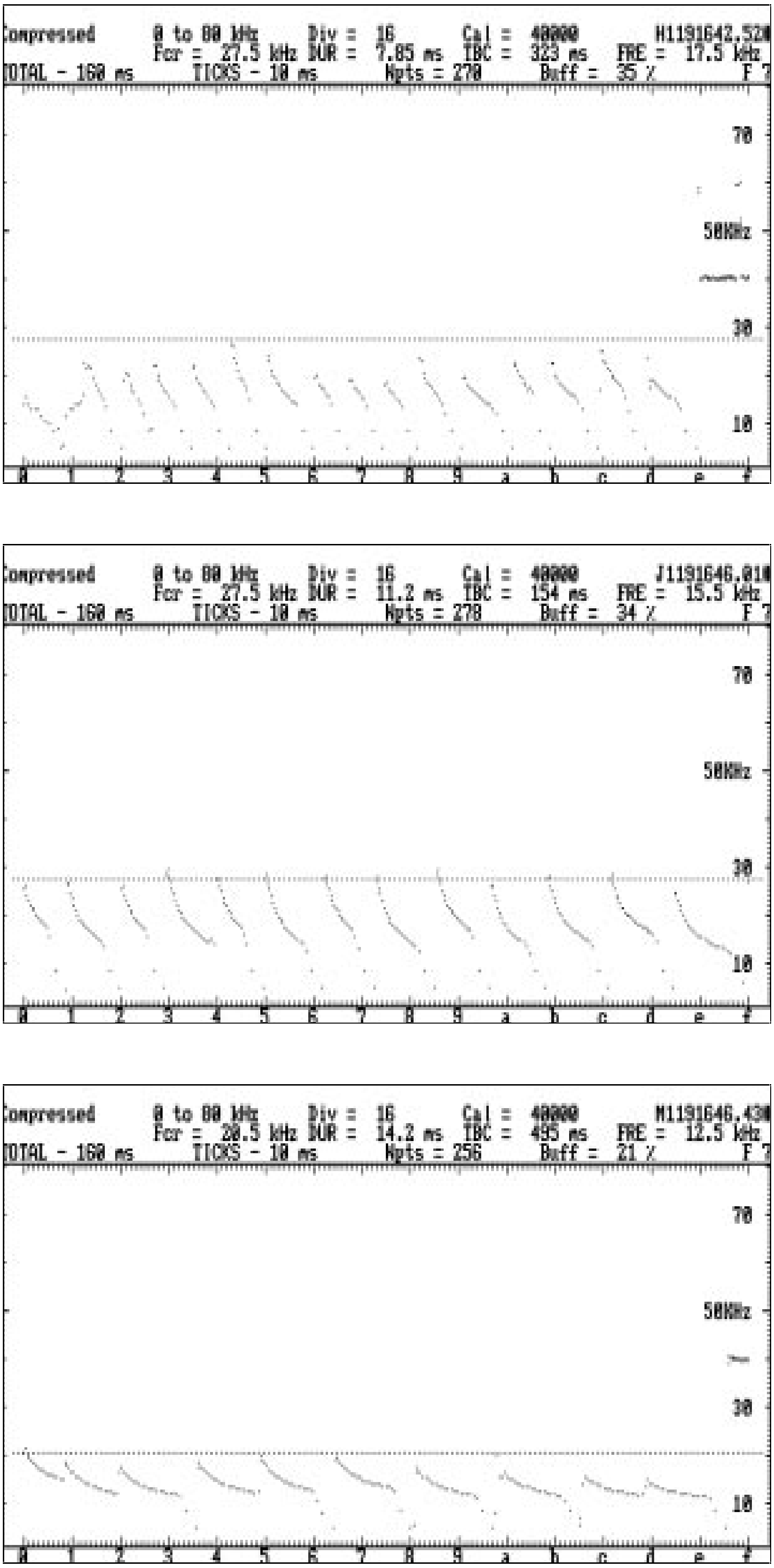

Figure 1: Sonogram of three phases of *N. australis* (1) commencing shortly after release, (2), spiralling and increasing height and (3)flying above canopy height .

The duration of the *N. australis* pulses at the start of its flight after release was significantly shorter than during the spiralling flight. The duration of the pulses again increases significantly when *N. australis* was flying over the canopy (table 1). The time between the pulses was shortest during spiralling flight. The maximum frequency of the calls after release and during spiralling flight was higher than when the bats fly above canopy, with the maximum frequency being highest during spiralling flight. The minimum frequency was lowest when the bats were flying above the canopy. The characteristic frequency was not statistically different between the first two flying stages, but dropped significantly when flying above canopy.

Discussion

Except for the characteristic frequency, all of the call parameters changed significantly during the different flights of *N. australis.* This species uses steep frequency modulated pulses, from 27 kHz to 13 kHz in the initial stages of flights, changing to a low frequency modulated calls when flying above canopy.

When flying above canopy the call structure changes to the more typical *N. australis* pulse shape (change of pulse frequency over time), moving from frequency modulation to almost constant frequency with a difference between maximum and minimum frequency of only 5 kHz (Figure 1).

The calls of *N. australis* have a high pulse repetition rate (expressed as TBP) and high maximum frequency during the spiralling phase. Pulses of that shape could be mistaken for the Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (Emballonuridae) particularly when relying on frequency parameters. Call parameters of *S. flaviventris* as extracted from a reference call provided by the ANABAT system are shown in table 2. It can be seen that the duration, TBP, Fmax, Fmean and Fc overlap in their value range (mean ± standard parameters). However when comparing the shape of the pulses the differences between both species become obvious. *S. flaviventris* calls (figure 2) are more similar to the above canopy calls of *N. australis* (figure 1), although higher in frequency.

Table 1: Comparison of call parameters of two female *N. australis* (1) immediately upon release, (2) during spiralling upwards, and (3) whilst flying above canopy (parameters ±1 standard deviation, n equals number of pulses).

parameter	1 (n=19)	2 (n=34)	test-value	p
Dur	6.46 (±1.84)	8.00 (±1.93)	f=8.00	<0.01
TBP	326.48 (±144.68)	154.56 (±54.53)	t=5.48	<0.001
Fmax	21.72 (±2.69)	26.81 (±2.06)	f=59.51	<0.001
Fmin	13.34 (±1.33)	14.42 (±1.68)	f=5.77	0.02
Fmean	16.32 (±1.38)	18.39 (±1.65)	f=21.34	<0.001
Fc	15.90 (±1.71)	16.61 (±2.12)	f=1.56	n.s.
	2 (n=34)	3 (n=29)		
Dur	8.00 (±1.93)	10.42 (±2.36)	f=20.06	<0.001
TBP	154.56 (±54.53)	431.33 (±190.09)	t=-6.77	<0.001
Fmax	26.81 (±2.06)	17.13 (±2.01)	f=352.89	<0.001
Fmin	14.42 (±1.68)	11.46 (±1.24)	t=8.01	<0.001
Fmean	18.39 (±1.65)	13.55 (±1.16)	t=13.60	<0.001
Fc	16.61 (±2.12)	12.13 (±0.96)	t=11.07	<0.001

Table 2: Call parameters of *S. flaviventris* as provided by ANABAT (parameters ±1 standard deviation, n equals number of pulses).

parameter	(n=19)
Dur	11.74 (±2.00)
TBP	221.25 (±28.09)
Fmax	24.13 (±1.25)
Fmin	18.80 (±0.61)
Fmean	20.59 (±0.50)
Fc	18.80 (±0.61)

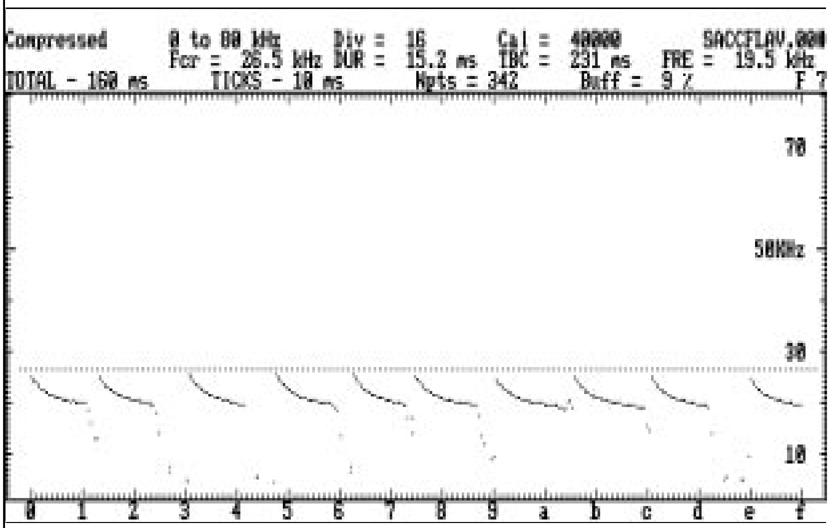

Figure 2: Echolocation call of *Saccolaimus flaviventris* as provided with the ANABAT system.

Conclusion

The call of *N. australis* can be very different in shape and frequencies. The three phases recorded from hand released individuals are also likely to be recorded in fauna surveys from animals emerging from their roosts. Ostensibly the calls of *N. australis* could be incorrectly identified as *S. flaviventris*, although by considering frequencies and call shape concurrently, the identification of *N. australis* should be readily achievable.

A Grey-headed Flying-fox Pteropus poliocephalus with four nipples, from Melbourne.

Lindy Lumsden
Arthur Rylah Institute for Environmental Research
Department of Natural Resources and Environment
123 Brown St
Heidelberg, Victoria 3084

Female bats usually have two nipples, one on each side of the body in the thoracic region. Some insectivorous bats (eg. Rhinolophids and Hipposiderids) additionally possess two pubic nipples immediately above the vulva. These nipples do not produce milk but are used as anchor points for the young to grip onto the female in flight. Multiple nipples in the thoracic region have been reported in some microchiropterans, eg. Hoary Bat *Lasiurus cinereus* (in USA) which can produce up to four young per litter (Shump and Shump 1982). However, multiple nipples have rarely been reported in megachiropterans.

A colony of Grey-headed Flying-foxes *Pteropus poliocephalus* established in the Royal Botanic Gardens in the centre of Melbourne, Victoria, in 1981 (Menkhorst and Dixon 1985). Initially visitation was seasonal with up to 1000 bats congregating in summer and autumn, however, since 1986 some individuals have stayed all year (Aston 1987). Initially only adults were seen, but in recent years dependent young have also been observed in the colony (Peake, Ward and Carr 1996).

On 7 June 1995 a female Grey-headed Flying-fox, was found at South Yarra, several kilometres from the Botanical Gardens colony and taken to a wildlife shelter, where I examined it three days later. It appeared uninjured except for a slight graze on the forehead which was healing well. It was an adult female, forearm length of 155 mm, weight of 850 g. On examining its nipples to assess reproductive condition, I was surprised to see four nipples. These were in the usual thoracic position but there were two nipples adjacent to each other, 6 mm apart, aligned down the length of the body (see photo). Each nipple was of a similar size, 3.5 mm in diameter. Milk was expressed from three of the four nipples. The fourth was the same size but only a small amount of clear fluid was expressed, giving the appearance that the nipple had been lactating and had recently dried up. Given that the animal had been in captivity for 3 days without being suckled it is not unexpected that milk production would have reduced. The nipples were checked again the following day and the three nipples were still producing milk.

A second female Grey-headed Flying-fox was examined on 11 June 1995, having similarly been brought into a wildlife shelter, six days earlier. This female had the normal compliment of two nipples. Milk was expressed from one nipple, the other appearing to have dried up recently.

Both individuals were banded with metal bird bands on the thumbs and were released adjacent to the colony in the Botanic Gardens on 11 June 1995.

It is unusual for flying-foxes to have four nipples, although it has occasionally been reported in Queensland (H. Luckoff, pers. comm.). The fact that the extra nipples were lactating showed that they were all functional. This phenomenon has also been reported in humans.

Little is known about the reproductive patterns of the Melbourne colony, however, it appears to be unusually late for females to be still lactating in June. In NSW and Queensland females usually give birth to a single young in September or October. The young are weaned at five or six months (Martin *et al.* 1987) and therefore females would normally cease lactating by early autumn. Numbers in the Melbourne colony were higher in 1995 than in previous years with counts of over 2000 individuals (Peake, Ward and Carr 1996). This increased number may have been due to drought conditions further north in NSW and Queensland affecting flowering patterns. Maybe the drought conditions also affected the timing of reproduction.

Acknowledgments

I would like to thank Shirley Smith and Michelle Manhal for access to the animals in their care.

References

1. Aston, H. (1987). Influx of Grey-headed flying-fox *Pteropus poliocephalus* (Chiroptera: Pteropodidae) to the Melbourne area, Victoria, in 1986. *Victorian Naturalist* **104**: 9-13.
2. Martin, L., Towers, P.A., McGuckin, M.A., Little, L., Luckoff, H. & Blackshaw, A.W. (1987). Reproductive biology of flying-foxes (Chiroptera: Pteropodidae). *Australian Mammalogy* **10**: 115-18.
3. Menkhorst, P.W. & Dixon, J.M. (1985). Influxes of the Grey-headed flying-fox *Pteropus poliocephalus* (Chiroptera: Pteropodidae) to Melbourne in 1981 and 1982. *Australian Mammalogy* **8**: 117-21.
4. Peake, P., Ward, L.A. & Carr, G.W. (1996). Grey-headed Flying-foxes at the Royal Botanic Gardens, Melbourne: Final Report. Ecology Australia Pty Ltd.
5. Shump, K.A. & Shump, A.U. (1982). *Lasiurus cinereus*. *Mammalian Species* No. **185**.

Keeping bats in captivity.

Ken Sanderson
School of Biological Sciences
Flinders University of South Australia
GPO Box 2100
Adelaide South Australia 5001
Email bikjs@cc.flinders.edu.au

In 1992 we (honours student Adam Cronin and supervisor Ken Sanderson) kept bats for something like 9 months in a basement room (3.5 m cubed) at Flinders University. The temperature of the room did not vary a great deal because it was in the basement - the temperature was 21-23°C - occasionally heating was required to achieve this. The room was placed on a reverse light cycle. Initially there were some difficulties because the room was full of junk, and we "lost" bats in this junk, and some completely disappeared. However after we got rid of the junk, we did not lose any more bats. Hessian bags were hung on the wall to provide roosting spots for the bats.

The bats were fed on insects caught in a light trap (mostly moths) and on mealworms. We equipped the room with a darklight so that we could watch some of the hunting behaviour. After a number of months in captivity some of the bats were quite accustomed to us, and would fly around with us in the room and the dark light on, so that we could see their activities. We had four Lesser Long-eared Bats *Nyctophilus geoffroyi*, which remained with us most of the year, and were eventually released where they had been obtained from, at Bridgewater in the Adelaide Hills. These bats were relatively easy to keep, as they fed themselves both on the moths which were released into the room, and mealworms which were placed on a tray in the room, which they would briefly descend to take the mealworms. To the best of my recall the bats were fed every day. We also had 1-2 bats of some other species, Gould's Wattled Bat *Chalinolobus gouldii*, Chocolate Wattled Bat *Chalinolobus morio*, and Large Forest Bat *Vespadelus darlingtoni*. These bats were all more difficult to keep, and in some cases had to be hand fed meal worms, and did not stay long with us (perhaps a few weeks) before we returned them.

NEWS FROM THE ANTIPODES

WESTERN AUSTRALIA

WA state roundup

Things have been rather quiet in the west of late. Kyle Armstrong has finished much of his field work on Pilbara *Rhinonycteris*, and is about to embark on a morphological and genetic study. His work will follow up and expand on the findings of Norm McKenzie and colleagues (soon to be submitted?) who found differences between Pilbara and more northern individuals. Norm has also been looking at bats (and other things) in the Carnarvon Basin. David Hosken has recently submitted his PhD entitled "Sperm storage, sperm fertility, torpor, and sperm competition in microchiropteran bats", and leaves for a post-doc in Switzerland in March. Jamie O'Shea has won an ARC small grant to further his investigations of heart innervation in bats and continues work on bat kidneys. Phil Withers and David Hosken have wrapped up their work on metabolism and physiology of microbats, although Phil may continue with some aspects of this work.

David Hosken

The Orange Leafnosed-bat *Rhinonycteris aurantius* in the Pilbara, W.A.

Kyle Armstrong
Department of Zoology
University of Western Australia.

As part of my study on the distribution and ecology of the Orange Leafnosed-bat *Rhinonycteris aurantius* (aka Orange Horseshoe-bat) in the semi-arid Pilbara region of Western Australia, I have made several interesting discoveries. This species appeared to occupy a number of small, seemingly unsuitable abandoned mines (based on their reported inability to tolerate low roost humidity) in the Marble Bar area as well as the deeper Klondyke Queen and Comet mines where they have been recorded previously. The species was also recorded at two new localities, namely near Nullagine and at Bamboo Creek mining centre. The most exciting discovery was made at Barlee Range Nature Reserve where a natural roost site was discovered in a shallow, horizontal fissure under a dry waterfall adjacent to the plunge pool. This is the first recorded natural roost site in the Pilbara. Genetic material was collected from the Kimberley region to add to that collected from the Pilbara and the Northern Territory by other workers. A genetic comparison can now be made between these three populations. Unfortunately, Queensland material is still unavailable. The remainder of the project will focus mainly on the comparative roost site characteristics of mines and natural roost sites and address whether Pilbara Rhinonycteris are distinct morphologically or genetically from northern populations.

SOUTH AUSTRALIA

Roundup of new bat programs and gossip from South Australia

Jonathan Codd (Honours at Flinders University - supervised by Dr. Ken Sanderson) is studying the behaviour of Naracoorte Bentwing-bats. Jonathan is making good use of the infra-red camera system that is installed in Bat Cave and his project has already produced some unexpected results, particularly in relation to energy budgets. The fortuitous visit by Merlin Tuttle at the beginning of the project was a great motivation for Jonathon.

Penelopy Day (Honours at Adelaide University - supervised by Dr. Steve Cooper of the SA Museum) is using DNA sequencing data to resolve the taxonomic relationships of populations of *Myotis adversus (sensu lato)* from Australia, Indonesia and New Guinea. If anyone is taking vouchers of this species from anywhere in Australia, Penny would greatly appreciate some freshly taken tissue (liver, membrane) in alcohol. If you can help, please ring Terry (08)82077460.

Sonia Dominelli (Bookmark Biosphere Reserve) has begun a study of the distribution and roosting ecology of the Little pied bat and the Greater Long-eared bat in South Australia. Her work is supported by a grant from the Wildlife Conservation Fund SA.

Lyssavirus, ah yes....not yet recorded from South Australia but the human and animal health authorities have taken the threat seriously. Most bat workers in South Australia have had rabies vaccinations. A lyssavirus advisory committee has been formed to deal with issues such as how to deal with human and animal cases, recommendations for people who work with bats, and testing of privately and commercially owned flying-foxes. The committee has decided not to undertake a survey of wild bats to test for the virus since experience has shown that this course of action is unlikely to be fruitful. At present, the only bats that will be tested are those which have bitten people or which display abnormal behaviours.

That's it for now.

Terry Reardon
South Australian Museum

NEW ZEALAND

Next boxes for the Long-tailed Bat *Chalinolobus tuberculatus*, in South Canterbury, South Island, New Zealand.

I am an amateur who has an interest in conservation issues over many years and needed a challenge for my retirement years. Bats are special in New Zealand because of their status as the only land mammal present before human settlement. I knew very little but decided to learn more after trips to Europe.

Members present at the South Australia Conference and those reading the Newsletter No.7, will remember the presentation by Richard Griffiths on our Long-tailed Bat in South Canterbury. I decided to engage in some "habitat enrichment" to encourage Richard's theory that the greater number of bats in the Hanging Rock area was due to safer roosts. Boxes were built of undressed Macrocarpa (an introduced pine from the USA) to a design in Phil Richardson's book "Bats" from Whittet Books, London. Aluminium sheet was obtained from the local newspaper company for wrapping around the tree trunks and we were in business. Thirty Boxes have now been fitted in South Canterbury at three sites -- Peel Forest, Hanging Rock and Kakahu.

Ian Temby, in his article on artificial roosts is correct to express concern over Southern Boobook (owls). The New Zealand Morepork is of the same species, *Ninox novaeseelandiae*, and Richard has observed the introduced Little Owl, *Athene noctua* having a go at our Hanging Rock bats. In spite of predation by owls, I hope that by giving a rat-free roost, the boxes may prove their worth. A check next year and again later should give an indication of the status of the population.

Kakahu is the site of a remnant of native bush which just has been saved from over-planting with Radiata Pine. I was able to confirm the presence of bats there this Summer. Bats were also recorded at a farm further South, in limestone cliffs on the North side of the Opihi River, up river from Hanging Rock .

Max Cullen
Christchurch
NEW ZEALAND

VICTORIA

The assessment of genetic variation within and between the three known southern Australian maternity caves of the Common Bentwing-bat *Miniopterus schreibersii*.

The Common Bentwing-bat is a cosmopolitan species, found in Africa, Europe and Southeast Asia. In Australia it is listed under the Victorian Flora and Fauna Guarantee Act (1988) due to its restricted colonial breeding. It, like all cave dwelling bats, is quite susceptible to disturbance.

The primary aim of this Honours project is to determine the relatedness of the bats inhabiting the three southern maternity caves, located at Naracoorte in South Australia, and at Warrnambool and Lakes Entrance in Victoria. The findings of this research will provide valuable direction as to the effective management of this species. If found to be distinct populations, the three sites would need to be carefully managed to ensure their continuing futures. As distinct populations, they would not be readily rescued by immigration if a population's numbers did decline.

At each of the locations I have successfully captured bats using harp traps. Measurements of weight, forearm and tibia were taken. Any differences found in morphometric data may be attributable to environmental to environmental influences rather than genetic variation. However, these measurements may help to give a preliminary idea of the relatedness of the three groups.

In order to achieve the primary aim, I took tissue samples from the wing membranes of thirty lactating or post-lactating females from each site. I cose to sample from these females to ensure that they were representative of the breeding group at each site. The small samples were taken using separate, disposable, sterile skin biopsy punches for each animal, to reduce the liklihood of contamination. This method is widely regarded as the least invasive technique of tissue collection from bats.

The DNA will be examined by investigating the differences within and between the groups. To do this I will focus on microsatellite markers.

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I would like to thank Lindy Lumsden, Tony Mitchell, Terry Reardon and Lawrie Conole for their invaluable assistance with background information and/or trapping. I would also like to thank Natasha Schedvin, Catherine Caddle and Catherine Pryde for their field assistance. Thanks must also go to my supervisor, Joanne Smissen for all her help and support.

Belinda R. Cardinal
School of Biological & Health Sciences
Deakin University
Geelong Vic 3217
<cardinal@deakin.edu.au>

RECENT PUBLICATIONS

Compiled By Grant Baverstock

1. Hosken, D.J. (1996). Roost selection by the lesser long-eared bat, *Nyctophilus geoffroyi*, and the greater long-eared bat, *Nyctophilus major* (Chiroptera: Vespertilionidae) in *Banksia* woodlands. *Journal of the Royal Society of Western Australia* **79**: 211-216.
2. Kitchener, D.J., Konishi, Y. & Suyanto, A. (1996). Morphological variation among eastern Indonesian island populations of *Hipposideros bicolor* (Chiroptera: Hipposideridae), with descriptions of three new subspecies. *Records of the Western Australian Museum* **18**: 179-192.
3. Clague, C.L., Coles, R.B. & Spencer, H.J. (1995). Survey of bat fauna in the Wet Tropics World Heritage Area of North Queensland, Australia. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
4. Corben, C. (1995). Some comments on the use of echolocation calls to identify bats. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. Bat Research News
5. Corben, C. (1996). The use of Acoustics in the Identification of Microbats. Abstracts of the Four Corners Regional Bat Conference, January 25 to 27, 1996. *Bat Research News*
6. Eby, P. (1995). Dispersal of large and small seeded diet species by *Pteropus poliocephalus* in fragmented rainforest habitat. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
7. Eby, P. (1995). The significance of associated gross and fine scale habitat use by *Pteropus poliocephalus* for conserving forest ecosystem function in Eastern Australia. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
8. Flannery, T.F. (1995). *Mammals of the south-west Pacific and Moluccan Islands.* (Reed Books: Melbourne).
9. Hall, L.S. (1995). The bats of Gua Payau (Deer Cave), Sarawak, Malaysia. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
10. Hand, S.J. (1995). Australian Fossil Bats: New pieces for ancient puzzles. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
11. Hosken, D.J. (1996). Roost selection by the lesser long-eared bat, *Nyctophilus geoffroyi*, and the greater long-eared bat, *N. major* (Chiroptera: Vespertilionidae) in *Banksia* woodlands. *Journal of the Royal Society of Western Australia* **79**: 211-216.
12. Hosken, D.J. & O'Shea, J.E. (1995). *Falsistrellus mackenziei* at Jandakot. *The Western Australian Naturalist* **19**: 351.
13. Kitchener, D.J., Konishi, Y. & Suyanto, A. (1996). Morphological variation among eastern Indonesian island populations of *Hipposideros bicolor* (Chiroptera: Hipposideridae), with descriptions of three new subspecies. *Records of the Western Australian Museum* **18**: 179-192.
14. Kitchener, D.J. & Maharadatunkamsi. (1996). Geographic variation in morphology of *Cynopterus nusatenggara* (Chiroptera: Pteropodidae) in south-eastern Indonesia and description of two new species. *Mammalia* **60**: 255- 276.
15. Law, B.S. (1996). Residency and site fidelity of marked populations of the common blossom bat *Syconycteris australis* in relation to the availability of *Banksia* inflorescences in NSW, Australia. *Oikos* **77**: 447-458.
16. Law, B.S. (1996). The ecology of bats in south-east Australian forests and potential impacts of forestry practices: a review. *Pacific Conservation Biology* **2**: 363-374.
17. Lumsden, L.F. & Bennett, A.F. (1995). Roost site selection of two species of Vespertilionids in a fragmented rural landscape in Southern Australia. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
18. Mills, D.J., Cunningham, R.B., Norton, T.W. & Parnaby, H.E. (1995). Temporal and spatial variation in surveying for forest-dwelling , insectivorous bats in southeast Australia: implications for survey design. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
19. Morris, D.A. (1995). Reconstruction of the evolutionary stages leading to Chiropteran flight. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*
20. O'Donnell, C.F.J. (1995). Identification of cryptic sub-groups in a population of a threatened bat *Chalinolobus tuberculatus* in a New Zealand rainforest. Abstracts of the 10th International

Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

21. Parnaby, H. & Mills, D. (1994). A record of the Golden-tipped Bat from the escarpment forests of southern New South Wales. *Australian Zoologist* **29**: 245-49.

22. Parsons, S. (1995). A comparison of the performance of four brands of bat detectors under field conditions in two habitat types. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

23. Richards, G.C. & Hall, L.S. (1995). The conservation biology of Australian bats: are recent advances solving our problems? Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

24. Schulz, M., (1995). Utilisation of suspended bird nests by the Golden-tipped Bat (*Kerivoula papuensis*) in Australia. *Mammalia* **59**: 280 - 83.

25. Sedgeley, J. (1995). Short term captive maintenance of a long-tailed bat. *Ecological Management* **3**: 10-13.

26. Sedgeley, J. & O'Donnell. C. (1995). A technique for harp trapping at bat roosts in tall forest canopy. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

27. Sinclair, E.A., Webb, N.J, Marchant, A.D. & Tidemann, C.R. (1996). Genetic variation in the little red flying-fox *Pteropus scapulatus* (Chiroptera: Pteropodidae) - Implications for management. *Biological Conservation* **76**: 45-50.

28. Spencer, H.J. & Flick, B.H. (1995). Secretion of marking fluid from the penis of the spectacled flying fox, *Pteropus conspicillatus.* Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

29. Spencer, H.J. & Flick, B.H. (1995). Midwife care of birthing in the Black Flying Fox, *Pteropus alecto.* Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

30. Spencer, H.J. & Flick, B.H. (1995). Hand-rearing and release of orphaned flying foxes (*Pteropus* sp.) in Eastern Australia -- a significant act for species conservation or merely misguided efforts? Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

31. Tidemann, C.R. and Vardon, M.J. (1997) Pests, pestilence, pollen and pot-roasts: the need for community-based management of flying foxes in Australia. *Australian Biologist* **10** (1) 79-85.

32. Tidemann, C.R., Vardon, M.J., Nelson, J.E., Speare, R. and Gleeson, L.J. (1997) Health and conservation implications of Australian bat lyssavirus. *Australian Zoologist* **30** (3): 369-376.

33. Vardon, M.J., Simpson, B.K., Sherwell, D. and Tidemann, C.R. (1997). Flying-foxes and tourists: a conservation dilemma in the Northern Territory. *Australian Zoologist* **30** (3): 1-5.

34. Webb, N.J. & Tidemann, C.R. (1996). Mobility of Australian flying - foxes, *Pteropus* spp. (Megachiroptera) - Evidence from genetic variation. *Proceedings of the Royal Society of London (Series B Biological Sciences)* **263**: 497-502

35. Worthington-Wilme, J.M., Moritz, C.M. & Hall, L.S. (1995). Genetic evidence for extreme population structuring in *Macroderma gigas*: implications for conservation. Abstracts of the 10th International Bat Research Conference, Boston USA, Aug. 1995. *Bat Research News*

36. Worthy, T.H., Daniel, M.J. & Hill, J.E. (1996). An analysis of skeletal size variation in *Mystacina robusta* Dwyer, 1962 (Chiroptera: Mystacinidae). *New Zealand Journal of Zoology* **23**: 99-110.

THE AUSTRALASIAN BAT SOCIETY

MEMBERSHIP APPLICATION FORM

The Australasian Bat Society was enthusiastically conceived at the 4th Australian Bat Research Conference (Brisbane 1991) and was formalised in the following year. The ABS unites people with a common interest in this unique fauna, whether positive or negative. Whether they be researchers, naturalists, foster-carers or fruitgrowers, everyone benefits from our unification. By presenting a united front to assist the resolution of conservation problems, or to lobby politicians, or simply spread the good word to the public, the goals of the ABS are conveyed more efficiently than through individual effort. Arranging a biennial meeting (with research proceedings) is another role of the ABS.

Communication is promoted through a bi-annual newsletter, where research news and notes, simple snippets or vexatious viewpoints are expounded. The newsletter takes over from our past communication efforts, *Macroderma* and its predecessor *Australian Bat Research News*. Should a conservation ‘emergency’ arise, members are advised through a 1-2 page news sheet

Subscription rates vary from $20.00 to $50.00. Further information or membership can be obtained from the ABS Secretary Jillian Snell, GPO BOX 5047, SYDNEY NSW 2001 (Fax 02 9267 5363, Ph 02 9264 1800) or Greg Richards, P.O. BOX 778. DICKSON, ACT 2602. (Fax and Phone +61 6 253 2050).

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