Macroderma

Volume 1 Number 1 March 1985

ISSN 0815-2152

Macroderma Volume 1, Number 1, March 1985

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Macroderma

Macroderma is published twice yearly in March and September by the Bat Research Group, Zoology Department, Australian National University, Head of Department - Professor C. Bryant.

Printed in Canberra by ANU Printer.
Cover design by S. Craven from a drawing by T. Clayton

EDITORIAL

A growing scientific interest in bats is a worldwide phenomenon, but it has become particularly apparent in Australia in the last few years. With the continuing development of new techniques it has become possible to scrutinize the biology of bats in the field and the laboratory and to build up a body of knowledge comparable to that which already exists for most other groups of mammals. The Australian bat fauna is still largely untapped. Witness, for example, the growing number of "new" species and the enormous extensions of the known range of many of the old.

Our responsibility as scientists to the animals we study also has increased enormously. With an ever-growing human population and concomitant pressures on land usage bats are increasingly being subjected to habitat destruction and other, more insidious, threats to their survival. The formation of Bat Conservation International in 1983 has gone some way towards making people aware of conservation problems specifically chiropteran, but it is up to bat biologists to provide the basic information upon which sensible management strategies can be founded.

We see *Macroderma* as a vehicle for the rapid transmission of information among bat-workers, not only in Australia, but also in surrounding areas. We hope that by providing a suitable venue we will be able to "harvest" the many incidental items of information which accrue during most research projects and are frequently lost to science. To these ends, it is our intention to produce *Macroderma* twice yearly, in March and September, to a standard similar to that of *Bat Research News* and *Myotis*. Thus, we hope to encourage people to submit research articles and short notes for publication. We shall include information on forthcoming conferences and other matters of general interest. In our efforts we will be assisted by regional correspondents whose names appear on the inside front cover. Information destined for *Macroderma* can be relayed through any of these people or directly to ANU.

In the September issue of *Macroderma* we intend to publish a list of bat workers and current research interests; a form is enclosed with this issue for that purpose. Would you please circulate it to anyone else whom you feel may be interested? An update to the current literature section, starting at 1980, will accompany Volume 1, Number 2 as a supplement.

P A P E R S

The Tasmanian Pipistrelle: *Pipistrellus tasmaniensis* Gould 1858: Annual Activity and Breeding Cycles

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ABSTRACT

The annual activity and breeding cycles of *P. tasmaniensis* from three sites near Canberra are described. *P. tasmaniensis* was trapped in this region in all but two months of the year suggesting that the species does not migrate coastwards for the winter as is commonly believed. The body weights of *P. tasmaniensis* increase throughout the warmer months and the activity of the species is reduced during the colder months from March to October.

Males produce sperm in summer and this is apparently stored in the epididymides throughout the following winter until spring. Ovaries contain hibernation follicles in autumn; these appear to be maintained throughout the winter until ovulation in spring. The trapping data suggest that maternity colonies free of adult males are formed by this species.

INTRODUCTION

The Tasmanian pipistrelle is Australia's second largest vespertilionid yet "... virtually nothing is known of its biology" (Parnaby 1983). The species is primarily a tree-dweller, although occasionally found in caves and old buildings. *Pipistrellus tasmaniensis* is restricted to the sub-coastal fringe and highlands of eastern Australia from southern Queensland to Tasmania and western Victoria (Hall and Richards 1979). In Western Australia it is found only on the south-western coastal margin (Parnaby 1983). The breeding cycle of the species has not been described and Parnaby (1983) suggests that "... some populations migrate in winter from the highlands to coastal areas ..." whilst "... others probably hibernate".

This paper describes observations of the annual activity and breeding cycles of *P. tasmaniensis* in the Canberra region. The information is drawn from trapping programmes carried out at three sites from 1977 to 1984 and an examination of museum specimens. Observations of the tree roosts selected by the species are recorded.

METHODS

Study Areas

The three study areas used in this work were all located within 50 kms of Canberra, Australian Capital Territory (Fig. 1). Bats were trapped using either harp traps (Tidemann and Woodside 1978) or mist nets placed across firetrails or over water holes.

A. Bull's Head, ACT

The Bull's Head site was approximately 10 sq kms of forest ranging in elevation from 800 to 1300 m. Twenty nine trapsites were established within this area; three of them beside water holes. Seven to nine harp traps were used at three to four weekly intervals to survey the bat population present within the area between January 1979 and October 1984. Individual firetrail sites were never used for consecutive trap sessions; however, water hole sites were trapped more frequently and occasionally in conjunction with mistnetting. From March 1980 all *P. tasmaniensis* caught were banded on the forearm with size three or four aluminium bird bands.

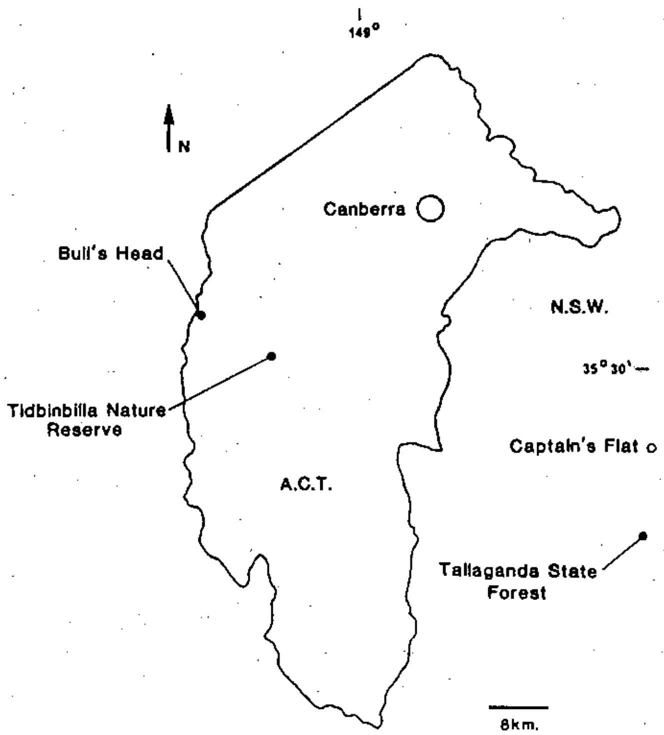

Figure 1: Map of the ACT and surrounding region showing the locations of the three study areas used.

B. **Tallaganda State Forest, Captain's Flat, NSW**

The Captain's Flat study area covered an area of approximately 40 sq kms and included 20 trapsites, three of which were over water. The area ranged in elevation from 1000 to 1200 m and seven to nine harp traps were used to census the populations at monthly intervals between January 1977 and August 1982.

C. **Tidbinbilla Nature Reserve, ACT**

Trapping on the Tidbinbilla area began in December 1982 and was concluded in October 1983. Three or four harp traps were used each month, sometimes for several nights in succession. One site was over water, the other seven were on trails. The area covered by the trapping programme was ten sq kms of forest, ranging in elevation from 800 to 1200 m.

Breeding Cycle

The breeding cycle of *P. tasmaniensis* was described from observations of overt reproductive status of live animals and histological examination of the reproductive tracts of museum specimens. The overt reproductive status of live *P. tasmaniensis* was classified according to the four stages described by Phillips and Inwards (1985). For females the four reproductive classes are: 1. Indeterminate, ie. not obviously pregnant, not lactating nor post-lactating; 2. Pregnant, as determined by palpation of the lower abdomen and increased body weight; 3. Lactating, enlarged nipples and milk apparent in the mammary glands; 4. Post-lactating, regrowth of fur around the nipples obvious.

In males, the degree of testis and epididymis enlargement was used to indicate the onset of spermatogenesis and ultimate storage of spermatozoa. The four reproductive classes are: 1. No obvious enlargement of testes or epididymides; 2. Minor hypertrophy of the testes; 3. Maximum testes size, epididymides not enlarged; 4. Testes regressed, epididymides distended with spermatozoa. These four classes are photographically shown for *Nyctophilus gouldi* by Phillips and Inwards (1985).

Most specimens used for histological examination of the reproductive tracts came from the museum collection of the CSIRO Division of Wildlife and Rangelands Research, Canberra. These specimens came from Mt. Tinderry, NSW (1 ♂, 3 ♀); Jenolan, NSW (2 ♂); Bendethera, NSW (1 ♂) and Vanity's Crossing, ACT (1 ♂). A further four samples were from the museum collection of the ANU Zoology Department; two from Tallaganda State Forest, Captain's Flat (1 ♂, 1 ♀) and two from Bull's Head (2 ♂).

All tracts were fixed in Bouin's solution for 48 hours, passed through serial washes of ethanol and finally embedded in paraffin wax. Female tracts were sectioned longitudinally at 8 μm. The testes and epididymides were sectioned transversely at 7 μm. Sections were stained with haematoxylin and counter-stained with 0.5% alcoholic eosin prior to microscopic examination.

Tree Roosts

A tree roost of *P. tasmaniensis* was found at the Bull's Head site in September 1983. A pulley device was affixed enabling a linen bag to be positioned over the entrance hole from ground level. During most trap sessions thereafter, the bag was placed over the entrance of the roost in order to determine the number and sex of bats occupying it.

RESULTS

Annual Activity Cycle

In 760 harp trap-nights and 19 mistnet-nights between January 1977 and October 1984, 123 *P. tasmaniensis* were trapped at the three study sites. Most (73 plus 2 animals retrapped twice, see below) were caught at the Bull's Head site although this is a reflection of the greater trap effort which occurred there (Table 1).

Table 1: Combined trapping results for all three study sites. The figures shown for trapping effort indicate the number of trap-nights and mist-net-nights (in parentheses) at Site A (Bull's Head), Site B (Captain's Flat) and Site C (Tidbinbilla).

Mth	Trapping Effort				Number Caught			
	Site A	Site B	Site C	Total	Ad ♂	J ♂	Ad ♀	J ♀
J	86 (2)	20 (2)	17	105 (4)	29*	2	11	-
F	61 (3)	10	10 (1)	81 (4)	14	6	8	-
M	61	23 (1)	4	88 (1)	4	-	1	-
A	27	-	-	27	-	-	-	-
M	29	6	4	39	3**	-	-	-
J	27	11	6	44	-	-	-	-
J	9	23	4	36	1	-	-	-
A	32	35	3	70	2	-	-	-
S	33	14	6	53	6	-	1	-
O	54 (3)	25	3	82 (3)	6	-	5	-
N	37 (4)	16 (2)	- (1)	53 (7)	12	-	-	-
D	60	12	10	82	13	-	1	-
	498 (12)	195 (5)	67 (2)	760 (19)	90	8	27	0

* roost found (Bull's Head)
** roost found (Captain's Flat)

Less *P. taemaniensis* were trapped per trap-night during the colder months from March to September although April and June were the only months when *P. taemaniensis* was not trapped (Fig. 2). The mean body weights of male *P. taemaniensis* gradually increased from September through to May (Fig. 2), probably indicating the deposition of body fat in preparation for the colder months. Insufficient females were caught to enable the body weight cycle to be fully described.

The ratio of males to females trapped was not the same at all three study sites. At Bull's Head, 71 males were caught and only 2 females. Trap-success was biased towards females at the Tidbinbilla Nature Reserve; the breakdown being one adult male to 14 adult females. At Captain's Flat the sex ratio of trapped animals was nearer to one with 16 males and 11 females trapped. Juvenile *P. taemaniensis* (8 males) were only caught at the Tidbinbilla site.

Of the 60 *P. taemaniensis* banded at the Bull's Head study site, only two were recaught. One male banded on 13 December 1980 was recaught at the same site on 27 November 1981. The second recapture was also a male; this animal was banded on 19 December 1982 and then found occupying a tree roost, 300 metres away, on 23 October 1983.

The tree roost located at the Bull's Head site was within a stem hole on the main trunk of a live *Eucalyptus dalrympleana*. The entrance was approximately 20 metres above the ground, had a diameter of 40-50 mm and a southern aspect. A total of 15 male *P. taemaniensis* were found occupying this roost at various times between October 1983 and January 1984 at which time the roost was seemingly abandoned. By using the linen bag over the exit, three males were caught in October 1983. In November of the same year, three males trapped at the waterhole trap-site 20 metres from the base of the tree, flew to and entered the roost. Two further males were found in the roost in late December 1983 and on 6 January 1984, ten adult males were taken from the roost. No females were ever found in this roost.

A roost was also located at the Captain's Flat study area. This roost was in a live *E. fastigata* and was also a stem hole in the main trunk. The entrance had a diameter of 50 mm, was about 10 m above the ground and faced south-east. Three males were observed to enter this roost on 25 May 1979, but no subsequent efforts were made to observe the occupants.

Breeding Cycle

Males

Observations of Overt Reproductive Condition

In male *P. taemaniensis* spermatogenesis occurred in summer. Males with testes of maximum dimension were caught in December (3), January (8) and February (1). It is notable that six males caught in February had enlarging testes suggesting relatively late summer/autumn sperm production. Males with apparently quiescent testes were trapped in October (1), November (6), December (1), January (5) and February (2) indicating that not all males which have ossified phalangeal epiphyses are sexually active, ie. that males may not produce sperm in their first year. Sperm storage, as shown by distended caudal portions of the epididymides, was seen in one male in January, four in October and one in November.

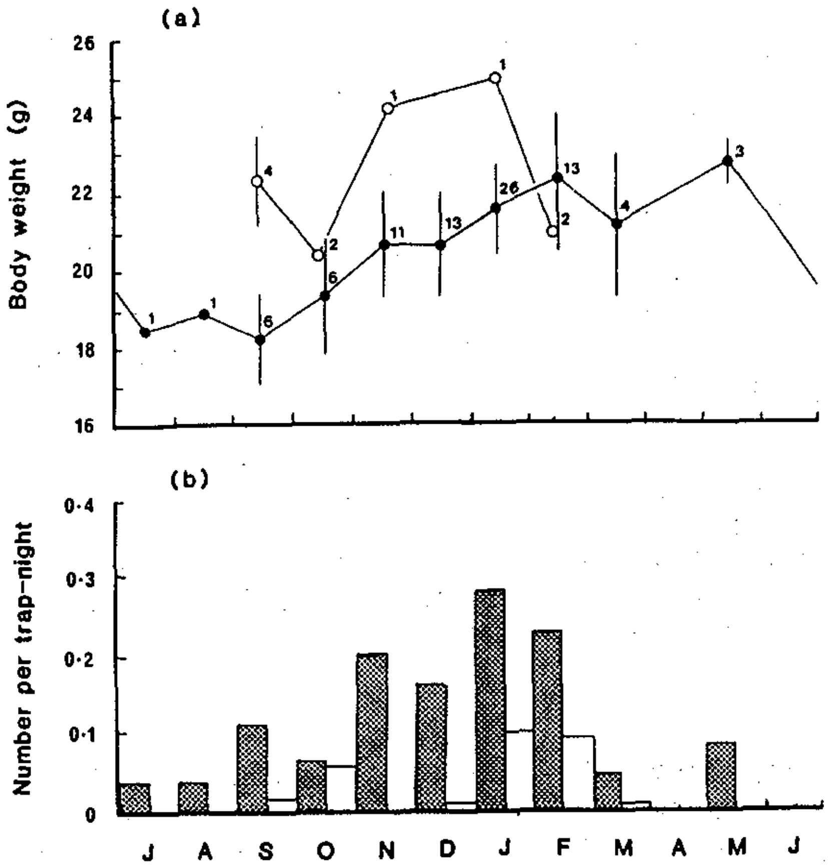

Figure 2: (a) The annual body weight cycle for male (•) and female (o) *P. tasmaniensis*. Values are mean ± one s.d. Sample sizes are superscripted. As an index of activity the number of males (hatched bars) and females (open bars) caught per trap-night for each month is presented (b).

Histological Observations

Histological examination of male reproductive tracts confirmed the breeding cycle described above from overt characteristics. There were no signs of spermatogenic activity in the testes of a male in late November and the epididymides contained no sperm. In mid-January spermatogenesis was obvious with the Sertoli cells arranged near the inner boundary of the tubules and closely associated with spermatids. By mid-February the testes were regressing and the epididymides contained spermatozoa. Males in February (1), April (1), July (3) and October(1), had testes which were completely regressed. Except for the one male in April, the epididymides of males from February through to October all contained spermatozoa (ie. six males in total).

Females

Observations of Overt Reproductive Condition

Relatively few female *P. tasmaniensis* females were encountered during this study and consequently the opportunities to describe the breeding cycle from overt characteristics were limited. A pregnant female was caught in mid-November and a lactating animal in mid-January. Three post-lactating females were trapped in late-January/February when juveniles were also caught (Table 1).

Histological Observations

The ovaries of a female in late-January were in pro-oestrus, containing mostly secondary follicles. Large tertiary follicles (hibernation follicles) were present in the ovaries of three females in April. Vesicles were apparent in the follicles and the oocyte was in a central position. Sperm were not seen in any female tracts.

DISCUSSION

This study has not shown that *P. tasmaniensis* migrates coastwards in winter nor has it conclusively shown that the species remains sedentary throughout the year and hibernates for the several colder months. However, several observations made throughout this study do favour the hibernator hypothesis over that of the migrator. Firstly, the presence of some *P. tasmaniensis* in the Canberra region for all but two months of the year (April and June) is indicative of a non-migratory species. Secondly, the annual activity pattern of *P. tasmaniensis* is not dissimilar from that of *N. gouldi* (Phillips and Inwards 1985), *N. geoffroyi, E. regulus, E. sagittula* and *C. morio* (Phillips, unpublished findings); other non-migratory species from the same area. Thirdly, the reproductive and body weight (fat) cycles of *P. tasmaniensis* are in synchrony with these other sedentary vespertilionids.

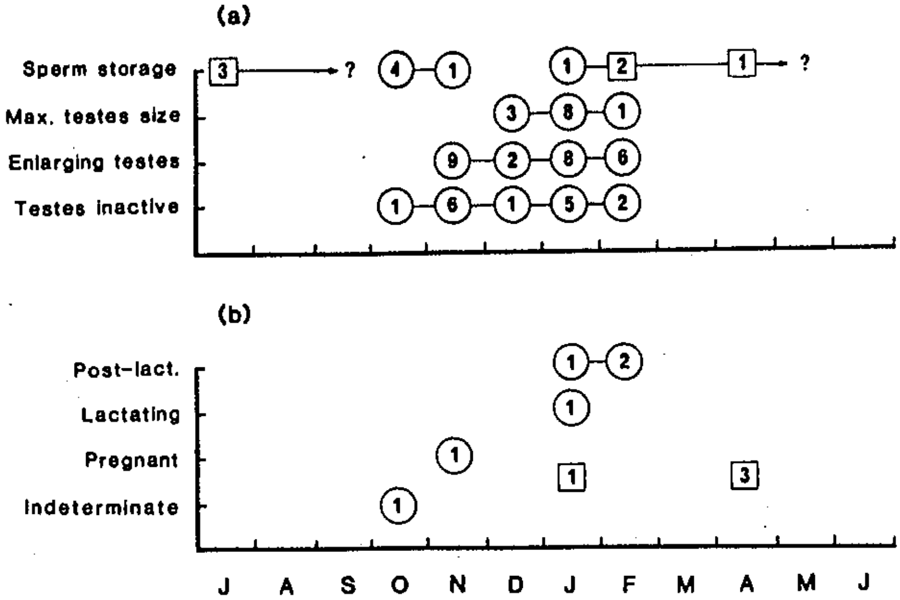

Figure 3: Summary of the reproductive cycle of *P. tasmaniensis* based on overt reproductive status (○) and histological observations (□). The total numbers of each reproductive class (see methods) caught in each month are also shown.

At the Bull's Head study site, the ratio of male to female *P. tasmaniensis* trapped (or bagged from the roost) was 35 to one. Only two females were trapped within this 10 sq km area of forest in almost six years of trapping. At the Tidbinbilla site the sex ratio was the reverse of that at Bull's Head, only one adult male caught and 14 adult females. Although sexual segregation is common among vespertilionids during pregnancy and lactation it is not possible to assess the extent of the sexual separation in the entire population on the basis of the Bull's Head and Tidbinbilla studies alone. For a highly mobile species such as *P. tasmaniensis* the scope of these studies was much too small to allow informed statements of social organisation in this species. The Captain's Flat study, which encompassed a much larger area of forest than the other two sites, caught almost equivalent numbers of males (16) and females (11) suggesting that the implications for sexual segregation indicated by the other sites may be spurious. By coincidence it appears that the Bull's Head area contained no maternity colonies of *P. tasmaniensis* and the Tidbinbilla site was located within the foraging range of only females and juveniles from a maternity colony.

Although the data should be cautiously interpreted and reinforced with further histological evidence, it appears that the reproductive cycle of *P. tasmaniensis* is similar to that of hibernating microchiroptera which use delayed fertilization (Gustafson 1979; Oxberry 1979). Like *N. gouldi* (Phillips and Inwards 1985) and *Eptesicus vulturnus* (Tidemann 1982) male *P. tasmaniensis* produce sperm in late summer/autumn and store it in the epididymides through the colder months until the females ovulate in spring. Female *P. tasmaniensis*, like *N. gouldi*, *E. vulturnus*, *E. regulus* (Kitchener and Halse 1978), *Chalinolobus gouldii* (Kitchener 1975) and *C. morio* (Kitchener and Coster 1981), maintain tertiary follicles within the ovaries throughout the winter period (follicles of hibernation) and these ultimately release ova in spring.

ACKNOWLEDGEMENTS

The authors wish to thank the relevant State and Territory fauna authorities for their permission to carry out this project. The assistance of Bruce Barrie in repairing bat traps and Noel Call in preparing histological material is gratefully acknowledged. Barry Baker and David Purchase criticised earlier drafts of this paper and we thank them for their valuable comments. The expertise of Wendy Lees in typing the manuscript is appreciated. We thank John Calaby for access to the National Wildlife Collection.

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SHORT COMMUNICATIONS

THE DIETARY ENERGY AND NITROGEN REQUIREMENTS OF THE GREY-HEADED FLYING FOX, *PTEROPUS POLIOCEPHALUS* (TEMMINCK)

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ABSTRACT (from BSc Hons thesis)

1. The maintenance energy (MER) and nitrogen (MNR) requirements of *Pteropus poliocephalus* were determined from a series of feeding trials using artificial diets. The low basal metabolic rate BMR: 225 $kJ.kg^{-0.75}.d^{-1}$) of this bat reported by Bartholomew *et al.* (1964) is associated with a low maintenance requirement for dietary nitrogen (457 $mg.kg^{-0.75}.d^{-1}$) but does not reflect a low maintenance energy requirement (667 $kJ.kg^{-0.75}.d^{-1}$). Using flight data of Carpenter (1975) and the MER from this study, a minimal field energy budget was calculated to be 944 $kJ.kg^{-0.75}.d^{-1}$. This value is high compared to microchiropteran bats.

2. Studies of the digestibility of two fruit diets, native fig and apple, showed that more of the fruit's energy was absorbed than of the nitrogen. The latter is a limiting nutrient in the apple diet, so that 3.2 times as much dry matter must be consumed in order to meet the nitrogen requirement than the field energy requirement.

3. It is postulated that the low BMR and low MNR is associated with an interrupted or restricted source of dietary nitrogen. A high maintenance energy requirement may provide a means by which surplus energy is dissipated as heat. An intake of excess energy in order to meet nitrogen requirements also explains how *P. poliocephalus* can afford a high field energy budget.

STRUCTURE AND COMPOSITION OF TASMANIAN BAT COMMUNITIES

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ABSTRACT (from BSc Hons thesis)

Patterns of resource use, community structure and composition of vespertilionid bat communities in five forest habitats in southeastern Tasmania were investigated. The structure and diversity of the bat communities differed between habitats, but most species were found to be widely distributed. *Eptesicus vulturnus, E. regulus, E. sagittula, Chalinolobus morio* and *Nyctophilus geoffroyi* were the most abundant species. *Nyctophilus gouldi* and *Pipistrellus tasmaniensis* were comparatively seldom trapped. *Chalinolobus gouldii* was not captured in any of the habitats sampled.

The timing of annual reproductive events was similar in *E. regulus, E. sagittula, C. morio* and *N. geoffroyi*. Parturition in Tasmanian populations of these species may occur later than it does in mainland populations.

Most species were found to have a generalised diet with Lepidoptera being the most important prey group. The exceptions were *P. tasmaniensis* which had a comparatively restricted diet, feeding mainly on Coleoptera, and *N. gouldi*, which was found to eat caterpillars gleaned from the ground or from vegetation surfaces. The dietary composition of most species was significantly correlated with the composition of insect samples taken in each habitat, suggesting that the bats were not selectively pursuing insect groups irrespective of their relative abundance. Evidence that many species fed opportunistically on temporarily abundant food sources was found.

Different size classes of moths and beetles were selected by different bats. There was a significant correlation between body size of bats and the size of prey selected, with larger bats generally taking larger insects.

Morphometric analysis revealed differences in wing shape between species. Wing morphology was found to be predictive of flight and foraging behaviour. Four distinctive patterns of flight and foraging behaviour were recognised, each describing two species in the Tasmanian bat fauna. It is hypothesised that these patterns reflect differences in habitat utilisation and dietary selection.

Nightly activity patterns of bats were bimodal during summer. Levels of foraging activity (based on capture times) peaked in the first hours after dark, declined to relatively low levels in the middle part of

the night and rose again to a secondary peak in the three hours before dawn. This pattern was consistent between habitats. There was a change in activity patterns during autumn, when sampling of echolocation calls with ultrasound monitoring equipment revealed strongly unimodal nightly patterns of foraging activity in each habitat. This is thought to reflect seasonal changes in energy demands.

The activity patterns of bats closely reflected patterns of insect activity at all times of the year.

Differences in the timing of foraging activity of different bat species were indicated from trapping data, but this was not seen as sufficient evidence of temporal partitioning of resources. Significant temporal partitioning by these bats is considered unlikely because nightly periods of insect activity were found to be relatively short.

The diversity of bat communities was not related to habitat structural diversity. There was also no evidence of significant differences in the foraging habitat preferences of bats, but it was concluded that trapping methods are unsuitable for assessing this.

Habitat requirements of most species in Tasmania appear to be extremely flexible. However, it is not known to what extent roost availability limits populations and distribution.

The ecological patterns observed in these Tasmanian bat communities were consistent with the hypothesis that interspecific competition has played a role in the evolution of community structure.

A BEHAVIOURAL STUDY OF THE GREY-HEADED FLYING FOX *PTEROPUS POLIOCEPHALUS* (MEGACHIROPTERA)

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ABSTRACT (from BSc Hons thesis)

This work is a behavioural study of *Pteropus poliocephalus* with some notes on *P. scapulatus*. It is a result of over 360 hours of observations made regularly from December 1980 and September 1981 at a flying fox camp at Gordon, Sydney. Additional observations are included which were made during visits to other camps of both species at several sites within NSW.

Structured and general observations provide quantitative and descriptive information on flying fox behaviour. Particular emphasis is placed on temperature regulation, reproduction and social organisation and changes in these throughout the year, coupled with an attempt to identify the major ecological factors affecting these activities. The study also provides species information on the Gordon camp, of interest as the most southerly breeding colony of *P. poliocephalus* known, and also because this camps' existence is potentially threatened by residential encroachment and other human disturbance.

New information is provided in the areas of: thermoregulatory behaviour in daylight hours; promiscuity and duration of the mating season for individual animals; factors affecting the timing and co-ordination of the nightly exodus out of, and back to, the camp for feeding purposes; lunar phobia; sex-ratio of bats feeding in commercial fruit orchards; behaviour of captive animals; and the affect of the bats on their roost site in relation to defoliation, soil fertility and seed transportation.

PRELIMINARY REPORT ON VERTEBRATE SURVEY OF GOOGONG FORESHORES

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Googong Foreshores Reserve encompasses an area of 4900 hectares of reservoir and surrounding land approximately 10 km south of Queanbeyan, NSW. The reservoir supplies domestic water to Queanbeyan and the ACT. The area is managed by the ACT Parks and Conservation Service as a wildlife refuge, and a recreational resource.

A survey of the vertebrate animals of the area is currently being undertaken. Preliminary results have shown that bats are the most significant mammalian group in the area. To date nine species have been recorded: *Eptesicus sagittula; E. regulus; E. vulturnus; Chalinolobus morio; C. gouldii; Nyctophilus gouldi; N. geoffroyi; Nycticeius orion,* and *Tadarida australis.* Apart from *Tadarida australis*, which was identified by its audible call, the other species were captured with harp traps.

The occurrence of *Nycticeius orion* in this area is significant. Despite extensive trapping in the Brindabella ranges and Captain's Flat areas this species has not been caught in the region, although it occurs commonly nearer the coast. The bats were caught in low open forest dominated by *Eucalyptus mannifera* with some *E. rossii* and *E. polyanthemos.* The site has little understory or ground cover, is on a north to north west aspect and is approximately 400-600 m from a permanent water course in the Queanbeyan river. Upon release one of the bats flew directly to a hollow 7 m above the ground in a *E. mannifera*; this could be a permanent day roost. Over two consecutive nights with two traps 4 bats of this species were caught, 2 adult males, 1 adult female and a juvenile female which suggests there may be a breeding colony in the area.

The survey will continue with trapping at two monthly intervals until December 1985.

BAT (AND BIRD) BANDING SCHEMES - UNDER NEW MANAGEMENT

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The Australian Bat (and Bird) Banding Schemes have recently been transferred from CSIRO to the Australian National Parks and Wildlife Service. Kim Lowe has been appointed co-ordinator of the schemes and Bill Phillips as Secretary.

With the transfer of the schemes their operations have been reviewed and a number of new initiatives taken on the advice of a specialist working group formed for the event. The major initiative so far taken has been to computerise the data storage and retrieval process, serving to streamline the day to day clerical chores and facilitate analysis of information. It is hoped that in the future the banding schemes will play a more active role in directing and collecting data of significance to wildlife conservation and management.

At present bat banding occupies a relatively minor component of the schemes' operations. There are about 30 active bat banders and most of these carry out their banding in a professional capacity either with state fauna authorities or through universities. As scientific and public awareness of bats continues to grow in this country there is no doubt that many ecological questions will need to be answered. The value of banding as an ecological tool should be recognised by those involved in this research and utilised to best effect under the guidance of the Australian Bat Banding Scheme. For example, well orchestrated bat banding programmes, of an appropriate scale, timing and duration, can greatly assist in determining the impact of forestry practices on forest-dwelling bats. If we can find a way to band large numbers of flying foxes then detailed information about their movement patterns can be collected; information of considerable value to several rural and medical issues currently gaining media coverage.

THE USE OF BIRD BANDS FOR MARKING TREE-DWELLING BATS A PRELIMINARY APPRAISAL

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With the advent of the collapsible harp trap (Tidemann and Woodside 1978) many tree-dwelling bats have become routinely accessible to the field ecologist making it practical to embark on marking surveys similar in design to those used to study birds and non-volant mammals. In March of 1980, Simon Inwards and myself commenced such a study at a site near Canberra. Twenty-nine 'ideal' trap-sites were selected within ten square kilometres of forest and a monthly trapping program employing 7-9 traps was initiated. Our aims were no different from those of all small mammal ecology studies of this nature, although the obvious mobility of bats prompted us to select a much larger study plot than has been traditional.

The study area selected offered a unique opportunity to examine, among other things, the movement patterns and longevity of tree-dwelling bats. Although cave-dwelling species have been the subject of extensive banding programs (for example Dwyer 1965), no concerted attempts had been made to band large numbers of tree-dwelling species in the one area and then to monitor the movements of individuals. David Purchase, at the time the secretary of the Bird and Bat Banding Schemes, suggested that as a pilot study for these species, we should use aluminium bird bands rather than bat bands. This action was apparently precipitated by the unacceptably high injury rate among some cave-dwelling bats banded with bat bands.

Monthly trapping and banding of the bat population has continued until the present (February 1985). Eight vespertilionid species have been encountered and a total of 1867 individuals have been banded on the forearm with bird bands ranging from size 1 to size 4 (Table 1). In the course of this banding exercise a number of methodological and tactical points concerning the banding of bats have arisen and these I wish to consider here. With any form of bird or bat banding there is always potential mortality, however ".... fatalities from human carelessness cannot be defended and .... those due to human ignorance and inexperience should be combated with the necessary information and education" (Houston 1974). Hopefully, I can impart some information gleaned from experience which will reduce the possibility of mortality due to the human factor.

Firstly, my comments regarding suitable band size and banding methods can only be considered preliminary and applicable to six of the eight species encountered in this study. Two of the species (*Eptesicus vulturnus* and *Chalinolobus gouldii*) are trapped in very low numbers and consequently very few or no individuals have been retrapped (Table 1). For the other species my preliminary conclusions are that bird bands are an acceptable marking method: with the proviso that some of the presently recommended band sizes be changed.

Table 1. Summary of banding information for the Bull's Head study site between March 1980 and February 1985.

Species	Bird Band Size	Number Banded	Number of Individuals Retrapped	Number with Band Induced Injury Minor	Major
E. vulturnus	1	7	1	0	0
	2	2	0	0	0
E. regulus	1	311	84	6	6
	2	127	14	1	0
E. sagittula	1	309	50	3	1
	2	52	1	0	0
C. morio	2	524	94	2	1
C. gouldii	3	24	0	0	0
	4	26	0	0	0
N. geoffroyi	2	267	9	0	0
N. gouldi	3	157	8	0	0
P. tasmaniensis	3	12	1	0	1
	4	49	1	0	0

For all bats retrapped the degree of damage to the animal caused by the band is assessed. In the overwhelming majority of cases there has been no obvious deleterious effect of the band even in bats recaught several years after banding. However, this does not mean that an acceptable situation prevails and that the banding operation is justifiable simply because the recapture rate far exceeds the injury rate. For example, in *Eptesicus regulus* 84 of 311 individuals banded with size 1 bands have been retrapped. Six of these had minor band-induced injuries (ie. chafing of the fore-arm) and six had major damage such as growth of tissue around the band and inflamed wounds. I find such an injury rate of 14.3% in retrapped bats unacceptable especially when the extrapolation to the total banded population is considered. A revision of banding method or band size is clearly indicated by these data.

The fundamental problem faced by the bat bander is finding the correct band size. Unlike birds where the band surrounds a relatively passive part of the animal during flight, the bat band is placed on the primary moving part of the animal. The rubbing of the band on the fore-arm is the apparent cause of major injury in these species. The band must be sufficiently closed around the fore-arm to prevent it slipping down and interfering with the propatagium. If too tightly closed the inner surface of the band will rub against the underlying tissue eventually creating a lesion which becomes infected, swells and further exacerbates the problem. Given the latter scenario it seems appropriate to suggest that it is better to use a band which is larger than expected in order to reduce the extent of contact between the band and the fore-arm. Contrary to some, I believe that a snug-fitting band is inappropriate to bat banding and in the long term will only result in unacceptable rates of injury.

For these reasons I have made the following changes to the bird band sizes used on bats.

	Old Band Size	New Band Size
Eptesicus regulus	1	2
Eptesicus sagittula	1	2
Pipistrellus tasmaniensis	3	4

The bird band sizes currently recommended for *E. vulturnus* (size 1), *Nyctophilus geoffroyi* (2), *N. gouldi* (3) and *Chalinolobus morio* (2) seem appropriate at this time, however, further retraps are needed before I can categorically support this claim.

We started banding the species listed above with the revised band sizes in January 1984 and the limited number of individuals thus far retrapped have given encouraging results with only one instance of minor band-induced injury so far observed.

In bats there seems to be little margin for error in band size and the tolerance about the optimal size appears to be small. As someone who has seen the damage caused by undersized bands, I strongly urge all banders to diligently adhere to the recommended band sizes suggested by the Australian Bat Banding Scheme.

In terms of the method used to attach the band to the bat: the use of the pliers provided by the scheme may help to retain the circularity of the band during the banding process and is therefore to be encouraged.

Equally, the band should be closed to the point of virtual contact with the wing membrane, allowing for some movement along the fore-arm but not to the extent of interference with the propatagium.

My other comments concern the tactical approach to bat banding where a number of harp traps is used to simultaneously survey a relatively large area of forest. At all times bats should be released at the site of capture. For all of the species retrapped in this study the mean distance between site of release and retrap is less than one kilometre and between 30 and 40% of retraps have occurred at the site of previous encounter. These data clearly indicate that forest-dwelling bats range little distance from a regular foraging area they are especially familiar with. It is difficult to predict the effect of releasing individuals in areas foreign to them, however, such perturbations to their well documented social systems must ultimately alter the ecology of the bat community and possibly affect the survivorship changes of banded individuals.

The retention of bats in captivity for any longer than necessary is also to be avoided; especially when females are feeding young. The scope of the survey should, therefore, be a compromise between the desire to trap as many individuals as possible in the one night and the resultant extensions to the handling and retention time. From my observations of vespertilionid females suckling very young bats in captive colonies, foraging bouts are greatly reduced and interspersed with short suckling periods of the young. At this stage we do not know how critical it is for very young bats to receive regular nourishment. Should lactating females be trapped during the early evening and then be retained until the following day, the survival chances of the infants may be compromised. I advocate that during the breeding season bats be banded and released during the evening rather than during the day-light hours of the following day. By quickly releasing lactating females caught during the early evening foraging peak at least the forced separation of mother from infant can be kept to a minimum.

If bats must be released during day-light hours it is worth checking the area for predators such as hawks and currawongs. These will quite readily take bats in flight and should be 'discouraged' from the immediate area by whatever means is available. Along a similar theme, I have often observed how visible aluminium bands are on bats active on moon-lit nights. Although we do not have any nocturnal predators which specialise in bats in Australia, a more cryptically coloured band is presently being considered by the Bat Banding Scheme.

Most banding surveys can be justified because of the benefits which ultimately accrue to the population if not necessarily to the banded individual. This view may placate the informed member of the public with conservationist views; however, the increasingly high public profile of animal welfare issues means bat banders must be prepared at all times to defend their activities. If injuries occur repeatedly then a revision of banding tactics, methods or band size is clearly warranted.

Banders are urged to inform the banding office of any injuries caused to bats due to inappropriate band size or perhaps resultant from the demeanour of the species involved, so that we can respond in an appropriate way.

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2. Houston S. 1974. Mortality in ringing - A personal viewpoint. International Ornithological Bulletin: The Ring, pp. 157-160.

3. Tidemann C.R. and Woodside D.P. 1978. A collapsible bat-trap and a comparison of results obtained with the trap and with mist-nets. Aust. Wildl. Res. 5, 355-362.

NOTICES

AUSTRALIAN MAMMAL SOCIETY

The Society will hold its Annual Scientific Meeting and Annual General Meeting during the period 15-17 May, 1985 at the University of Melbourne. These will be preceded by a Symposium on Bandicoots 13-14 May. Deadline for submission of abstracts was March 15.

Enquiries to: Mr P.R. Brown, Arthur Rylah Institute, 123 Brown St., Heidelberg, Vic., 3084; Phone (03) 459 2900.

BATORAMA

As part of the celebrations to commemorate the **75th** anniversary of the founding of the University of Queensland, an exposition on bats entitled "Batorama", will be held at the School of Anatomy on **15-18 May 1985.**

Activities will include presentation of scientific posters, audio visuals, live bat displays, demonstrations of the use of ultrasound equipment and mist nets, and a field trip to observe the evening departure of flying foxes.

Further information on the Batorama can be obtained by contacting Mal Graydon, Department of Anatomy, University of Queensland, St Lucia, QLD, 4067.

SEVENTH INTERNATIONAL BAT RESEARCH CONFERENCE/THIRD EUROPEAN BAT RESEARCH SYMPOSIUM JOINT MEETING

A joint meeting for the Seventh International Bat Research Conference and Third European Bat Research Symposium will be held at the University of Aberdeen, UK from 19-24 August 1985. Final registration closed on 15 March 1985.

Dedee Woodside will be attending the joint meeting and is prepared to distribute material/erect posters for those who are unable to attend. Anyone wishing to avail themselves of this kind offer should contact Dedee as soon as possible. Her address is: Taronga Park, Zoological Gardens, Mosman, NSW, 2088.

SYMPOSIUM ON FLYING FOXES

First Notice

On the weekend 28-29 September 1985 the Australian Mammal Society is organising a symposium on flying foxes which will be held at the University of Queensland, Brisbane.

The basic objective of the symposium is to highlight the major areas of interest and concern in flying fox biology.

An open invitation is extended to all fruit growers, researchers, politicians, conservationists, and interested public to attend.

As yet no programme has been established but topics to be covered both by discussion and formal papers include:

- crop damage by flying foxes
- crop protection methods
- management
- identification and distribution
- behaviour at daytime roosts
- reproduction
- maintenance in captivity
- rearing of orphaned young
- digestion and nutrition
- parasites
- vision and hearing

Contributions are expected from and/or will be solicited from people who are in any way involved with flying foxes, be it research, crop losses, management, or whatever.

It is hoped that information will be exchanged freely amongst participants and that a more holistic appreciation of flying fox biology will emerge from the conference.

A suitable publisher is being sought for the proceedings of the symposium.

For further details please contact Leslie S. Hall, Department of Anatomy, University of Queensland, St Lucia, QLD 4067, phone (07) 3773933.

NEW PRODUCTS

Radio Transmitters

Biotrack produces SS1 transmitters which weigh about 8-900 mg without battery. They are similar to the AVM SM-1 transmitter but have a higher gain transistor - thereby increasing range - and are considerably cheaper - £25 at last quote. They are ideal for small bats. With an R212 battery a complete package, weighing about 1 g, lasting for 6-8 days and detectable about 2 km away can be constructed.

Supplier: Biotrack, Manor Farmhouse, Church Causeway, Sawtry, Huntingdon, Cambs. UK.

Radio Receivers

There are many companies producing tracking receivers ranging from very expensive to quite cheap. One which is very good value is the Custom Electronics CE-12. The basic receiver is 12-channel, but this can be extended at fairly low cost. Custom Electronics has been producing these receivers for many years, but until recently they were marketed only by AVM as the LA-12. AVM no longer retails or services these receivers. Although the design of the receivers is old, they have proved extremely reliable in prolonged field use. Price is about $US700.

Supplier: Custom Electronics of Urbana Inc, 2009 Silver Court West., Urbana, Illinois 61801, USA

Ultrasonic Detectors

QMC has replaced their S100 tuned/broadband detector with the S200. There are some new features (for example power consumption has been reduced by a factor of 5; frequency countdown circuit) but it is essentially similar to the S100. Pice about £740. The QMC Mini Detector is still available at a cost of about £80.

Supplier: QMC Instruments Ltd, 229 Mile End Road, London E1 4AA UK

The report on the original (D920) bat detector from the Uppsala group (Ahlen *et al.* 1983 - current literature) suggests that it may do everything the QMC detector does, but better. A new model - the D940 is now available with some improvements over the D920. It may be the most useful detector yet produced. Price is SEK 8300 - about $A1150.

Supplier: L. Pettersson Elektronic, Sjudartorp, Lagga, S-741 00, Knivsta, Sweden.

Monofilament Mist-nets

These nets are extremely fine. Thus, they catch more bats than the conventional braided variety, although at the expense of net life. Extrication of bats from them is not much more difficult and they don't appear to cause damage to forearms etc. They are cheaper than conventional nets, although this must be weighed against their shorter life. A wide variety of sizes (mesh and net) is available.

Supplier: Bleitz Wildlife Foundation, 5334 Hollywood Boulevard, California 90027, USA

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